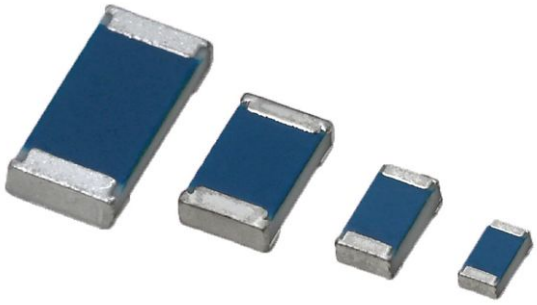
Precision Thin Film Chip Resistors



Automotive-grade MC AT precision thin film chip resistors are the perfect choice for most fields of modern precision electronics where reliability and stability is of major concern. Typical applications include automotive, industrial, telecommunication, medical equipment, precision test and measuring equipment.

FEATURES

- Rated dissipation P_{70} up to 0.4 W for size 1206
- AEC-Q200 qualified
- Approved to EN 140401-801
- Superior temperature cycling robustness
- Waste gas resistance verified by ASTM B 809
- Superior temperature cycling robustness
- Lead (Pb)-free solder contacts
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912

AUTOMOTIVE GRADE

RoHS COMPLIANT

APPLICATIONS

- Automotive
- Telecommunication
- Medical equipment
- Industrial equipment

TECHNICAL SPECIFICATIONS

	MCS 0402 AT	MCT 0603 AT	MCU 0805 AT	MCA 1206 AT
Imperial size	0402	0603	0805	1206
Metric size code	RR1005M	RR1608M	RR2012M	RR3216M
Resistance range (1)	47 Ω to 221 kΩ	47 Ω to 511 kΩ	47 Ω to 1 MΩ	47 Ω to 1 MΩ
Resistance tolerance	± 0.1 %			
Temperature coefficient	± 25 ppm/K; ± 15 ppm/K; ± 10 ppm/K			
Rated dissipation P_{70} (2)	0.100 W	0.125 W	0.200 W	0.400 W
Operating voltage, $U_{max.}$ AC/DC	50 V	75 V	150 V	200 V
Permissible film temperature, ϑ_F max. (2)	155 °C			
Operating temperature range	- 55 °C to 155 °C			
Insulation voltage				
1 min; U_{ins}	75 V	100 V	200 V	300 V
Continuous	75 V	75 V	75 V	75 V
Failure rate: $FIT_{observed}$	≤ 0.1 x 10^{-9}/h			

Notes

(1) The AEC-Q200 qualification of the extended ranges (> 100 kΩ; > 47 kΩ for 0402) is pending.

(2) Please refer to APPLICATION INFORMATION next page.

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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. Furthermore, a high level of ambient temperature or of power dissipation may raise the temperature of the solder joint, hence special solder alloys or board materials may be required to maintain the reliability of the assembly.

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. 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 DISSIPATION		
Operation mode	**Standard**	**Power**
Rated dissipation	P_{70}	P_{70}
MCS 0402 AT	0.063 W	0.100 W
MCT 0603 AT	0.100 W	0.125 W
MCU 0805 AT	0.125 W	0.200 W
MCA 1206 AT	0.250 W	0.400 W
Applied maximum film temperature, ϑ_F max.	125 °C	155 °C
Max. resistance change at rated dissipation for resistance range:		
MCS 0402 AT	47 Ω to 221 kΩ	47 Ω to 221 kΩ
MCT 0603 AT	47 Ω to 511 kΩ	47 Ω to 511 kΩ
MCU 0805 AT	47 Ω to 1 MΩ	47 Ω to 1 MΩ
MCA 1206 AT	47 Ω to 1 MΩ	47 Ω to 1 MΩ
$\lvert\Delta R/R\rvert$ max., after:		
1000 h	≤ 0.1 %	≤ 0.2 %
8000 h	≤ 0.2 %	≤ 0.4 %
225 000 h	≤ 0.6 %	-

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PART NUMBER AND PRODUCT DESCRIPTION

Part Number: MCT0603MD4641BPW00

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

TYPE/SIZE	VERSION	TCR	RESISTANCE	TOLERANCE	PACKAGING
MCS0402 **MCT0603** **MCU0805** **MCA1206**	**M** = AT (Automotive)	**F** = ± 10 ppm/K **E** = ± 15 ppm/K **D** = ± 25 ppm/K	**3 digit value** **1 digit** **multiplier** MULTIPLIER **9** = $*10^{-1}$ **0** = $*10^{0}$ **1** = $*10^{1}$ **2** = $*10^{2}$ **3** = $*10^{3}$ **4** = $*10^{4}$	**B** = ± 0.1 %	**E1** **E0** **P1** **P5** **PW**

Product Description: MCT 0603-25 0.1 % AT PW 4K64

MCT	0603	-25	0.1 %	AT	PW	4K64
TYPE	SIZE	TCR	TOLERANCE	VERSION	PACKAGING	RESISTANCE
MCS **MCT** **MCU** **MCA**	**0402** **0603** **0805** **1206**	± **10** ppm/K ± **15** ppm/K ± **25** ppm/K	± **0.1 %**	**AT** = Automotive	**E1** **E0** **P1** **P5** **PW**	**4K64** = 4.64 kΩ

Note

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

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE

DESCRIPTION		RESISTANCE RANGE			
TCR	**TOLERANCE**	**MCS 0402 AT**	**MCT 0603 AT**	**MCU 0805 AT**	**MCA 1206 AT**
± 25 ppm/K	± 0.1 %	47 Ω to 221 kΩ	47 Ω to 511 kΩ	47 Ω to 1 MΩ	47 Ω to 1 MΩ
± 15 ppm/K		47 Ω to 100 kΩ	47 Ω to 221 kΩ	47 Ω to 332 kΩ	47 Ω to 511 kΩ
± 10 ppm/K		47 Ω to 10 kΩ	47 Ω to 22.1 kΩ	47 Ω to 33.2 kΩ	47 Ω to 43.2 kΩ

Note

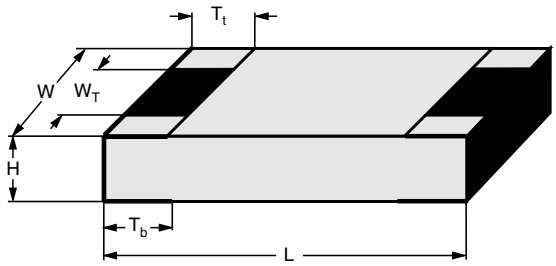
- Resistance values are available from the E24 and E192 series.

PACKAGING

TYPE	CODE	QUANTITY	PACKAGING STYLE	WIDTH	PITCH	REEL DIAMETER
MCS 0402 AT	E1	1000	Tape and reel cardboard tape acc. IEC 60286-3 Type I	8 mm	2 mm	180 mm/7"
	E0	10 000				330 mm/13"
MCT 0603 AT	P1	1000		8 mm	4 mm	180 mm/7"
	P5	5000				
	PW	20 000				330 mm/13"
MCU 0805 AT	P1	1000		8 mm	4 mm	180 mm/7"
	P5	5000				
	PW	20 000				330 mm/13"
MCA 1206 AT	P1	1000		8 mm	4 mm	180 mm/7"
	P5	5000				

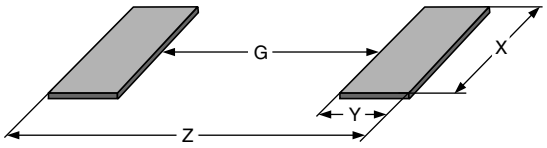
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DIMENSIONS



DIMENSIONS AND MASS							
TYPE	H (mm)	L (mm)	W (mm)	W_T (mm)	T_t (mm)	T_b (mm)	MASS (mg)
MCS 0402 AT	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 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	0.52 ± 0.1	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

SOLDER PAD DIMENSIONS



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

Note

- The rated dissipation applies only if the permitted film temperature is not exceeded. Furthermore, a high level of ambient temperature or of power dissipation may raise the temperature of the solder joint, hence special solder alloys or boardmaterials may be required to maintain the reliability of the assembly. Specified power rating above 125 °C requires dedicated heat-sink pads, which to a great extend depends on board materials and design.
  The given solder pad dimensions reflect the considerations for board design and assembly as outlined e.g. in standards IEC 61188-5-x, or in publication IPC-7351. They do not guarantee any supposed thermal properties, particularly as these are also strongly influenced by many other parameters.
  Still, the given solder pad dimensions will be found adequate for most general applications, e.g. those referring to “standard operation mode”. Please note however that applications for “power operation mode” require special considerations for the design of solder pads and adjacent conductor areas.
  The terminations design withstands extended temperature cycling on the PCB. The robustness has been verified with appropriate solder paste material through extensive testing.

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DESCRIPTION

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A homogeneous film of special 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. The resistor elements are covered by a unique 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** [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** [3]. 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)
- 2011/65/EU Restriction of the use of Hazardous Substances directive (RoHS)
- 2002/96/EC Waste Electrical and Electronic Equipment Directive (WEEE)

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 140400** and the variety of environmental test procedures of the **IEC 60068** [3] series. The detail specification refers to the climatic categories 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.

The resistors are qualified according to AEC-Q200. Qualification of the extended ranges is pending.

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** is granted for the Vishay BEYSCHLAG manufacturing process.

RELATED PRODUCTS

For more information about products with higher operation temperature please refer to the **professional** datasheet (www.vishay.com/doc?28760).

Chip resistor arrays may be used in sensing applications or precision amplifiers where close matching between multiple resistors is necessary. Please refer to the ACAS AT - Precision datasheet (www.vishay.com/doc?28770).

MC AT Precision is also available with gold termination for conductive gluing. Please refer to the datasheet (www.vishay.com/doc?28877).

Notes

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

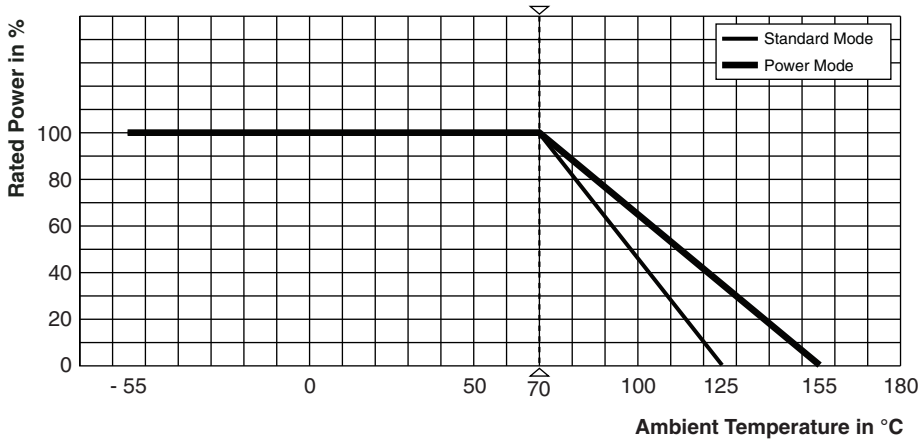
(2) CEFIC (European Chemical Industry Council), EECA (European Electronic Component Manufacturers Association), EICTA (European trade organisation representing the information and communications technology and consumer electronics), see www.eicta.org/index.php?id=995 → issues → environment policy → chemicals → chemicals for electronics.

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

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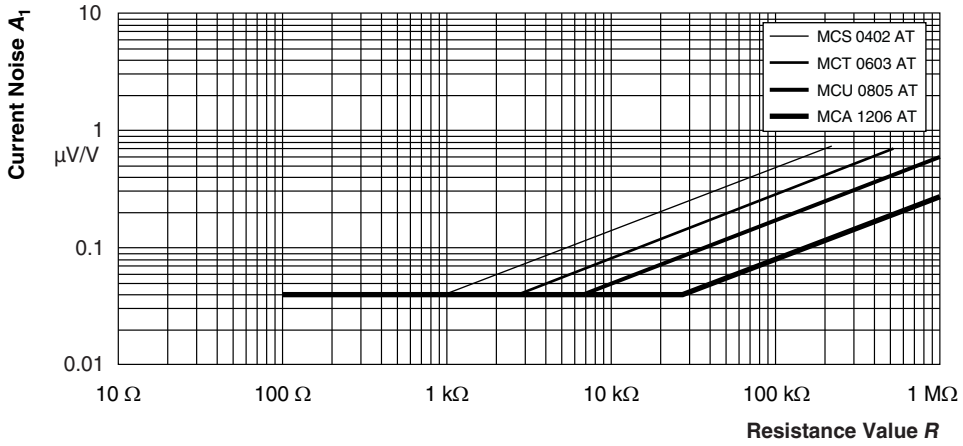
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FUNCTIONAL PERFORMANCE



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

Derating



Current noise A_1 in accordance with IEC 60195

Current Noise

TESTS AND REQUIREMENTS

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

EN 60115-1, generic specification

EN 140400, sectional specification

EN 140401-801, detail specification

The components are approved in accordance with the IECQ-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 = 125 °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 1060 mbar).

The components are mounted for testing on boards in accordance with EN 140400, 2.3.3 unless otherwise specified.

The requirements stated in the Test Procedures and Requirements table are based on the required tests and permitted limits of EN 140401-801. However, some additional tests and a number of improvements against those minimum requirements have been included.

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TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR) STABILITY CLASS 0.25 OR BETTER (1)
			Stability for product types:	
			MCS 0402 AT	47 Ω to 221 kΩ
			MCT 0603 AT	47 Ω to 511 kΩ
			MCU 0805 AT	47 Ω to 1 MΩ
			MCA 1206 AT	47 Ω to 1 MΩ
4.5	-	Resistance		± 0.1 % R
4.8.4.2	-	Temperature coefficient	At (20/- 55/20) °C and (20/155/20) °C	± 25 ppm/K; ± 15 ppm/K; ± 10 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 70 °C; 8000 h	± (0.1 % R + 0.02 Ω) ± (0.2 % R + 0.02 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 70 °C; 8000 h	± (0.2 % R + 0.02 Ω) ± (0.4 % R + 0.05 Ω)
4.25.3	-	Endurance at upper category temperature	125 °C; 1000 h 155 °C; 1000 h	± (0.15 % R + 0.02 Ω) ± (0.3 % R + 0.02 Ω)
4.24	78 (Cab)	Damp heat, steady state	(40 ± 2) °C; 56 days; (93 ± 3) % RH	± (0.1 % R + 0.02 Ω)
4.39	67 (Cy)	Damp heat, steady state, accelerated: Standard operation mode	(85 ± 2) °C (85 ± 5) % RH $U = \sqrt{0.1 \times P_{70} \times R}$; $U \leq 0.3 \times U_{max.}$; 1000 h	± (0.5 % R + 0.05 Ω)
4.23		Climatic sequence: Standard operation mode:		± (0.25 % R + 0.02 Ω)
4.23.2	2 (Ba)	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 (Aa)	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	$U = \sqrt{P_{70} \times R} \leq U_{max.}$; 1 min	
-	1 (Aa)	Storage at low temperature	- 55 °C; 2 h	± (0.05 % R + 0.01 Ω)
4.19	14 (Na)	Rapid change of temperature	30 min at - 55 °C and 30 min at 125 °C; 1000 cycles	± (0.25 % R + 0.02 Ω)
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	± (0.05 % R + 0.01 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	± (0.25 % R + 0.05 Ω)

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TEST PROCEDURES AND REQUIREMENTS				
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			Stability for product types:	
			MCS 0402 AT	47 Ω to 221 kΩ
			MCT 0603 AT	47 Ω to 511 kΩ
			MCU 0805 AT	47 Ω to 1 MΩ
			MCA 1206 AT	47 Ω to 1 MΩ
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)
4.40	-	Electro Static Discharge (Human Body Model)	IEC 61340-3-1; 3 pos. + 3 neg. (equivalent to MIL-STD-883, method 3015) MCS 0402 AT: 500 V MCT 0603 AT: 1000 V MCU 0805 AT: 1500 V MCA 1206 AT: 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	± (0.05 % 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	± (0.05 % 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)	RR1005M and RR1608M; 9 N	No visible damage
			RR2012M and RR3216M; 45 N	
4.33	21 (Ue_1)	Substrate bending	Depth 2 mm, 3 times	± (0.05 % 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

Note

[1] According to the detail specification EN 140401-801 the stability class applies to the category temperatures 85 °C and 125 °C and their respective test conditions.

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Material Category Policy

Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.

Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.

Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.

OCEAN CHIPS
Океан Электроники
Поставка электронных компонентов

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «**JONHON**», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «**FORSTAR**».

AVIC JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).

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Телефон: 8 (812) 309-75-97 (многоканальный)
Факс: 8 (812) 320-03-32
Электронная почта: ocean@oceanchips.ru
Web: http://oceanchips.ru/
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А