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Electronics assembly technology – Electronic modules

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IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

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Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRONICS ASSEMBLY TECHNOLOGY –
ELECTRONIC MODULES**

FOREWORD

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International Standard IEC 62421 has been prepared by IEC technical committee 91: Electronics assembly technology.

The text of this standard is based on the following documents:

FDIS	Report on voting
91/689/FDIS	91/722/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

ELECTRONICS ASSEMBLY TECHNOLOGY – ELECTRONIC MODULES

1 Scope and object

This International Standard provides a generic standard of electronic modules on which their sectional standards are based.

This standard provides a definition, business model, interface between the trading partners, and related areas of standardization of electronic modules. In addition a generic set of test method is provided.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068 (all parts), *Environmental testing*

IEC 60068-1:1988, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-1: *Environmental Testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2: *Environmental testing – Part 2-2: Tests – Tests B: Dry heat*

IEC 60068-2-6: *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-14: *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-20: *Environmental testing – Part 2-20: Tests – Test T: Soldering*

IEC 60068-2-21: *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-27: *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-45: *Environmental testing – Part 2-45: Tests – Test XA and guidance: Immersion in cleaning solvents*

IEC 60068-2-58: *Environmental testing – Part 2-58: Tests – Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*

IEC 60068-2-78: *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

ISO 3: *Preferred numbers – Series of preferred numbers*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in the IEC 60068 series, as well as the following, apply.

3.1

electronic module

functional block which contains individual electronic elements and /or electronic packages, to be used in a next level assembly

NOTE An individual module having an application-specific function, including electronic, optoelectronic, mechanical or other elements. The module typically provides protection of its elements and packages to assure the required level of reliability.

Electronic modules may be categorized by signal interface, for example:

- wired module: a module which has only electrical interfaces (majority of present day modules)
- wireless module: a module which has a wireless interface
- opto-electronic module: a module which has an optoelectronic interface
- sensor module: a module which can input physical information
- actuator module: a module which could output physical information

3.2

coplanarity

distance in height between the lowest and highest leads or terminals when the module is in its seating plane

3.3

operating temperature range

range of the ambient temperature at which an electronic module may be used continuously

3.4

storage temperature range

range of the ambient temperature at which an electronic module may be stored continuously

3.5

rated voltage

maximum d.c. voltage or the root-mean square value of an a.c. voltage which may be applied continuously to an electronic module at any temperature within the operating temperature range

4 Business model and interface between supplier and user

4.1 Business model (see Figure 1 and Figure 2)

4.1.1 General

Business models for electronic module manufacturing are classified into three types (See Figure 1):

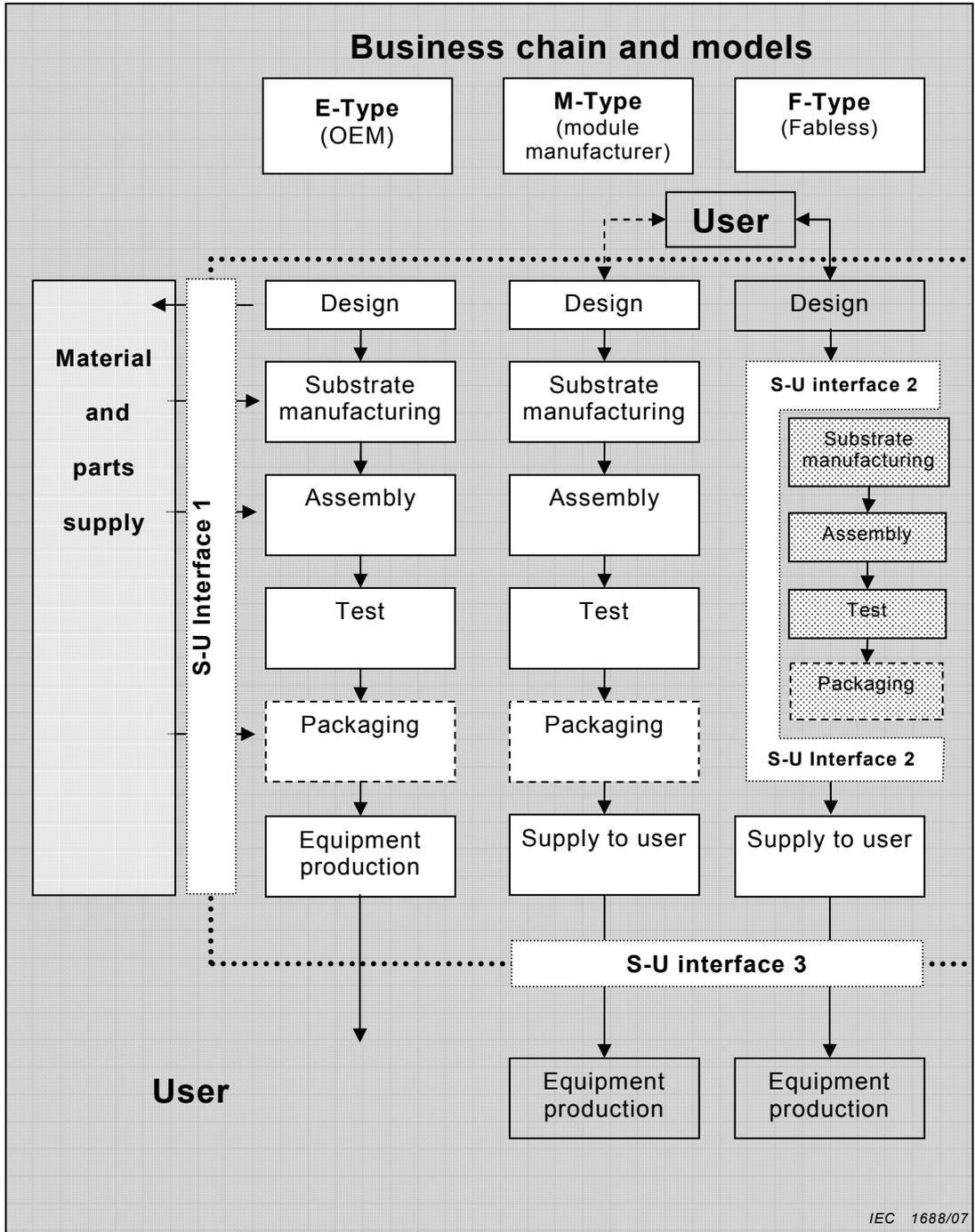
- E-type;
- M-type;
- F-type business models.

A supplier of material/parts is at one end of a business chain, from the viewpoint of an electronic module supplier. A user of electronic modules is at the other end of the chain.

Items to be specified in standards of electronic modules depend on the business model to which the relevant module is classified.

Items to be standardized basically depend on the relationship between suppliers and users (S-U Interface). Moreover, the S-U Interface depends on the business model.

The S-U interface showing the relationship between suppliers and users shall be clarified in the scope of a standard for an electronic module.



NOTE S-U interface: Supplier and user interface.

Figure 1 – S-U interfaces in each business model

4.1.2 E-type business model

The user of the electronic modules is also the supplier of the electronic modules. (The modules are designed, manufactured and used within the same company.)

An S-U interface exists only between the supplier of materials/parts and the supplier of the electronic modules.

NOTE Certain design or manufacturing processes may be subcontracted under the responsibility of the manufacturer.

4.1.3 M-type business model

The supplier of the electronic modules designs, manufactures and supplies the electronic modules to the user.

An S-U interface exists between the supplier and the user of the electronic modules. An additional S-U interface may also exist between suppliers of materials/parts and the supplier of the electronic modules.

NOTE Certain designs or manufacturing processes may be subcontracted under the responsibility of the module manufacturer.

4.1.4 F-type business model

The (fabless) supplier of the electronic modules designs and supplies the electronic modules to the user. Final design and manufacturing takes place at one or more specialized subcontractors (original design manufacturer (ODM) - foundries).

In this case, S-U interfaces are found between the designer (fabless) and the manufacturers (ODM - foundries) of electronic modules, between the supplier and the user of electronic modules, and also between the suppliers of materials/parts and the supplier of electronic modules.

NOTE More complex allotment of business may exist in the F-type business model. When sectional standards for F-type business model are developed, details of the interface should be defined in them.

4.2 S-U interface (see Figure 1)

4.2.1 S-U interface –1

The S-U interface–1 is defined as the interface between the supplier of electronic modules and supplier of material/parts.

This interface exists on all the E-type, M-type and F-type business models.

4.2.2 S-U interface–2

The S-U interface–2 is defined as the interface between designer (fabless) and the manufacturers (ODM - foundries) of electronic modules.

This interface is found only in the F-type business model.

4.2.3 S-U interface–3

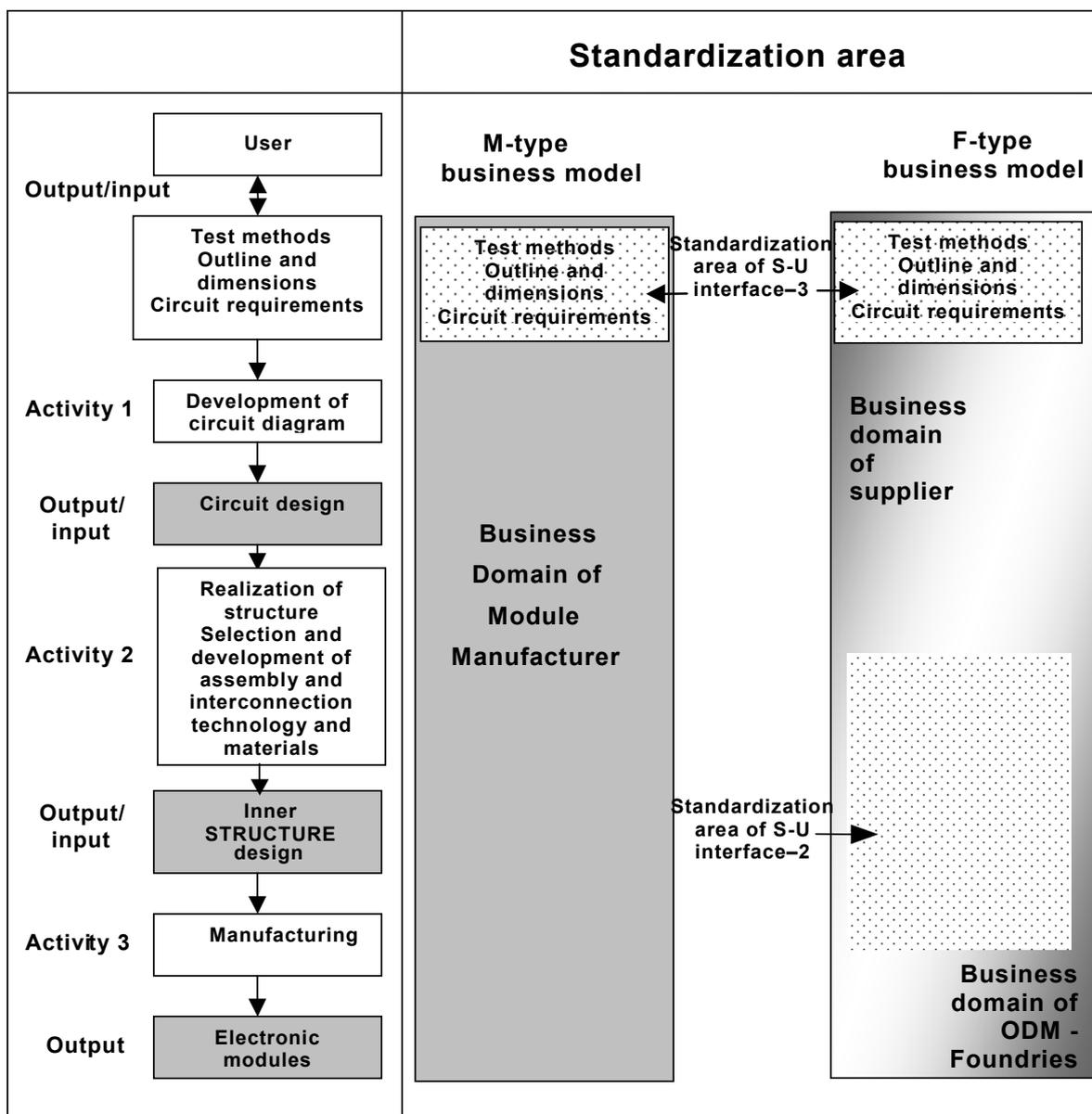
The S-U interface–3 is defined as the interface between supplier and user of electronic modules.

This interface exists in both of the M-type and F-type business models.

4.3 Standardization areas

Figure 2 shows typical standardization areas in M-type and F-type business models. The standardization area of S-U interface–3 is described in Clause 5 and Clause 6 of this standard.

The standardization area of S-U interface-2 shall be described by standards under the scope of the F-type business model.



IEC 1689/07

Figure 2 – Standardization areas in M-type and F-type business models

5 Preferred ratings

5.1 General

This standard provides the minimum number of items for which ratings need to be specified in sectional standards of electronic modules. Each sectional standard shall describe the preferred values appropriate to the subfamily of the electronic modules involved.

A rating is a value which establishes preferred ranges of either capability or condition beyond which damage to the electronic modules may occur. When typical values are required in these standards, it shall be understood that they are intended as an engineering guidance and are not guaranteed values for operation.

5.2 Preferred operating temperature range

Table 1 provides a list of preferred values of upper and lower operating temperatures.

Table 1 – Preferred temperatures to be selected for temperature ranges (°C)

–55	+40	+70	+125
–40	+45	+85	+150
–25	+55	+100	
–10	+60	+105	

5.3 Preferred rated voltage

The R10 series as specified in ISO 3 is preferred for the selection of rated voltage values. The preferred values of rated voltages below 200 V are as follows:

1,0; 1,25; [1,5]; 1,6; 2,0; 2,5; 3,15; [3,3]; 4,0; 5,0; 6,3; 8,0; 10,0; [12]

The values can be multiplied by 10^n , where n is a positive or a negative integer.

The preferred values of rated voltages equal to or higher than 200 V are as follows:

200, 250, 300, (315), 400, 500, 600, (630), 800, 1000

6 Tests and measuring methods

6.1 Standard atmospheric conditions

6.1.1 Standard atmospheric conditions for testing

Unless otherwise specified, all tests and measurements shall be made under the standard atmospheric conditions for testing given in 5.3 of IEC 60068-1:

- temperature: 15 °C to 35 °C;
- relative humidity: 25 % to 75 %;
- air pressure: 86 kPa to 106 kPa.

Before measurement, the module shall be stored at the measuring temperature for a time sufficient to allow the entire electronic module to reach the given temperature. The same duration of time as is prescribed for recovery at the end of a test is normally sufficient for this purpose.

When it is difficult to measure under standard atmospheric conditions, and when other conditions are allowed in the relevant specification, the conditions used during the measurement process shall be the ones stated in the test report.

In the event of dispute or where required, the referee conditions (as given in 6.1.2) shall be applied. If conversion is necessary, the conditions of 6.1.3 shall be employed.

During measurement, the electronic module shall not be exposed to draughts, direct sunlight or other influences likely to cause an error.

6.1.2 Referee conditions

For referee purposes, one of the standard atmospheric conditions for referee tests as given in Table 2, and specified in 5.2 of IEC 60068-1, shall be selected:

Table 2 – Referee conditions

Temperature °C	Relative humidity %	Air pressure kPa
20 ± 1	63 to 67	86 to 106
23 ± 1	48 to 52	86 to 106
25 ± 1	48 to 52	86 to 106
27 ± 1	63 to 67	86 to 106

6.1.3 Reference conditions

For reference purposes, the standard atmospheric conditions given in 5.1 of IEC 60068-1 apply:

- temperature: 20 °C;
- air pressure: 101,3 kPa.

The temperature alone may be specified as the reference condition.

6.2 Electrical performance tests

6.2.1 General

This clause describes general precautions needed to carry out the electrical performance tests of electronic modules.

Details of the test methods of electrical performances and special precautions for a particular electronic module category are given in the relevant specification.

6.2.2 Protection of electronic modules and test equipment

The test conditions for all measurements shall be such that the extreme values applied to the electronic module do not exceed the specified limiting values. It is recommended that the electronic modules should not be inserted into or removed from a circuit while it is under test, unless specifically allowed (e.g. hot plugging).

The output level of all the power supplies connected to the test circuit of modules shall be clamped to a specified value to protect the electronic module from possible damage caused by transient phenomena and surges during switching, adjustment and measurement.

6.2.3 Accuracy of measurement

6.2.3.1 Thermal equilibrium conditions

All electrical tests shall be conducted under thermal equilibrium conditions unless the measurement is performed under pulse conditions, or unless otherwise specified. When test conditions cause a significant change in duration of the characteristic being measured, means of compensation for such effects shall be specified; for example, the length of time that the electronic module shall be maintained at test conditions before making a measurement.

Thermal equilibrium may be considered to have been achieved if doubling the time between the application of power and the measurement causes no change in the indicated result within the expected error.

6.2.3.2 Power supplies

The ripples of a power supply shall not affect the designated accuracy of the measurement.

6.2.3.3 Circuit conditions

If low currents are measured, suitable precautions shall be taken to ensure that parasitic circuit currents or external leakage currents are small compared with the current being measured.

Care shall be taken to ensure that stray capacitance and inductance values have no effect on the measurement result within the desired accuracy, or alternatively that the effect of stray capacitance and inductance are taken into account in the result.

Care shall be taken to minimize spurious oscillations or distortions likely to affect the accuracy of the measurement.

6.2.3.4 Lighting conditions

When a characteristic is known to be light sensitive, the effect of lighting conditions shall be taken into account.

6.2.3.5 Measuring instruments

For any electronic module carrying large currents, separate current-carrying and voltage-measuring contacts are recommended. When this is not possible, corrections may have to be made to the measured values of inter-terminal voltage.

In addition, for high-current electronic modules, low residual inductance is essential.

The input and output waveforms of rectifying and converting circuits may be distorted from sinusoidal. Conventional sinusoidal conversion factors are not applicable to distorted waveforms, e.g. from average to r.m.s. or crest values. Such effects shall be considered in the measuring process. Allowance shall be made for the voltage drop across current measuring circuits and for the current taken by voltage measuring circuits, if these are significant.

6.3 Mechanical performance tests

6.3.1 Robustness of terminations and integral mounting devices

This test evaluates the resistance of terminations or of the electrodes of electronic modules to the stress applied during normal assembly or handling operations.

The relevant test given in Table 3 shall be applied to electronic modules in accordance with IEC 60068-2-21, unless otherwise specified in the detail specification. The details of applicable test methods and conditions shall be specified in the detail specification.

Table 3 – Application

Test	Type	Component	Mounted/not mounted
Ua ₁	Tensile	Leaded devices	Not mounted
Ub	Bending	Leaded devices	Not mounted
Uc	Torsion	Leaded devices	Not mounted
Ud	Torque	Threaded stud or screw termination	Not mounted
Ue ₁	Bending	Surface mounted devices	Mounted
Ue ₂	Pull/push	Surface mounted devices	Mounted
Ue ₃	Shear	Surface mounted devices	Mounted

6.3.2 Resistance to soldering heat

There are two types of resistance to soldering heat test for SMD, the solder bath method and the reflow method, as specified in IEC 60068-2-58. Where applicable, details of the applicable test methods and conditions shall be specified in the detail specification in accordance with IEC 60068-2-58.

NOTE Drying and/or moisture soak should be carried out prior to the test of resistance to soldering heat for electronic modules which contain plastic encapsulation, in accordance with IEC60749-20¹.

Solder bath and soldering iron methods are applicable to leaded modules for the test of resistance to soldering heat. Details of the test methods and conditions shall be specified in the detail specification in accordance with IEC 60068-2-20.

6.3.3 Solderability

There are two types of solderability test for SMD, the solder bath method and the reflow method, as specified in IEC 60068-2-58. Details of the test methods and conditions shall be specified in the detail specification in accordance with IEC 60068-2-58, unless otherwise specified in the detail specification.

Solder bath, soldering iron and solder globule methods are applicable to leaded modules for the test of solderability. Details of the test methods and conditions shall be specified in the detail specification in accordance with IEC 60068-2-20.

6.3.4 Shock

This test is to evaluate the resistance of electronic modules to shock during transport or use; the type of shock described is that which is relatively infrequent and non-repetitive.

Details of the test methods and conditions shall be specified in the detail specification in accordance with IEC 60068-2-27.

6.3.5 Vibration (sinusoidal)

This test is to evaluate the resistance of electronic modules to harmonic vibration during transport or use. The vibration of a harmonic pattern is generated primary by rotating, pulsating or oscillating forces, such as occur in ships, aircraft, land vehicles, rotorcraft and space applications, or are caused by machinery and seismic phenomena.

¹ IEC 60749-20: *Semiconductor devices – Mechanical and climatic test methods – Part 20: Resistance of plastic-encapsulated SMDs to the combined effect of moisture and soldering heat*

Details of the test methods and conditions shall be specified in the detail specification in accordance with IEC 60068-2-6.

6.3.6 Resistance to solvents

Many electronic modules mounted on printed boards are subjected to cleaning processes using solvent. This test is applicable to the evaluation of the resistance of electronic modules to solvents during cleaning.

Details of the test methods and conditions shall be specified in the detail specification in accordance with IEC 60068-2-45.

6.4 Climatic performance tests

6.4.1 Dry heat

This test is to evaluate the ability of electronic modules for use or storage at high temperatures. The high temperature load test shall be applied to evaluate the use at high temperatures, and the high temperature storage test for high temperature storage.

NOTE These dry heat tests are not designed to assess a specimen's ability to withstand or operate during temperature variations. In this case, it would be necessary to use 6.4.4.

The dry heat tests are subdivided as follows:

- a) Dry heat tests for non heat-dissipating specimens
 - with sudden change of temperature, Ba,
 - with gradual change of temperature, Bb;
- b) Dry heat tests for heat-dissipating specimens
 - with sudden change of temperature, Bc,
 - with gradual change of temperature, Bd.

Details of the test methods and conditions shall be specified in the detail specification in accordance with IEC 60068-2-2.

6.4.2 Cold

This test is to evaluate the ability of electronic modules for use or storage at low temperatures. The low temperature load test shall be applied to evaluate the use, and the low temperature storage test for storage.

NOTE These cold tests are not designed to assess a specimen's ability to withstand or operate during temperature variations. In this case, it would be necessary to use 6.4.4.

The cold tests are subdivided into follows:

- a) Cold tests for non heat-dissipating specimens
 - with sudden change of temperature, Aa,
 - with gradual change of temperature, Ab;
- b) Cold tests for heat-dissipating specimens
 - with gradual change of temperature, Ad.

Details of the test methods and conditions shall be specified in the detail specification in accordance with IEC 60068-2-1.

6.4.3 Damp heat, steady state

This test is to evaluate the ability of electronic modules for use or storage under high relative humidity.

Details of the test methods and conditions shall be specified in the detail specification in accordance with IEC 60068-2-78.

6.4.4 Change of temperature

This test is to evaluate the effect on electronic modules of a change of temperature or a succession of changes of temperatures.

Test Na in IEC 60068-2-14 shall be applied to electronic modules. Details of the test methods and conditions shall be specified in the detail specification in accordance with IEC 60068-2-14.

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

3, rue de Varembé
P.O. Box 131
CH-1211 Geneva 20
Switzerland

Tel: + 41 22 919 02 11
Fax: + 41 22 919 03 00
info@iec.ch
www.iec.ch

www.iec.ch