BS EN 140402-801:2015

BSI Standards Publication

Detail specification: Fixed low power wirewound surface mount (SMD) resistors — Rectangular — Stability classes 0,5; 1; 2

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National foreword

This British Standard is the UK implementation of EN 140402-801:2015. It supersedes BS EN 140402-801:2005 which is withdrawn.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.

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Contents

Foreword

This document (EN 140402-801:2015) has been prepared by CLC/TC 40XB "Resistors".

The following dates are fixed:

• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2015-12-15
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	2017-12-15

This European Standard supersedes EN 140402-801:2005.

Preceding document on the subject covered by this specification has been:

– CECC 40 402-801:2000-02.

EN 140402-801:2015 includes the following significant technical changes with respect to EN 140402-801:2005:

– adoption of P_{70} as the rated dissipation, leaving the prior used P_{25} as an additional information;

– for style RW1607M, increase of P_{70} to 2,4 W, with P_{25} = 3,0 W;

– introduction of a test on the resistance to electrostatic discharge (ESD) in 1.7 and Annex A;

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

– revision of ordering information in 1.10.4;

– adoption of the IECQ rules of procedure according to QC 001002-3:2005;

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

– editorial revision.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

This specification is part of a series of documents describing fixed low power wire wound surface mount (SMD) resistors as follows:

– EN 60115-1, *Fixed resistors for use in electronic equipment — Part 1: Generic specification (IEC 60115-1, modified)*

– EN 60115-8, *Fixed resistors for use in electronic equipment — Part 8: Sectional specification — Fixed surface mount resistors (IEC 60116-8, modified)*

– This detail specification.

Any detail specification within this series is written on the basis of

– EN 140402, *Blank Detail Specification: Fixed low power wirewound surface mount (SMD) resistors*.

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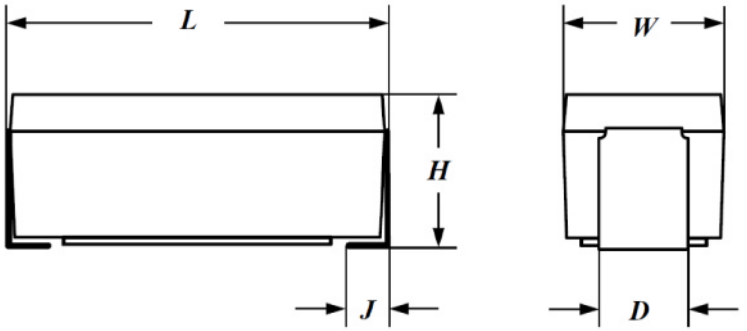
Specification available from CENELEC Central Secretariat, Avenue Marnix 17, B – 1000 Brussels, or from the National Committees members of CENELEC	**EN 140402-801**
Electronic components of assessed quality in accordance with: EN 60115-1:2011 EN 60115-8:2012 EN 140402:2015	**Issue 2** April 2015
 Other shapes are permitted within the given dimensions. **Figure 1 — Outline and dimensions (see Table 1)**	Fixed low power wire wound resistors with rectangular base for surface mounting. Style: RW Wire wound, insulated resistor with end terminations for application on printed board and flexible foils. Assessment level EZ [a] Level P: with 100 %-test Level R: with failure rate level and 100 %-test Stability classes 0,5; 1 and 2
[a] See 2.1.1 for an explanation on the assessment level EZ.	

1 Characteristics and ratings

1.1 General

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

1.2 Dimensions and ratings

The shape and dimensions of the resistors covered by this specification are shown in Figure 1, with the specific styles and their respective dimensions given in Table 1. Other shapes are permissible within the given dimensions.

Table 1 — Style and dimensions

Style [a]		Length L		Width W		Height H		Termination width D		Termination seating length J		Mass [b]
		mm		mm		mm		mm		mm		mg
metric	inch [b]	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	max.
RW0503M	RW2012	4,6	5,6	2,0	3,6	2,0	3,6	1,0	2,0	0,7	1,4	120
RW0704M	RW2515	5,7	8,0	3,0	4,5	2,4	4,5	1,0	3,0	0,8	1,6	250
RW1107M	RW4527	9,8	12,5	5,5	7,5	3,9	6,0	1,8	5,6	1,4	2,8	1 000
RW1607M	RW6927	14,5	19,0	5,5	7,5	5,5	7,5	3,0	5,8	1,4	2,8	2 000

[a] The given styles correspond to the historical styles of the prior CECC 40 402-801 as follows:

Style	Historic style
RW0704M	RW1
RW1107M	RW2
RW1607M	RW3

[b] For information only.

NOTE 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 2 — Ratings

Style	Rated dissipation P_{70} W	Maximum dissipation [a] P_{25} W	Limiting element voltage d.c. or a.c. (r.m.s.) [b] U_{max} V	Insulation voltage d.c. or a.c. (peak) U_{ins} V	
				1 min	continuous
RW0503M	0,6	0,75	28	500	75
RW0704M	0,8	1,0	50	500	75
RW1107M	1,6	2,0	112	500	75
RW1607M	2,4	3,0	200	500	75

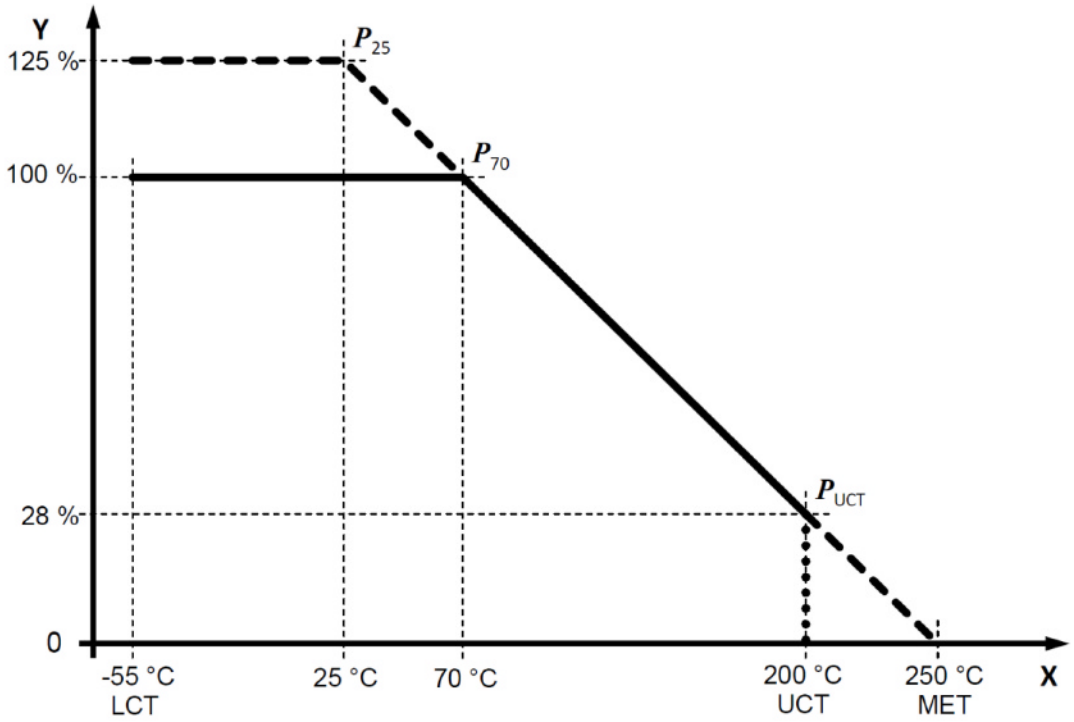
[a] For information only.

[b] For all resistance ranges given in Tables 3 and 4, the applicable voltage is determined by the rated or maximum dissipation and not limited by the limiting element voltage.

1.3 Derating curve

The permissible dissipation of resistors covered by this detail specification is the rated dissipation as given in Table 2, which is derated for an ambient temperature above the rated temperature 70 °C according to the diagram in Figure 2.

The manufacturer of the resistors covered by this detail specification may uprate the products by specification of an increased dissipation up to the maximum dissipation given in Table 2, which is derated for an ambient temperature above the reference temperature of 25 °C according to the diagram in Figure 2. The manufacturer shall support such uprating with respective test results.



Key

X ambient temperature ϑ_{amb}

Y fraction of the rated dissipation P_{70}

Figure 2 — Derating curve

NOTE Climatic tests and the assessment of the temperature coefficient of resistance apply the upper category temperature, UCT, as the highest temperature, whereas the loads applied under endurance testing aim to subject the resistive element to the maximum element temperature, MET.

The use of the full specified dissipation and temperature range results in a high temperature on the substrate (PCB) and in the solder joints. It may hence be required to select suitable substrate material and suitable solder material in order to maintain the reliability of the assembly.

1.4 Resistance range and tolerance on rated resistance

1.4.1 Level P

NOTE Product classification to Level P adopts and succeeds the former Version A as used in prior revisions of this detail specification.

Table 3 gives the combinations of temperature coefficient, tolerance on resistance and resistance range which may be approved to Level P according to this detail specification. The respective E Series are specified as a recommendation only for Level P.

Products from the extent given in Table 3 shall be used for the initial product qualification approval to Level P according to 2.2.2, and for the quality conformance inspection according to 2.3.

The qualification of resistances below or above the specified resistance ranges is permissible if they fulfil the requirements of the stability class prescribed for the closest resistance within a specified range; e.g. resistors of Style RW0704M, 1 %, > 2,43 kΩ shall fulfil the requirements of stability class 1.

Table 3 — Resistance range and tolerance on rated resistance for Level P

Style	Tolerance on rated resistance		Temperature coefficient [a]		Resistance range	Stability class	E Series [c]
	%	Code [b]	10^{-6}/K	Code [b]			
RW0503M	± 5	J	See Table 5.		0,047 Ω to 1 kΩ	2	E24
	± 1	F			0,1 Ω to 1 kΩ	1	E96
	± 0,5	D			0,1 Ω to 1 kΩ	0,5	E192
RW0704M	± 5	J			0,047 Ω to 2,4 kΩ	2	E24
	± 1	F			0,1 Ω to 2,43 kΩ	1	E96
	± 0,5	D			0,1 Ω to 2,43 kΩ	0,5	E192
RW1107M	± 5	J			0,047 Ω to 5,6 kΩ	2	E24
	± 1	F			0,1 Ω to 5,62 kΩ	1	E96
	± 0,5	D			0,1 Ω to 5,62 kΩ	0,5	E192
RW1607M	± 5	J			0,047 Ω to 13 kΩ	2	E24
	± 1	F			0,1 Ω to 13 kΩ	1	E96
	± 0,5	D			0,1 Ω to 13 kΩ	0,5	E192

[a] The waivers given in EN 60115-1:2011, 4.8.5 concerning the measurement of the temperature coefficient at resistors below 10 Ω and below 5 Ω shall not apply for this specification. A suitable test method shall be applied in order to ensure the required measurement accuracy.

[b] Code letters according to EN 60062.

[c] E Series according to IEC 60063.

The range of resistors approved in each style, together with the associated temperature coefficient and tolerance, shall be given in the register of approvals, as available for example on the website http://www.iecq.org.

1.4.2 Level R

NOTE Product classification to Level R adopts and succeeds the former Version E as used in prior revisions of this detail specification.

Table 4 gives the combinations of temperature coefficient, tolerance on resistance, resistance range and mandatory E Series which may be approved to Level R according to this detail specification.

Products from the extent given in Table 4 shall be used for the initial product qualification approval to Level P according to 2.2.3, and for the quality conformance inspection according to 2.3.

Table 4 — Resistance range and tolerance on rated resistance for Level R

Style	Tolerance on rated resistance		Temperature coefficient [a]		Resistance range	Stability class	E Series [c]
	%	Code [b]	10^{-6}/K	Code [b]			
RW0503M	± 5	J	See Table 5		0,47 Ω to 510 Ω	2	E24
	± 0,5	D			0,464 Ω to 511 Ω	0,5	E96
RW0704M	± 5	J			0,47 Ω to 1,2 kΩ	2	E24
	± 0,5	D			0,475 Ω to 1,21 kΩ	0,5	E96
RW1107M	± 5	J			0,47 Ω to 3,0 kΩ	2	E24
	± 0,5	D			0,475 Ω to 3,01 kΩ	0,5	E96
RW1607M	± 5	J			0,47 Ω to 6,8 kΩ	2	E24
	± 0,5	D			0,475 Ω to 6,81 kΩ	0,5	E96

[a] The waivers given in EN 60115-1:2011, 4.8.5 concerning the measurement of the temperature coefficient at resistors below 10 Ω and below 5 Ω shall not apply for this specification. A suitable test method shall be applied in order to ensure the required measurement accuracy.

[b] Code letters according to EN 60062.

[c] E Series according to IEC 60063.

The range of resistors approved in each style, together with the associated temperature coefficient and tolerance, shall be given in the register of approvals, as available for example on the website http://www.iecq.org.

1.5 Variation of resistance with temperature and temperature rise

The permissible limits for the reversible change of resistance at variation of resistance with temperature tests are given in Table 5 for the category temperatures applied in this detail specification.

Table 5 — Temperature coefficients and permissible change of resistance

Temperature coefficient			Resistance range	Limit of resistance change $\Delta R/R$ [d] %	
				Lower TCR	Upper TCR
	Code [b]	Code [c]		LCT / Reference temperature	Reference temperature / UCT
10^{-6}/K [a]			Ω	-55 °C / 20 °C	20 °C / 200 °C
± 250	U	A	R < 0,47	± 1,875	± 4,5
± 100	S	B	0,47 ≤ R < 1	± 0,75	± 1,8
± 50	R	C	1 ≤ R ≤ 10	± 0,375	± 0,9
± 25	Q	D	R > 10	± 0,188	± 0,45

[a] The unit 10^{-6}/K is traditionally referred to as ppm/K.

[b] Code letters according to EN 60062.

[c] Historical code letters according to EN 140400, for information only.

[d] The waivers given in EN 60115-1:2011, 4.8.5 concerning the measurement of the temperature coefficient at resistors below 10 Ω and below 5 Ω shall not apply for this specification. A suitable test method shall be applied in order to ensure the required measurement accuracy.

The permissible temperature rise $(\Delta\vartheta)_{max}$ for the temperature rise test according to EN 60115-1:2011, 4.14 is given in Table 6.

Table 6 — Limit of temperature rise

Stability class	Limit of temperature rise at rated dissipation
0,5; 1; 2	$\Delta\vartheta \leq$ 180 K

The thermal resistance is calculated to $R_{th} = (\Delta\vartheta)_{max} / P_{70}$.

1.6 Climatic categories

The climatic categories applied in this detail specification are given in Table 7.

Table 7 — Climatic categories

Stability class	Climatic category LCT / UCT / Duration
0,5; 1; 2	55 / 200 / 56

The upper category temperature (UCT), which is used for a number of test procedures, is lower than the maximum element temperature (MET), which may be observed in application conditions.

1.7 Limits for change of resistance at tests

The permissible limits for the change of resistance at tests are given in Table 8 for the stability classes applied in this detail specification.

Table 8 — Limits for change of resistance at tests

Stability class	Limit of resistance change ΔR Ω					
	Long term tests			Short term tests	Advanced stress tests	
	EN 60115-1:2011, 4.23 Climatic sequence 4.24 Damp heat, steady state 4.25.3 Endurance at a maximum temperature	EN 60115-1:2011, 4.25.1 Endurance at the rated temperature 70 °C [a] or 4.25.2 Endurance at room temperature 1 000 h	Extended, 8 000 h	EN 60115-1:2011, 4.13 Short time overload 4.18 Resistance to soldering heat 4.19 Rapid change of temperature, 5 cycles 4.21 Shock 4.22 Vibration 4.33 Substrate bending test	EN 60115-1:2011, 4.19 Rapid change of temperature, 100 cycles 4.27 Single-pulse high-voltage overload test [b] 4.38 Electrostatic discharge [c]	EN 60115-1:2011, 4.39 Periodic-pulse overload test
2	± (2 % R + 5 mΩ) [d]	± (2 % R + 5 mΩ) [d]	± (5 % R + 5 mΩ) [d]	± (0,5 % R+ 2 mΩ) [d]	± (1 % R + 2 mΩ) [d]	± (2 % R + 5 mΩ) [d]
1	± (1 % R + 2 mΩ) [d]	± (1 % R + 2 mΩ) [d]	± (2 % R + 2 mΩ) [d]	± (0,25 % R+ 2 mΩ) [d]	± (0,5 % R+ 2 mΩ) [d]	± (1 % R + 2 mΩ) [d]
0,5	± (0,5 % R + 2 mΩ) [d]	± (0,5 % R + 2 mΩ) [d]	± (1 % R + 2 mΩ) [d]	± (0,1 % R + 1m Ω) [d]		

[a] Testing endurance at the rated temperature 70 °C is mandatory for Level R.

[b] This test shall be applied to resistors of 10 Ω or above.

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

[d] Tightening of the general definition of stability classes against the requirements of EN 60115-8:2012, 2.1.4.

1.8 Non-linearity

No Provisions

NOTE Measurement of non-linearity is generally not considered as a meaningful or significant test for wirewound resistors.

1.9 Tests related to soldering

1.9.1 Severities for solderability testing

See EN 60115-8:2012, 2.3.2.

1.9.2 Severities for testing resistance to soldering heat

See EN 60115-8:2012, 2.3.3.

The solder bath method represents the soldering stress of all wave soldering and reflow soldering methods.

1.10 Marking, packaging and ordering designation

1.10.1 Marking of the component

SMD wirewound resistors are generally marked on the body. If some marking is applied to the body of resistors classified to Level P, the component shall be marked with the rated resistance using a letter and digit code according to EN 60062:2005, Clause 4, preferably the RKMG code system according to EN 60062:2005, 4.2.1. If possible, the tolerance shall be marked using the letter code of EN 60062:2005, 5.1.

Resistor classified to Level R shall be marked with the rated resistance using the RKMG code system according to EN 60062:2005, 4.2.1, and with the tolerance using the letter code of EN 60062:2005, 5.1.

Marking of the temperature coefficient and of any other item from the list given in EN 60115-1:2011, 2.4.1 shall be the choice of the manufacturer.

1.10.2 Packaging

Components shall be taped according to EN 60286-3, type 2a.

1.10.3 Marking of the packaging

The packaging of the component shall be marked with ordering information in accordance to 1.10.4 and additionally with

– CECC or IECQ sign of conformity,
– CECC or IECQ manufacturer code,
– NATO manufacturer code (only Level R),
– date code of manufacture according to EN 60062.

Additional information is permissible.

1.10.4 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 Level R; “E0” for Level P);
– form of delivery (in addition to the ordering information given in the schematic below).

Schematic of the ordering information for resistors covered by this specification:

Level P: EN140402–801EZRW1607MQ4K75FE0

Level R (with failure rate level): EN140402–801EZRW1607MQ4K75FE5

NOTE 1 Level P succeeds the former Version A, and Level R succeeds the former Version E.

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

EN140402–801	Detail specification number
EZ	Assessment level
RW1607M	Style (see Table 1)
Q	Temperature coefficient according to EN 60062 (see Table 5)
4K75	Resistance value, RKMG code system according to EN 60062, 4 characters
F	Tolerance on rated resistance (see Table 3 or Table 4)
E0; E5	Failure rate level according to EN 60115-1:2011, Table ZR.1

NOTE 2 The specific values for style, temperature coefficient, resistance, tolerance and failure rate level applied above have been used to exemplify the schematic and hence need to be replaced by the user’s relevant choices.

The ordering information used for electronic order processing shall not contain any spaces.

1.11 Additional information (not for inspection purpose)

1.11.1 Storage

The permitted storage time is 20 years under the conditions of EN 60115-1:2011, 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.

1.11.2 Mounting

The resistors are suitable for mounting on alumina substrates, common printed boards and flexible foils.

Temperatures next to the resistor resulting from use of the full specified dissipation and temperature range may exceed the specification limits of the substrate material and thus are likely to affect the reliability of the assembly. It may hence be required to select a suitable substrate material in order to maintain the reliability of the assembly.

1.11.3 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.

Temperatures in the solder joints resulting from use of the full specified dissipation and temperature range may exceed the specification limits of the above solder materials and thus are likely to affect the reliability of the assembly. It may hence be required to select a suitable solder material, e.g. a PbSn alloy

with a higher melting point, in order to maintain the reliability of the assembly. However, solderability to PbSn alloys and resistance to the increased level of soldering heat required for such solder is not subject to any test prescribed within this specification.

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.

1.11.4 Conductive gluing

No provisions.

1.11.5 Use of cleaning solvents

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

– alcohol, such as ethanol, propanol, isopropanol (IPA) 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.

1.11.6 Pulse load capability

1.11.6.1 General

The pulse load capability defines the ability of a resistor to withstand short overloads within the provided working period. The pulse load capability is limited by the maximum pulse dissipation $\hat{P}_{\text{max}}$ and the maximum pulse voltage $\hat{U}_{\text{max}}$ both depending on a given pulse duration t_{p} and possibly also on the actual resistance R for which the pulse load capability is examined. The following conditions shall be considered.

1.11.6.2 Average pulse dissipation

The average pulse dissipation $\overline{P}$ of any group or sequence of pulses shall not exceed the rated dissipation P_{70}, or the derated permissible dissipation P_{ϑ} for an ambient temperature above 70 °C according to the derating diagram of Figure 2. For resistances above the critical resistance the rated dissipation is determined by the resistance and the limiting element voltage U_{max}.

The average pulse dissipation is calculated to

$$\overline{P} = \frac{1}{T_{\text{p}} \cdot R} \int_{t_1}^{t_2} u^2(t)\,\mathrm{d}t$$

where
$\overline{P}$ is the average dissipation induced by the pulses
$u(t)$ is the function of the pulse voltage over time
T_{P} is the repetition period of the pulses
R is the resistance

NOTE All resistance ranges given in Tables 3 and 4 of this specification are below the respective critical resistance.

a) Rectangular pulses

For rectangular pulses as illustrated in Figure 3, the average dissipation due to pulse load is calculated to:

$$\overline{P} = \frac{1}{T_p \cdot R} \cdot \hat{U}^2 \cdot t_p$$

where
$\overline{P}$ is the average dissipation induced by the pulses
$\hat{U}$ is the peak pulse voltage
t_P is the duration of the rectangular pulses, $t_P = t_2 - t_1$
T_P is the repetition period of the pulses
R is the resistance

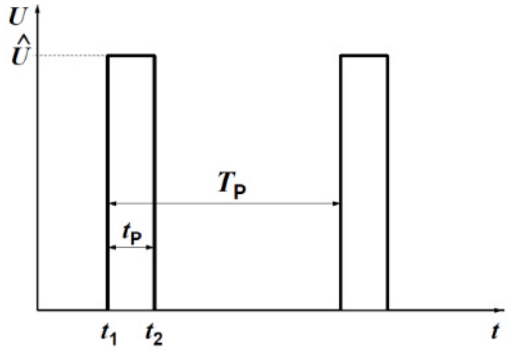


Figure 3 — Pulse parameters for rectangular pulses

b) Exponential pulses

For exponential pulses as illustrated in Figure 4, the average dissipation due to pulse load is calculated to:

$$\overline{P} = \frac{1}{T_p \cdot R} \cdot \hat{U}^2 \cdot \frac{\tau_p}{2}$$

where
$\overline{P}$ is the average dissipation induced by the pulses
$\hat{U}$ is the peak pulse voltage
τ_P is the time constant of the exponential pulse
T_P is the repetition period of the pulses
R is the resistance

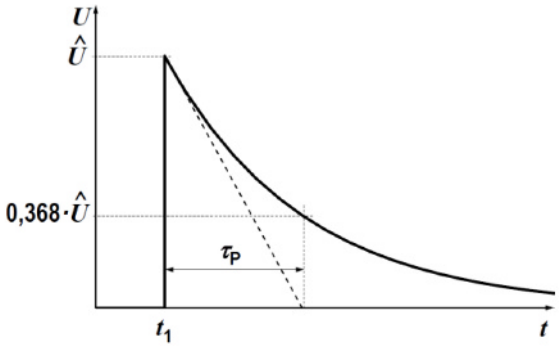


Figure 4 — Pulse parameters for exponential pulses

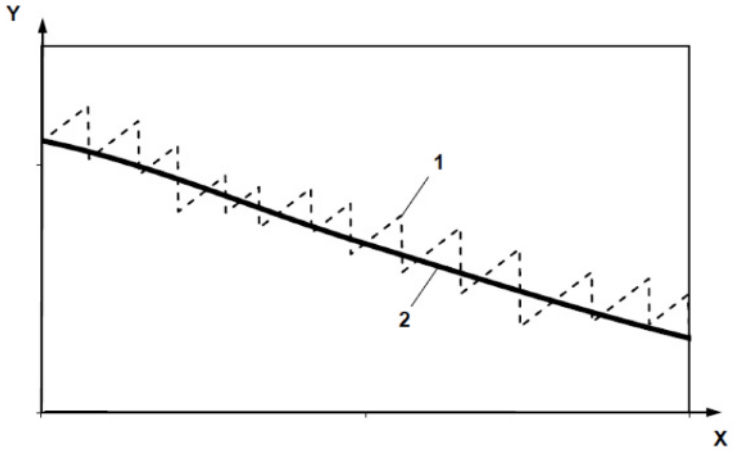
c) Other pulse shapes

Other pulse shape should be converted into a rectangular pulse having the same energy at given peak voltage.

1.11.6.3 Energy capability

The pulse load capability of wirewound resistors for short pulse durations is predominantly determined by the amount of thermal energy, which can be absorbed by the wound wire, hence by the thermal capacity of the wire and by the maximum acceptable temperature of its alloy and of any adjacent material. The thermal capacity of the wire depends on its diameter and length, parameters which also determine the resistance of the wirewound resistor.

At the manufacturing of SMD wirewound resistors, it will not be feasible to utilize a different dedicated wire for each offered resistance value. Instead, a limited variety of wires will probably be used to cover a range of resistance with each one of them. Then within every such range, the used wire length und hence also the pulse energy capability linearly rises with resistance. Beyond such range the next thinner wire will be used, resulting in a drop of the used wire length und hence also of the pulse energy capability. Figure 5 illustrates this with data from real series or wirewound resistors.



Key

X	resistance R
Y	permissible pulse energy E
1	factual example of the pulse energy capability of a real wirewound resistor
2	averaged curve of the pulse energy capability

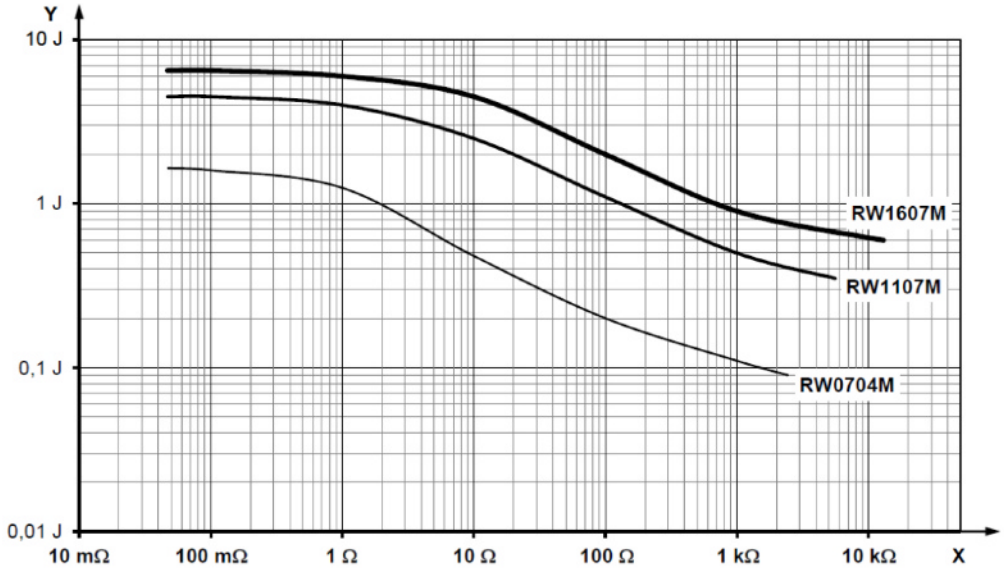
Figure 5 — Factual example and averaged curve of pulse energy capability

This saw tooth relationship between resistance and pulse energy capability is too sophisticated to allow a generalized discussion of the pulse load capability or SMD wirewound resistors. Furthermore, the relationship is solely at the discretion of the resistor manufacturer and therefore cannot be predicted or prescribed by this detail specification.

For the purpose of a generalized discussion of the pulse load capability or SMD wirewound resistors, an averaged pulse energy capability will be used, as indicated in Figure 5. Figure 6 provides averaged pulse energy graphs based on the properties of real products as covered by this specification. These data are used for the further considerations.

NOTE Pulse capability data for style RW0503M were not available until the editorial deadline of this detail specification.

The users of these components are reminded of the fact that the capability data shown in this clause are only general estimates, whereas true data for an individual product are only available from the component’s manufacturer.



Key
X resistance R
Y permissible pulse energy E

Figure 6 — Average pulse energy capability

The deduction of the pulse load capability of wirewound resistors from the energy storage capability of the wound wire provides the following basic relationships for the permissible pulse peak dissipation and pulse peak voltage

$$\hat{P} = \frac{E(R)}{t_P}, \text{ and}$$

$$\hat{U} = \sqrt{\frac{R \cdot E(R)}{t_P}}$$

where
$\hat{P}$ is the permissible pulse peak dissipation
$\hat{U}$ is the permissible pulse peak voltage
$E(R)$ is the permissible pulse energy, depending on the resistance
R is the resistance
t_P is the duration of a rectangular pulse

These relationships however do not reflect the persisting limitation of the voltage applicable in short pulses to a multiple of the rated voltage U_r, and finally to a multiple of the limiting element voltage U_{max} as given in Table 2. The relationships with the limiting factors applied as prescribed for the short time overload test of EN 60115-8:2012, 2.3.1 are as follows:

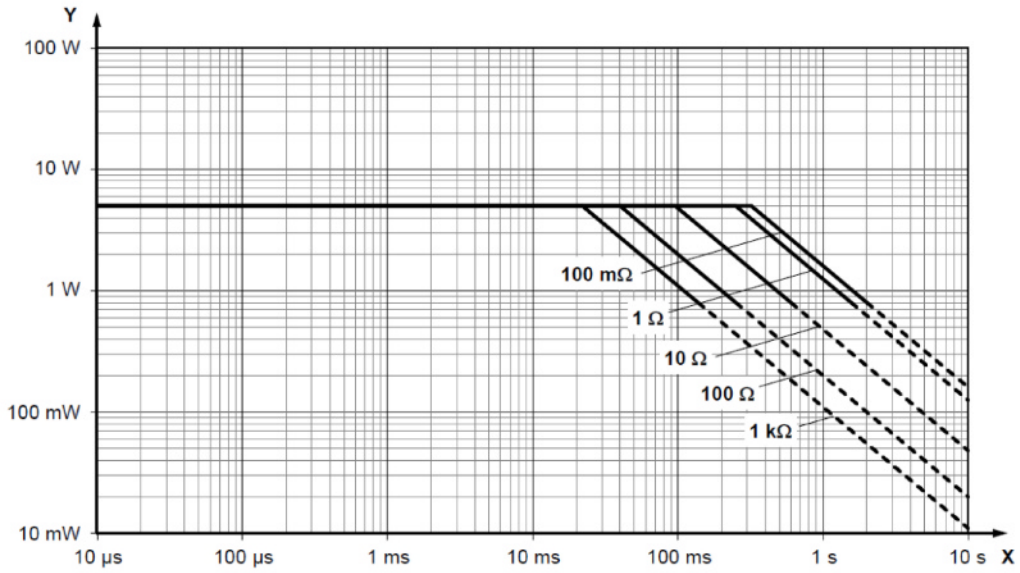
$$\hat{U}_{max} = 2{,}5 \cdot U_r, \text{ or}$$

$$\hat{U}_{max} = 2 \cdot U_{max}, \text{ whichever is lower}$$

where
$\hat{U}_{max}$ is the maximum permissible pulse peak voltage
U_r is the rated voltage, $U_r = \sqrt{P_{70} \cdot R}$
U_{max} is the maximum element voltage.

This limitation of the applicable pulse peak voltage results in a limitation of the applicable pulse peak dissipation, as shown in the following diagrams.

For SMD wirewound resistors of Style RW0704M and based on the averaged pulse energy capability for resistors of that style as shown in Figure 6, the permissible pulse peak dissipation for a set of representative resistances is shown in Figure 7, and respectively the permissible pulse peak voltage is shown in Figure 8.



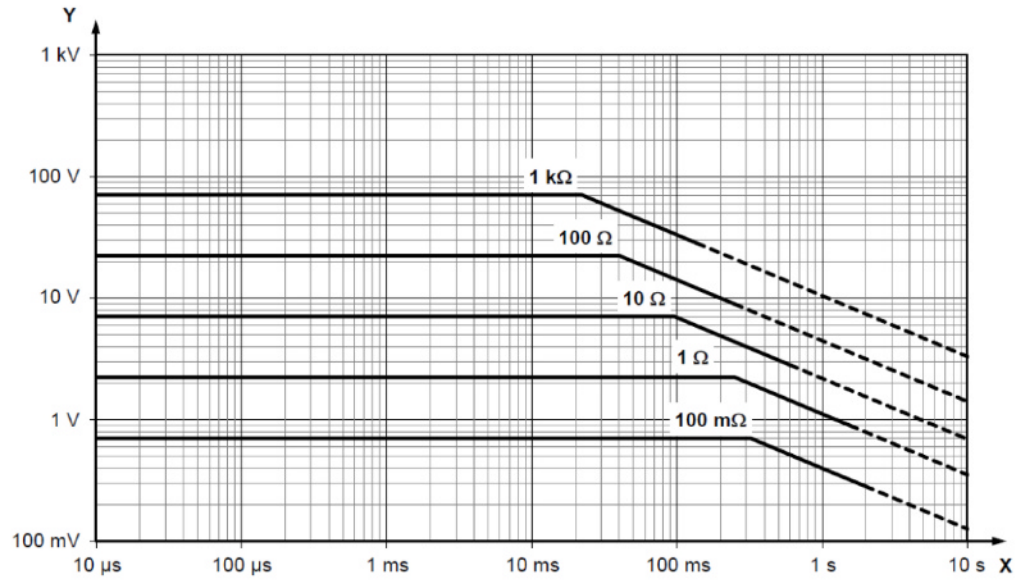
Key

X duration of a rectangular pulse t_P

Y permissible pulse peak dissipation $\hat{P}_{max}$

▪▪▪▪▪ The applicability of this limitation is subject to the derating given in Figure 2.

Figure 7 — Pulse peak dissipation permissible for RW0704M



Key

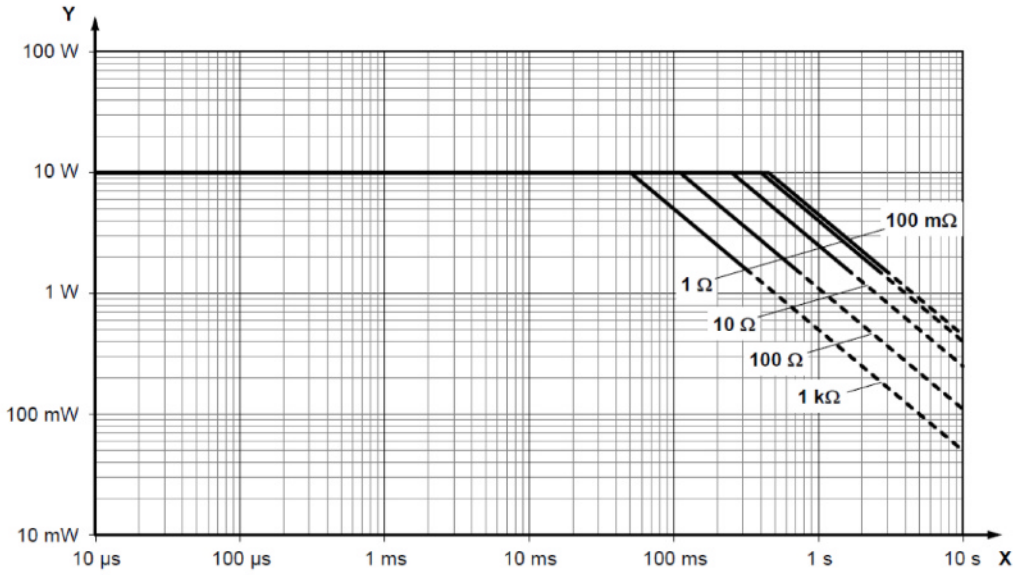
X duration of a rectangular pulse t_P

Y permissible pulse peak voltage $\hat{U}_{max}$

▪▪▪▪▪ The applicability of this limitation is subject to the derating given in Figure 2.

Figure 8 — Pulse peak voltage permissible for RW0704M

For SMD wirewound resistors of Style RW1107M and based on the averaged pulse energy capability for resistors of that style as shown in Figure 6, the permissible pulse peak dissipation for a set of representative resistances is shown in Figure 9, and respectively the permissible pulse peak voltage is shown in Figure 10.



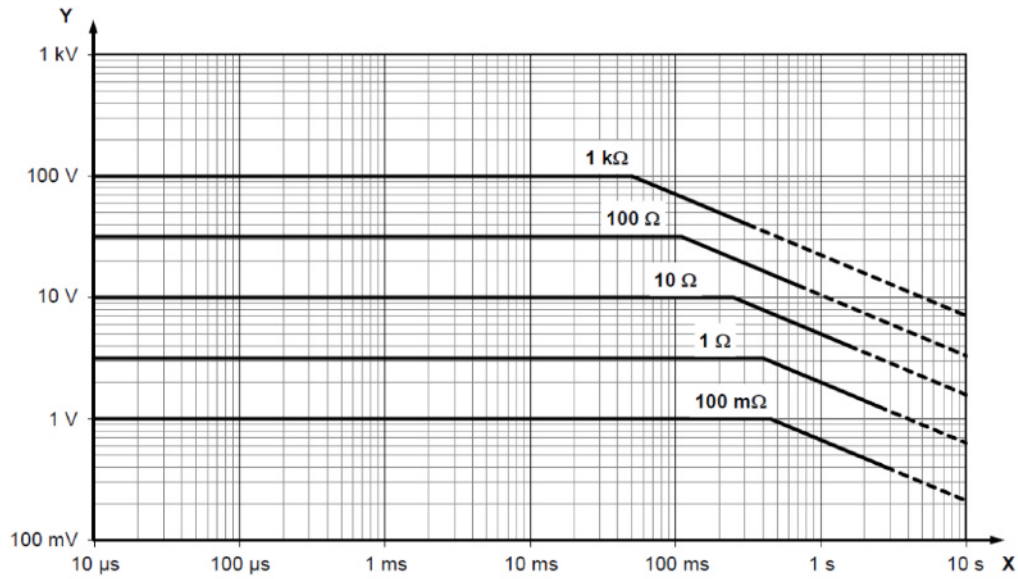
Key

X duration of a rectangular pulse t_P

Y permissible pulse peak dissipation $\hat{P}_{max}$

▪▪▪▪▪ The applicability of this limitation is subject to the derating given in Figure 2.

Figure 9 — Pulse peak dissipation permissible for RW1107M



Key

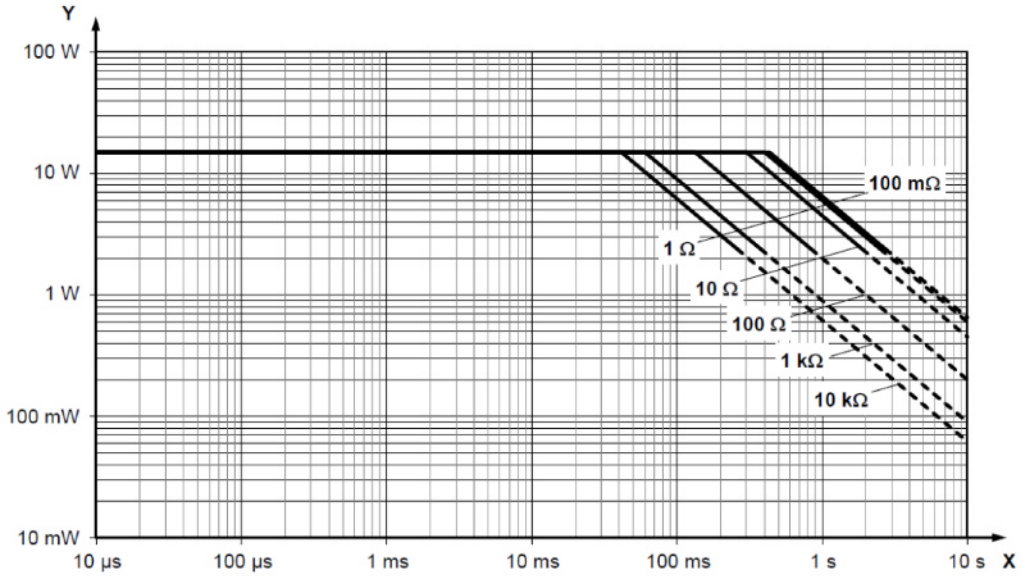
X duration of a rectangular pulse t_P

Y permissible pulse peak voltage $\hat{U}_{max}$

▪▪▪▪▪ The applicability of this limitation is subject to the derating given in Figure 2.

Figure 10 — Pulse peak voltage permissible for RW1107M

For SMD wirewound resistors of Style RW1607M and based on the averaged pulse energy capability for resistors of that style as shown in Figure 6, the permissible pulse peak dissipation for a set of representative resistances is shown in Figure 11, and respectively the permissible pulse peak voltage is shown in Figure 12.



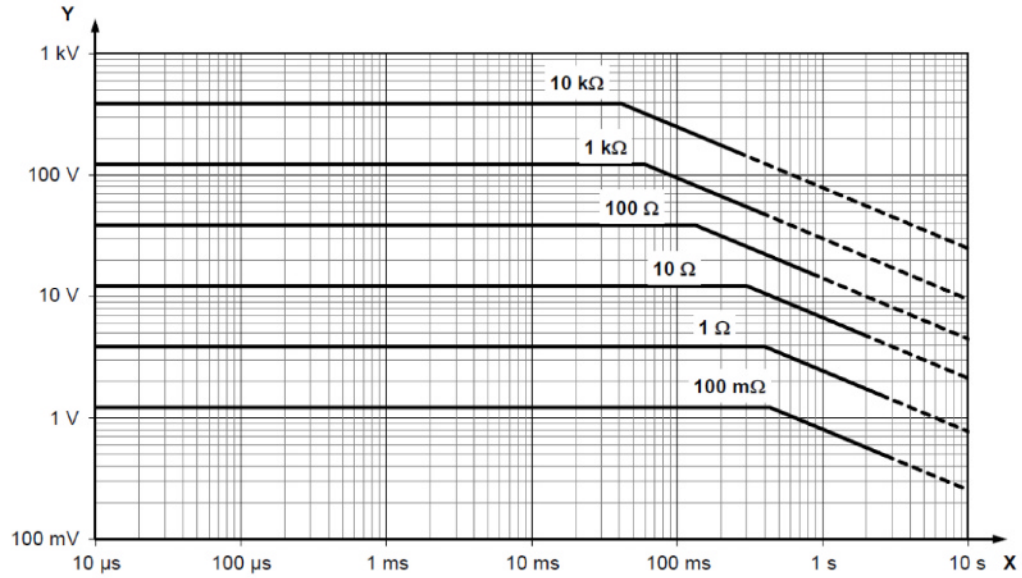
Key

X duration of a rectangular pulse t_P

Y permissible pulse peak dissipation $\hat{P}_{max}$

▪▪▪▪▪ The applicability of this limitation is subject to the derating given in Figure 2.

Figure 11 — Pulse peak dissipation permissible for RW1607M



Key

X duration of a rectangular pulse t_P

Y permissible pulse peak voltage $\hat{U}_{max}$

▪▪▪▪▪ The applicability of this limitation is subject to the derating given in Figure 2.

Figure 12 — Pulse peak voltage permissible for RW1607M

For longer pulse durations, e.g. above 0,1 s, the conduction of dissipated heat from the resistor to the circuit board and further to the ambient gains significance over the determination of pulse load capability by just the thermal energy storable in the wound wire.

The heat conduction through the circuit board however depends predominantly on the circuit board design and its surrounding conditions, none of which being subject of this detail specification. Therefore the user of components covered by this detail specification intending to apply any pulse load capability for longer pulse durations will need to consult the component manufacturer for relevant data, and to properly assess the thermal conditions of his intended assembly.

2 Quality assessment procedures

2.1 General

2.1.1 Zero defect approach

This specification fulfils the requirements of the zero defect approach. Assessment level EZ meets the requirements of the zero defect approach and aligns the assessment procedures and levels with the current industry practices, e.g. by setting the number of permitted non-conformities (acceptance number) to zero.

The sampling plans and inspection levels for assessment level EZ shall be selected from those given in EN 61193-2, except for those elements of the test schedule which are based on fixed sample sizes, irrespective of the size of the lot being inspected.

2.1.2 100 % Test

2.1.2.1 General

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

2.1.2.2 Resistance and tolerance

Resistance and tolerance on rated resistance shall be measured according to EN 60115-1:2011, 4.5.

This test shall be followed by re-inspection by sampling in order to monitor the outgoing quality level. The sampling level shall be established by the manufacturer, preferably according to EN 61193-2:2007, Annex A. All non-conforming units shall be counted for the assessment of a quality level.

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

2.1.2.3 Reduction of early-failure rate

The following screening method shall be applied in order to reduce the early-failure rate of the resistors covered by this specification:

– overload test according to the manufacturer’s specification; where the specification and limits are agreed by the IECQ Certification Body.

NOTE Measurement of non-linearity is generally not considered as a meaningful or significant test for wirewound resistors, hence also does not constitute a suitable means for a screening method.

2.1.3 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 assessment system (e.g. IECQ, successor of CECC).

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

2.1.4 Certified test records

Certified test records according to EN 60115-1:2011, Q.1.5 can be supplied if agreed between the customer and the manufacturer.

2.1.5 Failure rate level

Components qualified according to this detail specification, Level R, shall be delivered with a failure rate level:

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

Components qualified according to this detail specification, Level P, shall be delivered without a failure rate level:

Failure rate level = E0.

The procedure according to EN 60115-1:2011, Annex ZR 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

2.2.1 General

The fixed sample size procedure (see EN 60115-1:2011, Q.2) shall be used for the qualification approval. The qualification is to be performed according to Annex A.

2.2.2 Level P

NOTE Product classification to Level P adopts the former Version A as used in prior revisions of this specification.

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

2.2.3 Level R

NOTE Product classification to Level R adopts the former Version E as used in prior revisions of this specification.

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

2.3 Quality conformance inspection

2.3.1 General

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.

2.3.2 Qualification approval according to 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 60115-8:2012, 3.3.

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

If the manufacturer is certified according to a published 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 IECQ Certification Body (IECQ CB).

The manufacturer's TADD shall specify

- type and degree of non-conformity on which the IECQ CB 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 the Technology Approval Schedule, test results shall be continuously documented.

NOTE At the date of publication of this specification, there is no published Technology Approval Schedule known to cover the range of wirewound resistors.

2.3.4 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 wire wound SMD resistors

Table A.1 — Test schedule for qualification approval and quality conformance inspection, lot-by-lot tests, assessment level EZ (1 of 3)

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]	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 EN 60115-1:2011, 4.6.1.4,	ND	50	0			$R \geq 1$ GΩ
4.7	Voltage proof	See EN 60115-1:2011, 4.6.1.4 Voltage: $U = 1{,}42 \cdot U_{ins}$ Duration: 1 min				S-3	0	As in 4.7.3
4.13	Short time overload	See EN 60115-8:2012, 2.3.1; mounting: see Annex D, or unmounted. Voltage: $U = \sqrt{6{,}25 \cdot P_{70} \cdot R}$ or $U = 2 \cdot U_{max}$, whichever is the less severe Duration: 5 s for all styles Visual examination Resistance	D	(20 of the sample)				As in 4.13.3 As in Table 8

Table A.1 (2 of 3)

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		Group B2		
		D	40	0		0	
4.17. Solderability with SnPb solder	See EN 60115-8:2012, 2.3.2 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, > 95 % of the surface shall be covered by new solder
4.17. Solderability with lead-free solder	See EN 60115-8:2012, 2.3.2 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, > 95 % of the surface shall be covered by new solder

Table A.1 (3 of 3)

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 5		**Group B3**		
4.8 Variation of resistance with temperature	Mounting: see Annex D, or unmounted 20 °C / LCT / 20 °C / UCT / 20 °C Resistance	D	20	0			As in Table 5
4.8 Variation of resistance with temperature (applicable only to resistors with a temperature coefficient superior to $\pm$ 50 10^{-6}/K)	Mounting: see Annex D, or unmounted 20 °C / LCT / 20 °C / UCT / 20 °C Resistance	D			S-3	0	As in Table 5

[a] Clause numbers in this column refer to EN 60115-1:2011.

[b] Refer to B.1 for a list of letter symbols and to B.2 for a list abbreviations.

[c] First figure is sample size for Level P; second figure is sample size for Level R.

[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 (1 of 7)

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		Group C1			
		D	20	0	3	20	0	
4.33 Substrate bending test	See EN 60115-8:2012, 2.3.10; mounting: see Annex D Depth of bend 2 mm, 3 times Visual examination Resistance		(half of the sample)			(half of the sample)		Electrical continuity. No open circuits when the board is in the bent position of the last bend. As in 4.33.4 As in Table 8
4.19 Rapid change of temperature	Mounting: see Annex D ϑ_A = LCT, ϑ_B = UCT (see Table 7); 5 cycles Visual examination Resistance		(the other half of the sample)			(the other half of the sample)		As in 4.19.3 As in Table 8
4.21 Shock	See EN 60115-8:2012, 2.3.4 Acceleration : 500 m/s^2 Pulse duration : 11 ms Waveform : Half sine, Number of shocks: 3 successive shocks in each direction of the three axes (total 18 shocks) Visual examination Resistance							As in 4.21.5 As in Table 8

Table A.2 (2 of 7)

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 C1** (*continued*)			
4.22 Vibration	See EN 60115-8:2012, 2.3.5; mounting: see Annex D Endurance by sweeping 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							 As in 4.22.4 As in Table 8
4.23 Climatic sequence - Dry heat - Damp heat, cyclic - Cold - Low air pressure - Damp heat, cyclic - D.C. load - Final measurements	Mounting: see Annex D 16 h at UCT (see Table 7) 1 cycle, raising to (55 ± 2) °C 2 h at LCT (see Table 7) 1 h / 1 kPa at +15 °C to +35 °C 5 cycles, raising to (55 ± 2) °C Voltage: $U = \sqrt{P_{70} \cdot R}$ or $U = U_{max}$, whichever is the less severe; 1 min Visual examination Resistance Insulation resistance		(all of the sample)			(all of the sample)		 As in 4.23.8 As in Table 8 $R_{ins} \geq 100\ M\Omega$

Table A.2 (3 of 7)

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 7		Group C2			
4.25.1 Endurance at the rated temperature 70 °C (mandatory for resistors categorized as Level R)	Mounting: see Annex D 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	D	20 / 115 [c]	0	3	20	0	As in 4.25.1.7 As in Table 8 $R_{ins} \geq 1$ GΩ
4.25.1.8 Extended endurance at the rated temperature 70 °C	Duration extended to 8 000 h once a year Resistance				12	20		As in Table 8
Or 4.25.2 Endurance at room temperature (applicable only to resistors categorized as Level P, if agreed between manufacturer and Certification Body)	Mounting: see Annex D Voltage: $U = \sqrt{P_{Test} \cdot R}$ with P_{Test} calculated according to 4.25.2.4, 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				3	20	0	As in 4.25.1.7 As in Table 8 $R_{ins} \geq 1$ GΩ
4.25.2.8 Extended endurance at room temperature	Duration extended to 8 000 h once a year Resistance				12	20		As in Table 8

Table A.2 (4 of 7)

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 8		**Group C3**			
4.18 Resistance to soldering heat	See EN 60115-8:2012, 2.3.3 Solder bath method; (260 ± 5) °C, (10 ± 1) s Visual examination Resistance	D	20	0	3	20	0	 As in 4.18.3 As in Table 8
4.35 Flammability	Needle flame test of EN 60695-11-5 Duration of flame application, t_a = 10 s Duration of burning		(5 of the sample)		36	(5 of the sample)		 $t_b \leq 30$ s
					Group D1			
4.8 Variation of resistance with temperature (applicable only for resistors with a temperature coefficient of ± 50 10^{-6}/K or inferior)	Mounting: see Annex D, or unmounted 20 °C / LCT / 20 °C / UCT / 20 °C Resistance	D			12	20	0	 As in Table 5
			Group 9		**Group D2**			
4.24 Damp heat, steady state	Mounting: see Annex D, or unmounted Temperature: (40 ± 2) °C Relative humidity: (93 ± 3) % Duration: 56 d Visual examination Resistance Insulation resistance	D	20	0	12	20	0	 As in 4.24.4 As in Table 8 $R_{ins} \geq 100$ MΩ

Table A.2 (5 of 7)

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 10		**Group D3**			
4.4.3 Dimensions (detail)		D	20	0	36	20	0	As in Table 1
4.25.3 Endurance at a maximum temperature	see Annex D Temperature: UCT = 200 °C Category dissipation: P_{UCT} = 0,278 x P_{70} Duration: 1 000 h Visual examination Resistance Insulation resistance							As in 4.25.3.7 As in Table 8 $R_{ins} \geq 1$ GΩ
4.14 Temperature rise (applicable only to resistors below the critical resistance)	Mounting: see Annex D Temperature rise		(6 of the sample)			(6 of the sample)		As in Table 6
			Group 11		**Group E1**			
4.38 Electrostatic discharge	See EN 60115-8:1012, 2.3.11; mounting: see Annex D, or unmounted. Human body model (HBM) of EN 61340-3-1 3 pos. and 3 neg. discharges U_d = 20 kV for all styles Visual examination Resistance	D	20	0	12	20	0	As in 4.38.4 As in Table 8
4.29 Component solvent resistance	See EN 60115-8:2012, 2.3.7; mounting: see Annex D, or unmounted. Method 2; solvent: IPA; temperature: (50 – 5) °C Visual examination		(half of the sample)			(half of the sample)		As in 4.4.1

Table A.2 (6 of 7)

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 *(continued)*		**Group E1** *(continued)*			
4.30 Solvent resistance of marking (applicable only to marked resistor)	See EN 60115-8:2012, 2.3.8; mounting: see Annex D, or unmounted Method 1, rubbing device: tooth brush; solvent: IPA; temperature: (50 – 5) °C Visual examination		(the other half of the sample)			(the other half of the sample)		As in 4.4.1
			Group 12					
4.22 Vibration	See EN 60115-8:2012, 2.3.5; mounting: see Annex D Endurance by sweeping 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 8
4.39 Periodic-pulse overload test	See EN 60115-8:2012, 2.3.12; mounting: see Annex D 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 8

Table A.2 (7 of 7)

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 13		**Group F**			
4.19	Rapid change of temperature	Mounting: see Annex D, or unmounted ϑ_A = LCT = -55 °C; ϑ_B = UCT = 200 °C; 100 cycles for all styles Visual examination Resistance	D	20	0	36	20	0	 As in 4.19.3 As in Table 8
				Group 14		**Group G**			
4.27	Single-pulse high-voltage overload test (applicable only to resistors of 10 Ω or above)	See EN 60115-8:2012, 2.3.6; mounting: see Annex D, or unmounted Severity No. 4 (10/700) Visual examination Resistance	D	20	0	12	20	0	 As in 4.27.3.7 As in Table 8

[a] Clause numbers in this column refer to EN 60115-1:2011.

[b] Refer to B.1 for a list of letter symbols and to B.2 for a list abbreviations.

[c] The first figure is the sample size for Level P; the second figure is the sample size for Level R.

Annex B
(informative)

Letter symbols and abbreviations

B.1 Letter symbols

c	Permitted number of non-conformances per group, group acceptance criterion	1
n	Sample size	1
p	Periodicity	month^{-1}
P	Actual dissipation	W
P_{25}	Maximum dissipation at 25 °C ambient temperature	W
P_{70}	Rated dissipation at 70 °C ambient temperature	W
P_{UCT}	Category dissipation at the upper category temperature	W
P_{Test}	Relevant dissipation for the endurance at room temperature test	W
P_{ϑ}	Permissible dissipation at ambient temperature ϑ, derated above 70 °C	W
$\overline{P}$	Average dissipation, e.g. induced by pulses	W
$\hat{P}_{max}$	Permitted pulse peak dissipation	W
$\hat{P}$	Pulse peak dissipation	W
R	Resistance	Ω
R_{ins}	Insulation resistance	Ω
R_r	Rated resistance	Ω
ΔR	Change of resistance	Ω
$\Delta R/R$	Relative change of resistance (Resistance change related to prior resistance)	%
ϑ_{amb}	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_P	Pulse duration	s
T_P	Pulse period	s
$\Delta\vartheta$	Temperature rise	K
U_d	Discharge voltage	V
U_{ins}	Insulation voltage	V
$\hat{U}_{max}$	Permissible pulse peak voltage	V

$\hat{U}$	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
τ_P	Time constant of an exponential pulse	s

B.2 Abbreviations

CB	Certification body
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
IECQ CB	IECQ Certification Body
IL	Inspection level
IPA	Isopropyl alcohol, Isopropanol (CAS Registry Number: 67-63-0)
LCT	Lower category temperature
MET	Maximum element temperature
ND	Non-destructive
NSI	National supervising inspectorate NOTE 1 IECQ 01, *IEC Quality Assessment System for Electronic Components (IECQ Scheme) — Basic Rules*, has implemented in its 2007-12 revision a change of the term Supervising Inspectorate to IECQ Certification Body (IECQ CB).
ONS	Organisme National de Surveillance, National supervising inspectorate NOTE 2 This term has been used in specifications prior to using the term National Supervising Inspectorate (NSI).
RKMG code system	Coding system for resistance values, where the SI prefix indicating the decimal multiple of the unit Ohm is used to replace the decimal sign. NOTE 3 The code characters R, K, M, G are written in upper case, even though the SI prefix for kilo (10^3) is a lower case k. NOTE 4 The RKMG code system is not prescribed to provide a code of fixed length. However, trailing zeroes can be used to fill to a fixed length, if required.
RW	Resistor, Wirewound (SMD)
TA	Technology approval
TADD	Technology approval declaration document
TAS	Technology approval schedule
TCR	Temperature coefficient of resistance
UCT	Upper category temperature

Annex C
(normative)

Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 60062:2005 + Corrigendum 2007, *Marking codes for resistors and capacitors (IEC 60062:2004)*

EN 60115-1:2011, *Fixed resistors for use in electronic equipment — Part 1: Generic specification (IEC 60115-1:2008, modified)*

EN 60115-8:2012, *Fixed resistors for use in electronic equipment — Part 8: Sectional specification — Fixed surface mount resistors (IEC 60115-8:2009, modified)*

EN 60286-3, *Packaging of components for automatic handling — Part 3: Packaging of surface mount components on continuous tapes (IEC 60286-3)*

EN 60695-11-5*, Fire hazard testing — Part 11-5: Test flames — Needle-flame test method — Apparatus, confirmatory test arrangement and guidance (IEC 60695-11-5)*

EN 61193-2:2007, *Quality assessmenrt systems — Part 2: Selection and use of sampling plans for inspection of electronic components and packages (IEC 61193-2:2007)*

EN 61340-3-1, *Electrostatics — Part 3-1: Methods for simulation of electrostatic effects — Human body model (HBM) electrostatic discharge test waveforms (IEC 61340-3-1)*

EN 61760-1, *Surface mounting technology — Part 1: Standard method for the specification of surface mounting components (SMDs) (IEC 61760-1)*

EN 140402:2015, *Blank Detail Specification: Fixed low power wirewound surface mount (SMD) resistors*

IEC 60063*, Preferred number series for resistors and capacitors*

IEC QC 001002-3:2005, *IEC Quality Assessment System for Electronic Components (IECQ) — Rules of Procedure — Part 3: Approval procedures*

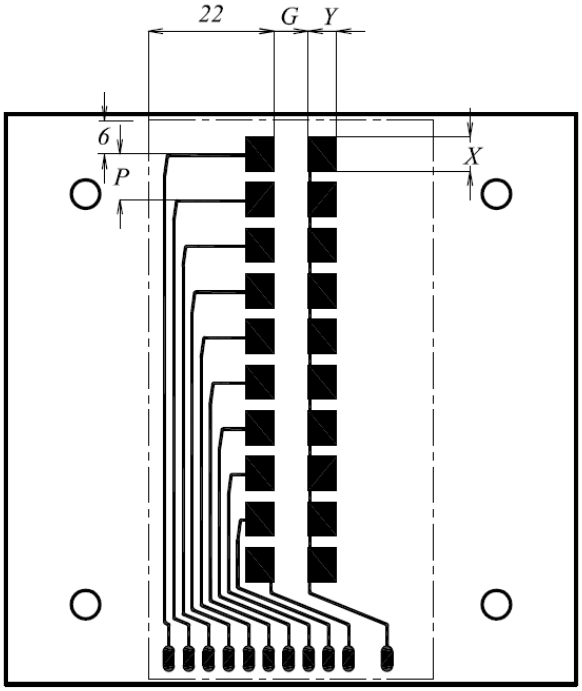
Annex D
(normative)

Mounting of components

D.1 Layout for mechanical tests

For mechanical tests, the resistors covered by this specification shall be mounted on a test board as shown in Figure D.1, with the dimensions X, Y, G and P as given in Table D.1.

Dimensions in millimetres



Key

■ solderable area

Figure D.1 — Basic layout for mechanical tests

The board material shall be epoxy woven glass or polyimide, with a thickness (1,6 ± 0,1) mm, furnished with a conductor layer of copper, with a thickness defined by the component manufacturer.

Kelvin (4 point) measurement shall be applied for specimen with a resistance R < 100 Ω.

Table D.1 — Soldering pad dimensions

Dimensions in millimetres

Style	X ± 0,1	Y ± 0,1	G ± 0,1	P ± 0,1
RW0503M	1,5	2,0	2,5	10,0
RW0704M	4,0	3,0	3,0	8,0
RW1107M	6,0	4,5	6,0	8,0
RW1607M	6,0	5,0	10,0	8,0

D.2 Layout for electrical test

For electrical tests, the resistors covered by this specification shall be mounted on a test board as shown in Figure D.2, with the dimensions X, Y and G as given in Table D.1.

Dimensions in millimetres

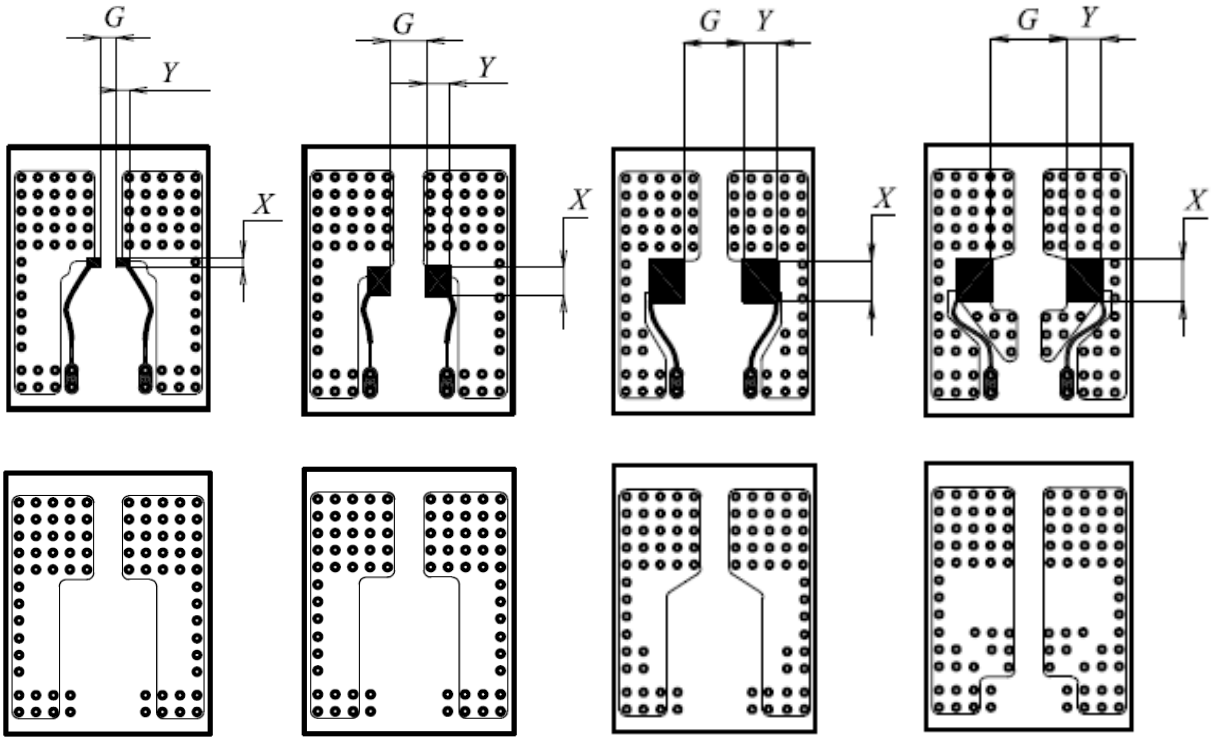


Figure D.2 — Basic layout for electrical tests

The board material shall be epoxy woven glass or polyimide, with a thickness (1,6 ± 0,1) mm, furnished with a conductor layer of copper, with a thickness defined by the component manufacturer.

The vial holes shall have diameter of (0,80 ± 0,08) mm, with a minimum annular ring (r_r - r_h) of 0,30 mm, see Figure D.3.

Kelvin (4 point) measurement shall be applied for specimen with a resistance R < 100 Ω.

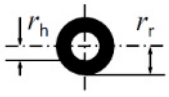


Figure D.3 — Annular ring dimensions

Bibliography

EN 60027-1, *Letter symbols to be used in electrical technology — Part 1: General (IEC 60027-1)*

EN 60068-1, *Environmental testing — Part 1: General and guidance (IEC 60068-1)*

EN 60068-2-1, *Environmental testing — Part 2-1: Tests — Test A: Cold (IEC 60068-2-1)*

EN 60068-2-2, *Environmental testing — Part 2-2: Tests — Test B: Dry heat (IEC 60068-2-2)*

EN 60068-2-6, *Environmental testing — Part 2-6: Tests — Test Fc: Vibration (sinusoidal) (IEC 60068-2-6)*

EN 60068-2-13, *Environmental testing — Part 2: Tests —Test M: Low air pressure (IEC 60068-2-13)*

EN 60068-2-14, *Environmental testing — Part 2: Tests — Test N: Change of temperature (IEC 60068-2-14)*

EN 60068-2-20, *Environmental testing — Part 2-20: Tests — Test T: Test methods for solderability and resistance to soldering heat of devices with leads (IEC 60068-2-20)*

EN 60068-2-21, *Environmental testing — Part 2-21: Tests — Test U: Robustness of terminations and integral mounting devices (IEC 60068-2-21)*

EN 60068-2-27, *Environmental testing — Part 2: Tests — Test Ea and guidance: Shock (IEC 60068-2-27)*

EN 60068-2-30, *Environmental testing — Part 2-30: Tests — Test Db: Damp heat, cyclic (12 h + 12 h cycle) (IEC 60068-2-30)*

EN 60068-2-45, *Environmental testing — Part 2: Tests — Test Xa and guidance: Immersion in cleaning solvents (IEC 60068-2-45)*

EN 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 60068-2-58)*

EN 60068-2-78, *Environmental testing — Part 2-78, Test Cab: Damp heat, steady state (IEC 60068-2-78)*

EN 80000 (all parts), *Quantities and units*

EN 140400[1)], *Sectional specification: Fixed low power surface mount (SMD) resistors*

EN ISO 80000 (all parts), *Quantities and units*

CECC 40 402-801[2)], *Detail Specification: Fixed low power wire wound surface mounting (SMD) resistors*

IECQ 01, *IEC Quality Assessment System for Electronic Components (IECQ System) — Basic Rules*

http://certificates.iecq.org, internet access to the public area of the IECQ On-Line Certificate System

IPC-A-600, *Acceptability of printed boards*

IPC 2221, *Generic standard on printed board design*

1) The latest edition EN 140400:2003 has been superseded by EN 60115-8:2012.

2) CECC 40 402-801:2000-02 was superseded with EN 140402-801:2005; see the Foreword.

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