
British Standard

Harmonized system of quality assessment for electronic components: Generic specification: Film resistor networks

Système harmonisé d'assurance de la qualité des composants
électroniques. Spécification générique. Réseaux résistifs à couches

Harmonisiertes Gütebestätigungssystem für Bauelemente der
Elektronik. Fachgrundspezifikation. Netzwerke aus festwiderständen
in Schichttechnik

National foreword

This British Standard has been produced under the direction of the Electronic Components Standards Policy Committee. It is identical with CENELEC Electronic Components Committee (CECC) 64000 'Harmonized system of quality assessment for electronic components : Generic specification : Film resistor networks'.

This standard is a harmonized specification within the CECC system.

Cross-references

International Standard	Corresponding British Standard
ISO 1000 (1973)*	BS 5555 : 1976 SI units and recommendations for the use of their multipliers and of certain other units (Identical)
IEC 62 (1972)	BS 1852 : 1975 Specification for marking codes for resistors and capacitors (Identical)
IEC 68	BS 2011 Environmental testing
IEC 68-1 (1982)	Part 1.1 : 1983 General and guidance (Identical)
IEC 68-2-1 (1974) Supplement A (1976)	Part 2.1 A : 1977 with amendment No. 1 : Tests A. Cold (Identical)
IEC 68-2-2 (1974) Supplement A (1976)	Part 2.1 B : 1977 Tests B. Dry heat (Identical)
IEC 68-2-3 (1969)	Part 2.1 Ca : 1977 Test Ca. Damp heat, steady state (Identical)
IEC 68-2-20 (1979)	Part 2.1 T : 1981 Test T. Soldering (Identical)
IEC 68-2-21 (1983)	Part 2.1 U : 1984 Test U. Robustness of terminations and integral mounting devices (Identical)
IEC 68-2-30 (1980)	Part 2.1 Db : 1981 Damp heat, cyclic (12 + 12 hour cycle) (Identical)
IEC 440 (1973)	BS 5694 : 1979 Method for measurement of non-linearity in resistors (Identical)

The following parts of British Standard BS 2011 are identical to more recent versions of the IEC documents than those referenced in this standard. Reference should be made to the note to 2.2 on page 5.

IEC 68-2-6 (1982)	Part 2.1 Fc : 1983 Test Fc. Vibration (sinusoidal)
IEC 68-2-13 (1983)	Part 2.1 M : 1984 Test M. Low air pressure
IEC 68-2-14 (1984)	Part 2.1 N : 1985 Test N. Change of temperature
IEC 68-2-27 (1987)	Part 2.1 Ea : 1988 Test Ea. Shock
IEC 68-2-29 (1987)†	Part 2.1 Eb : 1987 Test Eb. Bump

The technical committee has reviewed the provisions of IEC 27, IEC 63, IEC 117, IEC 191 and IEC 410 to which reference is made in the text and has decided that they are acceptable for use in conjunction with this standard.

International standard	Related British Standard
IEC 27	BS 1991 Letter symbols, signs and abbreviations
IEC 63	BS 2488 Schedule of preferred numbers for the resistance of resistors and the capacitance of capacitors for telecommunications equipment
IEC 117	BS 3939 Guide for graphical symbols for electrical power, telecommunications and electronics diagrams
IEC 191	BS 3934 Specification for dimensions of semiconductor devices and integrated electronic circuits
IEC 410	BS 6001 : 1972 Sampling procedures and tables for inspection by attributes

The standard which implements CECC 00100 is BS 9000 : Part 2 : 1983 'Specification for national implication of the CECC Basic Rules and Rules of Procedure'.

Standards implementing CECC 00107/1 and III are in the course of preparation.

Textual error. When adopting the text of the international standard, the textual error given below was discovered. It has been marked in the text and has been reported to CENELEC Electronics Components Committee (CECC) in a proposal to amend the text of the international standard.

2.3.21.1 Insert Δ at the beginning of line 6 to read:

' ΔR is the change in resistance between the two specified ambient temperatures.'

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

*ISO 1000-1973 has been superseded by ISO 1000-1981 which is identical to BS 5555 : 1981 'Specification for SI units and recommendations for the use of their multiples and of certain other units'.

† This test is incorrectly labelled 'Test Ed.' in 2.2 on page 5.

Förderverein für Elektrotechnische Normung (FEN) e. V.
Genelec Electronic Components Committee

CECC

English version

Harmonized System of Quality Assessment for
Electronic Components

GENERIC SPECIFICATION

FILM RESISTOR NETWORKS

Système Harmonisé d'Assurance de la Qualité
des Composants Electroniques

SPECIFICATION GENERIQUE

RESEAUX RESISTIFS A COUCHES

Harmonisiertes Gütebestätigungssystem für
Bauelemente der Elektronik

FACHGRUNDSPEZIFIKATION

NETZWERKE AUS FESTWIDERSTÄNDEN IN SCHICHTTECHNIK



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Edition
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FOREWORD

The CENELEC Electronic Components Committee (CECC) is composed of those member countries of the European Committee for Electrotechnical Standardization (CENELEC) who wish to take part in a harmonized System for electronic components of assessed quality.

The object of the System is to facilitate international trade by the harmonization of the specifications and quality assessment procedures for electronic components, and by the grant of an internationally recognized Mark, or Certificate, of Conformity. The components produced under the System are thereby accepted by all member countries without further testing.

This specification has been formally approved by the CECC, and has been prepared for those countries taking part in the System who wish to issue national harmonized specifications for FILM AND HYBRID INTEGRATED CIRCUITS. It should be read in conjunction with the current regulations for the CECC System.

At the date of printing of this specification, the member countries of the CECC are Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

PREFACE

This specification was prepared by CECC WG 21 : "HYBRID MICRO-CIRCUITS".

It is based, wherever possible, on the Publications of the International Electrotechnical Commission.

The text of this specification was circulated to the CECC for voting in the document indicated below and was ratified by the President of the CECC for printing as a CECC Specification.

<u>Document</u>	<u>Date of voting</u>	<u>Report on the voting</u>
CECC(Secretariat)1921	May 1986	CECC(Secretariat)2108

SECTION 1

1.1 SCOPE

This specification applies to fixed film resistor networks for use in electronic equipment.

It defines standard terms, inspection procedures and methods of test for use in sectional and detail specifications for Qualification Approval and Capability Approval of fixed resistor networks.

1.2 TECHNOLOGICAL CLASSIFICATION OF FILM RESISTOR NETWORKS

Fixed resistor networks are classified according to their structure and technology of manufacture as shown below.

Film	0) Thick film 1) Thin film
Added Components	0) None 1) All types of resistive devices
Circuit encapsulation	0) None 1) Embedded

SECTION 2

GENERAL

2.1 ORDER OF PRECEDENCE

Where any discrepancies occur for any reason, documents shall rank in the following order of precedence :

- the detail specification
- the sectional specification
- the generic specification
- the current regulations of the CECC System
- any other international, for example IEC documents, to which reference is made.

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

2.2 RELATED DOCUMENTS

ISO 1000	(1973)	SI units and recommendations for the use of their multiples and of certain other units.
IEC 27-1	(1971)	Letter symbols to be used in electrical technology : Part 1 : General.
IEC 50	-	International Electrotechnical Vocabulary.
IEC 62	(1974)	Marking codes for resistors and capacitors.
IEC 63	(1963)	Preferred number series for resistors and capacitors.
	(1967)	Amendment N° 1.
	(1977)	Amendment N° 2.
IEC 68	-	Basic environmental testing procedures.
IEC 68-1	(1982)	Part 1 : General.
IEC 68-2	-	Part 2 : Tests.
IEC 68-2-1	(1974)	Tests A : Cold.
	(1976)	Supplement A.
IEC 68-2-2	(1974)	Tests B : Dry heat.
	(1976)	Supplement A.
IEC 68-2-3	(1969)	Test Ca : Damp heat, steady state.
IEC 68-2-6	(1970)	Test Fc : Vibration (sinusoidal).
	(1982)	Amendment N° 1.

IEC 68-2-13 (1966)	Test M : Low air pressure.
IEC 68-2-14 (1974) (1978)	Test N : Change of temperature. Amendment N° 1.
IEC 68-2-20 (1979)	Test T : Soldering.
IEC 68-2-21 (1983)	Test U : Robustness of terminations and integral mounting devices.
IEC 68-2-27 (1972)	Test Ea : Shock.
IEC 68-2-29 (1968)	Test Ed : Bump.
IEC 68-2-30 (1980)	Test Db : Damp heat, cyclic (12 + 12 hour cycle).
IEC 117 -	Recommended graphical symbols.
IEC 191-3 (1974)	Mechanical standardization of semiconductor devices. Part 3 : General rules for the preparation of outline drawings of integrated circuits.
IEC 410 (1973)	Sampling plans and procedures for inspection by attributes (see CECC 00 007).
IEC 440 (1973)	Method of measurement of non-linearity in resistors.
CECC 00 100 (1974)	Basic Rules.
CECC 00 107/I Issue 3 (1982)	Quality assessment procedure for general usage.
CECC 00 107/III Issue 1 (1980)	Quality assessment procedure for capability approval.
CECC 00 007 (1978)	Basic Specification : Sampling plans and procedures for inspection by attributes.

Note : The above references apply to the current editions except for IEC 68 for which the referenced editions must be used.

2.3 UNITS, SYMBOLS AND TERMINOLOGY

2.3.1 General

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

ISO 1000	SI 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 117	Recommended graphical symbols.

The following clauses contain additional terminology applicable to resistor networks. A reference to the appropriate IEC document is given against each term.

Where further items are required they shall be derived in accordance with the principles of the documents listed above.

2.3.2 Type

A group of components having similar design features and the similarity of whose manufacturing techniques enables them to be grouped together either for qualification approval or for quality conformance inspection.

They are generally covered by a single detail specification.

Note : Components described in several detail specifications may, in some cases, be considered as belonging to the same type and may therefore be grouped together for approval and quality conformance inspection.

2.3.3 Style

A sub-division of a type, generally based on dimensional factors.

A style may include several variants, generally of a mechanical order.

2.3.4 Grade

A term to indicate additional general characteristics concerning the intended application e.g. long life applications.

The term "Grade" may be used only in combination with one or more words (e.g. long life grade) and not by a single letter or number.

Figures to be added after the term "Grade" should be arabic numerals.

2.3.5 Family (of electronic components)

A group of electronic components which predominantly displays a particular physical attribute and/or fulfils a defined function.

2.3.6 Sub-family (of electronic components)

A group of components within a family manufactured by similar technological methods.

2.3.7 Fixed resistor network

A network in which a number of resistive elements are physically inseparably associated, so that, in terms of specifications, tests, trade and maintenance, it is considered as indivisible.

2.3.8 Rated resistance

The resistance value for which each resistive element in the network has been designed.

2.3.9 Critical resistance

The resistance value at which the rated voltage is equal to the limiting element voltage (See 2.3.17 and 2.3.28).

At an ambient temperature of 70 °C the maximum voltage which may be applied across the terminations of a resistor is either the calculated rated voltage if the resistance is less than the critical resistance, or the limiting element voltage if the resistance is equal to or greater than the critical resistance. At temperatures other than 70 °C, account shall be taken of the derating curve and the limiting element voltage in the calculation of a voltage to be applied.

2.3.10 Category temperature range

The range of ambient temperatures for which the resistor network is designed to operate continuously; this is defined by the temperature limits of its appropriate category.

2.3.11 Upper category temperature

The maximum ambient temperature for which a resistor network has been designed to operate continuously at that portion of the rated dissipation which is indicated in the category dissipation.

2.3.12 Lower category temperature

The minimum ambient temperature at which a resistor network has been designed to operate continuously.

2.3.13 Maximum surface temperature

The maximum temperature permitted on the surface for any resistor network of that type when operated continuously at rated dissipation at an ambient temperature of 70 °C.

2.3.14 Rated resistor element dissipation

The maximum allowable dissipation which a resistor element is capable of dissipating in continuous operation at the ambient temperature of 70 °C.

2.3.15 Rated network dissipation

The maximum allowable dissipation which the resistor network is capable of dissipating in continuous operation at the ambient temperature of 70 °C.

2.3.16 Category dissipation

A fraction of the rated dissipation exactly defined in the detail specification, applicable at the upper category temperature, taking account of the derating curve prescribed in the detail specification.

Note : The category dissipation may be zero.

2.3.17 Rated voltage (U_R)

The d.c. or a.c. r.m.s. voltage of each resistive element calculated from the square root of the product of the rated resistance and the rated dissipation.

Note : At high values of resistance the rated voltage may not be applicable because of the size and the construction of the resistor (see Sub-clause 2.3.18).

2.3.18 Isolation voltage (applicable only to insulated resistor networks)

The maximum peak voltage which may be applied under continuous operating conditions between the resistor network terminations and any conducting mounting surface.

2.3.19 Insulated resistor network

A resistor network which fulfils the voltage proof and insulation resistance test requirements and the damp heat steady state test with a polarizing voltage applied when mounted on a metal plate.

2.3.20 Insulation resistance

Under consideration.

2.3.21 Variation of resistance with temperature

Variation of resistance with temperature can be expressed either as temperature characteristic or as temperature coefficient as defined below :

2.3.21.1 Temperature characteristic of resistance

The maximum reversible variation of resistance produced over a given temperature range within the category temperatures. It is normally expressed as a percentage of the resistance related to a reference temperature of 20 °C.

Temperature characteristic of resistance = $\frac{\Delta R}{R}$, where :

- * R is the change in resistance between the two specified ambient temperatures.

R is the resistance value at the reference temperature.

2.3.21.2 Temperature coefficient of resistance (α)

The relative variation of resistance between two given temperatures (mean coefficient), divided by the difference in temperature producing it.

It is normally expressed in parts per million per degree Celsius ($10^{-6}/^{\circ}\text{C}$)

$$\alpha = \frac{R_2 - R_1}{R_1 \cdot \Delta \theta}, \text{ where :}$$

$\Delta \theta$ (for calculation see 4.4.6.) is the algebraic difference, in degree Celsius, between the specified ambient temperature and the reference temperature.

Note : It should be noted that use of the term does not imply any degree of linearity for this function, nor should any be assumed.

2.3.22 Differential resistance/temperature characteristic

The difference at a given temperature, between the resistance/temperature characteristics of any two specified resistors of the same network over a given temperature range.

* See national foreword for details of textual error.

Example of calculation :

$$\Delta(R.T.C.) = (100 \frac{\Delta R_1}{R_1} - 100 \frac{\Delta R_2}{R_2}) (\%)$$

where :

$\Delta(R.T.C.)$ = the differential resistance/temperature characteristic between the two specified resistors expressed in %

R_1 and R_2 = the resistance values of each of the two resistors at the reference ambient temperature (normally 20 °C).

ΔR_1 and ΔR_2 = the change in resistance between a given ambient temperature and the reference ambient temperature. This given ambient temperature shall be within the category temperature range.

2.3.23 Differential temperature coefficient

The difference between the temperature coefficients at a given ambient temperature of any two specified resistors in the same network over a given temperature range.

Example of calculation :

$$\Delta(\alpha) = \frac{10^6}{\Delta\theta} \left(\frac{\Delta R_1}{R_1} - \frac{\Delta R_2}{R_2} \right)$$

where :

$\Delta(\alpha)$ = the differential coefficient of temperature between the two specified resistors expressed in $10^{-6}/^{\circ}\text{C}$

R_1 and R_2 = the resistance value of each of the two resistors at the reference ambient temperature (normally 20 °C)

ΔR_1 and ΔR_2 = the change in resistance value, between a given ambient temperature and the reference ambient temperature. This given ambient temperature shall be within a specified range included in the category temperature

$\Delta\theta$ = the algebraic difference, in degrees Celsius, between the reference and the given ambient temperature.

2.3.24 Differential resistance change

The difference between the resistance change of any two specified resistors of the same network at the end of a test.

Note : It is normally expressed in percent.

2.3.25 Visible damage

Visible damage which reduces the usability of the resistor network for its intended purpose.

2.3.26 Resistance ratio

The ratio of the resistance values of any two specified resistors of the same network.

When called for the rated value and the tolerance on this rated value of the ratio are given by the detail specification.

2.3.27 Functional characteristics

The functions for which the networks have been designed. These functions shall be defined when necessary by the detail specification which will state the methods of measurement, the performance requirements and the tests before, during and after which these functions shall be measured.

2.3.28 Limiting element voltage

The maximum d.c. or a.c. r.m.s. voltage that may be continuously applied to the terminations of each resistor in the network (it is generally dependent upon size and manufacturing technology of the resistor network).

Where the term a.c. r.m.s. voltage is used in this standard the peak voltage shall not exceed 1,42 times the r.m.s. value.

Note : This voltage shall only be applied to resistors when the resistance value is equal to or higher than the critical resistance value.

2.3.29 Film hybrid network

A film network on which at least one component, encapsulated or unencapsulated, has been mounted.

2.3.30 Passive film hybrid network

A film hybrid network in which all elements are passive.

2.3.31 Substrate

A piece of material forming a supporting base for film circuit elements and/or added components.