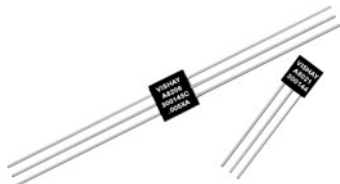


# Bulk Metal® Foil Technology High Precision Voltage Divider Resistors with TCR Tracking to 0.5 ppm/°C and Tolerance Match to 0.005 % (50 ppm)



## INTRODUCTION

### Why tight tolerance is important?

Why do users employ tight tolerance resistors? A system or a device or one particular circuit element must perform for a specified period of time and at the end of that service period it must still be performing within specifications.

During its useful life it may have been subjected to some hostile service conditions and it is no longer within purchased tolerance.

### What is ratio?

The ratio tolerances available in a divider are variable and dependent on resistor technology. Bulk Metal® foil provides the tightest ratio tolerance available.

The tight resolution capability and overall stability of foil resistors permit adjustment within the divider to ratio not available with other technologies. Ratios in network form, in a common package have a better chance of holding tight tolerances than those formed in a discrete matched set by sorting.

Molded foil 300144, 300145 resistors can be provided in a tolerance as tight as 0.005 %. Theoretically, ratios such as these can be made initially with other resistor technologies. However, less stable products will not hold these tight ratios tolerances over time and applied stresses like voltage and temperature.

Vishay Foil Resistors (VFR) Bulk Metal foil dividers/networks 300144, 300145 hold their ratio tolerances under defined circumstances. Networks with tight ratio tolerances and controlled tracking extend the useful life of equipment, whether expressed as mean-time-between-failures (MTBF) or service periods to recalibration or end-of-life-cycle.

### How to avoid thermal EMF?

When the resistor's terminals and the resistive element are made of dissimilar metals and two junctions are at a different temperature, a voltage is produced which is called "thermal EMF".

The level of voltage output is a function of the metals involved and the differential temperature. The voltage produced is either positive or negative depending on which junction is considered as a reference point. Virtually all resistive products have these metallic junctions. It is presumed they will eventually be terminated to copper as a final metallic combination and therefore copper is used as a typical reference material.

300144, 300145 have the lowest thermal EMF's because all junctions have low microvolts outputs. Moreover, construction of the resistive element is such that the input and output junctions of the resistor are so close that the temperature gradients between them is highly unlikely. These design factors produce a divider with very low thermal EMF.

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

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

## FEATURES

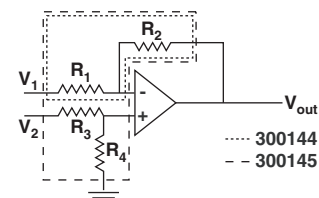
- Temperature coefficient of resistance (TCR) absolute:  $\pm 2$  ppm/°C typical (- 55 °C to + 125 °C, + 25 °C ref.)  
TCR tracking: 0.5 ppm/°C
- Tolerance: absolute and matching to 0.005 % (50 ppm)
- Power rating: 0.2 W at 70 °C, for the entire resistive element  $R_1$  and  $R_2$ , divided proportionally between the two values
- Load life ratio stability: < 0.005 % (50 ppm) 0.2 W at 70 °C for 2000 h
- Maximum working voltage: 200 V
- Resistance range: 100R to 20K per resistive element
- Vishay Foil resistors are not restricted to standard values/ratios; specific "as requested" values/ratios can be supplied at no extra cost or delivery (e.g. 1K2345 vs. 1K)
- Electrostatic discharge (ESD) up to 25 000 V
- Non-inductive, non-capacitive design
- Rise time: 1 ns effectively no ringing
- Thermal stabilization time < 1 s (nominal value achieved within 10 ppm of steady state value)
- Current noise: 0.010  $\mu V_{RMS}/V$  of applied voltage (< - 40 dB)
- Thermal EMF: 0.05  $\mu V/°C$  typical
- Voltage coefficient: < 0.1 ppm/V
- Non inductive: < 0.08  $\mu H$
- Non hot spot design
- Terminal finish: lead (Pb)-free or tin/lead alloy
- Compliant to RoHS directive 2002/95/EC
- Prototype quantities available in just 5 working days or sooner. For more information, please contact [foil@vishaypg.com](mailto:foil@vishaypg.com)
- For better performances see 300144Z, 300145Z (Z-Foil) datasheet



**RoHS\***  
COMPLIANT

## APPLICATIONS

- Instrumentation amplifiers
- Bridge networks
- Differential amplifiers
- Military
- Space
- Medical
- Automatic test equipment
- Down-hole (high temperature)



**TABLE 1A - MODELS 300144 AND 300145 SPECIFICATIONS**

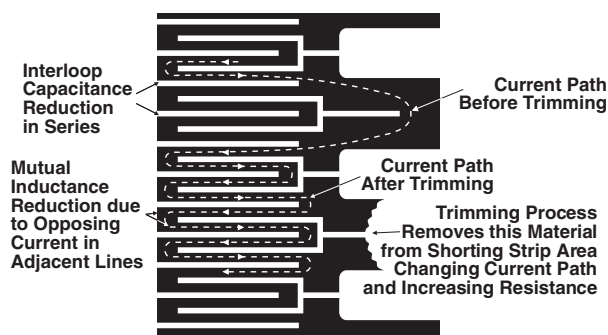
| RESISTANCE VALUES | ABSOLUTE TOLERANCE | ABSOLUTE TCR<br>(-55 °C to +125 °C,<br>+25 °C ref.) |
|-------------------|--------------------|-----------------------------------------------------|
|                   |                    | TYPICAL AND MAX. SPREAD                             |
| ≥ 500 Ω to 20 kΩ  | ± 0.005 %          | ± 2 ppm/°C ± 3 ppm/°C                               |
| 100 Ω to < 500 Ω  | ± 0.01 %           |                                                     |

**Note**

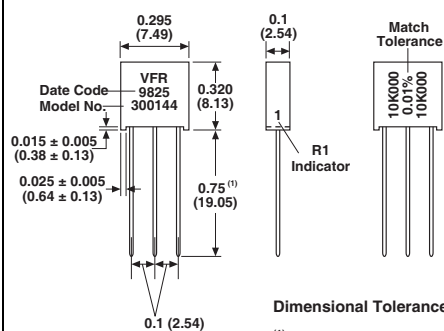
- See table 3 for additional established ratios

**TABLE 1B - MODELS 300144 AND 300145 SPECIFICATIONS**

| RESISTANCE RATIO | TOLERANCE MATCH | TCR TRACKING MAX. |
|------------------|-----------------|-------------------|
| 1:1              | 0.005 %         | 0.5 ppm/°C        |
| > 1:1 to 4:1     |                 | 1.0 ppm/°C        |
| > 4:1 to 10:1    | 0.01 %          | 1.5 ppm/°C        |
| > 10:1           |                 | 2.0 ppm/°C        |

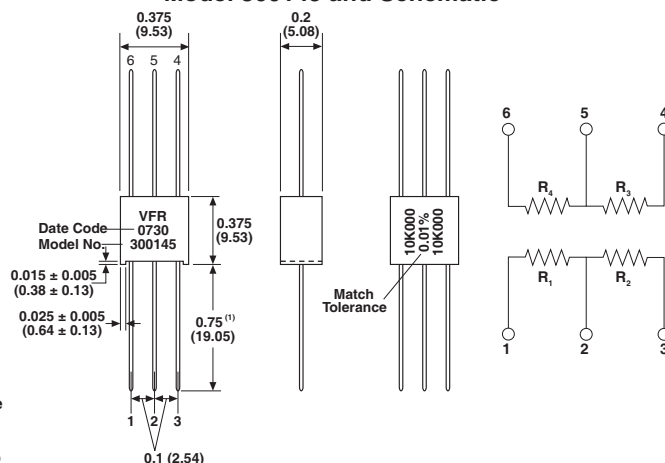
**FIGURE 1 - TRIMMING TO VALUES** (conceptual illustration)

Note: Foil shown in black, etched spaces in white

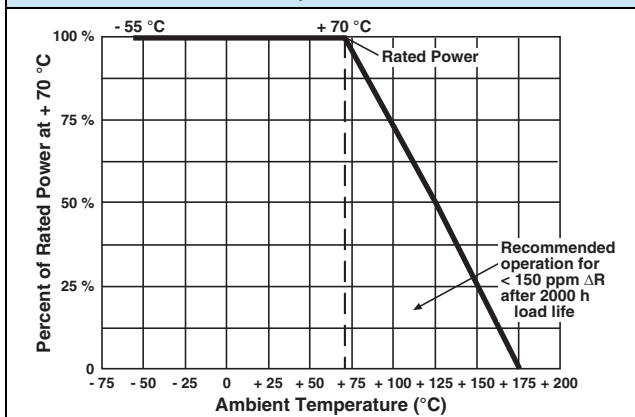
**FIGURE 2 - STANDARD PRINTING AND DIMENSIONS** in inches (millimeters)**Model 300144 and Schematic (2)**

Dimensional Tolerance: ± 0.010" (0.25)

- (1) Lead wires: #22 AWG solder coated copper, 0.75" minimum length
- (2) Each divider pair consists of two resistors on one single chip
- (3) For model 300145 the 2 chips are independent and with no special relationship from chip to chip

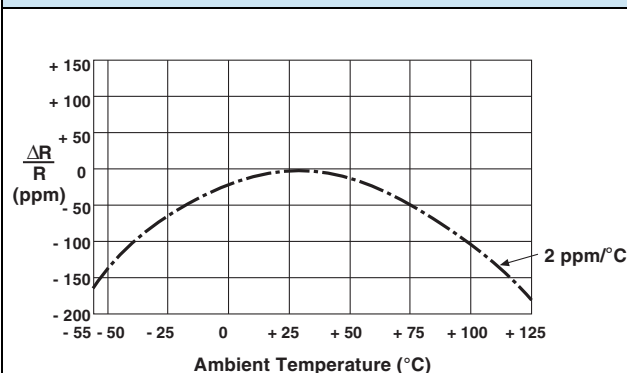
**Model 300145 and Schematic (2)(3)**

**FIGURE 3 - POWER DERATING CURVE  
300144, 300145**



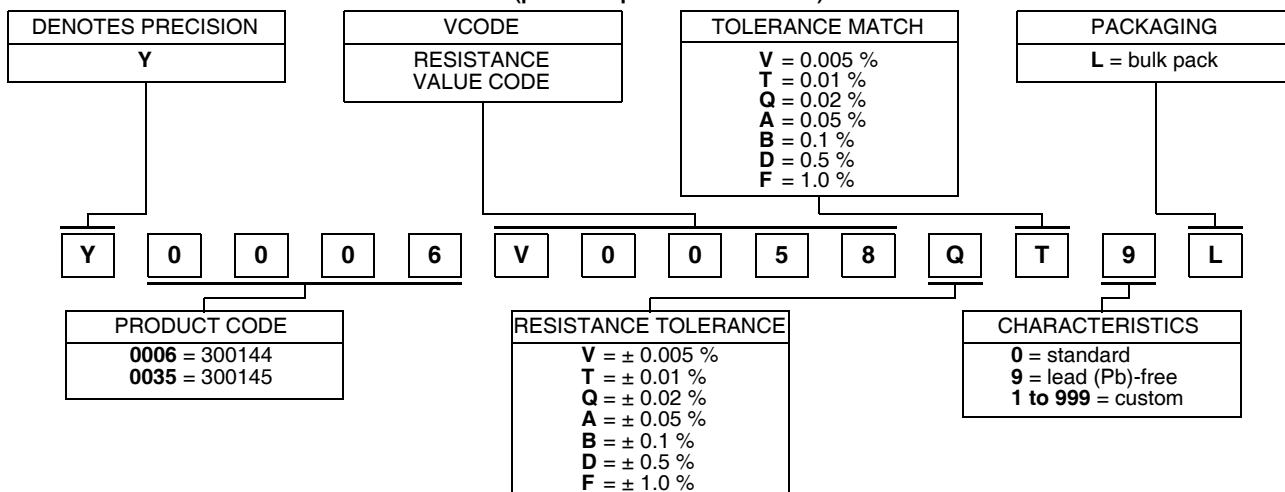
**Note:** Power is divided proportionally between the 2 values

**FIGURE 4 - TYPICAL RESISTANCE/  
TEMPERATURE CURVE**



**TABLE 2 - GLOBAL PART NUMBER INFORMATION (1)**

**NEW GLOBAL PART NUMBER: Y0006V0058QT9L (preferred part number format)**



FOR EXAMPLE: ABOVE GLOBAL ORDER Y0006 V0058 Q T 9 L:

TYPE: 300144  
VALUES: 2K/20K  
ABSOLUTE TOLERANCE: ± 0.02 %  
TOLERANCE MATCH: 0.01 %  
TERMINATION: lead (Pb)-free  
PACKAGING: bulk pack

**HISTORICAL PART NUMBER: 300144T 2K/20K TCR2 Q T B (will continue to be used)**

| 300144           | T                                           | 2K/20K                                                                                                            | TCR2               | Q                                                                                                          | T                                                                                            | B             |
|------------------|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------|--------------------|------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|---------------|
| MODEL            | TERMINATION                                 | OHMIC VALUE                                                                                                       | TCR CHARACTERISTIC | ABSOLUTE TOLERANCE                                                                                         | TOLERANCE MATCH                                                                              | PACKAGING     |
| 300144<br>300145 | T = lead (Pb)-free<br>None = tin/lead alloy | R <sub>1</sub> = 2 kΩ<br>R <sub>2</sub> = 20 kΩ<br>R <sub>3</sub> <sup>(2)</sup><br>R <sub>4</sub> <sup>(2)</sup> |                    | V = ± 0.005 %<br>T = ± 0.01 %<br>Q = ± 0.02 %<br>A = ± 0.05 %<br>B = ± 0.1 %<br>D = ± 0.5 %<br>F = ± 1.0 % | V = 0.005 %<br>T = 0.01 %<br>Q = 0.02 %<br>A = 0.05 %<br>B = 0.1 %<br>D = 0.5 %<br>F = 1.0 % | B = bulk pack |

**Notes**

(1) For non-standard requests, please contact application engineering

(2) For 300145 please specify the resistance value for each resistor even if all values are equal

**TABLE 3 - EXAMPLES OF VCODES FOR POPULAR VALUES** (other values available on request)

| 300144 RATIOS |                |                |        |                |                | 300145 RATIOS |                |                |                |                |
|---------------|----------------|----------------|--------|----------------|----------------|---------------|----------------|----------------|----------------|----------------|
| VCODES        | R <sub>1</sub> | R <sub>2</sub> | VCODES | R <sub>1</sub> | R <sub>2</sub> | VCODES        | R <sub>1</sub> | R <sub>2</sub> | R <sub>3</sub> | R <sub>4</sub> |
| V0009         | 20K            | 20K            | V0058  | 2K             | 20K            | V0008         | 10K            | 10K            | 10K            | 10K            |
| V0010         | 20K            | 10K            | V0030  | 2K             | 18K            | V0019         | 5K             | 5K             | 5K             | 5K             |
| V0100         | 20K            | 2K             | V0029  | 2K             | 4K             | V0092         | 1K             | 7K812          | 7K812          | 1K             |
| V0055         | 19K4           | 9K7            | V0059  | 2K             | 2K             | V0023         | 500R           | 500R           | 500R           | 500R           |
| V0223         | 17K5           | 20K            | V0103  | 2K             | 3K             | V0047         | 100R           | 8K8            | 100R           | 8K8            |
| V0097         | 15K            | 15K            | V0154  | 1K5            | 3K             | V0051         | 100R           | 10K            | 100R           | 10K            |
| V0001         | 10K            | 10K            | V0032  | 1K             | 16K            | V0051         | 100R           | 10K            | 100R           | 10K            |
| V0042         | 10K            | 8K323          | V0121  | 1K             | 2K             | V0227         | 350R           | 350R           | 350R           | 350R           |
| V0006         | 10K            | 2K             | V0004  | 1K             | 1K             | -             | -              | -              | -              | -              |
| V0166         | 10K            | 15K            | V0379  | 1K             | 7K             | -             | -              | -              | -              | -              |
| V0226         | 9K             | 10K            | V0374  | 800R           | 800R           | -             | -              | -              | -              | -              |
| V0003         | 9K             | 1K             | V0022  | 511R           | 16K2           | -             | -              | -              | -              | -              |
| V0013         | 8K             | 16K            | V0091  | 500R           | 500R           | -             | -              | -              | -              | -              |
| V0107         | 6K             | 20K            | V0162  | 500R           | 15K            | -             | -              | -              | -              | -              |
| V0014         | 6K             | 7K             | V0378  | 500R           | 4K5            | -             | -              | -              | -              | -              |
| V0160         | 6K             | 6K             | V0061  | 300R           | 300R           | -             | -              | -              | -              | -              |
| V0159         | 5K5            | 7K7            | V0088  | 100R           | 100R           | -             | -              | -              | -              | -              |
| V0005         | 5K             | 10K            | V0380  | 100R           | 15K            | -             | -              | -              | -              | -              |
| V0002         | 5K             | 5K             | V0375  | 100R           | 12K3           | -             | -              | -              | -              | -              |
| V0373         | 4K             | 12K            | V0381  | 100R           | 50R            | -             | -              | -              | -              | -              |
| V0026         | 3K             | 19K2           | V0377  | 50R            | 28K            | -             | -              | -              | -              | -              |
| V0156         | 3K             | 6K             | V0376  | 35R            | 20K            | -             | -              | -              | -              | -              |
| V0158         | 2K7            | 10K            | -      | -              | -              | -             | -              | -              | -              | -              |

**Note**

- A combination of these values are available in reverse order and in values up to 5 digits

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