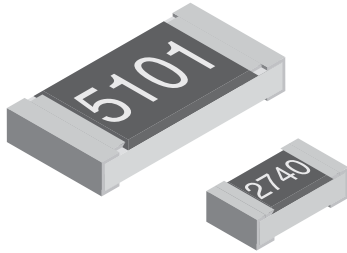


## High Stability Thin Film Chip Resistors



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 ( $\pm 0.1\%$ ;  $\pm 10$  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 <sup>(1)</sup>        | TNPW2010                       | TNPW2512 <sup>(1)</sup>        |
| Metric size                                      | RR 1005M   | RR 1608M                      | RR 2012M                    | RR 3216M                    | RR 3225M                       | RR 5025M                       | RR 6332M                       |
| Resistance range                                 | 10 $\Omega$ to 100 k $\Omega$                                  | 10 $\Omega$ to 332 k $\Omega$ | 10 $\Omega$ to 1 M $\Omega$ | 10 $\Omega$ to 2 M $\Omega$ | 10 $\Omega$ to 3.01 M $\Omega$ | 10 $\Omega$ to 4.99 M $\Omega$ | 10 $\Omega$ to 8.87 M $\Omega$ |
| Resistance tolerance                             | $\pm 1\%$ ; $\pm 0.5\%$ ; $\pm 0.1\%$                          |                               |                             |                             |                                |                                |                                |
| Temperature coefficient                          | $\pm 50$ ppm/K; $\pm 25$ ppm/K; $\pm 15$ ppm/K; $\pm 10$ ppm/K |                               |                             |                             |                                | $\pm 50$ ppm/K; $\pm 25$ ppm/K |                                |
| Rated dissipation, $P_{70}$ <sup>(2)</sup>       | 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, $\vartheta_F$ max. | 125 °C (155 °C)  |                               |                             |                             |                                |                                |                                |
| Operating temperature range                      | - 55 °C to 125 °C (155 °C)                                     |                               |                             |                             |                                |                                |                                |
| Thermal resistance <sup>(3)</sup>                | 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 <sub>observed</sub>            | $\leq 0.3 \times 10^{-9}/h$                                    | $\leq 0.3 \times 10^{-9}/h$   | $\leq 0.3 \times 10^{-9}/h$ | $\leq 0.3 \times 10^{-9}/h$ | $\leq 0.3 \times 10^{-9}/h$    | $\leq 0.3 \times 10^{-9}/h$    | $\leq 0.3 \times 10^{-9}/h$    |

### Notes

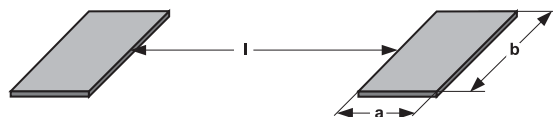
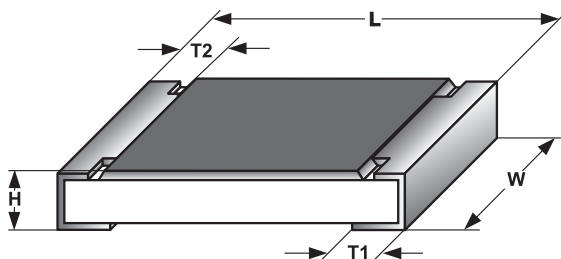
- TNPW 0402 without marking.

<sup>(1)</sup> Size not specified in EN 140401-801.

<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.

**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 |          |
| TNPW0603                                     | ± 50 ppm/K | ± 1 %     | 10R to 332K | 24; 96   |
|  |            | ± 0.5 %   | 10R to 332K | 24; 192  |
|  |            | ± 0.1 %   | 10R to 332K | 24; 192  |
|  | ± 25 ppm/K | ± 1 %     | 10R to 332K |          |
|  |            | ± 0.5 %   | 10R to 332K |          |
|  |            | ± 0.1 %   | 47R to 332K |          |
| TNPW0805                                     | ± 50 ppm/K | ± 1 %     | 10R to 1M0  | 24; 96   |
|  |            | ± 0.5 %   | 10R to 1M0  | 24; 192  |
|  |            | ± 0.1 %   | 10R to 1M0  | 24; 192  |
|  | ± 25 ppm/K | ± 1 %     | 10R to 1M0  |          |
|  |            | ± 0.5 %   | 10R to 1M0  |          |
|  |            | ± 0.1 %   | 47R to 1M0  |          |
| TNPW0805                                     | ± 15 ppm/K | ± 0.1 %   | 47R to 1M0  | 24; 192  |
|  |            | ± 0.1 %   |             |          |
|  | ± 10 ppm/K | ± 0.1 %   | 47R to 1M0  |          |
|  |            | ± 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  | 24; 192  |
|  | ± 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 | 24; 192  |
|  | ± 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<br>TNPW0603<br>TNPW0805<br>TNPW1206<br>TNPW1210<br>TNPW2010<br>TNPW2512        | R = Decimal<br>K = Thousand<br>M = Million<br>(4 digits)       | B = ± 0.1 %<br>D = ± 0.5 %<br>F = ± 1.0 % | H = ± 50 ppm/K<br>E = ± 25 ppm/K<br>X = ± 15 ppm/K<br>Y = ± 10 ppm/K           | TA<br>TD<br>CN<br>TY<br>TC      | Up to 2 digits<br>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<br>TNPW-0603<br>TNPW-0805<br>TNPW-1206<br>TNPW-1210<br>TNPW-2010<br>TNPW-2512 | Examples:<br>1K32 = 1320 Ω<br>99.68K = 99 680 Ω<br>360 = 360 Ω | ± 0.1 %<br>± 0.5 %<br>± 1.0 %             | T-2 = ± 50 ppm/K<br>T-9 = ± 25 ppm/K<br>T-10 = ± 15 ppm/K<br>T-13 = ± 10 ppm/K | RT1<br>RT7<br>R52<br>R75<br>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<br>acc. IEC 60286-3<br>Type I    | 8 mm  | 2 mm  | 180 mm/7"     |
| TNPW0603<br>TNPW0805<br>TNPW1206<br>TNPW1210 | R52 = CN | 1000 <sup>(1)</sup> |   | 8 mm  | 4 mm  |               |
|  | RT1 = TA | 5000                |   |       |       |               |
|  | RT6 = TC | 20 000              |   |       |       |               |
| TNPW2010<br>TNPW2512                         | R75 = TY | 1000                | Blister tape<br>acc. IEC 60286-3<br>Type II | 12 mm | 4 mm  | 180 mm/7"     |

**Note**

<sup>(1)</sup> 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.

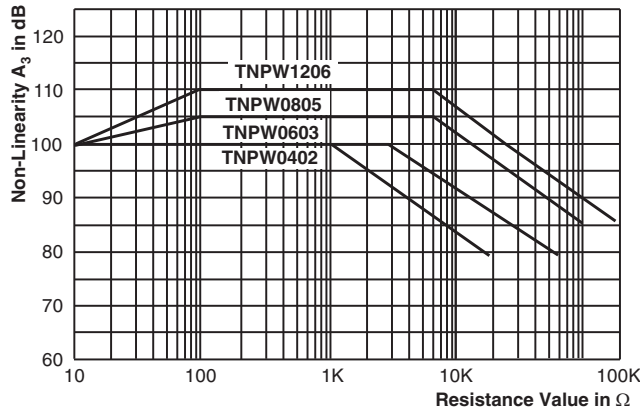
**ASSEMBLY**

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.

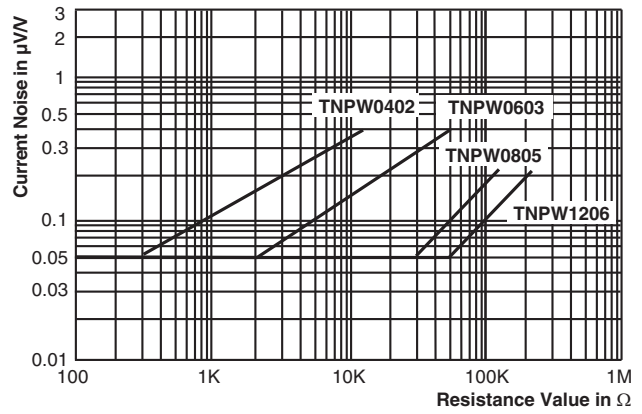
**RELATED PRODUCTS**

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.

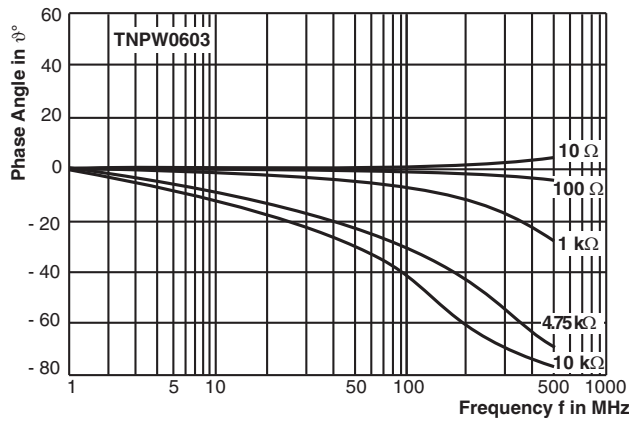
TNPS .... ESCC high-reliability thin film chip resistors are the premium choice for design and manufacture of equipment, where matured technology and proven reliability are of utmost importance. They are regularly used in communication and research satellites and fit equally well into aircraft and military 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.



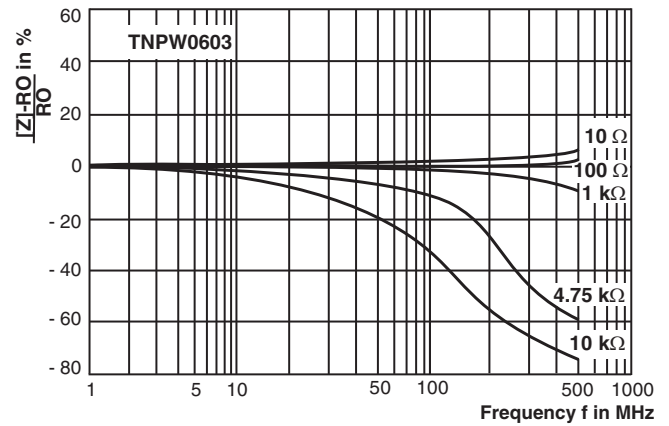
**Non-Linearity**



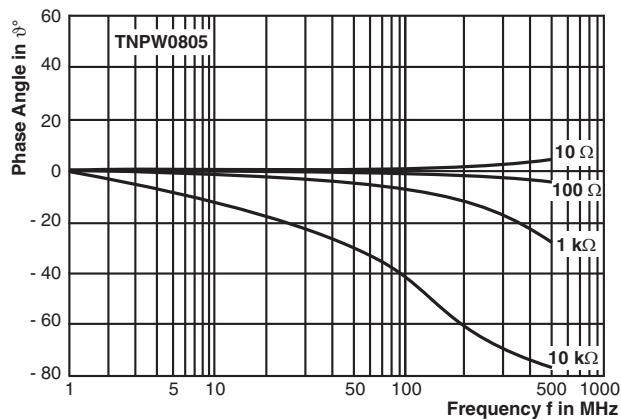
**Current Noise**



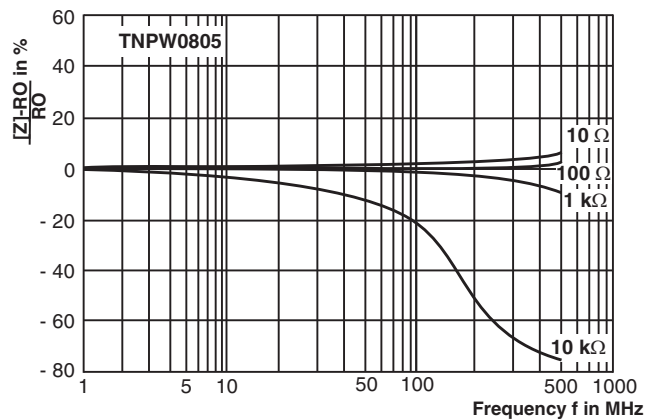
**HF Performance**



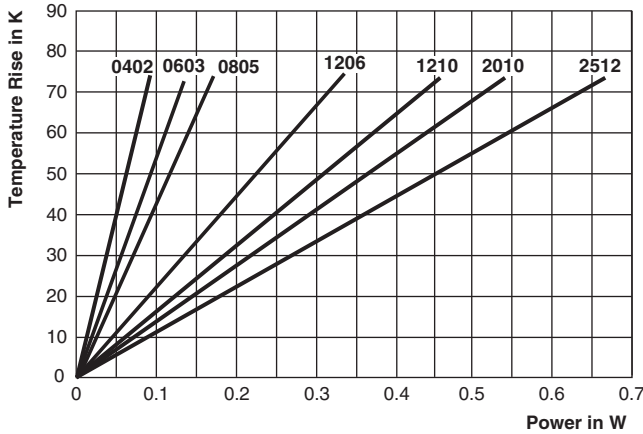
**HF Performance**



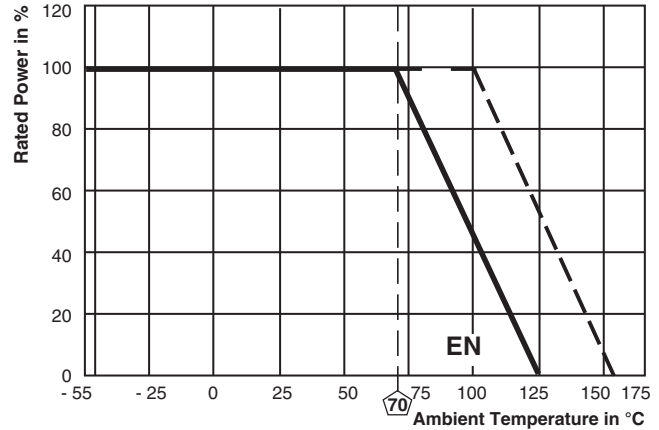
**HF Performance**



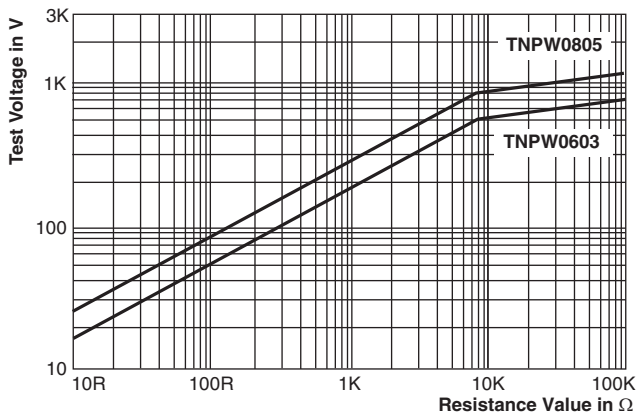
**HF Performance**



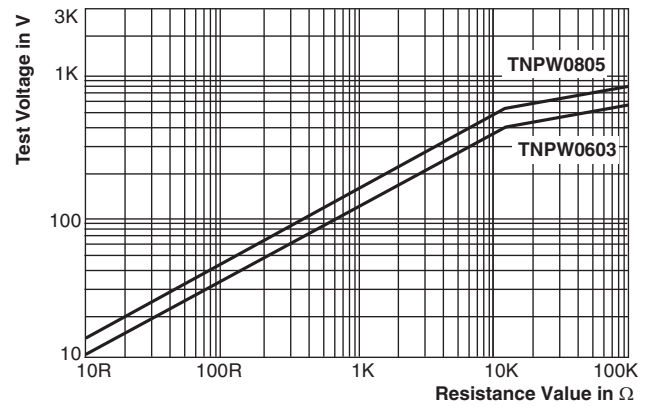
Temperature Rise



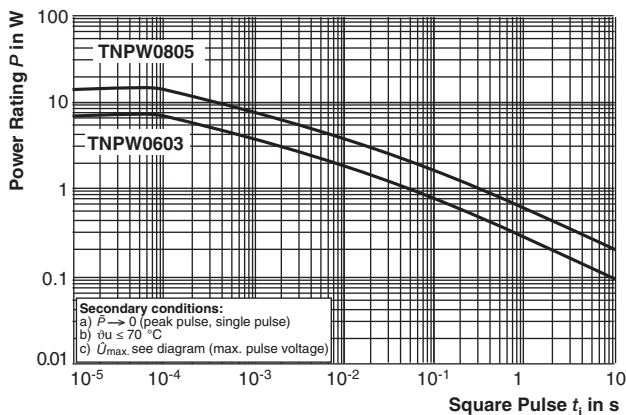
Derating



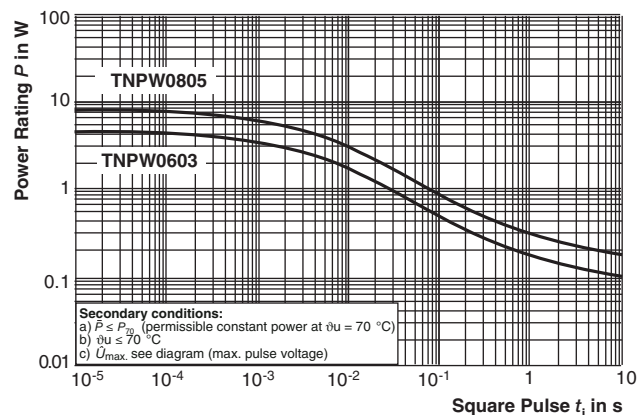
Single-Pulse High Voltage Overload Test  
1.2/50 μs EN 140000 4.27



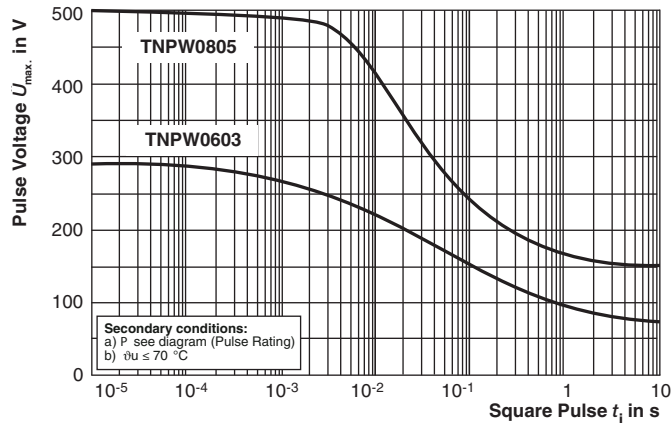
Single-Pulse High Voltage Overload Test  
10/700 μs EN 140000 4.27



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<br>CLAUSE             | IEC 60068-2<br>TEST METHOD | TEST                                    | PROCEDURE   | REQUIREMENTS PERMISSIBLE CHANGE ( $\Delta R$ )                 |                                 |                                |
|                                  |                            |   | Stability for product types:  |  |                                 |                                |
|                                  |                            |   | TNPW0402  | 10 $\Omega$ to < 100 $\Omega$                                  | 100 $\Omega$ to 100 k $\Omega$  | 10 $\Omega$ to 100 k $\Omega$  |
|                                  |                            |   | TNPW0603  |  | 100 $\Omega$ to 332 k $\Omega$  | 10 $\Omega$ to 332 k $\Omega$  |
|                                  |                            |   | TNPW0805  |  | 100 $\Omega$ to 1 M $\Omega$    | 10 $\Omega$ to 1 M $\Omega$    |
|                                  |                            |   | TNPW1206  |  | 100 $\Omega$ to 2 M $\Omega$    | 10 $\Omega$ to 2 M $\Omega$    |
|                                  |                            |   | TNPW1210  |  | 100 $\Omega$ to 3.01 M $\Omega$ | 10 $\Omega$ to 3.01 M $\Omega$ |
|                                  |                            |   | TNPW2010  |  | 100 $\Omega$ to 4.99 M $\Omega$ | 10 $\Omega$ to 4.99 M $\Omega$ |
|                                  |                            |   | TNPW2512  |  | 100 $\Omega$ to 8.87 M $\Omega$ | 10 $\Omega$ to 8.87 M $\Omega$ |
| 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) $^{\circ}\text{C}$   | $\pm 50$ ppm/K; $\pm 25$ ppm/K; $\pm 15$ ppm/K; $\pm 10$ ppm/K |                                 |                                |
| 4.25.1                           | -                          | Endurance at 70 $^{\circ}\text{C}$      | $U = \sqrt{P_{70} \times R}$<br>or $\leq U_{\text{max.}}$ ;<br>1.5 h on; 0.5 h off;<br>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                     | $U = 2.5 \times \sqrt{P_{70} \times R}$<br>$\leq 2 \times U_{\text{max.}}$ ; 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;<br>30 min at UCT;<br>LCT = - 55 $^{\circ}\text{C}$ ;<br>UCT = 125 $^{\circ}\text{C}$ ;<br>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) $^{\circ}\text{C}$ ;<br>56 days;<br>(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;<br>(260 $\pm$ 5) $^{\circ}\text{C}$ ;<br>(10 $\pm$ 1) s   | $\pm (0.05\% R + 0.01 \Omega)$                                 | $\pm (0.02\% R + 0.01 \Omega)$  | $\pm (0.1\% R + 0.02 \Omega)$  |





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