

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

**Semiconductor
devices —
Sectional specification
for semiconductor
integrated circuits
excluding hybrid
circuits**

ICS 31.200

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National Foreword

This British Standard is the UK implementation of IEC 60748- 11:1990 incorporating amendments 1:1995 and 2:1999. BS IEC 60748- 11:2000, BS QC 700000:1991 and IEC 747 - 10:1991 (*to be renumbered as BS IEC 60747 - 10:1991*) supersede BS 9450:1998, which has a status of obsolescence and remains available for use in connection with existing component approvals.

The start and finish of text introduced or altered by amendment is indicated in the text by tags **A1** **A1**. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by **A1** **A1**.

The standard is to be used in conjunction with BS QC 700000:1991 “*Harmonized system of quality assessment for electronic components. Semiconductor devices. Generic specification for discrete devices and integrated circuits*”.

A related British Standard to QC 001002 is BS 9000 “*General requirements for a system for electronic components of assessed quality — Part 3:1987 Specification for national implementation of IECQ basic rules and rules of procedures*”.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard, having been prepared under the direction of the Electronic Components Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 30 September 1991

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1 Scope

This sectional specification applies to encapsulated semiconductor integrated circuits, including multi-chip integrated circuits, but excluding hybrid circuits.

2 General

This specification shall be read together with the generic specification to which it refers and it gives details on the Quality Assessment Procedures, the inspection requirements, screening sequences, sampling requirements, and test and measurement procedures required for the assessment of semiconductor integrated circuits, including digital, analogue and interface circuits.

Instead of the Qualification Approval Procedure, it is allowed to apply the Capability Approval Procedure (see IEC Publication QC 001002, Rules of Procedure, Subclause 11.7; but at present, Capability Approval Procedures for integrated circuits are under consideration) for all devices manufactured in a defined process.

Additional application of the Quality Conformance Inspection rules (see IEC Publication 747-10, Sub-clause 3.6, and this specification, Clauses 5 to 9) is possible for any type or group of types, produced in that process, if required and technically feasible.

All the requirements of this specification remain valid, unless modified by the requirements set out in the new clause “Capability Approval Procedure” (under consideration).

2.1 Related documents

IEC Publication 747-10/QC 700000 (1984).

2.2 Recommended values of temperatures

See IEC Publication 748-1, Chapter VI, Clause 5.

2.3 Recommended values of voltages

See IEC Publication 748-1, Chapter VI, Clause 6.

2.4 Definitions related to manufacturing operations

2.4.1 Production line

A production line is defined as a single set of process operations including one or several of the following manufacturing phases:

- 1) diffusion;
- 2) preparation of dice;
- 3) assembly;
- 4) finishing and final electrical measurements;
- 5) screening (if applicable).

NOTE Quality assessment procedures are not included in these phases.

1) Diffusion

This phase is the set of manufacturing process operations from the primary stage of manufacture to the last step before separation of dice.

2) Preparation of dice

This phase is the set of manufacturing process operations to divide the wafer into dice. For the purpose of this specification, this phase may be included in either the diffusion or the assembly phase at the manufacturer's convenience.

3) Assembly

This phase is the set of manufacturing process operations comprising die attach, lead bonding and encapsulation.

4) Finishing and final electrical measurements

This phase is the final set of manufacturing process operations before lot release, including for example:

- post-treatment of terminals including plating operation, if any;
- coating;

- marking;
- final electric measurements.

5) Screening (if applicable)

This phase may be part of the assembly and/or finishing operation(s).

Screening is defined in Clause 8 below.

2.4.2 Production lot

A production lot consists of devices of the same type, manufactured in the same production line and passing through the same nominated process, normally within one week.

2.4.3 Changes in manufacturing operations

1) Definition of major changes

Any change in manufacturing process or technology which could affect the quality or performance of a product supplied to an approved specification, or which could require a product to be transferred from one structural similarity group of circuits to another (new or existing) group (see Clause 6 below) represents a change considered as major. It is the responsibility of the Chief Inspector to decide whether the change is major or not.

Some examples of major changes are given in 3) below.

2) Procedure in the event of a major change

Any major change shall only be implemented with notification and demonstration by test evidence of maintenance of quality to the NSI.

3) Examples of major changes

a) Die attach

- from eutectic solder to epoxy attachment.

Not considered as a major change: equipment change without changing the technology or the use of preform instead of gold plated alloy surfaces.

b) Crystal passivation

- from silicon-nitride to silicon-oxide;
- sequence of the passivation layers.

Not considered as a major change: changing of the method of deposition of the passivation layers.

c) Package material

- from ceramic to plastic;
- from plastic A to plastic B.

d) Metallization

- from gold to aluminium metallization.

e) Die size and/or die layout

- introduction of guard-rings and/or barrier layers.

f) Bonding

- from the thermo-compression to the ultrasonic method;
- from gold bond wire to aluminium wire.

g) Functional verification during quality conformance inspection

- any reduction of test sequences in the test programs.

3 Subcontracting

When the approved manufacturer invokes Rules of Procedure, Subclause 11.1.2 of IEC Publication QC 001002 concerning subcontracting, he shall ensure that the following conditions are satisfied:

— the subcontracted manufacturing process may be either the diffusion process or the assembly process, including screening steps which are incorporated in them. Screening operation applied after assembly process may also be independently subcontracted. The finishing process can only be subcontracted together with the complete assembly process, except for the lead plating operation which may be subcontracted separately (see 2.4.1 above).

The National Supervising Inspectorate (NSI) shall be satisfied that the Chief Inspector who is certifying the components under the IECQ system:

- has been provided with the full quality assessment and inspection documentation of any operation outside the IECQ geographical area. The documentation shall include the inspection records for each sample of the product which undergoes inspection;
- regularly verifies that the quality assessment and inspection is applied in accordance with the agreed requirements.

The Chief Inspector shall be provided and shall agree with the procedures for the transfer of the parts from the place of manufacture to the manufacturer within the IECQ geographical area who is certifying the component. The NSI shall be informed and have access to the applicable documents.

Any changes in inspection requirements and manufacturing procedures shall be reported back to the Chief Inspector who is certifying the components. The major changes shall be reported by the approved Chief Inspector to the NSI (see 2.4.3 above).

The approved manufacturer shall perform the acceptance tests prescribed by the detail specification for the component he is certifying. He can perform the acceptance tests in a facility outside the IECQ geographical area, provided that this facility is supervised by the NSI. Acceptance tests can be subcontracted to approved test laboratories within the IECQ geographical area.

4 Primary stage of manufacture

For the purpose of this sectional specification, this stage is defined as follows:

4.1 Bipolar devices

The first process that changes the monocrystalline semiconductor material from being either entirely P type or entirely N type.

4.2 Unipolar devices (for example MOS, field-effect devices)

The first oxidation of, or deposition on, the substrate.

5 Quality assessment procedures

5.1 Qualification approval procedures

Method b) of IEC Publication QC 001002, Rules of Procedure, Subclause 11.3.1, shall normally be used with the sampling requirements in accordance with those stated in Tables VII and VIII of this specification.

It is however permitted to use method a) of Rules of Procedure, Subclause 11.3.1, provided that the sampling requirements to be used are specified in the relevant blank detail specification.

5.1.1 Inspection lot

Inspection lot is defined in Subclause 12.2 of IEC Publication QC 001002.

In addition to this, lots from which samples are used for testing in Groups A, B and C shall consist of products coming from the same production line (see 2.4.1 above and 6.2.1 below) in the following conditions:

- *Groups A and B*: one inspection lot contains devices produced within a period of one month or four consecutive weeks as indicated by the used date code(s).
- *Group C*: samples from production submitted for periodic testing shall have been manufactured within a period of three months as indicated by three consecutive month date codes or by thirteen consecutive week date codes.
- *Group D*: samples from production submitted for periodic testing shall have been manufactured within a period of twelve months as indicated by twelve consecutive month date codes or by 52 consecutive week date codes.

5.2 Capability approval procedures

See Subclause 3.10 of the next edition of the IEC Publication 747-10 (in preparation).

6 Structural similarity procedures

6.1 General rules

6.1.1 Purpose

Structural similarity procedures are intended to permit a reduction in the number of inspection lots that shall be tested.

6.1.2 Principles

For a test applicable to a group of device types, the test may be performed on one type from the group and the results obtained considered as representative for all the types if the general and particular criteria for structural similarity described in this clause and applicable to this test are complied with (see Table I). The definition of these criteria shall be based on the principle that conformity and reliability verified on the representative type gives at least the same conformity and reliability assurance for the associated types.

Structural similarity procedures shall not be applied for electrical and visual tests under Group A.

6.1.3 Application conditions

1) Tests and measurements specified in sequence

Structural similarity procedures described in this clause apply to a single test.

When several tests are specified in sequence, the application shall be based on the following principles:

The essential test in the sequence of tests in a sub-group shall be decisive for criteria to be used for structural similarity grouping for the complete sequence.

NOTE For application of this principle for B5/C5 tests, the essential test is "Rapid change of temperature".

2) Application for quality assessment procedures

The application of the structural similarity procedures is specific to a considered quality assessment procedure and detailed application conditions are given in Clause 7 below.

6.1.4 General criteria for structural similarity

- 1) The type chosen as representative for a group of types in relation to a given test may differ from one period to another, depending on the types produced in that period.
- 2) For all relevant types in a group of types, the same acceleration test procedure shall be allowed.
- 3) If, although fulfilling the particular criteria for a group, significant difference(s) still exist in characteristic(s), the type selected for the relevant test shall be represented by the most critical device giving the greatest risk of failure for this test.
- 4) If failure occurs on a device type, all the devices associated with this representative type are to be considered affected.
- 5) If the devices are submitted to a screening procedure in accordance with Clause 8, and if several screening sequences are applied in the same production line, the devices can only be grouped if they are screened according to the same screening sequence.

6.2 Test dependent criteria for structural similarity

The test dependent criteria for structural similarity applicable to the Group B and periodic tests are given in Table I.

Subclauses 6.2.1 to 6.2.18 specify the interpretation of these criteria.

Example for the use of Table I:

Sub-group C3 requires that the test on the robustness of terminations be performed.

For this test, the following requirements for structural similarity apply (see Table I):

- subclause 6.2.1 — Assembly line;
- subclause 6.2.3 — Family of package;
- subclause 6.2.5 — Encapsulation methods;
- subclause 6.2.6 — External terminals material;
- subclause 6.2.7 — Finishing process.

Devices satisfying all the requirements of all the subclauses above are considered structurally similar for the "Robustness of terminations" test.

Table I — Test dependent criteria for structural similarity (see note)

Tests	Criteria																	
	Assembly line (6.2.1)			Outline and dimensions of the package (6.2.2)	Family of package (6.2.3)	Package material (6.2.4)	Encapsulation methods (6.2.5)	External terminals material (6.2.6)	Finishing process (6.2.7)	Marking methods (6.2.8)	Number of terminals (6.2.9)			Material of internal connections, wire bonding (6.2.10)	Die bonding (6.2.11)	Ratio of die areas (6.2.12)		
Dimensions, mass	X			X	X	X	X	X	X									
Immersion in cleaning solvents	X					X	X			X								
Salt mist	X					X		X	X	X								
Solderability	X				X		X	X	X									
Robustness of terminations	X				X		X	X	X									
Sealing	X				X	X	X	X	X		X							
Damp heat (cavity packages)	X				X	X	X	X	X	X								
Shock – Vibrations – Acceleration	X				X	X	X	X			X		X	X	X			
Resistance to solder heat	X				X	X	X	X			X		X	X	X			
Rapid change of temperature	X				X	X	X	X			X		X	X	X			
Damp heat (non-cavity packages)	X				X	X	X	X	X	X	X		X	X	X		X	X
Storage	X				X	X	X	X	X	X			X	X			X	X
Operating endurance	X				X	X	X	X	X				X	X			X	X
Verification of correlations (if applicable)																	X	X
Additional dynamic characteristics at 25 °C and extreme temperatures																	X	X
Additional functional and static characteristics at 25 °C and extreme temperatures																	X	X
Special electrical test																	X	X

NOTE – A cross in the table denotes that the criterion is mandatory for the corresponding test.