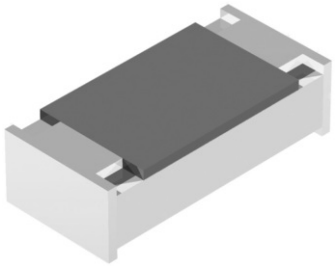
Professional Automotive Thin Film Chip Resistor



MC AT Professional Thin Film Chip Resistors are the perfect choice for most fields of modern professional electronics where reliability and stability is of major concern. Typical applications include automotive, telecommunication, industrial, medical equipment, precision test and measuring equipment.

FEATURES

- Operating temperature 175 °C, 1000 h
- Superior moisture resistivity < 0.5 % (85 °C; 85 % RH; 1000 h)
- Rated dissipation P_{85} up to 500 mW for size 1206
- AEC-Q200 compliant
- Green product, supports lead (Pb)-free soldering, RoHS compliant

RoHS COMPLIANT

APPLICATIONS

- Automotive
- Telecommunication
- Medical equipment
- Industrial equipment

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

TECHNICAL SPECIFICATIONS			
DESCRIPTION	**MCT 0603 AT**	**MCU 0805 AT**	**MCA 1206 AT**
Metric size	RR 1608M	RR 2012M	RR 3216M
Resistance range	100 Ω to 100 kΩ	100 Ω to 180 kΩ	100 Ω to 270 kΩ
Resistance tolerance	± 1 %; ± 0.5 %		
Temperature coefficient	± 50 ppm/K; ± 25 ppm/K		
Rated dissipation P_{85} (1)	0.150 W	0.25 W	0.500 W
Operating voltage, $U_{max.}$ AC/DC	75 V	150 V	200 V
Permissible film temperature (1)	175 °C		
Thermal resistance (2)	≤ 550 K/W	≤ 440 K/W	≤ 220 K/W
Insulation voltage			
1 min; U_{ins}	100 V	200 V	300 V
continuous	75 V	75 V	75 V
Observed failure rate $FIT_{observed}$	≤ 0.1 x 10^{-9}/h	≤ 0.1 x 10^{-9}/h	≤ 0.1 x 10^{-9}/h

Notes:

(1) Please refer to APPLICATION INFORMATION below

(2) Measuring conditions in accordance with EN 140401-801

For technical questions, contact: filmresistors.thinfilmchip@vishay.com
Document Number: 28760
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APPLICATION INFORMATION

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. At the maximum permissible film temperature of 175 °C the useful lifetime is specified for 1000 h. The designer may estimate the performance of the particular resistor application or set certain load and temperature limits in order to maintain a desired stability.

MAXIMUM RESISTANCE CHANGE AT RATED POWER - MCT 0603 AT				
DESCRIPTION		**MCT 0603 AT**		
Metric size		RR1608M		
Operation mode		Standard	Power	Advanced Temperature
Rated power		P_{70} = 0.1 W	P_{70} = 0.125 W	P_{85} = 0.15 W
Film temperature		125 °C	155 °C	175 °C
Max. resistance change at P_{70} for resistance range:		100 Ω to 100 kΩ		
$\Delta R/R$ max., after:	1000 h	≤ 0.15 %	≤ 0.25 %	
	8000 h	≤ 0.25 %	≤ 0.5 %	
	225 000 h	≤ 1.0 %	-	
Max. resistance change at P_{85} for resistance range:				100 Ω to 100 kΩ
$\Delta R/R$ max., after:	1000 h			≤ 0.5 %

MAXIMUM RESISTANCE CHANGE AT RATED POWER - MCU 0805 AT				
DESCRIPTION		**MCU 0805 AT**		
Metric size		RR 2012M		
Operation mode		Standard	Power	Advanced Temperature
Rated power		P_{70} = 0.125 W	P_{70} = 0.2 W	P_{85} = 0.25 W
Film temperature		125 °C	155 °C	175 °C
Max. resistance change at P_{70} for resistance range:		100 Ω to 180 kΩ		
$\Delta R/R$ max., after:	1000 h	≤ 0.15 %	≤ 0.25 %	
	8000 h	≤ 0.25 %	≤ 0.5 %	
	225 000 h	≤ 1.0 %	-	
Max. resistance change at P_{85} for resistance range:				100 Ω to 100 kΩ
$\Delta R/R$ max., after:	1000 h			≤ 0.5 %

MAXIMUM RESISTANCE CHANGE AT RATED POWER - MCA 1206 AT				
DESCRIPTION		**MCA 1206 AT**		
Metric size		RR 3216M		
Operation mode		Standard	Power	Advanced Temperature
Rated power		P_{70} = 0.25 W	P_{70} = 0.4 W	P_{85} = 0.5 W
Film temperature		125 °C	155 °C	175 °C
Max. resistance change at P_{70} for resistance range:		100 Ω to 270 kΩ		
$\Delta R/R$ max., after:	1000 h	≤ 0.15 %	≤ 0.25 %	
	8000 h	≤ 0.25 %	≤ 0.5 %	
	225 000 h	≤ 1.0 %	-	
Max. resistance change at P_{85} for resistance range:				100 Ω to 100 kΩ
$\Delta R/R$ max., after:	1000 h			≤ 0.5 %

PART NUMBER AND PRODUCT DESCRIPTION (1)

PART NUMBER: MCT0603MD4641DPW00

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

MODEL/SIZE	SPECIAL CHARACTER	TCR	VALUE	TOLERANCE	PACKAGING (2)	SPECIAL
MCT0603 **MCU0805** **MCA1206**	**M** = AT (Automotive)	**D** = ± 25 ppm/K **C** = ± 50 ppm/K **Z** = Jumper	**3 digit value** **1 digit multiplier** MULTIPLIER **0** = $*10^0$ **1** = $*10^1$ **2** = $*10^2$ **3** = $*10^3$ **4** = $*10^4$ **0000** = Jumper	**D** = ± 0.5 % **F** = ± 1 % **Z** = Jumper	**P5** **PW**	up to 2 digits **00** = standard

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

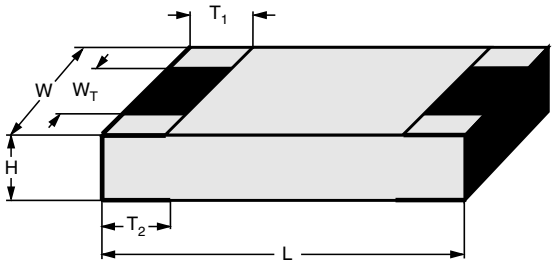
MCT	0603	- 25	0.5 %	AT	PW	4K64
MODEL	SIZE	TCR	TOLERANCE VALUE	SPECIAL CHARACTER	PACKAGING (2)	RESISTANCE VALUE
MCT **MCU** **MCA**	**0603** **0805** **1206**	± **25** ppm/K ± **50** ppm/K	± **0.5** % ± **1** %	**AT** = Automotive	**P5** **PW**	**47K** = 47 kΩ **0R0** = Jumper

Notes:

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

(2) Please refer to table PACKAGING below

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)
MCT 0603 AT	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 AT	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 AT	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	MCT 0603 AT	MCU 0805 AT	MCA 1206 AT
± 50 ppm/K	± 1 %	100 Ω to 100 kΩ	100 Ω to 180 kΩ	100 Ω to 270 kΩ
	± 0.5 %			
± 25 ppm/K	± 0.5 %			
Jumper	-	≤ 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
MCT 0603 AT	5000	P5
	20 000	PW
MCU 0805 AT	5000	P5
	20 000	PW
MCA 1206 AT	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 (96 % 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. 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. 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.

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) and 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)

APPROVALS

The resistors are tested in accordance with **EN 140401-801** (superseding **CECC 40401-801**) which refers to **EN 60115-1** and **EN 140400**. The approval is valid with regards to rated power P_{70} and a temperature range of - 55 °C to 155 °C.

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**.

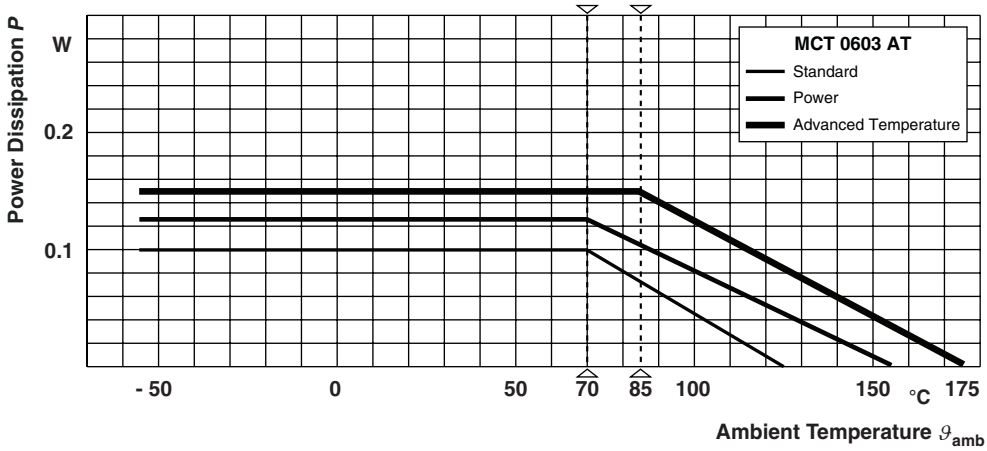
Notes

- The quoted IEC standards marked with an asterisk (*) are also released as EN standards with the same number and identical contents

(1) Global Automotive Declarable Substance List, see www.gadsl.org

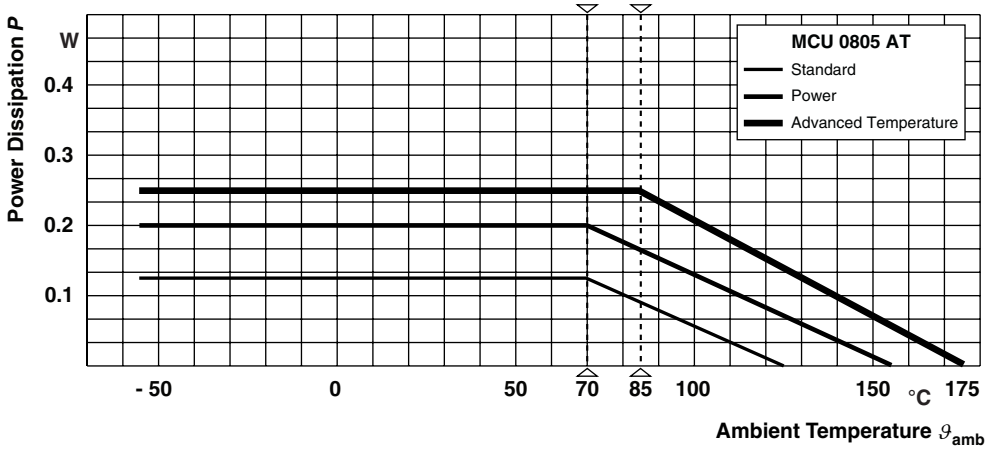
(2) CEFIC (European Chemical Industry Council), EECA (European Electronic Component Manufacturers Association), EICTA (European trade organisation representing the information and communications technology and consumer electronics), see www.eicta.org → issue → environment policy → chemicals → chemicals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

FUNCTIONAL PERFORMANCE



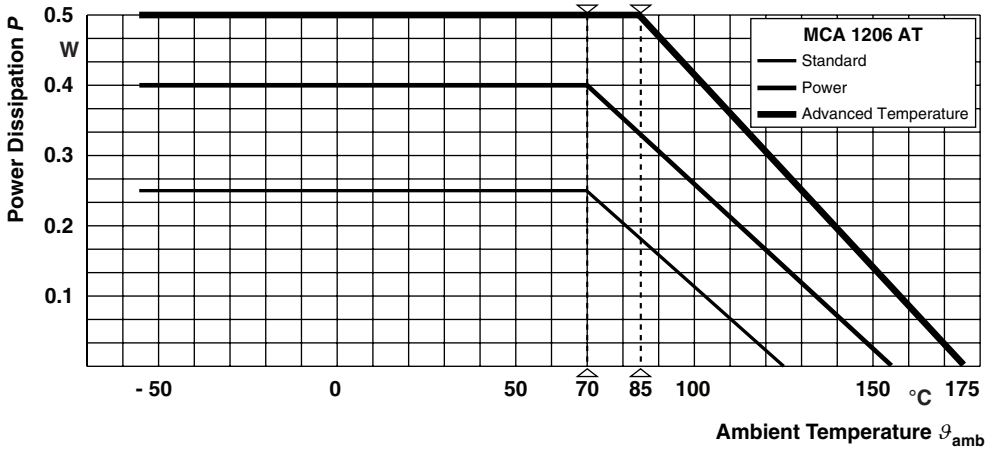
For permissible resistance change please refer to table MAXIMUM RESISTANCE CHANGE AT RATED POWER

Derating



For permissible resistance change please refer to table MAXIMUM RESISTANCE CHANGE AT RATED POWER

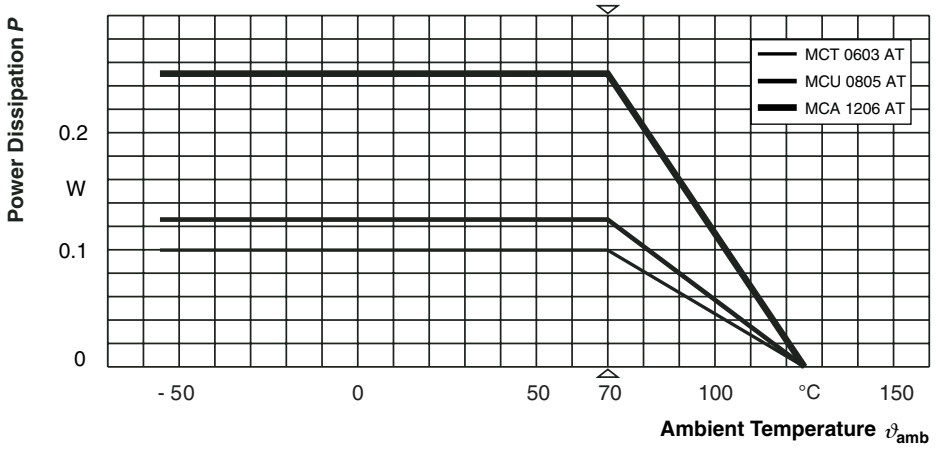
Derating



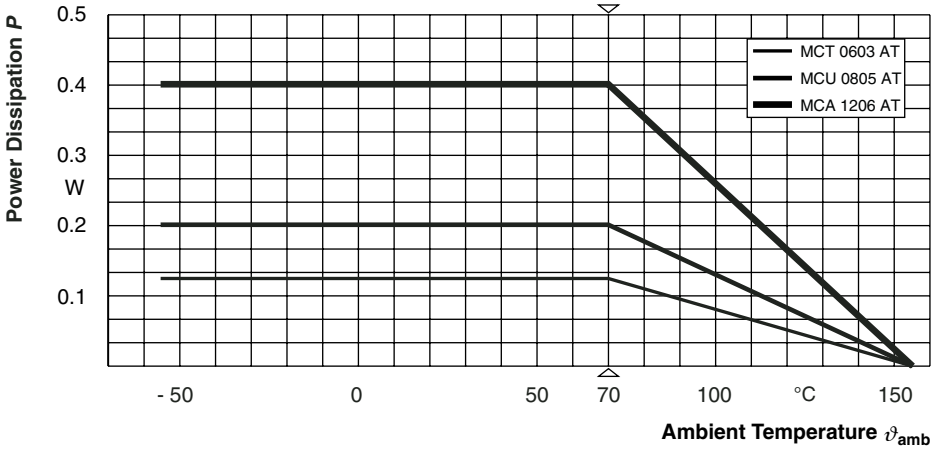
For permissible resistance change please refer to table MAXIMUM RESISTANCE CHANGE AT RATED POWER

Derating

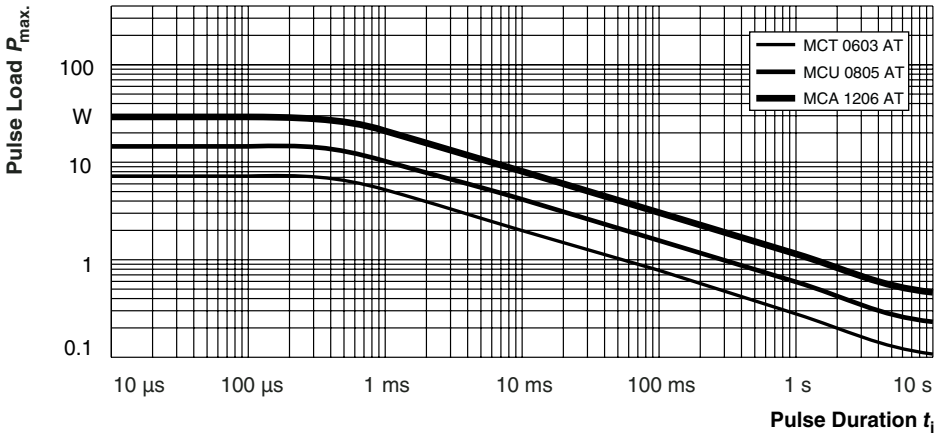
FUNCTIONAL PERFORMANCE



Derating - Standard Operation

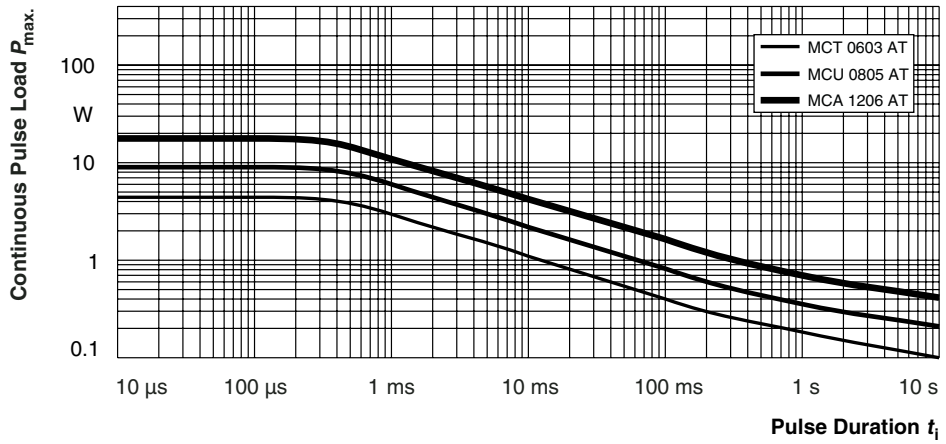


Derating - Power Operation



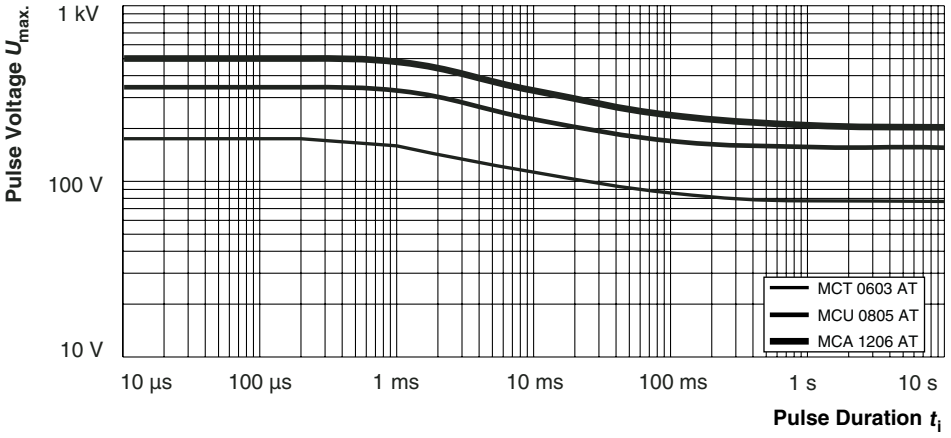
Maximum pulse load, single pulse; for permissible resistance change equivalent to 8000 h operation

Single Pulse



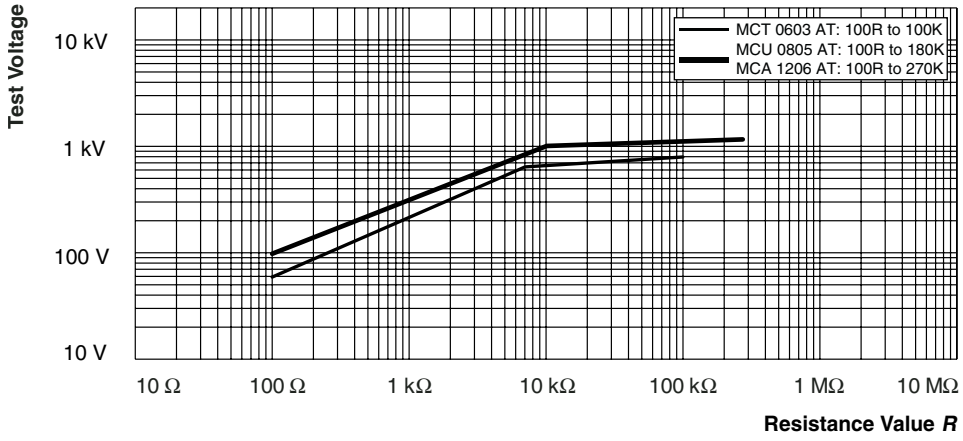
Maximum pulse load, continuous pulses; for permissible resistance change equivalent to 8000 h operation

Continuous Pulse



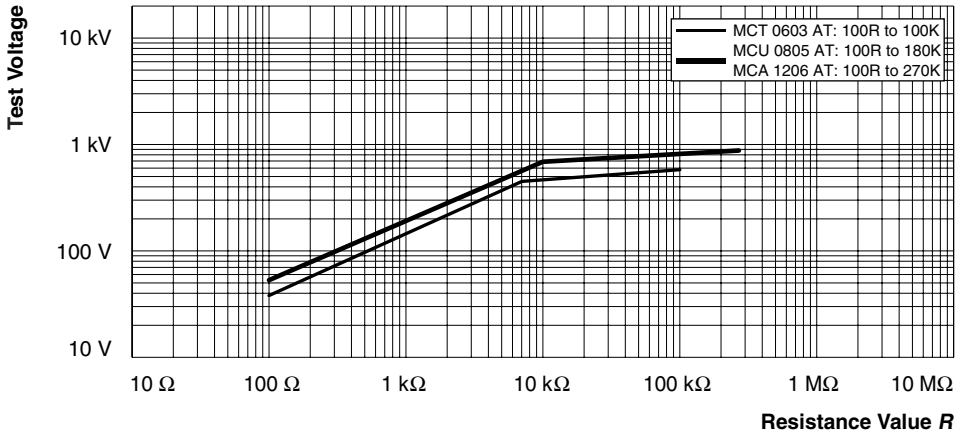
Maximum pulse voltage, single and continuous pulses; for permissible resistance change equivalent to 8000 h operation

Pulse Voltage



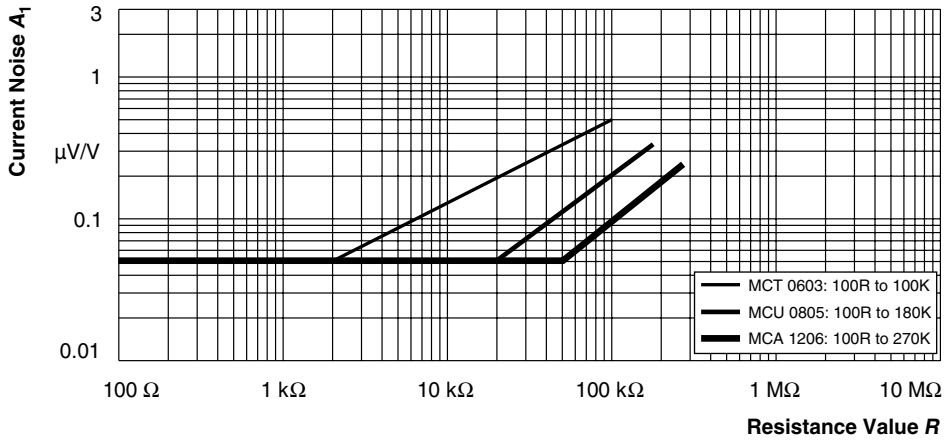
Pulse load rating in accordance with EN 60115-1 clause 4.27; 1.2 µs/50 µs; 5 pulses at 12 s interval;
for permissible resistance change 0.5 %

1.2/50 Pulse



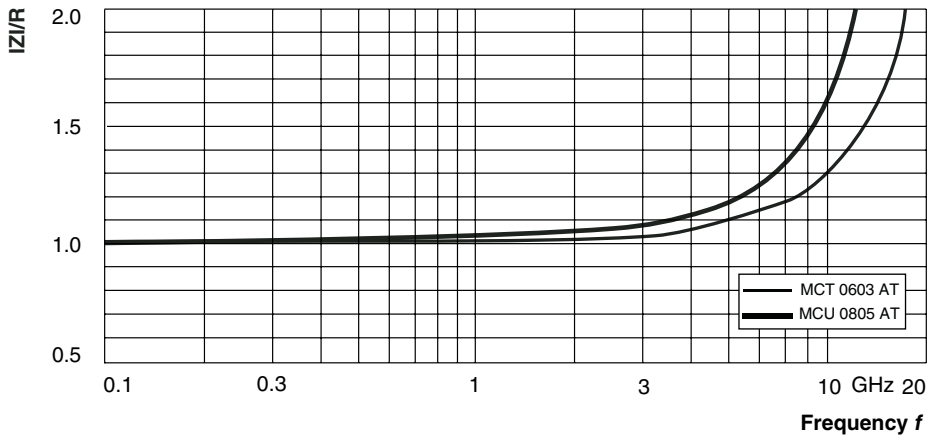
Pulse load rating in accordance with EN 60115-1 clause 4.27; 10 µs/700 µs;
10 pulses at 1 min intervals; for permissible resistance change 0.5 %

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

EN 140 400, Sectional specification

EN 140 401-801, Detail specification

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 (LCT = - 55 °C/UCT = 155 °C).

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 1 060 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 for product types:	
			MCT 0603 AT	100 Ω to 100 kΩ
			MCU 0805 AT	100 Ω to 180 kΩ
			MCA 1206 AT	100 Ω to 270 kΩ
4.5	-	Resistance		± 1 %; ± 0.5 %
4.8.4.2	-	Temperature coefficient	At 20/- 55/20 °C and 20/155/20 °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;	
			70 °C; 1000 h	± (0.15 % R + 0.05 Ω)
			70 °C; 8000 h	± (0.25 % 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;	
			70 °C; 1000 h	± (0.3 % R + 0.05 Ω)
			70 °C; 8000 h	± (0.5 % R + 0.05 Ω)
4.25.3	-	Endurance at upper category temperature	125 °C; 1000 h 155 °C; 1000 h 175 °C; 1000 h	± (0.15 % R + 0.05 Ω) ± (0.3 % R + 0.05 Ω) ± (0.5 % R + 0.05 Ω)
4.24	78 (Cab)	Damp heat, steady state	(40 ± 2) °C; 56 days; (93 ± 3) % RH $U = 0.3\ U_{rated}$	± (0.1 % 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 for product types:	
			MCT 0603 AT	100 Ω to 100 kΩ
			MCU 0805 AT	100 Ω to 180 kΩ
			MCA 1206 AT	100 Ω to 270 kΩ
4.39	67 (Cy)	Damp heat, steady state, accelerated	(85 ± 2) °C; (85 ± 5) % RH $U = 0.3\ U_{rated}$ 1000 h	± (0.5 % R + 0.05 Ω)
4.23		Climatic sequence:		
4.23.2	2 (Ba)	dry heat	155 °C; 16 h	
4.23.3	30 (Db)	damp heat, cyclic	55 °C; 24 h; > 90 % RH; 1 cycle	
4.23.4	1 (Aa)	cold	- 55 °C; 2 h	± (0.5 % R + 0.05 Ω)
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	
-	1 (Aa)	Storage at low temperature	- 55 °C; 2 h	± (0.1 % R + 0.01 Ω)
4.19	14 (Na)	Rapid change of temperature	30 min at - 55 °C and 30 min at 155 °C; 1000 cycles	± (0.5 % R + 0.01 Ω)
4.13	-	Short time overload; standard operation mode	$U = 2.5 \times \sqrt{P_{70} \times R} \leq 2 \times U_{max.}$; 5 s	± (0.1 % R + 0.01 Ω)
		Short time overload; power operation mode		± (0.25 % R + 0.05 Ω)
4.27	-	Single pulse high voltage overload; standard operation mode	Severity no. 4: $U = 10 \times \sqrt{P_{70} \times R} \leq 2 \times U_{max.}$; 10 pulses	± (0.25 % R + 0.05 Ω)
		Single pulse high voltage overload; power operation mode		± (0.5 % R + 0.05 Ω)
4.37	-	Periodic electric overload; standard operation mode	$U = \sqrt{15 \times P_{70} \times R} \leq 2 \times U_{max.}$; 0.1 s ON; 2.5 s OFF; 1000 cycles	± (0.5 % R + 0.05 Ω)
		Periodic electric overload; power operation mode		± (1.0 % 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 for product types:	
			MCT 0603 AT	100 Ω to 100 kΩ
			MCU 0805 AT	100 Ω to 180 kΩ
			MCA 1206 AT	100 Ω to 270 kΩ
-	-	ESD (Electro Static Discharge)	MIL-STD-883, Method 3015; 1000 V	± (0.5 % R + 0.05 Ω)
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
4.29	45 (XA)	Component solvent resistance	Isopropyl alcohol + 50 °C; method 2	No visible damage
4.32	21 (Ue_3)	Shear (adhesion)	RR 1608M; 9 N	No visible damage
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	Needle flame test; 10 s	No burning after 30 s