VISHAY PRECISION GROUP

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SPCD

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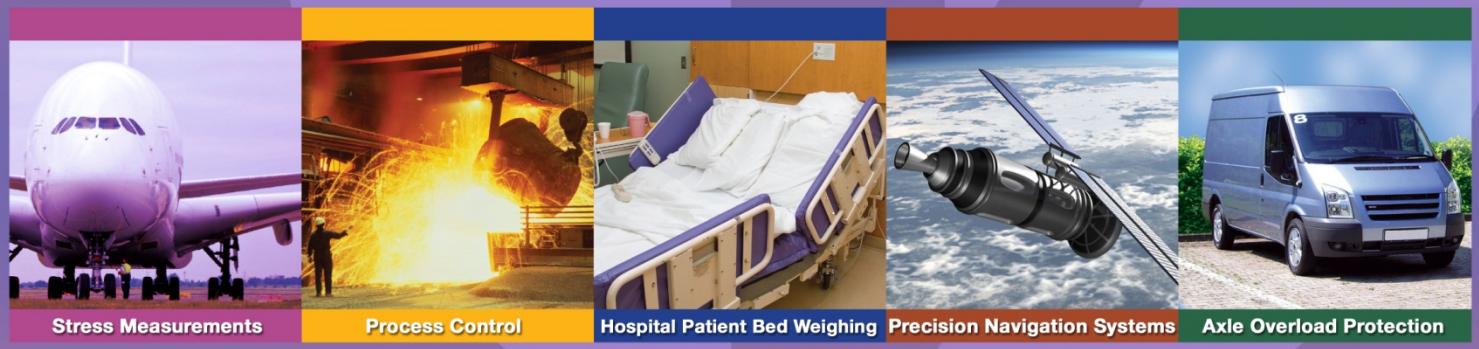


Where the World Goes
for Precision Measurement and Control

HISTORY

- In 1962, Dr. Zandman founded Vishay Intertechnology to develop and manufacture Bulk Metal® foil resistors. Concurrently, J.E. Starr started to produce foil resistance strain gages, which also became part of Vishay Intertechnology
- The company was growing by developing new products and technologies and later became a public company – in 1972 listed on ASE and in 1984 on NYSE
- In 90s Vishay became a multi-billion company of passive components and discrete semiconductors after series of acquisitions of resistor, capacitor and semiconductor manufacturers
- On July 6, 2010, the Measurement Group was spun off from Vishay Intertechnology as an independent, publicly traded company Vishay Precision Group (VPG)
- Vishay Precision Group produces foil resistors, sensors based on resistive foil technology, and sensor-based systems .
- More than five decades after its invention by physicist Dr. Felix Zandman in 1962, the Bulk Metal® Foil (BMF) technology still outperforms all other resistor technologies available today for applications that require precision, stability, and reliability

VPG WORLD WIDE

- **2012 Revenue:$217.6M**
  - **By Region: Americas 41%, Europe 41%, AP 18%**
  - **By End Market: 48% Precision Weighing, 25% Test Measurement, 13% Force Measurement, 9% AMS, 5% Medical**

- **2,250 employees by end of 2012**

- **17 locations over the world:**
  - **5 in Europe, 4 in Americas, 5 in Asia, 3 in Israel**

- **4 Divisions:**
  - **Vishay Foil Resistors – precision resistors and current sensors**
  - **Micro-Measurement – strain gages (resistive sensors)**
  - **Load Cells – transducers (digital and analog)**

VISHAY FOIL RESISTORS

- **2012 Revenue: about $60M**
  - **By Region: Americas 42%, Europe 30%, AP 28%**

- **Market Segments:**
  - **Industrial 75%**
  - **AMS 17%**
  - **Medical 4%**

- **3 facilities:**
  - **Vishay Advanced Technologies in Holon, Israel (65%)**
  - **Alpha Electronics in Akita, Japan (30%)**
  - **Powertron GmbH in Teltow, Germany (5%)**

VISHAY FOIL RESISTORS FEATURES

Metal Bulk Foil Unique Features

- **Temperature Coefficient of resistance absolute and tracking: from 0.2ppm/°C**
- **Resistance Tolerance absolute and match: from 0.001% (10ppm)**
- **Load Life stability: from 0.002% after 2000h at rated power**
- Power TCR (PCR): from 5ppm at rated power with Z-Foil resistors
- End of Life Tolerance (Total error budget): <0.05%
- Shelf Life stability : 2ppm for at least 6 years
- No minimum order quantity
- **Prototype samples can be delivered within 24 hrs from our local precision centers**

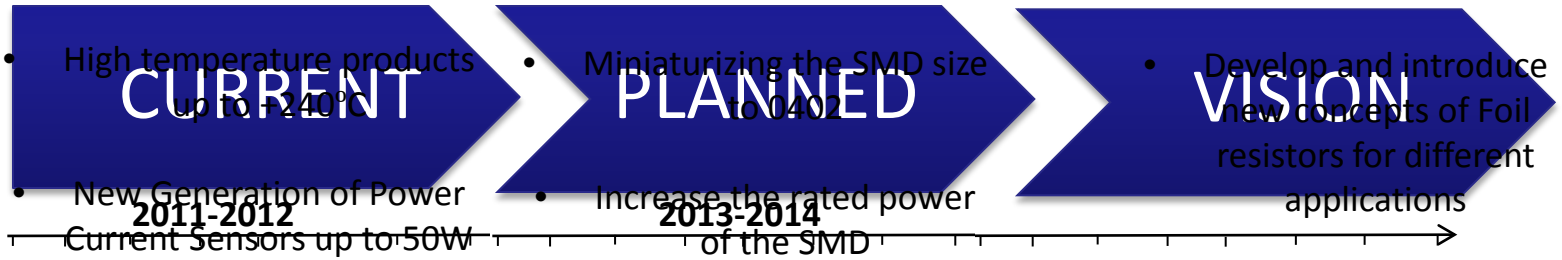
Inherent Characteristics of Foil Resistors

- **Vishay Foil Resistors are not restricted to standard values, specific "as-required" values can be supplied at no extra cost or delivery**

  (e.g., 100.1234Ω vs 100Ω)
- **Electrostatic discharge (ESD): at least to 25 kV**
- Rise time: 1 ns, effectively no ringing
- Thermal stabilization time < 1sec

  (nominal value achieved within 10ppm of steady state value)
- **Non-inductive, non-capacitive design**
- Voltage Coefficient: 0.1ppm/V
- Current noise: 0.010µVRMS/V of applied voltage (<- 40dB)
- **Thermal EMF: <0.1 µV/°C**

ROADMAP AT A GLANCE



- New Z1 technology products (e.g. FRSM)
- High temperature products up to T = 240°C
- New Generation of Power Current Sensors up to 50W
- Stress free resistors (Flexible terminations)
- New direct plug in standard resistor for most DMM's available in the market

- Introducing & qualifying new SMD for ER
- Miniaturizing the SMD size to 0402
- Increase the rated power of the SMD
- Introducing new design of Standard Foil resistors without ceramic substrate
- Developing new line of power resistors with almost zero thermal stabilization

- Maintain world leadership in precision resistors
- Develop and introduce new concepts of Foil resistors for different applications
- Provide the most stable resistors in the market
- Identify new market opportunities
- Provide solutions for the alternative energy industry & smart grid

VISHAY PRECISION GROUP

AVIONICS, MILITARY & SPACE (AMS)

Selected Vishay Foil Resistors Bulk Metal® Foil Resistors

Product	Type	Construction	Performance and Screening Specifications	Typical TCR -55°C to +125°C, +25°C ref. (ppm/°C)	Load Life Stability 2000 Hours, +70°C Under Power, Typical
	VSMP Series 0805 – 2512	Wrap-around surface mount	DSCC, EEE-INST-002 MIL-PRF-55342	0.2	0.005%
	VCS1625Z	Current-sense with Kelvin connections for high accuracy	DSCC, EEE-INST-002 MIL-PRF-55342	0.2	0.005%
	CSM2512 / CSM3637		DSCC, EEE-INST-002 MIL-PRF-49465	Max 15	0.005%
	SMR1DZ / SMR3DZ	Molded, flexible terminations with robust construction	DSCC, EEE-INST-002 MIL-PRF-55182	0.2	0.005%
	Z201	Through-hole	EEE-INST-002 MIL-PRF-55182	0.2	0.005%

SCREENING AND QUALIFICATION PER EEE-INST-002

- **CSM Series – 303144, 303145 Current Sensors**
  - Low Value (2mR to 200mR) with 4-terminal Kelvin Connection
  - Tested similar to MIL-PRF-49465 & 55342

- **VSMP Series – 303134 through 303138 Wraparound Chip Resistors**
  - 0805, 1206, 1506, 2010, 2512 sizes
  - Designed to exceed MIL-PRF-55342 performance

- **VCS1625 Series – 303119 Current Sensors**
  - Low Value (10mR to 10R) 4 terminal Kelvin Connection
  - Tested similar to MIL-PRF-55342 & 55182

- **SMR Series – 303139, 303140 SMD Resistor**
  - Flexible “J” Lead construction
  - Tested in accordance with MIL-PRF-55342 & 55182

HERMETIC PRECISION RESISTOR NETWORKS

Performances:

- **Fundamentally low TCR**
- **Hold tight TC track under influences of temperature, load and time**
- **Very small drift with load over time**
- **Common behavior: all the drifts move in the same direction with temperature, load and time**

Vishay Precision Group applies a proprietary stabilization process to minimize the drifts over extended time frames

THANK YOU FOR YOUR ATTENTION!