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Generic specification: Thermistors

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Spécification Générique: Thermistances

Fachgrundspezifikation: Temperaturabhängige Widerstände

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CECC

European Committee for Electrotechnical Standardization
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European Committee for Electrotechnical Standardization (CENELEC)
Cenelec Electronic Components Committee

CECC

English version

Harmonized System of Quality Assessment for Electronic Components

GENERIC SPECIFICATION:

THERMISTORS

Système Harmonisé d'Assurance de la Qualité des Composants Electroniques

SPECIFICATION GENERIQUE:

THERMISTANCES

Harmonisiertes Gütebestätigungssystem für Bauelemente der Elektronik

FACHGRUNDSPEZIFIKATION:

TEMPERATURABHÄNGIGE WIDERSTÄNDE

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Contents

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 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 document has been formally approved by the CECC, and has been prepared for those countries taking part in the System who wish to prepare and issue detail specifications for THERMISTORS. It should be read in conjunction with document CECC 00 100: Basic Rules (1974).

Preface

This generic specification was prepared by CECC Working Group 4: "Resistors".

In accordance with the requirements of document CECC 00100 it is based, wherever possible, on the Recommendations of the International Electrotechnical Commission and in particular on IEC 539: Directly heated negative temperature coefficient thermistors.

The text of this generic specification was circulated to the CECC for voting in the documents listed below and was ratified by the CECC for printing as a CECC specification.

Document	Voting date	Report on the voting
CECC(Secretariat)794	July 1979	CECC(Secretariat)877
CECC(Secretariat)795	July 1979	CECC(Secretariat)878
CECC(Secretariat)1007	December 1980	CECC(Secretariat)1092

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Section 1. Scope

1 Scope

This specification prescribes terms and methods of test applicable to directly heated thermistors, insulated and non-insulated types, with negative temperature coefficients (NTC-D).

Section 2. General

2.1 Related documents

ISO 3		Preferred numbers. Series of preferred numbers
ISO 1000		Rules for use of units of the International system of units and selection of the decimal multiples and sub-multiples of the SI units
IEC 27-1	5th Edition (1971)	Letter symbols to be used in electrotechnology. Part 1: General
IEC 50		International electrotechnical vocabulary
IEC 62	2nd Edition (1974)	Marking codes for values and tolerances of resistors and capacitors, with Amendment 1 (1968)
IEC 63	2nd Edition (1963)	Preferred number series for resistors and capacitors, with Amendment 1 (1967)
IEC 68		Basic environmental testing procedures namely:
	68-1 (1978) Part 1	General
	68-2-1 (1974)	Cold
	68-2-2 (1974)	Dry heat
	68-2-3 (1969)	Damp heat steady state
	68-2-4 (1960)	Damp heat accelerated
	68-2-6 (1970)	Vibration
	68-2-11 (1964)	Salt mist test
	68-2-13 (1966)	Low air pressure
	68-2-20 (1968)	Soldering
	68-2-20A (1970)	Resistance to soldering heat
	68-2-21 (1975)	Robustness of terminations
	68-2-27 (1972)	Shock
	68-2-29 (1968)	Bump
IEC 117		Recommended graphical symbols
IEC 294 (1969)		Measurement of a cylindrical component having two axial terminations
IEC 410 (1973)		Sampling plans and procedures for inspection by attributes (see CECC 00007)
CECC 00100 Issue 1 (1974)		Basic Rules
CECC 00107/1 Issue 2 (1980)		Quality Assessment Procedures
CECC 00109 Issue 1 (1974)		Certified Test Records
CECC 00111 Issue 2 (1977)		Specifications and their harmonization
CECC 00007		Basic specification for IEC 410: Sampling plans and procedures for inspection by attributes
IEC 539 (1976)		Directly heated negative temperature coefficient thermistors

2.2 Units, symbols and terminology

2.2.1 General

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

ISO 1000	Rules for the use of units of the International System of units and selection of the decimal multiples and sub-multiples of the SI 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 thermistors. 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.

2.2.2 Type (IEC 539, Clause **4.1**)

A type comprises products having similar design features manufactured by the same techniques and falling within the manufacturer's usual range of ratings for these products.

NOTE 1 Mounting accessories are ignored, provided they have no significant effect on the test results.

NOTE 2 Ratings cover the combination of:

— electrical ratings
— sizes
— environmental category

NOTE 3 The limits of the range of rating shall be given in the detail specifications.

2.2.3 Style

Style is a variation within a type having specific nominal dimensions and characteristics.

2.2.4 Thermistor (IEC 539, Clause **4.6**)

A thermistor is a thermally sensitive semiconductor resistor whose primary function is to exhibit an important change in electrical resistance with a change in body temperature.

2.2.5 Negative temperature coefficient thermistor (NTC) (IEC 539, Clause **4.7**)

An NTC thermistor is one in which the resistance decreases with increasing temperature.

2.2.6 Directly heated negative temperature coefficient thermistor (NTC-D)

A directly heated NTC-thermistor obtains its temperature variation by the passage of a current through the thermistor element and/or by changes of ambient temperature.

2.2.7 Insulated thermistors (IEC 539, Clause **4.9**)

Insulated thermistors are thermistors capable of meeting the requirements of the insulation resistance and voltage proof tests when specified in the test schedule.

2.2.8 Zero-power resistance (R_T) (IEC 539, Clause **4.10**)

The zero-power resistance is the value of the resistance of a thermistor, when measured at a specified temperature, under conditions such that the change in resistance due to the internal generation of heat is negligible with respect to the total error of measurement (see **4.4**).

2.2.9 Rated zero-power resistance (IEC 539, Clause **4.11**)

The rated zero-power resistance is the nominal value at the standard temperature of 25 °C unless otherwise specified.

2.2.10 Resistance ratio (IEC 539, Clause **4.12**)

The ratio of the zero-power resistance of a thermistor measured at 25 °C to that measured at 85 °C, or at such other pair(s) of temperatures as may be prescribed in the detail specification.

2.2.11 B-value (IEC 539, Clause **4.13**)

An index of the thermal sensitivity expressed in the formula:

$$B = \frac{T_1 \cdot T_2}{T_2 - T_1} \cdot \log_e \frac{R_1}{R_2}$$

or

$$B = 2{,}303 \frac{T_1 \cdot T_2}{T_2 - T_1} \cdot \log_{10} \frac{R_1}{R_2}$$

where

B = a constant in kelvins (K)

R_1 = zero-power resistance in ohms at temperature T_1

R_2 = zero-power resistance in ohms at temperature T_2

T_1 = 298,15 K

T_2 = 358,15 K

The values given above for T_1 and T_2 are the preferred values and are equivalent to 25 °C and 85 °C respectively. Where the detail specification prescribes that the B-value shall be measured at other temperatures, the specified values (in kelvins) shall be used for T_1 and T_2 in the calculation in place of the preferred values.

2.2.12 Zero-power temperature coefficient of resistance (α_T) (IEC 539, Clause **4.14**)

The ratio at a specified temperature (T), of the rate of change of zero-power resistance with temperature to the zero-power resistance of the thermistor, expressed by the formula:

$$\alpha_T = \frac{-100\ B}{T^2}$$

where α_T is expressed in % per kelvin

B is the index of the thermal sensitivity in kelvins

T is the temperature in kelvins

2.2.13 Category temperature range (IEC 539, Clause **4.15**)

The category temperature range is the range of ambient temperatures for which the thermistor has been designed to operate continuously at zero-power. The limits are the upper and lower category temperatures.

2.2.14 Upper category temperature ($\tau_{max.}$) (IEC 539, Clause **4.16**)

The upper category temperature is the maximum ambient temperature for which a thermistor has been designed to operate continuously at zero-power.

2.2.15 Lower category temperature ($\tau_{min.}$) (IEC 539, Clause **4.17**)

The lower category temperature is the minimum ambient temperature for which a thermistor has been designed to operate continuously.

2.2.16 Rated dissipation ($P_{max.}$) (IEC 539, Clause **4.18**)

The rated dissipation is the maximum dissipation which can be applied to the thermistor for an extended period of time, at an ambient temperature of 25 °C or at such temperature as may be specified in the detail specification. When the ambient temperature exceeds 25 °C, (or other temperature) the power-rating shall be derated linearly to zero at a temperature T_L which shall be prescribed in the detail specification.

2.2.17 Heat capacity (H)

The heat capacity is the energy (in J) required to increase the temperature of a thermistor by 1 kelvin. It is completely determined by the design of the thermistor.

2.2.18 Dissipation factor (δ) (IEC 539, Clause **4.19**)

The dissipation factor is the quotient (in W/K), at a specified ambient temperature in a specified medium of a change in power dissipation in a thermistor to the resultant body temperature change.

2.2.19 Thermal resistance

The thermal resistance of a thermistor (in K/W) at a specified temperature in a specified medium is the quotient of the temperature difference between the thermistor and its ambient divided by the power dissipated.

NOTE "Dissipation factor" and "thermal resistance" are mutually reciprocal.

2.2.20 Thermal time constant (ideal)

The time constant (ideal) of a thermistor is the product of its heat capacity and its thermal resistance.

NOTE Because of the impracticability of measuring heat capacity and the variation of thermal resistance with temperature it is usual to measure and specify the practical time constant.

2.2.21 Response time

The time (in s) required by a thermistor to change between two defined conditions of power input, or ambient or a combination of these conditions. The initial and final conditions are prescribed in the detail specification.

Where a special test is included in the inspection requirements of any detail specification that specification is to include full details of the method of measurement.

2.2.22 Thermal time constant by ambient change (τ_a)

The time (in s) required for a thermistor to respond to 63,2 % of an external step change in ambient the details of which are defined in the detail specification.

2.2.23 Thermal time constant by cooling (τ_c)

The time (in s) required for a thermistor to cool by 63,2 % of its temperature excess, due to electrical heating in still air.

2.2.24 Resistance/temperature characteristic (IEC 539, Clause **4.21**)

The relationship between the zero-power resistance of a thermistor and its body temperature.

The resistance law follows approximately the formula:

$$R = R_1 e^{B\left(\frac{1}{T} - \frac{1}{T_1}\right)}$$

where R and R_1 are the values of the zero-power resistance of the thermistor at temperatures T and T_1 respectively, expressed in kelvins, and B is the thermal sensitivity index (see **2.2.11**)

2.2.25 Voltage-current characteristic (IEC 539, Clause **4.22**)

The voltage/current characteristic is the relationship in still air at 25 °C or at such a temperature as may be prescribed in the detail specification between the dc or ac rms voltage across the thermistor and the applied steady-state current.

2.3 Preferred values

2.3.1 Ratings and characteristics. The values given in detail specifications shall preferably be selected from the following values:

2.3.1.1 Climatic categories. The thermistors covered by this specification are classified into climatic categories according to the general rules given in the appendix to IEC 68-1. The detail specification shall prescribe the appropriate category.

2.3.1.2 Preferred values of rated zero-powered resistance. The preferred values of the rated zero-power resistance shall be the E6 series given in IEC 63: Preferred number series for resistors and capacitors.

NOTE If other values are needed, they shall be selected from the finer series (E12 or E24).