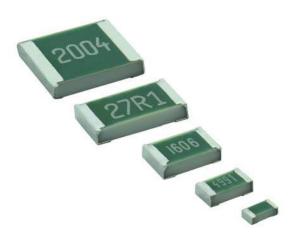


# Lead (Pb)-Bearing High Stability Thin Film Chip Resistors



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**

- Metal film layer on high quality ceramic
- SnPb termination plating, Pb content > 6 %
- 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)
- Single lot date code available

## **APPLICATIONS**

- Military
- Avionics
- Industrial

TECHNICAL SPECIFICATIONS							
DESCRIPTION	TNPW0402	TNPW0603	TNPW0805	TNPW1206	TNPW1210 <sup>(1)</sup>		
Imperial size	0402	0603	0805	1206	1210		
Metric size code	RR1005M	RR1608M	RR2012M	RR3216M	RR3225M		
Resistance range	10 Ω to 100 kΩ	10 Ω to 332 kΩ	10 $\Omega$ to 1 M $\Omega$	10 $\Omega$ to 2 M $\Omega$	10 Ω to 3.01 MΩ		
Resistance tolerance		±	1 %; ± 0.5 %; ± 0.1	%	<u> </u>		
Temperature coefficient		± 50 ppm/K; ± 2	25 ppm/K; ± 15 ppm	n/K; ± 10 ppm/K			
Climatic category (LCT/UCT/days)	55/125/56	55/125/56	55/125/56	55/125/56	55/125/56		
Rated dissipation, $P_{70}$ <sup>(2)</sup>	0.063 W	0.1 W	0.125 W	0.25 W	0.33 W		
Operating voltage, U <sub>max.</sub> AC <sub>RMS</sub> or DC	50 V	75 V	150 V	200 V	200 V		
Permissible film temperature, $\vartheta_{\text{F max}}$ .			155 °C				
Operating Temperature Range		-5	5 °C to 125 °C (155 °	°C)			
Thermal resistance (3)	870 K/W	550 K/W	440 K/W	220 K/W	170 K/W		
Insulation voltage:							
U <sub>ins</sub> 1 min	75 V	100 V	200 V	300 V	300 V		
Continuous	75 V	75 V	75 V	75 V	75 V		
Failure rate: FIT <sub>observed</sub> ≤ 0.3 x 10 <sup>-9</sup> /h							

#### **Notes**

<sup>(1)</sup> The detail specification EN140401-801 does not cover this product size.

<sup>(2)</sup> 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.

<sup>(3)</sup> Measuring conditions in accordance with EN 140401-801.



YPE	TCR	TOLERANCE	RESISTANCE	E-SERIES	
	±50 ppm/K	± 1 %	10.0 to 100 to	E24; E96	
	. OF nam//	± 0.5 %	10 Ω to 100 kΩ	E24; E192	
TNPW0402	±25 ppm/K	± 0.1 %			
	±15 ppm/K	± 0.1 %	47 Ω to 100 kΩ		
	±10 ppm/K	± 0.1 %			
	±50 ppm/K	± 1 %		E24; E96	
	±25 ppm/K	± 0.5 %	10 $\Omega$ to 332 k $\Omega$	E24; E192	
TNPW0603	±25 ppiii/K	± 0.1 %			
	±15 ppm/K	± 0.1 %	47 Ω to 332 kΩ		
	±10 ppm/K	± 0.1 %	47 52 to 332 K52		
	±50 ppm/K	± 1 %		E24; E96	
	- 25 ppm//	± 0.5 %	10 $\Omega$ to 1.0 M $\Omega$		
TNPW0805	±25 ppm/K	± 0.1 %		E24; E192	
	±15 ppm/K	± 0.1 %	47 Ω to 1.0 MΩ	L24, L192	
	±10 ppm/K	± 0.1 %	47 52 10 1.0 10152		
	±50 ppm/K	± 1 %		E24; E96	
	±25 ppm/K	± 0.5 %	10 $\Omega$ to 2.0 M $\Omega$		
TNPW1206	±25 ρρπ/Κ	± 0.1 %		E24; E192	
	±15 ppm/K	± 0.1 %	47 Ω to 2.0 MΩ	E24, E192	
	±10 ppm/K	± 0.1 %	47 12 10 2.0 10112		
	±50 ppm/K	± 1 %	10 Ω to 3.01 MΩ	E24; E96	
	. 05//	± 0.5 %	10.52 (0.3.01 10152		
TNPW1210	±25 ppm/K	± 0.1 %		E24; E192	
	±15 ppm/K	± 0.1 %	47 Ω to 2.13 MΩ	€24, €192	
	±10 ppm/K	± 0.1 %	7		

PART NUMBER	AND PRODUCT	DESCRIPTION			
Part Number: TNPW	12061K32DETA				
T N P	W 1 2	0 6 1	K 3 2	D E T	A
					<del>,,,</del>
TYPE/SIZE	RESISTANCE	TOLERANCE	TCR	PACKAGING	SPECIAL
TNPW0402 TNPW0603 TNPW0805 TNPW1206	R = Decimal K = Thousand M = Million (4 digits)	$\mathbf{B} = \pm 0.1 \%$ $\mathbf{D} = \pm 0.5 \%$ $\mathbf{F} = \pm 1.0 \%$	H = ± 50 ppm/K E = ± 25 ppm/K X = ± 15 ppm/K Y = ± 10 ppm/K	TP TD CN TA	Blank = Standard <b>0H</b> = Single lot  date code
TNPW1210  Product Description:	: TNPW-1206 1.32K 0.	5 % T-9 RT1		TC	
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: <b>1K32</b> = 1320 $\Omega$ <b>99.68K</b> = 99 680 $\Omega$ <b>360</b> = 360 $\Omega$	± 0.1 % ± 0.5 % ± 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 RT6	Blank = Standard BV20545 = Single lot date code

## Notes

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



PACKAGING						
TYPE	CODE	QUANTITY	PACKAGING STYLE	WIDTH	PITCH	REEL DIAMETER
TNPW0402	TP1 = TP <sup>(1)</sup>	1000		8 mm	2	180 mm/7"
TNPW0402	RT7 = TD	10 000		8 mm	2	180 mm/7"
TNPW0603 TNPW0805 TNPW1206 TNPW1210	R52 = CN <sup>(1)</sup>	1000	Tape and reel cardboard tape acc. IEC 60286-3 Type I	8 mm	4	180 mm/7"
TNPW0603 TNPW0805 TNPW1206 TNPW1210	RT1 = TA	5000	.,,,,,,	8 mm	4	180 mm/7"

#### Note

## **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<sub>2</sub>O<sub>3</sub>) 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 I**. Resistance marking is not applied on TNPW0402.

### **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** <sup>(1)</sup>. 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, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system.

## **RELATED PRODUCTS**

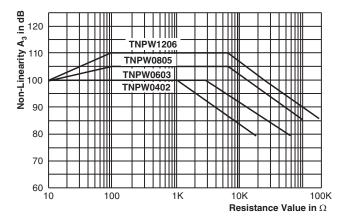
For ordering TNPW with lead free terminations please refer to latest edition of data sheet TNPW e3, (www.vishav.com/doc?28758).

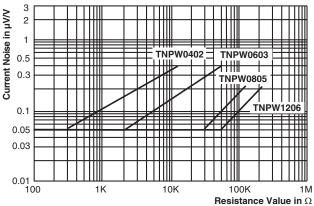
TNPS .... ESCC high-reliability thin film chip resistors are the premium choice for design and manufacture of equipment, where mature technology and proven reliability are of utmost importance.

(www.vishay.com/doc?28789)

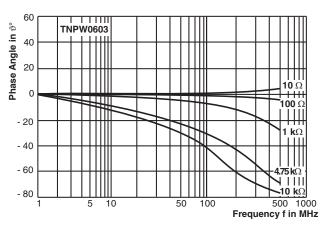
 $<sup>^{(1)}</sup>$  1000 pieces packaging quantity is only available for precision resistors with tolerance  $\pm$  0.1 %.



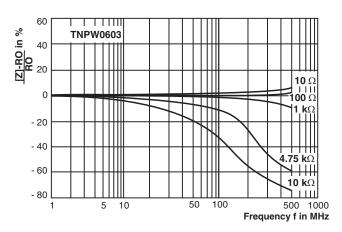




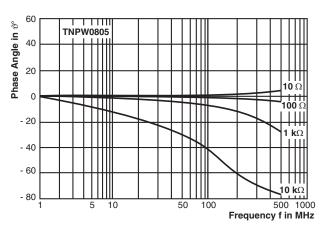
#### **Non-Linearity**



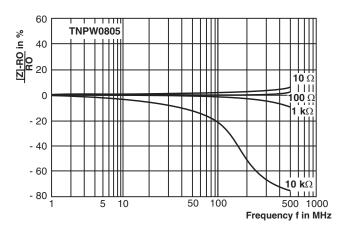
#### **Current Noise**



#### **HF Performance**



**HF Performance** 

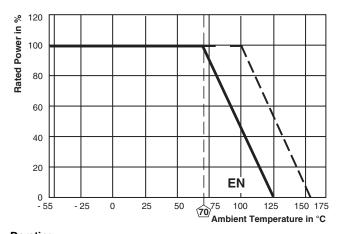


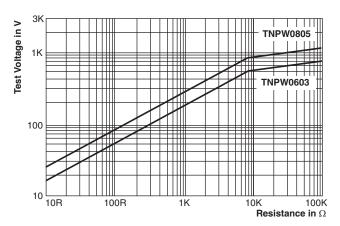
HF Performance

**HF Performance** 



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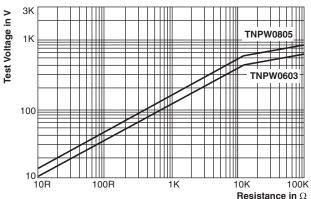


Single-Pulse High Voltage Overload Test 1.2/50 µs EN 140000 4.27

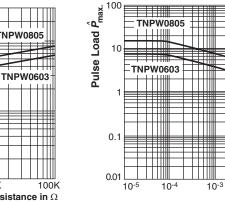
## Derating

#### 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 10/700 µs EN 140000 4.27



### Single Pulse

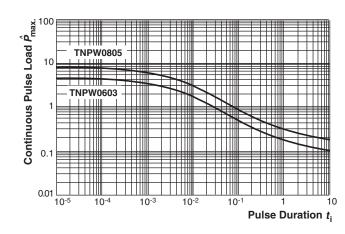
Maximum pulse load, single pulse; applicable if  $\bar{P} \to 0$  and  $n \le 1000$  and  $\hat{U} \le \hat{U}_{\rm max}$ ; for permissible resistance change equivalent to 8000 h operation in standard operation mode

10-2

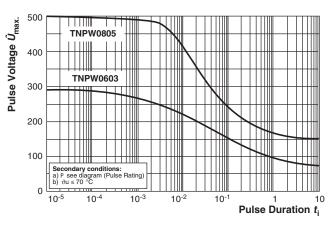
10-

10

Pulse Duration ti



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



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

### Continuous Pulse

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**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/ECA-703 and JIS-C-5201-1. The tests are carried out under standard atmospheric conditions in accordance with IEC 60068-1, 5.3. A climate category is applied, defined by the lower category temperature (LCT), the upper category temperature (UCT), and the number of days of the damp heat, steady-state test (56).

Unless otherwise specified the following values apply:

Temperature: 15 °C to 35 °C Relative humidity: 45 % to 75 %

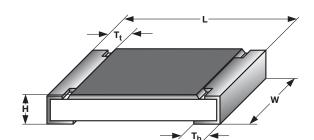
Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar).

The components are mounted for testing on boards in accordance with EN60115-1, 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 EN140401-801.

TEST PRO	TEST PROCEDURES AND REQUIREMENTS							
EN 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREM	HANGE (Δ <i>R</i> )			
			Stability for product type:					
			TNPW0402 TNPW0603 TNPW0805 TNPW1206 TNPW1210	10 $\Omega$ to < 100 $\Omega$	$\geq$ 100 $\Omega$ to 3.01 $M\Omega$	10 $\Omega$ to 3.01 M $\Omega$		
4.5	-	Resistance	-	± 0.	1 %	± 1 %; ± 0.5 %		
4.8.4.2	-	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		
4.25.1	-	Endurance at 70 °C	$U = \sqrt{P_{70} \times R}$ or \le U <sub>max</sub> ; 1.5 h on; 0.5 h off; $70 \text{ °C}; 1000 \text{ h}$	± (0.1 % R + 0.02 Ω)	± (0.05 % R + 0.01 Ω)	± (0.25 % R + 0.05 Ω)		
4.25.3	-	Endurance at upper category temperature	125 °C; 1000 h	± (0.1 % R + 0.02 Ω)	± (0.05 % R + 0.01 Ω)	± (0.5 % R + 0.05 Ω)		
4.13	-	Short time overload	$U = 2.5 \text{ x } \sqrt{P_{70} \text{ x } R}$ $\leq 2 \text{ x } U_{\text{max.}}; 2 \text{ s}$	± (0.05 % R + 0.01 Ω)	± (0.02 % R + 0.01 Ω)	± (0.1 % R + 0.02 Ω)		
4.24	78 (Cab)	Damp heat, steady state	(40 ± 2) °C; (93 ± 3) % RH; 56 days	± (0.1 % R + 0.02 Ω)	± (0.05 % R + 0.01 Ω)	± (0.5 % R + 0.05 Ω)		
4.19	14 (Na)	Rapid change of temperature	30 min at - 55 °C: 30 min at 125 °C; 5 cycles	± (0.05 % R + 0.01 Ω)	± (0.02 % R + 0.01 Ω)	± (0.1 % R + 0.02 Ω)		
4.18.2	58 (Td)	Resistance to soldering heat	Solder bath method; $(260 \pm 5)$ °C; $(10 \pm 1)$ s	± (0.05 % R + 0.01 Ω)	± (0.02 % R + 0.01 Ω)	± (0.1 % R + 0.02 Ω)		
4.35	-	Flammability, needle flame test	IEC 60695-11-5; 10 s		No burning after 30 s			



**DIMENSIONS** 



DIMENSIONS AND MASS								
TYPE	H (mm)	L (mm)	W (mm)	T <sub>t</sub> (mm)	T <sub>b</sub> (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	1.6 ± 0.10	0.85 ± 0.10	0.3 ± 0.20	0.3 ± 0.20	2		
TNPW0805	0.45 ± 0.10	2.0 ± 0.15	1.25 ± 0.15	0.4 ± 0.20	0.4 ± 0.20	5.5		
TNPW1206	0.55 ± 0.10	3.2 ± 0.15	1.6 ± 0.15	0.5 ± 0.25	0.5 ± 0.25	10		
TNPW1210	0.60 ± 0.15	3.2 ± 0.15	2.45 ± 0.15	0.5 ± 0.25	0.5 ± 0.25	16		

## **SOLDER PAD DIMENSIONS**



SOLDER PAD DIMENSIONS								
	R	EFLOW SOLDERIN	IG	WAVE SOLDERING				
TYPE	Y (mm)	X (mm)	G (mm)	Y (mm)	X (mm)	G (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		



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