TNPV

THIN FILM HIGH VOLTAGE RESISTOR
PRODUCT OVERVIEW

DRALORIC/BEYSCHLAG RESISTORS

A WORLD OF SOLUTIONS

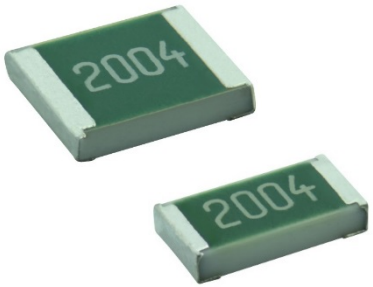
TNPV OVERVIEW

Purpose

- Introduction of the Vishay TNPV thin film high voltage resistor properties

Objectives

- Present an overview of this product's special performance properties
- Discuss product design and features
- Discuss product advantages
- Present possible applications



Welcome to the Vishay TNPV Thin Film High Voltage Resistors product overview. This tutorial will provide an overview of the TNPV high voltage thin film chip resistor family. The key functional performance parameters of the TNPV series will be discussed as well as design, features and benefits. A selection of potential applications from typical market segments will be presented.

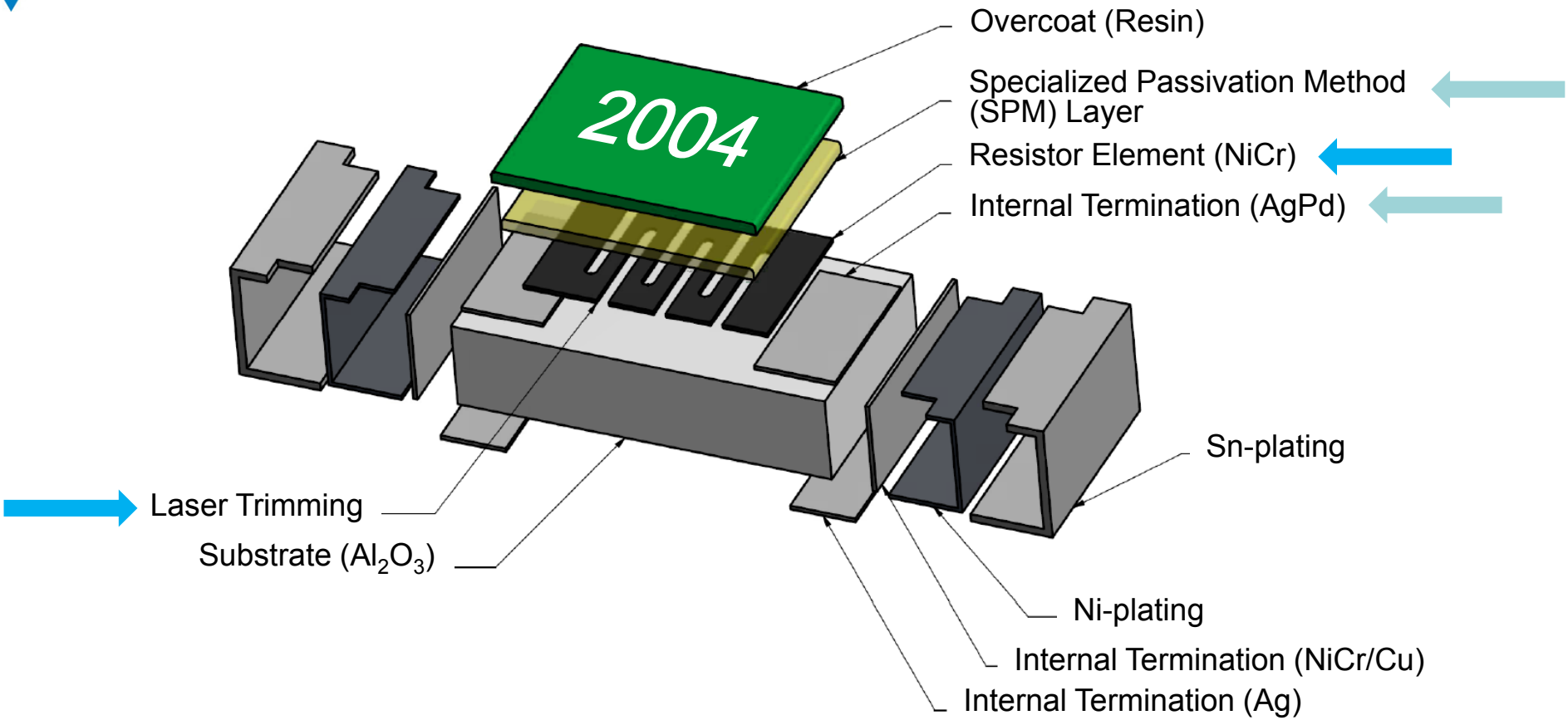
FUNCTIONAL PERFORMANCE OF THE TNPV SERIES

Key Properties

- High operating voltage to 1000 V
- Low voltage coefficient < 1 ppm/V
- Tolerance down to ±0.1%
- TCR down to ±10 ppm/^{0}C
- Advanced sulfur resistance verified according to ASTM B 809, 1000 h at 90ºC
- AEC-Q200 qualified

The TNPV high voltage thin film series from Vishay is an excellent choice for today's modern electronics operating at increased voltages. Important high-reliability applications will benefit from AEC-Q200 qualification, making this product series an ideal selection where high reliability, precision, and long-term stability at high operating voltages are required. This thin film series offers superior moisture resistance and is resistant to sulfur. The TNPV is RoHS compliant and halogen free.

DESIGN OF TNPV COMPONENTS



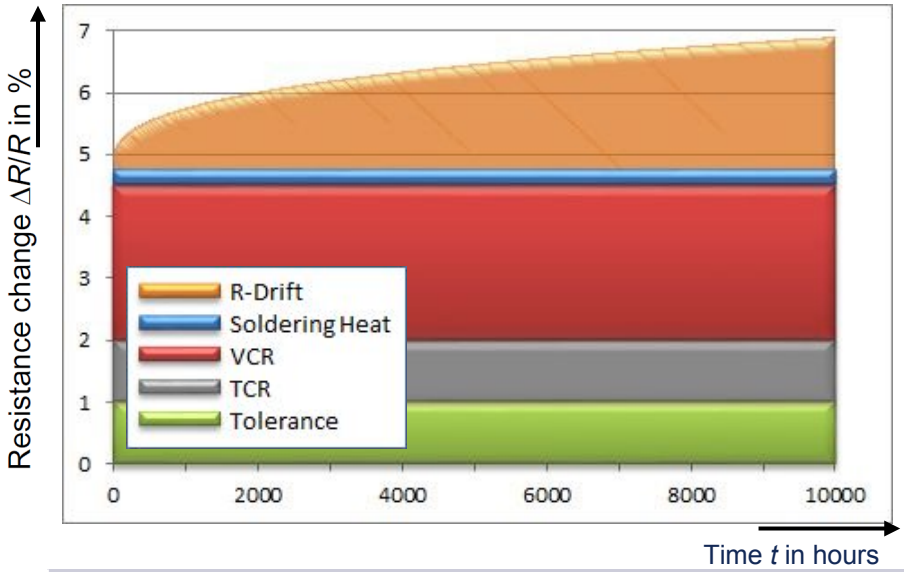
The TNPV design offers significant advantages compared to other resistor types. The resistive element is a high-quality homogeneous material with meander laser trimming. This trimming geometry allows the resistor to homogenously dissipate power and distribute thermal energy across the entire resistive element when the resistor is in use. This enhances the stability of TNPV components by reducing the intensity of any single hot spot on the resistive film. Additionally, the fine-trimming helps to reduce voltage gradients along the segments of the resistive element, thus enhancing stability at high voltages as compared to typical high voltage resistors with larger spacing between the current path segments.

Another important aspect is reliability in sulfur environments. An increase in incidents of corrosion failures related to high sulfur-containing environments has been observed in the electronics industry which has increased the interest in sulfur resistant resistors by designers. With silver palladium inner termination and a special design which protects the integrity of the junction between the product termination and the top coating, the TNPV series is impervious to sulfur exposure as verified in accordance with the ASTM B 809 standard.

UNRIVALED PRECISION OVER LIFETIME AT HIGH VOLTAGES

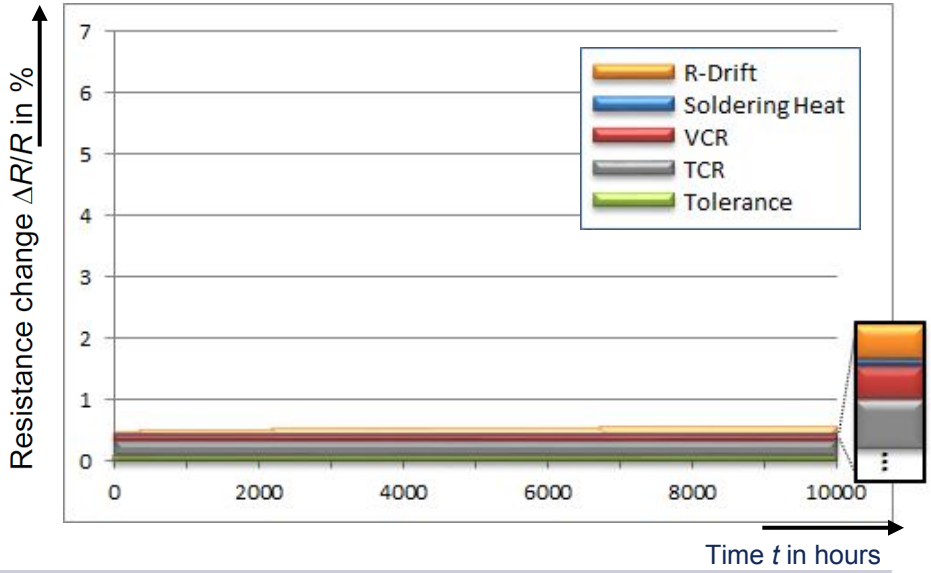
Typical High Voltage Thick Film Chip Resistor

- TCR ± 100 ppm/^{0}C, tolerance ± 1%, VCR < 25 ppm/V



TNPV High Voltage Thin Film Chip Resistor

- TCR ± 25 ppm/^{0}C, tolerance ± 0.1%, VCR < 1 ppm/V



Note: Worst case long-term stability is obtained by summing up resistance change caused by typical effects present during resistor application or mounting, including initial tolerance, TCR, VCR, resistance change due to soldering heat and resistance drift due to aging caused by operation at rated voltage of 1000 V resulting in a resistor film temperature of 125 ºC.

For high voltage applications, besides temperature coefficient of resistivity (TCR) and tolerance, the voltage coefficient of resistivity (VCR) is of major importance to guarantee precise electrical performance at high voltages. Due to the advanced thin film technology the VCR is largely reduced for the TNPV series as compared to standard thick film high voltage resistors. The effect of voltage-induced resistance change accounts for less than 0.1% for operation at 1000 V. Furthermore, the meander trimming allows TNPV to achieve best-in-class resistive drift of less than 0.1% when considering 8000 hours of operation with full power applied to the resistor. This is known as the endurance at 70ºC test as described in the product datasheet. The charts shown here illustrate worst case performance comparison of market standard high voltage thick film resistors as compared to the TNPV with typical specification. Long-term stability for the TNPV series at high operating voltage is about ten times better than its thick film competitors.

COMMERCIAL BENEFITS

TNPV High Voltage Thin Film Series allows the user to

- Greatly reduce the number of components needed for high voltage applications: *One* TNPV can replace up to *five* standard resistors of same case size

Reducing Component Counts

Case Size	Maximum Voltage Rating		Possible Component Count Reduction
	TNPV	Standard Thin Film	
1206	700 V	200 V	4 → 1
1210	1000 V	200 V	5 → 1

- Replace larger case sizes
- Greatly reduce pick and place costs
- Save board space or increase PCB integration density
- Increase application reliability by reducing the number of solder joints

The TNPV high voltage thin film series from Vishay offers significantly higher operating voltages as compared to standard precision thin film resistors with comparable case sizes. This allows for a reduction in component counts by replacing multiple devices of the same case size or larger case size resistors, consequently saving board space and lowering costs. Special high voltage thick film resistors can be replaced as well which allows a significant improved performance due to the superior voltage coefficient and precision properties at high voltages. The TNPV series thus enables developers to design cost-sensitive and accurate voltage measurement applications.

APPLICATIONS

Accurate High Voltage Measurement

Alternative Energy

- Solar Inverter
- Wind Energy Inverter
- Power Meters

AMS (Avionics, Military, Space)

- Military Imaging Systems
- Radar Systems

Automotive

- Battery Management
- Inverter for Electric and Hybrid-Electric Vehicles

Industrial

- DC-DC/AC-DC Converter
- Test and Measurement Equipment
- High-Voltage Monitoring

Medical

- Power Supply
- Electrocardiographs
- Defibrillators

Today, various applications operate at voltages which are significantly higher than the permissible operating voltage of a single resistor. Up to now, either several resistors in series or special high voltage thick film resistors are used. However, both possibilities are disadvantageous solutions due to large component counts or limited long-term stability. The TNPV series from Vishay allows the user to overcome these limitations and may be used in various applications of many market segments. From electric vehicles to alternative energy, there is a place for the TNPV series in a wide variety of circuitry types where long-term stability and precision at high operating voltages are required.

SUMMARY

- Greatly increases operating voltages as compared to standard thin film resistors without compromising on precision properties
- Significantly reduces component counts and saves board space
- Impervious to sulfur exposure and superior moisture resistivity
- Excellent choice for most fields of modern electronics where precision and long-term stability at increased operating voltages are required

In summary, the Vishay TNPV high voltage thin film chip resistor series offers operating voltages up to 1000 V which allows for a reduction in component counts to save board space and lower costs in precision high voltage circuits. With the special design of internal termination and the Vishay Specialized Passivation Method, the TNPV is sulfur impervious and shows superior moisture resistivity. Because the TNPV is a product featuring precision and long-term stability at increased operating voltages, important high-reliability applications will benefit from AEC-Q200 qualification, making the TNPV series an excellent choice for most fields of today's and tomorrow's emerging high voltage electronics, including alternative energy, automotive, industrial, AMS and medical applications.