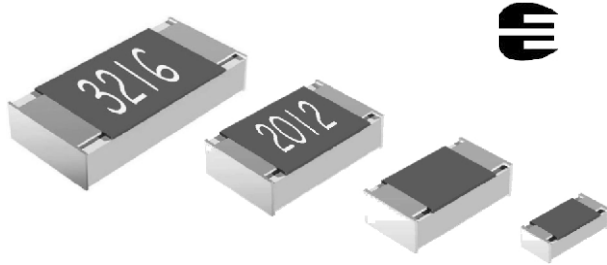




# Thin Film Chip Resistors with Established Reliability



MCS 0402 VG01, MCT 0603 VG01, MCU 0805 VG01 and MCA 1206 VG01 thin film flat chip resistors with established reliability are the perfect choice for all high-reliability applications typically found in military, aircraft and spacecraft electronics. These versions supplement the families of professional and precision thin film flat chip resistors MCS 0402, MCT 0603, MCU 0805 and MCA 1206.

## FEATURES

- Approved to EN 140401-801, version E
- Established reliability, failure rate level E6
- Advanced thin film technology
- Pure Sn termination on Ni barrier layer
- Single lot date code
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



## APPLICATIONS

- Military
- Avionics
- Space

METRIC SIZE				
IMPERIAL	0402	0603	0805	1206
EN/CECC	RR1005M	RR1608M	RR2012M	RR3216M

TECHNICAL SPECIFICATIONS				
DESCRIPTION	MCS 0402 VG01	MCT 0603 VG01	MCU 0805 VG01	MCA 1206 VG01
EN/CECC style (size)	RR1005M	RR1608M	RR2012M	RR3216M
Resistance range	10 Ω to 1 MΩ; 0 Ω	1 Ω to 1 MΩ; 0 Ω		
Resistance tolerance	± 1 %; ± 0.1 %			
Temperature coefficient	± 50 ppm/K; ± 15 ppm/K			
Rated dissipation, $P_{70}$	0.063 W	0.1 W	0.125 W	0.25 W
Operating voltage, $U_{max}$ AC/DC	50 V	75 V	150 V	200 V
Permissible film temperature, $\vartheta_{F max}$	125 °C			
Operating temperature range	- 55 °C to 125 °C			
Max. resistance change at $P_{70}$ for resistance range, $ \Delta R/R $ max. after:	10 Ω to 1 MΩ	1 Ω to 1 MΩ		
	1000 h	≤ 0.25 %		
	8000 h	≤ 0.5 %		
	225 000 h	≤ 1.5 %		
Permissible voltage against ambient (insulation):	1 min; $U_{ins}$	75 V	100 V	200 V
	Continuous	75 V	75 V	75 V
Assessed failure rate level	E6 = $10^{-6}/h$			
Quality factor, $\pi_Q$	0.3			
Failure rate: FIT <sub>observed</sub>	< 0.1 x $10^{-9}/h$			

### Notes

- 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 failure rate level E6 ( $10^{-6}/h$ ,  $\pi_Q = 0.3$ ), corresponding to MIL Level P, is superior to level E5 ( $10^{-5}/h$ ,  $\pi_Q = 1$ ) and thus may be used as a replacement.



PART NUMBER AND PRODUCT DESCRIPTION																	
Part Number: MCT0603HC2873FP500																	
Part Number: MCT0603HZ0000ZP500																	
M	C	T	0	6	0	3	H	C	2	8	7	3	F	P	5	0	0
M	C	T	0	6	0	3	H	Z	0	0	0	0	Z	P	5	0	0
TYPE/SIZE	VERSION				TCR				RESISTANCE				TOLERANCE		PACKAGING		
MCS 0402 MCT 0603 MCU 0805 MCA 1206	H = EN 140401-801, "Version E"; failure rate level E6				C = ± 50 ppm/K E = ± 15 ppm/K Z = Jumper				3 digit value 1 digit multiplier  MULTIPLIER 8 = *10 <sup>-2</sup> 9 = *10 <sup>-1</sup> 0 = *10 <sup>0</sup> 1 = *10 <sup>1</sup> 2 = *10 <sup>2</sup> 3 = *10 <sup>3</sup> 4 = *10 <sup>4</sup> 0000 = Jumper				F = ± 1 % B = ± 0.1 % Z = Jumper		E1 E0 P1 P5		
Product Description: MCT 0603-50 1 % VG01 P5 287K																	
Product Description: MCT 0603 VG01 P5 0R0																	
MCT 0603	-50	1 %	VG01				P5		287K								
MCT 0603	-	-	VG01				P5		0R0								
TYPE/SIZE	TCR		TOLERANCE		VERSION				PACKAGING		RESISTANCE						
MCS 0402 MCT 0603 MCU 0805 MCA 1206	± 50 ppm/K ± 15 ppm/K		± 1 % ± 0.1 %		VG01 = EN 140401-801, "Version E"; failure rate level E6				E1 E0 P1 P5		49R9 = 49.9 Ω 287K = 287 kΩ 0R0 = Jumper						

Notes

- The products can be ordered using either the PART NUMBER or the PRODUCT DESCRIPTION.
- Products within a packaging unit are single lot date code.



# MCS 0402 VG01, MCT 0603 VG01, MCU 0805 VG01, MCA 1206 VG01

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## EN 140401-801 ORDERING INFORMATION

Example of the ordering information for a resistor: MCT 0603-50 1 % VG01 287K

**EN140401-801EZRR1608MR287KFE6**

Example of the ordering information for a zero ohm jumper: MCT 0603 VG01 0R0

**EN140401-801EZRR1608M-0R00-E6**

The elements used in the component number have the following meaning:

<b>EN140401-801</b>	EN detail specification number
<b>EZ</b>	Assessment level for the zero-defect approach
<b>RR1608M</b>	Style (size)
<b>R</b>	Temperature coefficient, according to EN 60062 R = ± 50 ppm/K; P = ± 15 ppm/K
<b>287K</b>	Resistance, according to EN 60062, 4 characters
<b>F</b>	Tolerance on rated resistance, according to EN 60062 F = ± 1 %; B = ± 0.1 %
<b>E6</b>	Failure rate level according to EN 60115-1, annex ZR

### Note

- The ordering information according to EN 140401-801:2007 shown above succeeds and replaces the ordering information according to earlier versions of the detail specification EN 140401-801 or its predecessor CECC 40401-801, for example:

CECC 40401-801 EZ RR1608M C 287K F E6

CECC 40401-801 S RR1608M C 287K F E6

with EZ; S Assessment level, where EZ is successor to and superior replacement for S

RR1608M Style, with suffix M for "metric"

C Temperature coefficient, according to the detail specification

C = ± 50 ppm/K; E = ± 15 ppm/K

## TEMPERATURE COEFFICIENT AND RESISTANCE RANGE

DESCRIPTION		RESISTANCE			
TCR	TOLERANCE	MCS 0402 VG01	MCT 0603 VG01	MCU 0805 VG01	MCA 1206 VG01
± 50 ppm/K	± 1 %	10 Ω to 1 MΩ	1 Ω to 1 MΩ	1 Ω to 1 MΩ	1 Ω to 1 MΩ
± 15 ppm/K	± 0.1 %	100 Ω to 33.2 kΩ	100 Ω to 47.5 kΩ	100 Ω to 100 kΩ	43.2 Ω to 332 kΩ
Jumper		≤ 20 mΩ; I <sub>max.</sub> = 0.63 A	≤ 20 mΩ; I <sub>max.</sub> = 1 A	≤ 20 mΩ; I <sub>max.</sub> = 1.5 A	≤ 20 mΩ; I <sub>max.</sub> = 2 A

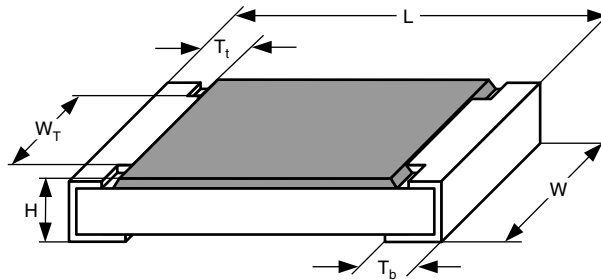
### Note

- According to EN 140401-801, resistance values are to be selected from the E96 series for ± 1 % tolerance and from the E192 series for ± 0.1 % tolerance.

## PACKAGING

TYPE	CODE	QUANTITY	CARRIER TAPE	WIDTH	PITCH	REEL DIAMETER
MCS 0402 VG01	E1	1000	Paper tape acc. IEC 60286-3 Type I	8 mm	2 mm	180 mm/7"
	E0	10 000				
MCT 0603 VG01	P1	1000				
	P5	5000				
MCU 0805 VG01	P1	1000		8 mm	4 mm	
	P5	5000				
MCA 1206 VG01	P1	1000				
	P5	5000				

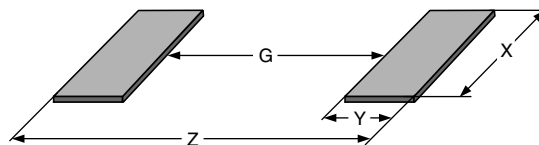
**DIMENSIONS**



DIMENSIONS AND MASS							
TYPE	H (mm)	L (mm)	W (mm)	W <sub>T</sub> (mm)	T <sub>b</sub> (mm)	T <sub>t</sub> (mm)	MASS (mg)
MCS 0402 VG01	0.32 ± 0.05	1.0 ± 0.05	0.5 ± 0.05	> 75 % of W	0.2 ± 0.1	0.2 + 0.1/- 0.15	0.6
MCT 0603 VG01	0.45 + 0.1/- 0.05	1.55 ± 0.05	0.85 ± 0.1		0.3 + 0.15/- 0.2	1.9	
MCU 0805 VG01	0.45 + 0.1/- 0.05	2.0 ± 0.1	1.25 ± 0.15		0.4 + 0.1/- 0.2	4.6	
MCA 1206 VG01	0.55 ± 0.1	3.2 + 0.1/- 0.2	1.6 ± 0.15		0.5 ± 0.25	9.2	

**Note**

- Resistors MCA 1206 VG01 and MCU 0805 VG01 are marked using the four-character code system of IEC 60062, 4.2.3. Resistors MCT 0603 VG01 and MCS 0402 VG01 do not show any marking on their light blue protective coating.



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 VG01	-	-	-	-	0.35	0.55	0.55	1.45
MCT 0603 VG01	0.55	1.10	1.10	2.75	0.65	0.70	0.95	2.05
MCU 0805 VG01	0.80	1.25	1.50	3.30	0.90	0.90	1.40	2.70
MCA 1206 VG01	1.40	1.50	1.90	4.40	1.50	1.15	1.75	3.80

**Note**

- 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, however, they will be found adequate for most general applications.



### 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 ( $Al_2O_3$ ) 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 performed on 100 % of the individual resistors. This includes pulse load screening for the elimination of products with a potential risk of early life failures according to EN 140401-801, 2.1.2.2 (feasible for  $R \geq 10 \Omega$ ). Only accepted products are laid directly into the paper tape in accordance with EN 60286-3<sup>(3)</sup>, Type I.

Products within a packaging unit are from the same production lot and carry the same date code.

### 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<sup>(3)</sup>. Solderability is specified for 2 years after production or requalification. The permitted storage time is 20 years.

The resistors are RoHS compliant; the pure tin plating provides compatibility with lead (Pb)-free soldering processes. The immunity of the plating against tin whisker growth has been proven under extensive testing.

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.

### Notes

(1) Global Automotive Declarable Substance List, see [www.gadsl.org](http://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=1053&id\\_article=340](http://www.eicta.org/index.php?id=1053&id_article=340).


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

All products comply with the GADSL<sup>(1)</sup> and the CEFIC-EECA-EICTA<sup>(2)</sup> 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<sup>(3)</sup> series.

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 IEC QC 001002-3, clause 2. The release certificate for “Technology Approval Schedule” in accordance with CECC 240001 based on IEC QC 001002-3, clause 6 is granted for the Vishay BEYSCHLAG manufacturing process.

The Vishay BEYSCHLAG production facility is registered with the CAGE code D9539.

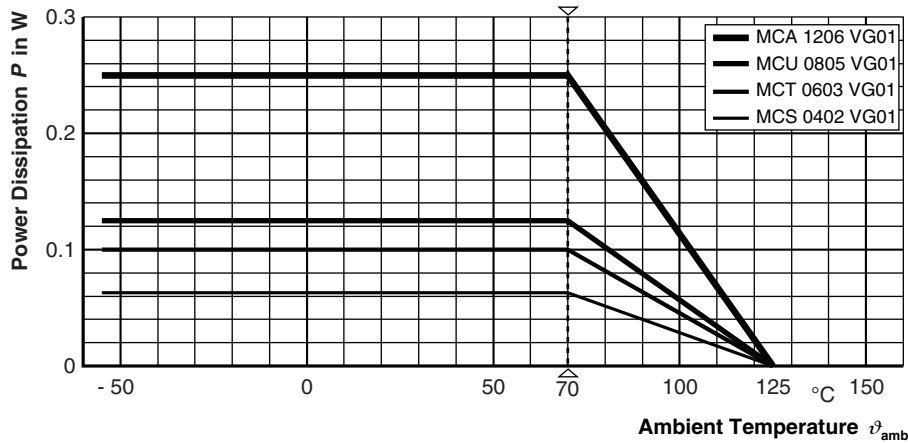
### RELATED PRODUCTS

A wider range of TCR, tolerance and resistance values, plus the option of values from a different E series is available with products approved to EN 140401-801, Version A, without established reliability, nominal failure rate level E0 (quality factor  $\pi_Q = 3$ ). See the datasheets:

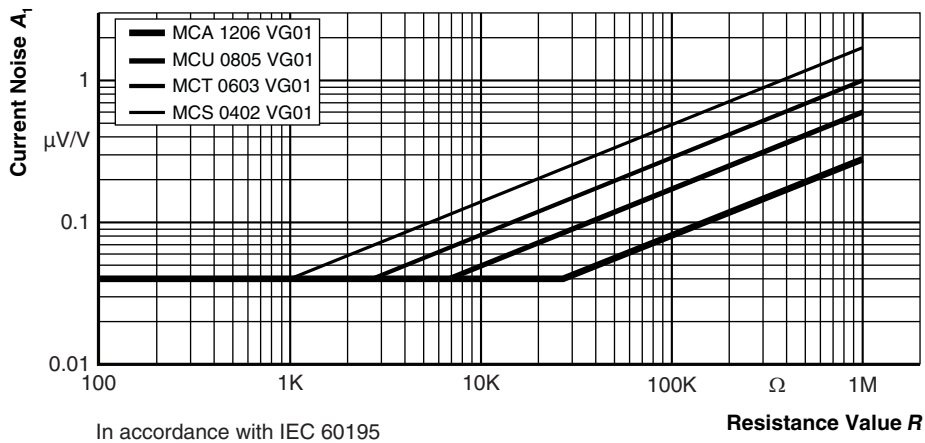
- “Professional Flat Chip Resistors” ([www.vishay.com/doc?28705](http://www.vishay.com/doc?28705))
- “Precision Flat Chip Resistors” ([www.vishay.com/doc?28700](http://www.vishay.com/doc?28700))



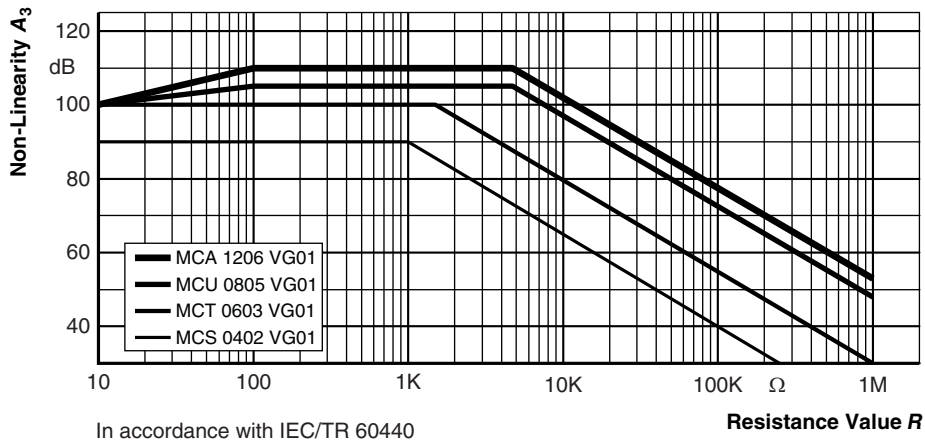
**FUNCTIONAL PERFORMANCE**



**Derating**



**Current Noise -  $A_1$**



**Non-Linearity -  $A_3$**



# MCS 0402 VG01, MCT 0603 VG01, MCU 0805 VG01, MCA 1206 VG01

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## FUNCTIONAL PERFORMANCE

Further information on the performance of these products is given in the following datasheets:

- “Professional Flat Chip Resistors”, document no. 28705
- “Precision Flat Chip Resistors”, document no. 28700

## 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

For further information on the tests and requirements of these products please refer to the specifications mentioned above, and to the following datasheets:

- “Professional Flat Chip Resistors”  
([www.vishay.com/doc?28705](http://www.vishay.com/doc?28705))
- “Precision Flat Chip Resistors”  
([www.vishay.com/doc?28700](http://www.vishay.com/doc?28700))

## HISTORICAL 12NC INFORMATION

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

## 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	5

## Historical 12NC Example

The 12NC of a MCT 0603 VG01 resistor, value 287K and TCR 50 with ± 1 % tolerance, supplied in cardboard tape of 5000 units per reel was: 2312 215 02874.

HISTORICAL 12NC - Resistor type and packaging						
DESCRIPTION			2312 ... ..			
			CARDBOARD TAPE ON REEL			
TYPE	TCR	TOL.	E1 1000 PIECES		E0 10 000 PIECES	
			MCS 0402 VG01	± 50 ppm/K	± 1 %	260 0...
± 15 ppm/K	± 0.1 %	262 0...		277 0...		
Jumper		262 90001		277 90001		
TYPE	TCR	TOL.	P1 1000 PIECES		P5 5000 PIECES	PW 20 000 PIECES
			MCT 0603 VG01	± 50 ppm/K	± 1 %	200 0...
± 15 ppm/K	± 0.1 %	202 0...		217 0...	-	
Jumper		202 90001		217 90001	207 90001	
MCU 0805 VG01	± 50 ppm/K	± 1 %	240 0...		255 0...	245 0...
	± 15 ppm/K	± 0.1 %	242 0...		257 0...	-
	Jumper		242 90001		257 90001	247 90001
MCA 1206 VG01	± 50 ppm/K	± 1 %	No 12NC assigned to MCA 1206 VG01			
	± 15 ppm/K	± 0.1 %				
	Jumper					



## Disclaimer

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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.**