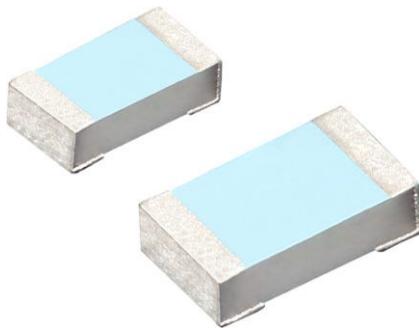


Low Ohmic Thick Film Flat Chip Resistors



NCT 0603 and NCU 0805 low ohmic flat chip resistors are best suited where low resistance paired with high stability and high reliability is required. Typical applications include current sensors and shunts in power supplies and battery chargers. Other demands for low ohmic resistors come from the computer industry.

FEATURES

- Unique low ohmic chip resistor
- Standard TCR: ± 100 ppm/K
- Excellent overall stability
- Wide low ohmic range: 0.1Ω to $< 1 \Omega$
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


**RoHS
COMPLIANT**

APPLICATIONS

- Power supplies
- Battery chargers
- Computer industry

TECHNICAL SPECIFICATIONS

DESCRIPTION	NCT 0603	NCU 0805
Imperial size	0603	0805
Metric size code	RR1608M	RR2012M
Resistance range	0.1Ω to 0.91Ω	
Resistance tolerance	$\pm 5\%$	
Temperature coefficient	± 100 ppm/K	
Rated dissipation, P_{70} ⁽¹⁾	0.125 W	0.200 W
Operating voltage, U_{max} AC _{RMS} /DC	Limited by P_{70}	
Permissible film temperature, θ_F max. ⁽¹⁾	155 °C	
Operating temperature range ⁽¹⁾	-55 °C to 155 °C	
Permissible voltage against ambient (insulation):	1 min; U_{ins}	100 V
Failure rate: FIT _{observed}	$\leq 0.1 \times 10^{-9}/h$	

Note

⁽¹⁾ Please refer to APPLICATION INFORMATION below.

APPLICATION INFORMATION

When the resistor dissipates power, a temperature rise above the ambient temperature occurs, dependent on the thermal resistance of the assembled resistor together with the printed circuit board. 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.

MAXIMUM RESISTANCE CHANGE AT RATED DISSIPATION		STANDARD	POWER
Rated dissipation, P_{70}	NCT 0603	0.100 W	0.125 W
	NCU 0805	0.125 W	0.200 W
Operating temperature range		-55 °C to +125 °C	-55 °C to +155 °C
Permissible film temperature, θ_F max.		125 °C	155 °C
Max. resistance change at P_{70} for resistance range, $ \Delta R/R $ after:	NCT 0603	0.1 Ω to 0.91 Ω	
	NCU 0805	0.1 Ω to 0.91 Ω	
1000 h		≤ 1 %	≤ 2 %
	8000 h	≤ 2 %	≤ 3 %

Note

- The presented operation modes do not refer to different types of resistors, but actually show examples of different loads, that lead to different film temperatures and different achievable load-life stability (drift) of the resistance value. A suitable low thermal resistance of the circuit board assembly must be safeguarded in order to maintain the film temperature of the resistors within the specified limits. Please consider the application note "Thermal Management in Surface-Mounted Resistor Applications" (www.vishay.com/doc?22844) for information on the general nature of thermal resistance.

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE				
TYPE / SIZE	TCR	TOLERANCE	RESISTANCE	E-SERIES
NCT 0603	± 100 ppm/K	± 5 %	0.1 Ω to 0.91 Ω	E24
NCU 0805				

PACKAGING						
TYPE / SIZE	CODE	QUANTITY	PACKAGING STYLE	WIDTH	PITCH	PACKAGING DIMENSIONS
NCT 0603	P5	5000	Paper tape acc. IEC 60286-3, Type 1a	8 mm	4 mm	Ø 180 mm / 7"
NCU 0805	P5	5000		8 mm	4 mm	Ø 180 mm / 7"

PART NUMBER AND PRODUCT DESCRIPTION						
Part Number: NCT06030B2207JP500						
N	C	T	0	6	0	
				3	0	
				B		
				2	2	
				0	7	
				J	P	
				5	0	
				0	0	
TYPE / SIZE		VERSION	TCR	RESISTANCE	TOLERANCE	
NCT0603 NCU0805		0 = neutral	$B = \pm 100$ ppm/K	3 digit value 1 digit multiplier Multiplier $7 = *10^{-3}$	$J = \pm 5$ %	PACKAGING
Product Description: NCT 0603-100 5 % P5 R22						
NCT	0603	-100	5 %	P5	R22	
TYPE	SIZE	TCR	TOLERANCE	PACKAGING	RESISTANCE	
NCT NCU	0603 0805	± 100 ppm/K	± 5 %	P5	$R56 = 0.56$ Ω $R1 = 0.1$ Ω	

Note

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

DESCRIPTION

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A highly conductive film is built on a high grade (Al_2O_3) ceramic substrate and conditioned to achieve the desired temperature coefficient. Optimized inner contacts are built on both sides of the substrate. A special laser is used to achieve the target value by smoothly cutting 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 and optical inspection performed on 100 % of the individual chip resistors. Only accepted products are laid directly into the paper tape in accordance with **IEC 60286-3 Type 1a** ⁽¹⁾.

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⁾. 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 matte 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.

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.

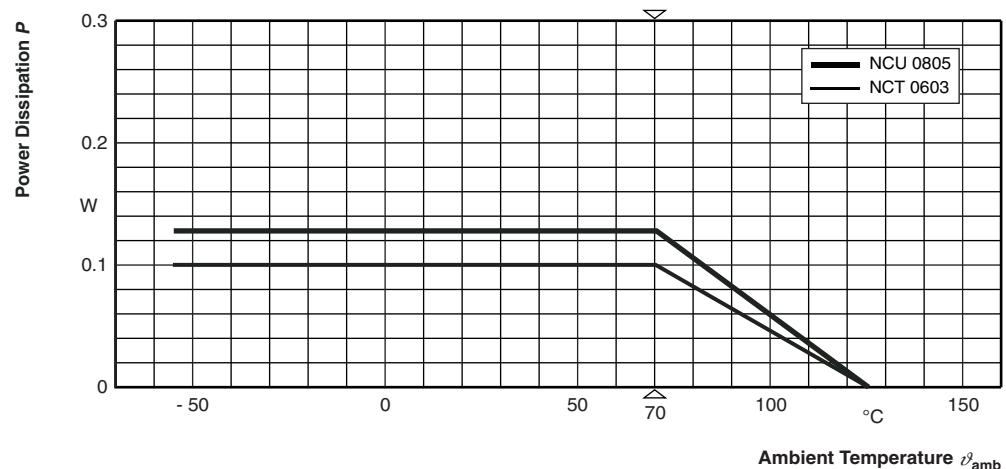
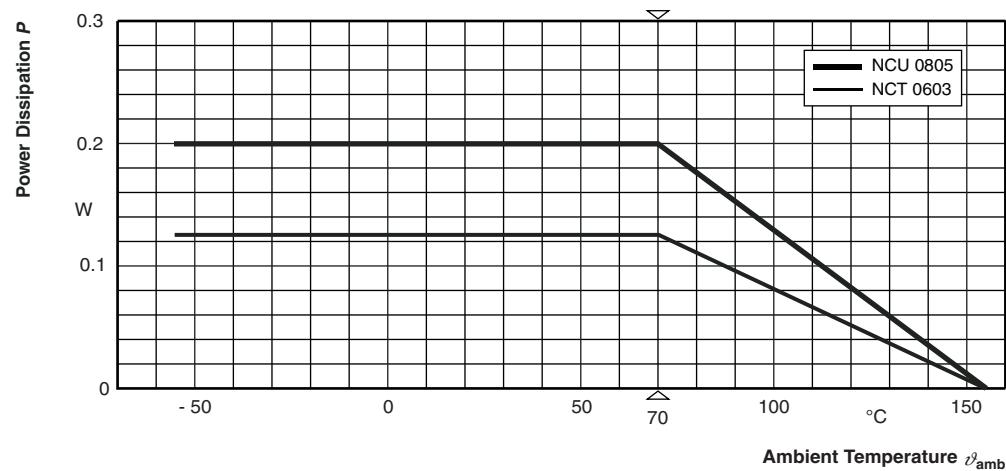
APPROVALS

The resistors are tested in accordance with **EN 140401-802** which refers to **EN 60115-1**, **EN 60115-8**, and the variety of environmental test procedures of the **IEC 60068** ⁽¹⁾ series.

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 03-3-1** is granted for the Vishay Beyschlag manufacturing process.

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 - Standard Operation

Derating - Power Operation

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 140401-802, detail specification

IEC 60068-2-xx, test methods

The parameters stated in the Test Procedures and Requirements table are based on the required tests and permitted limits of EN 140401-802. The table presents only the most important tests, for the full test schedule refer to the documents listed above. However, some additional tests and a number of improvements against those minimum requirements have been included.

The testing also covers most of the requirements specified by EIA/ECA-703 and JIS-C-5201-1.

The tests are carried out under standard atmospheric conditions in accordance with IEC 60068-1, 4.3, whereupon the following values are applied:

Temperature: 15 °C to 35 °C

Relative humidity: 25 % to 75 %

Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar).

A climatic category LCT / UCT / 56 is applied, defined by the lower category temperature (LCT), the upper category temperature (UCT), and the duration of exposure in the damp heat, steady state test (56 days).

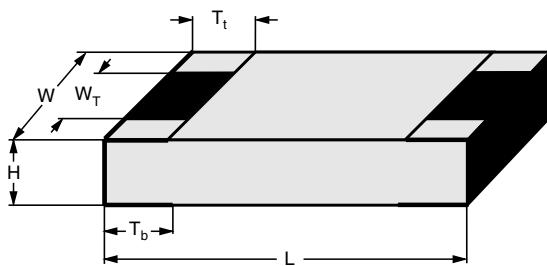
The components are mounted for testing on printed circuit boards in accordance with EN 60115-8, 2.4.2, unless otherwise specified.

TEST PROCEDURES AND REQUIREMENTS				
EN 60115-1 CLAUSE	IEC 60068-2 ⁽¹⁾ TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)
4.5	-	Resistance	Stability for product types:	
			NCT 0603	0.1 Ω to 0.91 Ω
			NCU 0805	0.1 Ω to 0.91 Ω
4.8	-	Temperature coefficient	At (20 / -55 / 20) °C and (20 / 125 / 20) °C	± 100 ppm/K
4.25.1	-	Endurance at 70 °C: standard operation mode	$U = \sqrt{P_{70} \times R}$; 1.5 h on; 0.5 h off 70 °C; 1000 h 70 °C; 8000 h	± (1 % R + 0.01 Ω) ± (2 % R + 0.01 Ω)
		Endurance at 70 °C: power operation mode	$U = \sqrt{P_{70} \times R}$; 1.5 h on; 0.5 h off 70 °C; 1000 h 70 °C; 8000 h	± (2 % R + 0.01 Ω) ± (3 % R + 0.01 Ω)
4.25.3	-	Endurance at upper category temperature	125 °C; 1000 h 155 °C; 1000 h	± (2 % R + 0.01 Ω) ± (3 % R + 0.01 Ω)
4.24	78 (Cab)	Damp heat, steady state	(40 ± 2) °C; 56 days; (93 ± 3) % RH	± (1 % R + 0.01 Ω)
4.23		Climatic sequence:		
4.23.2	2 (Bb)	dry heat	UCT; 16 h	
4.23.3	30 (Db)	damp heat, cyclic	55 °C; 24 h; > 90 % RH; 1 cycle	
4.23.4	1 (Ab)	cold	LCT; 2 h	± (1 % R + 0.01 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; 24 h; > 90 % RH; 5 cycles LCT = -55 °C; UCT = 125 °C	
4.23.7	-	DC load	$U = \sqrt{P_{70} \times R} \leq U_{max}; 1 \text{ min}$	

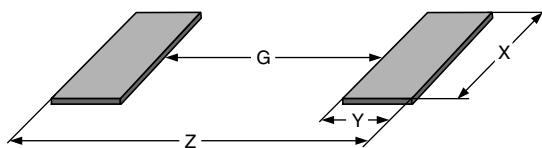
TEST PROCEDURES AND REQUIREMENTS				
EN 60115-1 CLAUSE	IEC 60068-2 (1) TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)
–	–	–	Stability for product types:	0.1 Ω to 0.91 Ω
			NCT 0603	
			NCU 0805	
–	1 (Aa)	Cold	-55 °C; 2 h	$\pm (0.5 \% R + 0.01 \Omega)$
4.19	14 (Na)	Rapid change of temperature	30 min at LCT and 30 min at UCT; LCT = -55 °C; UCT = 125 °C; 5 cycles LCT = -55 °C; UCT = 125 °C; 1000 cycles	$\pm (0.5 \% R + 0.01 \Omega)$ no visible damage $\pm (1 \% R + 0.01 \Omega)$ no visible damage
4.13	-	Short time overload: standard operation mode	$U = 2.5 \times \sqrt{P_{70} \times R} ; 5 \text{ s}$	$\pm (0.5 \% R + 0.01 \Omega)$
		Short time overload: power operation mode		$\pm (1 \% R + 0.01 \Omega)$
4.22	6 (Fc)	Vibration	Endurance by sweeping; 10 Hz to 2000 Hz; no resonance; amplitude $\leq 1.5 \text{ mm}$ or $\leq 200 \text{ m/s}^2$; 7.5 h	$\pm (0.5 \% R + 0.01 \Omega)$ no visible damage
4.17	58 (Td)	Solderability	Solder bath method; SnPb40; non-activated flux (215 ± 3) °C; (3 ± 0.3) s Solder bath method; SnAg3Cu0.5 or SnAg3.5; non-activated flux (235 ± 3) °C; (2 ± 0.2) s	Good tinning ($\geq 95\%$ covered); no visible damage
4.18	58 (Td)	Resistance to soldering heat	Solder bath method; (260 ± 5) °C; (10 ± 1) s	$\pm (0.5 \% R + 0.05 \Omega)$ 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)	NCT 0603: 9N NCU 0805: 45N	No visible damage
4.33	21 (Ue ₁)	Substrate bending	Depth 2 mm, 3 times	$\pm (0.5 \% R + 0.01 \Omega)$ no visible damage, no open circuit in bent position
4.7	-	Voltage proof	$U_{\text{RMS}} = U_{\text{ins}}; (60 \pm 5) \text{ s}$	No flashover or breakdown
4.35	-	Flammability	IEC 60695-2-2 (1), needle flame test; 10 s	No burning after 30 s

Note

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

DIMENSIONS


DIMENSIONS AND MASS							
TYPE / SIZE	H (mm)	L (mm)	W (mm)	W_T (mm)	T_t (mm)	T_b (mm)	MASS (mg)
NCT 0603	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
NCU 0805	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

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)
NCT 0603	0.55	1.10	1.10	2.75	0.65	0.70	0.95	2.05
NCU 0805	0.80	1.25	1.50	3.30	0.90	0.90	1.40	2.70

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.

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

12NC INFORMATION FOR HISTORICAL CODING REFERENCE ONLY

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

Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE	LAST DIGIT
0.1 Ω to 0.99 Ω	7

12NC Example

The 12 NC of a NCT 0603 resistor, value 0.22 Ω and TCR 100 with ± 5 % tolerance, supplied in cardboard tape of 5000 units per reel is: 2312 219 32207.

12NC - RESISTOR TYPE AND PACKAGING

TYPE	TCR	TOL.	P5 5000 UNITS
NCT 0603	± 100 ppm/K	± 5 %	219 3....
NCU 0805			259 3....

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