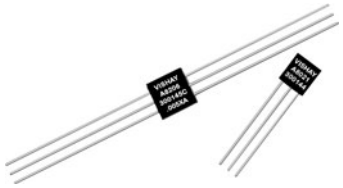
Bulk Metal® Foil Technology High Precision Voltage Divider Resistors with TCR Tracking to 0.5 ppm/°C and Tolerance Match to 0.005 % (50 ppm)



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 then 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.

FEATURES

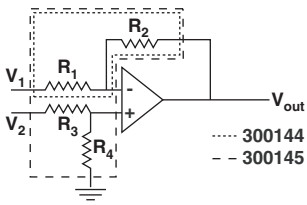
Pb-free Available

RoHS* COMPLIANT

- Temperature coefficient of resistance (TCR) absolute: ± 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 µV/°C typical
- Voltage coefficient: < 0.1 ppm/V
- Non inductive: < 0.08 µH
- 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
- For better performances see 300144Z, 300145Z (Z-Foil) datasheet

APPLICATIONS

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



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

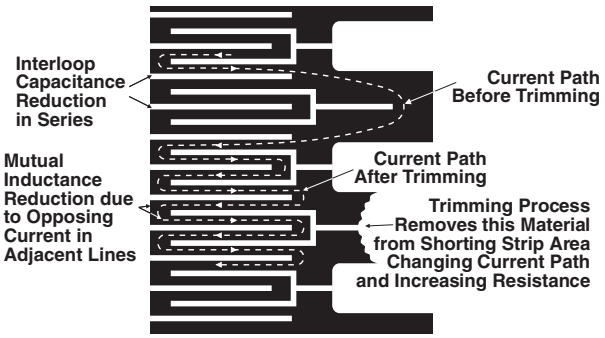
TABLE 1A - MODELS 300144 AND 300145 SPECIFICATIONS		
RESISTANCE VALUES	ABSOLUTE TOLERANCE	ABSOLUTE TCR (-55 °C to +125 °C, +25 °C ref.) TYPICAL AND MAX. SPREAD
≥ 500 Ω to 20 kΩ	± 0.005 %	± 2 ppm/°C ± 3 ppm/°C
100 Ω to < 500 Ω	± 0.01 %	

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

Note

- See table 3 for additional established ratios

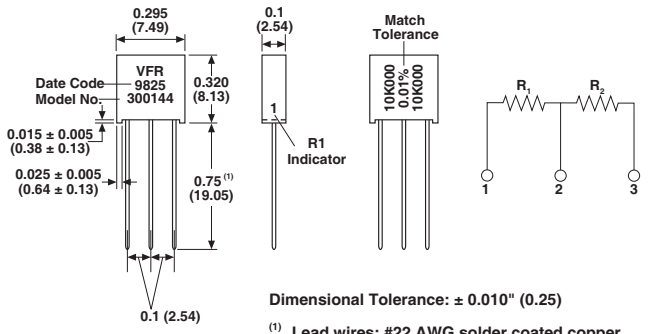
FIGURE 1 - TRIMMING TO VALUES (conceptual illustration)



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)

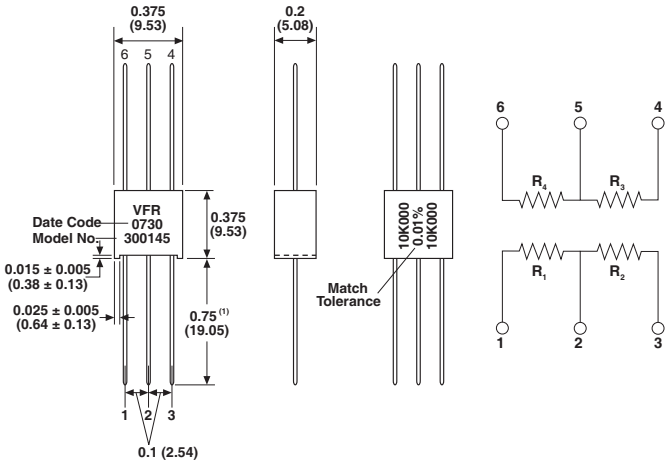


FIGURE 3 - POWER DERATING CURVE 300144, 300145

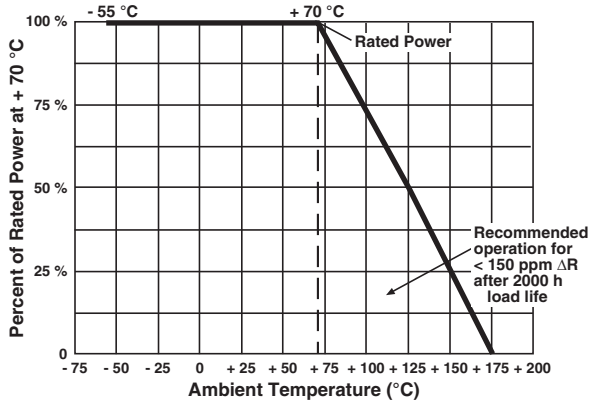
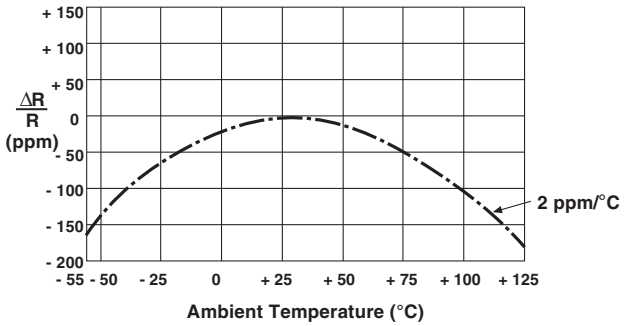


FIGURE 4 - TYPICAL RESISTANCE/ TEMPERATURE CURVE



Note: Power is divided proportionally between the 2 values

TABLE 2 - GLOBAL PART NUMBER INFORMATION (1)

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

DENOTES PRECISION	VCODE	TOLERANCE MATCH	PACKAGING
Y	RESISTANCE VALUE CODE	**V** = 0.005 % **T** = 0.01 % **Q** = 0.02 % **A** = 0.05 % **B** = 0.1 % **D** = 0.5 % **F** = 1.0 %	**L** = bulk pack

Y	0	0	0	6	V	0	0	5	8	Q	T	9	L

PRODUCT CODE	RESISTANCE TOLERANCE	CHARACTERISTICS
0006 = 300144 **0035** = 300145	**V** = ± 0.005 % **T** = ± 0.01 % **Q** = ± 0.02 % **A** = ± 0.05 % **B** = ± 0.1 % **D** = ± 0.5 % **F** = ± 1.0 %	**0** = standard **9** = lead (Pb)-free **1 to 999** = custom

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 **300145**	**T** = lead (Pb)-free **None** = tin/lead alloy	R_1 = 2 kΩ R_2 = 20 kΩ R_3 (2) R_4 (2)		**V** = ± 0.005 % **T** = ± 0.01 % **Q** = ± 0.02 % **A** = ± 0.05 % **B** = ± 0.1 % **D** = ± 0.5 % **F** = ± 1.0 %	**V** = 0.005 % **T** = 0.01 % **Q** = 0.02 % **A** = 0.05 % **B** = 0.1 % **D** = 0.5 % **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_1	R_2	VCODES	R_1	R_2	VCODES	R_1	R_2	R_3	R_4
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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