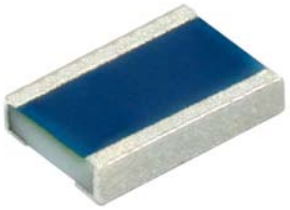
MCW 0406 AT - Professional

Vishay Beyschlag

Professional Wide Terminal Thin Film Chip Resistor



FEATURES

- Rated dissipation P_{85} up to 300 mW
- Superior temperature cycling robustness
- Operating temperature up to 175 °C for 1000 h
- AEC-Q200 qualified (pending)
- Compliant to RoHS Directive 2002/95/EC

RoHS COMPLIANT

APPLICATIONS

- Automotive
- Industrial
- High power and high temperature applications
- Replacement for larger case sizes

MCW 0406 AT Professional Wide Terminal Resistors are the perfect choice for most fields of modern professional power measurement electronics where reliability, stability, power dissipation, and robust design is of major concern.

Beside extremely high power ratings, the MCW 0406 AT is characterized by extraordinary temperature cycling robustness, verified through extensive testing.
The permissible power rating is specified with 300 mW. Typical applications include power electronics in automotive and industrial appliances.

METRIC SIZE	
INCH	0406
METRIC	RR 1016M

TECHNICAL SPECIFICATIONS	
DESCRIPTION	**MCW 0406 AT**
Metric size	RR 1016M
Resistance range	47 Ω to 100 kΩ
Resistance tolerance	± 1 %; ± 0.5 %
Temperature coefficient	± 50 ppm/K; ± 25 ppm/K
Rated dissipation P_{85} (1)	0.3 W
Operating voltage, $U_{max.}$ AC/DC	50 V
Permissible film temperature, ϑ_F max. (1)	175 °C
Operating temperature range	- 55 °C to + 175 °C
Insulation voltage	
1 min; U_{ins}	75 V
Continuous	75 V
Failure rate: $FIT_{observed}$	To be established

Note
(1) Please refer to APPLICATION INFORMATION, see next page.

For technical questions, contact: thinfilmchip@vishay.com
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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 lifetime limitation when operated within the limits of rated dissipation, permissible operating voltage and permissible film temperature. However, the resistance typically increases due to the resistor's film temperature over operating time, generally known as drift. The drift may exceed the stability requirements of an individual application circuit and thereby limits the 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 DISSIPATION

DESCRIPTION	MCW 0406 AT		
Operation mode	Standard	Power	Advanced Temperature
Rated dissipation	P_{70}	P_{70}	P_{85}
	0.2 W	0.25 W	0.3 W
Permissible film temperature, ϑ_F max.	125 °C	155 °C	175 °C
Max. resistance change at P_{70} for resistance range: $\Delta R/R$ max., after:	47 Ω to 100 kΩ		
1000 h	≤ 0.15 %	≤ 0.3 %	≤ 0.5 %
8000 h	≤ 0.25 %	≤ 0.5 %	-
225 000 h	≤ 1.0 %	-	-

PART NUMBER AND PRODUCT DESCRIPTION

PART NUMBER: MCW0406MD4641DPW00

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

TYPE/SIZE	VERSION	TCR	RESISTANCE	TOLERANCE	PACKAGING
MCW0406	**M** = AT (Automotive)	**D** = ± 25 ppm/K **C** = ± 50 ppm/K	**3 digit value** **1 digit multiplier** MULTIPLIER **9** = $*10^{-1}$ **0** = $*10^{0}$ **1** = $*10^{1}$ **2** = $*10^{2}$ **3** = $*10^{3}$	**D** = ± 0.5 % **F** = ± 1 %	**P5** **PW**

Product Description: MCW 0406-25 0.5 % AT PW 4K64

MCW	0406	-25	0.1 %	AT	PW	4K64
TYPE	SIZE	TCR	TOLERANCE	VERSION	PACKAGING	RESISTANCE
MCW	**0406**	± **25** ppm/K ± **50** ppm/K	± **0.5** % ± **1** %	**AT** = Automotive	**P5** **PW**	**4K64** = 4.64 kΩ

Note

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

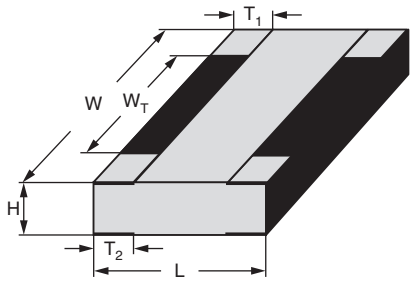
TEMPERATURE COEFFICIENT AND RESISTANCE RANGE		
DESCRIPTION		RESISTANCE
TCR	TOLERANCE	MCW 0406 AT
± 50 ppm/K	± 1 %	47 Ω to 100 kΩ
± 25 ppm/K	± 0.5 %	

Note

(1) Resistance values to be selected for ± 1 % tolerance from E24 and E96; for ± 0.5 % tolerance from E24 and E192.

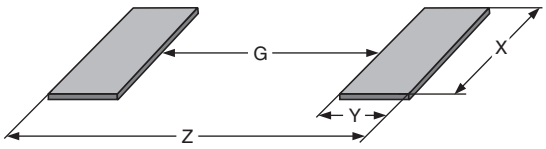
PACKAGING						
TYPE	CODE	QUANTITY	CARRIER TAPE	WIDTH	PITCH	REEL DIAMETER
MCW 0406 AT	P5	5000	Tape and reel cardboard tape acc. IEC 60286-3 Type I	8 mm	4 mm	180 mm/7"
	PW	20 000				330 mm/13"

DIMENSIONS



DIMENSIONS AND MASS							
TYPE	H (mm)	L (mm)	W (mm)	W_T (mm)	T_1 (mm)	T_2 (mm)	MASS (mg)
MCW 0406 AT	0.3 ± 0.05	1.0 ± 0.15	1.6 ± 0.15	> 75 % of W	0.2 + 0.1/- 0.15	0.2 ± 0.1	1.9

SOLDER PAD DIMENSIONS



RECOMMENDED SOLDER PAD DIMENSIONS				
TYPE	REFLOW SOLDERING			
	G (mm)	Y (mm)	X (mm)	Z (mm)
MCW 0406 AT	0.35	0.55	1.75	1.45

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 depend on boardmaterials.
  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” or “advanced temperature mode” require special considerations for the design of solder pads and adjacent conductor areas.

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 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 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 ≥ 10 Ω). Only accepted products are laid directly into the paper tape in accordance with **IEC 60286-3** (1).

ASSEMBLY

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using, reflow or vapour phase as shown in **IEC 61760-1** (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** (2) and the **CEFIC-EECA-EICTA** (3) 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

Where applicable the resistors are tested 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.

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 qualification of the MCW 0406 AT - Professional according to AEC-Q200 is pending.

RELATED PRODUCTS

For an alternative range of TCR and tolerance see the datasheet:

- Precision Wide Terminal Thin Film Chip Resistors (www.vishay.com/doc?28847)

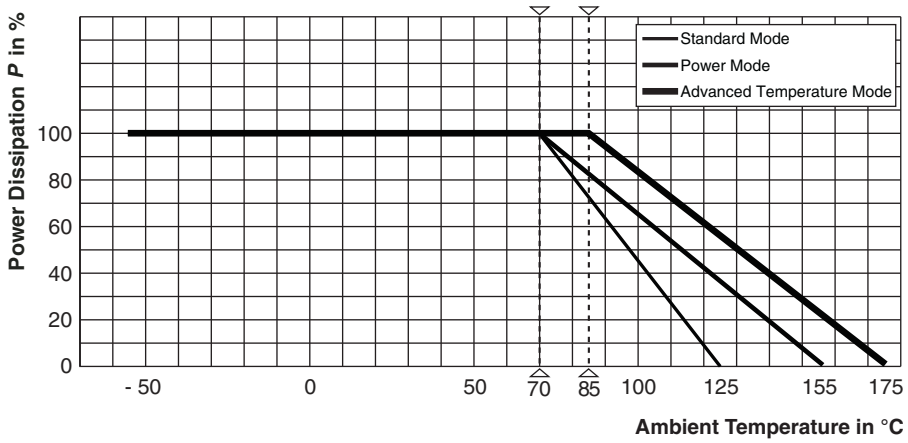
Notes

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

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

(3) 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 → issues → environment policy → chemicals → chemicals for electronics.

FUNCTIONAL PERFORMANCE



Derating

Note

- For the permissible resistance change in each operation mode please refer to table MAXIMUM RESISTANCE CHANGE AT RATED DISSIPATION, above.

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 testing also covers most of the requirements specified by EIA/IS-703 and JIS-C-5202.

The tests are carried out 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 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.

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)
			Stability for product types:	
			MCW 0406 AT	47 Ω to 100 kΩ
4.5	-	Resistance		± 1 % R; ± 0.5 % R
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 70 °C; 8000 h	± (0.15 % R + 0.05 Ω) ± (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 70 °C; 8000 h	± (0.3 % R + 0.05 Ω) ± (0.5 % R + 0.05 Ω)
		Endurance at 85 °C: Advanced temperature operation mode	$U = \sqrt{P_{85} \times R}$ or $U = U_{max.}$; whichever is the less severe; 1.5 h on; 0.5 h off; 85 °C; 1000 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 + 0.02 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	± (0.1 % R + 0.05 Ω)
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:		± (0.5 % R + 0.05 Ω)
4.23.2	2 (Bb)	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 (Ab)	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; 5 days > 90 % RH; 5 cycles	
4.23.7	-	DC load	$U = \sqrt{P_{70} \times R} \leq U_{max.}$; 1 min	
-	1 (Ab)	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	± (0.25 % R + 0.05 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	To be determined
		Single pulse high voltage overload; power operation mode		To be determined

TEST PROCEDURES AND REQUIREMENTS				
EN 60115-1 CLAUSE	**IEC 60068-2 TEST METHOD**	**TEST**	**PROCEDURE**	**REQUIREMENTS PERMISSIBLE CHANGE (ΔR)**
			Stability for product types:	
			MCW 0406 AT	47 Ω to 100 kΩ
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	To be determined
		Periodic electric overload; power operation mode		To be determined
4.40	-	Electro Static Discharge (Human Body Model)	IEC 61340-3-1; 3 pos. + 3 neg. (equivalent to MIL-STD-883, Method 3015) 500 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	± (0.1 % 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 + 0.02 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 1016M; 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

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