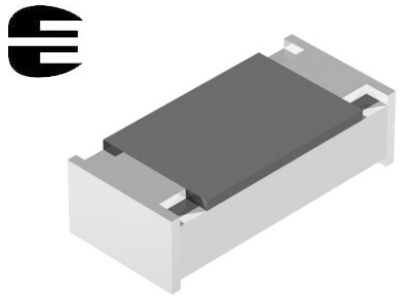
Professional Flat Chip Resistors



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 is of major concern. Typical applications include telecommunication, medical equipment and high-end computer and audio/video electronics.

FEATURES

- Approved according to EN 140401-801
- Excellent overall stability: Class 0.5
- Advanced thin film technology
- Pure Sn termination on Ni barrier layer
- Compatible with lead (Pb)-free and lead containing soldering processes
- Lead (Pb)-free and RoHS compliant

RoHS COMPLIANT

APPLICATIONS

- Automotive
- Telecommunication
- Medical equipment
- Industrial equipment

METRIC SIZE				
INCH:	0402	0603	0805	1206
METRIC:	RR 1005M	RR 1608M	RR 2012M	RR 3216M

TECHNICAL SPECIFICATIONS								
DESCRIPTION	**MCS 0402**		**MCT 0603**		**MCU 0805**		**MCA 1206**	
Metric size	RR 1005M		RR 1608M		RR 2012M		RR 3216M	
Resistance range	10 Ω to 4.99 MΩ		1 Ω to 10 MΩ		1 Ω to 10 MΩ		1 Ω to 10 MΩ	
Resistance tolerance	± 1 %; ± 0.5 %							
Temperature coefficient	± 50 ppm/K; ± 25 ppm/K							
Operation mode	Standard	Power	Standard	Power	Standard	Power	Standard	Power
Climatic category (LCT/UCT/days)	55/125/56	55/155/56	55/125/56	55/155/56	55/125/56	55/155/56	55/125/56	55/155/56
Rated dissipation, P_{70} (1)	0.063 W	0.1 W	0.1 W	0.125 W	0.125 W	0.2 W	0.25 W	0.4 W
Operating voltage, $U_{max.}$ AC/DC	50 V		75 V		150 V		200 V	
Film temperature	125 °C	155 °C	125 °C	155 °C	125 °C	155 °C	125 °C	155 °C
Max. resistance change at P_{70} for resistance range, $\Delta R/R$ max., after:	10 Ω to 4.99 MΩ		1 Ω to 10 MΩ		1 Ω to 10 MΩ		1 Ω to 10 MΩ	
1000 h	≤ 0.25 %	≤ 0.5 %	≤ 0.25 %	≤ 0.5 %	≤ 0.25 %	≤ 0.5 %	≤ 0.25 %	≤ 0.5 %
8000 h	≤ 0.5 %	≤ 1.0 %	≤ 0.5 %	≤ 1.0 %	≤ 0.5 %	≤ 1.0 %	≤ 0.5 %	≤ 1.0 %
225 000 h	≤ 1.5 %		≤ 1.5 %		≤ 1.5 %		≤ 1.5 %	
Insulation voltage:								
1 min; U_{ins}	75 V		100 V		200 V		300 V	
continuous	75 V		75 V		75 V		75 V	
$FIT_{observed}$	≤ 0.1 x 10^{-9}/h		≤ 0.1 x 10^{-9}/h		≤ 0.1 x 10^{-9}/h		≤ 0.1 x 10^{-9}/h	

Notes

(1) The power dissipation on the resistor generates a temperature rise against the local ambient, depending on the heat flow support of the printed-circuit board (thermal resistance). 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.

12NC INFORMATION FOR HISTORICAL CODING REFERENCE ONLY

- The resistors have a 12-digit numeric code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packing; see the 12NC table.
- The remaining 4 digits indicate the resistance value:
  - The first 3 digits indicate the resistance value.
  - The last digit indicates 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

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 is: 2312 215 14703.

12NC - resistor type and packaging

DESCRIPTION			ORDERING CODE 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

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

PART NUMBER AND PRODUCT DESCRIPTION (1)

PART NUMBER: MCT06030D4641DPW00

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

MODEL/SIZE	SPECIAL CHARACTER	TCR	VALUE	TOLERANCE	PACKAGING (2)	SPECIAL
MCS0402 **MCT0603** **MCU0805** **MCA1206**	**0** = neutral	**D** = ± 25 ppm/K **C** = ± 50 ppm/K **Z** = Jumper	**3 digit value** **1 digit multiplier** MULTIPLIER **7** = $*10^{-3}$ **8** = $*10^{-2}$ **9** = $*10^{-1}$ **0** = $*10^{0}$ **1** = $*10^{1}$ **2** = $*10^{2}$ **3** = $*10^{3}$ **4** = $*10^{4}$ **5** = $*10^{5}$ **6** = $*10^{6}$ **0000** = Jumper	**D** = ± 0.5 % **F** = ± 1 % **Z** = Jumper	**P5** **PW** **E0**	up to 2 digits **00** = standard

PRODUCT DESCRIPTION: MCT 0603-25 0.5 % PW 4K64

MCT	0603	-25	0.5 %	PW	4K64
MODEL	SIZE	TCR	TOLERANCE	PACKAGING (2)	RESISTANCE VALUE
MCS **MCT** **MCU** **MCA**	**0402** **0603** **0805** **1206**	± **25** ppm/K ± **50** ppm/K	± **0.5** % ± **1** %	**P5** **PW** **E0**	**47K** = 47 kΩ **50R1** = 50.1 Ω **0R0** = Jumper (3)

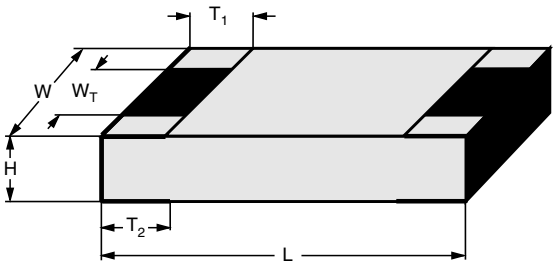
Notes

(1) Products can be ordered using either the PRODUCT DESCRIPTION or the PART NUMBER

(2) Please refer to table PACKAGING, next page

(3) Jumpers are ordered by the resistance value 0 Ω, e.g. MCT 0603 P5 0R0

DIMENSIONS



DIMENSIONS - chip resistor types, mass and relevant physical dimensions

TYPE	H (mm)	L (mm)	W (mm)	W_T (mm)	T_1 (mm)	T_2 (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

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE					
DESCRIPTION		RESISTANCE VALUE [1]			
TCR	TOLERANCE	MCS 0402	MCT 0603	MCU 0805	MCA 1206
± 50 ppm/K	± 1 %	10 Ω to 4.99 MΩ	1 Ω to 10 MΩ	1 Ω to 10 MΩ	1 Ω to 10 MΩ
	± 0.5 %	100 Ω to 221 kΩ	39 Ω to 511 kΩ	10 Ω to 1.5 MΩ	10 Ω to 2 MΩ
± 25 ppm/K	± 0.5 %	100 Ω to 221 kΩ	39 Ω to 511 kΩ	10 Ω to 1.5 MΩ	10 Ω to 2 MΩ
Jumper	-	≤ 20 mΩ; $I_{max.}$ = 0.63 A	≤ 20 mΩ; $I_{max.}$ = 1 A	≤ 20 mΩ; $I_{max.}$ = 1.5 A	≤ 20 mΩ; $I_{max.}$ = 2 A

Note
[1] Resistance values to be selected for ± 1 % tolerance from E24 and E96; for ± 0.5 % tolerance from E24 and E192

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

PACKAGING		
MODEL	REEL	
	PIECES/ PAPER TAPE ON REEL	CODE
MCS 0402	10 000	E0
MCT 0603	5000	P5
	20 000	PW
MCU 0805	5000	P5
	20 000	PW
MCA 1206	5000	P5
	20 000	PW

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 Al_2O_3 ceramic substrate 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 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. Only accepted products are laid directly into the paper tape in accordance with **EN 60286-3**.

ASSEMBLY

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapour 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, 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. The immunity of the plating against tin whisker growth has been proven under extensive testing.

All products comply with the **GADSL** [1] and the **CEFIC-EECA-EICTA** [2] list of legal restrictions on hazardous substances. This includes full compliance with the following directives:

- 2000/53/EC End of Vehicle life Directive (ELV) an Annex II (ELV II)
- 2002/95/EC Restriction of the use of Hazardous Substances Directive (RoHS)
- 2002/96/EC Waste Electrical and Electronic Equipment Directive (WEEE)

Solderability is specified for 2 years after production or requalification. The permitted storage time is 20 years.

APPROVALS

The resistors are tested in accordance with **EN 140401-801** (superseding **CECC 40401-801**) which refers to **EN 60115-1** and **EN 140400**. Approval of conformity is indicated by the **CECC** logo on the package label.

Vishay BEYSCHLAG has achieved **"Approval of Manufacturer"** in accordance with **EN 100114-1**. The release certificate for **"Technology Approval Schedule"** in accordance with **CECC 240 001** based on **EN 100114-6** is granted for the Vishay BEYSCHLAG manufacturing process.

SPECIALS

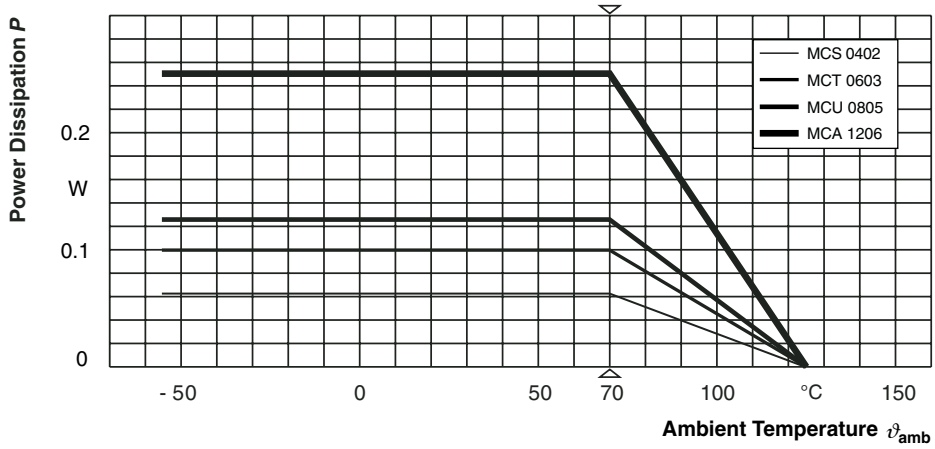
This product family of thin film flat chip resistors is completed by **Zero Ohm Jumpers**.
On request, resistors are available with established reliability in accordance with **EN 140401-801 Version E**. Please refer to the special data sheet for information on failure rate level, available resistance ranges and order codes.

Notes

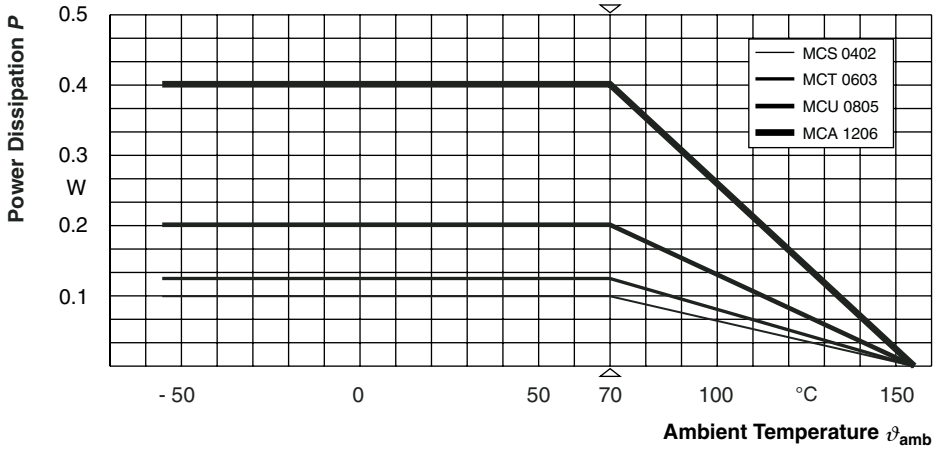
[1] Global Automotive Declarable Substance List, see www.gadsl.org

[2] CEFIC (European Chemical Industry Council), EECA (European Electronic Component Manufacturers Association), EICTA (European trade organisation representing the information and communications technology and consumer electronics), see www.eicta.org → issue → environment policy → chemicals → chemicals for electronics

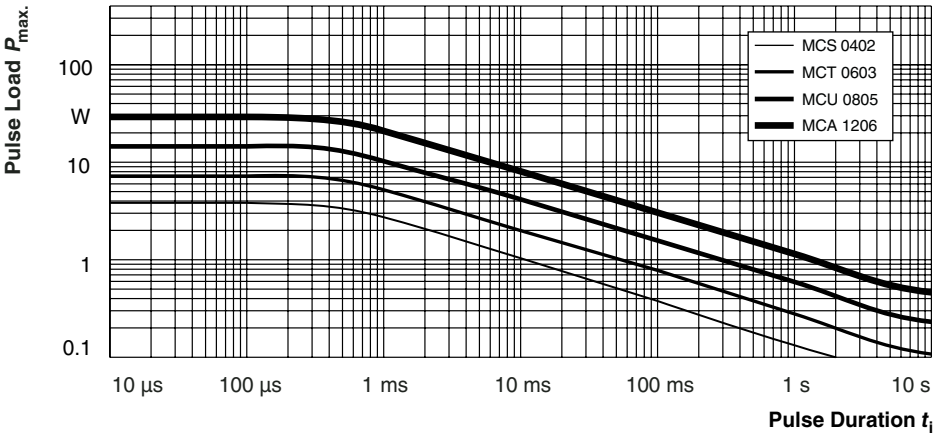
FUNCTIONAL PERFORMANCE



Derating - Standard Operation

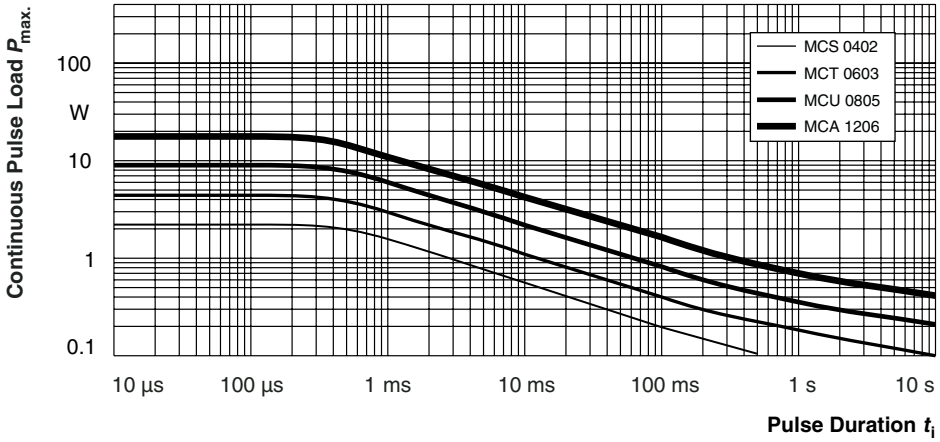


Derating - Power Operation



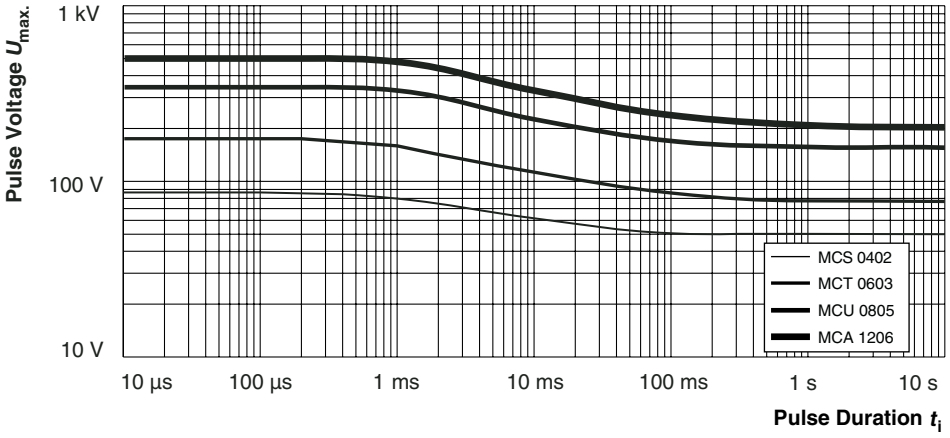
Maximum pulse load, single pulse; for permissible resistance change equivalent to 8000 h operation

Single Pulse



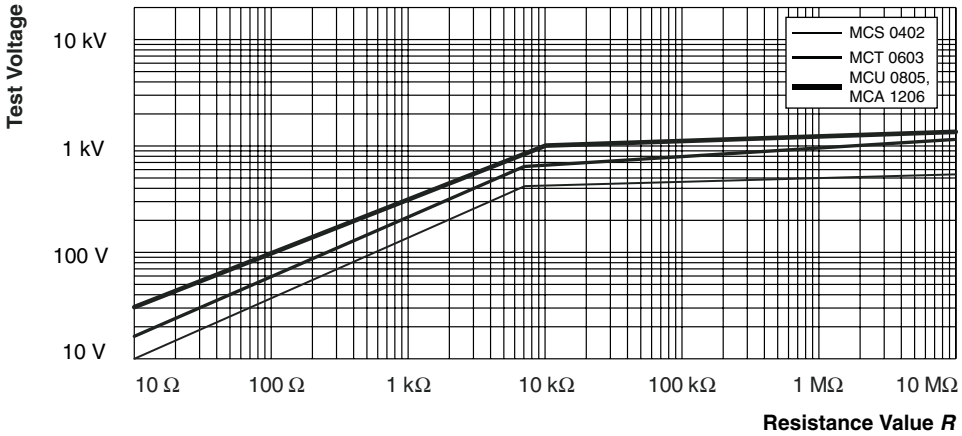
Maximum pulse load, continuous pulses; for permissible resistance change equivalent to 8000 h operation

Continuous Pulse



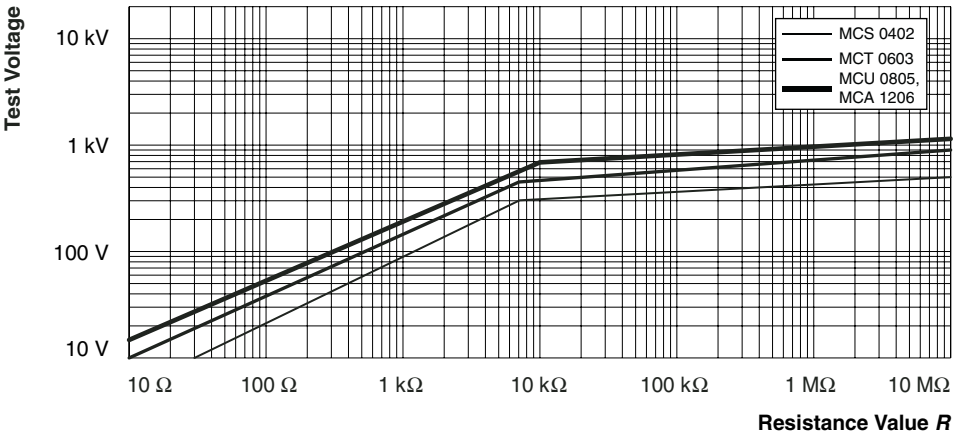
Maximum pulse voltage, single and continuous pulses; for permissible resistance change equivalent to 8000 h operation

Pulse Voltage



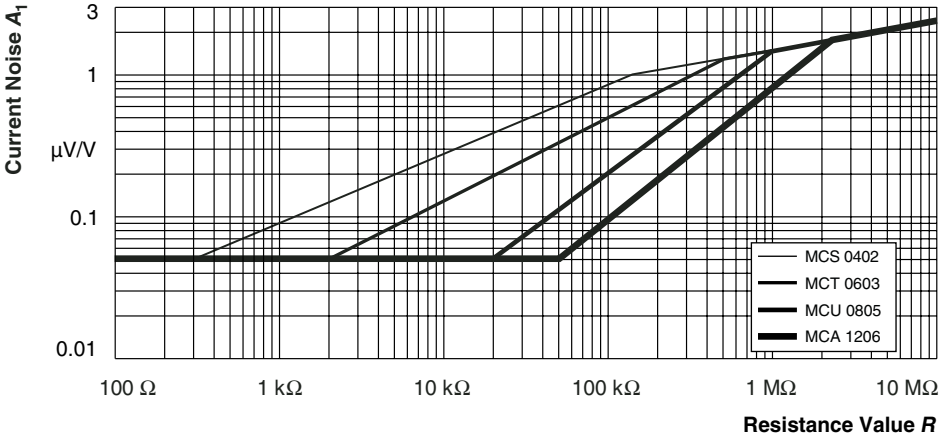
Pulse load rating in accordance with EN 60115-1 clause 4.27; 1.2 µs/50 µs; 5 pulses at 12 s interval; for permissible resistance change 0.5 %

1.2/50 Pulse



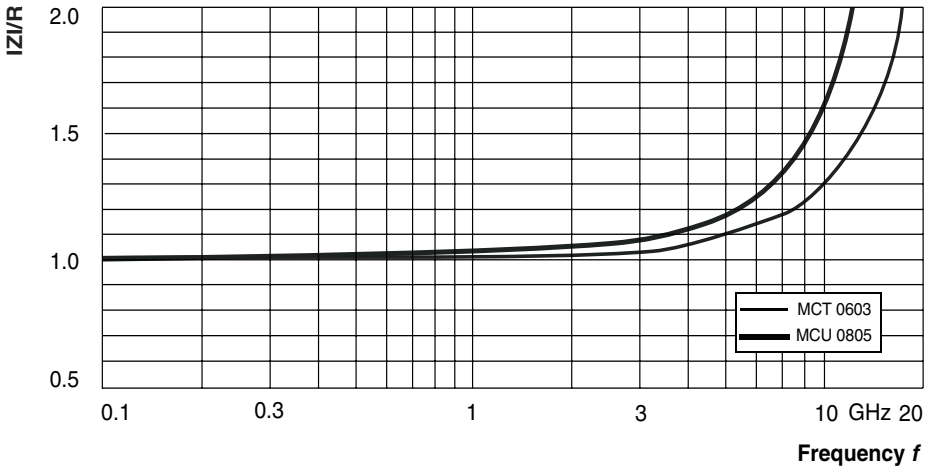
Pulse load rating in accordance with EN 60115-1 clause 4.27; 10 µs/700 µs;
10 pulses at 1 min intervals; for permissible resistance change 0.5 %

10/700 Pulse



Current noise A_1 in accordance with IEC 60 195

Current Noise



IZI/R for 49.9 Ω chip resistor

RF-Behaviour

TESTS AND REQUIREMENTS

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

EN 60115-1, Generic specification (includes tests)

EN 140 400, Sectional specification (includes schedule for qualification approval)

EN 140 401-801, Detail specification (includes schedule for conformance inspection)

The components are approved in accordance with the European CECC-system, where applicable. The following table contains only the most important tests. For the full test schedule refer to the documents listed above. The testing also covers most of the requirements specified by EIA/IS-703 and JIS-C-5202.

The tests are carried out in accordance with IEC 60068 and under standard atmospheric conditions in accordance with IEC 60068-1, 5.3. Climatic category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper Category Temperature; damp heat, long term, 56 days) is valid.

Unless otherwise specified the following values apply:

Temperature: 15 °C to 35 °C

Relative humidity: 45 % to 75 %

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

The components are mounted for testing on boards in accordance with EN 60115-1, 4.31 unless otherwise specified.

The requirements stated in the Test Procedures and Requirements table are based on the required tests and permitted limits of EN 140 401-801. However, some additional tests and a number of improvements against those minimum requirements have been included.

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)	
				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 10 MΩ
4.5	-	Resistance		± 1 %; ± 0.5 %	
4.8.4.2	-	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 1.5 h on; 0.5 h off 70 °C; 1000 h 70 °C; 8000 h	± (0.25 % R + 0.05 Ω) ± (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 1.5 h on; 0.5 h off 70 °C; 1000 h 70 °C; 8000 h	± (0.5 % R + 0.05 Ω) ± (1 % R + 0.05 Ω)	

TEST PROCEDURES AND REQUIREMENTS					
EN 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)	
				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 10 MΩ
4.25.3	-	Endurance at upper category temperature	125 °C; 1000 h 155 °C; 1000 h	± (0.25 % R + 0.05 Ω) ± (0.5 % R + 0.05 Ω)	± (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)
4.23		Climatic sequence:		± (0.5 % R + 0.05 Ω)	± (1 % R + 0.05 Ω)
4.23.2	2 (Ba)	Dry heat	UCT; 16 h		
4.23.3	30 (Db)	Damp heat, cyclic	55 °C; 24 h; > 90 % RH; 1 cycle		
4.23.4	1 (Aa)	Cold	LCT; 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; 5 days; > 90 % RH; 5 cycles		
4.23.7	-	D.c. load	$U = \sqrt{P_{70} \times R} \leq U_{max.}$; 1 min LCT = - 55 °C UCT = 125 °C		
-	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		± (0.25 % R + 0.05 Ω)	± (0.5 % R + 0.05 Ω)

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)	
				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 10 MΩ
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	
4.37	-	Periodic electric overload; standard operation mode	$U = \sqrt{15 \times P_{70} \times R}$ or $U = 2 \times U_{max.}$; whichever is the less severe; 0.1 s on; 2.5 s off; 1000 cycles	± (0.5 % R + 0.05 Ω) no visible damage	
		Periodic electric overload; power operation mode		± (1 % R + 0.05 Ω) no visible damage	
4.22	6 (Fc)	Vibration	Endurance by sweeping; 10 to 2000 Hz; no resonance; amplitude ≤ 1.5 mm or ≤ 200 m/s^2; 6 h	± (0.1 % R + 0.01 Ω) no visible damage	
4.17.2	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	
4.18.2	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)	RR 1005M and RR 1608M; 9 N	No visible damage	
			RR 2012M and RR 3216M; 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, needle flame test; 10 s	No burning after 30 s	

Disclaimer

All product specifications and data are subject to change without notice.

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