Resistive Products

Application Note

Advanced Medical Applications, Treatment Solutions, and Biotechnology

Introduction

Vishay's ultra-high-precision Bulk Metal® foil technology includes many types of resistors with a variety of standard configurations that can withstand unconventional environmental conditions above and below the surface.

A variety of foil resistor configurations and chip packages from the 0805 size and up are used to provide an array of power ratings, sizes, resistance values, and other operating specifications to meet stability and reliability needs in medical applications.

The stability of a resistor depends primarily on its temperature, which is affected by:
1. Changes in the ambient temperature and heat from adjacent components (defined by the temperature coefficient of resistance, or TCR).
2. Self-heating as a result of load (defined by the power coefficient of resistance (PCR), which is ΔR due to self-heating).

All of these performance characteristics are particularly desirable in medical instrumentation and equipment, where Bulk Metal foil resistors deliver proven reliability and stable performance, even when exposed to unstable levels of temperature and humidity or other harsh environmental conditions. Their long track record of success in medical applications and Vishay's long-term commitment to the medical market have made Bulk Metal foil the preferred resistor for medical applications including non-invasive equipment, imaging equipment and systems, and biological implants.

As a leading supplier to the worldwide medical market, Vishay has produced a steady stream of breakthroughs in component technology, including new Z-foil resistors that provide a temperature coefficient of ± 0.2 ppm/°C and a power coefficient of 5 ppm at rated power: a ten-fold improvement over standard foil resistors.

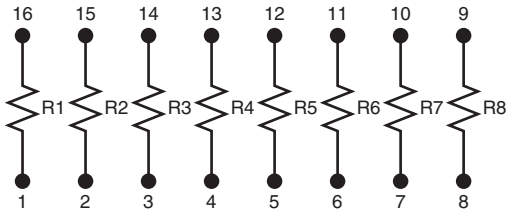
Many medical applications require custom or semi-custom component solutions. Vishay's Application Engineering department is available to advise customers and to make recommendations regarding non-standard technical requirements and special applications.

Please contact us at foil@vishaypg.com.

Example 1. End Product: Cardiac Mapping System Real Time Display of Heart Electrical Activity

Customer Schematic/Specifications:

- Ohmic value: 10 kΩ each
- Absolute tolerance: 0.005 %
- Ratio tolerance: 0.005 % between R1 thru R4, and R5 thru R8
- Absolute TCR (Temperature Coefficient of Resistance): 5 ppm/°C maximum
- TCR tracking: 0.5 ppm/°C between R1 thru R4, and R5 thru R8



Customer Requirements:

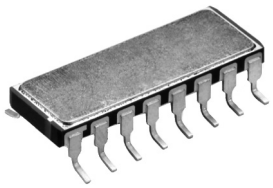
- High ratio stability under working conditions
- Surface mount devicel

Foil Solution: VSM46

- Hermetically sealed high precision network - 16 terminals gull wing configuration.

The Solution:

- Offers the best combination of tracking under power and temperature during time of service life. The common behavior of all resistors mounted into the same hermetic package contributes to maintain the excellent load life and ratio stabililty.
- Saves mounting time and real estate on PCB instead of using discrete resistors.

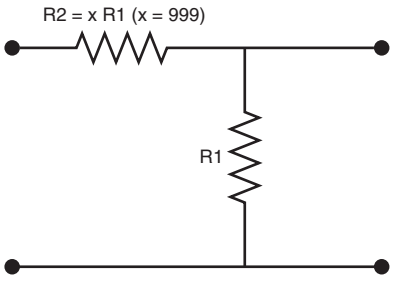


APPLICATION NOTE

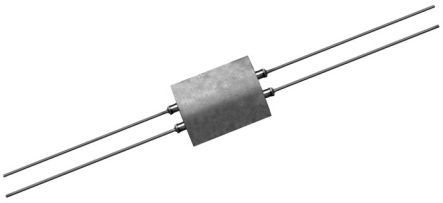
Advanced Medical Applications, Treatment Solutions, and Biotechnology

Example 2. End Product: Tomography Control of Magnetic Field Activity

Customer Schematic/Specifications:
- Ultra precision attenuator with very high ohmic value ratio: 1:1000
- R1 < 25 Ω
  R2: 999 x R1
- Ratio definition: R1 to (R1 + R2)
- Initial attenuation accuracy: 0.003 %
- Total attenuation of ratio:
  (TCR + Shift Under Load): 0.005 % after 2000 h



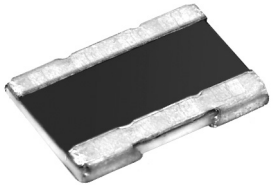
Foil Solution: VHA512 Style - 4 Terminals Using Z-Foil Technology
- Hermetically sealed oil filled network - custom design



The Solution:
- High ratio stability: 0.005 % under working conditions and ambient temperature variations
- Extremely low absolute TCR of 0.2 ppm/°C
- Non-measurable shelf life drifts

Example 3. End Product: Miniature Sensors with 3D Medical Imaging for Precise Diagnostics and Surgery

Customer Schematic/Specifications:
- Ultra precision current sensor
- Ohmic value: 0.3 Ω
- Absolute tolerance: 0.1 %
- Absolute TCR: 4 ppm/°C within + 30 °C to + 50 °C
- Working power: 0.05 W



Customer Requirements:
- Extremely tight TCR
- Very low PCR (power coefficient of resistance)
- Low total error budget
- Tight absolute tolerance
- Surface mount device

Foil Solution: VCS1625Z
- Ultra precision surface mount current sensing chip resistor, 4 terminals

The Solution:
A small surface mount device with:
- Extremely low TCR: 0.2 ppm/°C - typical
- Very low PCR: 5 ppm at rated power
- Tight tolerance: 0.1 %

APPLICATION NOTE