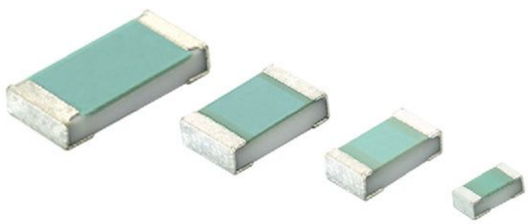
Professional Thin Film Chip Resistors



MCS 0402, MCT 0603, MCU 0805, and MCA 1206 professional thin film flat chip resistors are the perfect choice for most fields of modern professional electronics where reliability and stability are of major concern. Typical applications include telecommunication, medical equipment, high-end computer and audio / video electronics.

FEATURES

- Approved to EN 140401-801
- Excellent overall stability: class 0.5
- Professional tolerance of resistance: ± 0.5 % and ± 1 %
- Rated dissipation P_{70} up to 0.4 W for size 1206
- Sulfur resistance verified according to ASTM B 809
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT

APPLICATIONS

- Automotive
- Telecommunication
- Medical equipment
- Industrial equipment

TECHNICAL SPECIFICATIONS				
DESCRIPTION	**MCS 0402**	**MCT 0603**	**MCU 0805**	**MCA 1206**
Imperial size	0402	0603	0805	1206
Metric size code	RR1005M	RR1608M	RR2012M	RR3216M
Resistance range	10 Ω to 4.99 MΩ; 0 Ω	1 Ω to 10 MΩ; 0 Ω	1 Ω to 10 MΩ; 0 Ω	1 Ω to 2 MΩ; 0 Ω
Resistance tolerance	± 1 %; ± 0.5 %			
Temperature coefficient	± 50 ppm/K; ± 25 ppm/K			
Rated dissipation, P_{70} (1)	0.100 W	0.125 W	0.200 W	0.400 W
Operating voltage, $U_{max.}$ AC_{RMS}/DC	50 V	75 V	150 V	200 V
Permissible film temperature, $\vartheta_{F\ max.}$ (1)	155 °C			
Operating temperature range	-55 °C to 155 °C			
Permissible voltage against ambient (insulation): 1 min; U_{ins}	75 V	100 V	200 V	300 V
Failure rate: $FIT_{observed}$	≤ 0.1 x 10^{-9}/h			

Note

(1) Please refer to APPLICATION INFORMATION below.

APPLICATION INFORMATION

When the resistor dissipates power, a temperature rise above the ambient temperature occurs, dependent on the thermal resistance of the assembled resistor together with the printed circuit board. The rated dissipation applies only if the permitted film temperature is not exceeded.

These resistors do not feature a limited lifetime when operated within the permissible limits. However, resistance value drift increasing over operating time may result in exceeding a limit acceptable to the specific application, thereby establishing a functional lifetime.

MAXIMUM RESISTANCE CHANGE AT RATED DISSIPATION			
OPERATION MODE		**STANDARD**	**POWER**
Rated dissipation, P_{70}	**MCS 0402**	0.063 W	0.100 W
	MCT 0603	0.100 W	0.125 W
	MCU 0805	0.125 W	0.200 W
	MCA 1206	0.250 W	0.400 W
Operating temperature range		-55 °C to 125 °C	-55 °C to 155 °C
Permissible film temperature, $\vartheta_{F\ max.}$		125 °C	155 °C
Max. resistance change at P_{70} for resistance range, $\lvert \Delta R/R \rvert$ after:	**MCS 0402**	10 Ω to 4.99 MΩ	10 Ω to 4.99 MΩ
	MCT 0603	1 Ω to 10 MΩ	1 Ω to 10 MΩ
	MCU 0805	1 Ω to 10 MΩ	1 Ω to 10 MΩ
	MCA 1206	1 Ω to 2 MΩ	1 Ω to 2 MΩ
	1000 h	≤ 0.25 %	≤ 0.5 %
	8000 h	≤ 0.5 %	≤ 1.0 %
	225 000 h	≤ 1.5 %	-

Note

- The presented operation modes do not refer to different types of resistors, but actually show examples of different loads, that lead to different film temperatures and different achievable load-life stability (drift) of the resistance value. A suitable low thermal resistance of the circuit board assembly must be safeguarded in order to maintain the film temperature of the resistors within the specified limits. Please consider the application note "Thermal Management in Surface-Mounted Resistor Applications" (www.vishay.com/doc?28844) for information on the general nature of thermal resistance.

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE				
TYPE / SIZE	**TCR**	**TOLERANCE**	**RESISTANCE**	**E-SERIES**
MCS 0402	± 50 ppm/K	± 1 %	**10 Ω to 4.99 MΩ**	E24; E96
		± 0.5 %	10 Ω to 221 kΩ	E24; E192
	± 25 ppm/K	± 0.5 %	**10 Ω to 221 kΩ**	E24; E192
	Jumper, $I_{max.}$ = 0.63 A	≤ 20 mΩ	0 Ω	-
MCT 0603	± 50 ppm/K	± 1 %	**1 Ω to 10 MΩ**	E24; E96
		± 0.5 %	10 Ω to 511 kΩ	E24; E192
	± 25 ppm/K	± 0.5 %	**10 Ω to 511 kΩ**	E24; E192
	Jumper, $I_{max.}$ = 1 A	≤ 20 mΩ	0 Ω	-
MCU 0805	± 50 ppm/K	± 1 %	**1 Ω to 10 MΩ**	E24; E96
		± 0.5 %	10 Ω to 1.5 MΩ	E24; E192
	± 25 ppm/K	± 0.5 %	**10 Ω to 1.5 MΩ**	E24; E192
	Jumper, $I_{max.}$ = 1.5 A	≤ 20 mΩ	0 Ω	-
MCA 1206	± 50 ppm/K	± 1 %	**1 Ω to 2 MΩ**	E24; E96
		± 0.5 %	10 Ω to 2 MΩ	E24; E192
	± 25 ppm/K	± 0.5 %	**10 Ω to 2 MΩ**	E24; E192
	Jumper, $I_{max.}$ = 2 A	≤ 20 mΩ	0 Ω	-

Note

- Resistance ranges printed in bold are preferred TCR / tolerance combinations with optimized availability.

PACKAGING						
TYPE / SIZE	**CODE**	**QUANTITY**	**PACKAGING STYLE**	**WIDTH**	**PITCH**	**PACKAGING DIMENSIONS**
MCS 0402	E5	5000	Paper tape acc. IEC 60286-3, Type 1a	8 mm	2 mm	Ø 180 mm/7"
	E0	10 000				
MCT 0603	P5	5000			4 mm	Ø 180 mm/7"
	PW	20 000				Ø 330 mm/13"
MCU 0805	P5	5000				Ø 180 mm/7"
	PW	20 000				Ø 330 mm/13"
MCA 1206	P5	5000				Ø 180 mm/7"

PART NUMBER AND PRODUCT DESCRIPTION

Part Number: MCT06030D4641DPW00
Part Number: MCT06030Z0000ZP500

M	C	T	0	6	0	3	0	D	4	6	4	1	D	P	W	0	0

TYPE / SIZE	VERSION	TCR	RESISTANCE	TOLERANCE	PACKAGING
MCS0402 **MCT0603** **MCU0805** **MCA1206**	**0** = neutral	**D** = ± 25 ppm/K **C** = ± 50 ppm/K **Z** = jumper	3 digit value 1 digit multiplier **Multiplier** **8** = $*10^{-2}$ **9** = $*10^{-1}$ **0** = $*10^{0}$ **1** = $*10^{1}$ **2** = $*10^{2}$ **3** = $*10^{3}$ **4** = $*10^{4}$ **5** = $*10^{5}$ **0000** = jumper	**D** = ± 0.5 % **F** = ± 1 % **Z** = jumper	**E5** **E0** **P5** **PW**

Product Description: MCT 0603-25 0.5 % PW 4K64
Product Description: MCT 0603 P5 0R0

MCT	**0603**	**-25**	**0.5 %**	**PW**	**4K64**
TYPE	SIZE	TCR	TOLERANCE	PACKAGING	RESISTANCE
MCS **MCT** **MCU** **MCA**	**0402** **0603** **0805** **1206**	± **25** ppm/K ± **50** ppm/K	± **0.5 %** ± **1 %**	**E5** **E0** **P5** **PW**	**4K64** = 4.64 kΩ **50R1** = 50.1 Ω **0R0** = jumper

Note

- Products can be ordered using either the PART NUMBER or PRODUCT DESCRIPTION.

DESCRIPTION

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A homogeneous film of metal alloy is deposited on a high grade ceramic substrate (Al_2O_3) and conditioned to achieve the desired temperature coefficient. Specially designed inner contacts are deposited on both sides. A special laser is used to achieve the target value by smoothly cutting a meander groove in the resistive layer without damaging the ceramics. For the high and low ohmic range, optimized Cermet products provide comparable properties. The resistor elements are covered by a protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure tin on nickel plating.

The result of the determined production is verified by an extensive testing procedure and optical inspection performed on 100 % of the individual chip resistors. This includes full screening for the elimination of products with potential risk of early field failures (feasible for $R \geq 10\ \Omega$). Only accepted products are laid directly into the paper tape in accordance with **IEC 60286-3 Type 1a** [(1)].

ASSEMBLY

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapor phase as shown in **IEC 61760-1**. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions. The suitability of conformal coatings, potting compounds and their processes, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system.

The resistors are RoHS-compliant, the pure tin plating provides compatibility with lead (Pb)-free and lead-containing soldering processes. Solderability is specified for 2 years after production or requalification. The permitted storage time is 20 years. The immunity of the plating against tin whisker growth has been proven under extensive testing.

MATERIALS

Vishay acknowledges the following systems for the regulation of hazardous substances:

- IEC 62474, Material Declaration for Products of and for the Electrotechnical Industry, with the list of declarable substances given therein [(2)]
- The Global Automotive Declarable Substance List (GADSL) [(3)]
- The REACH regulation (1907/2006/EC) and the related list of substances with very high concern (SVHC) [(4)] for its supply chain

The products do not contain any of the banned substances as per IEC 62474, GADSL, or the SVHC list, see www.vishay.com/how/leadfree.

Hence the products fully comply with the following directives:

- 2000/53/EC End-of-Life Vehicle Directive (ELV) and Annex II (ELV II)
- 2011/65/EU Restriction of the Use of Hazardous Substances Directive (RoHS) with amendment 2015/863/EU
- 2012/19/EU Waste Electrical and Electronic Equipment Directive (WEEE)

Vishay pursues the elimination of conflict minerals from its supply chain, see the Conflict Minerals Policy at www.vishay.com/doc?49037.

APPROVALS

The resistors are approved within the IECQ-CECC Quality Assessment System for Electronic Components to the detail specification **EN 140401-801** which refers to **EN 60115-1**, **EN 60115-8** and the variety of environmental test procedures of the **IEC 60068** [(1)] series. The detail specification refers to the climatic category 55/125/56, which relates to the “standard operation mode” of this datasheet.

Conformity is attested by the use of the **CECC** logo (⊜) as the mark of conformity on the package label.

Vishay Beyschlag has achieved **“Approval of Manufacturer”** in accordance with **IECQ 03-1**. The release certificate for **“Technology Approval Schedule”** in accordance with **CECC 240001** based on **IECQ 03-3-1** is granted for the Vishay BEYSCHLAG manufacturing process.

RELATED PRODUCTS

For more information about products with better TCR and tighter tolerance please refer to the Precision Thin Film Chip Resistors datasheet (www.vishay.com/doc?28700).

Resistors are available with established reliability in accordance with EN 140401-801 version E. Please refer to the special datasheet (www.vishay.com/doc?28744) for information on failure rate level, available resistance ranges and order codes.

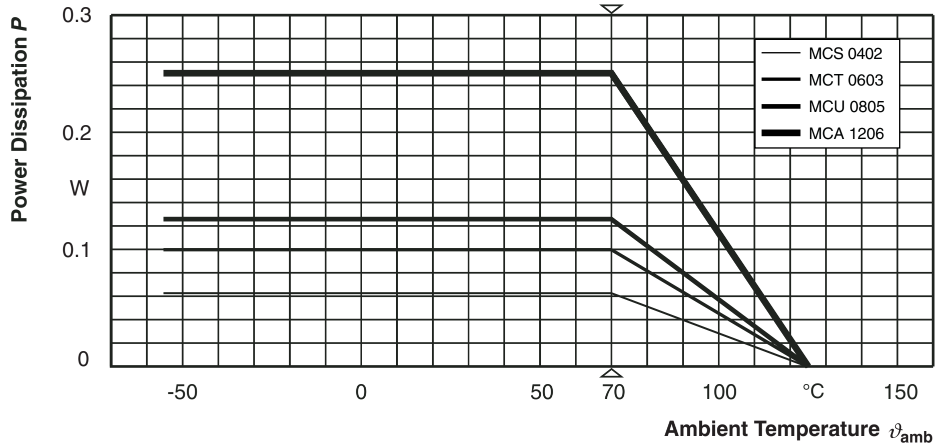
Precision chip resistor arrays may be used in voltage divider applications or precision amplifiers where close matching between multiple resistors is necessary. ACAS 0612 chip arrays are specified by the following datasheets:

- Professional type (www.vishay.com/doc?28754)
- Precision type (www.vishay.com/doc?28751)

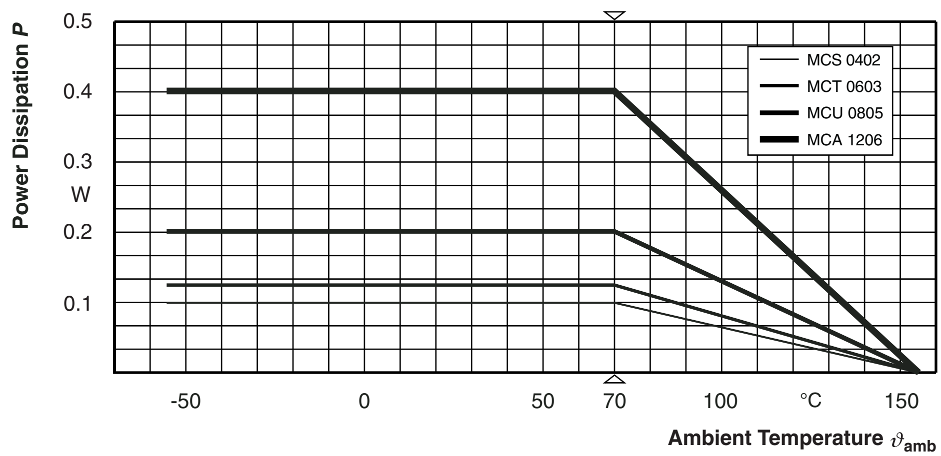
Notes

(1) The quoted IEC standards are also released as EN standards with the same number and identical contents.
(2) The IEC 62474 list of declarable substances is maintained in a dedicated database, which is available at http://std.iec.ch/iec62474.
(3) The Global Automotive Declarable Substance List (GADSL) is maintained by the American Chemistry Council and available at www.gadsl.org.
(4) The SVHC list is maintained by the European Chemical Agency (ECHA) and available at http://echa.europa.eu/candidate-list-table.

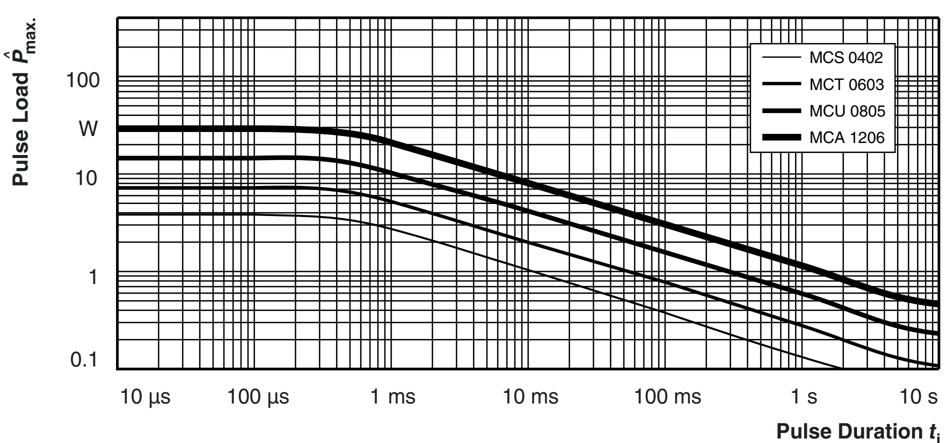
FUNCTIONAL PERFORMANCE



Derating - Standard Operation

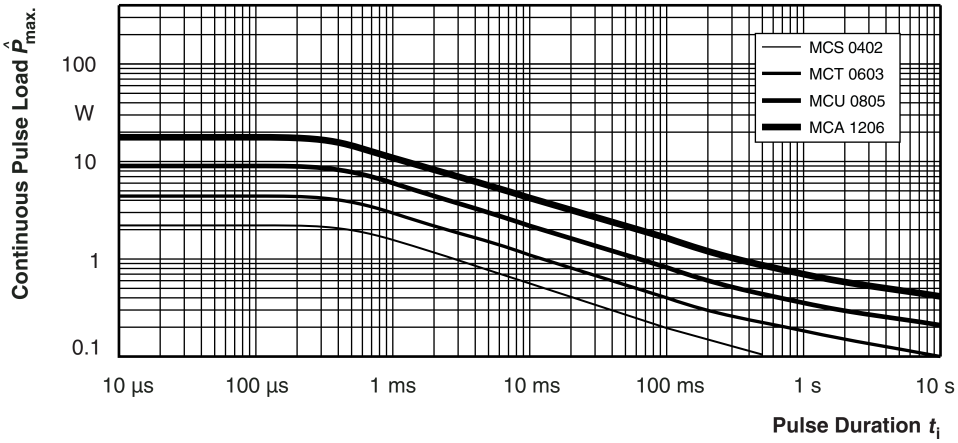


Derating - Power Operation



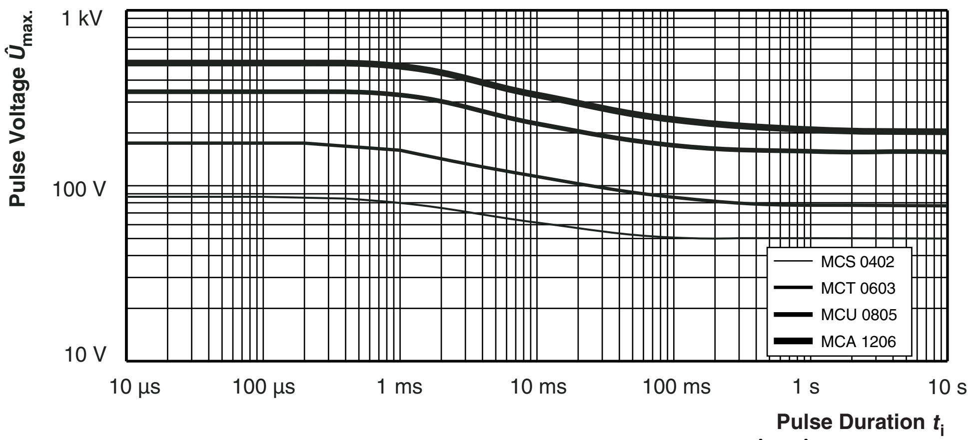
Maximum pulse load, single pulse; applicable if $\bar{P} \to 0$ and $n \leq 1000$ and $\hat{U} \leq \hat{U}_{max.}$;
for permissible resistance change equivalent to 8000 h operation in standard operation mode

Single Pulse



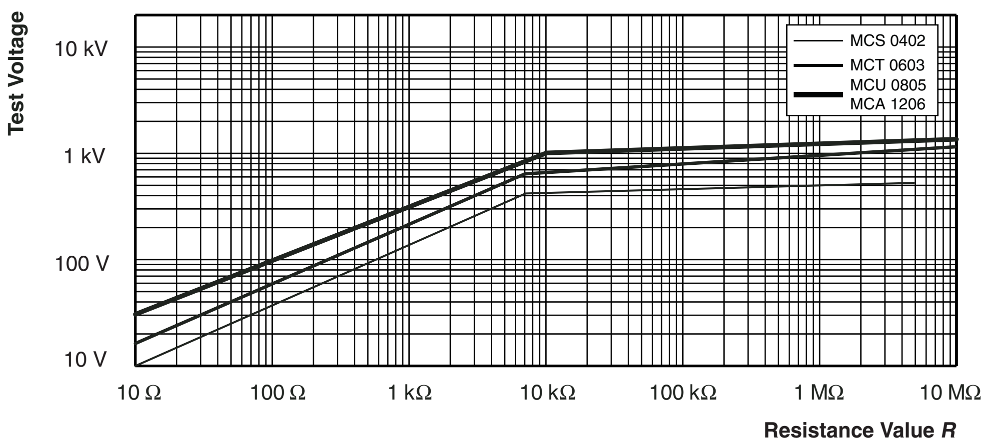
Maximum pulse load, continuous pulses; applicable if $\bar{P} \leq P(\vartheta_{amb})$ and $\hat{U} \leq \hat{U}_{max.}$;
for permissible resistance change equivalent to 8000 h operation in standard operation mode

Continuous Pulse



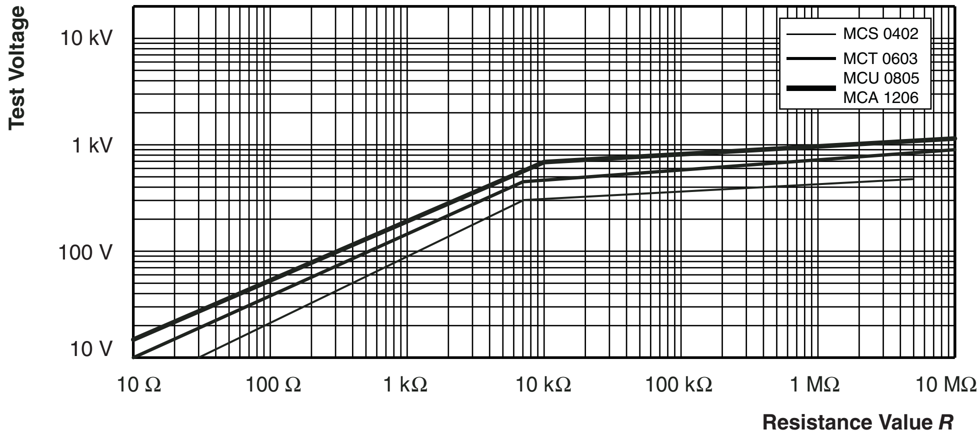
Maximum pulse voltage, single and continuous pulses; applicable if $\hat{P} \leq \hat{P}_{max.}$;
for permissible resistance change equivalent to 8000 h operation in standard operation mode

Pulse Voltage



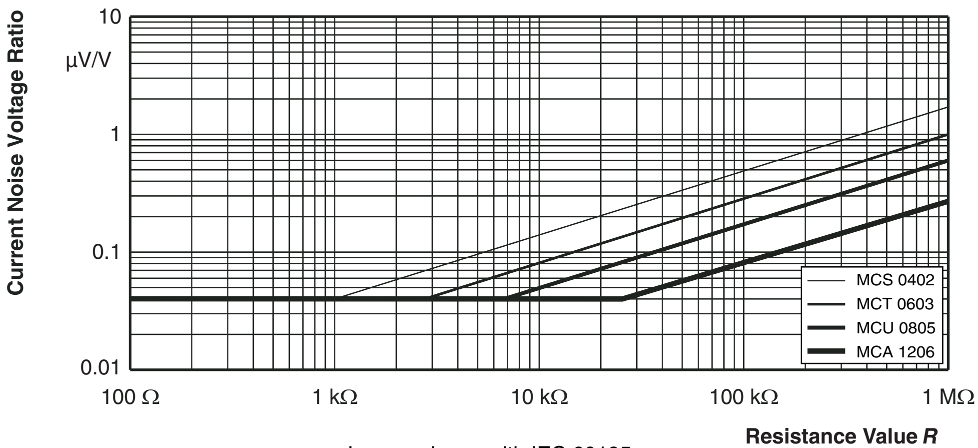
Pulse load rating in accordance with EN 60115-1 clause 4.27; 1.2 µs/50 µs; 5 pulses at 12 s interval;
for permissible resistance change ± (0.5 % *R* + 0.05 Ω)

1.2/50 Pulse



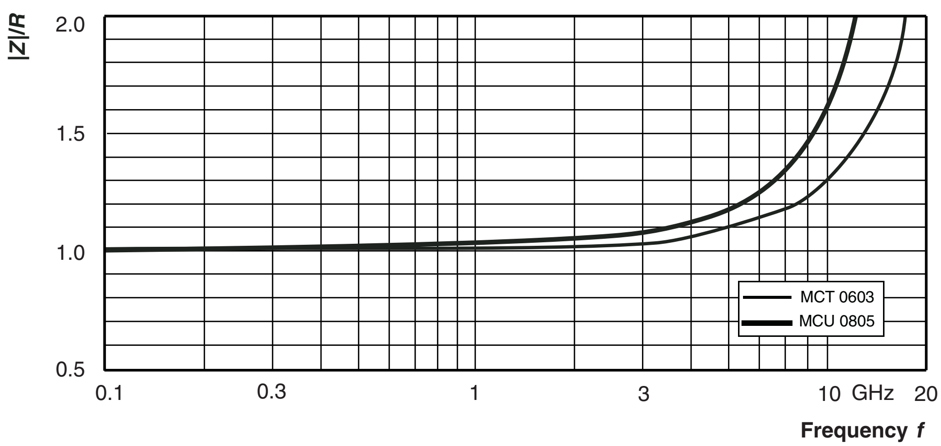
Pulse load rating in accordance with EN 60115-1 clause 4.27; 10 µs/700 µs;
10 pulses at 1 min intervals; for permissible resistance change ± (0.5 % *R* + 0.05 Ω)

10/700 Pulse



In accordance with IEC 60195

Current Noise Voltage Ratio



Relative impedance for 49.9 Ω chip resistor

RF-Behavior

TESTS AND REQUIREMENTS

All tests are carried out in accordance with the following specifications:

EN 60115-1, generic specification

EN 60115-8 (successor of EN 140400), sectional specification

EN 140401-801, detail specification

IEC 60068-2-xx, test methods

The components are approved under the IECQ-CECC quality assessment system for electronic components.

The parameters stated in the Test Procedures and Requirements table are based on the required tests and permitted limits of EN 140401-801. The table presents only the most important tests, for the full test schedule refer to the documents listed above. However, some additional tests and a number of improvements against those minimum requirements have been included.

The testing also covers most of the requirements specified by EIA/ECA-703 and JIS-C-5201-1.

The tests are carried out under standard atmospheric conditions in accordance with IEC 60068-1, 4.3, whereupon the following values are applied:

Temperature: 15 °C to 35 °C

Relative humidity: 25 % to 75 %

Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar)

A climatic category LCT / UCT / 56 is applied, defined by the lower category temperature (LCT), the upper category temperature (UCT), and the duration of exposure in the damp heat, steady state test (56 days).

The components are mounted for testing on printed circuit boards in accordance with EN 60115-8, 2.4.2, unless otherwise specified.

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 (1) TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (Δ*R*)	
				STABILITY CLASS 0.5	STABILITY CLASS 1
			Stability for product types:		
			MCS 0402	10 Ω to 33.2 kΩ	> 33.2 kΩ to 4.99 MΩ
			MCT 0603	10 Ω to 100 kΩ	1 Ω to < 10 Ω; > 100 kΩ to 10 MΩ
			MCU 0805	10 Ω to 221 kΩ	1 Ω to < 10 Ω; > 221 kΩ to 10 MΩ
			MCA 1206	10 Ω to 332 kΩ	1 Ω to < 10 Ω; > 332 kΩ to 2 MΩ
4.5	-	Resistance	-	± 1 % *R*; ± 0.5 % *R*	
4.8	-	Temperature coefficient	At (20 / -55 / 20) °C and (20 / 125 / 20) °C	± 50 ppm/K; ± 25 ppm/K	
4.25.1	-	Endurance at 70 °C: standard operation mode	$U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; whichever is the less severe; 1.5 h on; 0.5 h off;		
			70 °C; 1000 h	± (0.25 % *R* + 0.05 Ω)	
			70 °C; 8000 h	± (0.5 % *R* + 0.05 Ω)	
		Endurance at 70 °C: power operation mode	$U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; whichever is the less severe; 1.5 h on; 0.5 h off;		
			70 °C; 1000 h	± (0.5 % *R* + 0.05 Ω)	
			70 °C; 8000 h	± (1 % *R* + 0.05 Ω)	
4.25.3	-	Endurance at upper category temperature	125 °C; 1000 h	± (0.25 % *R* + 0.05 Ω)	± (0.5 % *R* + 0.05 Ω)
			155 °C; 1000 h	± (0.5 % *R* + 0.05 Ω)	± (1 % *R* + 0.05 Ω)
4.24	78 (Cab)	Damp heat, steady state	(40 ± 2) °C; 56 days; (93 ± 3) % RH	± (0.5 % *R* + 0.05 Ω)	± (1 % *R* + 0.05 Ω)

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 (1) TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR) STABILITY CLASS 0.5	STABILITY CLASS 1
			Stability for product types:		
			MCS 0402	10 Ω to 33.2 kΩ	> 33.2 kΩ to 4.99 MΩ
			MCT 0603	10 Ω to 100 kΩ	1 Ω to < 10 Ω; > 100 kΩ to 10 MΩ
			MCU 0805	10 Ω to 221 kΩ	1 Ω to < 10 Ω; > 221 kΩ to 10 MΩ
			MCA 1206	10 Ω to 332 kΩ	1 Ω to < 10 Ω; > 332 kΩ to 2 MΩ
4.23		Climatic sequence: standard operation mode:		± (0.5 % R + 0.05 Ω)	± (1 % R + 0.05 Ω)
4.23.2	2 (Bb)	dry heat	125 °C; 16 h		
4.23.3	30 (Db)	damp heat, cyclic	55 °C; 24 h; > 90 % RH; 1 cycle		
4.23.4	1 (Ab)	cold	-55 °C; 2 h		
4.23.5	13 (M)	low air pressure	8.5 kPa; 2 h; (25 ± 10) °C		
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 24 h; > 90 % RH; 5 cycles		
4.23.7	-	DC load	$U = \sqrt{P_{70} \times R} \le U_{max.}$; 1 min.		
-	1 (Aa)	Cold	-55 °C; 2 h	± (0.1 % R + 0.01 Ω)	± (0.25 % R + 0.05 Ω)
4.19	14 (Na)	Rapid change of temperature	30 min at LCT and 30 min at UCT; LCT = -55 °C; UCT = 125 °C; 5 cycles	± (0.1 % R + 0.01 Ω) no visible damage	
			LCT = -55 °C; UCT = 125 °C; 1000 cycles	± (0.25 % R + 0.05 Ω) no visible damage	
4.13	-	Short time overload: standard operation mode	$U = 2.5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max.}$; whichever is the less severe; 5 s	± (0.1 % R + 0.01 Ω)	± (0.25 % R + 0.05 Ω)
		Short time overload: power operation mode	$U = 2.5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max.}$; whichever is the less severe; 5 s	± (0.25 % R + 0.05 Ω)	± (0.5 % R + 0.05 Ω)
4.27	-	Single pulse high voltage overload: standard operation mode	Severity no. 4: $U = 10 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max.}$; whichever is the less severe; 10 pulses 10 µs/700 µs	± (0.5 % R + 0.05 Ω) no visible damage	
4.39	-	Periodic electric overload: standard operation mode	$U = \sqrt{15 \times P_{70} \times R}$ or $U = 2 \times U_{max.}$; 0.1 s on; 2.5 s off; whichever is the less severe; 1000 cycles	± (0.5 % R + 0.05 Ω) no visible damage	
		Periodic electric overload: power operation mode	$U = \sqrt{15 \times P_{70} \times R}$ or $U = 2 \times U_{max.}$; 0.1 s on; 2.5 s off; whichever is the less severe; 1000 cycles	± (1 % R + 0.05 Ω) no visible damage	

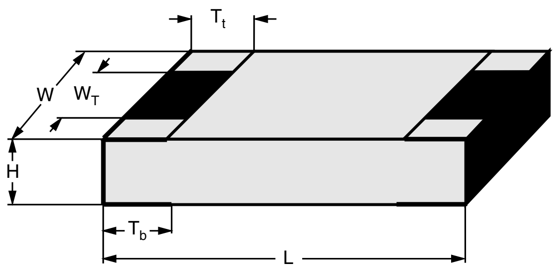
TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 [1] TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (Δ*R*) STABILITY CLASS 0.5	STABILITY CLASS 1
			Stability for product types:		
			MCS 0402	10 Ω to 33.2 kΩ	> 33.2 kΩ to 4.99 MΩ
			MCT 0603	10 Ω to 100 kΩ	1 Ω to < 10 Ω; > 100 kΩ to 10 MΩ
			MCU 0805	10 Ω to 221 kΩ	1 Ω to < 10 Ω; > 221 kΩ to 10 MΩ
			MCA 1206	10 Ω to 332 kΩ	1 Ω to < 10 Ω; > 332 kΩ to 2 MΩ
4.38	-	Electro static discharge (human body model)	IEC 61340-3-1 [1]; 3 pos. + 3 neg. (equivalent to MIL-STD-883, method 3015) MCS 0402: 500 V MCT 0603: 1000 V MCU 0805: 1500 V MCA 1206: 2000 V	± (0.5 % *R* + 0.05 Ω)	
4.22	6 (Fc)	Vibration	Endurance by sweeping; 10 Hz to 2000 Hz; no resonance; amplitude ≤ 1.5 mm or ≤ 200 m/s^2; 7.5 h	± (0.1 % *R* + 0.01 Ω) no visible damage	
4.17	58 (Td)	Solderability	Solder bath method; SnPb40; non-activated flux; (215 ± 3) °C; (3 ± 0.3) s	Good tinning (≥ 95 % covered); no visible damage	
			Solder bath method; SnAg3Cu0.5 or SnAg3.5; non-activated flux; (235 ± 3) °C; (2 ± 0.2) s	Good tinning (≥ 95 % covered); no visible damage	
4.18	58 (Td)	Resistance to soldering heat	Solder bath method; (260 ± 5) °C; (10 ± 1) s	± (0.1 % *R* + 0.01 Ω) no visible damage	± (0.25 % *R* + 0.05 Ω) no visible damage
4.29	45 (XA)	Component solvent resistance	Isopropyl alcohol +50 °C; method 2	No visible damage	
4.32	21 (Ue_3)	Shear (adhesion)	MCS 0402 and MCT 0603: 9 N	No visible damage	
			MCU 0805 and MCA 1206: 45 N		
4.33	21 (Ue_1)	Substrate bending	Depth 2 mm, 3 times	± (0.1 % *R* + 0.01 Ω) no visible damage, no open circuit in bent position	
4.7	-	Voltage proof	$U_{RMS} = U_{ins}$; (60 ± 5) s	No flashover or breakdown	
4.35	-	Flammability	IEC 60695-11-5 [1], needle flame test; 10 s	No burning after 30 s	

Note

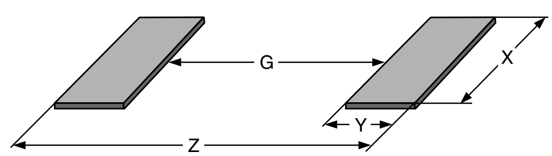
[1] The quoted IEC standards are also released as EN standards with the same number and identical contents.

DIMENSIONS



DIMENSIONS AND MASS							
TYPE / SIZE	**H (mm)**	**L (mm)**	**W (mm)**	**W_T (mm)**	**T_t (mm)**	**T_b (mm)**	**MASS (mg)**
MCS 0402	0.32 ± 0.05	1.0 ± 0.05	0.5 ± 0.05	> 75 % of W	0.2 + 0.1 / - 0.15	0.2 ± 0.1	0.6
MCT 0603	0.45 + 0.1 / - 0.05	1.55 ± 0.05	0.85 ± 0.1	> 75 % of W	0.3 + 0.15 / - 0.2	0.3 + 0.15 / - 0.2	1.9
MCU 0805	0.45 + 0.1 / - 0.05	2.0 ± 0.1	1.25 ± 0.15	> 75 % of W	0.4 + 0.1 / - 0.2	0.4 + 0.1 / - 0.2	4.6
MCA 1206	0.55 ± 0.1	3.2 + 0.1 / - 0.2	1.6 ± 0.15	> 75 % of W	0.5 ± 0.25	0.5 ± 0.25	9.2

SOLDER PAD DIMENSIONS



RECOMMENDED SOLDER PAD DIMENSIONS								
TYPE / SIZE	**WAVE SOLDERING**				**REFLOW SOLDERING**			
	G (mm)	**Y (mm)**	**X (mm)**	**Z (mm)**	**G (mm)**	**Y (mm)**	**X (mm)**	**Z (mm)**
MCS 0402	-	-	-	-	0.35	0.55	0.55	1.45
MCT 0603	0.55	1.10	1.10	2.75	0.65	0.70	0.95	2.05
MCU 0805	0.80	1.25	1.50	3.30	0.90	0.90	1.40	2.70
MCA 1206	1.40	1.50	1.90	4.40	1.50	1.15	1.75	3.80

Notes

- The given solder pad dimensions reflect the considerations for board design and assembly as outlined e.g. in standards IEC 61188-5-x [(1)], or in publication IPC-7351.

[(1)] The quoted IEC standards are also released as EN standards with the same number and identical contents.

HISTORICAL 12NC INFORMATION

- The resistors had a 12-digit numeric code starting with 2312.
- The subsequent 4 digits indicated the resistor type, specification and packaging; see the 12NC table.
- The remaining 4 digits indicated the resistance value:
  - The first 3 digits indicated the resistance value.
  - The last digit indicated the resistance decade in accordance with the last digit of 12NC indicating resistance decade table.

Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE	LAST DIGIT
1 Ω to 9.99 Ω	8
10 Ω to 99.9 Ω	9
100 Ω to 999 Ω	1
1 kΩ to 9.99 kΩ	2
10 kΩ to 99.9 kΩ	3
100 kΩ to 999 kΩ	4
1 MΩ to 9.99 MΩ	5
10 MΩ to 99.9 MΩ	6

Historical 12NC example

The 12NC of a MCT 0603 resistor, value 47 kΩ and TCR 50 with ± 1 % tolerance, supplied in cardboard tape of 5000 units per reel was: 2312 215 14703.

HISTORICAL 12NC - Resistor type and packaging					
DESCRIPTION			2312...		
			CARDBOARD TAPE ON REEL		
TYPE	TCR	TOL.	P5 (5000 UNITS)	E0 (10 000 UNITS)	PW (20 000 UNITS)
MCS 0402	± 50 ppm/K	± 1 %	-	275 1....	-
		± 0.5 %	-	275 5....	-
	± 25 ppm/K	± 0.5 %	-	276 5....	-
	Jumper	-	-	275 90001	-
MCT 0603	± 50 ppm/K	± 1 %	215 1....	-	205 1..
		± 0.5 %	215 5....	-	205 5....
	± 25 ppm/K	± 0.5 %	216 5....	-	206 5....
	Jumper	-	215 90001	-	205 90001
MCU 0805	± 50 ppm/K	± 0.5 %	255 5....	-	245 5....
	± 25 ppm/K	± 0.5 %	256 5....	-	246 5....
	Jumper	-	255 90001	-	245 90001

Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, “Vishay”), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay’s knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer’s responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer’s technical experts. Product specifications do not expand or otherwise modify Vishay’s terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.