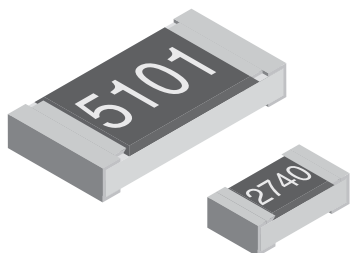


High Stability Thin Film Chip Resistors



TNPW precision thin film flat chip resistors are the perfect choice for most fields of modern electronics where reliability and stability is of major concern. Typical applications include industrial, medical equipment, and those, which are not necessarily subject to the RoHS directive like military and avionics.

FEATURES

- Excellent overall stability at different environmental conditions $\leq 0.05\%$ (1000 h rated power at 70 °C)
- Low temperature coefficient and tight tolerances ($\pm 0.1\%$; ± 10 ppm/K)
- Metal film layer on high quality ceramic
- SnPb termination plating, minimum 6 % Pb

APPLICATIONS

- Avionics
- Military
- Medical equipment
- Industrial equipment

STANDARD ELECTRICAL SPECIFICATIONS

	TNPW0402	TNPW0603	TNPW0805	TNPW1206	TNPW1210 ⁽¹⁾	TNPW2010	TNPW2512 ⁽¹⁾
Metric size	RR 1005M	RR 1608M	RR 2012M	RR 3216M	RR 3225M	RR 5025M	RR 6332M
Resistance range	10 Ω to 100 k Ω	10 Ω to 332 k Ω	10 Ω to 1 M Ω	10 Ω to 2 M Ω	10 Ω to 3.01 M Ω	10 Ω to 4.99 M Ω	10 Ω to 8.87 M Ω
Resistance tolerance	$\pm 1\%$; $\pm 0.5\%$; $\pm 0.1\%$						
Temperature coefficient	± 50 ppm/K; ± 25 ppm/K; ± 15 ppm/K; ± 10 ppm/K					± 50 ppm/K; ± 25 ppm/K	
Rated dissipation, P_{70} ⁽²⁾	0.063 W	0.1 W	0.125 W	0.25 W	0.33 W	0.4 W	0.5 W
Operating voltage, U_{max} AC/DC	50 V	75 V	150 V	200 V	200 V	300 V	300 V
Permissible film temperature, ϑ_F max.	125 °C (155 °C)						
Operating temperature range	- 55 °C to 125 °C (155 °C)						
Thermal resistance ⁽³⁾	870 K/W	550 K/W	440 K/W	220 K/W	170 K/W	140 K/W	110 K/W
Insulation voltage:							
U_{ins} 1 min	75 V	100 V	200 V	300 V	300 V	300 V	300 V
continuous	75 V	75 V	75 V	75 V	75 V	75 V	75 V
Failure rate: FIT _{observed}	$\leq 0.3 \times 10^{-9}/h$	$\leq 0.3 \times 10^{-9}/h$	$\leq 0.3 \times 10^{-9}/h$	$\leq 0.3 \times 10^{-9}/h$	$\leq 0.3 \times 10^{-9}/h$	$\leq 0.3 \times 10^{-9}/h$	$\leq 0.3 \times 10^{-9}/h$

Notes

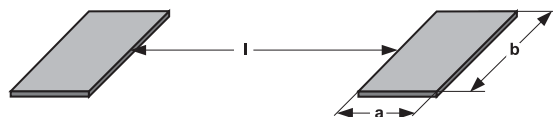
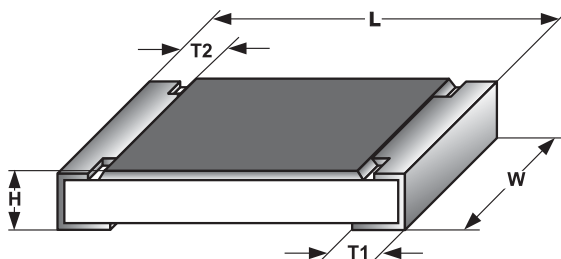
- TNPW 0402 without marking.

⁽¹⁾ Size not specified in EN 140401-801.

⁽²⁾ Rated voltage $\sqrt{P \times R}$. 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.

⁽³⁾ Measuring conditions in accordance with EN 140401-801.

DIMENSIONS



DIMENSIONS AND MASS

TYPE	L (mm)	W (mm)	H (mm)	T1/T2 (mm)	MASS (mg)
TNPW0402	1.0 ± 0.05	0.5 ± 0.05	0.35 ± 0.05	0.2 ± 0.10	0.65
TNPW0603	1.6 ± 0.10	0.85 ± 0.10	0.45 ± 0.10	0.3 ± 0.20	2
TNPW0805	2.0 ± 0.15	1.25 ± 0.15	0.45 ± 0.10	0.4 ± 0.20	5.5
TNPW1206	3.2 ± 0.15	1.6 ± 0.15	0.55 ± 0.10	0.5 ± 0.25	10
TNPW1210	3.2 ± 0.15	2.45 ± 0.15	0.60 ± 0.15	0.5 ± 0.25	16
TNPW2010	5.0 ± 0.15	2.5 ± 0.15	0.60 ± 0.15	0.6 ± 0.25	28
TNPW2512	6.3 ± 0.20	3.1 ± 0.15	0.60 ± 0.15	0.6 ± 0.25	39

SOLDER PAD DIMENSIONS

TYPE	REFLOW SOLDERING			WAVE SOLDERING		
	a (mm)	b (mm)	l (mm)	a (mm)	b (mm)	l (mm)
TNPW0402	0.4	0.6	0.5	-	-	-
TNPW0603	0.5	0.9	1.0	0.9	0.9	1.0
TNPW0805	0.7	1.3	1.2	0.9	1.3	1.3
TNPW1206	0.9	1.7	2.0	1.1	1.7	2.3
TNPW1210	0.9	2.5	2.0	1.1	2.5	2.3
TNPW2010	1.0	2.5	3.9	1.2	2.5	3.9
TNPW2512	1.0	3.2	5.2	1.2	3.2	5.2

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE

TYPE	TCR	TOLERANCE	RESISTANCE	E-SERIES
TNPW0402	± 50 ppm/K	± 1 %	10R to 100K	24; 96
		± 0.5 %	10R to 100K	24; 192
		± 0.1 %	47R to 100K	
	± 25 ppm/K	± 1 %	10R to 100K	24; 96
		± 0.5 %	10R to 100K	24; 192
		± 0.1 %	47R to 100K	
	± 15 ppm/K	± 0.1 %		
	± 10 ppm/K	± 0.1 %		
TNPW0603	± 50 ppm/K	± 1 %	10R to 332K	24; 96
		± 0.5 %	10R to 332K	24; 192
		± 0.1 %		
	± 25 ppm/K	± 1 %	10R to 332K	24; 96
		± 0.5 %	10R to 332K	24; 192
		± 0.1 %		
	± 15 ppm/K	± 0.1 %	47R to 332K	
	± 10 ppm/K	± 0.1 %		
TNPW0805	± 50 ppm/K	± 1 %	10R to 1M0	24; 96
		± 0.5 %	10R to 1M0	24; 192
		± 0.1 %		
	± 25 ppm/K	± 1 %	10R to 1M0	24; 96
		± 0.5 %	10R to 1M0	24; 192
		± 0.1 %		
	± 15 ppm/K	± 0.1 %	47R to 1M0	
	± 10 ppm/K	± 0.1 %		



TEMPERATURE COEFFICIENT AND RESISTANCE RANGE

TYPE	TCR	TOLERANCE	RESISTANCE	E-SERIES
TNPW1206	± 50 ppm/K	± 1 %	10R to 2M0	24; 96
		± 0.5 %	10R to 2M0	24; 192
		± 0.1 %		
	± 25 ppm/K	± 1 %	10R to 2M0	24; 96
		± 0.5 %	10R to 2M0	24; 192
		± 0.1 %		
	± 15 ppm/K	± 0.1 %	47R to 2M0	
	± 10 ppm/K	± 0.1 %		
TNPW1210	± 50 ppm/K	± 1 %	10R to 3M01	24; 96
		± 0.5 %	10R to 3M01	24; 192
		± 0.1 %	47R to 2M13	
	± 25 ppm/K	± 1 %	10R to 3M01	24; 96
		± 0.5 %	10R to 3M01	24; 192
		± 0.1 %		
	± 15 ppm/K	± 0.1 %	47R to 2M13	
	± 10 ppm/K	± 0.1 %		
TNPW2010	± 50 ppm/K	± 1 %	10R to 4M99	24; 96
		± 0.5 %	10R to 4M99	24; 192
		± 0.1 %	47R to 1M0	
	± 25 ppm/K	± 1 %	10R to 4M99	24; 96
		± 0.5 %	10R to 4M99	24; 192
		± 0.1 %	47R to 1M0	
TNPW2512	± 50 ppm/K	± 1 %	10R to 8M87	24; 96
		± 0.5 %	10R to 8M87	24; 192
		± 0.1 %	47R to 1M0	
	± 25 ppm/K	± 1 %	10R to 8M87	24; 96
		± 0.5 %	10R to 8M87	24; 192
		± 0.1 %	47R to 1M0	

PART NUMBER AND PRODUCT DESCRIPTION

Part Number: TNPW12061K32DETA

T	N	P	W	1	2	0	6	1	K	3	2	D	E	T	A		
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	--	--

TYPE/SIZE	RESISTANCE	TOLERANCE	TCR	PACKAGING	SPECIAL
TNPW0402 TNPW0603 TNPW0805 TNPW1206 TNPW1210 TNPW2010 TNPW2512	R = Decimal K = Thousand M = Million (4 digits)	B = $\pm 0.1\%$ D = $\pm 0.5\%$ F = $\pm 1.0\%$	H = ± 50 ppm/K E = ± 25 ppm/K X = ± 15 ppm/K Y = ± 10 ppm/K	TA TD CN TY TC	Up to 2 digits Blank = Standard

Product Description: TNPW-1206 1.32K 0.5 % T-9 RT1

TNPW-1206	1.32K	0.5 %	T-9	RT1
TYPE	RESISTANCE	TOLERANCE	TCR	PACKAGING
TNPW-0402 TNPW-0603 TNPW-0805 TNPW-1206 TNPW-1210 TNPW-2010 TNPW-2512	Examples: 1K32 = 1320 Ω 99.68K = 99 680 Ω 360 = 360 Ω	$\pm 0.1\%$ $\pm 0.5\%$ $\pm 1.0\%$	T-2 = ± 50 ppm/K T-9 = ± 25 ppm/K T-10 = ± 15 ppm/K T-13 = ± 10 ppm/K	RT1 RT7 R52 R75 RT6

Note

- The product can be ordered using either the PART NUMBER or the PRODUCT DESCRIPTION.
- For ordering TNPW e3 with lead free terminations please refer to latest edition of datasheet TNPW e3, document number 28758.

PACKAGING						
TYPE	CODE	QUANTITY	CARRIER TAPE	WIDTH	PITCH	REEL DIAMETER
TNPW0402	RT7 = TD	10 000	Paper tape acc. IEC 60286-3 Type I	8 mm	2 mm	180 mm/7"
TNPW0603 TNPW0805 TNPW1206 TNPW1210	R52 = CN	1000 ⁽¹⁾		8 mm	4 mm	
	RT1 = TA	5000				
	RT6 = TC	20 000				330 mm/13"
TNPW2010 TNPW2512	R75 = TY	1000	Blister tape acc. IEC 60286-3 Type II	12 mm	4 mm	180 mm/7"

Note

⁽¹⁾ 1000 pieces packaging is available only for precision resistors with tolerance $\pm 0.1\%$ and temperature coefficient $\leq \pm 25$ 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 and conditioned to achieve the desired temperature coefficient. A special laser is used to achieve the target value by smoothly cutting a meander groove in the resistive layer without damaging the ceramics. A further conditioning is applied in order to stabilize the trimming result. The resistor elements are covered by a protective coating designed for electrical, mechanical and climatic protection. The result of the determined production is verified by an extensive testing procedure on 100 % of the individual chip 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. Only accepted products are laid directly into the tape in accordance with EN 60286-3.

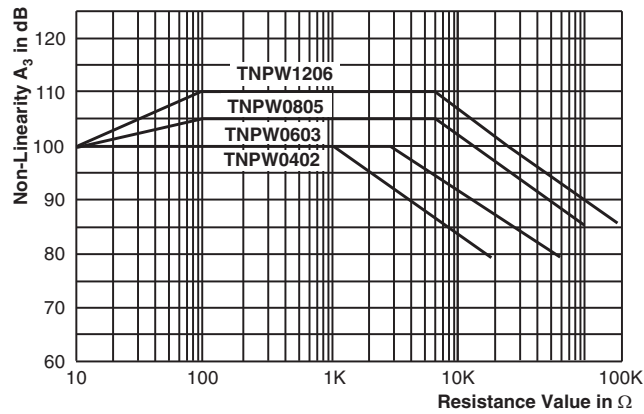
ASSEMBLY

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. 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. Solderability is specified for 2 years after production or re-qualification. The permitted storage time is 20 years.

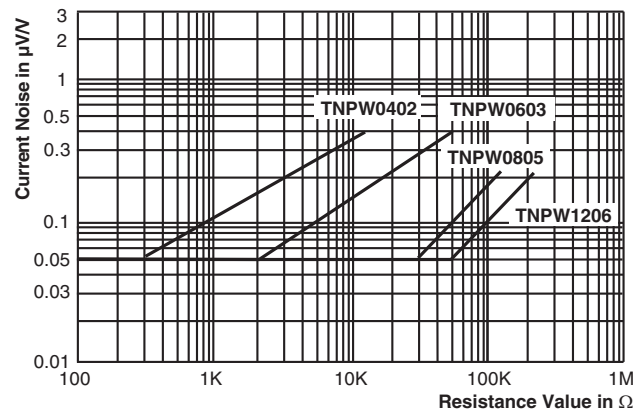
RELATED PRODUCTS

The lead free version TNPW e3 can be used as drop in replacement for the TNPW whenever lead bearing terminations are not mandatory. For ordering TNPW e3 please refer to latest edition of datasheet TNPW e3, document number 28758.

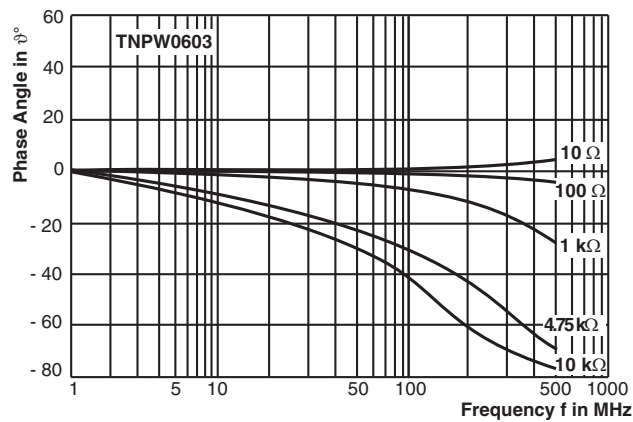
TNPS ESCC high-reliability thin film chip resistors are the premium choice for design and manufacture of equipment, where matured technology and proven reliability are of utmost importance. They are regularly used in communication and research satellites and fit equally well into aircraft and military electronic systems. Approval of the TNPS ESCC products is granted by the European Space Components Coordination and registered in the ESCC Qualified Parts List, REP005, document number 28789.



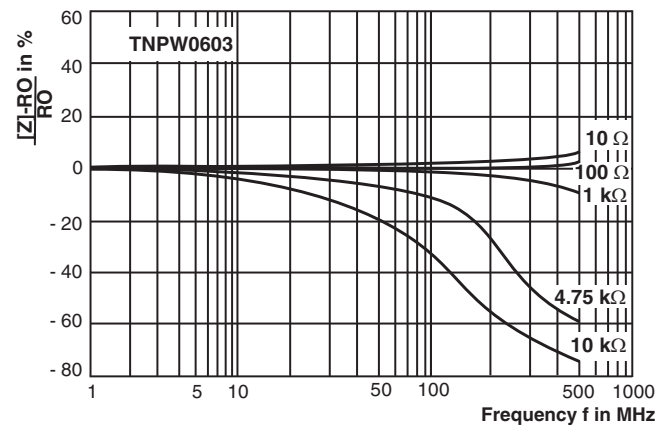
Non-Linearity



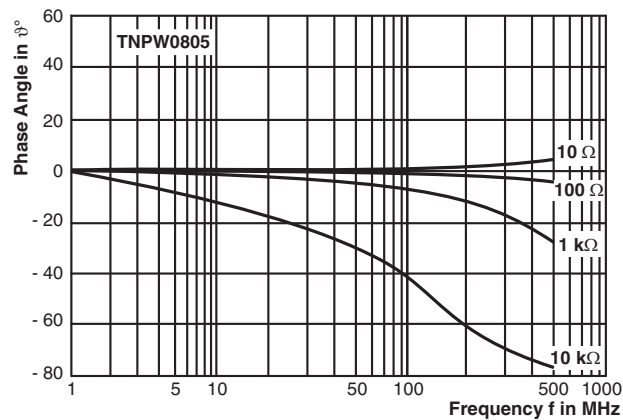
Current Noise



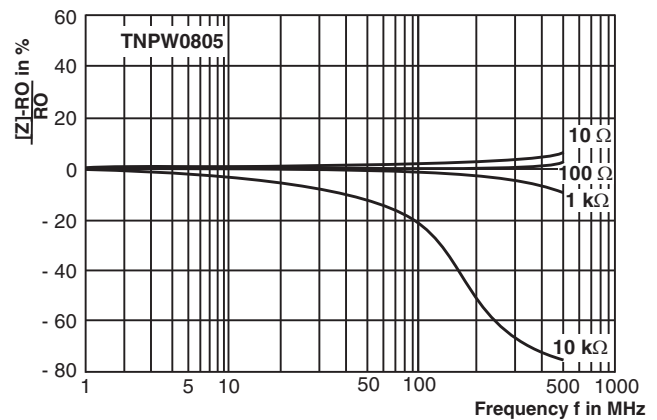
HF Performance



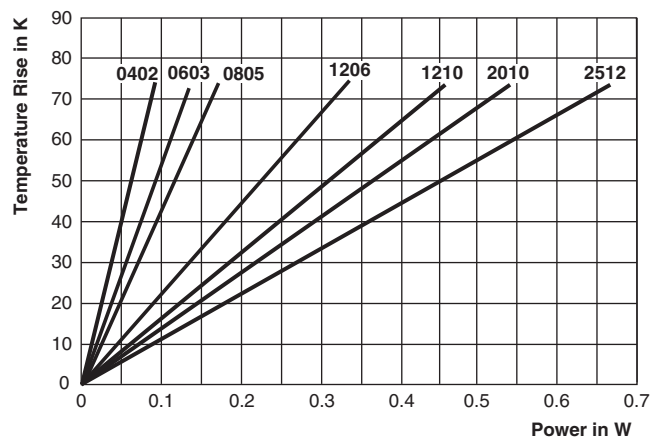
HF Performance



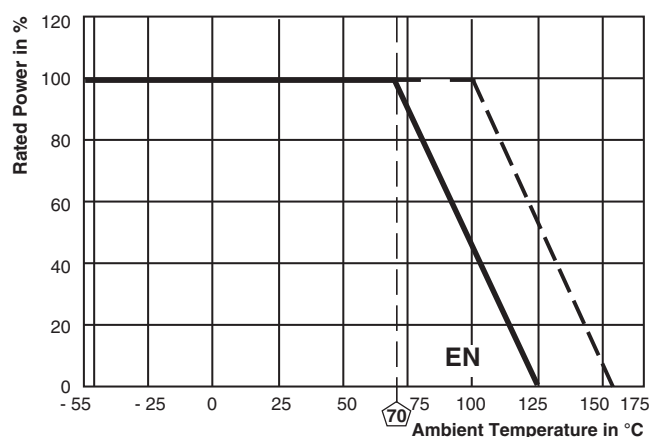
HF Performance



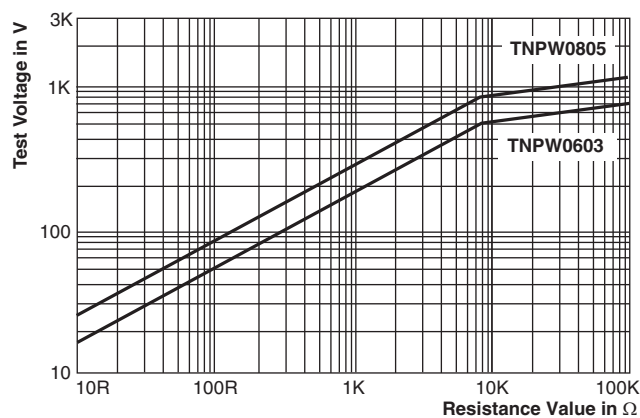
HF Performance



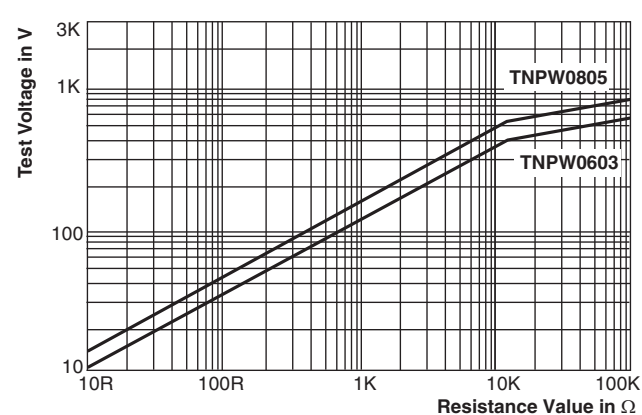
Temperature Rise



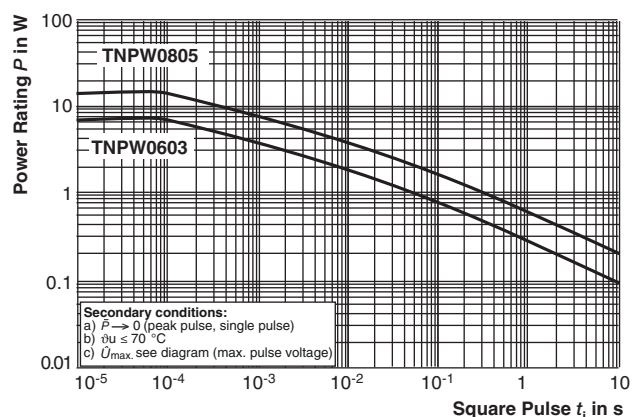
Derating



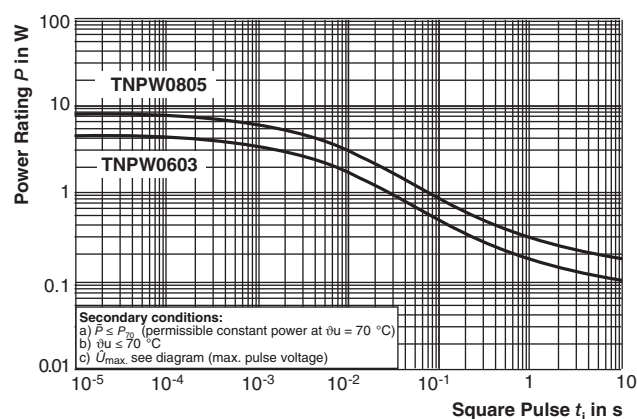
Single-Pulse High Voltage Overload Test
1.2/50 μ s EN 140000 4.27



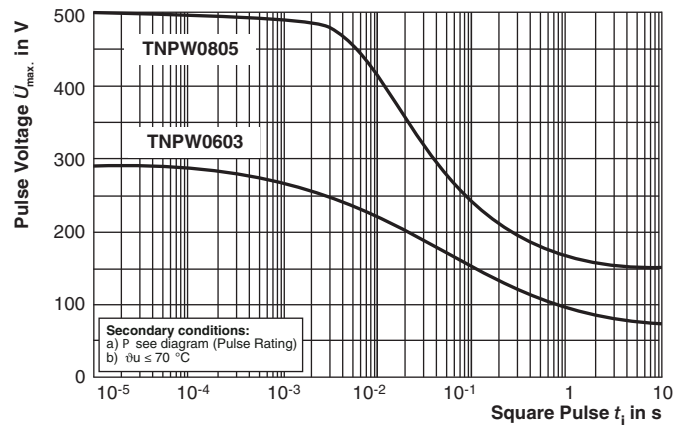
Single-Pulse High Voltage Overload Test
10/700 μ s EN 140000 4.27



Pulse Rating $\bar{P} \rightarrow 0$



Pulse Rating $\bar{P} \leq P_{70}$



Maximum Pulse Voltage

TEST AND REQUIREMENTS

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

- IEC 60115-1, generic specification (includes tests)
- EN 140400, sectional specification (includes schedule for qualification approval)
- EN 140401-801, detail specification (includes schedule for conformance inspection)

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. 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 60115-1, 4.31 unless otherwise specified. The parameters stated in the Test Procedures and Requirements table are based on the required tests and permitted limits of EN 140401-801.

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)		
			Stability for product types:	10 Ω to < 100 Ω		
			TNPW0402		100 Ω to 100 k Ω	10 Ω to 100 k Ω
			TNPW0603		100 Ω to 332 k Ω	10 Ω to 332 k Ω
			TNPW0805		100 Ω to 1 M Ω	10 Ω to 1 M Ω
			TNPW1206		100 Ω to 2 M Ω	10 Ω to 2 M Ω
			TNPW1210		100 Ω to 3.01 M Ω	10 Ω to 3.01 M Ω
			TNPW2010		100 Ω to 4.99 M Ω	10 Ω to 4.99 M Ω
			TNPW2512		100 Ω to 8.87 M Ω	10 Ω to 8.87 M Ω
4.5	-	Resistance		$\pm 0.1 \%$		$\pm 0.5 \%$; $\pm 1.0 \%$
4.8.4.2	-	Temperature coefficient	At (20/- 55/20) $^{\circ}\text{C}$ and (20/125/20) $^{\circ}\text{C}$	$\pm 50 \text{ ppm/K}$; $\pm 25 \text{ ppm/K}$; $\pm 15 \text{ ppm/K}$; $\pm 10 \text{ ppm/K}$		
4.25.1	-	Endurance at 70 $^{\circ}\text{C}$	$U = \sqrt{P_{70} \times R}$ or $\leq U_{\text{max.}}$; 1.5 h on; 0.5 h off; 70 $^{\circ}\text{C}$; 1000 h	$\pm (0.1 \% R + 0.02 \Omega)$	$\pm (0.05 \% R + 0.01 \Omega)$	$\pm (0.25 \% R + 0.05 \Omega)$
4.25.3	-	Endurance at upper category temperature	125 $^{\circ}\text{C}$; 1000 h	$\pm (0.1 \% R + 0.02 \Omega)$	$\pm (0.05 \% R + 0.01 \Omega)$	$\pm (0.5 \% R + 0.05 \Omega)$
4.13	-	Short time overload	$U = 2.5 \times \sqrt{P_{70} \times R}$ $\leq 2 \times U_{\text{max.}}$; 5 s	$\pm (0.05 \% R + 0.01 \Omega)$	$\pm (0.02 \% R + 0.01 \Omega)$	$\pm (0.1 \% R + 0.02 \Omega)$
4.19	14 (Na)	Rapid change of temperature	30 min at LCT; 30 min at UCT; LCT = - 55 $^{\circ}\text{C}$; UCT = 125 $^{\circ}\text{C}$; 5 cycles	$\pm (0.05 \% R + 0.01 \Omega)$	$\pm (0.02 \% R + 0.01 \Omega)$	$\pm (0.1 \% R + 0.02 \Omega)$
4.24	78 (Cab)	Damp heat steady state	(40 $\pm$ 2) $^{\circ}\text{C}$; 56 days; (93 $\pm$ 3) % RH	$\pm (0.1 \% R + 0.02 \Omega)$	$\pm (0.05 \% R + 0.01 \Omega)$	$\pm (0.5 \% R + 0.05 \Omega)$
4.18.2	58 (Td)	Resistance to soldering heat	Solder bath method; (260 $\pm$ 5) $^{\circ}\text{C}$; (10 $\pm$ 1) s	$\pm (0.05 \% R + 0.01 \Omega)$	$\pm (0.02 \% R + 0.01 \Omega)$	$\pm (0.1 \% R + 0.02 \Omega)$



Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and/or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

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.