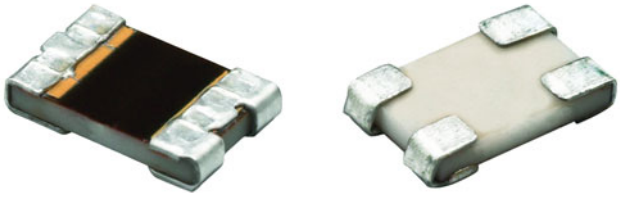
High Precision Foil Surface Mount Current Sensing Chip Resistors with TCR of ± 0.2 ppm/°C, Load Life Stability of ± 0.015 %, ESD Immunity up to 25 kV and Fast Thermal Stabilization



INTRODUCTION

The Z-foil technology provides a significant reduction of the resistive component's sensitivity to ambient temperature variations (TCR) and applied power changes (PCR).

Designers can now guarantee a high degree of stability and accuracy in fixed-resistor applications using solutions based on Vishay's Foil Resistors revolutionary Z-foil technology.

Model VCS1610Z is a surface mount chip resistor designed with 4 pads for Kelvin connection. Utilizing Vishay's Bulk Metal® Z-foil as the resistance element, it provides performance capabilities far greater than other resistor technologies can supply in a product of comparable size. ± 0.2 ppm/°C typical TCR (- 55 °C to + 125 °C,+ 25 °C ref.) removes errors due to temperature gradients.

This small device dissipates heat almost entirely through the pads so surface mount users are encouraged to be generous with the board's pads and traces.

Our application engineering department is available to advise and to make recommendations. For non-standard technical requirements and special applications, please contact us.

TABLE 1 - TOLERANCE AND TCR VS. RESISTANCE VALUE
(- 55 °C to + 125 °C, + 25° Ref.)

VALUE (Ω)	TOLERANCE	TYPICAL TCR AND MAX. SPREAD (ppm/°C)
0R5 to 10R	0.5 %, 1 %	± 0.2 ± 4.8
0R3 to 0R5	0.5 %, 1 %	± 0.2 ± 9.8

Note

• Tighter tolerances and higher values are available. Please contact application engineering foil@vishaypg.com

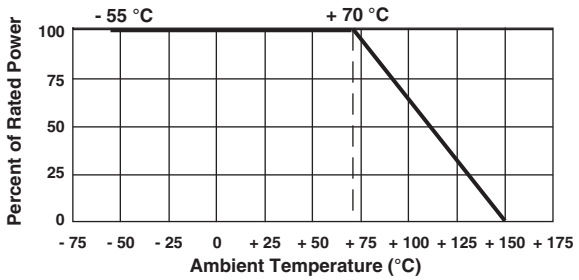
FEATURES

Pb-free Available

RoHS* COMPLIANT

- **Temperature coefficient of resistance (TCR): ± 0.2 ppm/°C typical (- 55 °C to + 125 °C, + 25 °C ref.) (see table 1)**
- Resistance range: 0.3 Ω to 10 Ω
- Resistance tolerance: to ± 0.5 %
- **Load life stability: ± 0.015 % at 70 °C, 2000 h at rated power**
- Power rating: 0.25 W at + 70 °C
- Vishay Foil resistors are not restricted to standard values; specific "as required" values can be supplied at no extra cost or delivery (e.g. 0.345 Ω vs. 0.3 Ω)
- Electrostatic discharge (ESD) at least to 25 kV
- **Thermal stabilization time < 1 s (nominal value achieved within 10 ppm of steady state value)**
- Short time overload < 0.005 %
- Non-inductive, non-capacitive design
- Thermal EMF: 0.05 µV/°C typical
- Current noise: 0.010 μV_{RMS}/V of applied voltage (< - 40 dB)
- Rise time: 1 ns effectively no ringing
- Voltage coefficient: < 0.1 ppm/V
- Non inductive: < 0.08 µH
- Non hot spot design
- Prototype quantities available in just 5 working days or sooner. For more information, please contact foil@vishaypg.com

FIGURE 1 - POWER DERATING CURVE (1)



Note

(1) Power rating: 0.25 W at + 70 °C

* TERMINATIONS

- Tin/lead plated
- Two options of lead (Pb)-free leads available:
  - Gold plated
  - Tin plated

* Pb containing terminations are not RoHS compliant, exemptions may apply

Why use Kelvin connections?

Four-terminal connections or Kelvin connections are required in these low ohmic value resistors to measure a precise voltage drop across the resistive element. The 4-terminal configuration eliminates the IR-drop error voltage that would be present in the voltage sense leads if a standard two-terminal resistor were used.

In current sense resistors the contact resistance and the terminations resistance may be greater than that of the resistive element itself so lead connection errors can be significant if only two terminal connections are used.

Why is the VCS1610Z vital in avoiding Thermal EMF (parasitic effect)?

When two dissimilar metals are heated, a parasitic voltage is generated and creates a DC-offset error. This voltage is proportional to a temperature difference between either end of the pair of conductors. This phenomenon is called a Thermal Electro-motive Force (Thermal EMF), or thermocouple effect. Thermal EMF is an important consideration in low ohmic current sensing resistors used mostly in DC circuits. The VCS1610Z is the ideal solution to minimize the effect of thermal EMF through the use of appropriate materials between the resistive layer and the terminations.

Should I be concerned about the impact of ESD on my resistor?

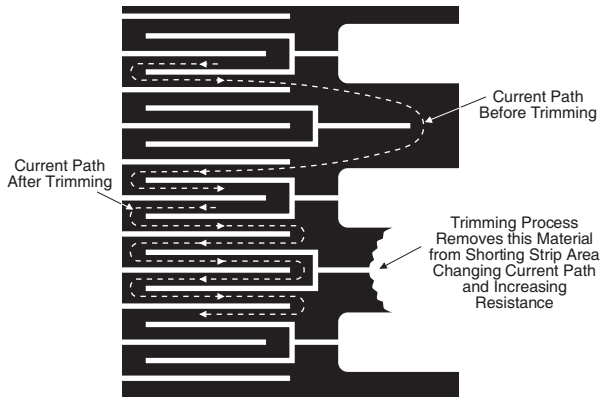
Electrostatic Discharge (ESD) is known to produce catastrophic failures in thin-film and thick-film (cermet) resistors at only 3000 V. On the other hand, the Bulk Metal® Foil resistor withstands ESD events up to 25 kV because its thicker resistance element and greater metallic mass afford much higher energy-handling capability than either the much thinner thin-film resistor or the sparse, non-homogeneous metallic content of the thick film resistor.

Should I be concerned about stability?

In order to select the resistor technology most appropriate to the application, a designer must take into account all normal and extraordinary stresses the resistor will experience in the application. In addition, the designer must consider the cost and reliability impact involved when it becomes necessary to add costly additional compensating circuitry when inadequate resistors are selected. The stability of Bulk Metal® Foil resistors, together with the advantages already mentioned, as well as the other basic advantages apparent in their specifications will not only provide unequalled performance in the circuit but will eliminate all the costs associated with extra compensation circuitry.

With VCS1610Z, only a minimal shift in resistance value will occur during its entire lifetime. Most of this shift takes place during the first few hundred hours of operation, and virtually no change is noted thereafter.

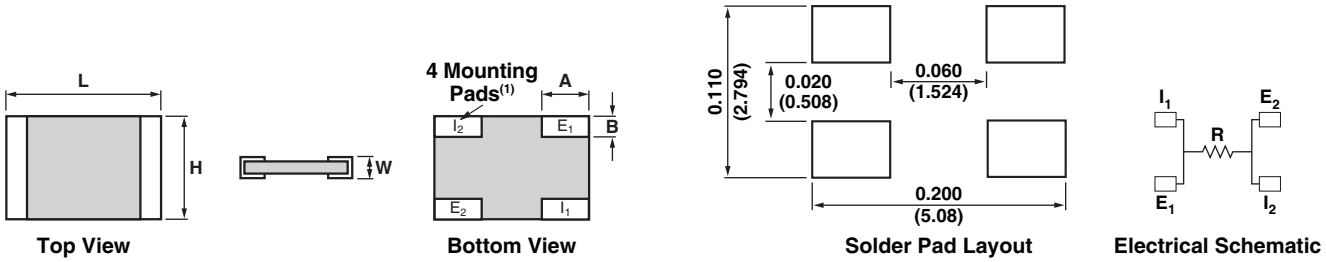
FIGURE 2 - TRIMMING TO VALUES (Conceptual Illustration)*



NOTE: Foil shown in black, etched spaces in white

* To acquire a precision resistance value, the Bulk Metal® Foil chip is trimmed by selectively removing built-in “shorting bars.” To increase the resistance in known increments, marked areas are cut, producing progressively smaller increases in resistance. This method eliminates the effect of “hot spot” and assures the long term stability of the Foil chips.

FIGURE 3 - DIMENSIONS in inches (millimeters)



Note
(1) I and E mounting pads are interchangeable

	INCHES	MILLIMETERS
L	0.160 ± 0.010	4.06 ± 0.25
H	0.100 ± 0.010	2.54 ± 0.25
W	0.040 maximum	1.02 maximum
A	0.045 ± 0.005	1.14 ± 0.13
B	0.030 ± 0.010	0.76 ± 0.25

FIGURE 4 - TYPICAL RESISTANCE/TEMPERATURE CURVE

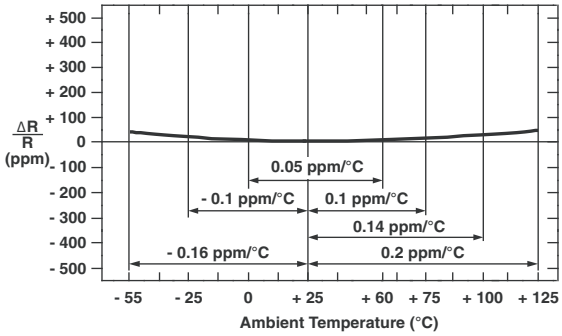


TABLE 2 - PERFORMANCE SPECIFICATIONS

TEST	MIL-PRF-55342 ΔR LIMITS	TYPICAL ΔR LIMITS*
Thermal Shock 5 x (- 65 °C to + 150 °C)	± 0.10 %	± 0.005 % (50 ppm)
Low Temperature Operation, - 65 °C, 45 min at P_{nom}	± 0.10 %	± 0.005 % (50 ppm)
Short Time Overload, 6.25 x Rated Power, 5 sec	± 0.10 %	± 0.005 % (50 ppm)
High Temperature Exposure, + 150 °C, 100 h	± 0.10 %	± 0.01 % (100 ppm)
Resistance to Soldering Heat, +245°C for 5 sec,+235°C for 30 sec	± 0.2 %	± 0.01 % (100 ppm)
Moisture Resistance	± 0.2 %	± 0.01 % (100 ppm)
Load Life Stability + 70 °C for 2000 h at Rated Power	± 0.5 %	± 0.015 % (150ppm)

Note
* Measurement error 0.001 R

FIGURE 5 - HIGH TEMPERATURE EXPOSURE

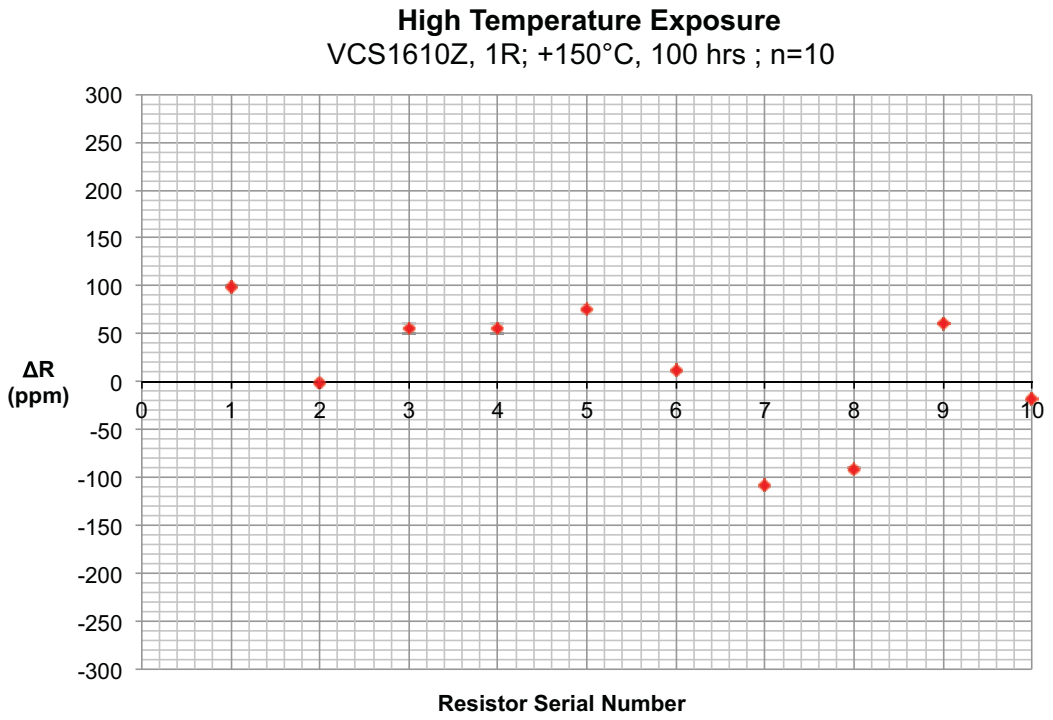


FIGURE 6 - LOAD LIFE

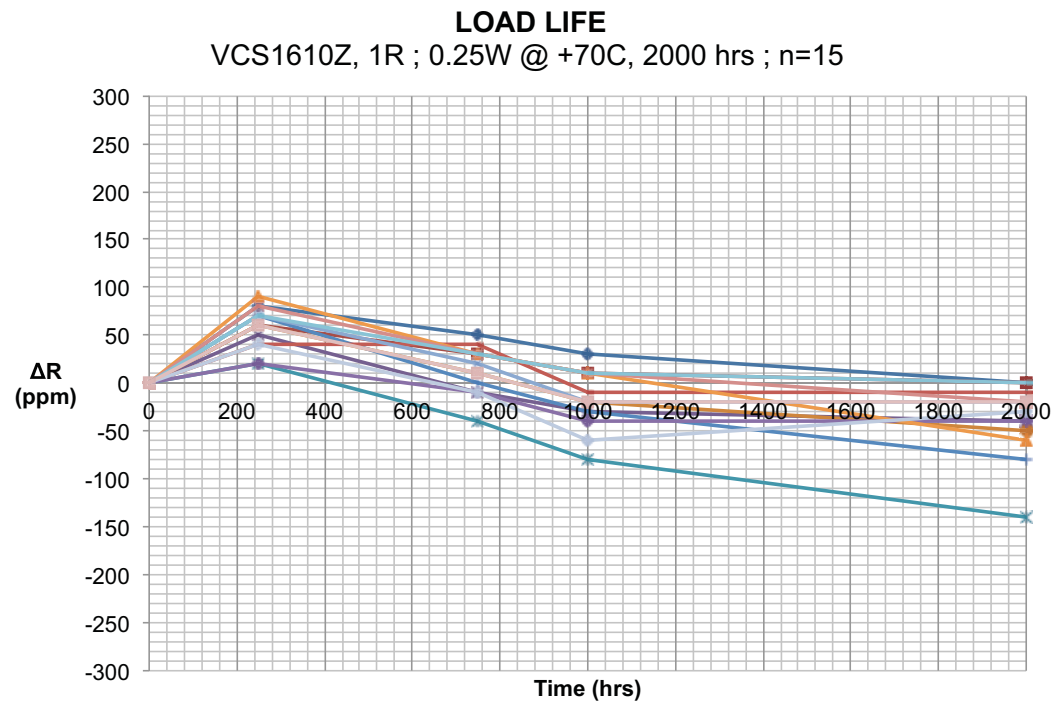


FIGURE 7 - LOW TEMPERATURE OPERATION

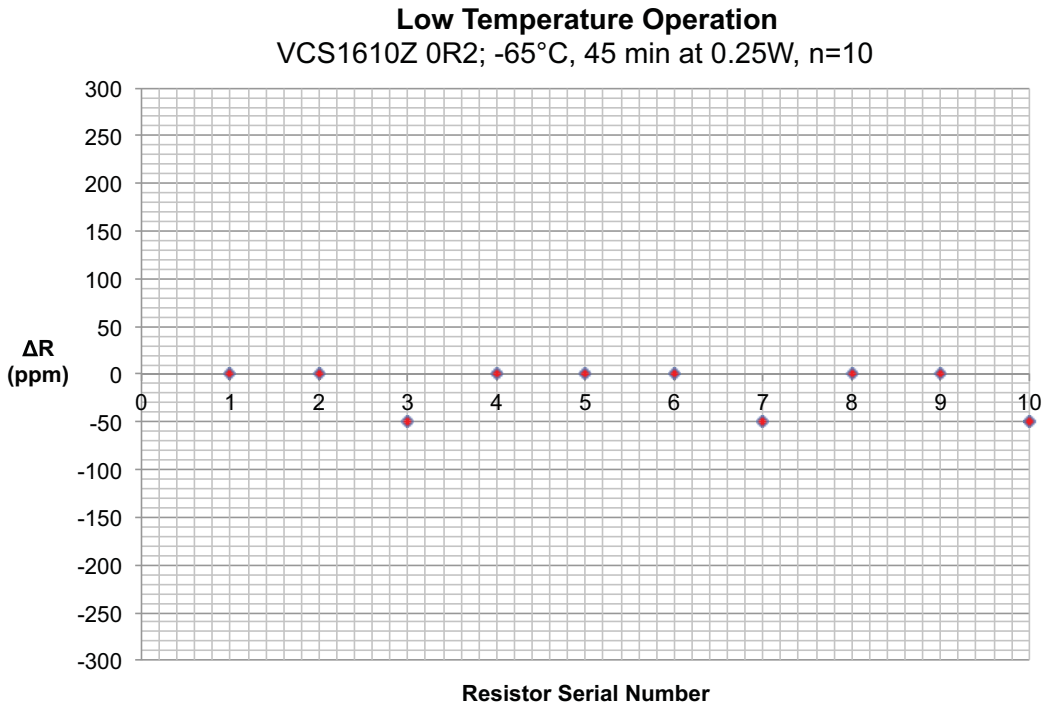


FIGURE 8 - SHORT TIME OVERLOAD

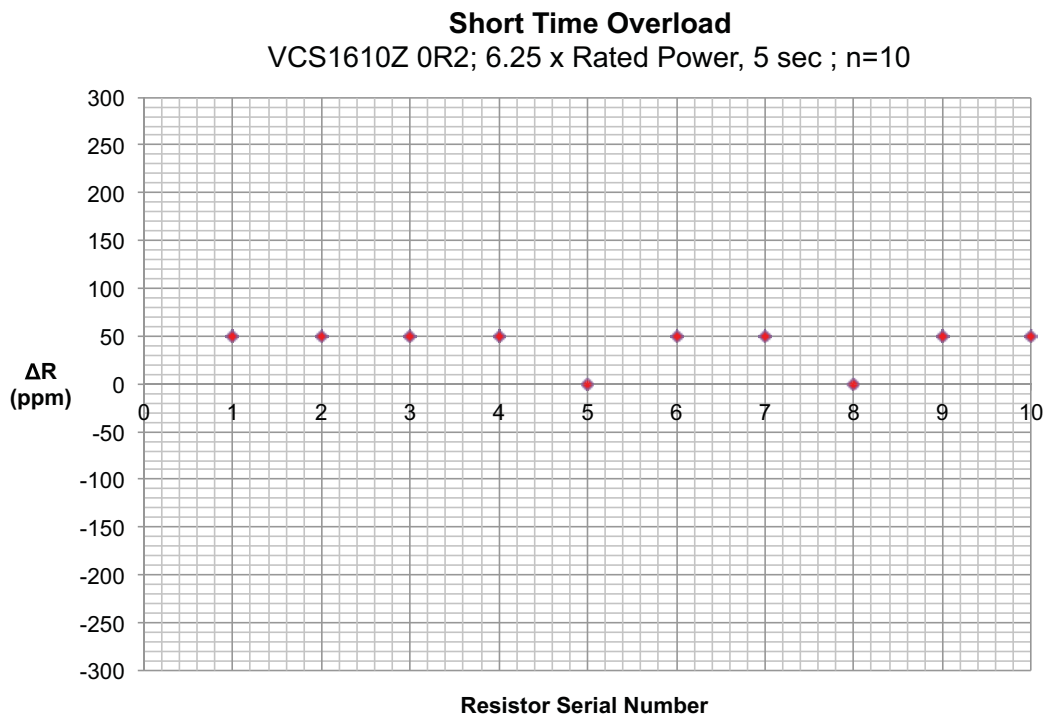
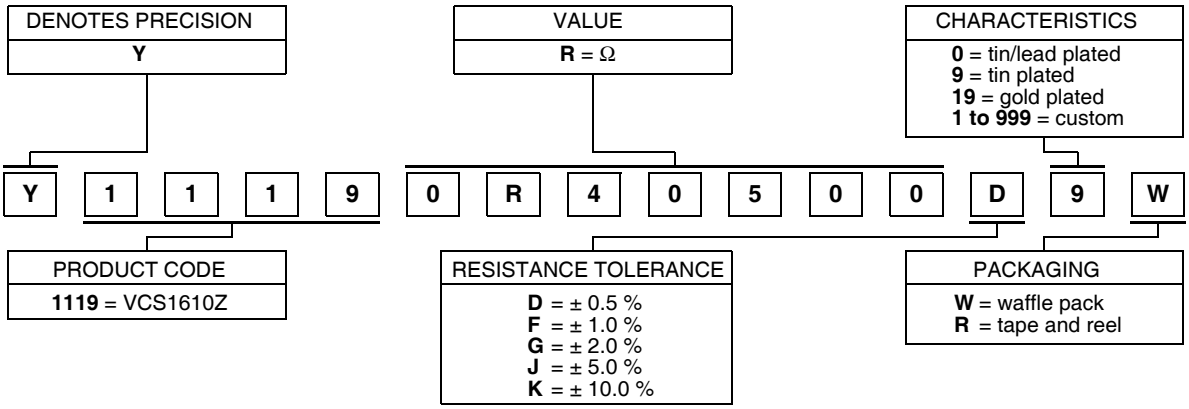


TABLE 3 - GLOBAL PART NUMBER INFORMATION (1)

NEW GLOBAL PART NUMBER: Y11190R40500D9W (preferred part number format)



FOR EXAMPLE: ABOVE GLOBAL ORDER Y1119 0R40500 D 9 W:

TYPE: VCS1610Z
VALUES: 0.405 Ω
ABSOLUTE TOLERANCE: ± 0.5 %
TERMINATION: tin plated, lead-free (Pb-free)
PACKAGING: waffle pack

Note

(1) For non-standard requests or additional values, please contact application engineering.

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