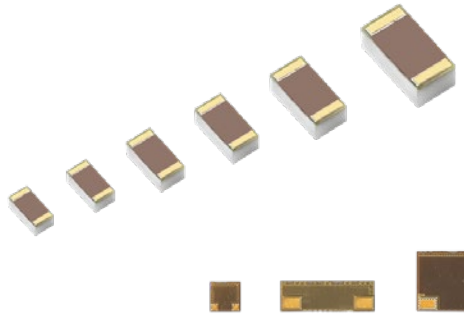
Ultra High Precision Z1 Foil Technology Gold Wire Bondable Chip Resistor

for Hybrid Circuits and High Temperature Applications up to +240°C, Long-Term Stability of 0.05%

FEATURES

- Temperature coefficient of resistance (TCR): ±3 ppm/°C typical (–55°C to +220°C, +25°C ref.)
- Resistance range: 5 Ω to 100 kΩ (for higher or lower values, please contact us)
- Resistance tolerance: to ±0.02%
- **Connection method: gold wire bonding**
- **Working power: to 150 mW at +220°C**
- **Long-term stability: to ±0.05% at +240°C for 2000 h, no power**
- **Load-life stability: to 0.05% at +220°C for 2000 h at working power**
- Bulk Metal® Foil resistors are not restricted to standard values; specific “as required” values can be supplied at no extra cost or delivery (e.g., 1K2345 vs. 1K)
- Thermal stabilization time <1 s (nominal value achieved within 10 ppm of steady state value)
- Electrostatic discharge (ESD) at least to 25 kV
- Non inductive, non capacitive design
- Rise time: 1 ns effectively no ringing
- Current noise: 0.010 μV_{RMS}/Volt of applied voltage (<–40 dB)
- Non inductive: <0.08 µH
- Non hot spot design
- Terminal finish: gold plated (lead (Pb)-free alloy)
- Prototype quantities available, please contact foil@vpgsensors.com



Pb-free Available
RoHS* COMPLIANT

INTRODUCTION

Vishay Foil Resistors HTHG series consists of Bulk Metal® Z1 Foil Technology hybrid chip resistors, connected using gold wire bonding. The HTHG series features two different layouts of chip designs according to the sizes (see figure 3 and table 4). These new types of hybrid chips were especially designed for high temperature applications up to +240°C[1] (working power: to 150 mW at +220°C), and include gold plated terminals.

The HTHG series is available in any value within the specified resistance range. Our application engineering department is available to advise and make recommendations.

For customized technical requirements and special applications, please contact foil@vpgsensors.com.

Figure 1 – Typical Power Derating Curve

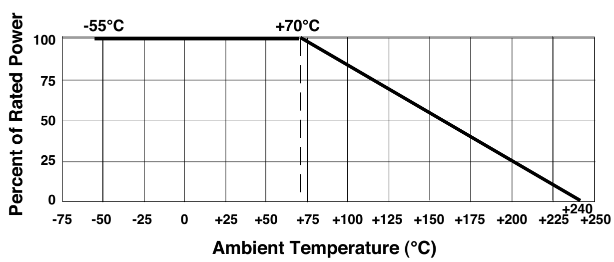


Table 1 – Tolerance and TCR vs. Resistance Value[1][2] (–55°C To +220°C, +25°C Ref.)

RESISTANCE VALUE (Ω)	TOLERANCE (%)	TCR Typical (ppm/°C)
100 to 100K	±0.02	±3
50 to <100	±0.05	
25 to <50	±0.1	
10 to <25	±0.25	
5 to 10	±0.5	

Notes

(1) Performances obtained with ceramic PCB.

(2) For tighter performances or different values, please contact our application engineering at foil@vpgsensors.com.

Note

* This datasheet provides information about parts that are RoHS-compliant and/or parts that are non-RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS compliant. Please see the information/tables in this datasheet for details.

HIGH TEMPERATURE AND HIGH PRECISION

Resistors are the passive building blocks of an electrical circuit. They may be used for dropping the voltage, buffering the surge when the circuit is turned on, providing feedback in a monitoring loop, sensing current flow, etc. When the application requires stability over time and load, initial accuracy, minimal change with temperature for more than 200°C, resistance to moisture and a number of other characteristics that will be described, only Bulk Metal® Z1 Foil Technology resistors have the attributes needed for this application. Many analog circuits for industrial, military, aerospace, medical, down-hole, oil well and automotive applications require passive components, such as resistors, to have a minimal drift from their initial values when operating above +175°C and in humid environments. In these applications, the most important factor is the end of life tolerance (which is part of the stability) and to a lesser extent, the initial tolerance.

The HTHG series resistors provide stabilities well under the maximum allowable drift required by industrial specifications through thousands of hours of operation under harsh conditions, such as the extreme temperatures and radiation-rich environments of down-hole oil-well logging applications in the frigid arctic, under the sea or in deep space. Bulk Metal Z1 Foil Technology resistors receive stabilization processing, such as repetitive short-term power overloads, to assure reliable service through the unpredictable stresses of extreme operation. Compared to Bulk Metal Foil, thick and thin film resistor elements are produced with a non-controllable material. Heat or mechanical stresses on the resistive elements cause the particles forming the film to expand. However, after these stresses are alleviated, the particles in the film matrix do not return to the exact original position. That degenerates their overall stability.

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 earth's surface using special post manufacturing operations specially developed for this purpose. The stability of a resistor depends primarily on its history of exposures to high temperature. Stability is affected by:

1. Changes in the ambient temperature and heat from adjacent components (defined by the temperature coefficient of resistance, or TCR)
2. Destabilizing thermal shock of suddenly-applied power (defined by the power coefficient of resistance, or PCR)
3. Long-term exposure to applied power (load-life stability)
4. Repetitive stresses from being switched on and off

In very high-precision resistors that need to operate in an environment with temperatures above +175°C, these effects must be taken into account to achieve high stability with changes in load (Joule effect) and ambient temperature.

The Bulk Metal Foil resistors' Z1 Foil Technology provides an order of magnitude reduction in the Bulk Metal Foil element's sensitivity to temperature changes – both external and internal – with emphasis on long-term stability in high temperature environments.

In order to take full advantage of the low TCR and long-term stability improvement, it is necessary to take into account the differences in the resistor's response to each of the above-mentioned effects. For high temperature applications where stability and total error budget is the main concern, the Bulk Metal Z1 Foil Technology offers the best resilience against time at elevated temperature.

The Bulk Metal Foil technology allows us to produce customer-oriented products designed to satisfy unique and specific technical requirements. In addition to the special chip stabilization under extreme environment conditions in the production line, we offer additional specially oriented post manufacturing operations (PMO) for high temperature applications that require an even higher degree of reliability and stability.

Electrostatic Discharge (ESD) is another potential problem that can cause unpredictable failure in high temperature applications that increase the sensitivity of the resistors to ESD.

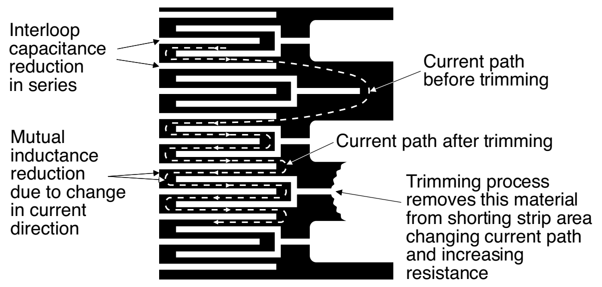
ESD damage to electronic devices can occur at any point in the device's life cycle, from manufacturing to field service. A resistor that is exposed to an ESD event may fail immediately or may experience a latent defect. With latent defects, premature failure can occur after the resistor is already functioning in the finished product after an unpredictable length of service. Bulk Metal Foil resistors are capable of withstanding electrostatic discharges at least to 25 kV volts without degradation.

Vishay Foil Resistors' Application Engineering department is always available to assist with any special requirements you might have. If you are not sure which resistor best suits your needs, please do not hesitate to contact them for more information: foil@vpgsensors.com

Table 2 – Product Specifications

PRODUCT	CONNECTING METHOD	SIZES
HTHG	Gold wire bonding	5 × 5, 15 × 5, 15 × 10
		0603, 0805, 1206, 1506, 2010, 2512

Figure 2 – Trimming to Values



Foil shown in black, etched spaces in white

Note

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 reduces the effect of “hot spots” and improves the long-term stability of Bulk Metal® Foil resistors.

Table 3 – Specifications

CHIP SIZE	RATED POWER at +70°C (mW)	WORKING POWER at +220°C[(1)] (mW)	RESISTANCE RANGE (Ω)
5 × 5	160	20	5 to 10k
15 × 5	400	50	5 to 30k
15 × 10	625	75	30K to 80k
0603	100	12.5	100 to 5k
0805	175	20	5 to 8k
1206	270	33	5 to 25k
1506	340	40	5 to 30k
2010	850	100	5 to 70k
2512	1200	150	5 to 100k

Note

(1) Maximum working voltage at +220°C for a given resistance value is calculated using $V = \sqrt{P \times R}$.

Figure 3 – Dimensions and Land Pattern in Inches (Millimeters)

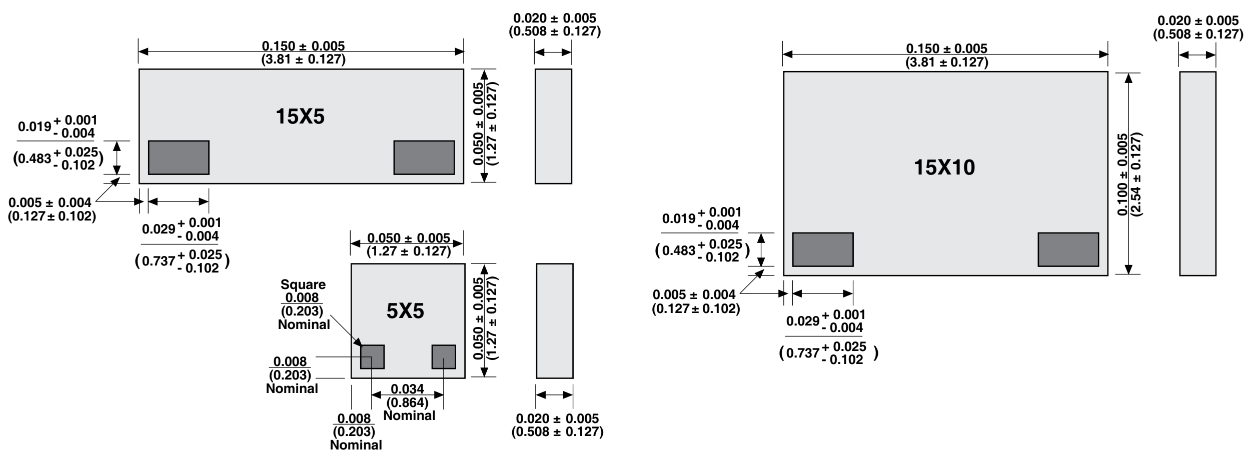
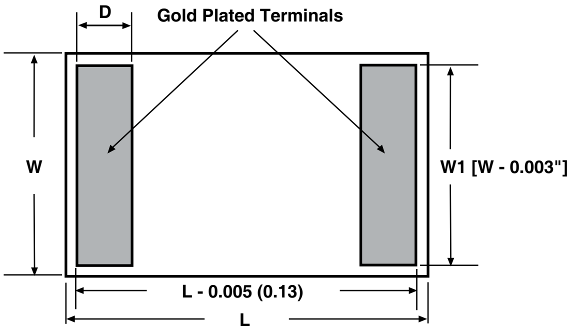


Table 4 – Dimensions in Inches (Millimeters)



CHIP SIZE	L ±0.005 (0.13)	W ±0.005 (0.13)	THICKNESS ±0.003 (0.08)	D NOMINAL
0603	0.063 (1.60)	0.032 (0.81)	0.02 (0.50)	0.006 (0.15)
0805	0.079 (2.01)	0.049 (1.24)	0.02 (0.50)	0.010 (0.25)
1206	0.126 (3.20)	0.062 (1.57)	0.02 (0.50)	0.015 (0.38)
1506	0.150 (3.81)	0.062 (1.57)	0.02 (0.50)	0.012 (0.30)
2010	0.200 (5.08)	0.100 (2.54)	0.02 (0.50)	0.020 (0.51)
2512	0.250 (6.35)	0.126 (3.20)	0.02 (0.50)	0.024 (0.61)

Note

Vacuum pick up is recommended for handling

Table 5 – Performance Limits[(1)(2)]

TEST	CONDITIONS	TYPICAL LIMIT % (ppm)	MAX LIMIT % (ppm)
Short Time Overload	$6.25 \times P_{nom}$.	±0.001% (10)	±0.015% (150)
High Temperature Exposure	+240°C, 2,000 h	±0.1% (1000)	±0.25% (2500)
Moisture Resistance	Per MIL-PRF-55342 (p. 4.8.9)	±0.01% (100)	±0.05% (500)
Load Life Test, 220°C, 2,000 h	At working power (see Table 3)	±0.05% (500)	±0.15% (1500)
Load Life Test, 70°C, 2,000 h	Rated power (see Table 3)	±0.005% (50)	±0.025% (250)
Thermal Shock	5 × (–65°C to +220°C)	±0.005% (50)	±0.02 (200)

Notes

(1) As shown +0.01 Ω to allow for measurement errors at low values.

(2) Performances obtained with ceramic PCB.

Table 6 – Global Part Number Information[(1)]

NEW GLOBAL PART NUMBER: Y079712K7560Q0W (preferred part number format)

Y	0	7	9	7	1	2	K	7	5	6	0	Q	0	W

DENOTES PRECISION
Y

VALUE
R = Ω **K** = kΩ

TERMINAL CHARACTERISTIC
0 = standard (gold plated) **1 to 999** = custom

PRODUCT CODE
0780 = HTHG5x5
0781 = HTHG15x5
0782 = HTHG15X10
0794 = HTHG0603
0795 = HTHG0805
0796 = HTHG1206
0797 = HTHG1506
0798 = HTHG2010
0799 = HTHG2512

RESISTANCE TOLERANCE
Q = ±0.02%
A = ±0.05%
B = ±0.10%
C = ±0.25%
D = ±0.5%
F = ±1.0%

PACKAGING
W = waffle pack

FOR EXAMPLE: ABOVE GLOBAL ORDER Y0797 12K7560 Q 0 W:

TYPE: HTHG1506
VALUES: 12.7560 kΩ
ABSOLUTE TOLERANCE: 0.02%
TERMINATION: standard (gold-plated)
PACKAGING: waffle pack

HISTORICAL PART NUMBER: HTHG1506 12K756 Q W (WILL CONTINUE TO BE USED)

HTHG1506	**12K756**	**Q**	**W**
MODEL	RESISTANCE VALUE	TOLERANCE	PACKAGING
0780 = HTHG5x5 0781 = HTHG15x5 0782 = HTHG15X10 0794 = HTHG0603 0795 = HTHG0805 0796 = HTHG1206 0797 = HTHG1506 0798 = HTHG2010 0799 = HTHG2512	12.756 kΩ	**Q** = ±0.02% **A** = ±0.05% **B** = ±0.10% **C** = ±0.25% **D** = ±0.5% **F** = ±1.0%	**W** = waffle pack

Note

[(1)] For customized requests, please contact application engineering at foil@vpgsensors.com

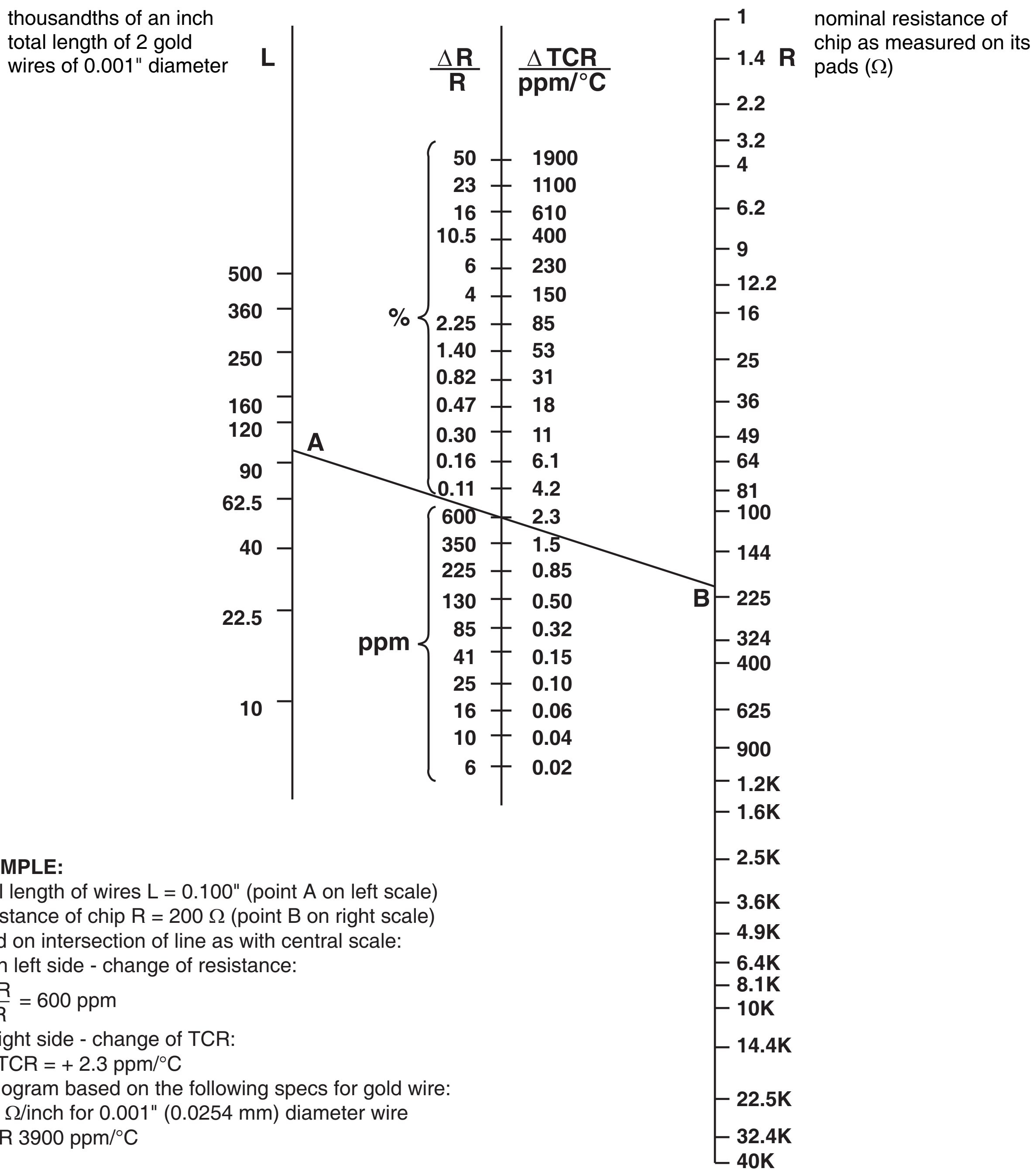
EFFECTS OF GOLD WIRE

The bonding of the gold wires to the chip has an effect on the overall resistance and on the temperature coefficient, according to the length of wire used.

The nomogram below shows the effect on both parameters with varying lengths of 0.001 in (0.0254 mm) diameter gold wire.

NOMOGRAM

Change of resistance and TCR due to a length L of gold wire added at wire bonding.



EXAMPLE:

Total length of wires L = 0.100" (point A on left scale)
Resistance of chip R = 200 Ω (point B on right scale)
Read on intersection of line as with central scale:

On left side - change of resistance:

$\frac{\Delta R}{R}$ = 600 ppm

On right side - change of TCR:

ΔTCR = + 2.3 ppm/°C

Nomogram based on the following specs for gold wire:

- 1.2 Ω/inch for 0.001" (0.0254 mm) diameter wire
- TCR 3900 ppm/°C

For any questions, contact
foil@vpgsensors.com

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[>>Vishay(威世)]