

Harmonized system of quality
assessment for electronic components

Semiconductor devices — Generic specification for discrete devices and integrated circuits

ICS 31.080

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National foreword

This British Standard is the UK implementation of IEC 60747-10:1991. It is identical to IEC 60747-10:1991.

BS QC 700000:1991/IEC 747-10:1991 (renumbered as BS IEC 60747-10:1991) and BS IEC 60748-11:2000 supersede BS 9450:1998, which has a status of obsolescence but remains available for use in connection with existing component approvals.

The Technical Committee has reviewed the provisions of IEC 27, IEC 50, IEC 410, IEC 747-11, QC 001002, and ISO 2859 to which reference is made in the text, and has decided that they are acceptable for use in conjunction with this standard. Related British Standards to IEC 50, IEC 410, QC 001002, and ISO 2859 are BS 6100-3.1, BS 6001-1, BS 9000-3, and BS 6001, respectively.

This publication does not purport to include all the necessary provisions of a contract. Users of British Standards 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 publication forms part of the IEC Quality Assessment System for Electronic Components (IECQ).

This publication is a generic specification for semiconductor devices: discrete devices and integrated circuits, including multichip integrated circuits, but excluding hybrid circuits.

It defines general procedures for quality assessment to be used in the IECQ System and gives general rules for:

- measurement methods of electrical characteristics;
- climatic and mechanical tests;
- endurance tests.

NOTE This publication must be supplemented by the approved sectional, family and blank detail specifications, where they exist, appropriate to the specific individual type or types.

2 General

2.1 Order of precedence

Where there are conflicting requirements, documents shall rank in the following order of authority:

- 1) the detail specification;
- 2) the blank detail specification;
- 3) the family specification, if any;
- 4) the sectional specification;
- 5) the generic specification;
- 6) the basic specification;
- 7) the IECQ Rules of Procedure;
- 8) any other international (e.g. IEC) document to which reference is made;
- 9) a national document.

The same order of precedence shall apply to equivalent national documents.

2.2 Related documents

The detail specification shall indicate the applicable documents.

IEC publications:

Publication 27:	<i>Letter symbols to be used in electrical technology.</i>
Publication 50:	<i>International electrotechnical vocabulary (IEV).</i>
Publication 68:	<i>Basic environmental testing.</i>
Publication 68-1 (1988):	<i>Part 1: General and guidance.</i>
Publication 68-2:	<i>Part 2: Tests</i>
Publication 191:	<i>Mechanical standardization of semiconductor devices.</i>
Publication 191-1 (1966) and supplements:	<i>Part 1: Preparation of drawings of semiconductor devices.</i>
Publication 191-2 (1966) and supplements:	<i>Part 2: Dimensions.</i>
Publication 191-3 (1974) and supplements:	<i>Part 3: General rules for the preparation of outline drawings of integrated circuits.</i>
Publication 410 (1973):	<i>Sampling plans and procedures for inspection by attributes.</i>
Publication 617:	<i>Graphical symbols for diagrams.</i>
Publication 747:	<i>Semiconductor devices. Discrete devices and integrated circuits.</i>

Publication 747-1 (1983):	Part 1: <i>General</i> .
Publication 747-5 (1984):	Part 5: <i>Optoelectronic devices</i> .
Publication 747-11 (1985):	Part 11: <i>Sectional specification for discrete devices</i> .
Publication 748:	<i>Semiconductor devices. Integrated circuits</i> .
Publication 748-1 (1984):	Part 1: <i>General</i> .
Publication 748-2 (1985):	Part 2: <i>Digital integrated circuits</i> .
Publication 748-3 (1986):	Part 3: <i>Analogue integrated circuits</i> .
Publication 748-11 (1990):	Part 11: <i>Sectional specification for semiconductor integrated circuits excluding hybrid circuits</i> .
Publication 749:	<i>Semiconductor devices. Mechanical and climatic test methods</i> .
Publication QC 001002 (1986):	<i>Rules of procedure of the IEC quality assessment system for electronic components (IECQ)</i> .

ISO Publications:

ISO Standard 1000 (1981):	<i>SI units and recommendations for the use of their multiples and of certain other units</i> .
ISO Standard 8601 (1988):	<i>Data elements and interchange formats — Information interchange — Representation of dates and times</i> .
ISO Standard 2859 (1989):	<i>Sampling procedures for inspection by attributes</i> .

2.3 Units, symbols and terminology

Units, graphical symbols, letter symbols and terminology shall, wherever possible, be taken from the following publications:

- ISO Standard 1000;
- IEC Publication 27;
- IEC Publication 50;
- IEC Publication 617.

Any other units, symbols or terminology peculiar to one of the semiconductor devices covered by this generic specification shall be taken from the relevant IEC or ISO documents (see subclause **2.2**) or derived in accordance with the principles of the documents listed above.

2.4 Preferred values of voltages, currents and temperatures

Preferred values of voltages, currents and temperatures for the measurement of characteristics, for tests and for operating conditions, are given in IEC Publications 747-1 and 748-1.

2.5 Marking

a) On the device

Where space permits, the following information shall be marked on the device:

- 1) Index point for terminal identification (see subclause **2.5.1**).
- 2) Type designation (see subclause **2.5.2**), categories of assessed quality (see subclause **2.6**) and, where appropriate, screening sequence (see subclause **2.7**).
- 3) Manufacturer's name, initial or trade mark and, where appropriate, factory identification code (see subclause **2.5.3**).
- 4) Inspection lot identification code (see subclause **2.5.4**).

- 5) Mark of conformity, unless a certificate of conformity is used.
- 6) Reference to special handling precautions, where appropriate.

Where space does not permit full marking, the detail specification shall give the minimum requirement in the above order of precedence.

b) On the primary packaging

The following information shall appear on the primary packaging used as initial protection or wrapping for delivery:

- 1) all the information listed in Item a) of subclause 2.5, except the terminal marking;
- 2) the detail specification reference;
- 3) any special handling precautions, for example caution labels.

2.5.1 Terminal identification (reference: IEC Publication 747-1, chapter VI, clause 8)

The terminals shall be identified in the detail specification by reference to the specified outline or base drawing.

2.5.2 Type designation

When the type designation is marked on the component, it shall be given preferably in letters and figures, or with a colour code when specified in the detail specification. Colour codes may be given in the sectional specification.

2.5.3 Manufacturer's name or trade mark

If the manufacturer's name or trade mark does not enable traceability to the manufacturing factory, a factory identification code shall also be used.

2.5.4 Inspection lot identification code

This is given in ISO Standard 8601 for the week, preceded by the last two digits of the year (example: 9145 = 45th week of 1991). When marking-space on the device is restricted, the first digit of the year may be omitted (example: 145 = 45th week of 1991) when specified in the detail specification. It is the date that the lot was submitted for inspection. When more than one lot of a type is submitted for inspection within the same week, an inspection lot identification suffix, such as a letter, shall be used to identify each successive lot.

2.6 Categories of assessed quality

This specification provides for three categories of assessed quality. The devices are grouped in an identified and date-coded inspection lot, which is tested to the specified quality categories. The AQLs or LTPDs associated with the same inspection group may vary for each category and shall be as specified in the detail specification.

The minimum requirements of the categories are as follows:

- | | |
|--------------|--|
| Category I | — In which the type meets the requirements of qualification approval to categories II or III. Each lot meets the inspection requirements of Group A which includes functional tests. Every three months, one lot meets the inspection requirements for solderability. Annually, one lot meets Group B and Group C inspection requirements. |
| Category II | — In which the lot meets the inspection requirements of Group A and Group B on a lot-by-lot basis and of Group C on a periodic basis. |
| Category III | — In which the lot is 100 % screened and meets the inspection requirements of Group A and Group B on a lot-by-lot basis and of Group C on a periodic basis. |

The sectional specifications shall define the minimum requirements for each category. A detail specification may contain additional requirements, including screening, to those given in the generic, sectional or blank detail specification.

2.7 Screening

A screening is an examination or test applied to all devices in a lot.

When required by the detail specification, all devices in the lot shall be screened by submitting them to one of the sequences given in the relevant table of the sectional specification and all defectives removed. Other sequences not specified herein are applicable only in case the above sequences are not correlated or in contradiction with recognized failure mechanisms. When a part of the screening process as given in the relevant table of the sectional specification forms part of the manufacturing process in the prescribed sequence, these procedures need not be repeated. For the purpose of this specification, burn-in is defined as thermal and electrical stress applied to all devices in a lot for a specified period of time for the purpose of detecting and removing potential early failures.

2.8 Handling

See IEC Publication 747-1, chapter IX.

Adequate warning shall be displayed in the case of harmful products (e.g. BeO).

3 Quality assessment procedures

Quality assessment comprises the procedure for obtaining qualification approval as defined in subclause 3.5, followed by quality conformance inspection on a lot-by-lot basis (including screening if required) and on a periodic basis as qualified in the detail specification.

The quality assessment tests are subdivided into Group A, B and C tests; these are performed lot by lot or periodically (as defined in subclause 2.6). In some cases, Group D tests may also be specified, for example, for qualification approval.

3.1 Eligibility for qualification approval

A type is eligible for qualification approval when the Rules of Procedure of IEC Publication QC 001002, clause 11, is satisfied.

3.1.1 Primary stage of manufacture

The primary stage of manufacture is defined in the sectional specification.

3.2 Commercially confidential information

If any part of the manufacturing process is commercially confidential, this shall be suitably identified, and the Chief Inspector shall demonstrate to the satisfaction of the National Supervising Inspectorate (NSI) that the requirements of the Rules of Procedure of IEC Publication QC 001002, subclause 10.2.2, have been complied with.

3.3 Formation of inspection lots

See the Rules of Procedure of IEC Publication QC 001002, subclause 12.2.

3.4 Structurally similar devices

See the Rules of Procedure of IEC Publication QC 001002, subclause 8.5.3.

Details concerning grouping are given in the relevant sectional specification.

3.5 Granting of qualification approval

See the Rules of Procedure of IEC Publication QC 001002, subclause 11.3.1.

Either method a) or b) of the Rules of Procedure, subclause 11.3.1, may be used at the manufacturer's option following inspection requirements given in the sectional specification. Samples may be composed of appropriate structurally similar devices. In some cases, Group D tests are required for qualification approval.

All variables measurements called for as post test end-points in the detail specification shall be recorded as variables data.

The qualification report shall include a summary of all the test results for each group and sub-group, including number of devices tested and number of devices failed. This summary shall have been derived from variables and/or attributes data.

Manufacturers shall retain all data for provision to the NSI on demand.

3.6 Quality conformance inspection

Quality conformance inspection shall consist of the examinations and tests of Groups A, B, C and D, as specified.

For Group B and C inspection, samples may be composed of structurally similar devices.

Samples for periodic tests shall be drawn from one or more lots which shall have passed Group A and B inspection. Individual devices shall have passed the Group A measurements called for in the detail specification.

3.6.1 Division into groups and sub-groups

The following guidelines are to be used in the preparation of detail specifications.

3.6.1.1 Group A inspection (lot by lot)

This group prescribes the visual inspection and the electrical measurements to be made on a lot-by-lot basis to assess the principal properties of a device. Unless otherwise specified, structural similarity groupings are not permitted.

Group A inspection is divided into appropriate sub-groups as follows:

- | | |
|------------------------------|--|
| <i>Sub-group A1:</i> | This sub-group comprises external visual examination as specified in subclause 4.2.1.1. |
| <i>Sub-group A2:</i> | This sub-group comprises measurements of primary characteristics of the device. |
| <i>Sub-groups A3 and A4:</i> | These sub-groups may not be required. They comprise measurements of secondary characteristics of the device. The correct requirements for each device category are given in the relevant sectional specification. The choice between sub-groups A3 or A4 for given measurements is essentially governed by the desirability of performing them at a given quality level. |

3.6.1.2 Group B inspection (lot by lot, except for category I [see subclause 2.6])

This group prescribes the procedures to be used to assess certain additional properties of the device, and includes mechanical, climatic and electrical endurance tests that can normally be performed in one week.

3.6.1.3 Group C inspection (periodic)

This group prescribes the procedures to be used on a periodic basis to assess certain additional properties of the devices, and includes electrical measurements, mechanical, climatic and endurance tests appropriate for checking at intervals of either three months (categories II and III) or one year (category I), or as specified in the relevant specification.

3.6.1.4 Division of Group B and Group C into sub-groups

To enable comparison and to facilitate change from Group B to Group C and vice versa when necessary (see subclause 3.6.3), tests in these groups have been divided among sub-groups bearing the same number for corresponding tests.

The division is as follows:

- | | |
|----------------------------|---|
| <i>Sub-groups B1/C1:</i> | Comprise measurements that control dimensional interchangeability of the devices. |
| <i>Sub-groups B2a/C2a:</i> | Comprise measurements that assess electrical and optical properties of the devices of a design nature. |
| <i>Sub-groups B2b/C2b:</i> | Comprise measurements that further assess some of the electrical and optical characteristics of the device already measured in Group A, by measurement under different voltage, current, temperature or optical conditions. |
| <i>Sub-groups B2c/C2c:</i> | Comprise verification of ratings of the device, where appropriate. |
| <i>Sub-groups B3/C3:</i> | Comprise tests intended to assess mechanical robustness of the terminations of the device, for example stud torque, lead bending. |
| <i>Sub-groups B4/C4:</i> | Comprise tests intended to assess solderability of the device. |
| <i>Sub-groups B5/C5:</i> | Comprise tests intended to assess the ability of the device to withstand climatic stresses, for example change of temperature, sealing. |

<i>Sub-groups B6/C6:</i>	Comprise tests intended to assess the ability of the device to withstand mechanical stresses, for example acceleration, steady state.
<i>Sub-groups B7/C7:</i>	Comprise tests intended to assess the ability of the device to withstand long-term humidity.
<i>Sub-groups B8/C8:</i>	Comprise tests intended to assess failure characteristics of the device under endurance testing.
<i>Sub-groups B9/C9:</i>	Comprise tests intended to assess electrical and optical properties of the device under storage conditions at extremes of temperature.
<i>Sub-groups B10/C10:</i>	Comprise tests intended to assess performance of the device during variations of air pressure.
<i>Sub-groups B11/C11:</i>	Comprise tests on permanence of marking.
<i>Sub-group CRRL:</i>	Lists a selection of tests and/or measurements done in the preceding sub-groups, the results of which are to be presented in the Certified Record of Released Lots (CRRL).

These sub-groups may not all be required.

3.6.1.5 Group D inspection

This group prescribes the procedures to be carried out at intervals of 12 months or for qualification approval only.

3.6.2 Inspection requirements

The statistical sampling procedures described in subclause 3.7 shall be used.

3.6.2.1 Criteria for lot rejection

Lots failing to meet the quality conformance inspection of either Group A or Group B inspection shall not be accepted. If during quality conformance inspection devices fail a test in a sub-group that would result in the lot being rejected, the quality conformance inspection can be terminated, and the lot shall be considered a rejected lot in Groups A and B. If a lot is withdrawn in a state of failing to meet quality conformance requirements and is not resubmitted, it shall be considered a rejected lot.

3.6.2.2 Resubmitted lots

Failing lots, that have been reworked when technically possible and are resubmitted for quality conformance inspection, shall contain only devices that were included in the original lot and shall be resubmitted only once for each inspection group (Groups A and B). Resubmitted lots shall be kept separate from new lots and shall be clearly identified as resubmitted lots. Resubmitted lots shall be randomly resampled and inspected for all failed sub-groups, using tightened inspection. Resubmission for a Group B failure shall include inspection to Group A.

3.6.2.3 Procedure in case of test equipment failure or operator error

If any devices are believed to have failed as a result of faulty test equipment or operator error, the failures shall be entered in the test record (but may be excluded from the CRRL by agreement with the NSI) and shall be submitted along with a complete explanation why the failures are believed to be invalid to the NSI. The Chief Inspector shall decide whether replacement devices from the same inspection lot may be added to the sample. Replacement devices shall be subjected to the same tests to which the discarded devices were subjected prior to failure and to any remaining specified tests to which the discarded devices were not subjected prior to failure.

3.6.2.4 Procedure in case of failure in periodic tests

When a Group B failure occurs, the corresponding Group C tests (see subclause 3.6.1.4) are invalid.

In the event of failing periodic tests inspection for causes other than faults or operator error:

See Rules of Procedure of IEC Publication QC 001002, subclause 12.6, with the following amendments:

- subclause 12.6.1, item a): “suspend further releases under the System of *all* components *within the structurally similar set*.”
- subclause 12.6.4, item a): “the procedure for release under the System of corrected lots shall be returned immediately *after correcting the manufacturing fault*.”