SLOVENSKI STANDARD
SIST EN 61709:2002

01-september-2002

Electronic components - Reliability - Reference conditions for failure rates and stress models for conversion (IEC 61709:1996)

Electronic components - Reliability - Reference conditions for failure rates and stress models for conversion

Bauelemente der Elektronik - Zuverlässigkeit - Referenzbedingungen für Ausfallraten und Beanspruchungsmodelle zur Umrechnung

Composants électroniques - Fiabilité - Conditions de référence pour les taux de défaillance et modèles d'influence des contraintes pour la conversion

Ta slovenski standard je istoveten z: **EN 61709:1998**

ICS:

21.020	Značilnosti in načrtovanje strojev, aparatov, opreme	Characteristics and design of machines, apparatus, equipment
31.020	Elektronske komponente na splošno	Electronic components in general

SIST EN 61709:2002 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 61709

April 1998

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Descriptors: Electronic components, reliability, reference conditions, failure rates, stress models

English version

Electronic components - Reliability Reference conditions for failure rates and stress models for conversion (IEC 61709:1996)

Composants électroniques - Fiabilité
Conditions de référence pour les taux de défaillance et modèles d'influence des contraintes pour la conversion
(CEI 61709:1996)

Bauelemente der Elektronik
Zuverlässigkeit
Referenzbedingungen für Ausfallraten und Beanspruchungsmodelle zur Umrechnung
(IEC 61709:1996)

This European Standard was approved by CENELEC on 1998-04-01. 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, Czech Republic, 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

The text of the International Standard IEC 61709:1996, prepared by IEC TC 56 Dependability, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 61709 on 1998-04-01 without any modification.

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) 1999-03-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1999-03-01

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annex ZA is normative and annexes A, B and C are informative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61709:1996 was approved by CENELEC as a European Standard without any modification.

In the official version, for annex C, Bibliography, the following notes have to be added for the standards indicated:

IEC 60068-1	NOTE: Harmonized, together with its corrigendum October 1988 and its amendment 1:1992, as EN 60068-1:1994 (not modified).
IEC 60255-23	NOTE: Harmonized as EN 60255-23:1996 (not modified).
IEC 60721-3-0	NOTE: Harmonized, together with its amendment 1:1987, as EN 60721-3-0:1993 (not modified).
IEC 60721-3-1	NOTE: Harmonized, together with its amendment 1:1991, as EN 60721-3-1:1993, which is superseded by EN 60721-3-1:1997 (not modified).
IEC 60721-3-2	NOTE: Harmonized, together with ist amendment 1:1991, as EN 60721-3-2:1993, which is superseded by EN 60721-3-2:1997 (not modified).
IEC 61078	NOTE: Harmonized as EN 61078:1993 (not modified).

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

Publication	Year	Title	EN/HD	Year
IEC 60050(191)	1990	International Electrotechnical Vocabulary (IEV) Chapter 191: Dependability and quality of service	-	-
IEC 60721-3-3	1994	Classification of environmental conditions Part 3: Classification of groups of environmental parameters and their severities Section 3: Stationary use at weather protected locations	EN 60721-3-3	1995

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Composants électroniques –

Fiabilité –
Conditions de référence pour les taux de défaillance et modèles d'influence des contraintes pour la conversion

Electronic components –

Reliability –
Reference conditions for failure rates and stress models for conversion

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For price, see current catalogue

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTRONIC COMPONENTS – Reliability – Reference conditions for failure rates and stress models for conversion

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

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3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.

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5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.

6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 1709 has been prepared by IEC technical committee 56: Dependability.

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

FDIS	Report on voting
56/494/FDIS	56/534/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.

Annexes A, B and C are for information only.

INTRODUCTION

Failure rate data are useful in the design phase of electronic equipment. They can be used to identify potential reliability problems, the planning of logistic support strategies and the evaluation of designs and reliability predictions. Predictions are essentially probability statements which are based on the failure rates of electronic components. These predictions should be carried out before hardware realization and/or the procurement process of an equipment.

Unsubstantiated failure rate data used in reliability predictions can cause inaccuracies. These inaccuracies can be reduced by post processing supplied failure data to remove information on replacements that are not real failures. Failure rate data should include knowledge of the failure criteria and the mechanical and electrical stresses which have resulted in the component failure. This International Standard serves as a guide to describe reference conditions for which field failure rates should be stated. This then allows, by the use of stress models, extrapolation to other operating conditions. Some of the limitations of the models are outlined in annex A. It is not intended to replace other valid handbooks.

The reference conditions adopted are typical of the majority of applications of components in equipment (e.g. telecommunication use, data processing). In this standard it is assumed that the failure rate used under reference conditions is specific to the component i.e. it includes the effect of complexity, technology of the casing, dependence on manufacturers and the manufacturing process, etc.

The component failure rates to be used with this standard are to be determined based upon agreement between the component manufacturer and the component user, using one or more of the following sources: equipment manufacturer data book, equipment user data book, component manufacturer data book or data from an independent third body. Sources should be the latest available that are applicable to the product and its specific use conditions. Ideally, failure rate data should be obtained from the field.

The stress factors for different conditions are specified in this standard. They are typical values for the individual component classes from various manufacturers. When actual conditions of use are in close agreement with reference conditions, then as a first approximation the agreed component failure rates can be used. The stress factors should be used, when they are known to be correct or as an approximation, if nothing else is known. Where they are applied, their use should be clearly stated. If other factors are known to be correct, they should be stated and used.

ELECTRONIC COMPONENTS – Reliability – Reference conditions for failure rates and stress models for conversion

1 Scope

This International Standard gives guidance on the use of failure rate data for the reliability prediction of components in electronic equipment. Reference conditions for failure rate data are specified, so that data from different sources can be compared on a uniform basis. If failure rate data are given in accordance with this standard then no additional information on the specified conditions is required.

The stress models described in this standard should be used as a basis for conversion of the failure rate data at reference conditions to the actual operating conditions. Conversion of failure rate data are only permissible within the specified functional limits of the components (see annex A).

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 50(191): 1990, *International Electrotechnical Vocabulary (IEV) – Chapter 191: Dependability and quality of service*

IEC 721-3-3: 1994, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 3: Stationary use at weather-protected locations*

3 Definitions

For the purpose of this International Standard, the following definitions apply:

3.1 **failure**: Termination of the ability of an item to perform a required function. [IEV 191-04-01]

3.2 **failure rate**: Limit, if this exists, of the ratio of the conditional probability that the instant of time, T, of a failure of an item falls within a given time interval, (t, $t + \Delta T$) and the length of this interval, ΔT, when ΔT tends to zero, given that the item is in an up state at the beginning of the time interval. [IEV 191-12-02].

The characteristic preferred for reliability data of electronic components is the failure rate as defined in IEV 191-12-02 (see also A.3).

NOTE In this definition T may also denote the time to failure or the time to first failure, as the case may be.

3.3 **mean failure rate**: Mean of the failure rate over a given time interval. [IEV 191-12-03, modified]

3.4 **reference conditions**: Reference conditions selected so as to correspond to the majority of applications of components in equipment.

3.5 **reference failure rate**: Failure rate stated under the reference conditions given in this standard.

NOTE – Reference failure rates are not necessarily equal because of the unquantifiable nature of the manufacturing processes and the assembly stages of components into equipment. However, failure rate values are found in practice to have similarities from one analysis to another. It is therefore suggested that the use of reference failure rate values can provide comparative information between different component categories and act as a useful guide for reliability calculations.

3.6 **failure criterion**: Condition for the presence of a failure.

NOTE – The failure criterion will also depend on the application of the component.

3.7 **operating mode**: Operating mode states whether components are continuously stressed during their operation. A distinction is made between continuous duty and intermittent duty.

Continuous duty is defined as operation for a long duration with constant or changing loads (e.g. process controls, telephone switch).

Intermittent duty is defined as operation with constant or changing loads during up state (e.g. numerical controls for machinery, road traffic signals).

3.8 **prediction**: Process of computation used to obtain the predicted value(s) of a quantity. [IEV 191-16-01]

NOTE – The term “prediction” may also be used to denote the predicted values of a quantity.

4 Symbols

In this standard, the following symbols are used:

λ	failure rate under operating conditions
λ_{ref}	failure rate under reference conditions
π_U	voltage dependence factor
π_I	current dependence factor
π_T	temperature dependence factor
π_{ES}	electrical stress dependence factor
π_S	switching rate dependence factor
θ_{amb}	ambient temperature in degrees Celsius
T_{amb}	ambient temperature in kelvins
$\theta_{amb,ref}$	reference ambient temperature in degrees Celsius
$T_{amb,ref}$	reference ambient temperature in kelvins
θ_{ref}	reference temperature in degrees Celsius
T_{ref}	reference temperature in kelvins

ΔT_{ref}	reference self-heating in degrees Celsius
ΔT	actual self-heating in degrees Celsius
θ_1	in degrees Celsius: – for integrated circuits the reference virtual (equivalent) junction temperature*; – for discrete semiconductors and optoelectronic components the reference junction temperature; – for resistors the average reference temperature of the resistor element; – for inductors the average reference temperature of the winding; – for capacitors the reference temperature of the capacitor; – for other electronic components the reference temperature of the component.
θ_2	in degrees Celsius: – for integrated circuits the actual virtual (equivalent) junction temperature; – for discrete semiconductors and optoelectronic components the actual junction temperature; – for resistors the average actual resistor element temperature; – for inductors the average actual winding temperature; – for capacitors the actual capacitor temperature; – for other electronic components the actual ambient temperature.
U	operating voltage
U_{ref}	reference voltage
U_{rat}	rated voltage
I	operating current
I_{ref}	reference current
I_{rat}	rated current
P	operating power dissipation
P_{ref}	reference power dissipation
P_{rat}	rated power dissipation
R_{th}	thermal resistance
$R_{th,amb}$	thermal resistance (to the environment)

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* In IEC 747-1, the virtual temperature T_{vj} is defined as internal equivalent temperature: a theoretical temperature which is based on a simplified representation of the thermal and electrical behaviour of the semiconductor device.

NOTES

1 For junction semiconductor devices, this term is sometimes called virtual (equivalent) junction temperature.

2 The virtual temperature is not necessarily the highest temperature in the device.