

Harmonized system of quality assessment for electronic components

Generic specification: semiconductor optoelectronic and liquid crystal devices

The European Standard EN 120000 : 1996 has the status of a
British Standard

ICS 31.260

Committees responsible for this British Standard

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- British Telecommunications plc
- Federation of the Electronics Industry
- Ministry of Defence
- National Supervising Inspectorate (BSI Product Certification)
- United Kingdom Optical Sensors Collaborative Association

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National foreword

This British Standard has been prepared by Technical Committee EPL/47/3 and is the English language version of EN 120000 : 1996, *Generic specification: Semiconductor optoelectronic and liquid crystal devices*, published by the European Committee for Electrotechnical Standardization (CENELEC). It supersedes BS CECC 20000 : 1983 which is declared obsolescent; BS CECC 20000 : 1983 is thereby still valid for existing approvals, but may not be used for any new approvals.

Cross-references

Publication referred to	Corresponding British Standard
ISO 1000 : 1973 ¹⁾	BS 5555 : 1993 <i>Specification for SI units and recommendations for the use of their multiples and certain other units</i>
EN 60065 : 1993 (IEC 65 : 1985)	BS EN 60065 : 1994 <i>Safety requirements for mains operated electronic and related apparatus for household and similar general use</i>
EN 60068-1 : 1994 (IEC 68-1 : 1988)	BS EN 60068 <i>Environmental testing</i> BS EN 60068-1 : 1995 <i>General and guidance</i>
IEC 68-2 EN 60068-2-2 : 1993 (IEC 68-2-2 : 1974)	BS EN 60068-2 <i>Test methods</i> BS EN 60068-2-2 : 1993 <i>Test B. Dry heat</i>
HD 323.2.3 S2 : 1987 (IEC 68-2-3 : 1969)	BS 2011 <i>Environmental testing</i> Part 2.1 Ca : 1977 <i>Test Ca. Damp heat, steady state</i>
EN 60068-2-6 : 1995 (IEC 68-2-6 : 1995)	BS EN 60068 <i>Environmental testing</i> BS EN 60068-2 <i>Test methods</i> BS EN 60068-2-6 : 1996 <i>Test Fc. Vibration (sinusoidal)</i>
EN 60068-2-7 : 1993 (IEC 68-2-7 : 1983)	BS EN 60068-2-7 : 1993 <i>Test Ga and guidance. Acceleration, steady state</i> BS 2011 <i>Environmental testing</i> Part 2.1N : 1985 <i>Test N. Change of temperature</i>
HD 323.2.14 S2 : 1987 (IEC 68-2-14 : 1984)	BS EN 60068 <i>Environmental testing</i> BS EN 60068-2 <i>Test methods</i> BS EN 60068-2-17 : 1995 <i>Test Q, sealing</i>
EN 60068-2-17 : 1994 (IEC 68-2-17 : 1994)	BS 2011 <i>Environmental testing</i> Part 2.1T : 1981 <i>Test T. Soldering</i>
HD 323.2.20 S3 : 1988 (IEC 68-2-20 : 1979)	Part 2.1U : 1984 <i>Test U. Robustness of terminations and integral mounting devices</i>
HD 323.2.21 S3 : 1988 (IEC 68-2-21 : 1983)	BS EN 60068 <i>Environmental testing</i> BS EN 60068-2 <i>Test methods</i> BS EN 60068-2-27 : 1993 <i>Environmental testing procedures. Tests. Test Ea and guidance. Shock</i>
EN 60068-2-27 : 1987 (IEC 68-2-27 : 1987)	BS 2011 <i>Environmental testing</i> Part 2.1Db : 1981 <i>Test Db and guidance: Damp heat, cyclic (12 + 12 hour cycle)</i>
HD 323.2.30 S3 : 1988 (IEC 68-2-30 : 1980)	Part 2.1Z/AD : 1977 <i>Test Z/AD. Composite temperature/humidity cyclic test</i>
HD 323.2.38 S1 : 1988 (IEC 68-2-38 : 1974)	

¹⁾ ISO 10000 : 1973 has been superseded by ISO 1000 : 1993 with which the cited British Standard is identical.

IEC 148 : 1969	BS 3363 : 1980 <i>Specification for letter symbols for semiconductor devices and integrated microcircuits</i>
IEC 191	BS 3934 <i>Mechanical standardization of semiconductor devices</i>
IEC 270 : 1981	BS 4828 : 1985 <i>Guide for partial discharge measurements</i>
IEC 410 : 1973	BS 6001 <i>Sampling procedures for inspection by attributes</i> Part 1 : 1991 <i>Specification for sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection</i>
IEC 536	BS 2754 : 1976 <i>Memorandum. Construction of electrical equipment for protection against electric shock</i>
IEC 617	BS 3939 <i>Graphical symbols for electrical power, telecommunications and electronics diagrams</i>
IEC 747	BS 6493 <i>Semiconductor devices</i>
IEC 747-1 : 1983	Part 1 <i>Discrete devices</i> Section 1.1 : 1984 <i>General</i>
IEC 747-2 : 1983	Section 1.2 : 1984 <i>Recommendations for rectifier diodes</i>
IEC 747-5 : 1992	Section 1.5 : 1992 <i>Recommendations for optoelectronic devices</i>
CECC 00109 : 1974	BS CECC 00109 : 1991 <i>Rule of procedure 9. Certified test records</i>
CECC 00114	BS CECC 00114 : <i>Rule of procedure 14. Quality assessment procedures</i>
ISO 497	BS 2045 : 1965 <i>Preferred numbers</i>
ISO 9000	BS EN ISO 9000 <i>Quality management and quality assurance standards</i>

Compliance with a British Standard does not of itself confer immunity from legal obligations.

English version

Generic specification: Semiconductor optoelectronic and liquid crystal devices

Specification générique:
Dispositifs à semiconducteurs optoélectroniques
et à cristaux liquides

Fachgrundspezifikation:
Optoelektronische Halbleiter und
Flüssigkeitskristall-Bauelemente

This European Standard was approved by CENELEC on 1995-11-28. 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.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

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 Working Group CLC/TC CECC/WG 20.

The text of the CECC 20000 : 1982 with its supplements 1 : 1984 and 2 : 1986 and its amendment 3 : 1992 together with document CECC (Secretariat) 2756 was submitted to the formal vote; together with the voting report, circulated as document CECC (Secretariat) 3024, it was approved as EN 120000 on 1992-02-14.

A number of documents modifying the existing text or adding new sections or annexes were submitted to the formal vote and approved.

A combined and slightly restructured document was submitted to the CENELEC Technical Board and approved as EN 120000 on 1995-11-29.

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) 1996-06-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1996-06-01

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PART 1: SEMICONDUCTOR OPTOELECTRONIC AND LIQUID CRYSTAL DEVICES

SECTION 1 - SCOPE

This European Standard specifies the terms, definitions, symbols, quality assessment procedures and test methods necessary to prepare detail specifications (DS) for semiconductor optoelectronic and liquid crystal devices in the CECC System.

It applies to:

- light emitting diodes - LED's;
- optoelectronic displays;
- infrared emitting diodes - IRED's;
- optocouplers;
- photoelements;
- photodiodes;
- phototransistors;
- photothyristors;
- semiconductor lasers;
- photoresistors;
- photoconductive cells;
- polycrystalline elements;
- physical receptors (of radiation);
- photoelectric receptors (photocell);
- liquid crystal displays - LCD's;
- charge coupled image sensing devices - CCD's (for image sensing devices).

SECTION 2 - GENERAL

2.1 Order of precedence

Where any discrepancies occur, documents shall rank in the following order of precedence, provided that the Generic, Blank Detail and Detail specifications have been prepared in accordance with the requirements of the System:

1. Basic Rules of the CECC System
2. Detail Specification
3. Relevant Generic and Blank Detail Specification
4. CECC Rules of Procedure and other documents to which reference is made
5. Basic specifications

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

2.2 Related documents

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE: When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 27	series	Letters symbols to be used in electrical technology	HD 245	series
IEC 65 (mod) + A1 + A2 + A3	1985 1987 1989 1992	Safety requirements for mains operated electronic and related apparatus for household and similar general use	EN 60065	1993
IEC 68	series	Environmental testing	EN 60068 HD 323	series series
IEC 68-1	1988	Part 1: General and guidance	EN 60068-1	1994
IEC 68-2-2 + IEC 68-2-2A	1974 1976	Tets B: Dry heat	EN 66068-2-2	1993
IEC 68-2-3	1969	Test Ca: Damp heat, steady state	HD 323.2.3 S2	1987
IEC 68-2-6	1995	Test Fc and guidance: Vibration (sinusoidal)	EN 60068-2-6	1995
IEC 68-2-7	1983	Test Ga and guidance: Acceleration, steady state	EN 60068-2-7	1993
IEC 68-2-14	1984	Test N: Change of temperature	HD 323.2.14 S2	1987
IEC 68-2-17	1994	Test Q: Sealing	EN 60068-2-17	1994
IEC 68-2-20	1979	Test T: Soldering	HD 323.2.20 S3	1988
IEC 68-2-21	1983	Test U: Robustness of terminations and integral mounting devices	HD 323.2.21 S3	1988
IEC 68-2-27	1987	Test Ea and guidance: Shock	EN 60068-2-27	1993
IEC 68-2-30	1980	Test Db and guidance: Damp heat, cyclic (12 + 12 hour cycle)	HD 323.2.30 S3	1988
IEC 68-2-38	1974	Test Z/AD: Composite temperature/humidity cyclic test	HD 323.2.38 S1	1988

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 134	1961	Rating systems for electronic tubes and valves and analogous semiconductor devices	-	-
IEC 148	1969	Letter symbols for semiconductor devices	-	-
IEC 148A	1974	and integrated microcircuits	-	-
IEC 148B	1979			
IEC 191	series	Mechanical standardization of semiconductor devices	-	-
IEC 270	1981	Partial discharge measurements	-	-
IEC 306	series	Measurement of photosensitive devices	-	-
IEC 410	1973	Sampling plans and procedures for inspection by attributes (see also CECC 00 007)	-	-
IEC 536	1986	Classification of electrical and electronic equipment with regard to protection against electric shock	-	-
IEC 617	series	Graphical symbols for diagrams	-	-
IEC 747-1 A2	1983 1992	Semiconductor devices - Discrete devices and integrated circuits Part 1: General	-	-
IEC 747-2	1983	Part 2: Rectifier diodes	-	-
IEC 747-5 A1 A2	1992 1994 1995	Part 5: Optoelectronic devices	-	-
CECC 00 007	-	Basic specification: Sampling plans and procedures for inspection by attributes		
CECC 00 100	1974	CECC Basic Rules		
CECC 00 109	1974	RP 9 : Certified Test Records		
CECC 00 114	series	RP 14: Quality Assessment Procedures		
ISO 497	1973	Guide to the choice of series of preferred numbers and of series containing more round values of preferred numbers	-	-
ISO 1000	1973	S.I. units and recommendations for the use of their multiples and of certain other units	-	-
ISO 9000	series	Quality management and quality assurance standards	EN 29000 EN ISO 9000	series series
ISO/R 2015	1971	Numbering of weeks	-	-

2.3 Units, symbols and terminology

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

ISO 1000	S.I. 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
IEC 148	Letter symbols for semiconductor devices and integrated microcircuits

Any other units, symbols and terminology peculiar to one of the components covered by this GS shall be taken from the relevant IEC or ISO documents listed under "Related documents" or be derived in accordance with the principles of the documents listed above.

2.4 Preferred values of ratings and characteristics

Preferred values of voltages and currents for characteristics shall conform to IEC 747-5.

2.5 Marking

The following shall be marked on the device, in the following order of precedence, as space permits. All the information, except the terminal identification, shall appear on the primary pack used as initial protection or wrapping for delivery:

- 1 Terminal identification (see 2.5.1);
- 2 Type designation (see 2.5.2);
- 3 Date code (see 2.5.4);
- 4 Factory identification code or manufacturer's name or trade-mark (see 2.5.8);
- 5 Mark of conformity unless a Certificate of Conformity is used

In addition, the primary pack only shall be marked with the Detail Specification reference.

2.5.1 Terminal identification (see IEC 747-5)

The terminals shall be identified in at least one of the following ways:

- in accordance with the specified outline or base drawing;
- as prescribed in the Detail Specification.

2.5.2 Type designation

This shall be given preferably in letters and figures, or with the following code for Pro Electron type numbers.

TWO LETTERS FOLLOWED BY A SERIAL NUMBER

FIRST LETTER gives information about the material used for the active part of the device.

- A Germanium or other material with band gap of 0,6 - 1,0 eV
- B Silicon or other material with band gap of 1,0 - 1,3 eV
- C Gallium-arsenide or other material with band gap of 1,3 eV or more
- D Compound materials (for instance cadmium-sulphide)

SECOND LETTER indicates the function for which the device is primarily designed.

- N Photo coupler
- P Radiation detector (for example : high sensitivity phototransistor)
- Q Radiation generator (for example : light emitting diodes (LED))

SERIAL NUMBER may be :

- three figures, running from 100 to 999, for devices primarily intended for consumer equipment.
- one letter (Z, Y, X, and so on) and two figures running from 10 to 99, for devices primarily intended for industrial/professional equipment. This letter has no fixed meaning except W which is used for transient suppressor diodes, after second letter Z.

EXAMPLES

CQY 17 GaAs, light emitting diode, industrial type
BFX 71 Si, phototransistor, industrial type

To the basic number can be added :

A VERSION LETTER

It indicates a minor variant of the basic type either electrically or mechanically. The letter never has a fixed meaning, except letter R, indicating reversed polarity.

A SUFFIX

Sub-classification may be used for devices supplied in a wide range of variants called associated types.

The following sub-coding suffixes are in use :

- RADIATION DETECTORS : ONE NUMBER, preceded by a hyphen.
The NUMBER indicates the depletion layer in μm . The resolution is indicated by a version LETTER.

Example : BPX 10-2A

- ARRAY OF RADIATION DETECTORS AND GENERATORS : ONE NUMBER, preceded by an oblique stroke.
The NUMBER indicates how many basic devices are assembled into the array.

Example : BPW 50/6, BPW 50/9, BPW 50/12

2.5.3 Manufacturer's name or trade-mark

Where the Certificate of Conformity enables traceability to a manufacturer's factory, the manufacturer's name or trade-mark is sufficient. In all other cases, the factory identification code shall be used.

2.5.4 Date code system

This shall conform with ISO/R 2015 for the week, preceded by the last two digits of the year (example : 7245 = 45th week of 1972).

2.6 Ordering information

Unless otherwise specified, the following minimum information is necessary to order a given device :

- precise type number
 - CECC DS number (see Note 1), with issue number and/or date when relevant
 - level of quality assessment as defined in the BDS (see Note 2) and if required, screening sequence as defined in 3.5.10.
- any other particulars

Note 1 When the intention is to have within the System several types of semiconductor optoelectronic devices falling within the same family, for instance obtained by a selection on the values of optical or electrical characteristics, such types should preferably be grouped in a single detail specification, which shall bear a single CECC reference number

Note 2 When the intention is to allow the same semiconductor optoelectronic device to be ordered according to different levels of quality assessment, such levels should preferably be given in a single detail specification which shall bear a single CECC reference number.

SECTION 3 - QUALITY ASSESSMENT PROCEDURES

The quality assessment tests are subdivided into Group A and Group B tests that are performed lot-by-lot, and Group C tests that are performed periodically.

3.1 Primary stage of manufacture and subcontracting

The primary stage of manufacture is one of the following :

- for monocrystalline semiconductor devices
"The first process which changes the monocrystalline semiconductor material from being wholly P-type or N-type".
- for polycrystalline semiconductor devices
"The deposition of a polycrystalline layer onto a substrate".
- for liquid crystal devices
"The generation of the pattern on a substrate".

When the approved manufacturer wishes to subcontract part of the manufacture (see CECC 00 114) he shall ensure that the following conditions are satisfied:

- the subcontracted manufacturing processes may be either the primary stage or the assembly of the device.
- the National Supervising Inspectorate (ONS) shall be satisfied that the Chief Inspector of the manufacturer who is certifying the components under the CECC System has been provided with the full quality assurance and inspection documentation from the production facility outside the CECC and that he has the responsibility for inspection of the work and the inspection arrangements there. Such documentation shall include the inspection records for each sample of the product which undergoes inspection.
- the Chief Inspector shall be provided with the production line process charts, the defined inspection points, the inspections requirements at each stage and quality control requirements, together with the procedures for the transfer of the parts from the place of manufacture to the manufacturer within CECC who is certifying the component. The ONS shall be informed and have access to this documentation and be able to verify the application of these requirements.
- any changes in inspection requirements and manufacturing procedures shall be reported back to the CECC approved manufacturer's Chief Inspector who is certifying the components. These changes shall be declared on the document accompanying the transferred parts. The significant changes shall be reported by the approved manufacturer's Chief Inspector to the ONS.
- the approved manufacturer shall perform the acceptance tests required by the detail specification for the component he is certifying. He is permitted to perform the acceptance test in a facility outside the CECC defined limits provided that this facility is supervised by the ONS.
Acceptance tests may be subcontracted to approved test laboratories within the CECC geographical limits.

3.2 Definition of a production lot

Unless otherwise stated, a production lot (referred to as "lot") consists of devices having the same design, manufactured on the same production line, only differing by a selection based on electrical and optical characteristic limits, and normally produced during one week.

For liquid crystal devices the same design may include displays with similar shapes and areas but with different aspects ratio (not larger than 2 : 1) and masks (characters and/or symbols).

Note 1 After this selection has been made, the lot can be divided into sub-lots of types, on which structural similarity can apply.

Note 2 Attention is also drawn to the clause of CECC 00 114 relevant to the formation of inspection lots.

3.3 Structurally similar devices

The crucial criterion for the grouping of types devices as structurally similar is that the differences between the various types have no influence on the results of the test for which the group has been formed.

To simplify the practical operation of inspection schemes, a more restricted definition is adopted for the purpose of this document.

Structurally similar devices are produced by one manufacturer, with essentially the same design, materials, processes and methods. They only differ because of manufacturing variations usually resulting in their classification into types having different electrical, photometric or radio-metric characteristics.

For the purposes of obtaining samples both for qualification approval and for quality conformance testing, semiconductor optoelectronic devices may be grouped as described below.

The application of these rules is illustrated in figure 1.

3.3.1 Electrical and optical characteristic tests in Groups A and/or C

Components having the same device design, manufactured on the same production line but differing only by a selection based on electrical and optical characteristic limits shall be divided into sub-lots of types according to these different electrical and optical characteristic limits (that is divided into types).

Such components should preferably be included in the same detail specification but in any case the details of the grouping used shall be explained in the qualification approval test report.

(1) Different electrical and optical characteristic limits

For those particular tests where different electrical and optical characteristic limits apply for the sub-lots, then each sub-lot shall be sampled with a sample size appropriate to the number of components in each sub-lot.

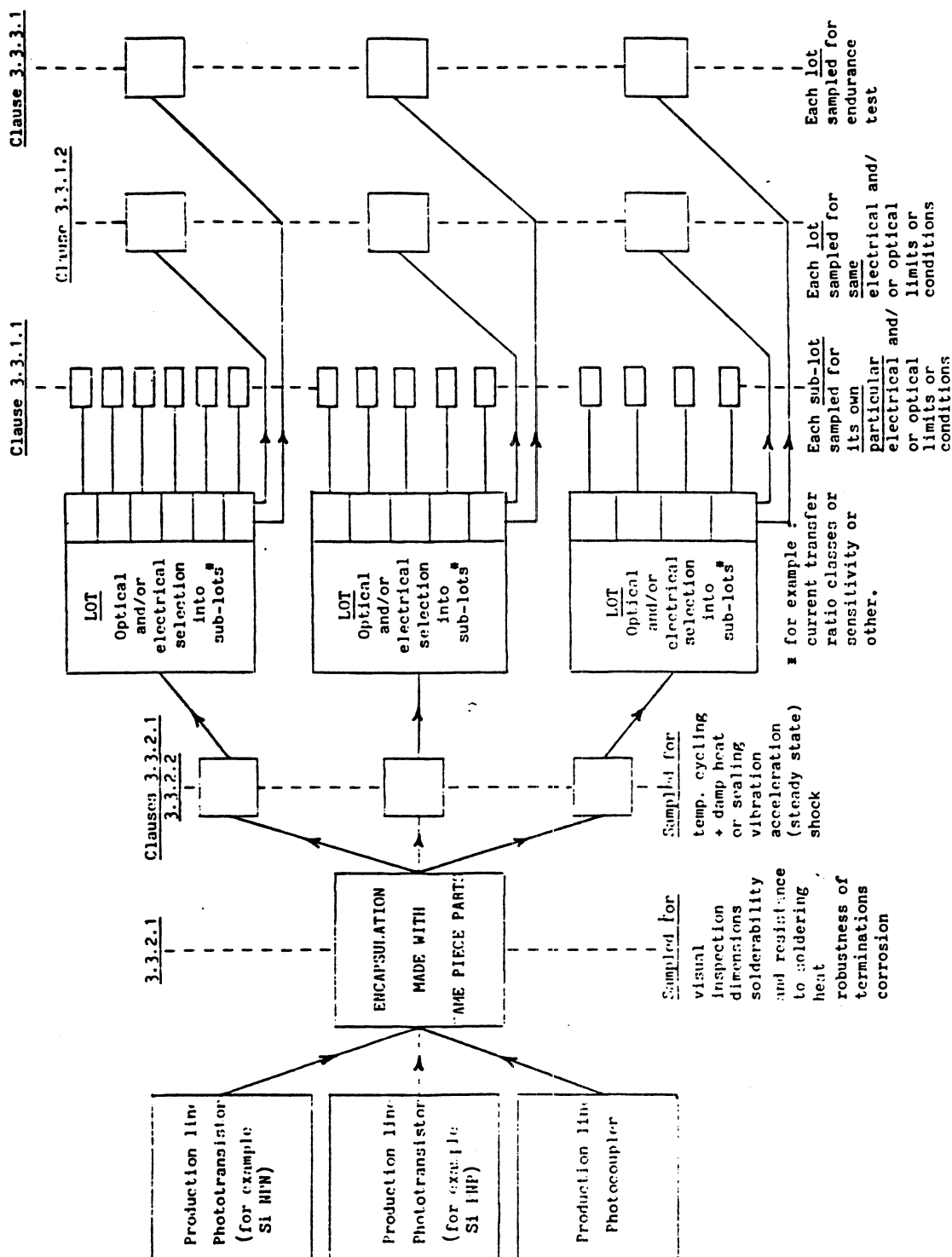


Figure 1: Example of structural similarity for phototransistor and photocoupler

Examples of such particular tests are :

- the selection of photo sensitive devices into various sub-lots with different photo-sensitivities
- the selection of photo coupling elements into various sub-lots with different output to input transfer ratio
- the selection of light emitting devices into various sub-lots with different luminous or radiant intensity.

(2) Identical electrical and optical characteristic limits

For those particular tests where the same electrical or optical characteristic limit and test conditions apply for all the sub-lots, then the total lot shall be assessed by testing either :

- a single sample, of a size appropriate to that for the total lot, comprising equal or proportionate quantities of all the sub-lots, or
- a single sample, of a size appropriate to that for the total lot, taken at random from the total lot.

3.3.2 Environmental tests in Groups B and/or C

Components which have been encapsulated by the same method, have the same basic type of internal mechanical structure, have used the same (X) piece parts and have been subjected to common sealing and finishing processes, may be considered as structurally similar, as described below, and a single sample, of a size appropriate to that of the total lot, may be taken to assess the total lot of such similar components.

(X)) Note : "same" means that the piece parts meet the applicable requirements of the incoming inspection.

(1) Components made on the same production line

The tests to which the above grouping may apply are :

- visual inspection
- dimensions
- soldering : solderability and resistance to soldering heat
- robustness of terminations
- corrosion (for example damp heat, steady state)
- change of temperature and accelerated damp heat (or sealing)
- vibration
- acceleration (steady state)
- shock

Examples of such components are various types of optoelectronic devices made on the same production line and encapsulated in a case made with the same piece parts.

(2) Components made on different production lines

The tests to which the above grouping may apply are limited to :

- visual inspection
- dimensions
- soldering : solderability and resistance to soldering heat
- robustness of terminations
- corrosion (for example damp heat, steady state)

3.3.3 Endurance tests

Unless otherwise specified in the Blank Detail Specification, for endurance tests such as :

- electrical endurance
- dry heat

components having the same device design, manufactured on the same production line but differing only by a selection based on electrical or optical characteristic limits, shall be divided into sub-lots of types according to those different electrical or optical characteristic limits. Devices from one of these sub-lots may be used for electrical endurance tests in accordance with (1) or (2).

Such devices should preferably be included in the same detail specification but in any case the details of the grouping used shall be declared in the qualification approval test report.

(1) When the tests are specified in Group B - lot by lot

The total lot may be assessed for each type of endurance test by taking a single sample, of a size appropriate to that of the total lot, from any one sub-lot provided that :

- the total quantity of devices in the sub-lot chosen, together with the total quantity of devices in all the other sub-lots which have either a lower rating or a less severe characteristic limit, comprise not less than 60 % of the total lot size of all the sub-lots, and
- the following additional tests shall be performed once every three months for the sub-lot with either the highest rating or the most severe electrical or optical characteristic limit, using a sample size appropriate to the average lot size during the three months period :

electrical endurance for 168 h

Example : sub-lots of light-emitting diodes having

$I_{v\min} = 0,5 ; 0,7 ; 1 ; 1,6 ; 3$ mcd with related quantities
N 1 ; N 2 ; N 3 ; N 4 ; N 5.

The total lot may be assessed, for instance by sub-lot
 $I_{v\min} = 1$ mcd provided that :

- $N 1 + N 2 + N 3 \geq 60 \% (N 1 + N 2 + N 3 + N 4 + N 5)$ and that
- sub-lot $I_{v\min} = 3$ mcd be specially assessed every 3 months.

(2) When the tests are only specified in Group C - periodic

For each type of endurance test, the total lot may be assessed by taking a single sample, of the size specified in the blank detail specification, preferably from the sub-lot containing the greatest number of components, but also assuring adequate rotation of other types over a longer period.

3.4 Qualification approval procedure

Qualification approval shall be given provided the results of the Groups A, B and C tests on one lot are within the limits quoted in the relevant detail specification (X).

The sample size for qualification approval shall be the minimum size for the applicable sampling conditions which lead to an acceptance criterion of one defect.

The qualification report shall include a complete record of all the test results and measured values.

(X) Note : If in the blank detail specification or detail specification a Group D inspection is included for the purpose of Qualification Approval or requalification as indicated in CECC 00 114, the detail specification shall define the tests to be performed.

3.5 Quality conformance inspection

3.5.1 Division into Groups and Sub-Groups

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.

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

Sub-Group A1 This sub-group comprises visual inspection, and polarity inspection when specified.

Sub-Group A2 This Sub-Group comprises those measurements which are of primary importance for verifying the description of the device ; it shall be subdivided to permit the assessment of non-operative devices.

Sub-Groups A3/A4 These sub-groups may not be required. When they are required, they shall comprise those measurements which are of secondary importance for verifying the description of the device.

The choice between Sub-Groups A3 or A4 for given measurements shall essentially be governed by the desirability to perform them at given sampling requirements, but shall also take into account whether the measurements can be made automatically on a large sample or shall be performed manually, but on a reduced number of specimens.

Group B inspection (lot-by-lot)

This Group prescribes the procedures to be used on a lot-by-lot basis to assess certain additional properties of the device, and includes mechanical, climatic and electrical endurance tests which can be completed in less than one week.

Group C inspection (periodic)

This Group prescribes the procedures to be used on a periodic basis to assess certain additional properties of the device, and includes electrical measurements, mechanical, climatic and endurance tests which are appropriate for checking at periodic intervals, generally three months or longer.

Samples for periodic tests shall be drawn from lots which have been accepted in Group A and B tests. Furthermore, the individual specimens shall have passed those Group A measurements called for in the failure criterion.

In the event of failure at Group C inspection the procedure as defined in CECC 00 114 shall be followed.

Division of Group B and Group C inspection into Sub-Groups

For ease of comparison, and to facilitate change from Group B to Group C and vice versa when necessary (see 3.5.3), the tests in these groups have been divided among sub-groups which bear the same number for corresponding tests.

The division is as follows :

Sub-Groups B1/C1 - comprise those measurements which control the dimensional interchangeability of the device.

Sub-Groups B2a/C2a - comprise those measurements which assess the electrical and optical properties of the device which are of a design nature.

Sub-Groups B2b/C2b - comprise those measurements which further assess, by measurement under different conditions of voltage, current or temperature, some of the electrical and optical properties of the device already measured in Group A.

Sub-Groups B2c/C2c - comprise verification of ratings of the device, where appropriate.

Sub-Groups B3/C3 - comprise those tests which are intended to assess the mechanical robustness of the terminations of the device (for instance stud torque, lead bending).

Sub-Groups B4/C4 - comprise those tests which are intended to assess the ability of the device to be soldered.

Sub-Groups B5/C5 - comprise those tests which are intended to assess the ability of the device to withstand climatic stresses (for instance change of temperature)

Sub-Groups B6/C6 - comprise those tests which are intended to assess the ability of the device to withstand mechanical stresses (for instance vibration).

Sub-Groups B7/C7 - comprise those tests which are intended to assess the ability of the device to withstand long term humidity.

Sub-Groups B8/C8 - comprise those tests which are intended to assess the failure characteristics of the device under endurance test.

Sub-Groups B9/C9 - comprise those tests which are intended to assess the electrical and optical properties of the device under storage conditions at extremes of temperature.

Sub-Groups B10/C10 - comprise those tests which are intended to assess the performance of the device during variations of air-pressure, if required.

Sub-Groups CTR - list a selection of the tests and/or measurements done in the preceding sub-groups, the results of which are to be presented in the Certified Test Record.

3.5.2 Inspection requirements

The relevant blank detail specification shall govern except that a detail specification may still add to the number of tests per Sub-Group, especially in Group A, or add a certain Sub-Group, (for instance B2c or C2c).

The inspection levels (IL) and AQL values, or alternatively the sample sizes (n) and acceptance criteria (c), given in the tables apply to the whole of each sub-group or section of each sub-group and not to any single test in the sub-group.

When "na" is indicated in the BDS, this means that the relevant sub-group is not applicable.

3.5.3 Supplementary procedures for reduced inspection

3.5.3.1 Reduced inspection for Group B tests

Special reduced inspection procedures for the tests in all sub-groups of Group B inspection may be used provided that the following conditions are met.

Such procedures apply to each sub-group individually, as and when it meets the required conditions.

(1) When sample sizes are based on the AQL system

When the conditions given in IEC 410 for the change from normal to reduced inspection are met, a manufacturer may carry-out the appropriate Group B test at normal inspection under Group C conditions at intervals of 3 months instead of on a lot-by-lot basis.

Reversion to normal inspection in Group B shall be made as soon as a sample has failed in the corresponding Group C.

(2) When sample sizes have fixed values

When the previous 10 consecutive lots have been accepted on normal inspection, a manufacturer may carry out the appropriate Group B test at normal inspection conditions but on $1/4$ of the lots ; optionally, especially for B8 endurance test, the manufacturer may test every lot with a sample equal to, or just above, $1/4$ the normal sample size and a moving 4 lots acceptance criterion equal to that already specified in the table. (Example : either test 38 devices every 4 lots with 1 reject allowed or, alternatively, test 10 devices every lot with a moving acceptance criterion of 1 on 4 consecutive lots).

Reversion to normal inspection shall occur as soon as the acceptance criterion on reduced inspection is exceeded.

3.5.3.2 Reduced inspection for Group C tests

The procedure given in CECC 00 114 is applicable to all Sub-Groups of Group C, including electrical endurance, which have a periodicity of three months or less ; it is not applicable to those Group C tests performed because special reduced inspection in Group B was applied.

3.5.4 Sampling requirements for small lots or for expensive devices : (provisional) (Sampling plans : see IEC 410)

Where the lot size indicates, for the specified AQL and inspection level, that a sampling plan with an acceptance number of zero shall be used, the Chief Inspector, at his discretion and with the approval of the ONS, may use any one of the following alternative procedures :

- (1) 100 % inspection
- (2) The plan having a larger sample with acceptance number of 1 for the specified AQL
- (3) The plan indicated for the given lot size and inspection level but the next higher AQL, if this leads to a plan with an acceptance number of 1
- (4) The plan with acceptance number of 0. However, if a single defective is obtained, either of the following procedures may be applied :
 - (4.1) A second sample shall be inspected, of such a size as to bring the combined first and second samples to that given by (2) above (that is the sample for a plan to accept on 1 for the same AQL). The lot is acceptable if no further defectives are obtained in the second sample.
 - (4.2) If the preceding 4 consecutive lots were acceptable under original inspection, such a lot may be held until the next lot has been inspected. If the sample from this next lot is acceptable, both lots shall be accepted. If the sample from this lot is not acceptable, both lots shall be rejected.

If both lots are accepted under this clause and in a subsequent lot a single defective occurs (when accepting on zero defects) before a clear run of four lots has been accepted then this lot shall be rejected immediately (without holding for the next lot).

Example

The system in (4.1) above is best illustrated by an example :

A batch of four hundred devices is to be sample tested at AQL = 1,0 % and inspection level S4. Looking at the sampling chart, the 281 to 500 column is used for a batch of 400.

S4 and the batch size of 400 gives a sample size of 13. This sample of 13 and an AQL of 1 % indicate an acceptance criterion of no failures, and thus if there are no failures, all 400 are acceptable. If one device fails, the AQL = 1,0 % column is read down to the figure 1 below the arrow.

The sample size for one failure is 50. Therefore, an additional $(50 - 13) = 37$ devices are tested. If there are no further failures, all 400 are accepted. In spite of the first failure, only 50 devices have been tested from a batch of 400.

3.5.5 Certified Test Records

The procedure given in CECC 00 109 shall apply. The Certified Test Records shall contain the relevant information required in the blank detail specification.

Unless otherwise stated, Certified Test Records should give :

- attributes information for tests in sub-groups : B3, B4, B5, B8, C3, C5, C6 and C9
- measurement information before and after endurance test : C8.

3.5.6 Delivery of devices subjected to destructive (D) or non destructive (ND) tests

Tests are identified as either ND or D in this specification and/or the associated BDSs and DSs. Devices subjected to ND tests may be included in a lot for delivery provided they are satisfactorily re-tested to Group A requirements, however devices subjected to a D test shall not.

A D test does not necessarily destroy a device but there is a risk of it being damaged or its appearance changed. Furthermore even a ND test may be damaging. For example, a solderability test, although marked ND, may so adversely affect gold plated leads so that their appearance changes and can therefore no longer be delivered ; the decision whether or not a ND test is destructive will depend on the type of device and shall be considered and agreed between the Chief Inspector and the CMS.

3.5.7 Delayed deliveries

Before delivery of lots which have been in store for more than two years, the lots, or the quantities to be delivered, shall satisfy the requirements of Sub-Groups A1, A2 and, where applicable, B4 (solderability). If this has been done for the complete lot, no further retesting before delivery is needed for another period of two years.

3.5.8 Supplementary procedure for deliveries

When this has been nationally recognized, manufacturers may, at their discretion, supply devices that have met a higher assessment level against orders for a lower assessment level.

3.5.9 Unchecked parameters (additional information)

When, in detail specifications, additional information is given, this shall not be the subject of inspection.

3.5.10 Screening

Screening test for photocoupler intended to bridge basic or supplementary insulation or to bridge double or reinforced insulation.

NOTE: See IEC 536 for the definitions of basic, supplementary, etc. insulation.

When screening is specified either in a detail specification or in the order for a given device, it shall consist of one of the tests given below and it shall apply to all devices:

- either prior to the formation of samples for quality conformance inspection (lot by lot and periodic);
- or after Groups A and B testing, in which case all of Group A tests and Sub-groups B4 and B5 tests shall be repeated after screening unless they are defined as parts of screening and satisfied before delivery.

When the screening test is already performed during production, under the conditions given below, it need not be repeated.

Screening test procedure to be performed at $T_{amb} = 25\text{ }^{\circ}\text{C}$: 100 % test

a) Isolation voltage test

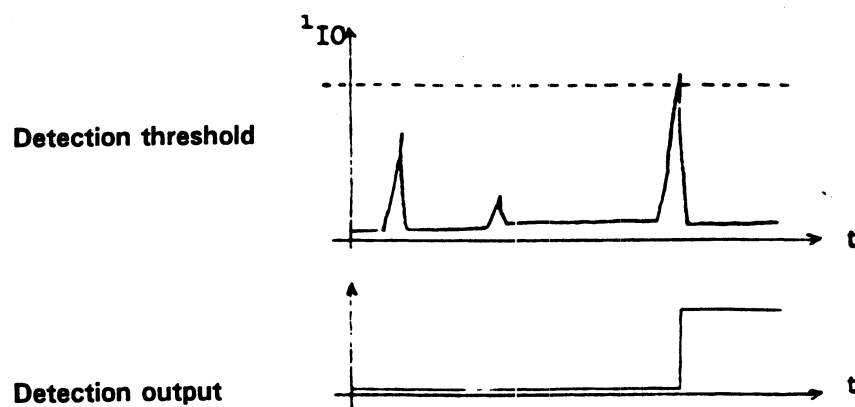
Isolation voltage V_{IORM} applied between input and output as specified.

Duration : 1 s

Detection threshold : $< 1\text{ }\mu\text{A}$ pulse (not d.c., see diagram)

Detection time constant : $< 1\text{ ms}$

NOTE: The specified value of V_{IORM} depends on the intended uses.



b) Partial discharge test

Partial discharge measurements as described in IEC 270:1981. The inception voltage shall be 1,6 times the specified value of V_{IORM} and the extinction voltage shall be 1,2 times the specified value of V_{IORM} . The apparent charge shall be lower than 5 pC. Tests duration: 1 s.

In both cases:

- any defective device is rejected;
- the complete lot is rejected if more than 1 % defectives are found during the test.

3.5.11 High reliability screening

3.5.11.1 Introduction

This subclause gives details of the screens or test sequences appropriate to different classes of screening for optoelectronic devices.

Such screens or test sequences are used as called for in the purchase order and shall be applied in accordance with the requirements of the relevant detail specification.

The screening sequences shall be as given in 3.5.11.2.

All screening tests precede the normal group A, B and C tests. The results from group A, B and C tests on devices which have been subject to screening tests shall be recorded separately, and shall not be included in CTR data for unscreened inspection lots.

For the purposes of group A, B and C tests, an inspection lot is not formed until screening has been completed (see figure 2).

Tests carried out during screening need not be repeated in conformance testing (group B).

Unless otherwise specified in the Detail Specification, production lots submitted to burn-in screen shall be rejected if more than 10% of the devices burned in fail the post burn-in electrical tests (i.e. 10% P.D.A. applies).

3.5.11.2 Screening procedures

3.5.11.2.1 Screening classes

The tables in figure 2 give the screens or test sequence applicable to each class of screening. They shall be read in conjunction with the following notes.

NOTES to figure 2:

- (1) Internal visual examination - See 3.5.11.3.
Internal visual examination shall normally be performed at the latest practical opportunity prior to package sealing; exception may occur, e.g. when a feature is obscured due to the mounting or interconnection technique used.

- (2) The storage at high temperature test is used a stabilization and shall be applied to devices using molybdenum-gold multilayered conductors immediately prior to performing visual examination.

For cavity devices using metallurgical systems other than molybdenum-gold, it shall be permissible to divide the total minimum stabilization time between pre-seal and post-seal stabilization as long as the total stabilization time equals or exceeds 24 h, the post-seal stabilization time equals or exceeds 16 h, and the pre-seal stabilization occurs immediately prior to sealing.

- (3) The sealing test
- applies only for cavity devices;
- is optional at this stage for class A devices;
- for class B, C, E or F devices, shall be performed in any sequence after the last thermal or mechanical screen and before final electrical tests, but after completion of all forming and shearing operations on the terminals.

PRODUCTION LOT

SCREENING CLASS A SCREENING CLASS B SCREENING CLASS C SCREENING CLASS D SCREENING CLASS E SCREENING CLASS F

1	Internal visual examination (1)	1	Internal visual examination (1)	1	Internal visual examination (1)	3	Change of temperature	3	Change of temperature
2	Storage at high temperature (2)	2	Storage at high temperature (2)	2	Storage at high temperature (2)				
3	Change of temperature	3	Change of temperature	3	Change of temperature				
4	Acceleration steady state	4	Acceleration steady state	4	Acceleration steady state				
5	Temperature cycling for thermal intermittence (17)	5	Temperature cycling for thermal intermittence (17)	5	Temperature cycling for thermal intermittence (17)				
6	Sealing	6	Sealing	6	Sealing	6	Sealing	6	Sealing
7	Particle impact noise detection					15	Tests at maximum operating temperature (14)	15	Tests at maximum operating temperature (14)
8	Serialization								
9	Pre burn-in tests (6) (8)	9	Pre burn-in tests (6) (8)			9	Pre burn-in tests (6) (8)	9	Pre burn-in tests (6) (8)
10	Burn-in (9) (15)	10	Burn-in (9) (15)			10	Burn-in (9) (15)	10	Burn-in (9) (15)
11	Post burn-in tests (6) (7)	11	Post burn-in tests (6)			11	Post burn-in tests (6)	11	Post burn-in tests (6)
12	Reverse bias burn-in (10) (15)								
11	Electrical tests (Post burn-in) (6) (7)								
6	Sealing								
13	Final electrical and optical tests (12)	13	Final electrical and optical tests (12)	13	Final electrical and optical tests (12)	13	Final electrical and optical tests (12)	13	Final electrical and optical tests (12)
14	Radiography								
16	External visual examination (16)	16	External visual examination (16)	16	External visual examination (16)	16	External visual examination (16)	16	External visual examination (16)
Inspection (on sample basis) followed by external visual examination									

Figure 2: Screening procedures - flow diagram
(Screen or test number at left of each block)

- (4) The particle impact noise detection (PIND) test may be performed in any sequence after acceleration, steady state screen and before the last post burn-in electrical tests. Until the test method has been agreed, this test may be omitted from the screening sequence.
- (5) The serialization operation
- applies only for class A devices, unless otherwise specified in the Detail Specification;
 - is performed before the pre burn-in electrical tests;
 - is defined as the completion of devices general marking by an own number allotted and recorded by the certifying Chief Inspector, following a unity step increasing sequence for each device's type.
- (6) The pre burn-in and post burn-in tests shall be performed to remove defective devices prior to further testing or to provide a basis for application of percent defective allowable (PDA) criterion when a PDA is applicable.

These tests need not include all specified device parameters but shall include those measurements that are most sensitive to and effective in removing electrically or optically defective devices.

The tests shall be specified in the Detail Specification.

- (7) The results of pre burn-in and post burn-in tests of each class A devices shall be read and recorded.
- (8) The pre burn-in tests are optional for class B, D or F devices, at the manufacturer's discretion except when delta limits measurements are required.

When delta limits measurements are required, they shall be specified in the Detail Specification and shall be included as pre burn-in and post burn-in electrical tests.

All devices shall be tested for those parameters requiring delta calculations and the maximum permitted deviations for each parameter shall be specified.

The procedure for device traceability shall be specified if other than by serialization or agreed between the Chief Inspector and the ONS.

- (9) A burn-in acceleration method
- shall never be applied to class A devices;
 - may be used for screening class B, D or F devices "provided a temperature-time equivalence has been demonstrated to the satisfaction of the ONS. This required a demonstration that there is a predominant failure mechanism with an established value of activation energy".

If a burn-in acceleration method is used on devices having an aluminium-gold metallurgical system, the acceleration steady state screen shall be performed subsequent to burn-in and before final electrical tests.

- (10) The reverse bias burn-in is a requirement only when specified in the relevant Detail Specification and is recommended only where surface sensitivity may be of concern.

When reverse bias burn-in is not required, the preceding post burn-in electrical tests are omitted.

The order of performing the burn-in and the reverse bias burn-in may be inverted.

- (11) The sealing test (post burn-in)
- applies only for cavity devices;
 - applies only for class A devices;
 - shall be performed in any sequence after the last post burn-in electrical tests and before the last external visual examination but after completion of all forming and shearing operations on the terminals.
- (12) The final electrical and optical tests ensure that all the devices meet the electrical and optical requirements of the relevant Detail Specification and shall include, as a minimum, all parameters, limits and conditions of tests which are specifically identified in the Detail Specification as final test requirements.

Final test requirements that are duplicated in the last post burn-in tests need not be repeated as final electrical tests.

- (13) The radiographic screen may be performed in any sequence after serialization. Until the test method has been agreed, this test may be omitted from the screening sequence.

- (14) The tests at maximum operating temperature apply only for non cavity devices.

- (15) Burn-in test

The optoelectronic devices shall be subjected to the burn-in screen by operating them in accordance with one of the specified test conditions given in the Blank Detail Specification or the Detail Specification.

The units shall be cooled down under bias conditions to an estimated junction temperature not exceeding 35 °C.

Alternatively, natural or convected cooling may be applied after removal of bias, provided that no more than 30 min elapses between removal and the time that the junction temperature drops to an estimated 35 °C maximum.

- (16) This external visual examination may, at the manufacturer's option, also be conducted after any of the thermal/mechanical screens, after the sequence or after the seal test.

- (17) Temperature cycling for thermal intermittence test is not required unless optical coupling material is in direct contact with the crystal surface or connecting system.

Monitoring of this function shall be specified in the Detail Specification.

- (18) The screening sequence as defined shall normally be followed. Where any divergence from this occurs, this shall be clearly stated in the Detail Specification.

3.5.11.2.2 Specified conditions

The following shall be prescribed by the Detail Specification:

- general procedures if other than those specified in this Generic Specification;
- the maximum allowable deviations in electrical test results;
- electrical conditions to be applied to all terminals;
- PDA requirements (where applicable) if other than 10%.

3.5.11.2.3 Screens and test descriptions

Table 1 defines the screens and tests, referring to the test numbers and notes of 3.5.11.2.1 and figure 2.

Table 1: Screens and tests description

Screen or test number	Screen or test	Reference to EN 120000, unless otherwise stated	Conditions	See note to figure 2
1	Internal visual examination	---	See 3.5.11.3	(1)
2	Storage at high temperature	4.4.1	$T = T_{stg} \text{ max.}$ $t = 24 \text{ h min}$ No final measurements	(2)
3	Change of temperature		Test Na or Nb $T_{min} = T_{stg} \text{ min}$ $T_{max} = T_{stg} \text{ max}$ 10 cycles No final measurement	
4	Acceleration steady state	4.4.11	Acceleration = 294 000 m/s ² (30 000 g _n) unless otherwise specified in the Generic Specification. Direction = Y _g Duration = 60 s No final measurement	
5	Temperature cycling for thermal intermittence	appendix E	Supply V _{cc} = circuit and resistor values: t _{amb(max)} = number of cycles	(17)
6	Sealing a: tracer gas method with mass spectrometer	4.4.10 (Qk)	max. 1x10 ⁻⁸ Pa.m ³ /s max. 0,01 Pa.cm ³ /s unless otherwise specified	(3) (11)
	b: gross leak	4.4.10 (Qc, method 2 or 3)	4.4.10 (2 or 3)	
7	Particle impact noise detection	Under consideration	Under consideration	(4)
8	Serialization	---	---	(5)
9	Pre burn-in tests	4.1	As for subgroups A2 and A3 of relevant Detail Specification, unless otherwise specified.	(6) (7) (8)

continued

Table 1: Screens and tests description (Concluded)

Screen or test number	Screen or test	Reference to EN 120000, unless otherwise stated	Conditions	See note to figure 2
10	Burn-in		$T_{amb} = 125\text{ }^{\circ}\text{C}$, unless otherwise limited by the technology, when a lower limit is specified in the Detail Specification. $160\text{ h} \leq t \leq 168\text{ h}$ (or any appropriate combination of T_{amb} and duration dependent on the technology and application). Conditions as specified in the Detail Specification.	(9) (15)
11	Post burn-in tests	4.5.1	As for subgroups A2 and A3 of relevant Detail Specification, unless otherwise specified. The Detail Specification will prescribe the maximum deviations allowable from the results recorded in the pre burn-in tests.	(6) (7)
12	Reverse bias burn-in	---	$T_{amb} = 150\text{ }^{\circ}\text{C}$, unless otherwise limited by the technology when a lower limit is specified in the Family or Detail Specification. $t = 72\text{ h min.}$ Electrical conditions as specified in the Detail Specification.	(10) (15)
13	Final electrical and optical tests	4.1	As for subgroup A2, A3 and A4 of the Detail Specification, unless otherwise specified	(12)
14	Radiography	Under consideration	Under consideration	(13)
15	Electrical tests at max operating temperature	---	As specified in the relevant Detail Specification	(14)
16	External visual examination	4.2.1	4.2.1	(16)

3.5.11.3 Internal visual inspection

Under consideration.

3.5.11.4 Specified conditions

Under consideration.

3.6 Levels of quality assessment

General inspection requirements for semiconductor optoelectronic devices

Two levels of quality assessment, arbitrarily designated S and Y, have been recognized and appear in tables 2 to 5. The actual tests to be performed are specified in the Blank Detail Specification relevant to the device.

Table 2: Levels of quality assessment - Group A: Lot-by-lot inspection

na = not applicable
IL = inspection level
AQL given in %

Examination or test	Test conditions refer to	S			Y		
		IL	AQL	Remarks	IL	AQL	Remarks
Sub-group A0 Internal visual examination		na	na		S4	2,5	
Sub-group A1a Standard visual inspection	4.2.1	I	1,5		I	0,25	
Sub-group A2a Non operative	4.3.4	II	0,1		II	0,1	
Sub-group A2b Electrical and/or optical measurements	4.3.4	II II	0,65 1,0	if < 4 tests if > 4 tests	II	0,1	
Sub-group A3 Electrical and/or optical measurements	4.3.4 at min/max temperature	I I	2,5 4,0	if < 4 tests if > 4 test	II	0,65	
Sub-group A4 Electrical and/or optical measurements	4.3.4 only dynamic characteristics	S4 S4	4,0 6,5	if < 4 tests if > 4 tests	S4	1,0	
Sub-group A5 Extended visual inspection according to Blank Detail Specification	as specified in Blank Detail Specification	II	0,1		II	0,1	

Table 3: Levels of quality assessment - Group B: Lot-by-lot

na = not applicable
n = sample size
c = acceptance criterion
AQL given in %

Examination or test	Test conditions refer to	S		Y	
		IL	AQL	n	c
Sub-group B1 Dimensions	4.4.2	S2	2,5	15 or 25	0 1
Sub-group B2c Verification of ratings (where appropriate)	4.3.4	S4	4,0	15 or 25	0 1
Sub-group B3 Robustness of terminations (if applicable)	4.4.9	S3	2,5	15 or 25	0 1
Sub-group B4 Solderability	4.4.7	S4	2,5	22 or 38	0 1
Sub-group B5 Change of temperature followed by: Accelerated damp heat or sealing	4.4.4 4.4.2 4.4.10	S4	2,5	15 or 25	0 1
Sub-group B5a Change of temperature followed by: (1) Cavity packages: Fine and gross leak test (2) Non cavity packages: Accelerated damp heat	4.4.0 10 cycles 4.4.10 4.4.2 Method 1 Test Da with bias (note 1)	na	na	15 or 25	0 1
Sub-group B6 Temperature cycling for detection of thermal intermittence of photocouplers		na	na	750 or 1250	0 1
Subgroup B8 Electrical endurance	4.5	S4	1,5	38 or 52	1 2
Sub-group CTR	Unless otherwise stated in the Blank Detail Specification: attributes information for B3, B4, B5 and B8.				
Note : Reverse bias voltage $U_R = 0,8 * U_{R \max.} (< 80 \text{ V})$.					

Table 4: Levels of quality assessment - Group C: Periodic

p = periodicity (months)
n = sample size
c = acceptance criterion
na = not applicable
amb = ambient-rated
case = case-rated

Examination or test	Test conditions refer to	S (p = 6 months)		Y (p = 6 months)	
		n	c	n	c
Sub-group C1 Dimensions	4.2.2	8	0	8 or 13	0 1
Sub-group C2a Electrical measurements	4.3.4	13	1	15 or 25	0 1
Sub-group C2b Complementary characteristics	4.3.3			32 or 55	0 1
	4.3.4	18	1	15 or 25	0 1
Sub-group C2c Verification of ratings (where appropriate)	4.3.4	13 (if not in B2c)	1	15 or 25	0 1
Sub-group C3 Tensile and/or torque	4.4.9	8	1	15 or 25	0 1
Sub-group C4 Soldering heat	4.4.8	18	1	22 or 38	0 1
Sub-group C5 Change of temperature (1) for cavity and non-cavity packages: Two-fluid-bath method followed by damp heat (2) for cavity fibre pig-tail devices: Two-chamber method followed by sealing	4.4.4 Nc 500 cycles 4.4.2	na (see B5)	na (see B5)	15 or 25	0 1
	4.4.4 Na 100 cycles 4.4.10	na (see B5)	na (see B5)	15 or 25	0 1
Sub-group C6 For cavity packages only: Shock or acceleration. Vibration	4.4.5 or 4.4.11 4.4.6	8	1	15 or 25	0 1
Sub-group C7 For cavity packages only: Damp heat (steady state)	4.4.3 56 days	18	1	15 or 25	0 1
Subgroup C7a For non cavity packages: Damp heat (steady state) End point test: Electrical tests as for sub-groups A2b, A3	IEC 749-5b (85 °C / 85 % r.h. / 1 000 h) test. proced. 4.5 (reverse bias voltage < 80 V)	na	na	32	2

Continued

Table 4: Levels of quality assessment - Group C: Periodic (Concluded)

Examination or test	Test conditions refer to	S (p = 6 months)		Y (p = 6 months)	
		n	c	n	c
Sub-group C8 Electrical endurance	4.5 1 000 h	43 34	3 (amb) 3 (case)	38 or 52	1 2
Sub-group C8a High temperature reverse bias	4.5 2 000 h	na	na	31 or 52	1 2
Sub-group C9 Storage at high temperature	4.4.1 1 000 h	43 34	3 (amb) 2 (case)	38 or 52	1 2
Sub-group C10 Low pressure (where appropriate)	IEC 68-2-13 Method M	na	na	15 or 25	0 1
Sub-group C11 Salt mist (where appropriate)	IEC 68-2-11 Method KA	na	na	15 or 25	0 1
Sub-group C12.1 Immersion into cleaning solvents	IEC 749, chapter IV, clause 2, method 1. S	na	na	15 or 25	0 1
Sub-group C12.2 Permanence of marking	IEC 749, chapter IV, clause 2, method 2.	na	na	15 or 25	0 1
Sub-group CTR	Unless otherwise stated in the Blank Detail Specification: attributes information for C3, C5 and C7 measurement information before and after C8 and C9				

**Table 5: Levels of quality assessment - Group D
(for qualification approval only)**

Examination or test	Test conditions refer to	S		Y		M	
		n	c	n	c	n	c
Sub-group D1 Electrical endurance	Note 2 4.5 5 000 h	na	na	32	2	na	na
Note : Unless otherwise specified in Blank Detail Specification.							

SECTION 4 - TEST AND MEASUREMENTS CONDITIONS

4.1 Standard conditions for testing

Unless otherwise specified, all measurements are carried out under the following conditions based on IEC 68-1.

Ambient temperature	: $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$
Relative humidity	: between 45 % and 75 %
Atmospheric pressure	: between 86 kPa and 106 kPa (860 mbar and 1 060 bar)
Illumination source	: see subclause 3.12.6 of IEC 306-1

Measurements can be carried out at other temperatures provided the ONS is satisfied that the device will be in accordance with all the provisions of the Detail Specification when tested at an ambient temperature of $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$, and relative humidity between 48 % and 52 %, when this is important

4.2 Visual examination

4.2.1 Visual inspection

Unless otherwise specified, visual inspection shall be performed under normal factory lighting and under normal visual conditions. Inspection shall include the following items, if applicable:

- correctness of marking;
- correctness of terminal identification;
- correctness of appearance (for example no broken encapsulation or terminals, no cracks in encapsulation, no open encapsulation, no misplacement of die or lens, colour of case);
- lens defects (for example air bubbles, blemishes);
- fibre pigtail defects (for example kinks in the pigtail, defects in the secondary coating or cable).

4.2.2 Dimensions

Dimensions shall be checked in accordance with the specified drawing.

The package outline dimensions to be checked as part of Groups B and C are given in table 6. Such dimensions are indicated by the standardized letters of IEC 191-1 and 191-2, to which reference is made.

Where applicable, optically related dimensions and the group in which they are tested shall be given in the Detail Specification.

Table 6: Dimensions to be checked as part of Groups B and C

Configuration of devices (IEC)	Group B	Group C
1 Wire mounted single ended For example C4 with base B4A (T05)	$\varnothing$ D A	All *
2 Stud mounted lug ended For example A4U (D05) or A14U (T065)	$\varnothing$ D J	All * All *
3 Flat base mounted For example C14A with base B18 (T03)	U_1 U_2 q A	All *
4 Other packages to be defined in conjunction with relevant BDS		
* All dimensions included in the IEC 191-2 drawing called up in the specification, or in the drawing given in the Detail Specification prepared in accordance with IEC 191-1, except those already covered in Group B.		

4.2.3 Permanence of marking

Under consideration.

4.3 Electrical and optical measurements

4.3.1 Alternative methods

Measurements shall be carried out either by using the methods specified or by any other method giving compatible results, but in case of dispute, only the specified method shall be used.

NOTE: By "compatible" is meant that, when the results obtained with the alternative method satisfy appropriate limits, the device would have met the originally specified limits as if it had been measured with the originally specified method (see also CECC 00 114)

4.3.2 Precision of measurement

The limits quoted in the Detail Specification are absolute. Measurement inaccuracies shall be taken into account when determining the actual measurement limits. Usual precautions should be taken to reduce measurement errors to a minimum and to avoid damage to the device.

4.3.3 Measurements at specified temperatures

The measurement shall be carried out by one of the methods below. Unless otherwise stated in the Blank Detail - or Detail - Specification, the temperature shall be selected from the following values

125 °C ± 5 °C; 100 °C ± 3 °C; 85 °C ± 3 °C; 70 °C ± 3 °C; 55 °C ± 3 °C; 40 °C ± 3 °C; 0 °C ± 3 °C; -10 °C ± 3 °C; -25 °C ± 3 °C; -40 °C ± 3 °C; -55 °C ± 3 °C

Method 1

For an ambient rated device the measurement shall be carried out after a time sufficient for the device to achieve temperature equilibrium as specified in 4.4.1, except that the duration of exposure is limited to a time sufficient to reach temperature equilibrium, and that the recovery conditions do not apply.

Method 2

For a case rated device, the device to be measured shall be mounted by its normal fixing, to a copper or similar high conductivity metal block. The block, which should have a mass of at least ten times that of the device under test, shall be maintained at the specified temperature. Sufficient time for the device to reach temperature equilibrium shall elapse before the measurements commence.

4.3.4 Methods for electrical photometrical and radiometrical measurements

Electrically or optically non-operative devices are defined in the relevant Blank Detail Specification.

Methods for electrical and optical measurements are listed hereafter.

Where applicable, reference is made to the relevant IEC publication. Measurements not defined in IEC publications are described on the indicated page.

List of methods for electrical and optical measurements

Ref.	Symbol	Title	IEC method or page
1. <u>Light emitting diodes, infrared emitting diodes, laser diodes, laser modules</u>			
<u>General measurements</u>			
L-001	I_v I_e	Luminous intensity and radiant intensity	IEC 747-5 Ch. IV, subcl. 1.1 & 1.2
L-002	L_v L_e	Luminance and radiance	39
L-003	λ_p $\Delta\lambda$	Wavelength at peak emission and spectral bandwidth	IEC 747-5 Ch. IV, subcl. 1.4
L-004	$\theta_{1/2}$ $\Delta\theta$	Radiation diagram, half intensity angle and misalignment	IEC 747-5 Ch. IV, subcl. 1.11
L-005	t_{on} , t_{off}	Switching times	IEC 747-5 Ch. IV, subcl. 1.5
L-006	V_F	Forward voltage	IEC 747-2 Subcl. 1.2
L-007	I_R	Reverse current	IEC 747-5 Ch. IV, subcl. 2.1
L-008	C_{tot}	Capacitance	IEC 747-1
L-009	ϕ_v ϕ_e	Luminous flux Radiant flux	IEC 747-5 Ch. IV, subcl. 1.3
L-010	R_{th}	Thermal resistance	42

List of methods for electrical and optical measurements (Continued)

Ref.	Symbol	Title	IEC method or page
2. Photocouplers			
C-001	$V_{CE(sus)}$	Collector-emitter sustaining voltage	45
C-002	$C_{(BR)ECO}$	Emitter-collector breakdown voltage	IEC 747-2 Ch. IV, subcl. 1.3
C-003	$V_{(BR)CBO}$	Collector-base breakdown voltage	IEC 747-2 Ch. IV, subcl. 1.3
C-004	$V_{(BR)EBO}$	Emitter-base breakdown voltage	IEC 747-2 Ch. IV, subcl. 1.3
C-005	$V_{CE(sat)}$	Collector-emitter saturation voltage	IEC 747-5 Ch. IV, subcl. 3.6
C-006	V_{IO} or V_{IORM}	Continuous or repetitive peak isolation voltage	48
C-007	V_{IOSM}	Surge isolation voltage	49
C-008	I_{CEO}	Collector-emitter cut-off current	IEC 747-2
C-009	I_{CBO}	Collector-base cut-off current	IEC 747-2
C-010	I_C/I_F	Current transfer ratio	IEC 747-5 Ch. IV, subcl. 3.1
C-011	h_{FE}	Static value of the forward current transfer ratio	IEC 747-5 Ch. IV, subcl. 3.1
C-012	R_{IO}	Isolation resistance between input and output	IEC 747-5 Ch. IV, subcl. 3.3
C-013	C_{IO}	Input to output capacitance	IEC 747-5 Ch. IV, subcl. 3.2
C-014	t_{on}, t_{off}	Switching times	IEC 747-5 Ch. IV, subcl. 3.7
C-015	-	Surge test	IEC 65, subcl. 14.2.4 with parallel resistor R_2 (see figure 7a)
C-016	-	Input/output safety test	50

List of methods for electrical and optical measurements (Continued)

Ref.	Symbol	Title	IEC method or page
3. <u>Photodiodes, phototransistors, photodarlington transistors</u>			
P-001	I_R (H), I_R (e), I_C (H), I_C (e)	Current under irradiation and responsivity	IEC 747-5 Ch. IV, subcl. 3.1
P-002	I_R , I_{CEO} , I_{ECO} , I_{EBO}	Dark current	IEC 747-5 Ch. IV, subcl. 3.1
P-003	$V_{CE(sat)}$	Collector-emitter saturation voltage	IEC 747-5 Ch. IV, subcl. 2.3
P-004	t_d , t_r , t_s , t_f	Switching times	IEC 747-5 Ch. IV, subcl. 2.8
P-005	C_{tot}	Capacitance of photodiodes	51
P-006	-	Cut-off frequency of a photodiode for fibre optics applications	IEC 747-5 Ch. IV, subcl. 2.6
P-007	-	Noise measurement	IEC 747-5 Ch. IV, subcl. 2.4
4. <u>Liquid crystal displays</u>			
Q-001	I_s	Supply current	52
Q-002	R_{tot} , C_{tot}	Impedance	54
Q-003	K_1 , K_2	Contrast	56
Q-004	t_{on} , t_{off}	Switching time	60
Q-005	V_{th} , V_{sat}	Threshold and saturation voltage	64
Q-006	R_0 , R_1	Reflectivity	69
Q-007		Luminance/colour variations	73
Q-008		Crosstalk	77

Method L-002

Luminance L_v and radiance L_e

Purpose

The purpose of these methods is to measure either the luminance or the radiance of semiconductor emitting devices along one of the following

- 1) its mechanical axis
- 2) its optical axis
- 3) any other axis to be defined by a drawing

Method A

Purpose

This method is designed to measure either the luminance or the radiance of semiconductor emitting devices with well defined apparent radiating surfaces.

Description

Measurement of luminance or radiance involves the measurement of luminous or radiant intensity of an emitting device and the area of the measurable apparent radiating surface.

Luminous or radiant intensity is measured by method L-001. Using the area of the radiating surface indicated in the relevant specification the luminance or radiance value is obtained from the formula

$$L_v = I_v / A \text{ or } L_e = I_e / A$$

where: I_v = Luminous intensity of the device under test

I_e = Radiant intensity of the device under test

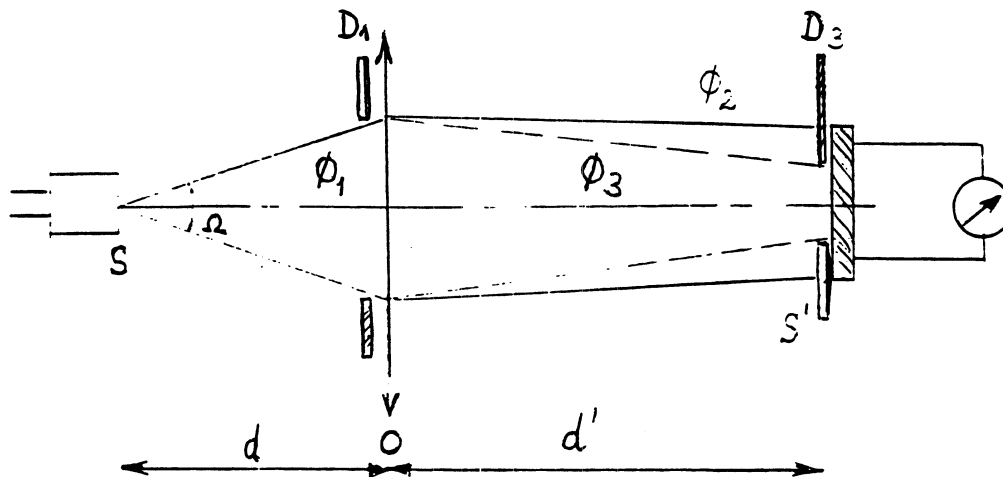
A = Area of the radiating surface

Method B

Purpose

This method is designed to measure the luminance or radiance of semiconductor emitting devices.

Optical arrangement



ϕ_1 = flux coming from S and crossing D_1

S = elementary area of the emitter

O = focusing lens

D_1 = diaphragm diameter (area A_1)

D_3 = diaphragm diameter (area A_3)

S' = image of S

$\phi_2 = K \phi_1$ = flux measured after crossing the lens

K = transmission coefficient of the lens

ϕ_3 = flux measured by the photodetector through D_3

Ω = solid angle defined by S and D_1

d = distance from S to lens

d' = distance from lens to image

Circuit Description and Requirements

S shall be small with respect to A_1

$A_3 < S'$

D_1 shall be small with respect to d

When D_3 encompasses a small part of the image of the source, it may be considered as a point source for measurement purposes.

When D_3 encompasses a large part of the image of the source, it may be considered as a uniform source for measurement purposes.

The photodetector shall be calibrated in luminous flux (lumens) units or radiant power (watts).

Precautions

No flux other than ϕ_3 shall reach the photodetector.

In order to prevent parasitic reflections, additional non-limiting diaphragms may be placed between the device being measured and the photodetector.

Measurement Procedure

1. Set the device current as specified. Replace diaphragm D_3 by a white screen. Adjust the system to obtain a sharp image of 'S' on the screen.
2. Diaphragm D_3 is restored, the flux received by the photodetector is measured, the luminance (radiance) is calculated.

$$L = \frac{16}{K \pi^2} \frac{d^2}{D_1^2 D_3^2} \phi_3$$

Specified conditions

The following shall be stated:

- Method A or B
- Ambient conditions
- Forward current in the emitting devices
- Measurement axis
- Area of source to be measured.

Method L-10

Thermal resistance R_{th}

METHOD

Thermal resistance (R_{th}) of a laser diode (e.g. window package) or laser diode module or laser diode on a sub-mount.

PURPOSE

To measure and derive the thermal resistance (R_{th}) of a laser diode in order to verify the die attach quality under specified CW or pulse conditions.

DEFINITION

Thermal resistance (R_{th}) is defined as the ratio of the temperature increase due to a specified electrical power input.

$$R_{th} = \frac{\Delta T}{P_{el}}$$

The R_{th} is calculated, using the temperature coefficient of one of the following parameters and their change due to a specified electrical power input:

- a) Radiant flux, radiant power (ϕ_e)
Measuring method see IEC 747-5, Chapter IV, Subclause 1.3
- b) Threshold current ($I_{(th)}$)
see: "New and revised concepts and letter symbols for optoelectronic devices, Revision of IEC 747-5, Chapter I and II;"
Chapter II, Subclause 4.2.4 and figure 5.
- c) Differential radiant power efficiency, (η_{ed})
see: "New and revised Revision of IEC 747-5, Chapter I and II;"
Chapter II, Subclause 4.2.2.5
- d) Central Wavelength ($\bar{\lambda}$)
see: "New and revised Revision of IEC 747-3, Chapter I and II;"
Chapter II, Subclause 4.2.7.4

- a. Radiant power (ϕ_e)

$$T = T_0 \log n \frac{\phi_e (CW, T_2)}{\phi_e (pulse, T_2)}$$
$$\text{with } T_0 = \frac{T_2 - T_1}{\log n \frac{\phi_e (pulse, T_2)}{\phi_e (pulse, T_1)}}$$

b. Threshold current (I_{th})

$$T = T_0 \log n \frac{I_{th}(CW, T_2)}{I_{th}(pulse, T_2)}$$

with

$$T_0 = \frac{(T_2 - T_1)}{\log n \frac{I_{th}(pulse, T_2)}{I_{th}(pulse, T_1)}}$$

and $P_{el} = I_F \times V_F$

c. Differential radiant power efficiency (η_{ed})

$$T = T_0 \log n \frac{\eta_{ed}(CW, T_2)}{\eta_{ed}(pulse, T_2)}$$

with $T_0 = \frac{(T_2 - T_1)}{\log n \frac{\eta_{ed}(pulse, T_2)}{\eta_{ed}(pulse, T_1)}}$

d. Central Wavelength ($\bar{\lambda}$)

$$T = T_0 \log n \frac{\bar{\lambda}(CW, T_2)}{\bar{\lambda}(pulse, T_2)}$$

with $T_0 = \frac{T_2 - T_1}{\log n \frac{\bar{\lambda}(pulse, T_2)}{\bar{\lambda}(pulse, T_1)}}$

CIRCUIT DIAGRAM

a) Measuring of Radiant power, P_e

see: IEC 747-5, Chapter IV, Subclause 1.3

PRECAUTIONS TO BE OBSERVED

The measurement pulse shall be sufficiently short so that it does not cause significant internal heating of the laser diode.

The temperature difference should be sufficiently high to ensure accuracy; i.e. $T_2 = T_{op\max} (\geq 60^\circ\text{C})$ where $T_1 = 25^\circ\text{C}$.

MEASUREMENT PROCEDURE

Measure the threshold current (I_{th}) at two case/submount temperatures T_1 and T_2 under pulse conditions to calculate the temperature coefficient of threshold current (I_{th}). Preferably $T_1 = 25^\circ\text{C}$, $T_2 \geq 60^\circ\text{C}$, see "Precautions".

The threshold current and forward voltage drop (V_F) are then measured under CW conditions at the high temperature (T_2) in order to calculate the temperature increase due to the input power where $P_{el} = I_F \times V_F$.

SPECIFIED CONDITIONS

T_1 , T_2 , Pulse conditions, Central wavelength λ , Radiant power ϕ_e , P_{el} or I_F