

Process assessment schedule for

Printed board design facilities

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee EPL/52, Printed circuits, on which the following bodies were represented:

- British Telecommunications plc
- Electrical and Electronic Industries Association (BEAMA Ltd.)
- Federation of the Electronics Industries
- GAMBICA (BEAMA Ltd.)
- Institute of Metal Finishing
- National Supervisory Inspectorate
- Printed Circuit Interconnection Federation
- Surface Mount and Related Technologies (SMART Group)

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National foreword

This British Standard has been prepared by Technical Committee EPL/52 and is the English language version of QC 200012:1996 (issue 2), *Process Assessment Schedule for Printed Board Design Facilities*, published by the International Electrotechnical Commission (IEC) which is identical with CECC 200012:1996 published by the CENELEC Electronic Components Committee (CECC).

Cross-references

Publication referred to ¹⁾	Corresponding British Standard
EN 100114-1	BS EN 100114 <i>Rule of procedure 14. Quality assessment procedures</i> BS EN 100114-1:1994 <i>Approval of manufacturers and other organizations</i> (Identical)
CECC 00200	BS CECC:1995 <i>Register of approvals</i> (Identical)
EN ISO 9000	BS EN ISO 9000 <i>Quality management and quality assurance standards</i>
EN ISO 9001	BS EN ISO 9001:1994 <i>Quality systems — Model for quality assurance in design, development, production, installation and servicing</i> (Identical)

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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, the QC title page, pages 2 to 36, 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.

¹⁾ Undated in text.

Process Assessment Schedule
for
Printed Board Design Facilities



Up-to-date lists and bibliographical references of other Process Assessment Schedules (PASs) may be obtained on application to the IEC Central Office or to any IEC member.

IEC

International Electrotechnical Commission
Commission Electrotechnique Internationale

Box 131, rue de Varembe, CH 1211 Geneva 20, Switzerland

IEC Foreword

The IECQ Quality Assessment System for Electronic Components (IECQ) is composed of those member countries of the International Electrotechnical Commission (IEC) who wish to take part in a harmonised system for electronic components of assessed quality.

The object of the System is to facilitate international trade by the harmonisation of the specifications and quality assessment procedures for electronic components, and by the grant of an internationally recognised Mark, or Certificate of Conformity. The components produced or services provided under the system are thereby acceptable in all member countries without further testing.

The IEC and CECC (Cenelec Electronic Components Committee) have agreed upon a policy of convergence, and the quality assessment procedures and other related documents covering Process Approval of Specialist Contractors within the electronic components industry have been accepted for use as part of this convergence programme.

The technical requirements of this Process Assessment Schedule (PAS) are derived from and identical to CECC 200 012 issue 2. The list of CECC – IECQ cross-references given below is to facilitate the use of this document by IECQ users who are unfamiliar with the CECC system.

This PAS is based upon the requirements of IEC Publication QC 200000. It has been prepared for use by those IEC member countries taking part in the system who wish to apply Process Approval to Printed Board Design Facilities. This PAS should be read in conjunction with the current regulations for the IECQ system.

At the date of printing of this specification, the member countries of CECC and/or IECQ are Austria, Belarus, Belgium, China, the Czech Republic, Denmark, Finland, France, Germany, Hungary, India, Ireland, Israel, Italy, Japan, the Republic of Korea, the Netherlands, Norway, Poland, Portugal, the Russian Federation, Singapore, Spain, South Africa, Sweden, Switzerland, Thailand, Ukraine, the United Kingdom, the United States of America, and Yugoslavia.

CECC – IECQ Cross References

CECC Term or Reference	IECQ Term or Reference
CECC 00 200	QC 001005
CECC 00 401	No direct equivalent
CECC 00 114 part 5	QC 001002 part 3 clause 5
CECC 200 000	QC 200000 (presently CMC/433/4Mv)
CECC 200 012	QC 200012
EN 100 114 part 1	QC 001002 part 3 clause 2 (presently CMC/427/DIS)
EN ISO 9000	ISO 9000
CSM (CECC System Manager)	DMR (Designated Management Representative)
ONH (Organisme National Habilité)	NAI (National Authorized Institution)
ONS (Organisme National de Surveillance)	NSI (National Supervising Inspectorate)

Organisation Responsible for Preparing this Process Assessment Schedule (PAS):

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History

Issue 1 of this document was drafted by Product Reliability and Quality Limited on behalf of the (UK) Defence Research Agency, and published as a CECC specification in May 1995. Issue 1 was then submitted to BSI for consideration to be formally adopted as a British Standard.

This second issue of CECC 200 012 enhances the previous issue with additional material from:

BSI Technical Committee EPL/52
The Design Group of the Printed Circuit Interconnection Federation
The Surface Mount Club

It is based, wherever possible, on publications of the International Electrotechnical Commission (IEC). After publication of this second issue, the text will be forwarded for adoption as a British Standard.

Introduction

The CECC 200 000 series of specifications applies to Process Approval of specialist contractors to the electronic components industry in accordance with RP14-V. The mechanism of Process Approval is described in the Process Assessment Schedule (PAS) which defines how the principles given in RP14-V are applied to a given process activity or service.

PASs are a recent new concept in CECC specifying in greater detail the manufacturing process and the associated quality factors reducing or eliminating the need for costly end-of-line testing. The PAS also permits, where applicable, the application of Statistical Process Control techniques.

This specification describes the requirements that a Design Facility must satisfy in order to obtain a CECC Specialist Contractor Approval for the design, and (where applicable) control of subsequent sub-contract manufacture, of printed boards. The Process Approval concept places emphasis on understanding of the technology concerned and on process control. In the absence of a component as a final product, this is considered the best way to ensure a consistent and reliable service.

NOTE The term "Design Facility" has been chosen to describe both independent design bureaux, and design centres that may be part of a larger manufacturing organization.

1 General requirements

1.1 Scope

This PAS specifies the terms, definitions, symbols, quality system, assessment and verification methods, and other requirements relevant to the operation of a Printed Board Design Facility in compliance with the general requirements of the CECC System for electronic components of assessed quality.

The scope of this PAS does not cover the activity of designing the basic electronic functionality of a product or sub-assembly.

1.2 Definitions

Definitions relevant to the technology in addition to those given in CECC RP14-V are given at Annex A. Where a Design Facility uses terms other than those found in Annex A, such terms shall be defined in the Process Manual.

1.3 Related documents

1.3.1 Requirements

The Design Facility shall list all documents referenced in its Process Manual under the following, or similar, headings:

- Documents referenced in the PAS
- Other National or International Standards
- Internally (i.e. Design Facility's own) issued documents

The list shall give full titles and reference numbers in respect of documents to which reference is made in the Process Manual. Subsequently, it is sufficient to quote the reference number only (for example, "EN ISO 9001").

1.3.2 Documents referenced in this PAS

EN 100 114-I, *Rule of Procedure 14* —

Part 1: Approval of Manufacturers and other organisations (RP14/I).

CECC 00 114-V, *Rule of Procedure 14* —

Part V: Process approval of specialist contractors within the electronic components industry (RP14/V).

CECC 00 200, *CECC Qualified Products List*

CECC 00 401, *Glossary of abbreviations, terms and definitions of the CECC System.*

EN ISO 9000, *Quality management and quality assurance standards — Guidelines for selection and use.*

EN ISO 9001, *Quality systems — Model for quality assurance in design/development, production, Installation and servicing.*

EN 100 114-I, *Rule of Procedure 14* —

Part I: Approval of Manufacturers and other Organisations (RP14/I).

1.4 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*.

Any other units, symbols and terminology peculiar to the processes or services covered by this PAS shall be taken from the relevant IEC or ISO documents, listed under “Related documents”.

NOTE All terms and concepts specifically relating to Process Approval are explained in RP14-V, in other parts of RP14 or in CECC 00 401. Specialist contractors who are unfamiliar with these documents are advised to study them.

1.5 Quality system

The Design Facility shall establish and maintain a quality system satisfying the requirements of EN ISO 9001, as invoked by RP14-I and RP14-V. Certain of these requirements receive particular attention and are developed further in the following sections of this PAS.

In carrying out the appraisal on a Design Facility, the ONS shall take account of any relevant certificate to EN ISO 9001 issued by an organization declared competent to do so by the appropriate national authority.

2 Quality requirements of the technology

2.1 Process description

The activity covered by this PAS is:

- the design, or
- the design and project management of subcontracted manufacture of printed boards. Manufactured (unpopulated) printed boards shall be released under an approved manufacturer’s Capability or Technology Approval.

A Process Approval granted for this activity shall fall into one of the two categories set out in **2.1.1** and **2.1.2**.

The Design Facility shall declare the extent of the process, processes or service for which it is seeking approval, indicating how this falls within the scope of the referenced PAS.

A Design Facility approved to Class A is permitted to act under Class B.

2.1.1 Class A

A Design Facility capable of:

- undertaking printed board design services, and
- project management of the release of printed boards against a customer’s order by subcontracting the manufacturing and testing to suitably approved organizations.

The contract to supply printed boards is between the customer and the Design Facility, not between the customer and the printed board manufacturer.

On receipt of an order for printed boards from a customer, the Design Facility shall translate the customer’s functional requirements into a practical printed circuit design.

The Design Facility may subcontract the generation of master phototools.

It shall subcontract printed board manufacture, inspection and test only to a manufacturer who is CECC approved for these processes and does not further subcontract them.

The Design Facility shall receive the finished components into its own bonded store, from which it shall release them to the customer under a CECC Certificate of Conformity. Alternatively, the Design Facility may arrange for shipment of the printed board direct to the customer from the manufacturer, A CECC Certificate of Conformity shall then be sent under separate cover by the Design Facility to the customer. In either case, the manufacturer’s Certificate of Conformity is received and retained by the Design Facility.

Unless other wise agreed, any printed boards to be returned by the customer shall be directed to the Design Facility, since it is between those two bodies that the contract exists. Responsibility for investigating faults and implementing corrective action (with the subcontractor if necessary) shall rest with the Design Facility.

2.1.2 Class B

A Design Facility capable of:

- undertaking printed circuit design services, and
- releasing design data against a customer’s order.

The contract to supply design services is between the customer (who may be a printed board user, or another organization such as a printed board manufacturer requiring design work to be undertaken on behalf of a printed board user) and the Design Facility.

On receipt of an order for printed circuit design services from a customer, the Design Facility shall translate the customer's functional requirements into a practical printed circuit design.

The Design Facility may subcontract the generation of master phototools if it does not have the necessary facilities in-house.

The Design Facility shall release the printed circuit design data to the customer under a CECC Certificate of Conformity. Note that design data may be transmitted by modem; in such cases the Certificate of Conformity must of necessity be sent separately.

A Class B Design Facility may be an independent design house, or it may exist as Part of a larger organization.

2.2 Quality factors

Quality factors are those aspects of the process and of the Design Facility's organization that significantly affect the quality and reliability of the service provided.

The following list identifies those quality factors considered to influence the quality of output from a Design Facility. This list is therefore deemed to be the minimum mandatory that shall be addressed by the Design Facility:

- competence in the technology
- control of design
- control of software
- control of subcontractors, where applicable
- project management
- design tools and equipment
- commercial interfaces

This list not exhaustive. Each Design Facility shall list these and any other quality factors it considers relevant in its Process Manual. To obtain a process approval, a Design Facility shall demonstrate that it has adequate control of the quality factors affecting its declared process.

For each quality factor listed in the Process Manual, the Design Facility shall identify the critical parameters. Critical parameters are those which when routinely verified and controlled address the quality factor sufficiently well to ensure a consistent and acceptable output from the process stage under consideration.

2.2 1) to 2.2 7) set out examples of parameters that a Design Facility may consider critical for the mandatory quality factors:

- 1) Competence in the technology, e.g.

- the experience of the Design Facility and its personnel in producing designs to the limits of the declared capability (number of circuit layers, feature sizes, through-hole or surface mount technology, etc.)

- awareness of printed board manufacturing requirements

- ²⁾awareness of printed board assembly, inspection, rework and test requirements

- ²⁾optimising fine conductor width and spacing requirements to accommodate the intended printed board manufacturer

2) Control of design, e.g.

- adopting agreed design rules and policies with regard to layer count, conductor widths and spacings, hole-to-pad ratios, aspect ratios, solder resist clearances etc. to ensure a practical and manufacturable design.

- taking due account of electro-magnetic compatibility and thermal considerations in the design

- incorporating any specific instructions given by the customer fully in the design

- building inspections and checks into the design process

- verifying before release that the design output satisfies the customer's requirements

- controlling and recording design changes and identifying the revision of drawings, phototools, magnetic media or other design data.

- taking due account of end of product life and subsequent disposal

3) Control of software, e.g.

- employing design software at the correct revision

- recording the revision of software used for given designs

- identifying software (both program files and data files) on disks, tapes, data cartridges, etc.

- making and storing safely backup copies of software, especially design data files.

4) Control of subcontractors, e.g.

- selecting and approving subcontractors

- placing orders for printed boards only on manufacturers having suitable CECC approval

- monitoring subcontractor performance and acting on findings.

5) Project management, e.g.

²⁾ These activities require that the board fabricator and assembly facility are selected before layout commences.

— proper scheduling, monitoring and control of projects to ensure delivery of service or products to customers within the agreed timescale.

6) Design tools and equipment, e.g.

— using adequate hardware and software tools and other equipment to perform the service offered efficiently

— maintaining and, where appropriate, calibrating equipment.

7) Commercial interfaces, e.g.

— reviewing contracts, purchase orders, specifications and other agreement documents to ensure that a clear and common understanding of requirements prevails at all times between the Design Facility and its customers and subcontractors.

Each quality factor shall form the basis of a section in a Process Specification that states how the Design Facility shall identify and monitor these factors, and that shall explain how control of these factors ensures an acceptable end product or service.

2.3 Process specifications

The Design Facility shall prepare Process Specifications in accordance with the recommended format given in Annex B. Each process step included in the declared capability shall be included. These Process Specifications may be issued separately by the Design Facility or may be included within the Design Facility's Process Manual.

The Design Facility's design rules and inspection or verification procedures shall be embodied in these Process Specifications.

2.4 Demonstration, Verification, and Validation Programme

2.4.1 Demonstration

Demonstration is the act of proving to a customer or third party that the claims made by the Design Facility can be met in practice.

2.4.2 Verification

The Design Facility shall establish and declare a mechanism for ensuring that the service and overall capability that is offered in the Facility's promotional, sales and marketing literature at all times is consistent with, and adequately supported by, the Process Manual, Process Specifications and related documents.

The ONS shall verify that this is the case before the Design Facility may proceed with validation.

2.4.3 Validation

For Class A approval, no validation of the (bare) printed board manufacturing facilities is required outside of the subcontractor control exercised by the Design Facility. This is because the manufacture of printed boards is subcontracted only to CECC approved organizations, and orders are placed *only* for products falling within the scope of the manufacturers' approvals.

Validation of the Design Facility's in-house process is effected by processing a Test Vehicle as described in clause 2.4.4. During and/or after the validation programme, the ONS shall review the procedures and controls applied during the exercise (from initial acceptance of design brief to completion of deliverable items) to ensure that all Quality Factors have been addressed and that all provisions of the Process Manual, Process Specifications and related documents have been observed.

The Design Facility shall demonstrate its ability to collate the respective design inputs from the customer, the intended board supplier and the intended assembler, and to collate them with its own in-house design rules and guidelines before starting a board layout. The following diagrammes show the necessary philosophy and interrelationships required:

Satisfactory completion of the validation programme will normally result in an approval being recommended by the ONS, and the issue of an approval certificate by the ONH.

