VPG Foil Resistors

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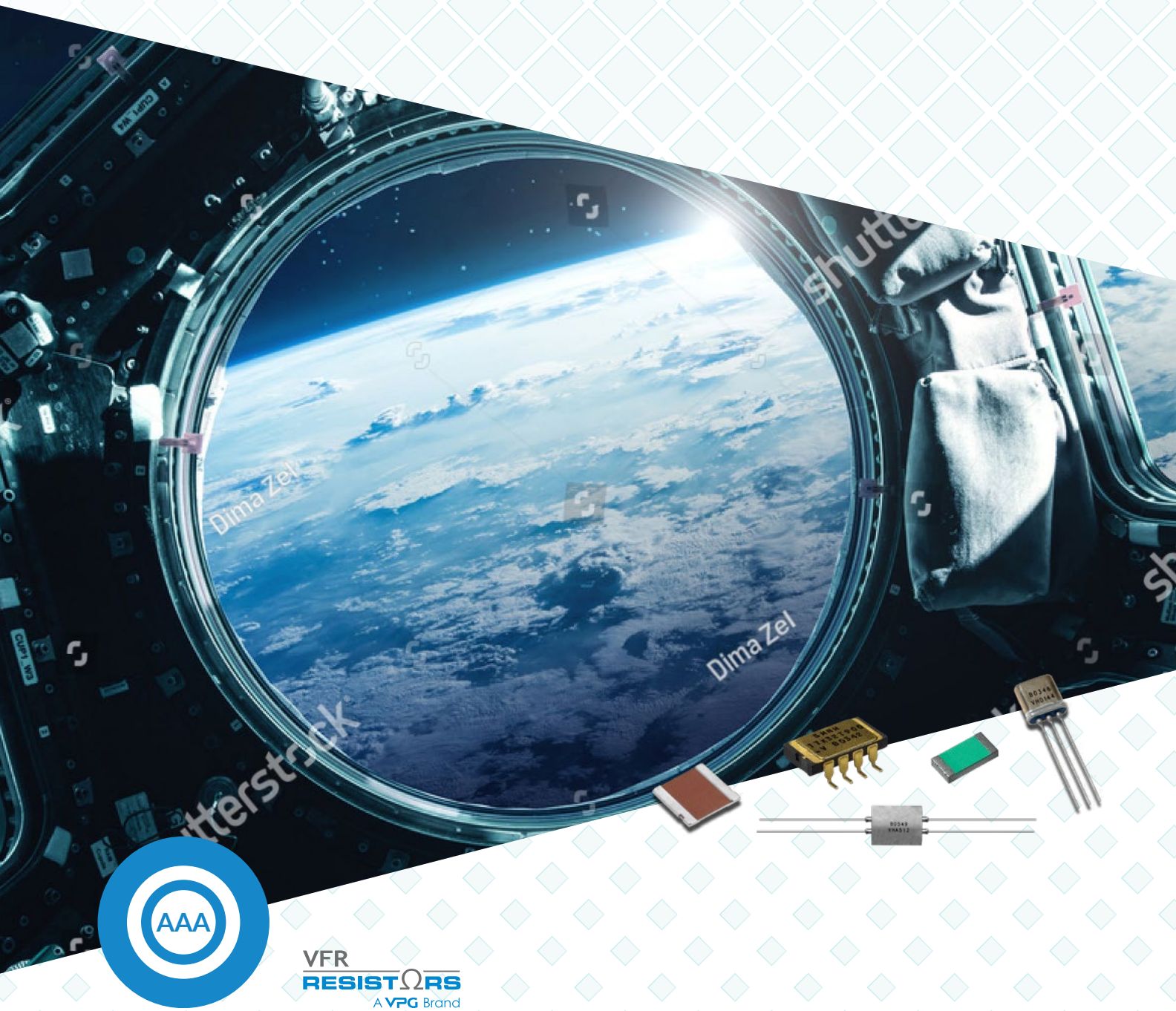


AAA

VFR RESISTΩRS A VPG Brand

Bulk Metal® Foil Ultra-Precision Resistors

Product Overview

Our unique Bulk Metal® Foil technology outperforms all other resistor technologies.

Consistent Precision & Reliability.

What Makes a Difference

VFR produces AAA-class Bulk Metal® Foil ultra-precision resistors made to order, offering high standing reliability and best long-term stability, meeting the EEE/QPL standards.

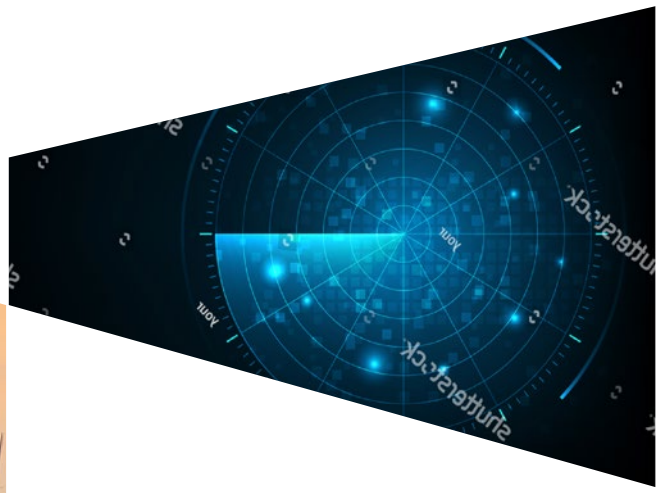
The VFR portfolio includes discrete resistors and resistor networks in surface-mount and through-hole (leaded) configurations, precision trimming potentiometers, and discrete chips for use in hybrid circuits, with customized chip resistor networks and arrays available, including military-established-reliability components (EEE-INST-002, DLA, CECC, ESA, ER, QPL, etc.) and devices for high-temperature applications.

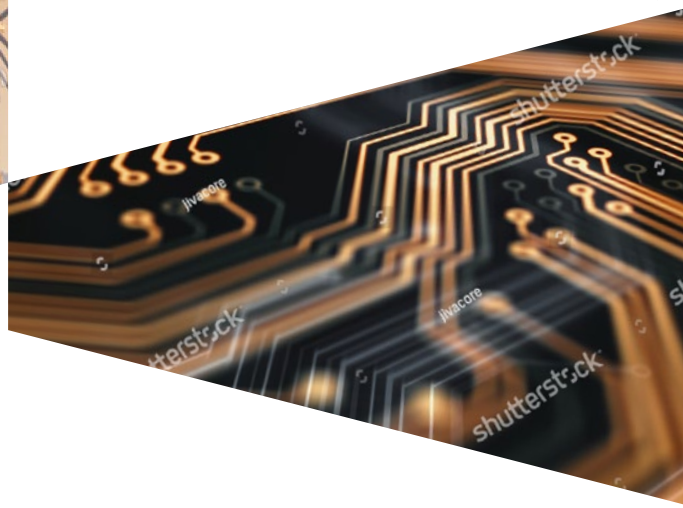
This ultra-precision technology provides extremely low temperature coefficient of resistance (TCR) and exceptional long-term stability through temperature extremes.

VFR, a part of the VPG Foil Resistors product group incorporating worldclass brands Alpha Electronics, Powertron and APR, stands for unparalleled precision, stability, and reliability. Our resistor portfolio encompasses a wide variety of configurations and packages designed to surpass the requirements of even the most demanding applications.

Check our video library for performance demonstrations - Scan QR code below!

Scan me for videos





Bulk Metal® Foil in Action

Aerospace

The space segment demands ongoing reliability under extremely harsh environments. Every component must activate when required and perform flawlessly to the end of the mission.

Avionics

In engine, cabin, and flight control applications resistors need to maintain their values despite their exposure to temperature excursions, shock and vibration, moisture, and the test of time.

Military

Different qualification inspection plans are applicable depending on the application ranging from a DLA specification up to MIL-qualified component with an established reliability level.

Industrial

Reliable and stable resistors get products to market more effectively and efficiently avoiding additional circuitry to compensate for replacements or the lack of precision.

Medical

Accurate and stable instrumentation in the medical field requires the ability to detect very small signals without producing false readings.

Available Features

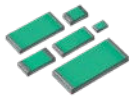
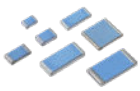
- Four terminal Kelvin configuration as standard, 2-terminal configuration where beneficial
- Networks
- SMD, Power Shunt, Lead Wire construction
- Hermetically sealed resistors
- RoHS compliant and tin/lead components available
- Suitable for most types of soldering processes
- Electron beam welded shunts

Customization Options

- Size and type of package, heatsink, mounting method
- Performance specifications
- Matched sets
- In-process and Post Manufacturing Operations (PMO) tests

Surface-Mount Resistors

Our ultra-precision surface-mount Bulk Metal® Foil technology resistors offer a wide range of capabilities and configurations for different applications and can be tailored to specific customer requirements.

Product	Model	Configuration	Resistance Range	Best Tolerance	TCR (-55°C to +125°C, +25°C ref., typical)	Rated Power (at +70°C)	Load Life Stability (2000 hours, +70°C under power, typical)
	FRSM Series 0603-2512	Wraparound Z1 Foil resistor	5 Ω to 125 kΩ	±0.01%	±0.2 ppm/°C	to 0.75 W	±0.0025%
	SMR1D(Z) SMR3D(Z)	Molded, flexible termination	5 Ω to 80 kΩ	±0.01%	±0.2 ppm/°C	0.25 W	±0.005%
	FRFC Series 0805-2512	Flip-chip Z1 Foil resistor for space saving	5 Ω to 125 kΩ	±0.01%	±0.2 ppm/°C	to 0.75 W	±0.005%
	FRFS0402	Flip-chip Z1 Foil resistor with unique flip-chip construction in 0402 size	170 Ω to 1 kΩ	±0.05%	±0.2 ppm/°C	0.075 W	±0.007%
	VPR220SZ	Z Foil resistor TO-220 package	5 Ω to 10 kΩ	±0.01%	±0.2 ppm/°C	8 W, chassis mounted	±0.05%
	VSMP Series 0603-2512	Wraparound Z Foil resistor	5 Ω to 125 kΩ	±0.01%	±0.2 ppm/°C	to 0.75 W	±0.005%
	VSM Series 0805-2512	Wraparound precision resistor	5 Ω to 125 kΩ	±0.01%	±2 ppm/°C	to 0.4 W	±0.01%
	VFCD1505	Flip-chip voltage divider Z Foil resistor	1 kΩ to 10 kΩ	±0.01%, Ratio Match: ±0.01%	±0.2 ppm/°C Tracking: 0.1ppm/°C	0.1 W	Absolute: ±0.01% Ratio: 0.005%

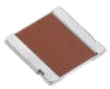
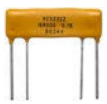
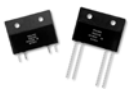
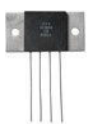
Leaded Resistors

Ultra-precision leaded Bulk Metal® Foil technology resistors are the ultimate choice for the most demanding analog applications. Tighter performances and higher or lower value resistance values are available for all models upon request.

Product	Model	Configuration	Resistance Range	Best Tolerance	TCR (-55°C to +125°C, +25°C ref., typical)	Rated Power (at +70°C)	Load Life Stability (2000 hours, +70°C under power, typical)
	Z Series	Leaded high-precision Z Foil resistors	5 Ω to 600 kΩ	±0.005%	±0.2 ppm/°C	to 2 W	to ±0.005%
	S Series	Leaded high-precision foil resistors	0.5 Ω to 1 MΩ	±0.005%	±1 ppm/°C	to 2 W	to ±0.005%
	VAR	Leaded audio foil resistor	10 Ω to 100 kΩ	±0.01%	±0.2 ppm/°C	0.4 W	±0.005%
	VSA101	Axial leads foil resistor	5 Ω to 100 kΩ	±0.005%	±0.2 ppm/°C	0.6 W	±0.005%
	E102(Z)	Leaded foil resistors	100 kΩ to 300 kΩ	±0.005%	±0.2 ppm/°C	0.6 W	±0.005%
	VSH(Z) VSC(Z)	Conformal coated leaded foil resistors	5 Ω to 120 kΩ	±0.01%	±2 ppm/°C	0.3 W	±0.01%
	VTA(Z) Series	Cylindrical axial leads foil resistors	5 Ω to 300 kΩ	±0.01%	±0.2 ppm/°C	to 1 W	±0.005%
	VPR220(Z)	Power foil resistor TO-220 package	5 Ω to 10 kΩ	±0.01%	±0.2 ppm/°C	8 W at +25°C, on heat sink	±0.005%
	1202-1285 Trimmers	Edge mounted top or side adjust foil trimmers	2 Ω to 20 kΩ	±5%	±10 ppm/°C	to 0.5 W at +25°C	±0.1%

Power Current Sense Resistors

Power current-sensing resistors were developed with a low absolute TCR and Kelvin connections (4-terminal connection) to measure a precise voltage drop across the resistive element. The 4-terminal configuration is offered in a wide range of capabilities for different applications.

Product	Model	Configuration	Resistance Range	Best Tolerance	TCR (-55°C to +125°C, +25°C ref., typical)	Rated Power (at +70°C)	Load Life Stability (2000 hours, +70°C under power, typical)
	CSM3637(P) CSM2512	SMD current sense metal strip resistors	1 mΩ to 200 mΩ	±0.1%	to ±15 ppm/°C	to 3 W (5 W with heat sink), (at +70°C)	±0.2%
	CSM3637F CSM2512F FRCS3637 FRCS2512	SMD current sense foil resistors	20 mΩ to 500 mΩ	±0.1%	to ±10 ppm/°C	to 3 W (at +70°C)	±0.05%
	VCS1610(Z) VCS1625(ZP)	SMD current sense foil resistors	10 mΩ to 10 Ω	±0.1%	to ±0.2 ppm/°C	to 1 W (at +70°C)	to ±0.015%
	VPR221(Z) VPR221S(Z)	Leaded & SMD foil resistors	0.5 Ω to 500 Ω	±0.01%	to ±0.2 ppm/°C	8 W, chassis mounted	±0.005% (at +25°C)
	VCS232(Z)	Leaded current sense Z Foil resistors	0.2 Ω to 500 Ω	±0.02%	to ±0.2 ppm/°C	2 W	±0.005% (at +25°C)
	VCS301 VCS302	Leaded current sense foil resistors	5 mΩ to 250 mΩ	±0.5%	to ±3 ppm/°C	10 W, on heatsink	±0.02% (at +25°C)
	VCS331Z VCS332Z	Leaded current sense Z Foil resistors	250 mΩ to 500 Ω	±0.01%	to ±0.2 ppm/°C	10 W, on heatsink	±0.005% (at +25°C)
	VFP3 VFP4(Z)	Leaded current sense foil resistors	50 mΩ to 80 kΩ	±0.01%	to ±2 ppm/°C	10 W, on heatsink	±0.005% (at +25°C)
	CSNG	Leaded current sense foil resistors	6m Ω to 500 Ω	±0.01%	to ±0.2 ppm/°C	20 W	±0.005% (at +25°C)

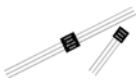
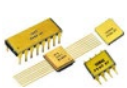
Hermetically Sealed Resistors

Hermetically sealed resistors eliminate the ingress of both oxygen, which degrades resistors over long periods, and moisture, which degrades resistors more quickly. When combined with hermetic sealing and oil filling, the Bulk Metal® Foil technology resistors become the most precise and stable resistors available.

Product	Model	Configuration	Resistance Range	Best Tolerance	TCR (-55°C to +125°C, +25°C ref., typical)	Rated Power (at +70°C)	Load Life Stability (2000 hours, +70°C under power, typical)
	HZ Series	Leaded 2- & 4-terminals hermetically sealed Z Foil resistors	5 Ω to 1.1 MΩ	±0.001%	±0.2 ppm/°C	to 2.5 W	±0.002% (at +25°C)
	VHP100 Series	Leaded 2-terminals hermetically sealed foil resistor	100 Ω to 150 kΩ	±0.005%	±0.6 ppm/°C	0.3 W	to ±0.005%
	VHS102(Z) Series	Leaded 2-terminals hermetically sealed Z Foil resistor	1 Ω to 150 kΩ	±0.005%	±0.2 ppm/°C	0.6 W	to ±0.005%
	SMNH1/2	SMD hermetically sealed foil resistor network	5 Ω to 33 kΩ (each resistor)	±0.005% Ratio Match: 0.005%	±2 ppm/°C Tracking: ±0.5 ppm/°C	0.4 W	Absolute: ±0.015% Ratio: 0.005%
	VHD144 VHD200	Hermetically sealed foil resistor voltage divider	100 Ω to 20 kΩ (each resistor)	±0.005% Ratio Match: 0.001%	±2 ppm/°C Tracking: ±0.1 ppm/°C	to 0.2 W	to ±0.001%
	Transistor Outline 1401 to 1422	3-pin to 16-pin transistor outline hermetic foil resistor	5 Ω to 480 kΩ	±0.005% Ratio Match: 0.002%	±2 ppm/°C Tracking: ±0.5 ppm/°C	to 0.6 W	Absolute: ±0.015% Ratio: 0.005%
	VHP3 VHP4(Z) VHP247(Z)	Hermetic current sensing foil resistors	0.05 Ω to 80 kΩ	±0.01%	±0.2 ppm/°C	10 W, on heatsink	±0.01% (at +25°C)
	H Series	Leaded 2 & 4 terminals hermetically sealed foil resistors	5 Ω to 1.84 MΩ	±0.001%	±2 ppm/°C	to 2.5 W	±0.002% (at +25°C)

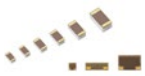
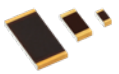
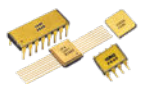
Voltage Dividers and Network Resistors

Ultra-precision Bulk Metal® Foil resistor technology voltage dividers and networks meet the demand of ideal performance: stable, high-speed, high-accuracy components that will operate with assured, predictable reliability for years in a variety of environments. Hermetically sealed networks are custom-configured to your specifications.

Product	Model	Configuration	Resistance Range	Best Tolerance	TCR (-55°C to +125°C, +25°C ref., typical)	Rated Power (at +70°C)	Load Life Stability (2000 hours, +70°C under power, typical)
	DSM(Z)	Molded foil resistor divider with flexible termination construction	100 Ω to 12 kΩ per resistor	±0.02% Ratio Match: 0.01%	±0.2 ppm/°C Tracking: ±0.1 ppm/°C	0.1 W	±0.005%
	SMN(Z)	Molded 4-foil resistors network, dual-in-line package	100 Ω to 10 kΩ per resistor	±0.02% Ratio Match: 0.01%	±0.2 ppm/°C Tracking: ±0.1 ppm/°C	0.1 W	±0.005%
	300144(Z) 300145(Z)	Leaded radial and axial foil resistor voltage divider	100 Ω to 20 kΩ per resistor	±0.005% Ratio Match: 0.005%	±0.2 ppm/°C Tracking: ±0.1 ppm/°C	0.2 W	±0.005%
	VFD244(Z)	Leaded radial and axial Z Foil resistor voltage divider	1 Ω to 150 kΩ per resistor	±0.005% Ratio Match: 0.005%	±0.2 ppm/°C Tracking: ±0.1 ppm/°C	1 W	±0.005%
	VSM40 VSM42 VSM45 VSM46	SMD hermetic networks in gull wing configuration 8, 14, and 16-pin ceramic dual-in-line package	5 Ω to 360 kΩ	±0.005% Ratio Match: 0.002%	±2 ppm/°C Tracking: ±0.5 ppm/°C	to 1.4 W	±0.005%
	VSM85 to VSM89	SMD hermetic networks in leadless chip carrier 16-32 multi gold-plated terminals	5 Ω to 420 kΩ	±0.005% Ratio Match: 0.002%	±2 ppm/°C Tracking: ±0.5 ppm/°C	to 1.4 W	±0.005%
	1442, 1445, 1446, 1457 ("L" brazed), 1460	Hermetic dual-in-line package (DIP) network 8, 14, 16, and 20-pin side-brazed ceramic DIP	5 Ω to 2.19 MΩ	±0.005% Ratio Match: 0.002%	±2 ppm/°C Tracking: ±0.5 ppm/°C	to 2.4 W	Absolute: ±0.015% Ratio: 0.005%
	1476 1491	Hermetic flatpack foil resistor network high chip capacity	5 Ω to 2.25 MΩ	±0.005% Ratio Match: 0.002%	±2 ppm/°C Tracking: ±0.5 ppm/°C	to 2.4 W	Absolute: ±0.015% Ratio: 0.005%

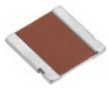
High Temperature Resistors

Precision Bulk Metal® Foil technology resistors designed for high temperatures (above +175°C) provide stability levels well under the maximum allowable drift required by customer specifications and have been proven through thousands of hours of operation under harsh conditions.

Product	Model	Configuration	Resistance Range	Best Tolerance	TCR (-55°C to +125°C, +25°C ref., typical)	Rated Power (at +70°C)	Load Life Stability (2000 hours, +70°C under power, typical)
	HTHG Series 0603-2512	SMD foil resistor, up to 240°C, gold-plated terminals, gold wire bonding	5 Ω to 100 kΩ	±0.02%	±3 ppm/°C (-55°C to +220°C, +25°C ref.)	to 0.15 W	±0.005%
	FRSG Series 0603-2512	SMD foil resistor, up to 225°C, gold-plated terminals	10 Ω to 125 kΩ	±0.01%	±2.5 ppm/°C (-55°C to +200°C, +25°C ref.)	to 0.75 W	±0.01%
	FRSH Series 0603-2512	SMD foil resistor, up to 225°C, Extended pads	10 Ω to 125 kΩ	±0.02%	±2.5 ppm/°C (-55°C to +200°C, +25°C ref.)	to 1.2 W	±0.05% (at +200°C)
	FRST Series 0603-2512	SMD foil resistor, wraparound, to 200°C	5 Ω to 125 kΩ	±0.01%	±2.5 ppm/°C (-55°C to +175°C, +25°C ref.)	to 0.15 W at +175°C	±0.005%
	HTHA Series 0603-2512	SMD foil resistors, up to 240°C, aluminium wire bonding	5 Ω to 125 kΩ	±0.02%	±2.5 ppm/°C (-55°C to +220°C, +25°C ref	to 0.15 W	±0.05%
	PRND HT	Precision foil resistor network, custom design	5 Ω to 240 kΩ	±0.01% Ratio Match: 0.005%	±2.5 ppm/°C Tracking: ±2.5 ppm/°C (-55°C to +200°C, +25°C ref.)	to 1.4 W	±0.03% Ratio: 0.015% (at +200°C)
	Hybrid Chips V5x5PU(ZT) V15x5PU(ZT) V15x10PU(ZT)	Hybrid chip foil resistor, gold plated pads	5 Ω to 80 kΩ	±0.02%	±3 ppm/°C (-55°C to +220°C, +25°C ref.)	to 0.15 W	±0.05% (at +220°C)
	Z201 HT	Leaded Z Foil resistor for high temperature	10 Ω to 100 kΩ	±0.01%	±1 ppm/°C (-55°C to +200°C, +25°C ref.)	0.1 W at +200°C	±0.1% 1000 hours, +200°C under rated power

Avionics, Military & Space (AMS) Resistors

Avionics, military, and space (AMS) applications have reliability requirements that exceed the standard processes of electronic component manufacturing. Our portfolio includes military established reliability and space-qualified resistors (EEE-INST-002, DLA, CECC, ESA, ER, QPL, etc.) optimal for such critical circuitry.

Product	Model	Configuration	Resistance Range	Best Tolerance	TCR (-55°C to +125°C, +25°C ref., typical)	Rated Power (at +70°C)	Load Life Stability (2000 hours, +70°C under power, typical)
	303261 to 303266 (0603 to 2512)	FRSM SMD Z Foil resistors with test flow in compliance with MIL-PRF-55342 EEE-INST-002 (tables 2A and 3A, level 1)	10 Ω to 75 kΩ	±0.01%	±0.2 ppm/°C	to 0.4 W	±0.02% max.
	303139 303140	Molded SMD foil resisors with test flow in compliance with MIL-PRF-55182 EEE-INST-002 (tables 2A and 3A, level 1)	5 Ω to 40 kΩ	±0.02%	±0.2 ppm/°C	to 0.6 W	±0.05% max.
	303119(Z)	Current sense SMD foil resistors with test flow in compliance with MIL-PRF-55342 EEE-INST-002 (tables 2A and 3A, level 1)	0.01 Ω to 10 Ω	to ±0.5%	±0.2 ppm/°C	0.5 W	±0.05% max.
	303144 303145	CSM3637 & CSM2512 current sense resistors with test flow in compliance with MIL-PRF-49465 & 55342 EEE-INST-002 (tables 2A and 3A, level 1)	0.002 Ω to 0.2 Ω	to ±0.5%	to ± 20 ppm/°C	to 3 W	±1% max.
	303337	CSM3637F current sense foil resistor with test flow in compliance with MIL-PRF-49465 & 55342 EEE-INST-002 (tables 2A and 3A, level 1)	0.02 Ω to 0.2 Ω	to ±0.1%	to ± 10 ppm/°C	to 3 W	±0.1% max.
	303336	CSM2512F current sense foil resistor with test flow in compliance with MIL-PRF-49465 & 55342 EEE-INST-002 (tables 2A and 3A, level 1)	0.05 Ω to 0.2 Ω	to ±0.1%	to ± 10 ppm/°C	to 1 W	±0.1% max.
	303143 Series	Leaded resisors in compliance with EEE-INST-002/ MIL-PRF-55182 test flow S-311-P813 proposed by NASA	10 Ω to 100 kΩ	to ±0.005%	to ±0.2 ppm/°C	to 0.6 W	±0.005% max.
	RNC90	Leaded foil resistor qualified to MIL-PRF-55182/9 QPL product with Established Reliability (ER)	4.99 Ω to 121 kΩ	to ±0.005%	to ± 5 ppm/°C	to 0.6 W	±0.05% max. at +125°C
	RS92N AN	Leaded foil resistors CECC qualified	80.6 Ω to 120 kΩ	to ±0.01%	to ±2 ppm/°C	to 0.5 W	±0.01% max.
	1445Q 1446Q	Hermetic dual-in-line package (DIP) network, qualification to characteristic "C"; tested per MIL-PRF-83401	100 Ω to 10 kΩ	Absolute: ±0.1% Ratio Match: 0.1%	±50 ppm/°C Tracking: ±5 ppm/°C	0.1 W	±0.1% max. (1000 hrs)
	RJ26 Trimmer	Trimmer with smooth leadscrew adjustment, qualified to MIL-PRF-22097 (QPL approved)	20 Ω to 5 kΩ	to ±10%	to ±10 ppm/°C	0.25 W at +85°C	±0.1% at +85°C, Rated Power (typical)

VFR
RESISTORS
A VPG Brand

Contact us at foil@vpgsensors.com | vpgfoilresistors.com

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