Ultra Precision Metal Film Leaded Resistors

FEATURES

- Exceptional low TCR: ± 2 ppm/K to ± 10 ppm/K
- Super tight tolerance: ± 0.01 % to ± 0.25 %
- Exceptional overall stability: class 0.02
- Wide resistance range: 22 Ω to 1 MΩ
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS COMPLIANT

DESCRIPTION

UXA 0204, UXB 0207, and UXE 0414 high precision leaded thin film resistors combine the proven reliability of the professional products with an exceptional level of precision and stability. Therefore they are perfectly suited for applications in the fields of precision test and measuring equipment and particularly for the design of calibration references and standards.

APPLICATIONS

- Precision test and measuring equipment
- Design of calibration references and standards

TECHNICAL SPECIFICATIONS

DESCRIPTION	UXA 0204	UXB 0207	UXE 0414
DIN size	0204	0207	0414
CECC size	A	B	D
Resistance range	22 Ω to 221 kΩ	10 Ω to 1 MΩ	22 Ω to 511 kΩ
Resistance tolerance	± 0.25 %; ± 0.1 %; ± 0.05 %; ± 0.01 %	± 0.25 %; ± 0.1 %; ± 0.05 %; ± 0.01 %	± 0.1 %; ± 0.05 %
Temperature coefficient	± 10 ppm/K; ± 5 ppm/K; ± 2 ppm/K	± 10 ppm/K; ± 5 ppm/K; ± 2 ppm/K	± 10 ppm/K; ± 5 ppm/K
Rated dissipation:			
P_{85}	0.05 W	0.125 W	0.25 W
P_{70}	0.1 W	0.25 W	0.5 W
Operating voltage, $U_{max.}$ AC/DC	200 V	250 V	300 V
Operating temperature range (1)	-20 °C to 125 °C		
Peak permissible film temperature (1)	125 °C		
Insulation voltage:			
1 min.; U_{ins}	300 V	500 V	800 V
Continuous	75 V	75 V	75 V
Max. resistance change at P_{70} for resistance range, $\Delta R/R$ max., after:	100 Ω to 100 kΩ	100 Ω to 250 kΩ	100 Ω to 100 kΩ
2000 h	≤ 0.05 %	≤ 0.05 %	≤ 0.05 %
Max. resistance change at P_{85} for resistance range, $\Delta R/R$ max., after:	100 Ω to 100 kΩ	100 Ω to 250 kΩ	100 Ω to 100 kΩ
1000 h	≤ 0.02 %	≤ 0.02 %	≤ 0.02 %
8000 h	≤ 0.04 %	≤ 0.04 %	≤ 0.04 %
225 000 h	≤ 0.12 %	≤ 0.12 %	≤ 0.12 %
Failure rate: $FIT_{observed}$	≤ 0.1 x 10^{-9}/h		

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE				
TYPE	**TCR**	**TOLERANCE**	**RESISTANCE (1)(2)(3)**	**E-SERIES**
UXA 0204	± 10 ppm/K	± 0.25 %	22 Ω to 221 kΩ	E192
		± 0.1 %	43 Ω to 221 kΩ	E192
		± 0.05 %	100 Ω to 180 kΩ	E192
		± 0.01 %	200 Ω to 150 kΩ	E192
	± 5 ppm/K	± 0.25 %	47 Ω to 150 kΩ	E192
		± 0.1 %	47 Ω to 150 kΩ	E192
		± 0.05 %	100 Ω to 150 kΩ	E192
		± 0.01 %	200 Ω to 150 kΩ	E192
	± 2 ppm/K (3)	± 0.25 %	100 Ω to 100 kΩ	E192
		± 0.1 %	100 Ω to 100 kΩ	E192
		± 0.05 %	150 Ω to 100 kΩ	E192
		± 0.01 %	200 Ω to 100 kΩ	E192
UXB 0207	± 10 ppm/K	± 0.25 %	10 Ω to 1 MΩ	E192
		± 0.1 %	10 Ω to 1 MΩ	E192
		± 0.05 %	24 Ω to 301 kΩ	E192
		± 0.01 %	24 Ω to 301 kΩ	E192
	± 5 ppm/K	± 0.25 %	10 Ω to 1 MΩ	E192
		± 0.1 %	10 Ω to 1 MΩ	E192
		± 0.05 %	24 Ω to 221 kΩ	E192
		± 0.01 %	24 Ω to 221 kΩ	E192
	± 2 ppm/K (3)	± 0.25 %	100 Ω to 150 kΩ	E192
		± 0.1 %	100 Ω to 150 kΩ	E192
		± 0.05 %	150 Ω to 150 kΩ	E192
		± 0.01 %	200 Ω to 150 kΩ	E192
UXE 0414	± 10 ppm/K	± 0.1 %	22 Ω to 511 kΩ	E192
		± 0.05 %	100 Ω to 301 kΩ	E192
	± 5 ppm/K	± 0.1 %	47 Ω to 301 kΩ	E192
		± 0.05 %	100 Ω to 301 kΩ	E192

Notes

(1) Resistance values to be selected from the E192 series, for other values please contact the factory.

(2) TCR 10 and TCR 05 are specified over the temperature range from -20 °C to +85 °C.

(3) TCR 02 is specified over the temperature range 0 °C to +60 °C.

PART NUMBER AND PRODUCT DESCRIPTION

PART NUMBER: UXB02070F1001AC100

U	X	B	0	2	0	7	0	F	1	0	0	1	A	C	1	0	0

TYPE / SIZE	VARIANT	TCR	VALUE	TOLERANCE	PACKAGING	SPECIAL
UXA0204 **UXB0207** **UXE0414**	**0** = neutral	**H** = ± 2 ppm/K **G** = ± 5 ppm/K **F** = ± 10 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** = $*10^{4}$	**T** = ± 0.01 % **A** = ± 0.05 % **B** = ± 0.1 % **C** = ± 0.25 %	**C1** **CU** **R1** **R2** **RP**	Up to 2 digits **00** = standard

PRODUCT DESCRIPTION: UXB 0207-10 0.05 % C1 1K0

UXB	0207	10	0.05 %	C1	1K0
TYPE	SIZE	TCR	TOLERANCE	PACKAGING (1)	RESISTANCE VALUE
UXA **UXB** **UXE**	**0204** **0207** **0414**	**± 2** ppm/K **± 5** ppm/K **± 10** ppm/K	**± 0.01 %** **± 0.05 %** **± 0.1 %** **± 0.25 %**	**C1** **CU** **R1** **R2** **RP**	**1K0** = 1.0 Ω **47K** = 47 kΩ **50R5** = 50.5 Ω

Note

- The part number is shown to facilitate the introduction of a unified part numbering system.

PACKAGING

TYPE / SIZE	CODE	QUANTITY	PACKAGING STYLE	WIDTH	PITCH	DIMENSIONS
UXA 0204	CU	100	Taped acc. to IEC 60286-1 fan-folded in a box	53 mm	5 mm	74 mm x 42 mm x 184 mm
	C1	1000				
UXB 0207	CU	100	Taped acc. to IEC 60286-1 fan-folded in a box	53 mm	5 mm	75 mm x 40 mm x 187 mm
	C1	1000				
	R1	1000	Taped acc. to IEC 60286-1 on a reel	53 mm	5 mm	315 mm x 70 mm x 80 mm
	RP	5000				315 mm x 76 mm x 86 mm
UXE 0414	CU	100	Taped acc. to IEC 60286-1 fan-folded in a box	53 mm	5 mm	47 mm x 84 mm x 374 mm
	C1	1000				
	R2	2500	Taped acc. to IEC 60286-1 on a reel	53 mm	5 mm	315 mm x 80 mm x 90 mm

SCRIPT MARKING - Printed resistance value and letter coding for TCR and tolerance

RESISTANCE VALUE	TOL. (%)	LETTER CODE	TCR (ppm/K)	LETTER CODE
Clear text code for value	± 0.25	C	± 10	B
	± 0.1	B	± 5	A
	± 0.05	A	± 2	T
	± 0.01	T	-	-

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 body (85 % Al_2O_3) and conditioned to achieve the desired temperature coefficient. Nickel plated steel termination caps are firmly pressed on the metallized rods. Special laser devices are used repeatedly to achieve the target value by slowly and smoothly cutting a helical groove in the resistive layer without damaging the ceramics. A further conditioning is applied in order to stabilise the trimming result. Connecting wires of electrolytic copper plated with pure tin are welded to the termination caps. The resistors are covered by protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure tin on nickel plating. Script marking designates the resistance value plus coded TCR and tolerance.

The result of the determined production is verified by an accelerated aging (burn-in) and extensive testing procedure performed on 100 % of the individual resistors. Only accepted products are stuck directly on the adhesive tapes in accordance with **IEC 60286-1**.

ASSEMBLY

The resistors are suitable for processing on automatic insertion equipment and cutting and bending machines. Excellent solderability is proven, even after extended storage. They are suitable for automatic soldering using wave or dipping. 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 completely lead (Pb)-free, the pure tin plating provides compatibility with lead (Pb)-free and lead-containing soldering processes. 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 (1)
- The Global Automotive Declarable Substance List (GADSL) (2)
- The REACH regulation (1907/2006/EC) and the related list of substances with very high concern (SVHC) (3) 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

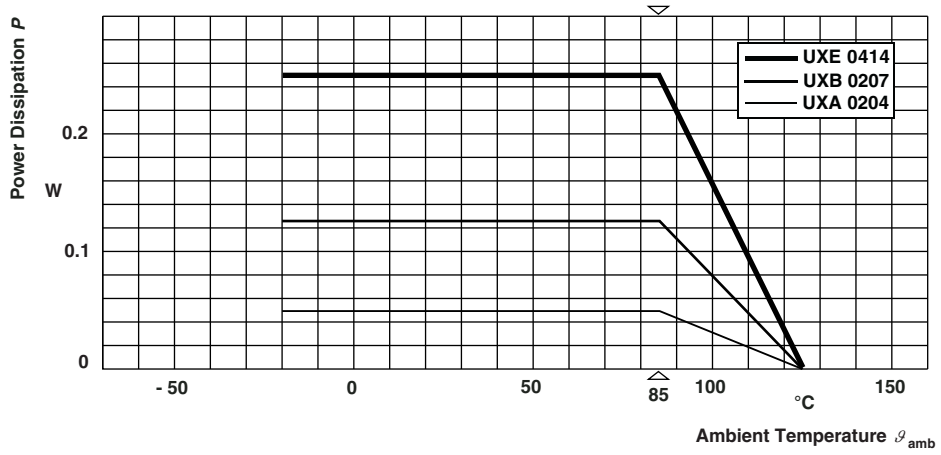
Where applicable, the resistors are tested in accordance to **EN 60115-1** and **EN 140100**.

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.

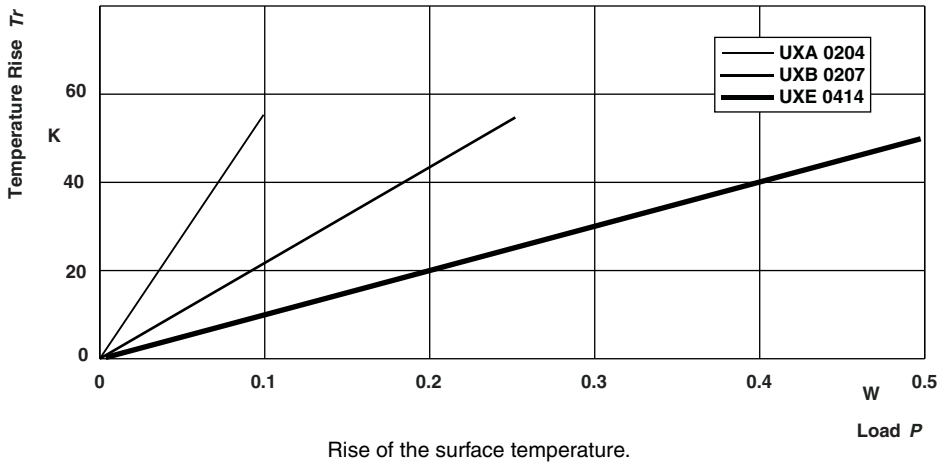
Notes

(1) The IEC 62474 list of declarable substances is maintained in a dedicated database, which is available at http://std.iec.ch/iec62474.
(2) The Global Automotive Declarable Substance List (GADSL) is maintained by the American Chemistry Council and available at www.gadsl.org.
(3) The SVHC list is maintained by the European Chemical Agency (ECHA) and available at http://echa.europa.eu/candidate-list-table.

FUNCTIONAL DESCRIPTION

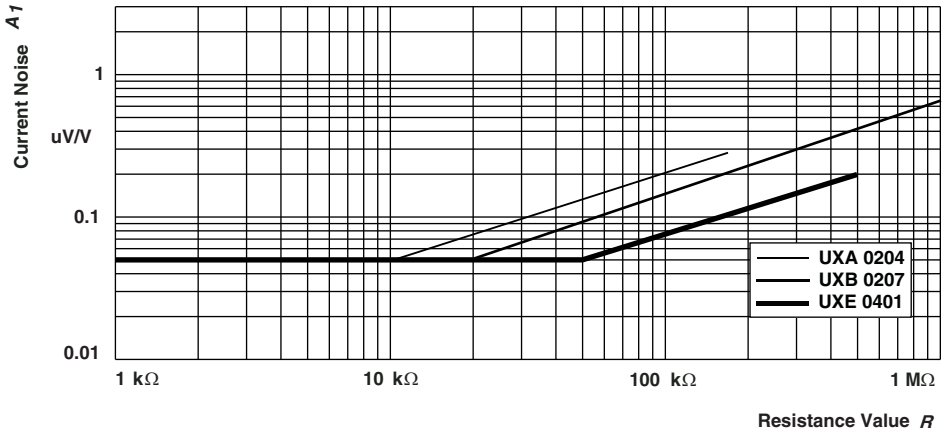


Derating - Standard Operation



Rise of the surface temperature.

Temperature Rise



Current Noise A_1 in accordance with IEC 60195

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the following specifications:

- EN 60115-1, Generic specification (includes tests)

The Test Procedures and Requirements 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 60068-2-xx test method and under standard atmospheric conditions in accordance with IEC 60068-1, 5.3. Climatic category -20 °C / +125 °C / 56 days (rated temperature range: Lower category temperature, upper category temperature; damp heat, long term, 56 days) is valid.

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).

For testing the components are mounted on a test board in accordance with IEC 60115-1, 4.31 unless otherwise specified.

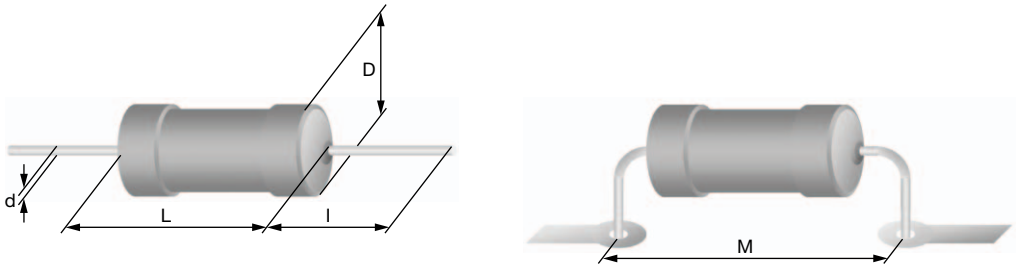
In the Test Procedures and Requirements table only the tests and requirements are listed with reference to the relevant clauses of IEC 60115-1 and IEC 60068-2-xx test method. A short description of the test procedure is also given.

TEST PROCEDURES AND REQUIREMENTS

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)		
			Stability for product types:			
			UXA 0204	100 Ω to 100 kΩ	22 Ω to < 100 Ω > 100 kΩ to 221 kΩ	-
			UXB 0207	100 Ω to 250 kΩ	40.2 Ω to < 100 Ω > 250 kΩ to 301 kΩ	10 Ω to < 40.2 Ω > 301 kΩ to 1 MΩ
			UXE 0414	100 Ω to 100 kΩ	22 Ω to < 100 Ω > 100 kΩ to 511 kΩ	-
4.5	-	Resistance	-	± 0.25 %; ± 0.1 %; ± 0.05 %; ± 0.01 %		
4.7	-	Voltage proof	$U_{RMS} = U_{ins}$; 60 s	No flashover or breakdown		
4.8	-	Temperature coefficient	At (20 / -20 / 20) °C and (20 / 85 / 20) °C	10 ppm/K; 5 ppm/K		
			At (20 / 0 / 20) °C and (20 / 60 / 20) °C	2 ppm/K		
4.13	-	Short time overload	Room temperature; $U = 2.5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max.}$; 5 s	± (0.01 % R + 0.01 Ω)	± (0.01 % R + 0.01 Ω)	± (0.02 % R + 0.01 Ω)
4.16	21 (Ua_1) 21 (Ub) 21 (Uc)	Robustness of terminations	Tensile, bending, and torsion	± (0.01 % R + 0.01 Ω)	± (0.01 % R + 0.01 Ω)	± (0.02 % R + 0.01 Ω)
4.17	20 (Ta)	Solderability	at +235 °C; 2 s; solder bath method; SnPb40	Good tinning (> 95 % covered); no damage		
			at +245 °C; 3 s; solder bath method; SnAg3Cu0.5			
4.18.2	20 (Tb)	Resistance to soldering heat	Unmounted components; (260 ± 5) °C; (10 ± 1) s	± (0.01 % R + 0.01 Ω)	± (0.01 % R + 0.01 Ω)	± (0.02 % R + 0.01 Ω)
4.19	14 (Na)	Rapid change of temperature	30 min at -55 °C 30 min at +125 °C 5 cycles	± (0.01 % R + 0.01 Ω)	± (0.01 % R + 0.01 Ω)	± (0.02 % R + 0.01 Ω)
4.22	6 (B4)	Vibration	10 sweep cycles per direction; 10 Hz to 2000 Hz 1.5 mm or 200 m/s^2	± (0.01 % R + 0.01 Ω)	± (0.01 % R + 0.01 Ω)	± (0.02 % R + 0.01 Ω)

TEST PROCEDURES AND REQUIREMENTS						
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)		
			Stability for product types:			
			UXA 0204	100 Ω to 100 kΩ	22 Ω to < 100 Ω > 100 kΩ to 221 kΩ	-
			UXB 0207	100 Ω to 250 kΩ	40.2 Ω to < 100 Ω > 250 kΩ to 301 kΩ	10 Ω to < 40.2 Ω > 301 kΩ to 1 MΩ
			UXE 0414	100 Ω to 100 kΩ	22 Ω to < 100 Ω > 100 kΩ to 511 kΩ	-
4.23		Climatic sequence:				
4.23.2	2 (Ba)	Dry heat	125 °C; 16 h			
4.23.3	30 (Db)	Damp heat, cyclic	55 °C; 24 h; 90 % to 100 % RH; 1 cycle			
4.23.4	1 (Aa)	Cold	-55 °C; 2 h	± (0.04 % R + 0.01 Ω); no visible damage	± (0.05 % R + 0.01 Ω); no visible damage	± (0.06 % R + 0.01 Ω); no visible damage
4.23.5	13 (M)	Low air pressure	8.5 kPa; 2 h; 15 °C to 35 °C			
4.23.6	30 (Db)	Damp heat, cyclic	55 °C; 5 days; 95 % to 100 % RH; 5 cycles			
4.23.7		DC load	apply rated power for 1 min			
4.24	78 (Cab)	Damp heat, steady state	(40 ± 2) °C; 56 days; (93 ± 3) % RH	± (0.04 % R + 0.01 Ω)	± (0.05 % R + 0.01 Ω)	± (0.06 % R + 0.01 Ω)
4.25.1	-	Endurance (at 70 °C)	$U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; 1.5 h on; 0.5 h off			
			70 °C; 2000 h	± (0.05 % R + 0.01 Ω)	± (0.05 % R + 0.01 Ω)	± (0.05 % R + 0.01 Ω)
			85 °C; 1000 h	± (0.02 % R + 0.01 Ω)	± (0.03 % R + 0.01 Ω)	± (0.04 % R + 0.01 Ω)
			85 °C; 8000 h	± (0.04 % R + 0.01 Ω)	± (0.06 % R + 0.01 Ω)	± (0.08 % R + 0.01 Ω)
4.25.3	-	Endurance at upper category temperature	125 °C; 1000 h	± (0.04 % R + 0.01 Ω)	± (0.06 % R + 0.01 Ω)	± (0.08 % R + 0.01 Ω)
4.29	45 (XA)	Component solvent resistance	Isopropyl alcohol (used in industrial application) +23 °C; toothbrush method	Marking legible; no visible damage		

DIMENSIONS



DIMENSIONS - Leaded resistor types, mass, and relevant physical dimensions						
TYPE	$D_{max.}$ (mm)	$L_{max.}$ (mm)	$d_{nom.}$ (mm)	$l_{min.}$ (mm)	$M_{min.}$ (mm)	MASS (mg)
UXA 0204	1.6	3.6	0.5	29.0	5.0	125
UXB 0207	2.5	6.3	0.6	28.0	7.5	220
UXE 0414	4.0	11.9	0.8	31.0	15.0	750

12NC INFORMATION FOR HISTORICAL CODING REFERENCE

- The resistors have a 12-digit part number starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see the 12NC Part Number 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 12NC Indicating Resistance Decade table.

Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE	LAST DIGIT
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

12NC Example

The part number of a UXA 0204 resistor, value 47 kΩ and TCR 10 with ± 0.1 % tolerance, supplied on bandolier in a box of 1000 units is: 2312 662 34703.

12NC PART NUMBER - Resistor type and packaging

DESCRIPTION			2312				
			BANDOLIER IN BOX	BANDOLIER IN BOX	BANDOLIER ON REEL	BANDOLIER ON REEL	BANDOLIER ON REEL
TYPE	TCR	TOL.	CU 100 units	C1 1000 units	R1 1000 units	R2 2500 units	RP 5000 units
UXA 0204	± 10 ppm/K	± 0.25 %	562 2....	662 2....	462 2....	-	-
		± 0.1 %	562 3....	662 3....	462 3....	-	-
		± 0.05 %	562 4....	662 4....	462 4....	-	-
		± 0.01 %	562 7....	662 7....	462 7....	-	-
		(1)	562 91...	662 91...	462 91...	-	-
	± 5 ppm/K	± 0.25 %	563 2....	663 2....	463 2....	-	-
		± 0.1 %	563 3....	663 3....	463 3....	-	-
		± 0.05 %	563 4....	663 4....	463 4....	-	-
		± 0.01 %	563 7....	663 7....	463 7....	-	-
		(1)	563 91...	663 91...	463 91...	-	-
	± 2 ppm/K	± 0.25 %	564 2....	664 2....	464 2....	-	-
		± 0.1 %	564 3....	664 3....	464 3....	-	-
		± 0.05 %	564 4....	664 4....	464 4....	-	-
		± 0.01 %	564 7....	664 7....	464 7....	-	-
		(1)	564 91...	664 91...	464 91...	-	-
UXB 0207	± 10 ppm/K	± 0.25 %	572 2....	672 2....	472 2....	-	577 2....
		± 0.1 %	572 3....	672 3....	472 3....	-	577 3....
		± 0.05 %	572 4....	672 4....	472 4....	-	577 4....
		± 0.01 %	572 7....	672 7....	472 7....	-	577 7....
		(1)	572 91...	672 91...	472 91...	-	577 91...
	± 5 ppm/K	± 0.25 %	573 2....	673 2....	473 2....	-	578 2....
		± 0.1 %	573 3....	673 3....	473 3....	-	578 3....
		± 0.05 %	573 4....	673 4....	473 4....	-	578 4....
		± 0.01 %	573 7....	673 7....	473 7....	-	578 7....
		(1)	573 91...	673 91....	473 91...	-	578 91...
	± 2 ppm/K	± 0.25 %	574 2....	674 2....	474 2....	-	579 2....
		± 0.1 %	574 3....	674 3....	474 3....	-	579 3....
		± 0.05 %	574 4....	674 4....	474 4....	-	579 4....
		± 0.01 %	574 7....	674 7....	474 7....	-	579 7....
		(1)	574 91...	674 91...	474 91...	-	579 91...
UXE 0414	± 10 ppm/K	± 0.1 %	592 3....	692 3....	-	597 3....	-
		± 0.05 %	592 4....	692 4....	-	597 4....	-
		(1)	592 91...	692 91...	-	597 91...	-
	± 5 ppm/K	± 0.1 %	593 3....	693 3....	-	598 3....	-
		± 0.05 %	593 4....	693 4....	-	598 4....	-
		(1)	593 91...	693 91...	-	598 91...	-

Note

(1) Readable 12NC coding of resistance values is restricted to values with three significant digits. For resistance values with more than three significant digits, a non readable sequential number will be issued by the factory for each requested combination of resistance value and tolerance.

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