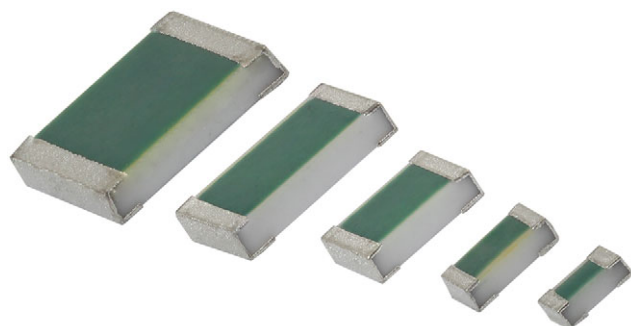


Lead (Pb)-Bearing High Stability Thin Film Chip Resistors

**HALOGEN
FREE**


TNPW high stability thin film chip resistors are the perfect choice for most fields of modern electronics where lead (Pb)-bearing terminations are mandatory and reliability and stability are of major concern.

FEATURES

- SnPb termination plating, Pb content > 6 %
- AEC-Q200 qualified
- Single lot date code available
- Excellent overall stability at different environmental conditions ≤ 0.05 % (1000 h rated power at 70 °C)
- Low temperature coefficient and tight tolerances (± 0.1 %; ± 10 ppm/K)
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

APPLICATIONS

- Military
- Avionics

TECHNICAL SPECIFICATIONS

DESCRIPTION	TNPW0402	TNPW0603	TNPW0805	TNPW1206	TNPW1210
Imperial size	0402	0603	0805	1206	1210
Metric size code	RR1005M	RR1608M	RR2012M	RR3216M	RR3225M
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
Resistance tolerance	± 1 %; ± 0.5 %; ± 0.1 %				
Temperature coefficient	± 50 ppm/K; ± 25 ppm/K; ± 15 ppm/K; ± 10 ppm/K				
Rated dissipation, P_{70} ⁽¹⁾	0.063 W	0.1 W	0.125 W	0.25 W	0.33 W
Operating voltage, U_{max} AC RMS or DC	50 V	75 V	150 V	200 V	200 V
Permissible film temperature, $\vartheta_{F max}$ ⁽¹⁾	155 °C				
Operating temperature range	-55 °C to 125 °C (155 °C)				
Internal thermal resistance (typical) ⁽¹⁾	90 K/W	63 K/W	38 K/W	32 K/W	-
Insulation voltage: U_{ins} 1 min	75 V	100 V	200 V	300 V	300 V
Failure rate: FIT _{observed}	$\leq 0.3 \times 10^{-9}/h$				

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.

Please consider the application note "Thermal Management in Surface-Mounted Resistor Applications" (www.vishay.com/doc?28844) for information on the general nature of thermal resistance.

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**

TYPE	TCR	TOLERANCE	RESISTANCE	E-SERIES
TNPW0402	± 50 ppm/K	± 1 %	10 Ω to 100 k Ω	E24; E96
	± 25 ppm/K	± 0.5 %	47 Ω to 100 k Ω	E24; E192
		± 0.1 %		
	± 15 ppm/K	± 0.1 %		
	± 10 ppm/K	± 0.1 %		
TNPW0603	± 50 ppm/K	± 1 %	10 Ω to 332 k Ω	E24; E96
	± 25 ppm/K	± 0.5 %	47 Ω to 332 k Ω	E24; E192
		± 0.1 %		
	± 15 ppm/K	± 0.1 %		
	± 10 ppm/K	± 0.1 %		
TNPW0805	± 50 ppm/K	± 1 %	10 Ω to 1.0 M Ω	E24; E96
	± 25 ppm/K	± 0.5 %	47 Ω to 1.0 M Ω	E24; E192
		± 0.1 %		
	± 15 ppm/K	± 0.1 %		
	± 10 ppm/K	± 0.1 %		
TNPW1206	± 50 ppm/K	± 1 %	10 Ω to 2.0 M Ω	E24; E96
	± 25 ppm/K	± 0.5 %	47 Ω to 2.0 M Ω	E24; E192
		± 0.1 %		
	± 15 ppm/K	± 0.1 %		
	± 10 ppm/K	± 0.1 %		
TNPW1210	± 50 ppm/K	± 1 %	10 Ω to 3.01 M Ω	E24; E96
	± 25 ppm/K	± 0.5 %	47 Ω to 2.13 M Ω	E24; E192
		± 0.1 %		
	± 15 ppm/K	± 0.1 %		
	± 10 ppm/K	± 0.1 %		

PACKAGING

TYPE	CODE	QUANTITY	PACKAGING STYLE	WIDTH	PITCH	REEL DIAMETER
TNPW0402	TP1 = TP ⁽¹⁾	1000	Paper tape according IEC 60286-3, Type 1a	8 mm	2 mm	180 mm/7"
	RT7 = TD	10 000		8 mm	2 mm	180 mm/7"
TNPW0603	R52 = CN ⁽¹⁾	1000		8 mm	4 mm	180 mm/7"
TNPW0805 TNPW1206 TNPW1210	RT1 = TA	5000		8 mm	4 mm	180 mm/7"

Note

⁽¹⁾ 1000 pieces packaging quantity is only available for precision resistors with tolerance ± 0.1 %

**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	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	TP TD CN TA	Blank = standard OH = single lot date code

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

TNPW-1206	1.32K	0.5 %	T-9	RT1	
TYPE / SIZE	RESISTANCE	TOLERANCE	TCR	PACKAGING	SPECIAL
TNPW-0402 TNPW-0603 TNPW-0805 TNPW-1206 TNPW-1210	Examples: 1K32 = 1320 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	TP1 RT7 R52 RT1	Blank = standard BV20545 = single lot date code

Notes

- The products can be ordered using either the PRODUCT DESCRIPTION or the PART NUMBER



DESCRIPTION

The 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 (Al_2O_3) and conditioned to achieve the desired temperature coefficient. A special laser is used to achieve the target value by smoothly cutting an appropriate 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 tin-lead (SnPb) on nickel plating. The result of the determined production is verified by an extensive testing procedure performed on 100 % of the individual resistors. Only accepted products are placed into the tape in accordance with **IEC 60286-3, Type 1a**.

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** ⁽¹⁾. Solderability is specified for 2 years after production. The permitted storage time is 20 years.

The terminations are plated with SnPb solder, controlled for a minimum lead Pb content of 6 % for compliance with the respective requirements of Bellcore, MIL and ESCC specifications.

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.

RELATED PRODUCTS

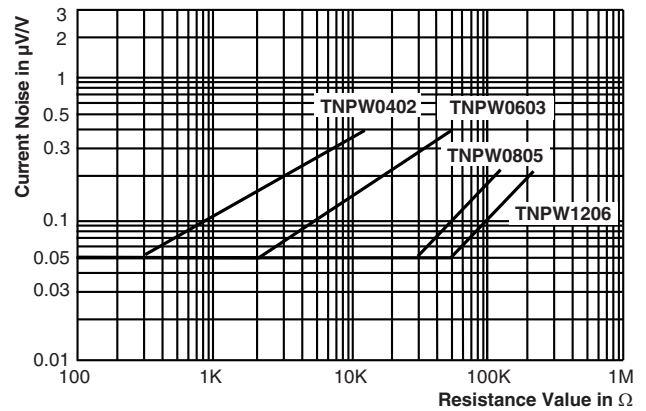
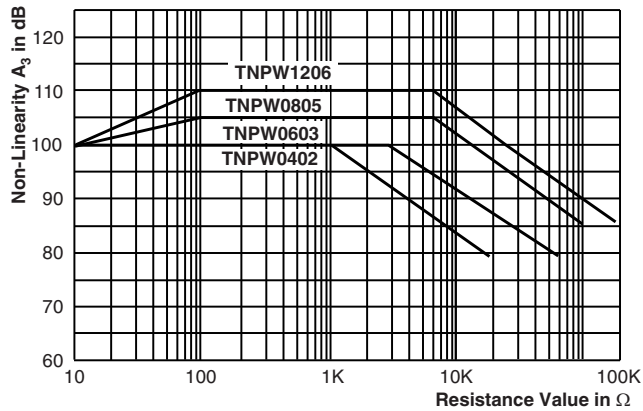
For ordering TNPW with lead free terminations please refer to latest edition of data sheet TNPW e3, (www.vishay.com/doc?28758).

TNPS ESCC high-reliability thin film chip resistors are the premium choice for design and manufacture of equipment, where mature technology and proven reliability are of utmost importance.

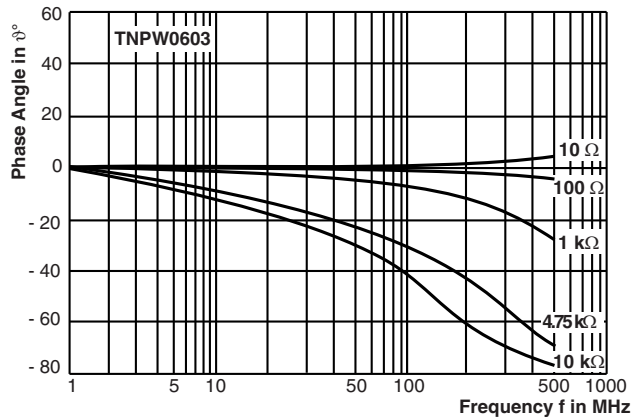
(www.vishay.com/doc?28789)



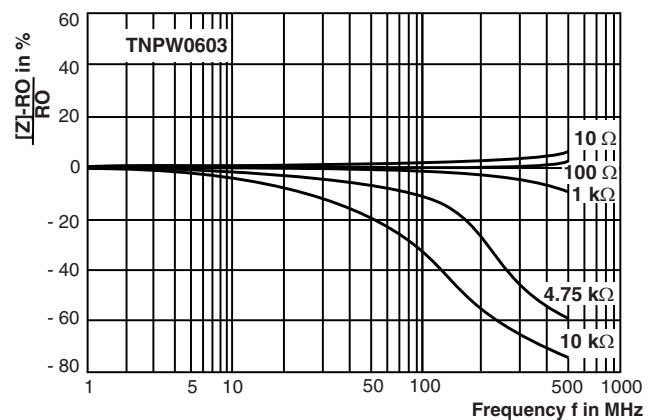
FUNCTIONAL PERFORMANCE



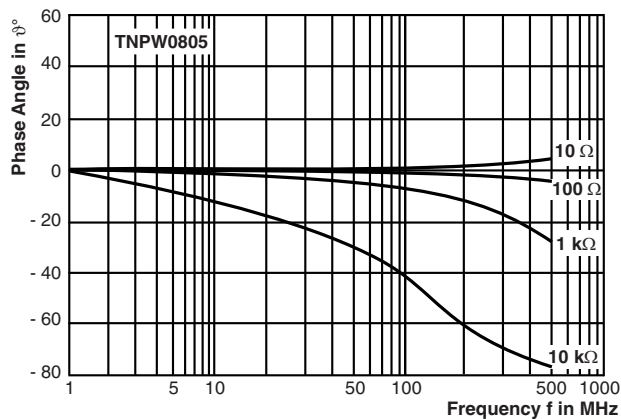
Non-Linearity



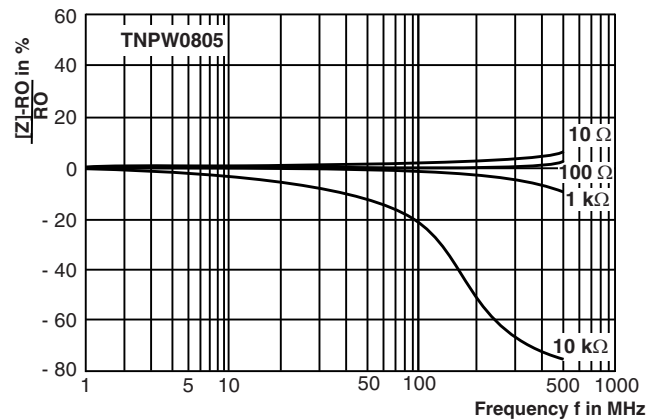
Current Noise



HF Performance

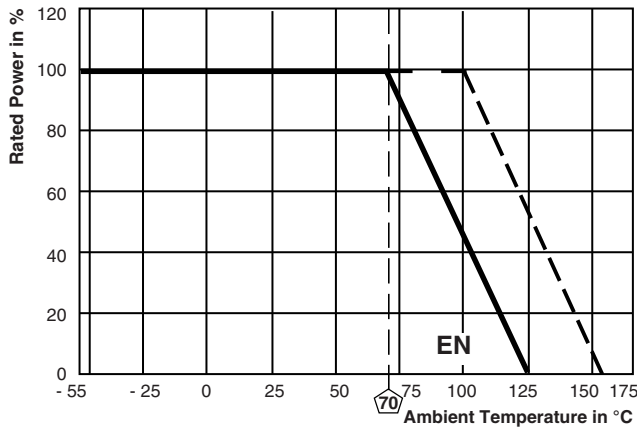


HF Performance



HF Performance

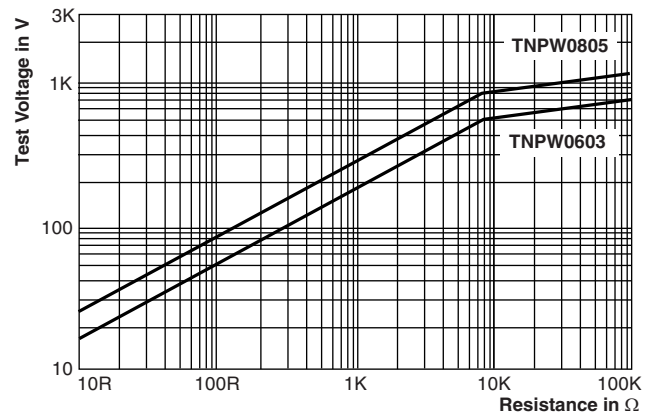
HF Performance



Derating

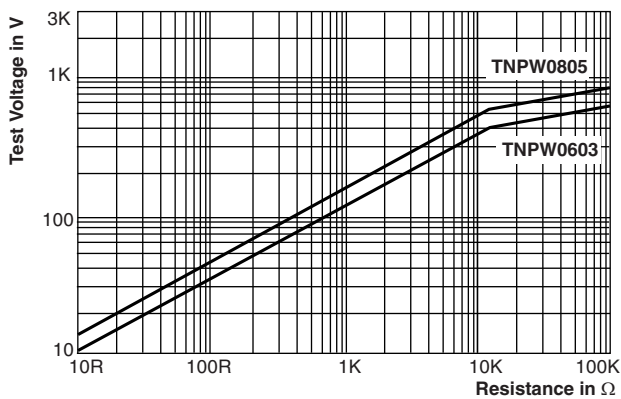
Note

- The solid line is based on IEC/EN reference test conditions which is considered as standard mode. However, above that the maximum permissible film temperature is 155 °C (dashed line)



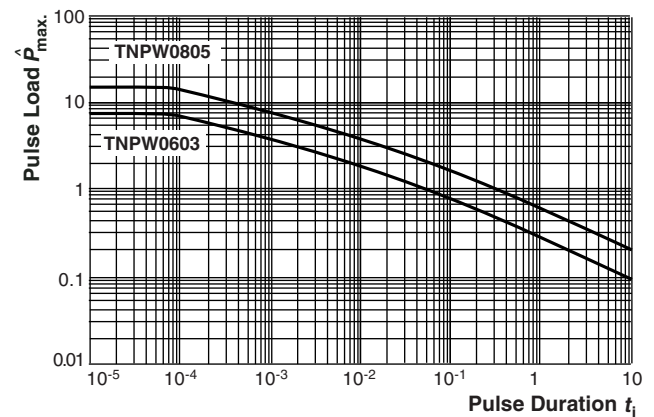
Single-Pulse High Voltage Overload Test

1.2/50 μs EN 140000 4.27



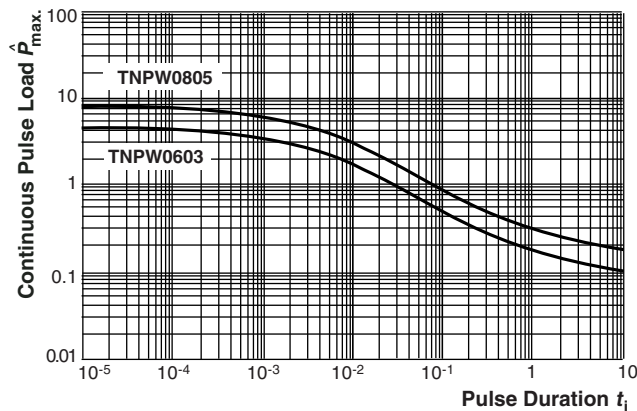
Single-Pulse High Voltage Overload Test

10/700 μs EN 140000 4.27



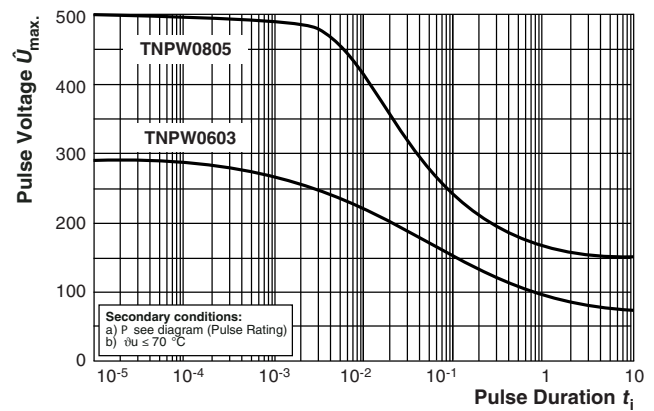
Maximum pulse load, single pulse; applicable if $\bar{P} \rightarrow 0$ and $n \leq 1000$ and $\dot{U} \leq \dot{U}_{max}$; for permissible resistance change equivalent to 8000 h operation in standard operation mode

Single Pulse



Maximum pulse load, continuous pulses; applicable if $\bar{P} \leq P_{(i_{amb})}$ and $\dot{U} \leq \dot{U}_{max}$; for permissible resistance change equivalent to 8000 h operation in standard operation mode

Continuous Pulse



Maximum pulse voltage, single and continuous pulses; applicable if $P \leq P_{max}$; for permissible resistance change equivalent to 8000 h operation in standard operation mode

Pulse Voltage

**TEST 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

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 140401-801. 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: 45 % 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).

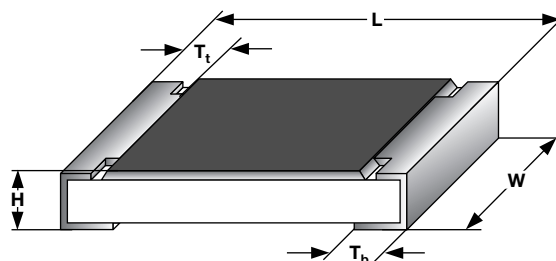
The components are mounted for testing on printed circuit boards in accordance with EN 60115-8, 2.4.2, unless otherwise specified.

TEST PROCEDURES AND REQUIREMENTS						
EN 60115-1 CLAUSE	IEC 60068-2 ⁽¹⁾ TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)		
			Stability for product type:			
			TNPW0402 TNPW0603 TNPW0805 TNPW1206 TNPW1210	10 Ω to < 100 Ω	$\geq 100 \Omega$ to 3.01 M Ω	10 Ω to 3.01 M Ω
6.1	-	Resistance	-	$\pm 0.1 \%$		$\pm 1 \%$; $\pm 0.5 \%$
6.2	-	Temperature coefficient	At (20 / -55 / 20) °C and (20 / 125 / 20) °C	± 25 ppm/K; ± 15 ppm/K; ± 10 ppm/K		± 50 ppm/K; ± 25 ppm/K
7.1	-	Endurance at 70 °C	$U = \sqrt{P_{70} \times R}$ or $\leq U_{max}$; 1.5 h on; 0.5 h off; 70 °C; 1000 h	$\pm (0.1 \% R + 0.02 \Omega)$	$\pm (0.05 \% R + 0.01 \Omega)$	$\pm (0.25 \% R + 0.05 \Omega)$
7.3	-	Endurance at upper category temperature	125 °C; 1000 h	$\pm (0.1 \% R + 0.02 \Omega)$	$\pm (0.05 \% R + 0.01 \Omega)$	$\pm (0.5 \% R + 0.05 \Omega)$
8.1	-	Short time overload	$U = 2.5 \times \sqrt{P_{70} \times R}$ $\leq 2 \times U_{max}$; 2 s	$\pm (0.05 \% R + 0.01 \Omega)$	$\pm (0.02 \% R + 0.01 \Omega)$	$\pm (0.1 \% R + 0.02 \Omega)$
10.4	78 (Cab)	Damp heat, steady state	(40 $\pm$ 2) °C; (93 $\pm$ 3) % RH; 56 days	$\pm (0.1 \% R + 0.02 \Omega)$	$\pm (0.05 \% R + 0.01 \Omega)$	$\pm (0.5 \% R + 0.05 \Omega)$
10.1	14 (Na)	Rapid change of temperature	30 min at - 55 °C; 30 min at 125 °C; 5 cycles	$\pm (0.05 \% R + 0.01 \Omega)$	$\pm (0.02 \% R + 0.01 \Omega)$	$\pm (0.1 \% R + 0.02 \Omega)$
11.2.4.3	58 (Td)	Resistance to soldering heat	Solder bath method; (260 $\pm$ 5) °C; (10 $\pm$ 1) s	$\pm (0.05 \% R + 0.01 \Omega)$	$\pm (0.02 \% R + 0.01 \Omega)$	$\pm (0.1 \% R + 0.02 \Omega)$
12.4	-	Flammability, needle flame test	IEC 60695-11-5 ⁽¹⁾ ; 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	H (mm)	L (mm)	W (mm)	T _t (mm)	T _b (mm)	MASS (mg)
TNPW0402	0.35 ± 0.05	1.0 ± 0.05	0.5 ± 0.05	0.2 ± 0.10	0.2 ± 0.10	0.65
TNPW0603	0.45 ± 0.10	1.55 ± 0.05	0.85 ± 0.10	0.3 ± 0.20	0.3 ± 0.20	2
TNPW0805	0.45 ± 0.10	2.0 ± 0.10	1.25 ± 0.15	0.4 ± 0.20	0.4 ± 0.20	5.5
TNPW1206	0.55 ± 0.10	3.2 + 0.1 / - 0.2	1.6 ± 0.15	0.5 ± 0.25	0.5 ± 0.25	10
TNPW1210	0.60 ± 0.15	3.2 + 0.1 / - 0.2	2.45 ± 0.15	0.5 ± 0.25	0.5 ± 0.25	16

SOLDERING RECOMMENDATIONS

For recommended solder pad dimensions please refer to www.vishay.com/doc?28950.

For recommended soldering profiles please refer to www.vishay.com/doc?31090.



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.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Vishay products are not designed for use in life-saving or life-sustaining applications or any application in which the failure of the Vishay product could result in personal injury or death unless specifically qualified in writing by Vishay. 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.