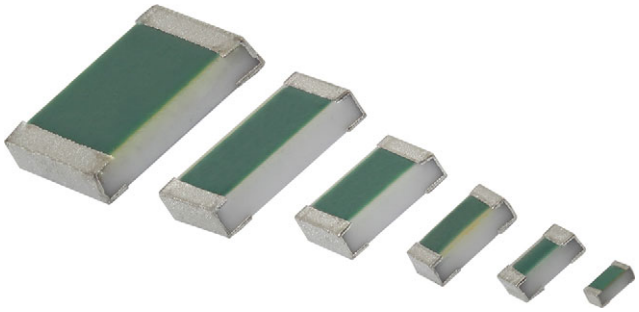
# High Stability Thin Film Flat Chip Resistors



## FEATURES

- Rated dissipation $P_{70}$ up to 0.52 W for size 1206
- AEC-Q200 qualified
- Products are PFAS free
- Permissible film temperature up to 175 °C
- Superior temperature cycling robustness
- Excellent overall stability at different environmental conditions
- Superior moisture resistivity, $|\Delta R/R| < 0.1$ % (85 °C; 85 % RH; 1000 h)
- Superior sulfur resistance verified according to ASTM B 809 and ANSI/EIA-977
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

AUTOMOTIVE GRADE

Pb-free

RoHS COMPLIANT

HALOGEN FREE

GREEN (5-2008)

## LINKS TO ADDITIONAL RESOURCES

3D Models | Product Page | Infographics | Order Samples

Vishay Automotive Grade TNPW e3 thin film flat chip resistors are the perfect choice for most fields of modern electronics where highest reliability and stability is of major concern. Typical applications include automotive, industrial, test and measuring equipment, and medical equipment.

## APPLICATIONS

- Automotive
- Industrial equipment with enhanced requirements
- Test and measuring equipment
- Medical equipment

## TECHNICAL SPECIFICATIONS

| DESCRIPTION | TNPW0201 e3 | TNPW0402 e3 | TNPW0603 e3 | TNPW0805 E3 | TNPW1206 e3 | TNPW1210 e3 |
|---|---|---|---|---|---|---|
| Imperial size | 0201 | 0402 | 0603 | 0805 | 1206 | 1210 |
| Metric size code | RR0603M | RR1005M | RR1608M | RR2012M | RR3216M | RR3225M |
| Resistance range | 22 Ω to 40 kΩ | 10 Ω to 100 kΩ | 1 Ω to 332 kΩ | 1 Ω to 1 MΩ | 1 Ω to 2 MΩ | 10 Ω to 3.01 MΩ |
| Resistance tolerance (1) | ± 0.5 %; ± 0.1 % | ± 1 %; ± 0.5 %; ± 0.1 % | | | | |
| Temperature coefficient (1) | ± 25 ppm/K | ± 50 ppm/K; ± 25 ppm/K; ± 15 ppm/K; ± 10 ppm/K | | | | |
| Rated dissipation, $P_{70}$ (2) | 0.075 W | 0.130 W | 0.210 W | 0.260 W | 0.520 W | 0.520 W |
| Rated dissipation, $P$ | 0.25 W | 0.33 W | 0.5 W | 0.75 W | 1 W | 1.25 W |
| at terminal part temperature, $\vartheta_t$ (3) | 105 °C | | | | | |
| Operating voltage, $U_{max.}$ $AC_{RMS}$ or DC | 25 V | 75 V | 100 V | 150 V | 200 V | 200 V |
| Permissible film temperature, $\vartheta_{F\ max.}$ (2) | 175 °C | | | | | |
| Operating temperature range (4) | -55 °C to 175 °C | | | | | |
| Permissible voltage against ambient (insulation): 1 min; $U_{ins}$ | 50 V | 75 V | 100 V | 200 V | 300 V | 300 V |
| Failure rate: $FIT_{observed}$ | ≤ 0.1 x $10^{-9}$/h | | | | | |

**Notes**

(1) Please refer to TNPU e3 - Ultra Precision Thin Film Chip Resistors for ultra precision options with resistance tolerances ≤ ± 0.1% and temperature coefficients ≤ ± 10 ppm/K

(2) Please refer to APPLICATION INFORMATION

(3) The specified maximum terminal part temperature must not be exceeded; compliance shall be ensured by appropriate thermal management and PCB design at the customer's application level

(4) Please refer to table MAXIMUM RESISTANCE CHANGE AT RATED DISSIPATION, see below



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## 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.

| MAXIMUM RESISTANCE CHANGE AT RATED DISSIPATION | | | | |
|---|---|---|---|---|
| **OPERATION MODE** | | **GENERAL** | **POWER** | **ADVANCED** |
| Rated dissipation, $P_{70}$ | **TNPW0201 e3** | 0.050 W | 0.075 W | - |
| | **TNPW0402 e3** | 0.070 W | 0.105 W | 0.130 W |
| | **TNPW0603 e3** | 0.110 W | 0.170 W | 0.210 W |
| | **TNPW0805 e3** | 0.140 W | 0.220 W | 0.260 W |
| | **TNPW1206 e3** | 0.270 W | 0.420 W | 0.520 W |
| | **TNPW1210 e3** | 0.330 W | 0.500 W | 0.520 W |
| Operating temperature range | | -55 °C to 125 °C | -55 °C to 155 °C | -55 °C to 175 °C |
| Permissible film temperature, $\vartheta_{F\ max.}$ | | 125 °C | 155 °C | 175 °C |
| Max. resistance change at $P_{70}$ for resistance range, $\lvert\Delta R/R\rvert$ after: | **TNPW0201 e3** | 22 Ω to 40 kΩ | | |
| | **TNPW0402 e3** | 10 Ω to 100 kΩ | | |
| | **TNPW0603 e3** | 1 Ω to 332 kΩ | | |
| | **TNPW0805 e3** | 1 Ω to 1 MΩ | | |
| | **TNPW1206 e3** | 1 Ω to 2 MΩ | | |
| | **TNPW1210 e3** | 1 Ω to 3.01 MΩ | | |
| | 1000 h | ≤ 0.05 % | ≤ 0.10 % | ≤ 0.20 % |
| | 8000 h | ≤ 0.10 % | ≤ 0.20 % | - |
| | 225 000 h | ≤ 0.30 % | ≤ 0.60 % | - |

**Note**

- The presented operation modes do not refer to different types of resistors, but actually show examples of different loads, that lead to different film temperatures and different achievable load-life stability (drift) of the resistance value. A suitable low thermal resistance of the circuit board assembly must be safeguarded in order to maintain the film temperature of the resistors within the specified limits. 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


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## TEMPERATURE COEFFICIENT AND RESISTANCE RANGE

| TYPE / SIZE | TCR | TOLERANCE | RESISTANCE | E-SERIES |
|---|---|---|---|---|
| **TNPW0201 e3** | ± 25 ppm/K | ± 0.5 % | 22 Ω to 40 kΩ | E24; E192 |
| | | ± 0.1 | 22 Ω to 25 kΩ | |
| **TNPW0402 e3** | ± 50 ppm/K | ± 1 % | 10 Ω to 100 kΩ | E24; E96 |
| | | ± 0.5 % | | E24; E192 |
| | | ± 0.1 % | 47 Ω to 100 kΩ | |
| | ± 25 ppm/K | ± 1 % | 10 Ω to 100 kΩ | E24; E96 |
| | | ± 0.5 % | | E24; E192 |
| | | ± 0.1 % | 47 Ω to 100 kΩ | |
| | ± 15 ppm/K | ± 0.1 % | | |
| | ± 10 ppm/K | | | |
| **TNPU0402 e3** [1] | | ± 0.05 % | 100 Ω to 100 kΩ | |
| | ± 5 ppm/K | ± 0.1 % | | |
| | | ± 0.05 % | | |
| **TNPW0603 e3** | ± 50 ppm/K | ± 1 % | 1 Ω to 332 kΩ | E24; E96 |
| | | ± 0.5 % | | E24; E192 |
| | | ± 0.1 % | 3.5 Ω to 332 kΩ | |
| | ± 25 ppm/K | ± 1 % | 1 Ω to 332 kΩ | E24; E96 |
| | | ± 0.5 % | | E24; E192 |
| | | ± 0.1 % | 3.5 Ω to 332 kΩ | |
| | ± 15 ppm/K | ± 0.1 % | 47 Ω to 332 kΩ | |
| | ± 10 ppm/K | | | |
| **TNPU0603 e3** [1] | | ± 0.05 % | 24.9 Ω to 100 kΩ | |
| | ± 5 ppm/K | ± 0.1 % | | |
| | | ± 0.05 % | | |
| | | ± 0.02 % | 100 Ω to 100 kΩ | |
| | ± 2 ppm/K | ± 0.1 % | 500 Ω to 20 kΩ | |
| | | ± 0.05 % | | |
| | | ± 0.02 % | | |
| **TNPW0805 e3** | ± 50 ppm/K | ± 1 % | 1 Ω to 1 MΩ | E24; E96 |
| | | ± 0.5 % | | E24; E192 |
| | | ± 0.1 % | 3.5 Ω to 1 MΩ | |
| | ± 25 ppm/K | ± 1 % | 1 Ω to 1 MΩ | E24; E96 |
| | | ± 0.5 % | | E24; E192 |
| | | ± 0.1 % | 3.5 Ω to 1 MΩ | |
| | ± 15 ppm/K | ± 0.1 % | | |
| | ± 10 ppm/K | | | |
| **TNPU0805 e3** [1] | | ± 0.05 % | 100 Ω to 332 kΩ | |
| | ± 5 ppm/K | ± 0.1 % | | |
| | | ± 0.05 % | | |
| | | ± 0.02 % | 100 Ω to 200 kΩ | |
| | ± 2 ppm/K | ± 0.1 % | 500 Ω to 20 kΩ | |
| | | ± 0.05 % | | |
| | | ± 0.02 % | | |
| **TNPW1206 e3** | ± 50 ppm/K | ± 1 % | 1 Ω to 2 MΩ | E24; E96 |
| | | ± 0.5 % | | E24; E192 |
| | | ± 0.1 % | 3.5 Ω to 2 MΩ | |
| | ± 25 ppm/K | ± 1 % | 1 Ω to 2 MΩ | E24; E96 |
| | | ± 0.5 % | | E24; E192 |
| | | ± 0.1 % | 3.5 Ω to 2 MΩ | |
| | ± 15 ppm/K | ± 0.1 % | 47 Ω to 2 MΩ | |
| | ± 10 ppm/K | | | |
| **TNPU1206 e3** [1] | | ± 0.05 % | 100 Ω to 511 kΩ | |
| | ± 5 ppm/K | ± 0.1 % | | |
| | | ± 0.05 % | | |
| | | ± 0.02 % | 100 Ω to 200 kΩ | |
| | ± 2 ppm/K | ± 0.1 % | 500 Ω to 20 kΩ | |
| | | ± 0.05 % | | |
| | | ± 0.02 % | | |


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## TEMPERATURE COEFFICIENT AND RESISTANCE RANGE

| TYPE / SIZE | TCR | TOLERANCE | RESISTANCE | E-SERIES |
|---|---|---|---|---|
| TNPW1210 e3 | ± 50 ppm/K | ± 1 % | 10 Ω to 3.01 MΩ | E24; E96 |
| | | ± 0.5 % | | E24; E192 |
| | | ± 0.1 % | 47 Ω to 2.13 MΩ | |
| | ± 25 ppm/K | ± 1 % | 10 Ω to 3.01 MΩ | E24; E96 |
| | | ± 0.5 % | | E24; E192 |
| | | ± 0.1 % | 47 Ω to 2.13 MΩ | |
| | ± 15 ppm/K | ± 0.1 % | | |
| | ± 10 ppm/K | | | |

**Note**

(5) For more information on the TNPU e3 series, please refer to www.vishay.com/ppg?28779

## PACKAGING

| TYPE / SIZE | CODE | QUANTITY | PACKAGING STYLE | WIDTH | PITCH | PACKAGING DIMENSIONS |
|---|---|---|---|---|---|---|
| TNPW0201 e3 | ET7 = ED | 10 000 | Paper tape according IEC 60286-3, Type 1a | 8 mm | 2 mm | Ø 180 mm / 7" |
| TNPW0402 e3 | ET7 = ED | 10 000 | | | | |
| TNPW0603 e3<br>TNPW0805 e3<br>TNPW1206 e3<br>TNPW1210 e3 | ET1 = EA | 5000 | | | 4 mm | Ø 180 mm / 7" |
| | ET6 = EC (1) | 20 000 | | | 4 mm | Ø 330 mm / 13" |

**Notes**

- For more information on the TNPU e3 series, please refer to www.vishay.com/ppg?28779

(1) 20 000 pieces packaging is available only for resistors with TCR ± 25 ppm/K and ± 50 ppm/K

## PART NUMBER AND PRODUCT DESCRIPTION

**Part Number: TNPW12061K32DEEA**

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

| TYPE / SIZE | RESISTANCE | TOLERANCE | TCR | PACKAGING | SPECIAL |
|---|---|---|---|---|---|
| **TNPW0201**<br>**TNPW0402**<br>**TNPW0603**<br>**TNPW0805**<br>**TNPW1206**<br>**TNPW1210** | **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 | ED<br>**EA**<br>**EC**<br>(E.. = lead (Pb)-free) | Up to 2 digits<br>Blank = standard<br>0H = single lot date code |

**Product Description: TNPW1206 1K32 0.5 % T-9 ET1 e3**

| TNPW1206 | 1K32 | 0.5 % | T-9 | ET1 | e3 |
|---|---|---|---|---|---|
| TYPE / SIZE | RESISTANCE | TOLERANCE | TCR | PACKAGING | LEAD (Pb)-FREE |
| **TNPW0201**<br>**TNPW0402**<br>**TNPW0603**<br>**TNPW0805**<br>**TNPW1206**<br>**TNPW1210** | **54R1** = 54.1 Ω<br>**1K32** = 1320 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 | ET7<br>**ET1**<br>**ET6**<br>(E.. = lead (Pb)-free) | **e3** = pure matte tin termination finish<br><br>BV 20545 = single lot date code |

**Notes**

- The product can be ordered using either the PART NUMBER or the PRODUCT DESCRIPTION
- For more information on the TNPU e3 series, please refer to www.vishay.com/ppg?28779


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## DESCRIPTION

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A homogeneous film of special metal alloy is deposited on a high grade ceramic substrate ($Al_2O_3$) and conditioned to achieve the desired temperature coefficient. Specially designed inner contacts are deposited on both sides. A special laser is used to achieve the target value by smoothly fine trimming 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 terminations receive a final pure matte tin on nickel plating. The result of the determined production is verified by an extensive testing procedure and optical inspection performed on 100 % of the individual chip resistors. This includes full screening for the elimination of products with a potential risk of early life failures (feasible for $R \geq 10\ \Omega$). Only accepted products are laid directly into the tape in accordance with **IEC 60286-3, Type 1a** [(1)].

## 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)]. 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 [(2)].

The resistors are RoHS-compliant, the pure matte tin plating provides compatibility with lead (Pb)-free and lead-containing soldering processes. Solderability is specified for 2 years after production or requalification. The permitted storage time is 20 years. 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 [(3)]
- The Global Automotive Declarable Substance List (GADSL) [(4)]
- The REACH regulation (1907/2006/EC) and the related list of substances with very high concern (SVHC) [(5)] 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.

## RELATED PRODUCTS

The TNPW with SnPb termination plating is designed for those applications, where lead bearing terminations are mandatory. For ordering TNPW with SnPb terminations please refer to latest edition of datasheet TNPW (www.vishay.com/doc?31006).

TNPU e3 ultra precision thin film flat chip resistors combine the proven reliability of TNPW e3 products with a most advanced level of precision and stability (www.vishay.com/doc?28779).

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 (www.vishay.com/doc?28789).

TNPV e3 High Voltage Thin Film Flat Chip Resistors are designed for most fields of modern electronics where precision, reliability and stability at high operating voltage are primary concerns (www.vishay.com/doc?28881).

**Notes**

(1) The quoted IEC standards are also released as EN standards with the same number and identical contents
(2) For details refer to application note “Preserving Precision: Conformal Coatings Applied to Thin Film Resistors” www.vishay.com/doc?28960
(3) The IEC 62474 list of declarable substances is maintained in a dedicated database, which is available at http://std.iec.ch/iec62474
(4) The Global Automotive Declarable Substance List (GADSL) is maintained by the American Chemistry Council and available at www.gadsl.org
(5) The SVHC list is maintained by the European Chemical Agency (ECHA) and available at http://echa.europa.eu/candidate-list-table



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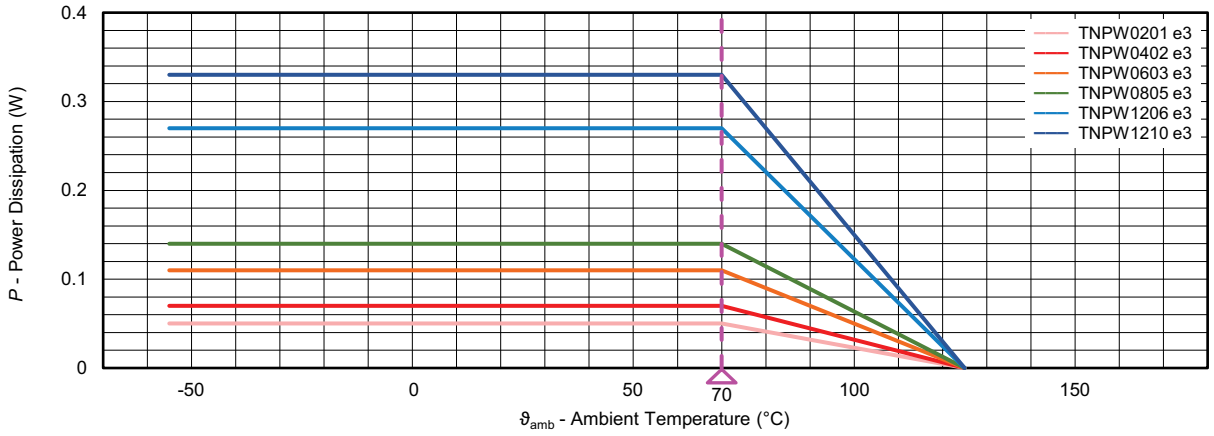
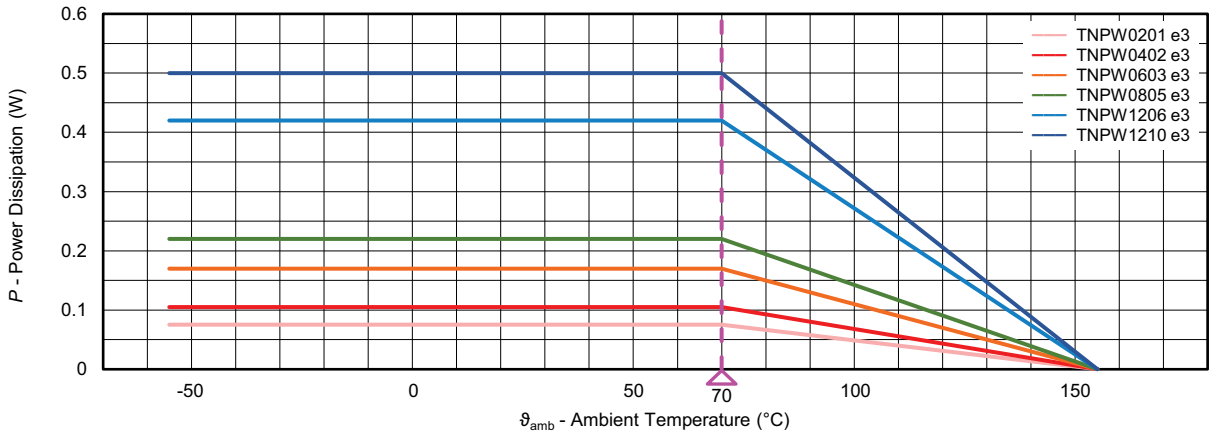
## FUNCTIONAL PERFORMANCE

| PERFORMANCE IN SULFUR-CONTAINING AMBIANCE | | |
|---|---|---|
| **TEST NAME** | **HUMID SULFUR VAPOR TEST FOS-90** | **DRY SULFUR TEST FOS-105** |
| Reference specification | ASTM B 809 | ANSI/EIA-977 |
| Test conditions (temperature, humidity) | 90 °C ± 2 °C<br>76 % to 95 % RH | 105 °C ± 2 °C<br>RH not specified, not applicable |
| Aggressive agent | Sulfur (saturated vapor) | Sulfur, sublimed |
| Failure criteria in VI under magnification | Silver sulfide growth: length shall be < 50 µm | Not applicable |
| Failure criteria in electrical test | ≤ (± 1 % $R$ + 0.05 Ω) | ≤ (± 1 % $R$ + 0.05 Ω) |
| Test duration | 1000 h | 1000 h |




**Derating - General Operation**




**Derating - Power Operation**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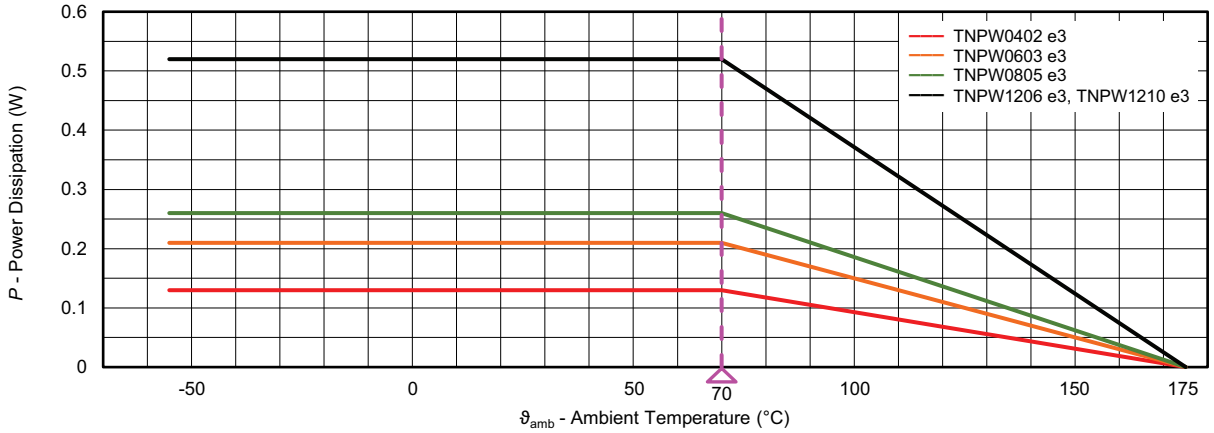
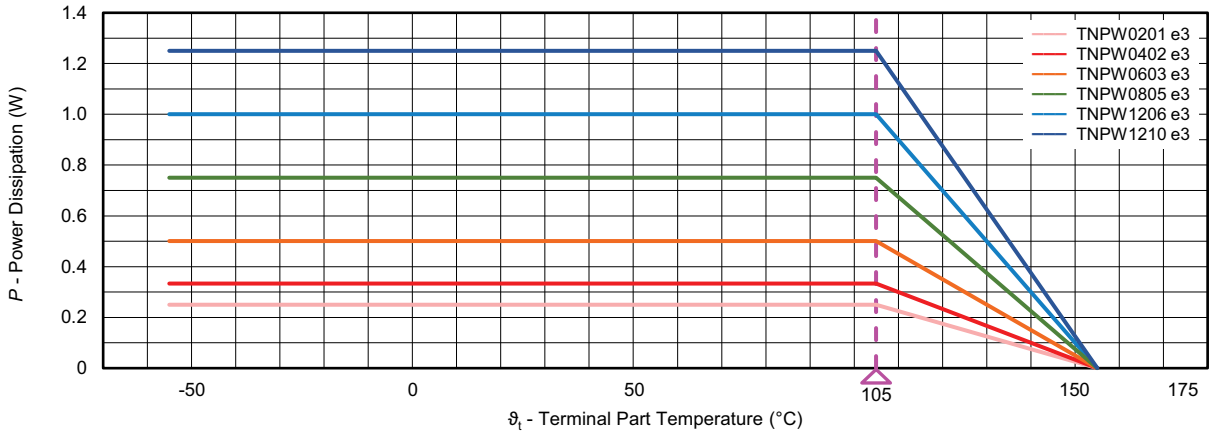
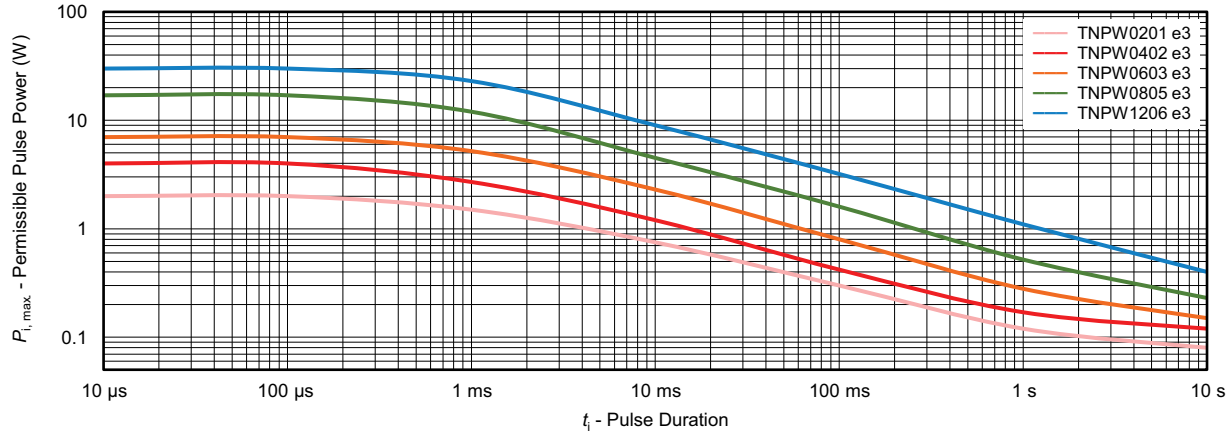



**Derating - Advanced Operation**




**Derating - Terminal Part Temperature**




Maximum pulse load, single pulse; applicable if $\overline{P} \rightarrow 0$ and n ≤ 1000 and $\hat{U} \leq \hat{U}_{max.}$;
for permissible resistance change ± (0.5 % $R$ + 0.05 Ω)

**Single Pulse**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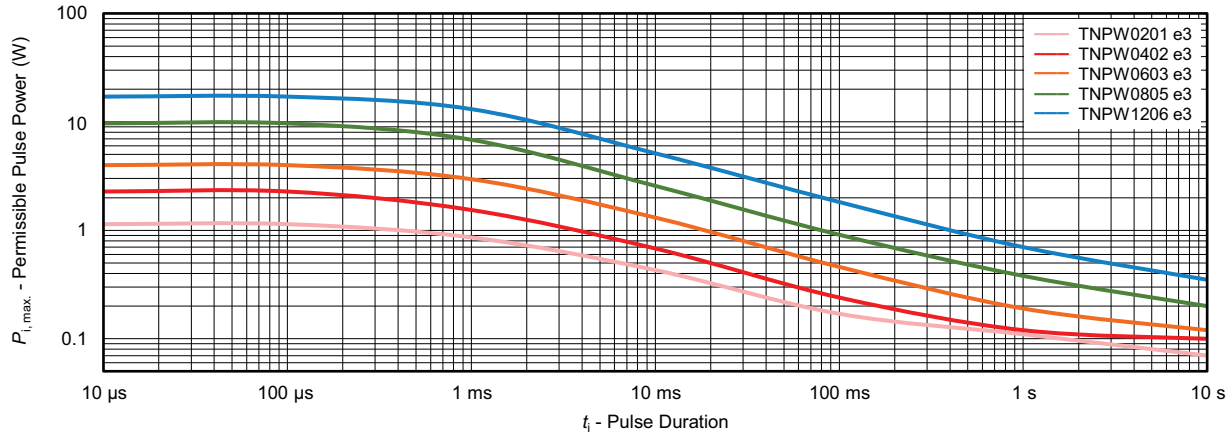
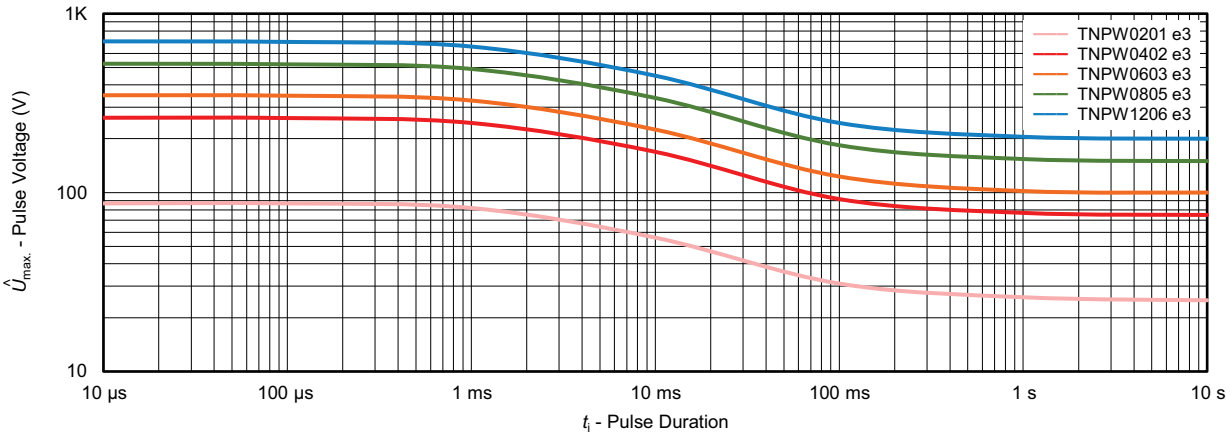


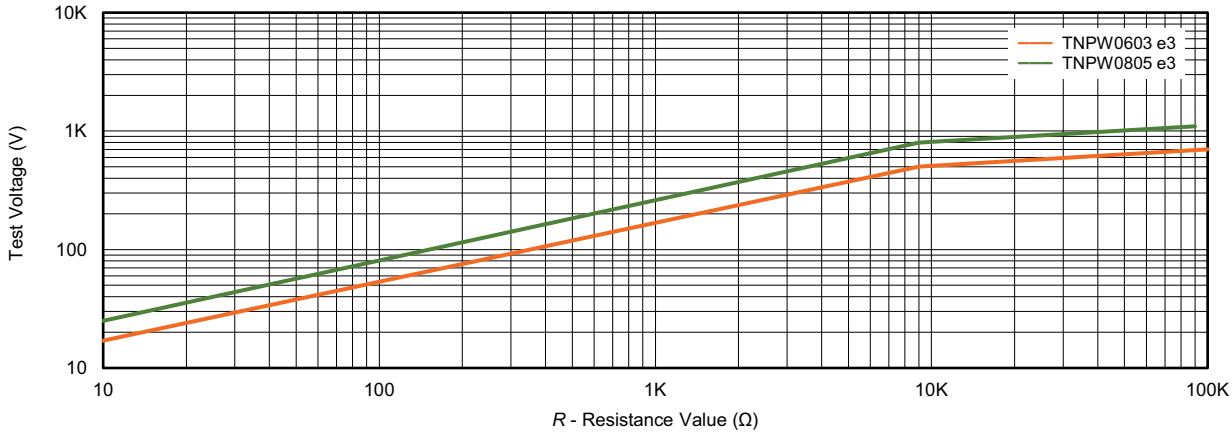

Maximum pulse load, continuous pulse; applicable if $\overline{P} \leq P\ (\vartheta_{amb})$ and $\hat{U} \leq \hat{U}_{max.}$;
for permissible resistance change ± (0.5 % $R$ + 0.05 Ω)

**Continuous Pulse**




Maximum pulse voltage, single and continuous pulses; applicable if $\hat{P} \leq \hat{P}_{max.}$;
for permissible resistance change ± (0.5 % $R$ + 0.05 Ω)

**Pulse Voltage**




Pulse load rating in accordance with EN 60115-1 clause 4.27; 1.2 µs/50 µs;
5 pulses at 12 s intervals; for permissible resistance change ± (0.5 % $R$ + 0.05 Ω)

**1.2/50 Pulse**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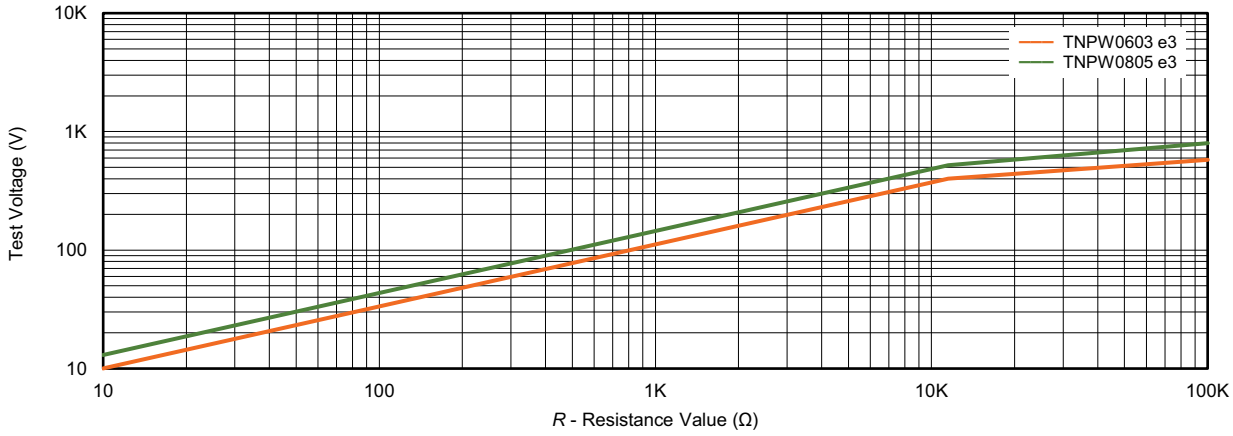
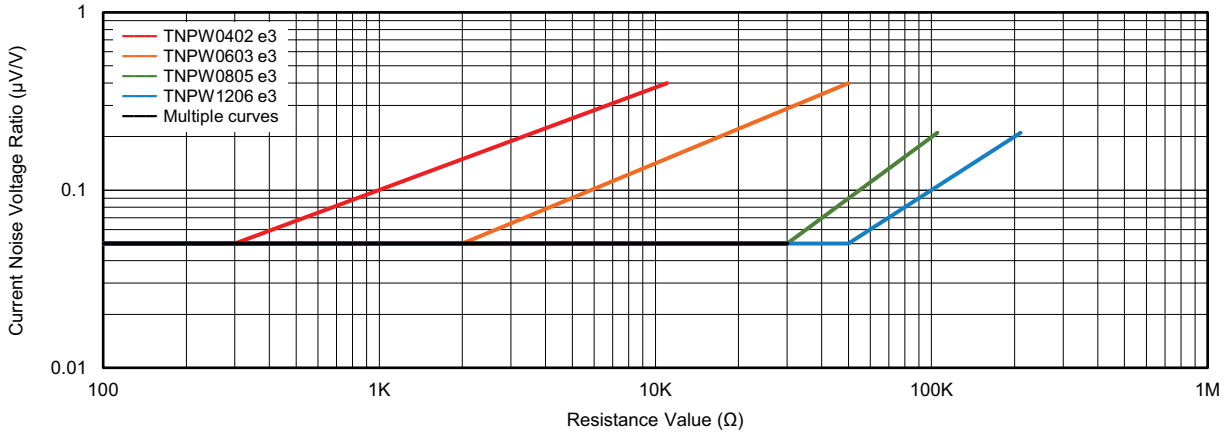


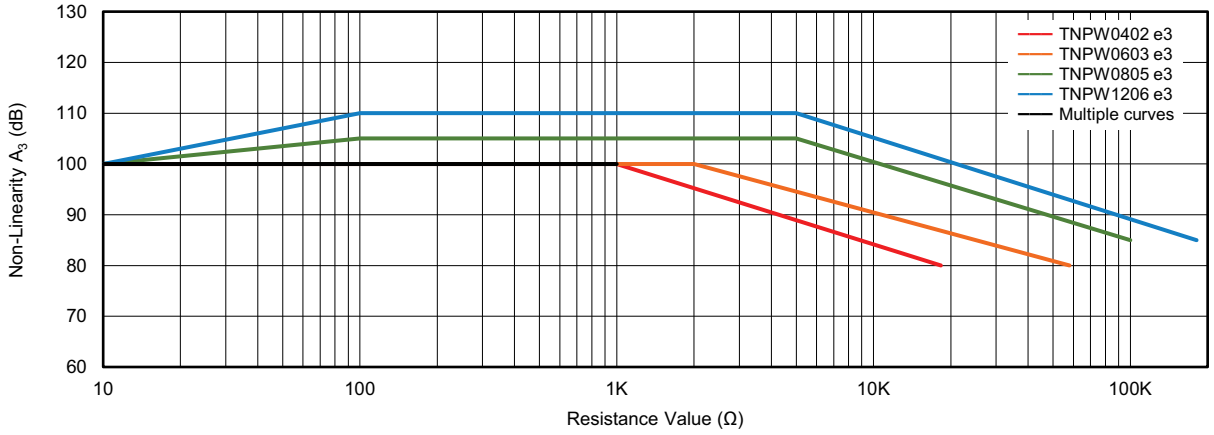

Pulse load rating in accordance with EN 60115-1 clause 4.27; 10 µs/700 µs;
10 pulses at 1 minute intervals; for permissible resistance change ± (0.5 % *R* + 0.05 Ω)

**10/700 Pulse**




In accordance with IEC 60195

**Current Noise Voltage Ratio**




In accordance with IEC 60195

**Non-Linearity**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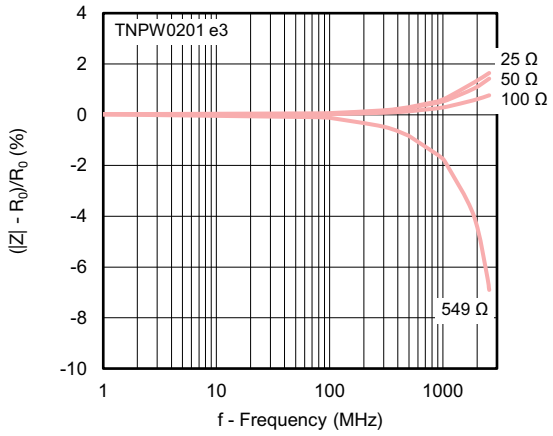


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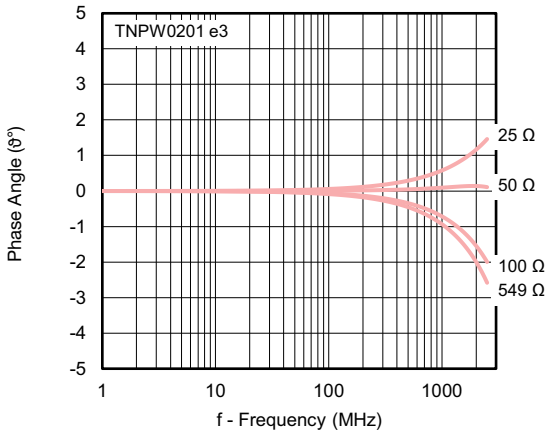


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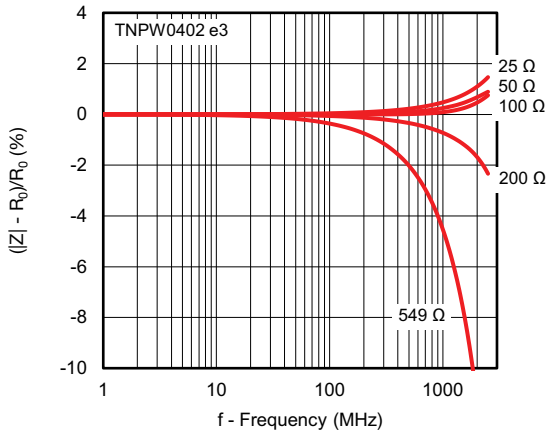


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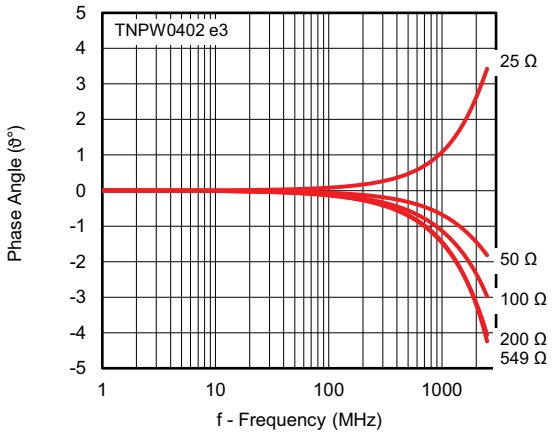


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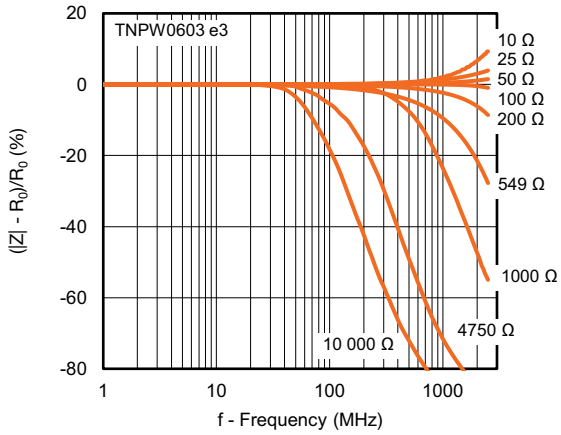


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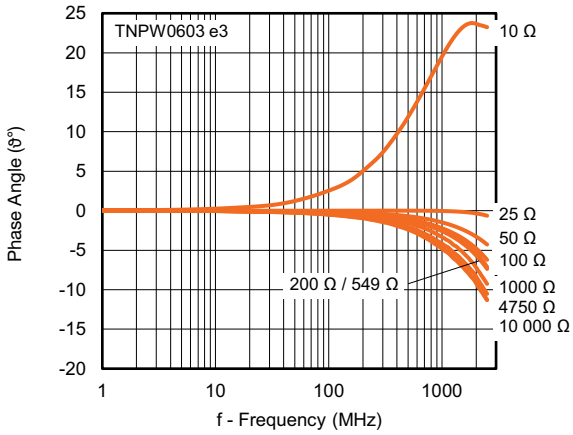


**HF Performance (1)**

**Note**

(1) Typical figures, HF-characteristic also depends on termination and circuit design


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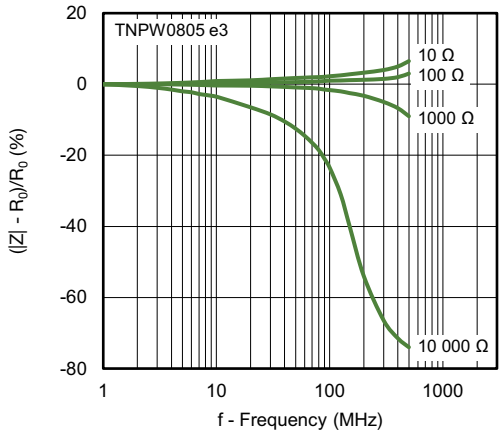
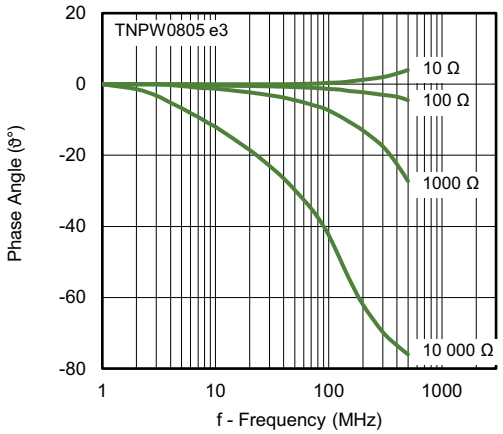



**HF Performance** (1)




**HF Performance** (1)

**Note**

(1) Typical figures, HF-characteristic also depends on termination and circuit design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## TEST AND REQUIREMENTS

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

EN 60115-1, generic specification

EN 60115-8, 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 detail specification EN 140401-801 does not cover case size 0201. 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: 25 % 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, 5.2.2, unless otherwise specified.

**TEST PROCEDURES AND REQUIREMENTS**

| EN 60115-1 CLAUSE | IEC 60068-2 [1] TEST METHOD | TEST | PROCEDURE | REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R$) |
|---|---|---|---|---|
| | | | **Stability for product types:** | |
| | | | **TNPW0201 e3** | 22 Ω to 40 kΩ |
| | | | **TNPW0402 e3** | 10 Ω to 100 kΩ |
| | | | **TNPW0603 e3** | 1 Ω to 332 kΩ |
| | | | **TNPW0805 e3** | 1 Ω to 1 MΩ |
| | | | **TNPW1206 e3** | 1 Ω to 2 MΩ |
| | | | **TNPW1210 e3** | 10 Ω to 3.01 MΩ |
| 6.1 | - | Resistance | - | ± 1 %; ± 0.5 %; ± 0.1 % |
| 6.2 | - | Temperature coefficient | At (20 / -55 / 20) °C and (20 / 125 / 20) °C | ± 50 ppm/K; ± 25 ppm/K; ± 15 ppm/K; ± 10 ppm/K |
| 7.1 | - | Endurance at 70 °C: general operation mode | $U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; whichever is the less severe; 1.5 h on; 0.5 h off; | |
| | | | 70 °C; 1000 h | ± (0.05 % $R$ + 0.01 Ω) |
| | | | 70 °C; 8000 h | ± (0.1 % $R$ + 0.02 Ω) |
| | | | 70 °C; 225 000 h | ± (0.3 % $R$ + 0.05 Ω) |
| | | Endurance at 70 °C: power operation mode | $U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; whichever is the less severe; 1.5 h on; 0.5 h off; | |
| | | | 70 °C; 1000 h | ± (0.1 % $R$ + 0.01 Ω) |
| | | | 70 °C; 8000 h | ± (0.2 % $R$ + 0.02 Ω) |
| | | | 70 °C; 225 000 h | ± (0.6 % $R$ + 0.05 Ω) |
| | | Endurance at 70 °C: advanced mode | $U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; whichever is the less severe; 1.5 h on; 0.5 h off; | |
| | | | 70 °C; 1000 h | ± (0.2 % $R$ + 0.05 Ω) |
| 7.3 | - | Endurance at upper category temperature | 125 °C; 1000 h | ± (0.05 % $R$ + 0.01 Ω) |
| | | | 155 °C; 1000 h | ± (0.1 % $R$ + 0.02 Ω) |
| | | | 175 °C; 1000 h | ± (0.25 % $R$ + 0.05 Ω) |


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| TEST PROCEDURES AND REQUIREMENTS | | | | |
|---|---|---|---|---|
| **EN 60115-1 CLAUSE** | **IEC 60068-2 (1) TEST METHOD** | **TEST** | **PROCEDURE** | **REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R$)** |
| | | | **Stability for product types:** | |
| | | | **TNPW0201 e3** | 22 Ω to 40 kΩ |
| | | | **TNPW0402 e3** | 10 Ω to 100 kΩ |
| | | | **TNPW0603 e3** | 1 Ω to 332 kΩ |
| | | | **TNPW0805 e3** | 1 Ω to 1 MΩ |
| | | | **TNPW1206 e3** | 1 Ω to 2 MΩ |
| | | | **TNPW1210 e3** | 10 Ω to 3.01 MΩ |
| 10.4 | 78 (Cab) | Damp heat, steady state | (40 ± 2) °C; 56 days; (93 ± 3) % RH | ± (0.1 % $R$ + 0.01 Ω) |
| 10.5 | 67 (Cy) | Damp heat, steady state accelerated: general operation mode | (85 ± 2) °C (85 ± 5) % RH $U = \sqrt{0.1 \times P_{70} \times R}$; $U \leq 0.3 \times U_{max.}$; 1000 h | ± (0.1 % $R$ + 0.01 Ω) |
| - | 1 (Ab) | Cold | -55 °C; 2 h | ± (0.05 % $R$ + 0.01 Ω) |
| 10.1 | 14 (Na) | Rapid change of temperature | 30 min at LCT and 30 min at UCT; LCT = -55 °C; UCT = 155 °C; 1000 cycles | ± (0.1 % $R$ + 0.01 Ω) |
| 8.1 | - | Short time overload: general operation mode | $U = 2.5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max.}$; whichever is the less severe; 5 s | ± (0.05 % $R$ + 0.01 Ω) |
| | | Short time overload: power operation mode | $U = 2.5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max.}$; whichever is the less severe; 5 s | ± (0.1 % $R$ + 0.01 Ω) |
| 8.2 | - | Single pulse high voltage overload: general operation mode | Severity no. 4: $U = 10 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max.}$; whichever is the less severe; 10 pulses 10 µs/700 µs | ± (0.5 % $R$ + 0.02 Ω) no visible damage |
| | | Single pulse high voltage overload: power operation mode | Severity no. 4: $U = 10 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max.}$; whichever is the less severe; 10 pulses 10 µs/700 µs | ± (1 % $R$ + 0.02 Ω) no visible damage |
| 8.4 (2) | - | Periodic electric overload: general operation mode | $U = \sqrt{15 \times P_{70} \times R}$ or $U = 2 \times U_{max.}$; 0.1 s on; 2.5 s off; whichever is the less severe; 1000 cycles | ± (0.5 % $R$ + 0.05 Ω) no visible damage |
| | | Periodic electric overload: power operation mode | $U = \sqrt{15 \times P_{70} \times R}$ or $U = 2 \times U_{max.}$; 0.1 s on; 2.5 s off; whichever is the less severe; 1000 cycles | ± (1 % $R$ + 0.05 Ω) no visible damage (2) |


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| TEST PROCEDURES AND REQUIREMENTS | | | | |
|---|---|---|---|---|
| **EN 60115-1 CLAUSE** | **IEC 60068-2 (1) TEST METHOD** | **TEST** | **PROCEDURE** | **REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R$)** |
| | | | **Stability for product types:** | |
| | | | **TNPW0201 e3** | 22 Ω to 40 kΩ |
| | | | **TNPW0402 e3** | 10 Ω to 100 kΩ |
| | | | **TNPW0603 e3** | 1 Ω to 332 kΩ |
| | | | **TNPW0805 e3** | 1 Ω to 1 MΩ |
| | | | **TNPW1206 e3** | 1 Ω to 2 MΩ |
| | | | **TNPW1210 e3** | 10 Ω to 3.01 MΩ |
| 8.5 | - | Electro static discharge (human body model) | IEC 61340-3-1 (1); 3 pos. + 3 neg. (equivalent to MIL-STD-883, method 3015) TNPW0201 e3: 400 V TNPW0402 e3: 500 V TNPW0603 e3: 1000 V TNPW0805 e3: 1500 V TNPW1206 e3: 2000 V | ± (0.5 % $R$ + 0.05 Ω) |
| 9.11 | 6 (Fc) | Vibration | Endurance by sweeping; 10 Hz to 2000 Hz; no resonance; amplitude ≤ 1.5 mm or ≤ 200 m/s$^2$; 7.5 h | ± (0.05 % $R$ + 0.01 Ω) no visible damage |
| 11.1 | 58 (Td) | Solderability | Solder bath method; SnPb40; non-activated flux (215 ± 3) °C; (3 ± 0.3) s | Good tinning (≥ 95 % covered); no visible damage |
| | | | Solder bath method; SnAg3Cu0.5 or SnAg3.5; non-activated flux (235 ± 3) °C; (2 ± 0.2) s | |
| 11.2 | 58 (Td) | Resistance to soldering heat | Solder bath method; (260 ± 5) °C; (10 ± 1) s (3) | ± (0.02 % $R$ + 0.01 Ω) |
| 11.3 | 45 (XA) | Component solvent resistance | Isopropyl alcohol + 50 °C; method 2 | No visible damage |
| 9.7 | 21 (Ue$_3$) | Shear (adhesion) | TNPW0201 e3: 2 N | No visible damage |
| | | | TNPW0402 e3 and TNPW0603 e3: 9 N | |
| | | | TNPW0805 e3, TNPW1206 e3, and TNPW1210 e3: 45 N | |
| 9.8 | 21 (Ue$_1$) | Substrate bending | Depth 2 mm, 3 times | ± (0.05 % $R$ + 0.01 Ω) no visible damage, no open circuit in bent position |
| 12.2 | - | Voltage proof | $U_{RMS} = U_{ins}$; 60 ± 5 s | No flashover or breakdown |
| 12.4 | - | Flammability | IEC 60695-11-5 (1), needle flame test; 10 s | No burning after 30 s |

**Notes**

(1) The quoted IEC standards are also released as EN standards with the same number and identical contents

(2) Periodic electric overload test for power operation mode not applicable for case size 0201

(3) For TNPW0201 e3 only similar to DIN EN 60115-8 test procedure. Due to the components small size they were fixed by glue previous to testing instead of applying tweezers



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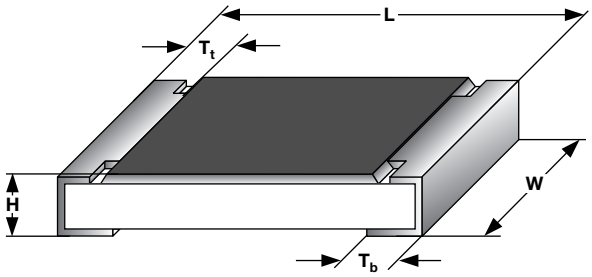
## DIMENSIONS




| DIMENSIONS AND MASS | | | | | |
|---|---|---|---|---|---|
| TYPE / SIZE | L (mm) | W (mm) | H (mm) | $T_t$ / $T_b$ (mm) | MASS (mg) |
| **TNPW0201 e3** | 0.6 ± 0.05 | 0.3 ± 0.05 | 0.23 ± 0.03 | 0.12 ± 0.05 | 0.14 |
| **TNPW0402 e3** | 1.0 ± 0.05 | 0.5 ± 0.05 | 0.35 ± 0.05 | 0.2 ± 0.10 | 0.65 |
| **TNPW0603 e3** | 1.55 ± 0.05 | 0.85 ± 0.10 | 0.45 ± 0.10 | 0.3 ± 0.20 | 2 |
| **TNPW0805 e3** | 2.0 ± 0.1 | 1.25 ± 0.15 | 0.45 ± 0.10 | 0.4 ± 0.20 | 5.5 |
| **TNPW1206 e3** | 3.2 + 0.1 / - 0.2 | 1.6 ± 0.15 | 0.55 ± 0.10 | 0.5 ± 0.25 | 10 |
| **TNPW1210 e3** | 3.2 + 0.1 / - 0.2 | 2.45 ± 0.15 | 0.60 ± 0.15 | 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.

| REVISION HISTORY | |
|---|---|
| REVISION DATE | DESCRIPTION |
| **10-Apr-2026** | • Update of material categorization<br>• Added rated dissipation at terminal part temperature 105 °C |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