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QC 440001

Thermistors – Directly heated positive step-function temperature coefficient – Part 1-1: Blank detail specification – Current limiting application – Assessment level EZ

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THERMISTORS – DIRECTLY HEATED POSITIVE STEP-FUNCTION TEMPERATURE COEFFICIENT –

Part 1-1: Blank detail specification – Current limiting application – Assessment level EZ

FOREWORD

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International Standard IEC 60738-1-1 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This third edition cancels and replaces the second edition issued in 1998. It constitutes a technical revision.

This edition contains changes with respect to the referenced subclauses of the revised generic specification IEC 60738-1.

This publication is to be read in conjunction with IEC 60738-1.

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

FDIS	Report on voting
40/1874/FDIS	40/1891/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.

The QC number that appears on the front cover of this publication is the specification number in the IEC Quality Assessment System for Electronic Components (IECQ).

The list of all parts of the IEC 60738 series, under the (new) general title *Thermistors – Directly heated positive step-function temperature coefficient*, can be found on the IEC website.

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- withdrawn,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.

INTRODUCTION

Blank detail specification

A blank detail specification is a supplementary document to the generic specification and contains requirements for style and layout and minimum content of detail specifications. Detail specifications not complying with these requirements shall not be considered as being in accordance with IEC specifications nor shall they so be described.

In the preparation of detail specifications the content of IEC 60738-1:2006,1.4 shall be taken into account.

The numbers between brackets on the first page correspond to the following information which shall be inserted in the position indicated.

Identification of the detail specification

[1] The "International Electrotechnical Commission" or the National Standards Organization under whose authority the detail specification is drafted.

[2] The IEC or National Standards number of the detail specification, date of issue and any further information required by the national system.

[3] The number and issue number of the IEC or national generic specification.

[4] The IEC number of the blank detail specification.

Identification of the thermistor

[5] A short description of the type of thermistor.

[6] Information on typical construction (if applicable).

NOTE When the thermistor is not designed for use on printed boards, this should clearly be stated in the detail specification in this position.

[7] Outline drawing with main dimensions which are of importance for interchangeability and/or reference to the national or international documents for outlines. Alternatively, this drawing may be given in an annex to the detail specification.

[8] Application or group of applications covered and/or assessment level.

[9] Reference data on the most important properties, to allow comparison between the various thermistor types.

<table>
<tr><td>[1]</td><td>IEC 60738-1-1-XXX [2]
QC 440001XXXXXX</td></tr>
<tr><td rowspan="2">ELECTRONIC COMPONENTS OF ASSESSED QUALITY IN ACCORDANCE WITH:

[3]</td><td>IEC 60738-1-1 [4]
QC 440001</td></tr>
<tr><td rowspan="3">DIRECTLY HEATED POSITIVE STEP-FUNCTION TEMPERATURE COEFFICIENT THERMISTORS [5]
FOR CURRENT LIMITING APPLICATION</td></tr>
<tr><td rowspan="2">Outline drawing: [see 1.2]
[… angle projection]

[7]
[Other shapes are permitted within the dimensions given]</td></tr>
<tr><td>MODIFIED FERRO-ELECTRIC CERAMIC MATERIAL [6]</td></tr>
<tr><td></td><td>Assessment level: EZ [8]</td></tr>
</table>

Information on the availability of components qualified to this detail specification is given in the Register of Approvals. [9]

THERMISTORS – DIRECTLY HEATED POSITIVE STEP-FUNCTION TEMPERATURE COEFFICIENT –

Part 1-1: Blank detail specification – Current limiting application – Assessment level EZ

1 General data

1.1 Method(s) of mounting (to be inserted)

(See IEC 60738-1:2006, 7.30).

1.2 Dimensions

(All dimensions are in millimetres or inches and millimetres; it shall be stated which dimensions are suitable for gauging).

Dimensioned drawing(s) shall be given in the detail specification. If necessary, the dimensions may be listed in tabular form with reference to styles or codes.

1.3 Coating

The detail specification shall state

a) whether the thermistor is insulated or non-insulated,

b) the material,

c) the colour, if applicable.

1.4 Terminations

The detail specification shall state whether the terminations are suitable for soldering. If they are not, suitable methods of connection shall be stated for example: welding, clamping or crimping.

1.5 Flammability

The detail specification shall state whether the thermistor is actively or passively flammable if applicable. The test method shall be given in the test schedule.

1.6 Resistance to solvents

The detail specification shall state whether the coating and the marking of the thermistor are solvent resistant if applicable. The test methods shall be given in the test schedule.

1.7 Packaging

The detail specification shall give the following information (if required):

a) whether bulk packed or taped and if taped, drawing or references;

b) the dimensions of the immediate packaging and the number of thermistors packed;

c) the dimensions of the outer package and the number of immediate packages;

d) methods of disposal of the packaging material.

1.8 Electrical data/Ratings and characteristics

The detail specification shall give units and tolerances or limiting values for the following parameters. If necessary, electrical data may be listed in tabular form, with reference to styles and codes.

Upper/Lower category temperatures (UCT/LCT);

Operating temperature range at maximum voltage;

Maximum voltage ($U_{max.}$);

Zero-power resistance (R_T);

Isolation voltage (insulated thermistors only);

Insulation resistance (insulated thermistors only);

Tripping current (I_t);

Maximum non-tripping current ($I_{max.\ nt}$);

Residual current at $U_{max.}$ (I_{res});

Maximum overload current (I_{mo});

Switching temperature (T_b) for information only.

1.9 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 60068-2-58, *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 60410:1973, *Sampling plans and procedures for inspection by attributes*

IEC 60738-1:2006, *Thermistors – Directly heated positive step-function temperature coefficient – Part 1: Generic specification*

1.10 Marking

The marking of the thermistors and package containing the thermistors shall be in accordance with the requirements of IEC 60738-1:2006, 5.2.

The details of the marking of the thermistors and package containing the thermistor shall be given in full in the detail specification.

1.11 Ordering information

Orders for thermistors covered by this specification shall contain, in clear or in coded form, the following minimum information:

a) style reference;

b) maximum continuous a.c. voltage;

c) number and issue reference of the detail specification.

1.12 Additional information *(not for inspection purposes)*

1.13 Additional or increased severities or requirements to those specified in the generic sectional specification

NOTE Additions or increased requirements should be specified only when essential.

2 Inspection requirements

2.1 Procedures

2.1.1 For qualification approval, the procedures shall be in accordance with the generic specification, IEC 60738-1:2006, 6.5.

2.1.2 For quality conformance inspection, the test schedules (tables 1 and 2) include sampling, periodicity, severities and requirements. The formation of inspection lots is covered by the generic specification IEC 60738-1:2006, 6.5.7.

The following list applies to the test schedules developed in tables 1 and 2:

1) Subclause numbers of tests and performance requirements refer to the generic specification, IEC 60738-1:2006, and clause 1 of this document.
2) Number to be tested: sample size as directly allotted to the code letter for *IL* in Table IIA of IEC 60410:1973 (single sampling plan for normal inspection).
3) In these tables: *p* is the periodicity (in months)
   n is the sample size
   c is the acceptance criterion (permitted number of non-conforming items)
   D indicates a destructive test
   ND indicates a non-destructive test
   IL is the inspection level
4) The temperature at which the zero-power resistance shall be measured is the temperature specified in the detail specification. This temperature shall be stated, where required, in the test schedule.
5) The specimens used for this group may, at the discretion of the manufacturer, be used for any subsequent group which is identified as being "destructive".
6) The soldering – solderability and soldering – resistance to heat tests shall only be applied where the thermistor has terminations which are appropriate for soldering.
7) Where the terminations are stated to be suitable for printed wiring applications, the appropriate test conditions in IEC 60068-2-58 shall apply.
8) The thermistors shall be mounted by their normal means.
9) The bump test and the shock test are alternatives. The test selected in the detail specification shall be used.
10) The detail specification shall specify which of the endurance tests in groups C4, C5 and D1 respectively are appropriate to the construction and application of the thermistor.
11) Any deviation from Annex B of the generic specification shall be given in the detail specification.
12) 100 % testing shall be followed by re-inspection by sampling in order to monitor outgoing quality level by non-conforming items per million ($\times 10^{-6}$). The sampling level shall be established by the manufacturer. For the calculation of $\times 10^{-6}$ values any parametric failure shall be counted as a non-conforming item. In case one or more non-conforming items occur in a sample, this lot shall be rejected.

Table 1 – Test schedule for quality conformance inspection: lot-by-lot

Subclause number and test (see list item 1)	D or ND	Conditions of test (see list item 1)	*IL*	*n*	*c*	Performance requirements (see list item 1)
			(see list item 3)			
GROUP A INSPECTION (lot-by-lot)						
Subgroup A0	ND		100 % (see list item 12)			
7.5 Zero-power resistance R_T		Temperature:... °C Voltage:... V Frequency:... Hz (if applicable)				As in 7.5.3
Subgroup A1	ND		S-4	(See list item 2)	0	
7.4.1 Visual examination						As in 7.4.1
Subgroup A2	ND		S-3	(See list item 2)	0	
7.4.2 Marking						As in 7.4.2
7.4.3 Dimensions (gauging)						As specified in the detail specification
GROUP B INSPECTION (lot-by-lot)						
Subgroup B1	ND		S-2	(See list item 2)	0	
7.25 Tripping current		See detail specification I_t:... mA				As in 7.25
7.27 Residual current						$I_{res} \leq$... mA
7.26 max. non-tripping current		See detail specification ($I_{max.nt}$):... mA				As in 7.26
Subgroup B2	ND		S-2	(See list item 2)	0	
7.8 Voltage proof		(Insulated thermistors only) Method:... Applied voltage:... V a.c.				As in 7.8.4
7.16 Solderabilty		(see list item 6 and 7) Solder bath method				The terminations shall be uniformly tinned

Table 2 – Test schedule for quantity conformance inspection: periodic

Subclause number and test (see list item 1)	D or ND	Conditions of test (see list item 1)	Sample size and acceptance criterion (see list item 3)			Performance requirements (see list item 1)
			p	*n*	*c*	
GROUP C INSPECTION (periodic)						
Subgroup C1A	D	(see list item 6 and 7)	6	5	0	
Part of sample						
7.17 Resistance to soldering heat		Temperature:... °C Visual examination Zero-power resistance (Temperature:... °C) (Voltage:... V)				As in 7.17.4 and 7.17.5 $\Delta R/R$: from... % to... %
7.15 Robustness of terminations		Tensile, bending and torsion tests as appropriate to type of terminations, if applicable Visual examination Zero-power resistance (Temperature:... °C) (Voltage:... V)				As in 7.15.4 and 7.15.5 $\Delta R/R$: from... % to... %
Subgroup C1B	D		6	5		
Other part of sample						
7.18 Rapid change of temperature		2_A= LCT 2_B= LCT Visual examination Zero-power resistance (Temperature:... °C) (Voltage:... V)				As in 7.18 $\Delta R/R$: from... % to... %
7.19 Vibration		Frequency range: ... Hz to... Hz Amplitude: 0,75 mm or acceleration: 98 m/s^2 (whichever is the less severe) Sweep endurance Total duration: 6 h Number of sweep cycles: see 5.1.3 Final measurements: Visual examination Zero-power resistance (Temperature:... °C) (Voltage:... V)				As in 7.19 $\Delta R/R$: from... % to... %
7.20 Bump (or shock, see list item 9)		Acceleration:... m/s^2 Number of bumps:... (see list item 8) Visual examination Zero-power resistance (Temperature:... °C) (Voltage:... V)				As in 7.20 $\Delta R/R$: from... % to...

Table 2 *(continued)*

Subclause number and test (see list item 1)	D or ND	Conditions of test (see list item 1)	Sample size and acceptance criterion (see list item 3)			Performance requirements (see list item 1)
			p	*n*	*c*	
7.21 Shock (or bump, see list item 9)		Pulse shape: halfsine Acceleration:... m/s^2 (see list item 8) Pulse duration:... ms Visual examination Zero-power resistance (Temperature:... °C) (Voltage:... V)				As in 7.21 $\Delta R/R$: from... % to... %
Subgroup C1 **Combined sample of specimens of sub-groups C1A and C1B** 7.22 Climatic sequence - Dry heat - Damp heat, cyclic, first cycle - Cold - Damp heat, cyclic, remaining cycles - Final measure-ments	D	(Low air pressure test not applicable) Visual examination Zero-power resistance (Temperature:... °C) (Voltage:... V) Insulation resistance (Insulated thermistors only) Voltage proof (Insulated thermistors only)	6	10		As in 7.22.7 $\Delta R/R$: from... % to... % $R \geq$... MΩ As in 7.22.7
Subgroup C2 7.14 Thermal time constant by cooling (if applicable)	ND	Method:... T_0:... °C T_3:... °C Thermal time constant	6	10	0	As specified in the detail specification
Subgroup C3 7.6 Temperature coefficient of resistance (if applicable) 7.4.4 Dimensions (detail) 7.10 Dissipation fac-tor at $U_{max.}$ (if specified) (see list item 11)	ND	(see list item 5) T_p:... °C T_b:... °C Voltage:... V Dissipation factor	6	10	0	 α_R: (from... to...) %/K As specified in the detail specification As specified in the detail specification

Table 2 *(continued)*

Subclause number and test (see list item 1)	D or ND	Conditions of test (see list item 1)	Sample size and acceptance criterion (see list item 3)			Performance requirements (see list item 1)
			p	***n***	***c***	
Subgroup C4 7.24.2 Endurance at upper category temperature	D	(see list item 10) Duration: 1 000 h Examination at 168 h and 500 h Zero-power resistance (Temperature:... °C) (Voltage:... V) Examination at 1 000 h Visual examination Zero-power resistance (Temperature:... °C) (Voltage:... V) Residual current Insulation resistance (Insulated thermistors only) Method:...	6	10	0	 $\Delta R/R$: from... % to... % As in 7.24.2 $\Delta R/R$: from... % to... % $I_{res} \leq$... mA $R \geq$... MΩ
Subgroup C5 7.24.3 Endurance at maximum operating temperature and maximum voltage	D	(see list item 10) (The detail specification shall describe the method of mounting, see 7.24.3) Duration:... h Examination at 168 h and 500 h (if applicable) Zero-power resistance (Temperature:... °C) (Voltage:... V) Examination at... h Visual examination Zero-power resistance (Temperature:... °C) (Voltage:... V) Residual current Insulation resistance (Insulated thermistors only) Method:...	6	10	0	 $\Delta R/R$: from... % to... % As in 7.24.3 $\Delta R/R$: from... % to... % $I_{res} \leq$... mA $R \geq$... MΩ

Table 2 *(continued)*

Subclause number and test (see list item 1)	D or ND	Conditions of test (see list item 1)	Sample size and acceptance criterion (see list item 3)			Performance requirements (see list item 1)
			p	*n*	*c*	
GROUP D INSPECTION						
Subgroup D1 7.24.1 Endurance at room temperature (cycling)	D	(see list item 10) The detail specification shall describe the method of mounting (see 7.24.1) Duration:... cycles Applied voltage:... V Applied current:... A	12	10	0	
		Where the detail specification specifies that intermediate measurements shall be made, they shall be performed at the intervals and to the limits specified in the detail specification				
		Final measurements: Visual examination Zero-power resistance (Temperature:... °C) (Voltage:... V)				As in 7.24.1 $\Delta R/R$: from... % to... %
		Residual current				$I_{res} \leq$... mA
		Insulation resistance (Insulated thermistors only) Method:...				$R \geq$... MΩ
Subgroup D2 7.24.4 Cold environmental electrical cycling	D	The detail specification shall be specified in 7.24.4. Final measurements: Zero-power resistance Visual examination	12	10	0	As in 7.24.4 $\lvert \Delta R / R \rvert \leq$ ...%
Subgroup D3 7.24.5 Thermal runaway	D	The detail specification shall be specified in 7.24.5 Final measurements: Visual examination	12	10	0	As in 7.24.5

Table 2 *(concluded)*

Subclause number and test (see list item 1)	D or ND	Conditions of test (see list item 1)	Sample size and acceptance criterion (see list item 3)			Performance requirements (see list item 1)
			p	***n***	***c***	
Subgroup D4	D		12	10	0	
7.23 Damp heat, steady state		(When specified in the detail specification for insulated thermistors, the d.c. voltage shall be given) Voltage:... V				
		Visual examination Zero-power resistance (Temperature:... °C) (Voltage:... V)				As in 7.23 $\Delta R/R$: from... % to... %
		Insulation resistance (Insulated thermistors only) Method:...				$R \geq$... MΩ
		Voltage proof (Insulated thermistors only) Method:...				As in 7.23

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