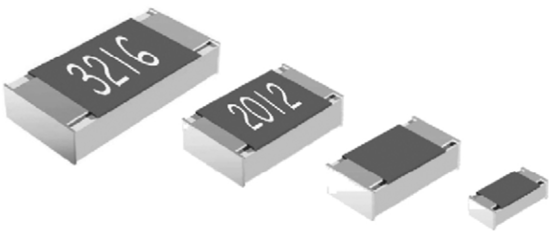
Thin Film Chip Resistors With Established Reliability



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

- IECQ-CECC approved to EN 140401-801, version E
- Established reliability, failure rate level E6
- Advanced thin film technology
- Single Lot Date Code
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS
COMPLIANT

APPLICATIONS

- Military
- Avionics
- Space

TECHNICAL SPECIFICATIONS				
DESCRIPTION	**MCS 0402 VG01**	**MCT 0603 VG01**	**MCU 0805 VG01**	**MCA 1206 VG01**
Imperial size	0402	0603	0805	1206
Metric size code (EN/CECC style)	RR1005M	RR1608M	RR2012M	RR3216M
Resistance range	10 Ω to 1 MΩ; 0 Ω	1 Ω to 1 MΩ; 0 Ω	1 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_{RMS} or 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, $\lvert \Delta R/R \rvert$ 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	300 V
Assessed failure rate level	E6 = 10^{-6}/h			
Quality factor, π_Q	0.3			
Failure rate: $FIT_{observed}$	< 0.1 x 10^{-9}/h			

Notes

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

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE [1]

TYPE / SIZE	TCR	TOLERANCE	RESISTANCE	E-SERIES
MCS 0402 VG01	± 50 ppm/K	± 1 %	10 Ω to 1 MΩ	E96
	± 15 ppm/K	± 0.1 %	100 Ω to 33.2 kΩ	E192
	Jumper [2]; $I_{max.}$ = 0.63 A	≤ 20 mΩ	0 Ω	-
MCT 0603 VG01	± 50 ppm/K	± 1 %	1 Ω to 1 MΩ	E96
	± 15 ppm/K	± 0.1 %	100 Ω to 47.5 kΩ	E192
	Jumper [2]; $I_{max.}$ = 1 A	≤ 20 mΩ	0 Ω	-
MCU 0805 VG01	± 50 ppm/K	± 1 %	1 Ω to 1 MΩ	E96
	± 15 ppm/K	± 0.1 %	100 Ω to 100 kΩ	E192
	Jumper [2]; $I_{max.}$ = 1.5 A	≤ 20 mΩ	0 Ω	-
MCA 1206 VG01	± 50 ppm/K	± 1 %	1 Ω to 1 MΩ	E96
	± 15 ppm/K	± 0.1 %	43.2 Ω to 332 kΩ	E192
	Jumper [2]; $I_{max.}$ = 2 A	≤ 20 mΩ	0 Ω	-

Notes

- Other TCR or tolerances, or combinations thereof, or resistance values from other E-series than given are not permitted in EN 140401-801 for version E products

(1) For the approved IECQ-CECC resistance range, please refer to www.vishay.com/doc?28945

(2) The temperature coefficient of resistance (TCR) is not specified for 0 Ω jumpers

PACKAGING

TYPE / SIZE	CODE	QUANTITY	PACKAGING STYLE	WIDTH	PITCH	PACKAGING DIMENSIONS
MCS 0402 VG01	E1	1000	Paper tape acc. IEC 60286-3, Type 1a, on reel	8 mm	2 mm	Ø 180 mm/7"
	E0	10 000				
MCT 0603 VG01	P1	1000		8 mm	4 mm	
	P5	5000				
MCU 0805 VG01	P1	1000				
	P5	5000				
MCA 1206 VG01	P1	1000				
	P5	5000				

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** = $*10^{-2}$ **9** = $*10^{-1}$ **0** = $*10^{0}$ **1** = $*10^{1}$ **2** = $*10^{2}$ **3** = $*10^{3}$ **4** = $*10^{4}$ **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

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:

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

Note

- The ordering information according to EN 140401-801:2014 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

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. The resistor elements are covered by a protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure matte 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 **IEC 60286-3 (1), Type 1a.**

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 vapor phase as shown in **IEC 61760-1 (1)**. Solderability is specified for 2 years after production or requalification. The permitted storage time is 20 years.

The resistors are RoHS-compliant; the pure matte 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, potting compounds, and their processes, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system.

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

Where applicable, 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.

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** and based on **IECQ 03-3-1** 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 Thin Film Chip Resistors" (www.vishay.com/doc?28705)
- "Precision Thin Film Chip Resistors" (www.vishay.com/doc?28700)

Notes

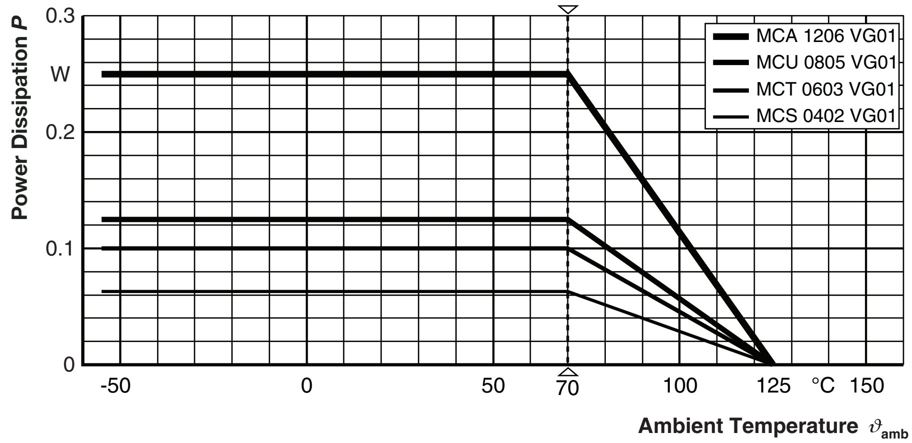
(1) The quoted IEC standards are also released as EN standards with the same number and identical contents

(2) The IEC 62474 list of declarable substances is maintained in a dedicated database, which is available at http://std.iec.ch/iec62474

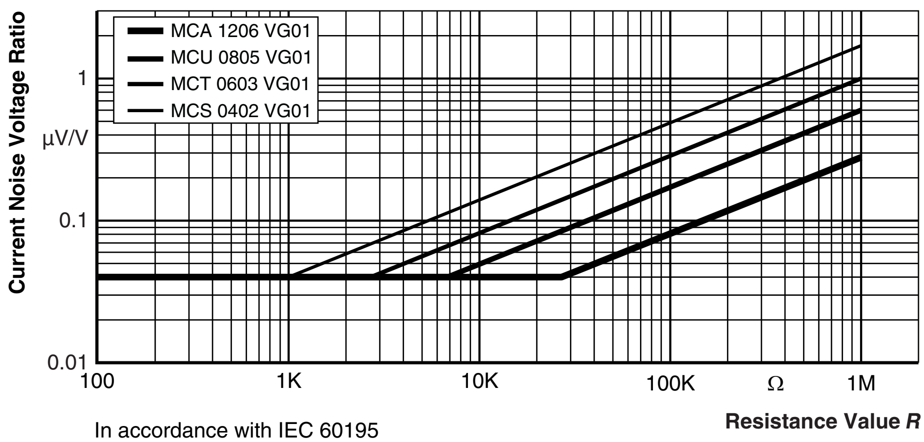
(3) The Global Automotive Declarable Substance List (GADSL) is maintained by the American Chemistry Council, and available at www.gadsl.org

(4) The SVHC list is maintained by the European Chemical Agency (ECHA) and available at http://echa.europa.eu/candidate-list-table

FUNCTIONAL PERFORMANCE

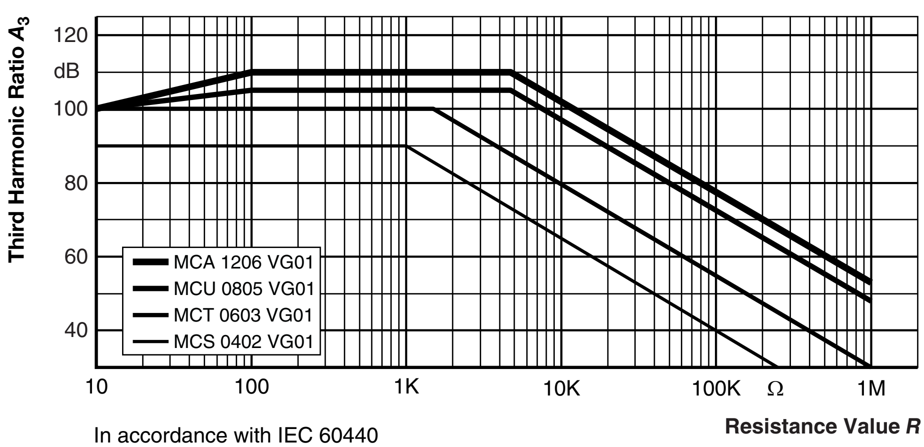


Derating



In accordance with IEC 60195

Current Noise Voltage Ratio



In accordance with IEC 60440

Non-Linearity - Third Harmonic Ratio A_3

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

- "Professional Thin Film Chip Resistors" (www.vishay.com/doc?28705) for products ± 50 ppm/K; ± 1 % and 0 Ω jumper
- "Precision Thin Film Chip Resistors" (www.vishay.com/doc?28700) for products ± 15 ppm/K; ± 0.1 %

TESTS AND REQUIREMENTS

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

EN 60115-1, generic specification

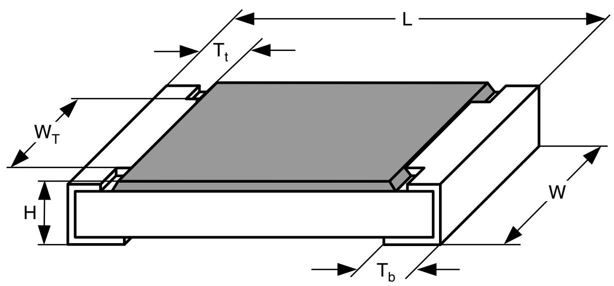
EN 60115-8 (successor of EN 140400), sectional specification

EN 140401-801, detail specification

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

- "Professional Thin Film Chip Resistors" (www.vishay.com/doc?28705) for products ± 50 ppm/K; ± 1 % and 0 Ω jumper
- "Precision Thin Film Chip Resistors" (www.vishay.com/doc?28700) for products ± 15 ppm/K; ± 0.1 %

DIMENSIONS

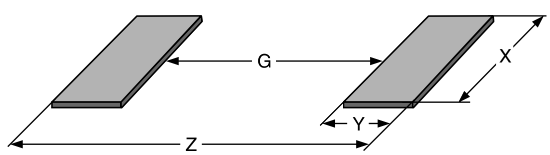


DIMENSIONS AND MASS							
TYPE / SIZE	**H (mm)**	**L (mm)**	**W (mm)**	**W_T (mm)**	**T_t (mm)**	**T_b (mm)**	**MASS (mg)**
MCS 0402 VG01	0.32 ± 0.05	1.0 ± 0.05	0.5 ± 0.05	> 75 % of W	0.2 + 0.1/- 0.15	0.2 ± 0.1	0.6
MCT 0603 VG01	0.45 + 0.1/- 0.05	1.55 ± 0.05	0.85 ± 0.1		0.3 + 0.15/- 0.2		1.9
MCU 0805 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 according to the four-character code system of IEC 60062 [(1)], 4.2.3. Resistors MCT 0603 VG01 and MCS 0402 VG01 do not show any marking on their blue protective coating

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 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

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. They do not guarantee any supposed thermal properties, however, they will be found adequate for most general applications

[(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 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	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....	275 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....	215 0....	205 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				

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