BS EN 140401:2009

BSI Standards Publication

Blank Detail Specification: Fixed low power film surface mount (SMD) resistors

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National foreword

This British Standard is the UK implementation of EN 140401:2009. It supersedes BS EN 140401:2002 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/40X, Capacitors and resistors for electronic equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Blank Detail Specification: Fixed low power film surface mount (SMD) resistors

Spécification particulière cadre: Résistances fixes à couches et à faible dissipation pour montage en surface (CMS)

Vordruck für Bauartspezifikation: Oberflächenmontierbare (SMD) Schicht-Festwiderstande niedriger Belastbarkeit

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: avenue Marnix 17, B - 1000 Brussels

Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 40XB, Resistors.

The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 140401 on 2009-03-01.

This European Standard supersedes EN 140401:2002.

Preceding documents on the subject covered by this specification have been

– EN 140401:1996,

– CECC 40 401:1989.

Compared to the superseded standard, the following changes have been implemented:

– modification of the title;

– introduction of a test on the resistance to electrostatic discharge (ESD) in 1.6 and Annex A;

– introduction of description and test methods for lead-free soldering in 1.8, 1.10.3 and Annex A;

– introduction of code letters for the temperature coefficient (TCR) as in EN 60062:2005;

– revision of ordering information in 1.9.4;

– adoption of the IECQ rules of procedure, IEC QC 001002-3;

– revision of the sample quantities and the sequence of tests in Annex A;

– editorial revision.

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)	2010-03-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2012-03-01

This specification supports the building of a series of documents describing fixed low power film resistors as follows:

– EN 60115-1	Fixed resistors for use in electronic equipment – Part 1: Generic specification (IEC 60115-1, mod.)
– EN 140400	Sectional specification: Fixed low power surface mount (SMD) resistors
– EN 140401-xxx	Relevant detail specification(s) written on the basis of this blank detail specification

Contents

Introduction

Blank detail specification

A blank detail specification is a supplementary document to the sectional 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 European standards nor shall they be so described.

In the preparation of the detail specification the content of EN 140400:2003, 1.2 shall be taken into account.

The detail specification should be written by using the preferred values given in EN 140400.

The detail specification should contain a table of contents prior the first page of the actual specification. For the use of SI units refer to ISO 1000, for the use of letter symbols to be used in electrical technology, refer to EN 60027-1.

Notes in this document shall be considered as guidance and are not part of the detail specification itself.

Identification of the detail specification and the component

The first page of the detail specification should have the layout recommended on page 5.

The numbers in square brackets correspond to the indications to be completed thereunder:

[1] the name of the Standardisation Organisation under whose authority the detail specification is published and if applicable, the organisation from whom the detail specification is available;

[2] the CECC symbol and the number allocated to the detail specification by the CENELEC General Secretariat;

[3] the number and issue number of the EN generic and sectional specification as relevant; also national reference if different;

[4] the national number of the detail specification, date of issue and any further information required by the national system, together with any amendment numbers, if different from the EN number;

[5] a brief description of the component or range of components;

[6] information on typical construction (where applicable);

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

[8] the level of quality assessment covered by the detail specification.

For [5] and [6] the text to be given in the detail specification should be suitable for an entry in a register of approvals and the “CENELEC Catalogue of European Standards”.

Specification available from: [1]	**EN 140401-º** [2] (Specification number)
Electronic components of assessed quality in accordance with: [3] EN 60115-1:2001 + A1:2001 + A11:2007 EN 140400:2003	**Issue º** [4] (Month) (Year)
[7]	Fixed low power film surface mount (SMD) resistors, Style … [5]
	(Description of the component) [6]
	Assessment level EZ [a] [8] Version A: with 100 %-test Version E: with failure rate level and 100 %-test Stability classes …
Other shapes are permitted within the given dimensions. **Figure 1 ± Outline and dimensions (see Table 1)**	
[a] For explanation on assessment level EZ see 2.1.1	

NOTE Version E is optional.

1 Characteristics and ratings

Various parameters of this component are precisely defined in this specification. Unspecified parameters may vary from one component to another.

1.1 Dimensions and ratings

Table 1 ± Style and dimensions

Style		**Length *L*** mm		mm		mm		mm		**Mass** [a] mg
metric	**x**	**min.**	**max.**	**min.**	**max.**	**min.**	**max.**	**min.**	**max.**	**max.**

[a] For information only.

[x] Optional column for additional information (e.g. size code).

NOTE See EN 140400:2003, 1.2 a).

Information about manufacturers who have components qualified to this detail specification is available in the approvals section of the website http://www.iecq.org.

Table 2a ± Ratings

Style	x	Rated dissipation P_{70} mW	Limiting element voltage d.c. or a.c. (r.m.s.) U_{max} V	Insulation voltage d.c. or a.c. (peak) U_{ins} V	
				1 min	continuous

x Optional column for additional information (e.g. stability class, rated dissipation at other ambient temperature than 70 °C)

NOTE 1 See EN 140400:2003, 1.2 g), h), i).

NOTE 2 Should it be necessary to control further parameters, a more detailed specification should be used. Then the additional test method(s) shall be fully described and appropriate limits and inspection levels (IL) shall be specified.

Table 2b ± Ratings for 0 Ω resistors

Style	Maximum current I_{max} A	Maximum resistance $R_{res\ max}$ mΩ	Insulation voltage d.c. or a.c. (peak) U_{ins} V	
			1 min	continuous

NOTE Table 2b is optional.

1.2 Derating curve

Resistors covered by this specification are derated according to the following diagram:

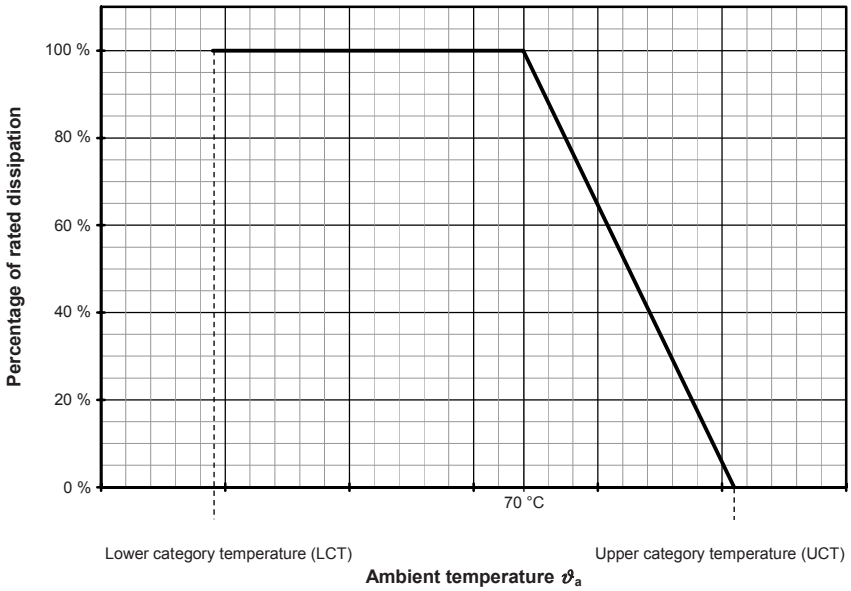


Figure 2 ± Derating curve

NOTE 1 See EN 140400:2003, 1.2 g).

NOTE 2 A larger area of operation may be given in the detail specification, provided it includes all the area given above.

1.3 Resistance range and tolerance on rated resistance

1.3.1 Version A

The following combinations of temperature coefficient and tolerance on rated resistance may be approved only. Products from this extent shall be used for the qualification approval according to 2.2.1 and for the quality conformance inspection according to 2.3. Resistance values of an E-series according to IEC 60063 shall be used.

The qualification of resistance values below or beyond the specified resistance values is permitted if they fulfil the requirements of the closest stability class (e.g. Style … shall fulfil the requirements of stability class …).

Table 3a ± Resistance range and tolerance on rated resistance for version A

Style	Tolerance on rated resistance		Temperature coefficient	Resistance range	Stability class [b]
	%	Code [a]	10^{-6}/K		
0 Ω resistors according to Table 2b for styles …					

[a] Code letters according to EN 60062:2005.
[b] For the category temperatures of stability classes refer to Table 6.

1.3.2 Version E

The following combinations of temperature coefficient, tolerance on rated resistance, resistance range and E-series according to IEC 60063 are permitted only. Products from this extent shall be used for the qualification approval according to 2.2.2 and for the quality conformance inspection according to 2.3 and are permitted only:

Table 3b ± Resistance range and tolerance on rated resistance for version E

Style	Tolerance on rated resistance		Temperature coefficient	Resistance range	Stability class [b]	E series
	%	Code [a]	10^{-6}/K			
0 Ω resistors according to Table 2b for styles …						

[a] Code letters according to EN 60062:2005.
[b] For the category temperatures of stability classes, refer to Table 6.

NOTE Table 3b is only required for version E and should be a subset of Table 3a.

1.4 Variation of resistance with temperature and temperature rise

Table 4 ± Temperature coefficients and permissible change of resistance

Temperature coefficient			Limit of resistance change $\Delta R/R$ %			
			LCT / Reference temperature °C		Reference temperature / UCT °C	
10^{-6}/K	Code[a]	Code[b]	-… / 20	-… / 20	20 / …	20 / …

[a] Code letters according to EN 60062:2005.
[b] Historical code letters according to …, for information only.

NOTE 1 Second code column with historical reference is optional.

NOTE 2 See EN 140400:2003, 1.2 f).

Table 5 ± Limit of temperature rise

Stability class	Limit of temperature rise at rated dissipation
	$T_r \leq$ …
	$T_r \leq$ …

1.5 Climatic categories

NOTE See EN 140400:2003, 1.2 b).

Table 6 ± Climatic categories

Stability class	Climatic category LCT / UCT / Duration
	… / … / …
	… / … / …

1.6 Limits for change of resistance at tests

NOTE See EN 140400:2003, 1.2 c).

Table 7a ± Limits for change of resistance at tests

Stability class	Limit of resistance change $\Delta R/R$			
	EN 60115-1 [a]	EN 60115-1 [a]		EN 60115-1 [a]
	4.23 Climatic sequence 4.24 Damp heat, steady state 4.25.3 Endurance at upper category temperature	4.25.1 Endurance at 70 °C		4.13 Overload 4.18 Resistance to soldering heat 4.19 Rapid change of temperature, 5 cycles 4.22 Vibration 4.33 Substrate bending
		1 000 h	Extended, 8 000 h	

[a] EN 60115-1:2001 + A1:2001 + A11:2007.

Table 7b ± Limits for change of resistance at tests

Stability class	Limit of resistance change $\Delta R/R$			
	EN 60115-1 [a]	EN 60115-1 [a]	EN 60115-1 [a]	EN 60115-1 [a]
	4.19 Rapid change of temperature, ≥ 100 cycles	4.27 Single pulse high voltage overload test	4.27 Periodic electric overload	4.40 Electrostatic discharge [b]

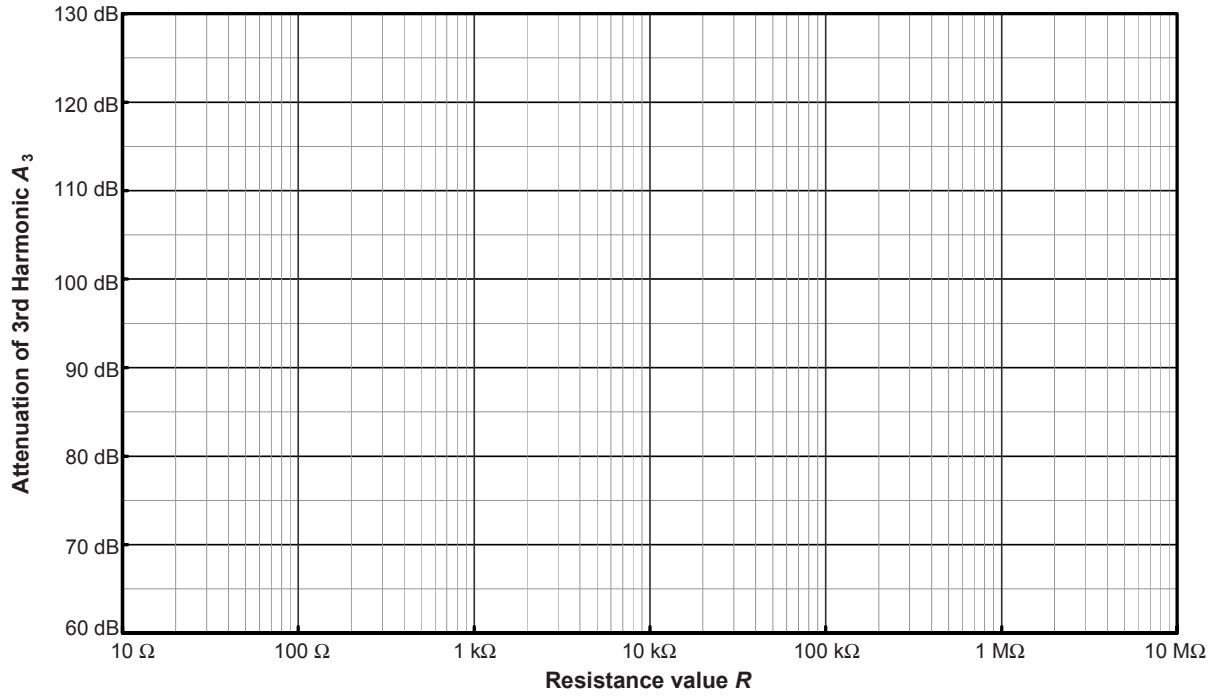
[a] EN 60115-1:2001 + A1:2001 + A11:2007.

[b] Human body model (HBM) according to EN 61340-3-1, 3 positive + 3 negative discharges.

NOTE The number of cycles for the rapid change of temperature test should preferably be 1 000.

1.7 Non-linearity

If for resistors in the range 10 Ω ≤ R ≤ … measurement of non-linearity is required according to 2.1.2, the measured values shall be above the limits given in the diagram below. The resistors shall be tested according to IEC/TR 60440 where the test voltage shall be the rated voltage.



NOTE The X-scale shall be in accordance to the resistance range given in Table 3a.

Figure 3 ± Limits of non-linearity in resistance

1.8 Tests related to soldering

1.8.1 Severities for solderability testing

Solderability testing shall be preceded by an accelerated ageing according to EN 60068-2-58:2004, 5.2, Test Td: 4 h at 155 °C dry heat.

To prove the compatibility of resistors according to this specification with lead free solder, e.g. SnCu, SnCuNi, SnAg or SnAgCu and traditional SnPb solder, solderability shall be tested with both types of solder.

a) Solderability with traditional SnPb solder shall be tested according to EN 60068-2-58:2004, 8.2.1, Test Td, solder bath method, with the following conditions:
   Solder alloy: Sn60Pb40 or Sn63Pb37
   Solder bath temperature: (235 ± 5) °C
   Immersion time: (2 ± 0,2) s

b) Solderability with lead-free solder shall be tested according to EN 60068-2-58:2004, 8.1.1, Test Td, solder bath method, with the following conditions (Group 3):
   Solder alloy: Sn96,5Ag3,0Cu0,5
   Solder bath temperature: (245 ± 5) °C
   Immersion time: (3 ± 0,3) s
   or with the following conditions (Group 4):
   Solder alloy: Sn99,3Cu0,7
   Solder bath temperature: (250 ± 5) °C
   Immersion time: (3 ± 0,3) s

The categories Group 3 and Group 4 are defined in EN 60068-2-58 for the discrimination of the wide variety of lead-free solder alloys by means of the related typical soldering processes and their specific temperature ranges. Group 3, described as „medium-high temperature“, lists examples of solder alloys SnAg, SnAgCu and SnAgBi, all intended for both reflow and flow (wave) soldering. Group 4, described as „high temperature“, covers SnCu solder, primarily intended for flow (wave) soldering.

1.8.2 Severities for testing resistance to soldering heat

The severity of the resistance to soldering heat test is determined by the peak temperature and by the temperature slopes before and after the dwell time at the peak temperature. Therefore no separate tests are required for lead free soldering, e.g. SnCu, SnCuNi, SnAg or SnAgCu and traditional SnPb soldering, if the more severe test condition from those given in EN 60068-2-58 is adopted.

a) For the solder bath method, EN 60068-2-58:2004, 8.1.1 for lead-free soldering and EN 60068-2-58:2004, 8.2.1 for SnPb soldering require similar test conditions:

Solder alloy:	any alloy SnPb or SnCu or SnAgCu or SnAg
Solder bath temperature:	(260 ± 5) °C
Immersion time:	(10 ± 1) s
Test cycles	one only

b) For reflow soldering using the vapour phase reflow method, the most severe test conditions from EN 61760-1:2006, Clause 6 for lead-free soldering and EN 60068-2-58:2004, 8.2.4 for SnPb soldering are:

Solder alloy	none, specimen shall be placed on an unmetallized ceramic substrate
Temperature slopes	(3 ± 0,5) K/s
Peak temperature	(230 ± 5) °C
Peak dwell time	(40 ± 1) s
Test cycles	3, the recovery period between two successive cycles shall be the time it takes until the specimen drops below 50 °C

c) For reflow soldering using the infrared and forced gas convection reflow method, the most severe test conditions from EN 60068-2-58:2004, 8.1.2 for lead-free soldering and EN 60068-2-58:2004, 8.2.4 for SnPb soldering are:

Solder alloy	none, specimen shall be placed on an unmetallized ceramic substrate
Preheating	150 °C to 180 °C for (120 ± 5) s
Peak temperature	(255 ± 5) °C
Dwell times	(20 ± 1) s above 245 °C (60 ± 5) s above 220 °C
Test cycles	3, the recovery period between two successive cycles shall be the time it takes until the specimen drops below 50 °C

The solder bath method is the most severe of the above test methods, representing the soldering stress of all wave soldering and reflow soldering methods.

For precision resistors, where the prime concern is the overall stability of the resistance, wave soldering is not considered a recommendable method.

Table 8 ± Test method for resistance to soldering heat test

Stability class	Test method for resistance to soldering heat test

For version E resistors the solder bath method shall be used.

1.9 Marking, packaging and ordering designation

NOTE The marking of components and packaging shall be in accordance with the requirements of EN 60115-1:2001 + A1:2001 + A11:2007, 2.4 and EN 140400:2003, 1.2 k) and l).

1.9.1 Marking of the component

NOTE Marking of the component can be mandatory or not.

1.9.2 Packaging

Components may be taped or put in a bulk case. For environmental protection packaging into bulk cases is preferred.

Taping shall be in accordance with EN 60286-3. Bulk case packaging shall be in accordance with EN 60286-6.

1.9.3 Marking of the packaging

The packaging of the component shall be marked with ordering information in accordance to 1.9.4 and additionally with

– CECC or IECQ sign of conformity,
– CECC or IECQ manufacturer code,
– NATO manufacturer code (only version E, if required),
– date code of manufacture according to EN 60062.

Additional information is permissible.

1.9.4 Ordering information

Orders for resistors covered by this specification shall contain the following information:

– detail specification number;
– assessment level;
– style;
– temperature coefficient;
– rated resistance;
– tolerance on rated resistance;
– failure rate level (only for Version E);
– form of delivery, packaging method (in addition to the ordering information given in the examples below).

Example of the ordering information for 4,75 kΩ resistors:

Version A:	EN140401–xxxEZ<style>R4K75FE0
Version E (with failure rate level):	EN140401–xxxEZ<style>R4K75FE5

Example of the ordering information for 0 Ω resistors:

Version A:	EN140401–xxxEZ<style>–0R00–E0
Version E (with failure rate level):	EN140401–xxxEZ<style>–0R00–E5

The elements used in this ordering information have the following meaning:

EN140401–xxx	Detail specification number
EZ	Assessment level
<style>	Style (see Table 1)
R	Temperature coefficient according to EN 60062 (see Table 4)
4K75	Resistance value according to EN 60062, 4 characters
F	Tolerance on rated resistance (see Table 3a or Table 3b)
E0; E5	Failure rate level according to EN 60115-1:2001 + A1:2001 + A11:2007, Table ZB.1

1.10 Additional information (not for inspection purpose)

NOTE The detail specification may include information (which is not required to be verified by the inspection procedure) for the clarification of the detail specification. The information below should be given in the detail specification as a minimum.

1.10.1 Storage

The permitted storage time is 20 years under the conditions of EN 60115-1:2001, 2.7.

Solderability and resistance may be affected by storage. Therefore test of solderability and measurement of resistance are recommended before delivery if the storage time exceeds two years.

1.10.2 Mounting

The resistors are suitable for mounting on all common printed boards and flexible foils.

1.10.3 Soldering process

The resistors are suitable for all soldering methods according to EN 61760-1.

This includes full compatibility with

– lead free solder, e.g. SnCu, SnCuNi, SnAg or SnAgCu,
– conventional SnPb solder.

The immersion time shall not exceed 10 s when the components are immersed in a solder of 260 °C.

It is recommended to only use fluxes which do not require a cleaning process after soldering. Flux residues may be hard to remove, particularly from the space between the resistor and the circuit board or substrate. Flux residues may establish some conductivity in parallel to the assembled resistor and thereby adversely affect the performance of the electronic circuit.

1.10.4 Use of cleaning solvents

For the removal of flux residues the following agents may be used:

– alcohol, such as ethanol, propanol, isopropanol or butanol;
– aqueous solutions;
– deionized water.

Reaction time of the solvent shall not exceed 5 min.

Consultation with the resistor manufacturer is recommended if the use of other cleansing agents is intended.

2 Quality assessment procedures

NOTE See also EN 60115-1:2001, Clause 3 and EN 140400:2003, Clause 3.

2.1 General

2.1.1 Zero defect approach

This specification fulfils the requirements of the zero defect approach. The new assessment level EZ is introduced to align the assessment procedures and levels with current industry practices. Therefore

– the agreed number of permissible non-conforming items (acceptance number) used in fixed sample size schedules and in test schedules for quality conformance inspections together with the AQL figures in lot-by-lot schedules are replaced by the acceptance number “0”;

– the sample size for lot-by-lot testing will be determined from IEC 60410 by directly allotting the code letter for sample size selected from Table I to Table II.

For the interpretation of sampling plans see EN 60115-1:2001, Annex A.

2.1.2 100 % Test

All resistors according to this specification are subject to a 100 % test during the manufacturing process. The following tests shall be performed:

2.1.2.1 Resistance and tolerance

Resistance and tolerance on rated resistance shall be measured according to EN 60115-1:2001, 4.5.

This test shall be followed by re-inspection by sampling in order to monitor the outgoing quality level, to be expressed in non-conforming units per million (ppm). The sampling level shall be established by the manufacturer. For the calculation of the ppm values all non-conforming units shall be considered.

A lot shall not be released if one or more non-conforming units occur in the sample.

2.1.2.2 Reduction of early-failure rate

One of the following methods shall be applied to resistors ≥ 10 Ω in order to reduce the early-failure rate:

– overload test according to the manufacturer specification; specification and limits agreed by the NSI;
– non-linearity A_3 measured according to EN 60115-1:2001, 4.10, limits given in 1.7.

2.1.3 0 Ω Resistors

All tests described in Annex A shall be carried out for 0 Ω resistors, except the tests

– variation of resistance with temperature,
– single pulse high voltage overload test.

For 0 Ω resistors the following alterations shall apply to Table A.1 and Table A.2:

– in column “Conditions of test”,
the maximum current given in Table 2b shall be used where rated voltage is required;
– in column “Performance requirements”,
compliance with the maximum resistance as given in Table 2b shall be used where electrical requirements of Table 7a or Table 7b are referenced.

NOTE This subclause is only necessary if 0 Ω resistors are specified.

2.1.4 Certificate of Conformity (CoC)

The conformity is declared by marking the packaging in accordance to the relevant system rules if components are qualified to this specification by a certification body of a quality assurance system (e.g. IECQ-CECC).

An additional Certificate of Conformity is not required for qualified components.

2.1.5 Certified test records

Certified test records according to EN 60115-1:2001, 3.9 can be supplied if agreed between the customer and the manufacturer.

2.1.6 Failure rate level

Components qualified to this detail specification, Version E, shall be delivered with a failure rate level:

Failure rate level = E5 or E6 or E7 or E8.

Components qualified to this detail specification, Version A, shall be delivered without a failure rate level:

Failure rate level = E0.

The procedure according to EN 60115-1:2001, Annex ZB shall be applied for the determination and qualification of the failure rate level and for the evaluation of the quality factor (π_Q).

2.2 Qualification approval

The fixed sample size procedure (see EN 60115-1:2001, 3.5.3 (2)) shall be used for the qualification approval. The qualification is to be performed according to Annex A.

2.2.1 Version A

The qualification approval for Version A shall be granted after successful completion of 1 000 h of the test Endurance at 70 °C and all other tests of Annex A.

2.2.2 Version E

The qualification approval for Version E, failure rate level E5 shall be granted after successful completion of 1 000 h of the test Endurance at 70 °C and all other tests of Annex A.

Thereafter, the qualification approval for Version E, failure rate level E6 shall be granted after successful completion of 8 000 h of the test Endurance at 70 °C.

The qualification approval for Version E shall be withdrawn, if the 8 000 h test is not completed successfully.

2.3 Quality conformance inspection

The quality of the components according to this detail specification is monitored using one of the following quality evaluation procedures.

The Certificate of Approval shall state which quality evaluation procedures is used by the manufacturer.

2.3.1 Qualification approval according to IEC QC 001002-3:2005, Clause 3

For quality conformance inspection the test schedule shown in Annex A includes provisions for periodicity, sampling and requirements. Inspection lots shall be formed according to EN 140400:2003, 3.1.2.

2.3.2 Technology approval according to IEC QC 001002-3:2005, Clause 6

If the manufacturer is certified according to CECC 240 001, Technology approval schedule, the following modifications and amendments apply to the lot-by-lot tests of Annex A:

The tests of groups A and B may be performed during the production process according to the established Technology approval declaration document (TADD) of the manufacturer if equivalence of test results is confirmed by the National Supervising Inspectorate (NSI).

The manufacturer's TADD shall specify

- type and degree of non-conformity on which the NSI shall be informed by the Designated Management Representative (DMR) and permissible protraction period for this information,
- conditions for the withdrawal of the Technology Approval,
- corrective actions for non-conformities.

As required by CECC 240 001:1996, 6.2, test results shall be continuously documented.

2.3.3 Non-conforming items

All tests of a sub-group shall be repeated on a new sample if one non-conforming item is obtained during Quality conformance inspection tests. Then no non-conforming items are permitted. Release of product may continue during repeat testing.

For mounted specimen, any specimen found defective after mounting shall not be taken into account when calculating the permissible non-performing items for the succeeding tests. They shall be replaced by spare parts.

Annex A
(normative)

Fixed sample size Qualification Approval and Quality Conformance Inspection test schedule for fixed low power film resistors

Table A.1 ± Test schedule for qualification approval and quality conformance inspection, lot-by-lot tests, assessment level EZ

ASSESSMENT LEVEL EZ, ACCEPTANCE NUMBER C = 0			Qualification Approval		Quality Conformance Inspection (Lot-by-lot tests)		
Tests [a]	**Conditions of test**	**D or ND**[b]	n^b	c^b	IL^b	c^b	**Performance requirements** [a]
			Group 1		**Group A1**		
4.5 Resistance		ND	260 / 355[c]	0	100 % (see 2.1.2)		As in 4.5.2
			Group 2		**Group A2**		
4.4.1 Visual examination [d]	See 2.4.1 Marking, if applicable	ND	260 / 355[c]	0	S-4 / II [c]	0	As in 4.4.1
4.4.2 Dimensions (gauging) [d]	A calliper shall be used		(20 of the sample)		S-4	0	As in Table 1
			Group 3		**Group B1**		
4.6 Insulation resistance	See 4.6.1.4, V-block method	ND	50	0			$R \geq 1$ GΩ
4.7 Voltage proof	See 4.6.1.4, V-block method Voltage: $U = 1{,}4 \cdot U_{ins}$ Duration: 1 min				S-3	0	As in 4.7.3

Table A.1 ± Test schedule for qualification approval and quality conformance inspection, lot-by-lot tests, assessment level EZ *(continued)*

Tests [a]	Conditions of test	D or ND[b]	Qualification Approval		Quality Conformance Inspection (Lot-by-lot tests)		Performance requirements [a]
			n[b]	c[b]	IL[b]	c[b]	
			Group 3 *(continued)*		**Group B1** *(continued)*		
4.13 Overload	Mounting: see EN 140400:2003, 2.3.3 or unmounted Voltage: $U = 2{,}5 \cdot \sqrt{P_{70} \cdot R}$ or $U = 2 \cdot U_{max}$, whichever is the less severe Style … Duration … s … s Visual examination Resistance	D	(20 of the sample)				As in 4.13.3 As in Table 7a
			Group 4		**Group B2**		
		D	40	0		0	
4.17. Solderability (SnPb solder)	Ageing 4 h at 155 °C, dry heat; Method 1: Solder bath Solder: Sn60Pb40; (235 ± 5) °C, (2 ± 0,2) s Visual examination		(Half of the sample)		S-3		As in 4.17.3.2, > 95 % of the surface shall be covered by new solder

Table A.1 ± Test schedule for qualification approval and quality conformance inspection, lot-by-lot tests, assessment level EZ *(continued)*

Tests [a]	Conditions of test	D or ND[b]	Qualification Approval		Quality Conformance Inspection (Lot-by-lot tests)		Performance requirements [a]
			n[b]	c[b]	IL[b]	c[b]	
			Group 4 *(continued)*		**Group B2** *(continued)*		
4.17. Solderability (leadfree solder)	Ageing 4 h at 155 °C, dry heat Method 1: Solder bath Solder: Sn96,5Ag3Cu0,5; (245 ± 5) °C, (3 ± 0,3) s or Solder: Sn99,3Cu0,7; (250 ± 5) °C, (3 ± 0,3) s Visual examination		(The other half of the sample)		S-3		As in 4.17.3.2, > 95 % of the surface shall be covered by new solder
					Group B3		
4.8 Variation of resistance with temperature (Only for resistors with a temperature coefficient lower than ± 50 10^{-6}/K)	Mounting: see EN 140400:2003, 2.3.3 or unmounted 20 °C / LCT / 20 °C / UCT / 20 °C Resistance	D			S-3	0	As in Table 4

[a] Clause numbers in this column refer to EN 60115-1:2001 + A1:2001 + A11:2007.
[b] For list of abbreviations refer to B.2.
[c] First figure is sample size for Version A; second figure is sample size for Version E.
[d] For quality conformance inspection this tests may be replaced by in-production testing if the manufacturer installs SPC on dimensional measurements or other mechanisms to avoid parts exceeding limits.

Table A.2 ± Test schedule for qualification approval and quality conformance inspection, periodic tests, assessment level EZ

Tests [a]	Conditions of test	D or ND[b]	Qualification Approval		Quality Conformance Inspection			Performance requirements [a]
					Periodic tests			
			n[b]	c[b]	P[b]	n[b]	c[b]	
			Group 5		**Group C1**			
		D	20	0	3	20	0	
4.33 Substrate bending test	Mounting: see EN 140400:2003, 2.3.3 As in EN 60068-2-21: Depth of bend 2 mm, 3 times Visual examination Resistance		(half of the sample)	0	3	(half of the sample)	0	Electrical continuity. No open circuits when in the bent position after 3 bendings As in 4.16.6 a) As in Table 7a [e]
4.32 Shear test	Mounting: see EN 140400:2003, 2.3.3 As in 4.32.2 b) Visual examination		(the other half of the sample)			(the other half of the sample)		 As in 4.32.3
4.19 Rapid change of temperature	ϑ_A = LCT, ϑ_B = UCT (see Table 6); 5 cycles Visual examination Resistance							 As in 4.19.3 As Table 7a

Table A.2 ± Test schedule for qualification approval and quality conformance inspection, periodic tests, assessment level EZ *(continued)*

Tests [a]	Conditions of test	D or ND[b]	Qualification Approval		Quality Conformance Inspection			Performance requirements [a]
					Periodic tests			
			n[b]	c[b]	P[b]	n[b]	c[b]	
			Group 5 *(continued)*			**Group C1** *(continued)*		
4.23 Climatic sequence			(all of the sample)			(all of the sample)		
- Dry heat	16 h at UCT (see Table 6)							
- Damp heat, cyclic	1 cycle at +55 °C							
- Cold	2 h at LCT (see Table 6)							
- Low air pressure	1 h / 1 kPa at +15 °C to +35 °C							
- Damp heat, cyclic	5 cycles at +55 °C							
- D.C. load	Voltage: $U = \sqrt{P_{70} \cdot R}$ or $U = U_{max}$, whichever is the less severe, 1 min							
- Final measurements	Visual examination Resistance Insulation resistance, V-block-method							As in 4.23.8 As Table 7a $R \geq 100$ MΩ
			Group 6			**Group C2**		
4.25.1 Endurance at 70 °C	Mounting: see EN 140400:2003, 2.3.3	D	20 / 115[c]	0	3	20	0	
	Voltage: $U = \sqrt{P_{70} \cdot R}$ or $U = U_{max}$, whichever is the less severe; 1,5 h on and 0,5 h off; duration 1 000 h							
	Visual examination Resistance Insulation resistance, V-block-method							As in 4.25.1.7 As Table 7a $R \geq 1$ GΩ

Table A.2 ± Test schedule for qualification approval and quality conformance inspection, periodic tests, assessment level EZ *(continued)*

Tests [a]	Conditions of test	D or ND[b]	Qualification Approval		Quality Conformance Inspection			Performance requirements [a]
					Periodic tests			
			n[b]	c[b]	P[b]	n[b]	c[b]	
			Group 6 *(continued)*		**Group C2** *(continued)*			
4.25.1.8 Extended endurance	Duration extended to 8 000 h once a year Examination at 4 000 h (for information only) Resistance			0	(12)	(20)	0	 As in Table 7a
			Group 7		**Group C3**			
4.18 Resistance to soldering heat (For stability class …)	As in 4.18.2 c): Solder bath method, see 1.8.2 a) (260 ± 5) °C, (10 ± 1) s Visual examination Resistance	D	20	0	3	20	0	 As in 4.18.3 As Table 7a
4.18 Resistance to soldering heat (Only for Version A, stability class …)	As in 4.18.2 c): Solder reflow method, see 1.8.2 b) or c) Visual examination Resistance							 As in 4.18.3 As Table 7a
4.35 Flammability	As in EN 60695-11-5 Duration: 10 s		(5 of the sample)		36	(5 of the sample)		Burning time: max. 30 s
			Group 8		**Group D1**			
4.8 Variation of resistance with temperature	Mounting: see EN 140400:2003, 2.3.3 or unmounted 20 °C / LCT / 20 °C / UCT / 20 °C Resistance	D	20	0	12	20	0	 As in Table 4

Table A.2 ± Test schedule for qualification approval and quality conformance inspection, periodic tests, assessment level EZ *(continued)*

Tests [a]	Conditions of test	D or ND[b]	Qualification Approval		Quality Conformance Inspection			Performance requirements [a]
					Periodic tests			
			n[b]	c[b]	P[b]	n[b]	c[b]	
			Group 9		**Group D2**			
4.24 Damp heat, steady state	Mounting: see EN 140400:2003, 2.3.3 or unmounted As in EN 60068-2-78, Test Cab: Temperature: (40 ± 2) °C Relative humidity: (93 ± 3) % Duration: 56 days Visual examination Resistance Insulation resistance, V-block-method	D	20	0	12	20	0	As in 4.24.4 As in Table 7a $R \geq 100$ MΩ
			Group 10		**Group D3**			
4.4.3 Dimensions (detail)		D	20	0	36	20	0	As in Table 1
4.25.3 Endurance at upper category temperature	Mounting: see EN 140400:2003, 2.3.3 or unmounted Duration: 1 000 h Visual examination Resistance Insulation resistance, V-block-method							As in 4.25.3.7 As in Table 7a $R \geq 1$ GΩ
4.14 Temperature rise (Only for 0 Ω resistors and for resistors below the critical resistance)	Mounting: see EN 140400:2003, 2.3.3		(6 of the sample)			(6 of the sample)		As in Table 5

Table A.2 ± Test schedule for qualification approval and quality conformance inspection, periodic tests, assessment level EZ *(continued)*

Tests [a]		Conditions of test	D or ND[b]	Qualification Approval		Quality Conformance Inspection			Performance requirements [a]
						Periodic tests			
				n[b]	c[b]	P[b]	n[b]	c[b]	
				Group 11		**Group E1**			
4.40	Electrostatic discharge	Mounting: see EN 140400:2003, 2.3.3 or unmounted Human body model (HBM) as in EN 61340-3-1: 3 positive and 3 negative discharges Style: … / Voltage: … V Visual examination Resistance	D	20	0	12	20	0	As in 4.27.3.7.1 As in Table 7b
4.29	Component solvent resistance	Mounting: see EN 140400:2003, 2.3.3 or unmounted Solvent: Ethanol Temperature: 50 °C Method 2 Visual examination		(half of the sample)			(half of the sample)		As in 4.4.1
4.30	Solvent resistance of marking (marked resistors only)	Mounting: see EN 140400:2003, 2.3.3 or unmounted Solvent: Ethanol Temperature: 50 °C Method 1, tooth brush Visual examination		(the other half of the sample)			(the other half of the sample)		As in 4.4.1

Table A.2 ± Test schedule for qualification approval and quality conformance inspection, periodic tests, assessment level EZ *(continued)*

Tests [a]		Conditions of test	D or ND[b]	Qualification Approval		Quality Conformance Inspection			Performance requirements [a]
						Periodic tests			
				n[b]	c[b]	P[b]	n[b]	c[b]	
				Group 12					
4.22	Vibration	Mounting: see EN 140400:2003, 2.3.3 As in EN 60068-2-6:1995, 8.2.1: Mounting of the specimen in such a way that they are not exposed to resonances. Frequency range: 10 Hz to 2 000 Hz ; Amplitude: 1,5 mm or 200 m/s², whichever is the less severe; 10 sweep cycles in each axis Visual examination Resistance	D	20	0				As in 4.22.4 As in Table 7a
4.37	Periodic electric overload	Mounting: see EN 140400:2003, 2.3.3 or unmounted Voltage: $U = \sqrt{15 \cdot P_{70} \cdot R}$ or $U = 2 \cdot U_{max}$, whichever is the less severe; 0,1 s on and 2,5 s off; 1 000 cycles Visual examination Resistance							As in 4.37.4 As in Table 7b
				Group 13		**Group F**			
4.19	Rapid change of temperature	Mounting: see EN 140400:2003, 2.3.3 or unmounted ϑ_A = LCT, ϑ_B = UCT (see Table 6) Style / Cycles: … / …; … / … Visual examination Resistance	D	20	0	36	20	0	As in 4.19.3 As in Table 7b

Table A.2 ± Test schedule for qualification approval and quality conformance inspection, periodic tests, assessment level EZ *(continued)*

Tests [a]		Conditions of test	D or ND[b]	Qualification Approval		Quality Conformance Inspection			Performance requirements [a]
						Periodic tests			
				n^b	c^b	P^b	n^b	c^b	
				Group 14		**Group G**			
4.27	Single pulse high voltage overload test	Mounting: see EN 140400:2003, 2.3.3 or unmounted	D	20	0	12	20	0	
		Severity No. … (10/700)							
		Visual examination Resistance							As in 4.27.3.7.1 As in Table 7b

[a] Clause numbers in this column refer to EN 60115-1:2001 + A1:2001 + A11:2007.
[b] For list of abbreviations refer to B.2.
[c] First figure is sample size for Version A; second figure is sample size for Version E.

Annex B
(informative)

Letter symbols and abbreviations

B.1 Letter symbols

A_1	Current noise index for one frequency decade, geometrically centred at 1 000 Hz	µV/V
A_3	Attenuation of the third harmonic (Ratio of the fundamental voltage over the e.m.f. of the third harmonic generated in a resistor)	dB
I_{max}	Maximum permissible current	A
M	Drift factor	—
P	Actual dissipation	W
P_{70}	Rated dissipation at 70 °C ambient temperature	W
P_ϑ	Permissible dissipation at ambient temperature ϑ, derated above 70 °C	W
$\overline{P}$	Average pulse load	W
$P_{i,\,max}$	Permitted pulse power depending on pulse duration t_i	W
$P_{i,\,peak}$	Peak pulse power	W
R	Resistance	Ω
R_{ins}	Insulation resistance	Ω
R_n	Nominal resistance	Ω
$R_{res\,max}$	Maximum permissible residual resistance	Ω
ΔR	Change of resistance	Ω
$\Delta R/R$	Relative change of resistance (Resistance change related to prior resistance)	%
ϑ_a	Ambient temperature	°C
ϑ_A	Low temperature of a change of temperature test	°C
ϑ_B	High temperature of a change of temperature test	°C
ϑ_s	Surface temperature	°C
t_a	Duration of application of test flame	s
t_b	Duration of burning after removal of test flame	s
t_i	Pulse duration	s
t_p	Pulse period	s
T_r	Temperature rise	K
τ_e	Time constant	s
U_{ins}	Insulation voltage	V
$U_{i,\,max}$	Permitted pulse voltage depending on pulse duration t_i	V
$U_{i,\,peak}$	Peak pulse voltage	V
U_{max}	Limiting element voltage, maximum permissible voltage	V
U_r	Rated voltage, $U_r = \sqrt{P_{70} \cdot R}$	V

B.2 Abbreviations

C	Group acceptance criteria (permitted number of non-conformities per group)
CoC	Certificate of Conformity
D	Destructive
DMR	Designated management representative (Quality system manager)
ESD	Electrostatic discharge
HBM	Human body model, representation of the capacitance and resistance of a human body for ESD testing
IL	Inspection level
LCT	Lower category temperature
n	Sample size
ND	Non-destructive
NSI	National supervising inspectorate
ONS	Organisme National de Surveillance, National supervising inspectorate
P	Periodicity, given in months
TA	Technology approval
TAS	Technology approval schedule
TADD	Technology approval declaration document
TCR	Temperature coefficient of resistance
UCT	Upper category temperature

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