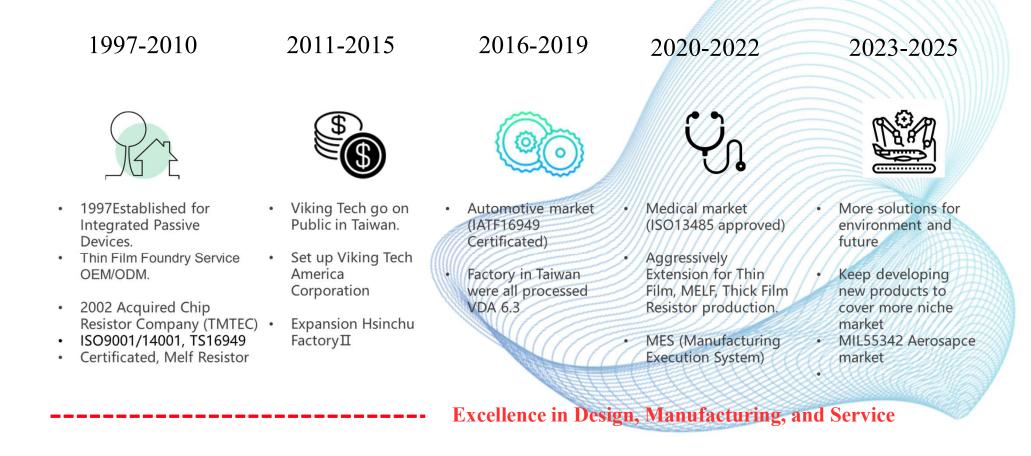
Advanced Technology in Thin Film TaN / NiCr Chip / MELF Precision Resistors

Viking Tech Corporation

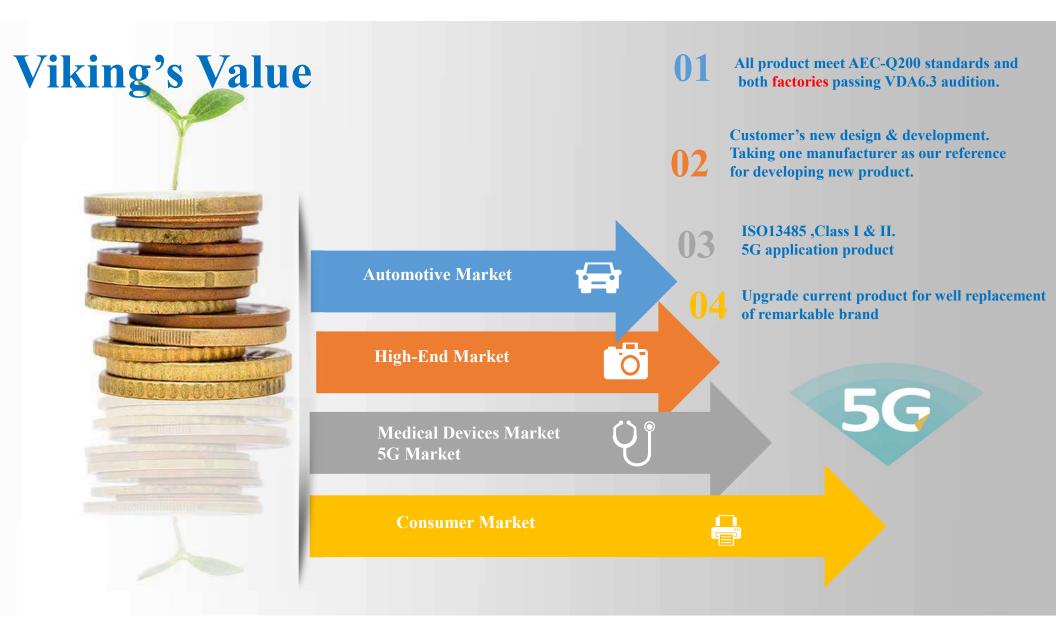


ISO9001 ISO14001 ISO13485 IATF16949 AEC-Q200 VDA6.3 RoHS

ABOUT VIKING Your Reliable Partner in Passive Components







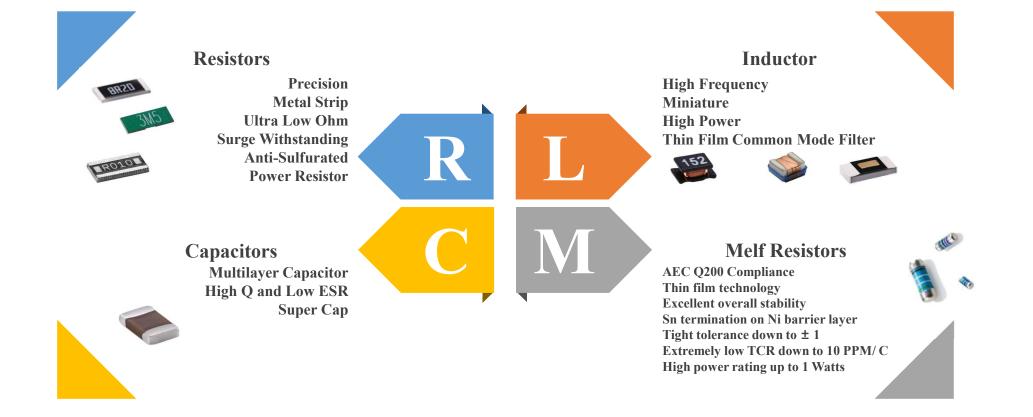
Viking Core Technology





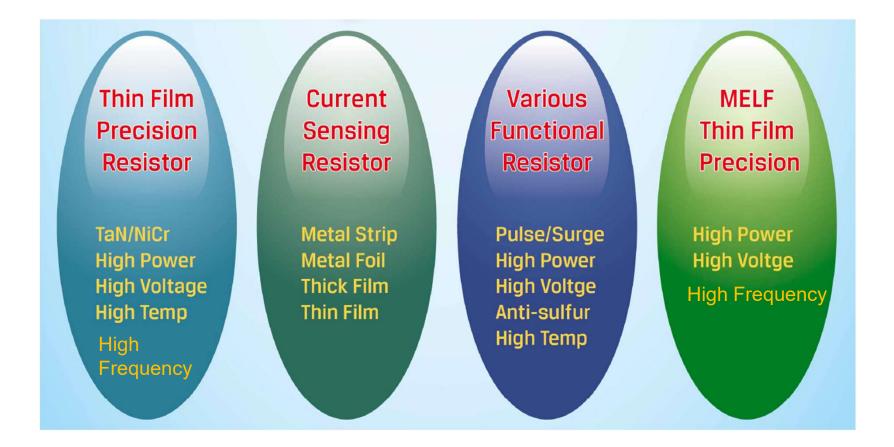


Major Products

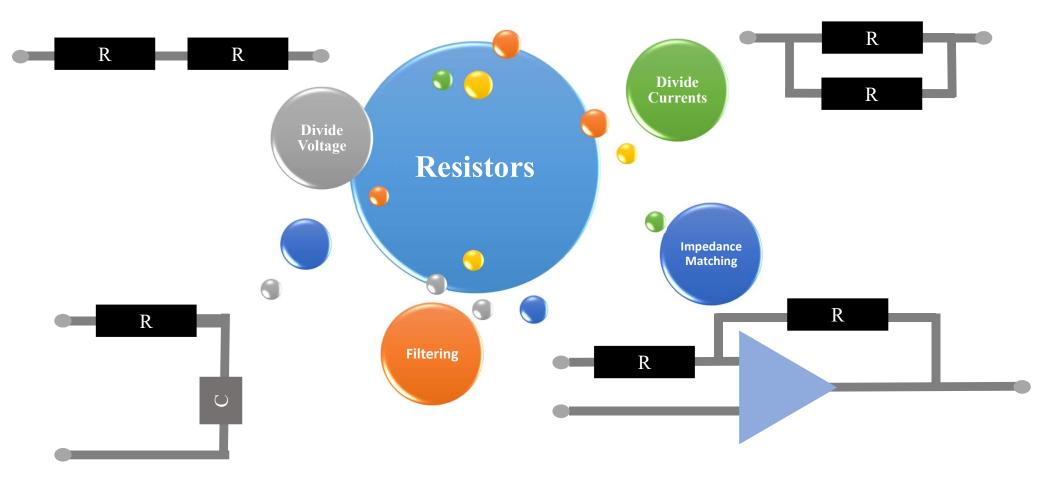




Chip /MLEF Resistor



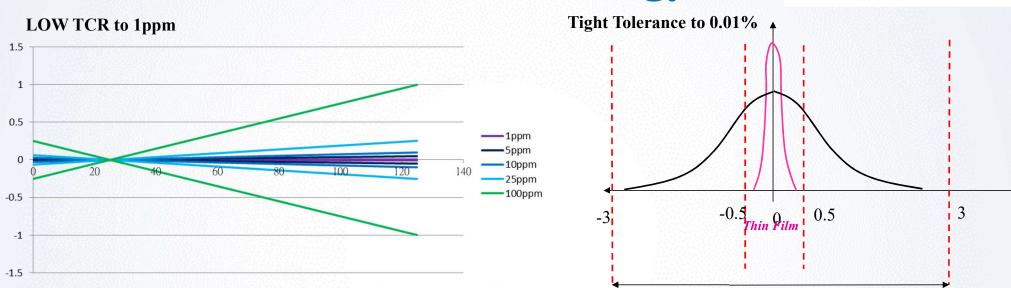
Role of resistors



Aspect	Thin Film	Thick Film		
Structure	Protective coating Alumina substrate Electrode (Between) Electrode (Duter)	Protective coating Alumina substrate Electrode (Between) Thick film resistive element		
Resistive Element Thickness	<1um	15-20 um		
Resistive Formation	Sputtering Photolithoghaphic, etc.	Screen Printing		
Resistance material	Metal Alloy film (NiCr or TaN)	Ruthenium Oxide (RuO2) paste		
Ceramic Alumina Substrate	High Density Alumina Substrate	General Alumina Substrate		

Aspect	Thin Film	Thick Film
Resistance Adjustment Laser Trimming		
TCR(Temp coefficient of R)	1ppm~25ppm	50ppm~200ppm (or higher)
Tolerance	0.01%~1%	0.5%~5%
Current Noise	Low $0.1 \sim 1.0 \mu V/V$	Higher 1~8 µV/V
Frequency	ARF -Higher up to 70G	Low
3rd Harmonic (none-Linearity)	Excellent	General
Power	Excellent	Excellent
Pulse Withstanding	Excellent	Good
Load life	+/-0.05%	+/-1%
Cost	Higher	Lower

Thin Film Technology



Wiking

Term	Short time overload	Endurance	Damp Heat with Load	Resistance to Soldering Heat	Biased Humidity 85/85 1000 hours	Rapid Change of Temp
Thin Film	ΔR±0.05%/ 0.1%	ΔR±0.05%/ 0.1%	ΔR±0.05%	ΔR±0.05%/0.1%	$\Delta R \pm 0.1\%$	ΔR±0.05%
	ΔR±0.2% for high power rating	ΔR±0.5% for high power rating	ΔR±0.5% for high power rating			ΔR±0.5% for high power rating
Thick Film	$\Delta R \pm 1\%$	$\Delta R \pm 1\%$	$\Delta R \pm 1\%$	ΔR±0.5%	ΔR±1~2%	ΔR±0.5%

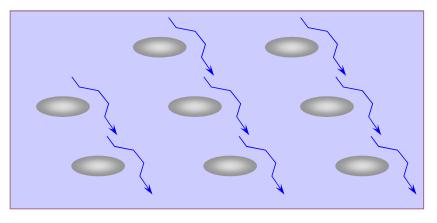
Why thin films provide better anti-Pulse / ESD ?

Resistance material of Thin Film

Ni-Cr alloy

Current flow is

practically even

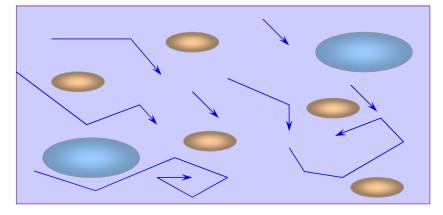


Resistance material of Thick Film

Metal & Insulator composite

Current flow is

not even





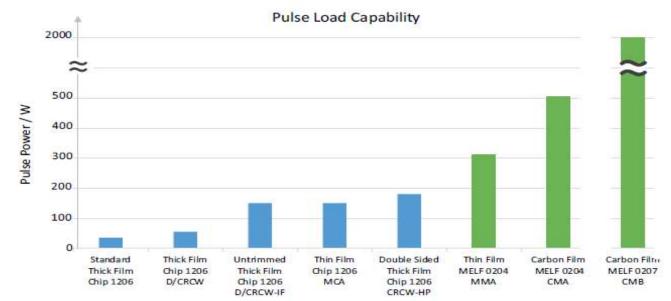


Fig. 7 - Typical destructive pulse load limits for a low standard thick film resistor and Vishay resistors of different technologies ($R = 1 \text{ k}\Omega$). Pulses were applied by capacitor discharge, with a pulse length corresponding to a 3 ms rectangular pulse.

Refer to above marketing (Vishay's) info And Viking's experiences

- Thick Film < Thin Film < MELF</p>
- Trimmed <Untrimmed < Double Sided</p>
- Small Size < Big Size</p>
- \blacktriangleright RuO₂ < NiCr < Carbon

Wide Terminal - Current Sensing, Thick film, Thin film

Automotive Grade Availability

Dimensions: 1225/1020/0612/0508



Features

Highly reliable multilayer electrode construction



Short Terminal





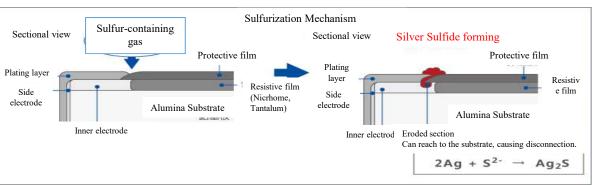
Wide Terminal

* The main feature of this product is ultra-high power. Designed with long-side direction electrodes to prevent the heat generated from damaging the product. This product is mainly used in the power supply industry, batteries, motors, etc., to make the product more stable in power application.

Power rating comparison

Size	Short Terminal	Size	Wide Terminal
0805	0.125W	0508	1W
1206	0.25W	0612	1.5W
2010	0.75W	1020	2W
2512	1W	1225	3W

Sulfurization



Normal chip resistor



- Failure mode includes open and short. \geq
- The C4 electrode structure increases \succ the pathways for sulfur to penetrate.
- Silver alloyed with palladium (Pd-Ag) can ≻ inhibit sulfur reactions.
- Sulfur can also react with copper. \succ



Sulfurized chip resistor

Silver sulfide forming



The main difference between ASTM B809 and EIA 977 is that EIA 977 requires the definition of the change after testing to be based on the product's tolerance.

Currently, the mainstream test for thin films on the market primarily follow ASTM B809.

	Test Conditions						
Test Parameters	A	В					
Temperature	60 ± 2°C (140°F±3.6°F)	105°C ± 2°C (221°F±3.6°F)					
Humidity	Not a	oplicable					
Duration	480 Hours	750 hours					
Reagent	Sulfur, Sublimed (Flo	owers of Sulfur, or FoS).					
Amount of Reagent	base of the chamber with a bed of sulfur to 10 mm dept	chamber or on the base of the chamber. Cover the tray or n minimum. The greater the amount of sulfur placed in the se chamber air will reach equilibrium.					
Component Sample Size	22 units. The case size to be qualified will be 0402 or smallest size available larger than 0402 or AABUS (As Agreed By User and Supplier).	15 units each from 3 different production lots (of the same style, termination design and manufactured under the same process and conditions with the same materials.). The case size to be qualified will be 0402 or smallest size available larger than 0402 or AABUS (As Agreed By User an Supplier).					
Sample Nominal	Most appropriate component value for the series being q	ualified (for resistors, this is the lowest available resistance					
Component Value	or	ABUS					
Sample Tolerance	Nominal tolerance to be qualified.	Nominal tolerance to be qualified.					
Mounted on PCB	Yes or AABUS	Yes or AABUS					
Failure Criteria	b) Using 50X magnification, any Ag ₂ S crystals present on any electrode, termination or component surface, OR B) S in component electrical specifications outside datasheet electrical parameters. Thus a resistance shift of > ±1% fo 1% tolerance component or > ±5% for a 5% tolerance component is considered a failure. Passive components (resistors, capacitors, inductors and all others) must meet all specified datasheet electrical parameters.						

Test conditions based on modification of ASTM B 809

Viking Anti-Sulfur resistor

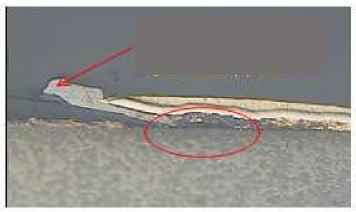
Two Major ways for our resistor to anti-sulfur

1. Material

Anti-sulfur material for internal electrodes to make the internal silver resist sulfide better.

2. Construction

The sulfurized gas will invade from the gap between the protective and the electroplating layer and then react with the silver in the internal electrode. Viking's anti-sulfur resistor has a protective design on the electrode to prevent the internal electrode from reacting with sulfur to achieve the purpose of Anti-sulfur.







Thin Film Resistors

THIN FILM HIGH VOLTAGE PRECISION

SOLUTIONS VIRONMENT AND FUTURE

ISO9001 AEC-Q200

ROHS

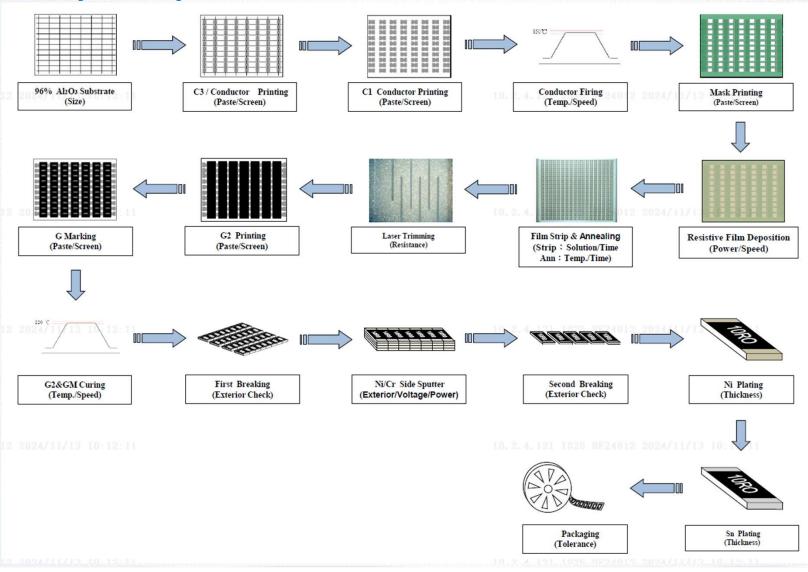
NiCr vs TaN



A thin film resistor consists of a sputtered thin film of either NiCr (Nichrome) or TaN (Tantalum Nitride) as the resistive element.

Property	NiCr (Nichrome)	TaN (Tantalum Nitride)
Cost	Lower cost	Higher cost
Electrical Performance	Best performance, TCR as low as 1 ppm	Lower performance than NiCr
Tolerance	Very tight, down to 0.01%	Moderate
Max Resistance	Up to $3M\Omega$	Slightly lower than NiCr
Moisture Sensitivity	Sensitive to moisture during current flow	Moisture-impervious, stable under high humidity
Durability	Weaker, vulnerable to water or acid	Very robust, forms stable oxide layer
Applications	Wide range of electronics	Critical environments, long-term stability
Humidity Endurance	Limited	Passes biased humidity tests at 85°C/85% RH

Thin Film resistors production process



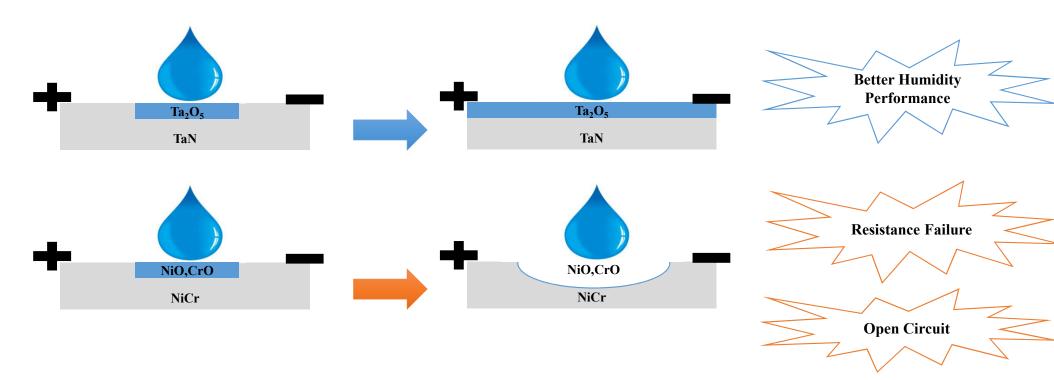
Two Technologies of Making Precision Resistors

- Photo-Lithography Process:
- Deposits resistive film on alumina substrate
- Applies photo-sensitive chemical and uses UV light to create patterns
- High precision, but costly and time-consuming
- Laser Trimming Process:
- Sputters resistive layer on alumina substrate
- Uses computer-controlled laser scribing to adjust resistance
- Improved process control with sensors and PC monitoring
- High yield rate and shorter production time, making it more cost-effective
- Viking's Approach:
- Uses laser trimming for NiCr and TaN resistors
- Reduces costs while offering flexible resistance values and tight specs
- New TaN (TAR series) product is competitive and high-quality, overcoming the expensive photo-lithography process

Thin Film Properties

TaN thin film resistors

Viking



Standard thin film Resistor- AR Series

Series	PN	Size	Power	Tolerance	Resistance	TCR/PPM	
	AR01	0201	1/32W, 1/20W	±0.1%~ ±1%	22Ω - 75ΚΩ	$\pm 25/50$	
	AR02	0402	1/16W, 1/10W		$4\Omega - 511 \mathrm{K}\Omega$		
Precision NiCr	AR03	0603	1/16W, 1/10W,1/6W		1Ω~1ΜΩ	±10/15/ 25/50	
	AR05	0805	1/10W, 1/8W,1/4W	. 0. 010/	1Ω~2ΜΩ		
	AR06	1206	1/8W,1/4W, 1/3W	$\pm 0.01\% \sim \pm 1\%$	1Ω~3ΜΩ		
	AR13	1210	1/4W, 1/3W				
	AR10	2010	1/4W,1/3W, 1/2W				
	AR12	2512	1/2W,3/4W, 1W		1Ω~3ΜΩ		
	AR02	0402	1/16W, 1/10W		49.9Ω - 20ΚΩ		
	AR03	0603	1/16W, 1/10W		24.9Ω - 60ΚΩ		
Ultra low TCR	AR05	0805	1/10W, 1/8W	±0.01%~	24.9Ω - 150ΚΩ		
Precison	AR06	1206	1/8W,1/4W	±1%		$\pm 1/2/3/5$	
NiCr	AR13	1210	1/4W,1/3W		24.9Ω - 300ΚΩ		
	AR10	2010	1/4W,1/3W		24.732 - 300K32		
	AR12	2512	1/2W				

AEC-Q200 Compliance Anti-sulfur Automotive



Viking

Features:

-Advanced thin film technology, special passivated film for protection

-Very tight tolerance down to $\pm 0.01\%$

-Extremely low TCR to 1ppm

-Wide resistance range 10hm ~ 3Mega ohm

- Special materials, design, and processing for high sulfur applications

Applications:

-Medical Equipment

-Testing / Measurement Equipment

-Power supplies ,Converters

-Printer Equipment, High-end NB

-Automatic Equipment Controller

-Audio, Amplifier

-Communication Device, Cell Phone, GPS, PDA

Tantalum Nitride (TaN) Thin Film Precision Chip Resistor-TAR Series

The Tantalum Nitride (TaN) resistive film creates a moisture-impervious tantalum pentoxide barrier layer, capable of withstanding thousands of hours of biased humidity testing at 85 °C and 85% relative humidity. This robust, precision performance makes it an ideal choice for applications requiring high precision resistance, long-term stability, reliability, and resistance to critical environmental conditions. The TaN thin film resistor is well-suited for high-level application designs.

PN	Size	Power	Tolerance	Resistance	TCR/PPM	
TAR02	0402	1/16W		40Ω - 35ΚΩ		
TAR03	0603	1/6W	±0.05%~±1%	$40\Omega - 130 K\Omega$	$\pm 10/15/25/50$	
TAR05	0805	1/5W	<u>+0.0370</u> <u>+</u> 170	$10\Omega - 350K\Omega$	<u>-</u> 10/15/25/50	
TAR06	1206	1/2W		10Ω - 1ΜΩ		

Tantalum Nitride (TaN) accounts for approximately 40% of the market share in resistors used in aerospace, military, and high-end equipment applications.

Features:

- -Tantalum nitride thin film resistor
- -High stability in humid environments
- -Moisture resistant tantalum nitride resistive film
- -AEC-Q200 Compliance, 85/85 10,000 hrs tested
- -Tight tolerance down to $\pm 0.05\%$, 0.1%
- –Extremely low TCR down to ± 10 PPM/°C
- -Resistance values from 10 ohm to 1M ohm
- -Test proven immunity to humidity, moisture, and sulfur

Applications

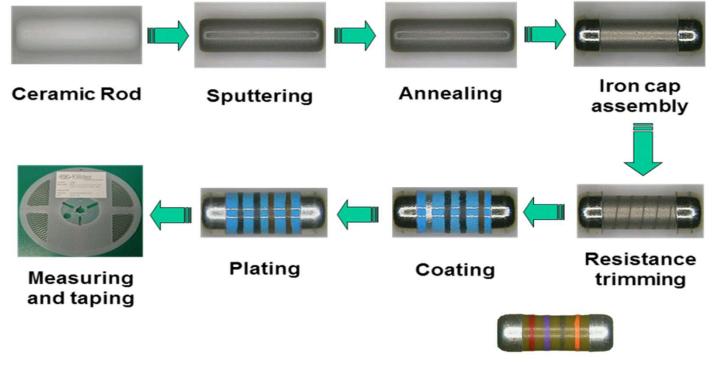
- -Automotive
- -Medical Equipment
- -Testing / Measurement Equipment
- -Automatic Equipment Controller
- -Converters
- -Communication Device
- -Instrumentation
- -Aerospace
- -Portable communications, diagnostic equipment, Medical devices

MELF Metal Film Precision Resistor -CSRV/CSR.A series

The MELF is cylindrical in shape and with metal electrode Leadless face resistor. Land pattern sizes are the same as SMD chip resistors.

It is manufactured by depositing a homogeneous film of NiCr onto a high-grade ceramic body.

Metal Film Precision Resistor Process Flow



CSRA automotive

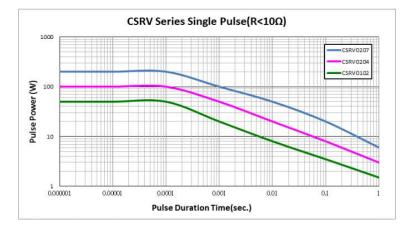
Summary of Metal Film MELF Resistor

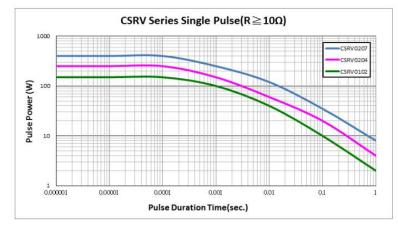


Feature	PN	Size	Power	Tolerance	Resistance	TCR/PPM	FIFE FILE
Advanced	CSRV0102	0102	1/8, 1/5W, 0.3W	±0.1%~	1Ω~1ΜΩ	±10/15/25/ 50/100	Features – AEC-Q200 Compliance
Advanced	CSRV0204	0204	1/4W, 2/5W	±5%	0.1Ω~3.4ΜΩ	±5/10/15/25/	 Thin film technology Excellent overall stability
	CSRV0207	0207	1/2W, 1W		$0.132 \sim 3.410132$	50/100	- Sn termination on Ni barrier layer
	CSRF0102	0102	1/5W, 3/10W	±1%	50Ω , $6.8\Omega{\sim}100\Omega$	±50	 Tight tolerance down to ±0.1% Extremely low TCR down to ±5 ppm/°C High power rating up to 1 Watts SMD enabled structure Lead-free and RoHS compliant
High Frequency	CSRF0204	0204	1/4W, 2/5W		50Ω , 1.5Ω~ 220 Ω		
	CSRF0207	0207	1/2W, 1W		50Ω , 6.8Ω~220Ω		
Automotivo	CSRA0102	0102	1/5W, 3/10W		0Ω, 1Ω~1ΜΩ	Cross Vishay MMx HF $\pm 5/\pm 10/\pm 15/\pm 25/$	Applications
Automotive	CSRA0204	0204	1/4W, 2/5W	$\pm 0.1\% \sim \pm 5\%$		$\pm 50/\pm 100$	- Industrial
	CSRA0207	0207	1/2W, 1W		$0\Omega, 0.1\Omega \sim 10M\Omega$		- Telecommunication
	CSRP0204	0204	2/5W, 500V	±0.1%~	240KO 10M O	1.25/50	 Medical Equipment Measurement/Testing Equipment
High Voltage	CSRP0207	0207	1W, 1000V	$\frac{10.176}{\pm 1\%}$ 340K Ω ~10M Ω	$\pm 25/50$	measurement resting Equipment	

Pulse withstanding capacity

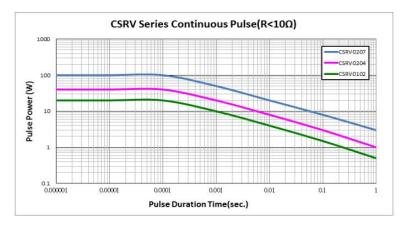
The single impulse graph represents the result of applying a rectangular-shaped impulse. The acceptance criterion was a resistance shift of less than 1% from the initial value. The applied power was limited by the maximum permissible impulse voltage, as shown in the accompanying graph.

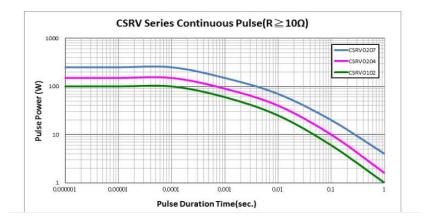




Continuous Pulse

The continuous load graph was generated by applying repetitive rectangular pulses, with the pulse period adjusted so that the average power dissipated in the resistor matched its rated power at 70 °C. The acceptance criterion remained a resistance shift of less than 1% from the initial value.

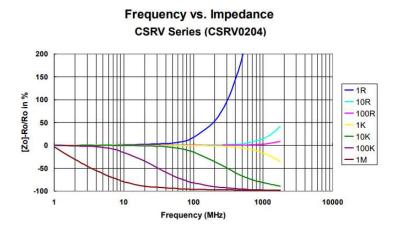


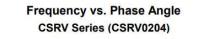


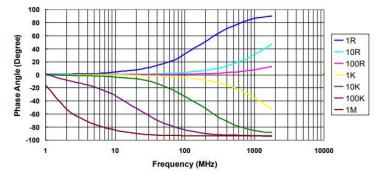
Frequency behavior

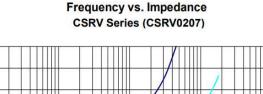
Resistors are designed to operate according to Ohm's law, which holds true for frequencies up to 100 kHz. At higher frequencies, however, the impedance of an ideal resistor is influenced by an additional component: an ideal resistor in series with an inductor and both in parallel with a capacitor. The values of the capacitance and inductance are primarily determined by the dimensions of the terminations and the length of the conductive paths. Additionally, the surrounding environment of the components significantly impacts their behavior on the printed circuit board.

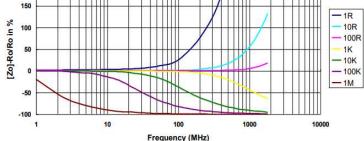
200

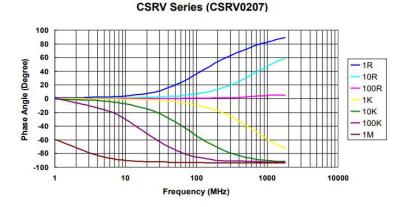






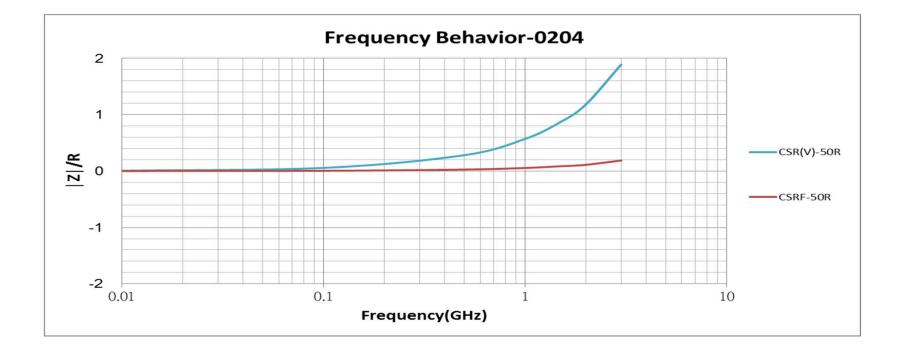






Frequency vs. Phase Angle

Frequency behavior comparison of General type MELF Resistor(CSRV) and High Frequency MELF Resistor(CSRF) :



Thin film resistor comparison table

Series	Function	Align competitor series	Size	Speical Feature	Sulfur resistance	AEC-Q200
ARG	General	YX -RT	0402-1206	Low cost		
ARA	Precision Automotive	VX TNPW e3 , KX-RN73H, YX - AT	0402~2512	0.05% TC10~50	V	V
AR	Precision	As list	0201-2512	0.01%,TCR 1~5ppm	N/A	N/A
RAM	Meter	(Special Mainly for Meters)	0402~2512	Q/GDW 11179.3 compliance	N/A	N/A
ARMA	Advanced AR series	SX-RG	0402-1206		V	V
ARN	Aluminum Nitride High power	VX -PCAN	0603-2512	Power rating up to 6W(2512)	N/A	N/A
ARP	High power	SX-HRG	1206	1206 1W	V	V
ARHVA	High Voltage	VX-TNPV e3	1206-1210	1206 1/4W 1400V 1210 1/3W 2000V	V	V
ARTPA	High power+ High Temp	VX-MCx AT HP	0402-0805	175C for 1000hr, 0805 0.4W	V	V
ARTA	High Temp	VX -MCx AT Professional	0402-1206	175C for 1000hr	V	V
TAR	Tantalum Nitride High reliability Precision	TX-PFC, VX-PAT/PTN	0402-1206	High stability in humid environment	V 85C/85%RH	V
ARF	Thin Film High Frequency	VX-FC	0402-1206	High Frequency	X	X

Why Choose Viking?



Advanced, Experienced Component Technology



Flexible Extension Sufficient Capacity



Wide Range Products. Excellent Technical Support



Well-Organized, ERP System. IATF16949, Automotive Grade



Ouick Turnaround Time and Response



On Public Company Superior Management High Yield, Cost Effective



Short Lead Time and Free Sample Support



Extensive RD Team, Miniature Size, High Power, New Product Development

