



VISHAY INTERTECHNOLOGY, INC.

# INTERACTIVE

## data book

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## VISHAY DALE THIN FILM PRODUCTS


VISHAY DALE THIN FILM

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VSE-DB0024-1206

### Notes:

1. To navigate:
  - a) Click on the Vishay logo on any datasheet to go to the Contents page for that section. Click on the Vishay logo on any Contents page to go to the main Table of Contents page.
  - b) Click on the products within the Table of Contents to go directly to the datasheet.
  - c) Use the scroll or page up/page down functions.
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One of the World's Largest Manufacturers of  
**Discrete Semiconductors and Passive Components**



**RESISTORS**

Vishay Dale Thin Film



Vishay Intertechnology, Inc.



## Vishay Dale Thin Film Products Data Book

- Surface Mount Networks
- Surface Mount Chips
- Through Hole Networks
- RC Networks
- Prototyping

One of the World's Largest Manufacturers of  
**Discrete Semiconductors and Passive Components**

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### SEMICONDUCTORS

#### MOSFETS AND ICs

- MOSFETs
  - Low-Voltage TrenchFET® Power MOSFETs
  - Medium-Voltage TrenchFET® Power MOSFETs
  - High-Voltage Planar MOSFETs
  - High-Voltage Super Junction MOSFETs
- ICs
  - Power ICs
  - Analog Switches

#### DIODES

- Rectifiers
  - Schottky Rectifiers
  - Ultra-Fast Recovery Rectifiers
  - Standard and Fast Recovery Rectifiers
  - High-Power Rectifiers/Diodes
- Small-Signal Diodes
  - Schottky and Switching Diodes
  - Zener Diodes
  - Tuner/Capacitance Diodes
  - Bandswitching Diodes
  - RF PIN Diodes
- Protection Diodes
  - TVS Diodes or TRANSZORB®  
(uni-directional, bi-directional)
  - ESD Protection Diodes (including arrays)

- Thyristors/SCRs
  - Phase-Control Thyristors
  - Fast Thyristors
- Power Modules
  - Input Modules  
(diodes and thyristors)
  - Output and Switching Modules  
(contain MOSFETs, IGBTs, and diodes)
  - Custom Modules

#### OPTOELECTRONICS

- Infrared Emitters and Detectors
- Optical Sensors
- Infrared Remote Control Receivers
- Optocouplers
  - Phototransistor, Photodarlington
  - Linear
  - Phototriac
  - High-Speed
  - IGBT and MOSFET Driver
- Solid-State Relays
- LEDs and 7-Segment Displays
- Infrared Data Transceiver Modules
- Custom Products

### PASSIVE COMPONENTS

#### RESISTORS

- Film Resistors
  - Metal Film Resistors
  - Thin Film Resistors
  - Thick Film Resistors
  - Metal Oxide Film Resistors
  - Carbon Film Resistors
- Wirewound Resistors
- Power Metal Strip® Resistors
- Chip Fuses
- Variable Resistors
  - Cermet Variable Resistors
  - Wirewound Variable Resistors
  - Conductive Plastic Variable Resistors
- Networks/Arrays
- Non-Linear Resistors
  - NTC Thermistors
  - PTC Thermistors
  - Varistors

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- Inductors
- Transformers

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- Tantalum Capacitors
  - Molded Chip Tantalum Capacitors
  - Coated Chip Tantalum Capacitors
  - Solid Through-Hole Tantalum Capacitors
  - Wet Tantalum Capacitors
- Ceramic Capacitors
  - Multilayer Chip Capacitors
  - Disc Capacitors
- Film Capacitors
- Power Capacitors
- Heavy-Current Capacitors
- Aluminum Capacitors

# Vishay Dale

## Thin Film Products

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**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**



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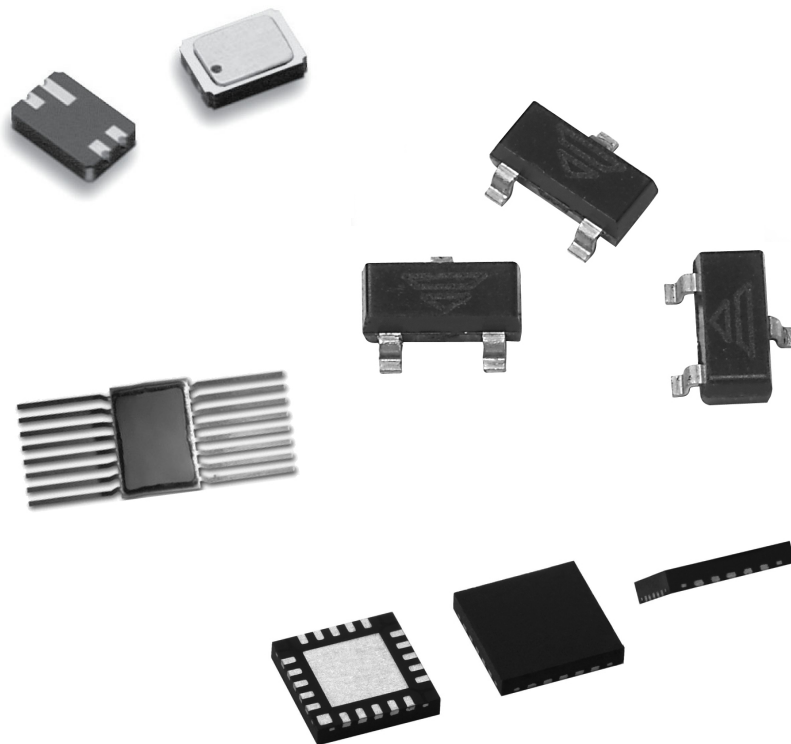
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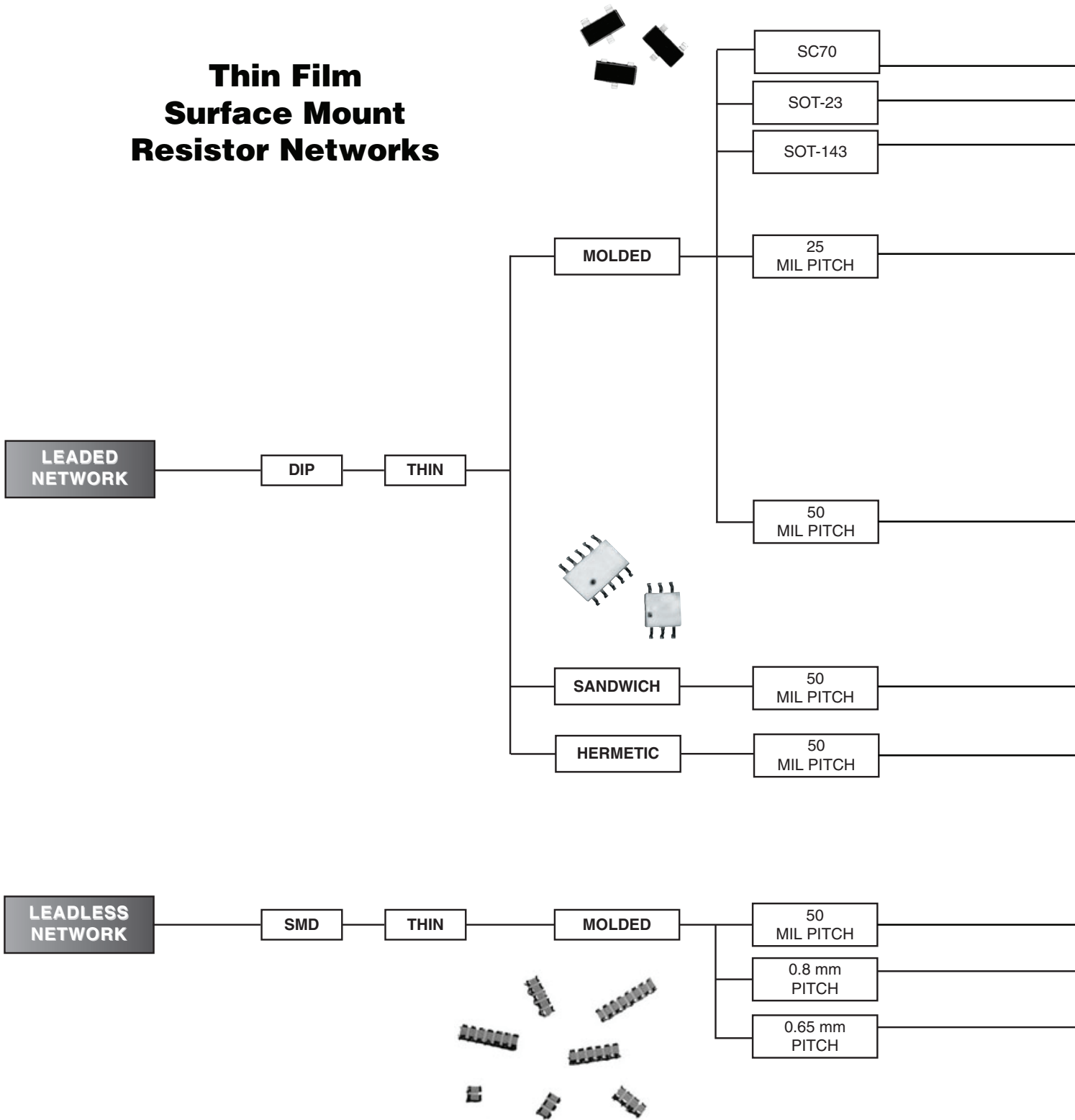
# Surface Mount Networks

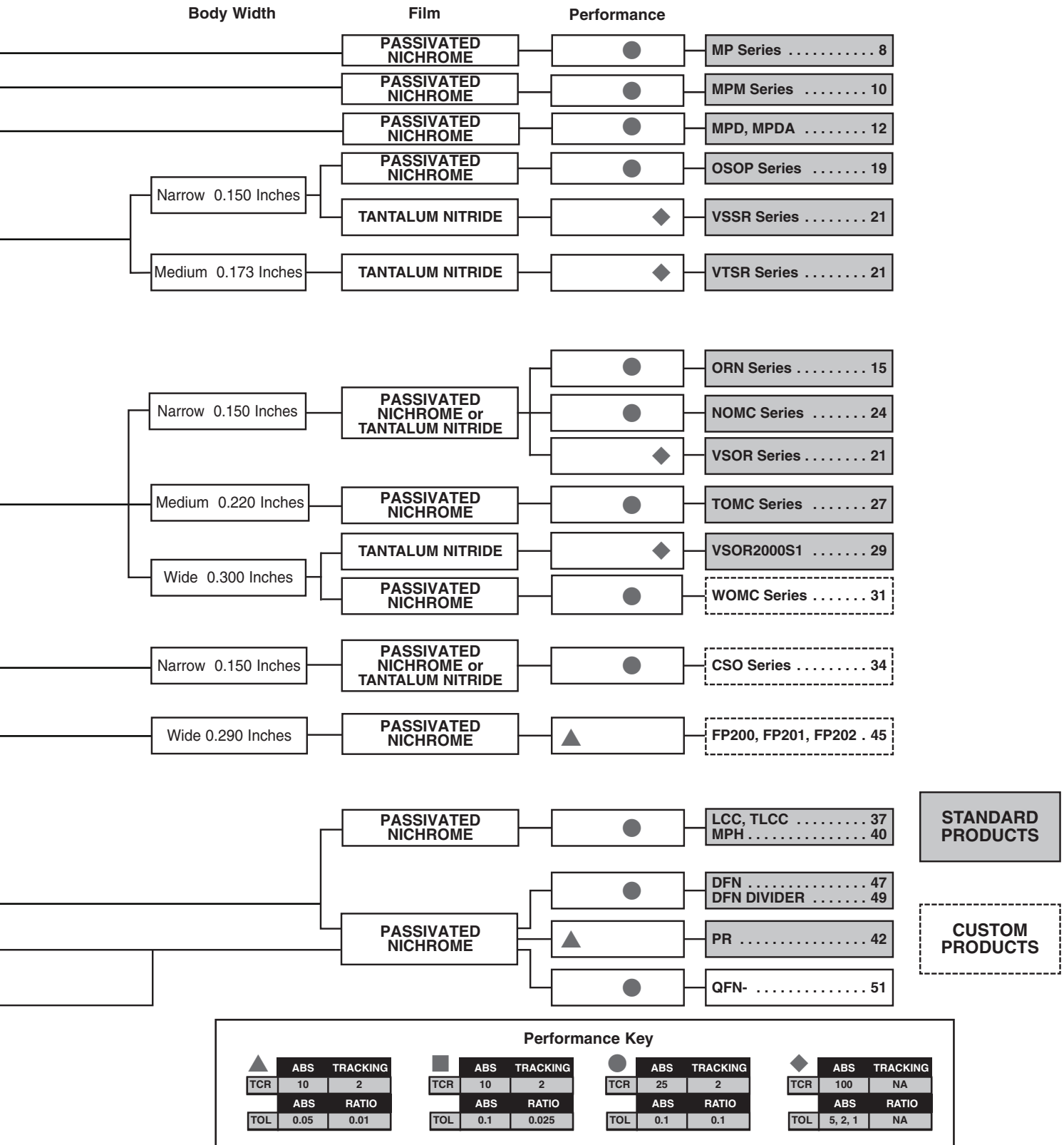


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# Thin Film Surface Mount Resistor Networks

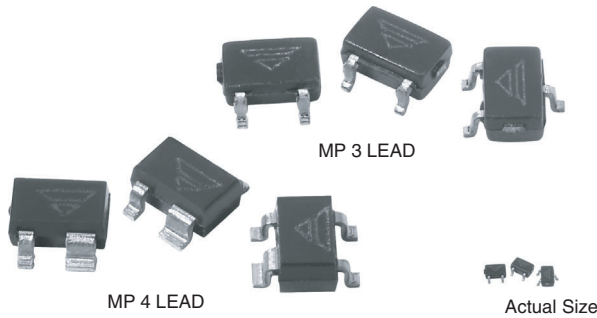




STANDARD PRODUCTS

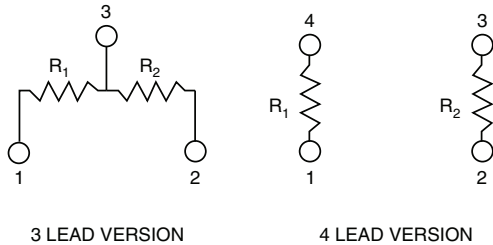
CUSTOM PRODUCTS

# Molded, SC70 Thin Film Resistor, Surface Mount Network



Vishay Dale Thin Film MP Series Dividers provide  $\pm 2$  ppm/ $^{\circ}\text{C}$  tracking and a ratio tolerance as tight as  $\pm 0.05\%$ , ultra small size, 3 or 4 lead package and exceptional stability for all surface mount applications. The standard SC70 package format with common standard resistance values provide easy selection for most applications requiring matched pair resistor elements. If you require a non-standard ratio, consult the applications engineering group as we may be able to meet your requirements.

## SCHEMATIC



## FEATURES

- Small physical size EIAJ SC70 format
- Tight resistance ratio tolerances  $\pm 0.05\%$
- Low TCR tracking  $\pm 2$  ppm
- Excellent long term ratio stability ( $\Delta R \pm 0.015\%$  at  $70^{\circ}\text{C}$  for 2000 h)
- Center-tapped or isolated matched pair resistors
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



**RoHS\***  
COMPLIANT  
HALOGEN  
**FREE**

## Note

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

## TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
TCR	25	2
	ABSOLUTE	RATIO
TOL.	0.1	0.05

## STANDARD RESISTANCE VALUES

TYPE	STANDARD VALUES	
	R <sub>1</sub> ( $\Omega$ )	R <sub>2</sub> ( $\Omega$ )
MP3	500	500
	1K	1K
	10K	10K
MP4	1K	1K
	10K	10K
	50K	50K

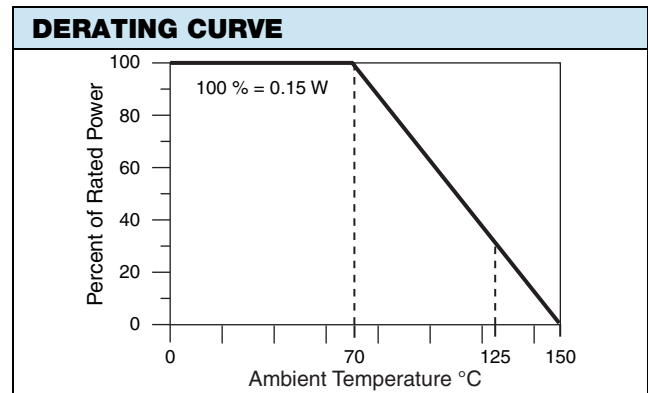
## STANDARD ELECTRICAL SPECIFICATIONS

TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	3, 4	-
Resistance Range	100 $\Omega$ to 50 k $\Omega$ per resistor	-
TCR: Absolute	$\pm 25$ ppm/ $^{\circ}\text{C}$	- 55 $^{\circ}\text{C}$ to + 125 $^{\circ}\text{C}$
TCR: Tracking	$\pm 2$ ppm/ $^{\circ}\text{C}$ (typical)	- 55 $^{\circ}\text{C}$ to + 125 $^{\circ}\text{C}$
Tolerance: Absolute	$\pm 0.10\%$ to $\pm 1.0\%$	+ 25 $^{\circ}\text{C}$
Tolerance: Ratio	$\pm 0.05\%$ (standard), $\pm 1.0\%$	-
Power Rating: Resistor	0.075 W	Maximum at + 70 $^{\circ}\text{C}$
Power Rating: Package	0.150 W	Maximum at + 70 $^{\circ}\text{C}$
Stability: Absolute	$\Delta R \pm 0.05\%$	2000 h at + 70 $^{\circ}\text{C}$
Stability: Ratio	$\Delta R \pm 0.015\%$	2000 h at + 70 $^{\circ}\text{C}$
Voltage Coefficient	0.1 ppm/V	-
Working Voltage	100 V max. not to exceed $\sqrt{P \times R}$	-
Operating Temperature Range	- 55 $^{\circ}\text{C}$ to + 125 $^{\circ}\text{C}$	-
Storage Temperature Range	- 55 $^{\circ}\text{C}$ to + 150 $^{\circ}\text{C}$	-
Noise	< - 30 dB	-
Thermal EMF	0.1 $\mu\text{V}/^{\circ}\text{C}$	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01\%$	1 year at + 25 $^{\circ}\text{C}$
Shelf Life Stability: Ratio	$\Delta R \pm 0.002\%$	1 year at + 25 $^{\circ}\text{C}$



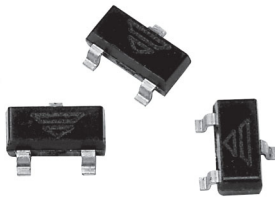
DIMENSIONS AND IMPRINTING in millimeters					
			<b>DIMENSION</b>	<b>MIN.</b>	<b>MAX.</b>
			A	0.800	1.100
			A1	0.000	0.100
			A2	0.800	1.000
			B	0.100	0.018
			b1	0.400	0.500
			b2	0.200	0.250
			D	1.800	2.200
			E	1.800	2.400
			E1	1.150	1.350
			e	1.300	-
			e2	0.650	-
			L	0.100	0.030

MECHANICAL SPECIFICATIONS	
Resistive Element	Passivated nichrome
Substrate Material	Silicon
Body	Molded epoxy
Terminals	Copper alloy
Lead (Pb)-free Option	100 % matte tin
Tin Lead Option	Sn85
Tin Lead and Lead (Pb)-free Finish	Plated



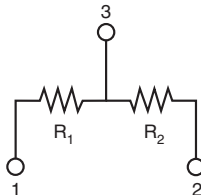
GLOBAL PART NUMBER INFORMATION											
New Global Part Numbering: <b>MP32001AWS</b>											
	M	P	3	2	0	0	1	A	W	S	
	M	P	T	4	2	0	0	1	B	T	1
GLOBAL MODEL (2 or 3 digits)	LEADS		RESISTANCE				TOLERANCE AND RATIO TOLERANCE		PACKAGING		
<b>MP</b> (Tin Lead)	3 4		The first 3 digits are significant figures and the last digit specifies the number of zeros to follow. When like values are required use total resistance.  Example: 2001 = 2K (1K/1K) 2002 = 20K (10K/10K)				Abs. Tol.    Ratio <b>A</b> = 0.1 %    0.05 % <b>B</b> = 0.1 %    0.1 % <b>C</b> = 0.25 %    0.1 % <b>D</b> = 0.5 %    0.1 % <b>F</b> = 1.0 %    0.5 %		<b>BS</b> = BULK 100 min., 1 mult <b>WS</b> = WAFFLE 100 min., 1 mult  TAPE AND REEL <b>T1</b> = 1000 min., 1000 mult <sup>(1)</sup>		
<b>MPT</b> (Lead (Pb)-free) (e3)									<b>Note</b> <sup>(1)</sup> Preferred packaging code		
Historical Part Number example: <b>MP32002BW</b> (for reference purposes only)											
<b>MP</b>	<b>3</b>	<b>2002</b>	<b>B</b>	<b>W</b>							
SERIES	LEADS	RESISTANCE	TOLERANCE AND RATIO TOLERANCE	PACKAGING							

# Molded, SOT-23 Thin Film Resistor, Surface Mount Network



Vishay Dale Thin Film MPM Series Dividers provide  $\pm 2$  ppm/ $^{\circ}$ C tracking and a ratio tolerance as tight as 0.01 %, small size, and exceptional stability for all surface mount applications. The standard SOT-23 package format with unity and common standard resistance divider ratios provide easy selection for most applications requiring matched pair resistor elements. The ratios listed are available for off the shelf delivery. If you require a non-standard ratio, consult the applications engineering group as we may be able to meet your requirements.

## SCHEMATIC



## FEATURES

- Excellent long term ratio stability ( $\Delta R \pm 0.015$  %, 2000 h, + 70  $^{\circ}$ C)
- Ratio tolerances to  $\pm 0.01$  %
- Low TCR tracking  $\pm 2$  ppm
- Standard JEDEC TO-236 package variation AB
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



**RoHS\***  
COMPLIANT  
HALOGEN  
**FREE**

## Note

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

## TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
TCR	25	2
	ABSOLUTE	RATIO
TOL.	0.1	0.05

## STANDARD DIVIDER RATIO ( $R_2/R_1$ )

RATIO	$R_2$ ( $\Omega$ )	$R_1$ ( $\Omega$ )
100:1	100K	1K
50:1	50K	1K
25:1	25K	1K
20:1	20K	1K
10:1	10K	1K
9:1	9K	1K
6:1	6K	1K
5:1	10K	2K
5:1	5K	1K
4:1	8K	2K
4:1	4K	1K
2:1	10K	5K
2:1	2K	1K
1:1	50K	50K
1:1	25K	25K
1:1	10K	10K
1:1	5K	5K
1:1	2.5K	2.5K
1:1	1K	1K
1:1	500	500
1:1	250	250

## STANDARD ELECTRICAL SPECIFICATIONS

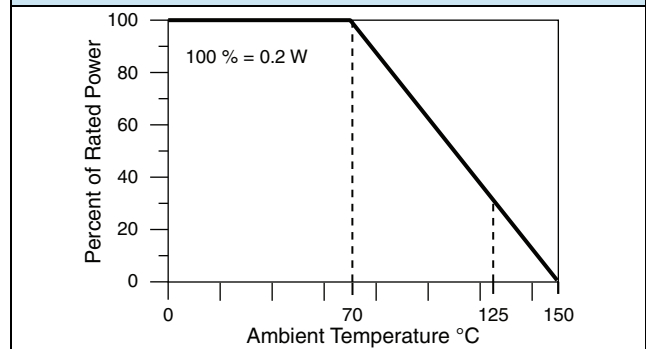
TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	3	-
Resistance Range	250 $\Omega$ to 100 k $\Omega$ per resistor	-
TCR: Absolute	$\pm 25$ ppm/ $^{\circ}$ C	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
TCR: Tracking	$\pm 2$ ppm/ $^{\circ}$ C (typical)	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
Tolerance: Absolute	$\pm 0.05$ % to $\pm 1.0$ %	+ 25 $^{\circ}$ C
Tolerance: Ratio	$\pm 0.01$ % to 0.5 %	+ 25 $^{\circ}$ C
Power Rating: Resistor	100 mW	Maximum at + 70 $^{\circ}$ C
Power Rating: Package	200 mW	Maximum at + 70 $^{\circ}$ C
Stability: Absolute	$\Delta R \pm 0.05$ %	2000 h at + 70 $^{\circ}$ C
Stability: Ratio	$\Delta R \pm 0.015$ %	2000 h at + 70 $^{\circ}$ C
Voltage Coefficient	0.1 ppm/V	-
Working Voltage	100 V max. not to exceed $\sqrt{P \times R}$	-
Operating Temperature Range	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C	-
Storage Temperature Range	- 55 $^{\circ}$ C to + 150 $^{\circ}$ C	-
Noise	< - 30 dB	-
Thermal EMF	0.2 $\mu$ V/ $^{\circ}$ C	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01$ %	1 year at + 25 $^{\circ}$ C
Shelf Life Stability: Ratio	$\Delta R \pm 0.002$ %	1 year at + 25 $^{\circ}$ C

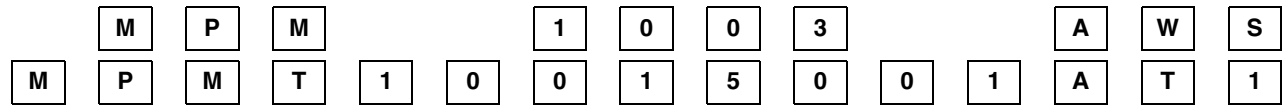
**DIMENSIONS AND IMPRINTING** in inches and millimeters

DIMENSION	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	0.031	0.040	0.79	1.02
A1	0.001	0.004	0.02	0.10
B	0.105	0.120	2.67	3.05
S	0.071	0.079	1.80	2.00
W	0.015	0.021	0.38	0.54
L	0.083	0.098	2.10	2.50
H	0.047	0.055	1.20	1.40
T	0.005	0.010	0.13	0.25
J	0.0035	0.0059	0.089	0.15
K	0.017	0.022	0.44	0.55
Ø	0	8°	0	8°

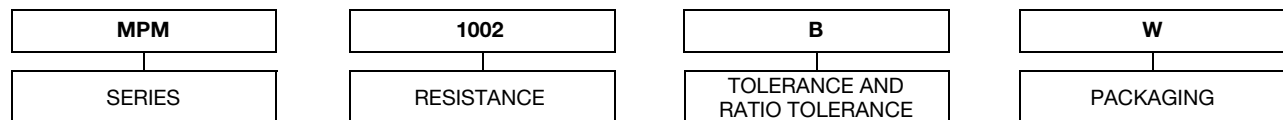
**MECHANICAL SPECIFICATIONS**

Resistive Element	Passivated nichrome
Substrate Material	Silicon
Body	Molded epoxy
Terminals	Copper alloy
Lead (Pb)-free Option	100 % matte tin
Tin Lead Option	Sn85
Tin Lead and Lead (Pb)-free Finish	Plated

**DERATING CURVE**

**GLOBAL PART NUMBER INFORMATION**

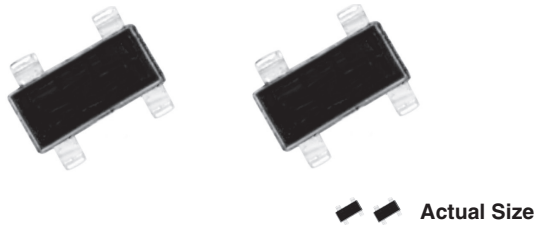
 New Global Part Numbering: **MPM1003AWS**


GLOBAL MODEL (3 or 4 digits)	RESISTANCE (4 or 8 digits)	TOLERANCE AND RATIO TOLERANCE	PACKAGING																
<b>MPM</b> (Tin lead)  <b>MPMT</b> (Lead (Pb)-free) (e3)	First 3 digits are significant figures and the last digit specifies the number of zeros to follow. When like values are required use total resistance. When dual values are required list both values.  Example: (List R <sub>1</sub> first in part number with dual values) 1002 = 10K (5K/5K) 1003 = 100K (50K/50K) 10011002 = 1K/10K divider	<table border="1"> <thead> <tr> <th>Abs. Tol.</th> <th>Ratio</th> </tr> </thead> <tbody> <tr> <td><b>A</b> = 0.1 %</td> <td>0.05 %</td> </tr> <tr> <td><b>B</b> = 0.1 %</td> <td>0.1 %</td> </tr> <tr> <td><b>C</b> = 0.25 %</td> <td>0.1 %</td> </tr> <tr> <td><b>D</b> = 0.5 %</td> <td>0.1 %</td> </tr> <tr> <td><b>F</b> = 1 %</td> <td>0.5 %</td> </tr> <tr> <td><b>Z</b> = 0.1 % <sup>(1)</sup></td> <td>0.025 %</td> </tr> <tr> <td><b>Q</b> = 0.05 % <sup>(1)</sup></td> <td>0.01 %</td> </tr> </tbody> </table>	Abs. Tol.	Ratio	<b>A</b> = 0.1 %	0.05 %	<b>B</b> = 0.1 %	0.1 %	<b>C</b> = 0.25 %	0.1 %	<b>D</b> = 0.5 %	0.1 %	<b>F</b> = 1 %	0.5 %	<b>Z</b> = 0.1 % <sup>(1)</sup>	0.025 %	<b>Q</b> = 0.05 % <sup>(1)</sup>	0.01 %	<b>BS</b> = BULK 100 min., 1 mult <b>WS</b> = WAFFLE 100 min., 1 mult  <b>TAPE AND REEL</b> <b>T0</b> = 100 min., 100 mult <b>T1</b> = 1000 min., 1000 mult <sup>(2)</sup> <b>T3</b> = 300 min., 300 mult <b>T5</b> = 500 min., 500 mult <b>TF</b> = Full reel 4000 <b>TS</b> = 100 min., 1 mult
Abs. Tol.	Ratio																		
<b>A</b> = 0.1 %	0.05 %																		
<b>B</b> = 0.1 %	0.1 %																		
<b>C</b> = 0.25 %	0.1 %																		
<b>D</b> = 0.5 %	0.1 %																		
<b>F</b> = 1 %	0.5 %																		
<b>Z</b> = 0.1 % <sup>(1)</sup>	0.025 %																		
<b>Q</b> = 0.05 % <sup>(1)</sup>	0.01 %																		

 Historical Part Number example: **MPM1002BW** (for reference purposes only)

**Notes**

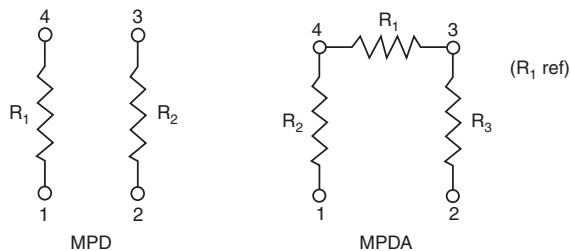
- (1) Tol. available 1K and up equal values only  
 (2) Preferred packaging code

## Molded, SOT-143 Thin Film Resistor, Surface Mount Network



Vishay Dale Thin Film MPD Series Dividers provide  $\pm 2$  ppm/ $^{\circ}\text{C}$  tracking and a ratio tolerance as tight as  $\pm 0.05\%$ , small size, and exceptional stability for all surface mount applications. The standard SOT-143 package format with unity and common standard resistance divider ratios provide easy selection for most applications requiring matched pair resistor elements. The ratios listed are available for off the shelf convenience, if you require a non-standard ratio, consult the applications engineering group as we may be able to meet your requirements.

### SCHEMATIC



### FEATURES

- Tight ratio tolerances to 0.05 %
- $\pm 2$  ppm tracking
- Standard values stocked
- Standard JEDEC TO-253 package
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



**RoHS\***  
COMPLIANT  
HALOGEN  
**FREE**

### Note

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

### TYPICAL PERFORMANCE

TCR	ABSOLUTE	TRACKING
	25	2
TOL.	ABSOLUTE	RATIO
	0.1	0.05

### STANDARD VALUES

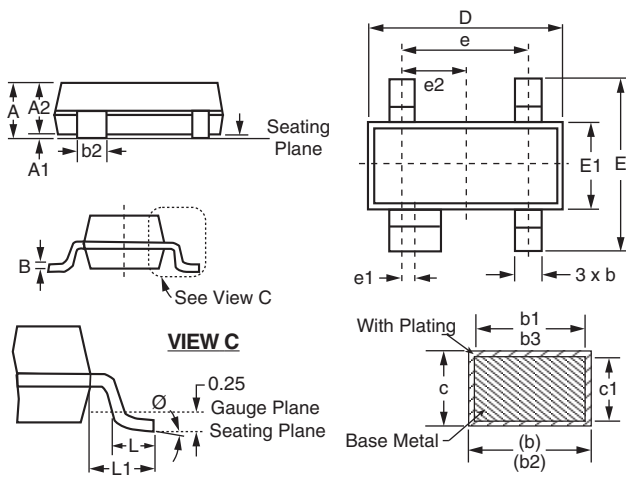
MODEL	R <sub>1</sub> ( $\Omega$ )	R <sub>2</sub> ( $\Omega$ )	R <sub>3</sub> ( $\Omega$ )
MPD	100K	100K	-
	50K	50K	-
	25K	25K	-
	20K	20K	-
	10K	10K	-
	5K	5K	-
	2K	2K	-
MPDA	1K	1K	-
	10K	10K	10K

### STANDARD ELECTRICAL SPECIFICATIONS

TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	4	-
Resistance Range	1000 $\Omega$ to 100 k $\Omega$ per resistor	-
TCR: Absolute	$\pm 25$ ppm/ $^{\circ}\text{C}$	- 55 $^{\circ}\text{C}$ to + 125 $^{\circ}\text{C}$
TCR: Tracking	$\pm 2$ ppm/ $^{\circ}\text{C}$ (typical)	- 55 $^{\circ}\text{C}$ to + 125 $^{\circ}\text{C}$
Tolerance: Absolute	$\pm 0.1\%$ to $\pm 1.0\%$	+ 25 $^{\circ}\text{C}$
Tolerance: Ratio	$\pm 0.05\%$ to $\pm 0.5\%$	+ 25 $^{\circ}\text{C}$
Power Rating: Resistor	100 mW	Maximum at + 70 $^{\circ}\text{C}$
Power Rating: Package	200 mW	Maximum at + 70 $^{\circ}\text{C}$
Stability: Absolute	$\Delta R \pm 0.05\%$	2000 h at + 70 $^{\circ}\text{C}$
Stability: Ratio	$\Delta R \pm 0.015\%$	2000 h at + 70 $^{\circ}\text{C}$
Voltage Coefficient	0.1 ppm/V	-
Working Voltage	100 V max. not to exceed $\sqrt{P \times R}$	-
Operating Temperature Range	- 55 $^{\circ}\text{C}$ to + 125 $^{\circ}\text{C}$	-
Storage Temperature Range	- 55 $^{\circ}\text{C}$ to + 150 $^{\circ}\text{C}$	-
Noise	< - 25 dB	-
Thermal EMF	0.2 $\mu\text{V}/^{\circ}\text{C}$	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01\%$	1 year at + 25 $^{\circ}\text{C}$
Shelf Life Stability: Ratio	$\Delta R \pm 0.002\%$	1 year at + 25 $^{\circ}\text{C}$

### Note

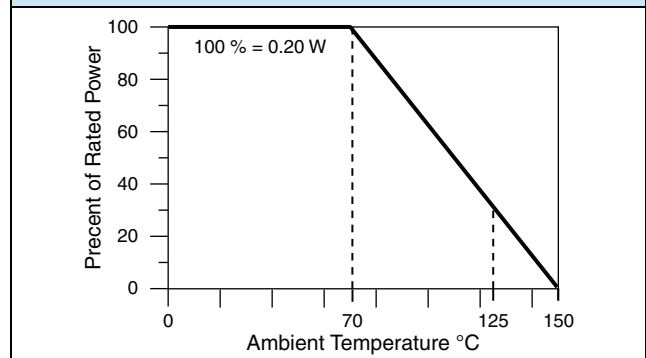
- Tantalum nitride film is available on special orders

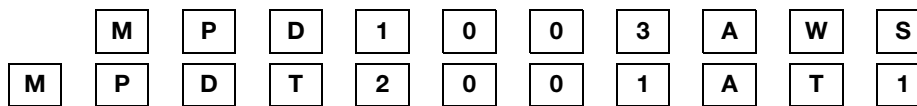
**DIMENSIONS AND IMPRINTING** in millimeters


DIMENSION	MIN.	NOM.	MAX.
A	0.80	-	1.22
A1	0.05	-	0.15
A2	0.75	0.90	1.07
b	0.30	-	0.50
b1	0.30	0.40	0.45
b2	0.76	-	0.89
b3	0.76	0.80	0.84
c	0.08	-	0.20
c1	0.08	0.10	0.16
D	2.80	2.90	3.04
E	2.10	-	2.64
E1	1.20	1.30	1.40
e	1.92 BSC		
e1	0.20 BSC		
L	0.40	0.50	0.60
L1	0.54 REF.		
N	4		
Ø	0"	-	8"

**MECHANICAL SPECIFICATIONS**

Resistive Element	Passivated nichrome
Substrate Material	Silicon
Body	Molded epoxy
Terminals	Copper alloy
Lead (Pb)-free Option	100 % matte tin
Tin Lead Option	Sn85
Tin Lead and Lead (Pb)-free Finish	Plated

**DERATING CURVE**

**GLOBAL PART NUMBER INFORMATION**

 New Global Part Numbering: **MPD1003AWS**


GLOBAL MODEL (3 or 4 digits)	RESISTANCE (4 or 8 digits)	TOLERANCE AND RATIO TOLERANCE	PACKAGING												
<b>MPD</b> (Two resistors, tin lead) <b>MPDT</b> (Two resistors, lead (Pb)-free) (e3)	The first 3 digits are significant figures and the last digit specifies the number of zeros to follow. When like values are required use total resistance.  Example: 1002 = 10K (5K/5K) 1003 = 100K (50K/50K)	<table border="1"> <thead> <tr> <th>Abs. Tol.</th> <th>Ratio</th> </tr> </thead> <tbody> <tr><td><b>A</b> = ± 0.1 %</td><td>± 0.05 %</td></tr> <tr><td><b>B</b> = ± 0.1 %</td><td>± 0.1 %</td></tr> <tr><td><b>C</b> = ± 0.25 %</td><td>± 0.1 %</td></tr> <tr><td><b>D</b> = ± 0.5 %</td><td>± 0.1 %</td></tr> <tr><td><b>F</b> = ± 1 %</td><td>± 0.5 %</td></tr> </tbody> </table>	Abs. Tol.	Ratio	<b>A</b> = ± 0.1 %	± 0.05 %	<b>B</b> = ± 0.1 %	± 0.1 %	<b>C</b> = ± 0.25 %	± 0.1 %	<b>D</b> = ± 0.5 %	± 0.1 %	<b>F</b> = ± 1 %	± 0.5 %	<b>BS</b> = BULK 100 min., 1 mult <b>WS</b> = WAFFLE 100 min., 1 mult  TAPE AND REEL <b>T1</b> = 1000 min., 1000 mult <sup>(1)</sup>
Abs. Tol.	Ratio														
<b>A</b> = ± 0.1 %	± 0.05 %														
<b>B</b> = ± 0.1 %	± 0.1 %														
<b>C</b> = ± 0.25 %	± 0.1 %														
<b>D</b> = ± 0.5 %	± 0.1 %														
<b>F</b> = ± 1 %	± 0.5 %														
<b>Historical Part Number example: MPD1002BW (for reference purposes only)</b>															
<table border="1"> <tr><td><b>MPD</b></td></tr> <tr><td>SERIES</td></tr> </table>	<b>MPD</b>	SERIES	<table border="1"> <tr><td><b>1002</b></td></tr> <tr><td>RESISTANCE</td></tr> </table>	<b>1002</b>	RESISTANCE	<table border="1"> <tr><td><b>B</b></td></tr> <tr><td>TOLERANCE AND RATIO TOLERANCE</td></tr> </table>	<b>B</b>	TOLERANCE AND RATIO TOLERANCE	<table border="1"> <tr><td><b>W</b></td></tr> <tr><td>PACKAGING</td></tr> </table>	<b>W</b>	PACKAGING				
<b>MPD</b>															
SERIES															
<b>1002</b>															
RESISTANCE															
<b>B</b>															
TOLERANCE AND RATIO TOLERANCE															
<b>W</b>															
PACKAGING															

**Note**
<sup>(1)</sup> Preferred packaging code

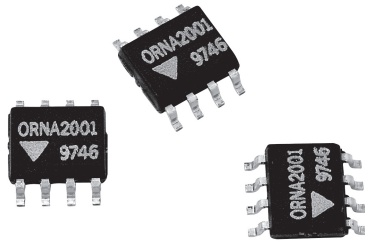


GLOBAL PART NUMBER INFORMATION															
<b>New Global Part Numbering: MPDAT3002AWS</b>															
M	P	D	A												
3	0	0	2												
A	W	S													
M	P	D	A												
T	3	0	0												
2	A	W	S												
<p><b>GLOBAL MODEL</b> (4 or 5 digits)</p> <p><b>MPDA</b> (Three equal series resistors, tin/lead)</p> <p><b>MPDAT</b> (Three equal series resistors, lead (Pb)-free) (e3)</p>	<p><b>RESISTANCE</b></p> <p>First 3 digits are significant figures and the last digit specifies the number of zeros to follow. When like values are required use total resistance.</p> <p style="text-align: center;">Example: 3002 = Three 10 kΩ resistors</p>	<p><b>TOLERANCE AND RATIO TOLERANCE</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left;">Abs. Tol.</th> <th style="text-align: left;">Ratio</th> </tr> <tr> <td><b>A</b> = ± 0.1 %</td> <td>± 0.05 %</td> </tr> <tr> <td><b>B</b> = ± 0.1 %</td> <td>± 0.1 %</td> </tr> <tr> <td><b>C</b> = ± 0.25 %</td> <td>± 0.1 %</td> </tr> <tr> <td><b>D</b> = ± 0.5 %</td> <td>± 0.5 %</td> </tr> <tr> <td><b>F</b> = ± 1 %</td> <td></td> </tr> </table>	Abs. Tol.	Ratio	<b>A</b> = ± 0.1 %	± 0.05 %	<b>B</b> = ± 0.1 %	± 0.1 %	<b>C</b> = ± 0.25 %	± 0.1 %	<b>D</b> = ± 0.5 %	± 0.5 %	<b>F</b> = ± 1 %		<p><b>PACKAGING</b></p> <p><b>BS</b> = BULK 100 min., 1 mult <b>WS</b> = WAFFLE 100 min., 1 mult</p> <p style="text-align: center;"><b>TAPE AND REEL</b></p> <p><b>T1</b> = 1000 min., 1000 mult <sup>(1)</sup></p>
Abs. Tol.	Ratio														
<b>A</b> = ± 0.1 %	± 0.05 %														
<b>B</b> = ± 0.1 %	± 0.1 %														
<b>C</b> = ± 0.25 %	± 0.1 %														
<b>D</b> = ± 0.5 %	± 0.5 %														
<b>F</b> = ± 1 %															
<b>Historical Part Number example: MPDA3002BT (for reference purposes only)</b>															
MPDA	3002	B	T												
SERIES	RESISTANCE	TOLERANCE AND RATIO TOLERANCE	PACKAGING												

**Note**

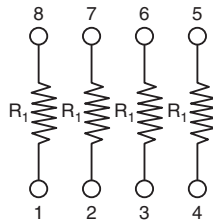
<sup>(1)</sup> Preferred packaging code

## Molded, 50 mil Pitch, Dual-In-Line Thin Film Resistor, Surface Mount Network


**Actual Size**

ORN series resistor networks feature four isolated resistors with standard 50 mil pitch lead spacing. The networks feature close TCR tracking and tight ratio tolerance and are ideally suited for unity gain operational amplifier circuitry. The standard resistance offering listed are available for immediate delivery.

### SCHEMATIC



### FEATURES

- 0.068" (1.73 mm) maximum seated height
- Rugged molded case construction with no internal solder
- Low temperature coefficient ( $\pm 25$  ppm/ $^{\circ}\text{C}$ )
- JEDEC MS-012 STD variation AA package
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



**RoHS\***  
COMPLIANT  
HALOGEN  
**FREE**

### Note

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

### TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
TCR	25	5
	ABSOLUTE	RATIO
TOL.	0.1	0.05

### STANDARD RESISTANCE OFFERING ( $R_1 =$ )

49.9 $\Omega$	10 k $\Omega$
100 $\Omega$	20 k $\Omega$
500 $\Omega$	50 k $\Omega$
1 k $\Omega$	100 k $\Omega$
2 k $\Omega$	200 k $\Omega$
4.99 k $\Omega$	500 k $\Omega$
5 k $\Omega$	

### Note

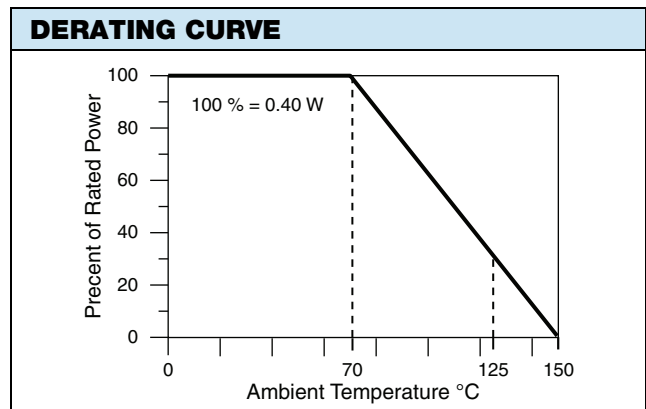
- Consult factory for additional values and schematics

STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	8	-
Resistance Range	33 $\Omega$ to 500 k $\Omega$ per resistor	-
TCR: Absolute	$\pm 25$ ppm/ $^{\circ}\text{C}$	- 55 $^{\circ}\text{C}$ to + 125 $^{\circ}\text{C}$
TCR: Tracking	$\pm 5$ ppm/ $^{\circ}\text{C}$	- 55 $^{\circ}\text{C}$ to + 125 $^{\circ}\text{C}$
Tolerance: Absolute	$\pm 0.05$ % to $\pm 1.0$ %	+ 25 $^{\circ}\text{C}$
Tolerance: Ratio	$\pm 0.01$ % to $\pm 0.5$ %	+ 25 $^{\circ}\text{C}$
Power Rating: Resistor	100 mW	Maximum at + 70 $^{\circ}\text{C}$
Power Rating: Package	400 mW	Maximum at + 70 $^{\circ}\text{C}$
Stability: Absolute	$\Delta R \pm 0.05$ %	2000 h at + 70 $^{\circ}\text{C}$
Stability: Ratio	$\Delta R \pm 0.015$ %	2000 h at + 70 $^{\circ}\text{C}$
Voltage Coefficient	0.1 ppm/V (typical)	-
Working Voltage	100 V max. not to exceed $\sqrt{P \times R}$	-
Operating Temperature Range	- 55 $^{\circ}\text{C}$ to + 125 $^{\circ}\text{C}$	-
Storage Temperature Range	- 55 $^{\circ}\text{C}$ to + 150 $^{\circ}\text{C}$	-
Noise	< - 30 dB	-
Thermal EMF	0.08 $\mu\text{V}/^{\circ}\text{C}$	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01$ %	1 year at + 25 $^{\circ}\text{C}$
Shelf Life Stability: Ratio	$\Delta R \pm 0.002$ %	1 year at + 25 $^{\circ}\text{C}$

DIMENSIONS AND IMPRINTING in inches and millimeters			
	<b>DIMENSION</b>	<b>INCHES</b>	<b>MILLIMETERS</b>
	A	0.157	3.99
	B	0.0165 ± 0.0025	0.4 ± 0.06
	C	0.050	1.27
	D	0.195 max.	4.93
	E	0.008 ± 0.001	0.20 ± 0.03
	F	0.028 ± 0.001	0.71 ± 0.02
	G	0.239 ± 0.005	6.07 ± 0.13
	H	0.068 max.	1.73
	I	0.008 ± 0.002	0.22 ± 0.06
	Ø	2° to 6°	2° to 6°

**Note**  
 • Marking - Vishay symbol, part number from ordering information

MECHANICAL SPECIFICATIONS	
Resistive Element	Passivated nichrome
Substrate Material	Silicon
Body	Molded epoxy
Terminals	Copper alloy
Lead (Pb)-free Option	100 % matte tin
Tin Lead Option	Sn90
Tin Lead and Lead (Pb)-free Finish	Plated

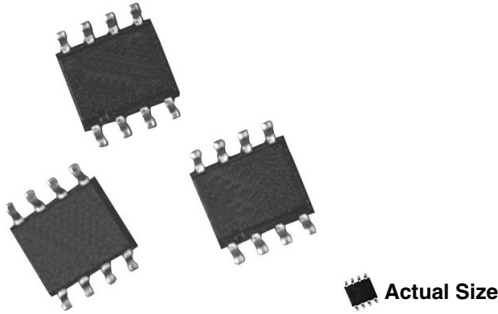


GLOBAL PART NUMBER INFORMATION																											
New Global Part Numbering: ORNA1002AUF																											
<table border="0" style="width: 100%; text-align: center;"> <tr> <td>O</td><td>R</td><td>N</td><td>A</td><td>1</td><td>0</td><td>0</td><td>2</td><td>A</td><td>U</td><td>F</td> </tr> <tr> <td>O</td><td>R</td><td>N</td><td>T</td><td>A</td><td>1</td><td>0</td><td>0</td><td>3</td><td>Z</td><td>T</td><td>S</td> </tr> </table>					O	R	N	A	1	0	0	2	A	U	F	O	R	N	T	A	1	0	0	3	Z	T	S
O	R	N	A	1	0	0	2	A	U	F																	
O	R	N	T	A	1	0	0	3	Z	T	S																
<b>GLOBAL MODEL</b> (3 or 4 digits)  <b>ORN</b> (Tin lead)  <b>ORNT</b> (Lead (Pb)-free) (e3)	<b>SCHEMATIC</b>  A = 4 isolated equal resistors	<b>RESISTANCE</b>  The first 3 digits are significant figures and the last digit specifies the number of zeros to follow. R designates the decimal point.  Example: 1002 = 10 kΩ 1003 = 100 kΩ 4991 = 4.99 kΩ 50R0 = 50 Ω	<b>TOLERANCE AND RATIO TOLERANCE</b>  Abs. Tol.      Ratio  <b>A</b> = ± 0.1 % <sup>(3)</sup> ± 0.05 % <b>B</b> = ± 0.1 %        ± 0.1 % <b>C</b> = ± 0.25 %       ± 0.1 % <b>D</b> = ± 0.5 %        ± 0.1 % <b>F</b> = ± 1 %            ± 0.5 % <b>Q</b> = ± 0.05 % <sup>(1)</sup> ± 0.01 % <b>Z</b> = ± 0.1 % <sup>(1)</sup> ± 0.025 %	<b>PACKAGING</b>  TAPE AND REEL <b>T0</b> = 100 min., 100 mult <b>T1</b> = 1000 min., 1000 mult <sup>(2)</sup> <b>T3</b> = 300 min., 300 mult <b>T5</b> = 500 min., 500 mult <b>TF</b> = Full reel 3000 <b>TS</b> = 100 min., 1 mult  <b>UF</b> = TUBED																							
Historical Part Number example: ORNA1001F (for reference purposes only)																											
<table border="1" style="margin: auto;"> <tr><td>ORN</td></tr> <tr><td>SERIES</td></tr> </table>	ORN	SERIES	<table border="1" style="margin: auto;"> <tr><td>A</td></tr> <tr><td>SCHEMATIC</td></tr> </table>	A	SCHEMATIC	<table border="1" style="margin: auto;"> <tr><td>1001</td></tr> <tr><td>RESISTANCE</td></tr> </table>	1001	RESISTANCE	<table border="1" style="margin: auto;"> <tr><td>F</td></tr> <tr><td>TOLERANCE AND RATIO TOLERANCE</td></tr> </table>		F	TOLERANCE AND RATIO TOLERANCE															
ORN																											
SERIES																											
A																											
SCHEMATIC																											
1001																											
RESISTANCE																											
F																											
TOLERANCE AND RATIO TOLERANCE																											

**Notes**  
 (1) Tol. available 1K and up  
 (2) Preferred packaging code  
 (3) Ratio tolerance available 250 Ω and up

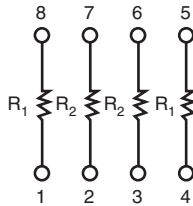


## Molded, 50 mil Pitch, Dual-In-Line Thin Film Divider, Surface Mount Resistor Network



Vishay Dale Thin Film ORN series Dividers provide optimum ratio precision, small size and exceptional stability for most applications. They offer a wide ratio range that is listed in the selection guide and are available for immediate delivery. The tight ratio tolerance offered on the standard ratios will provide exceptional performance throughout life.

### SCHEMATIC



### FEATURES

- 0.068" (1.73 mm) maximum seated height
- Rugged molded case construction with no internal solder (JEDEC MS-012 variation AA package)
- Low TCR tracking  $\pm 5$  ppm/ $^{\circ}\text{C}$
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



**RoHS\***  
COMPLIANT  
HALOGEN  
**FREE**

### Note

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

### TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
TCR	25	5
	ABSOLUTE	RATIO
TOL.	0.1	0.05

### STANDARD RESISTANCE OFFERING ( $R_1/R_2$ )

RATIO	$R_1$	$R_2$
100:1	100K	1K
50:1	50K	1K
25:1	25K	1K
20:1	20K	1K
10:1	10K	1K
5:1	10K	2K
2:1	10K	5K

### STANDARD ELECTRICAL SPECIFICATIONS

TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	8	-
Resistance Range	1000 $\Omega$ to 100 k $\Omega$ per resistor	-
TCR: Absolute	$\pm 25$ ppm/ $^{\circ}\text{C}$	- 55 $^{\circ}\text{C}$ to + 125 $^{\circ}\text{C}$
TCR: Tracking	$\pm 5$ ppm/ $^{\circ}\text{C}$	- 55 $^{\circ}\text{C}$ to + 125 $^{\circ}\text{C}$
Tolerance: Absolute	$\pm 0.1$ %	+ 25 $^{\circ}\text{C}$
Tolerance: Ratio	$\pm 0.05$ %	+ 25 $^{\circ}\text{C}$
Power Rating: Resistor	100 mW	Maximum at + 70 $^{\circ}\text{C}$
Power Rating: Package	400 mW	Maximum at + 70 $^{\circ}\text{C}$
Stability: Absolute	$\Delta R \pm 0.05$ %	2000 h at + 70 $^{\circ}\text{C}$
Stability: Ratio	$\Delta R \pm 0.015$ %	2000 h at + 70 $^{\circ}\text{C}$
Voltage Coefficient	< 0.1 ppm/V	-
Working Voltage	100 V max. not to exceed $\sqrt{P \times R}$	-
Operating Temperature Range	- 55 $^{\circ}\text{C}$ to + 125 $^{\circ}\text{C}$	-
Storage Temperature Range	- 55 $^{\circ}\text{C}$ to + 150 $^{\circ}\text{C}$	-
Noise	< - 30 dB	-
Thermal EMF	0.08 $\mu\text{V}/^{\circ}\text{C}$	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01$ %	1 year at + 25 $^{\circ}\text{C}$
Shelf Life Stability: Ratio	$\Delta R \pm 0.002$ %	1 year at + 25 $^{\circ}\text{C}$

### Note

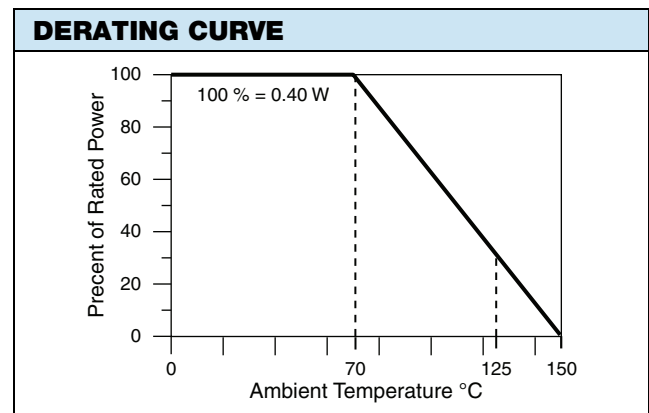
- Tantalum nitride film is custom, consult factory

DIMENSIONS AND IMPRINTING in inches and millimeters			
	<b>DIMENSION</b>	<b>INCHES</b>	<b>MILLIMETERS</b>
	A	0.157	3.99
	B	0.0165 ± 0.005	0.4 ± 0.06
	C	0.050	1.27
	D	0.195 max.	4.93
	E	0.008 ± 0.001	0.20 ± 0.03
	F	0.028 ± 0.001	0.71 ± 0.02
	G	0.239 ± 0.005	6.07 ± 0.13
	H	0.068 max.	1.73
	I	0.008 ± 0.002	0.22 ± 0.06
Ø	2° to 6°	2° to 6°	

**Note**

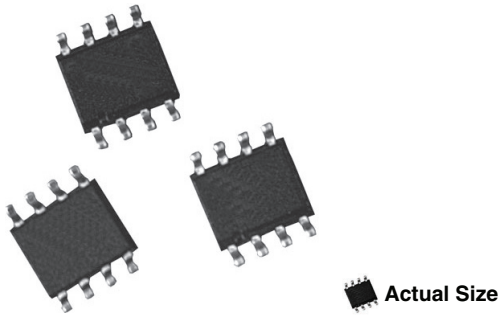
- Marking - Vishay symbol, part number from ordering information

MECHANICAL SPECIFICATIONS	
Resistive Element	Passivated nichrome
Substrate Material	Silicon
Body	Molded epoxy
Terminals	Copper alloy
Lead (Pb)-free Option	100 % matte tin
Tin Lead Option	Sn90
Tin Lead and Lead (Pb)-free Finish	Plated



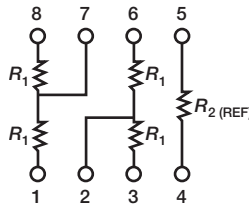
GLOBAL PART NUMBER INFORMATION												
New Global Part Numbering: ORNA5-1UF												
	O	R	N	A		5	-	1		U	F	
	O	R	N	T	A	1	0	0	-	1	U	F
GLOBAL MODEL (4 or 5 digits)	RESISTANCE (3, 4 or 5 digits)					PACKAGING						
ORNA (Tin/lead)	2-1 5-1 10-1 20-1 25-1 50-1 100-1					TAPE AND REEL T0 = 100 min., 100 mult T1 = 1000 min., 1000 mult T3 = 300 min., 300 mult T5 = 500 min., 500 mult TF = Full reel 3000 TS = 100 min., 1 mult						
ORNTA (Lead (Pb)-free) (e3)							UF = TUBED					
Historical Part Number example: ORNA2-1 (for reference purposes only)												
ORNA2-1	2:1	10K	5K	2								
PART NUMBER	DIVIDER NETWORK	R <sub>1</sub> VALUE	R <sub>2</sub> VALUE	R <sub>1</sub> /R <sub>2</sub> RATIO								

## Molded, 50 mil Pitch, Dual-In-Line Thin Film Divider, Surface Mount Resistor Network



Vishay Dale Thin Film ORNV series voltage dividers provide optimum ratio precision, small size and exceptional stability for most applications. They offer a wide ratio range that is listed in the selection guide and are available for immediate delivery. The tight ratio tolerance offered on the standard ratios will provide exceptional performance throughout life.

### SCHEMATIC



### FEATURES

- Close ratio tolerance (0.05 %)
- Tight TCR tracking  $\pm 5$  ppm/ $^{\circ}$ C
- 0.068" (1.73 mm) maximum seated height
- Rugged molded case construction with no internal solder (JEDEC MS-012 variation AA package)
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



### Note

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

### TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
TCR	25	5
	ABSOLUTE	RATIO
TOL.	0.1	0.05

### STANDARD RESISTANCE OFFERING

$R_1$ ( $\Omega$ ) (4 Voltage Divider Resistors)	$R_2$ ( $\Omega$ ) (Reference)
2K	2K
	5K
	10K
5K, 10K, 20K, 25K, 50K	5K
	10K
	20K
	25K
	50K

### Note

- Consult factory for additional values and schematics

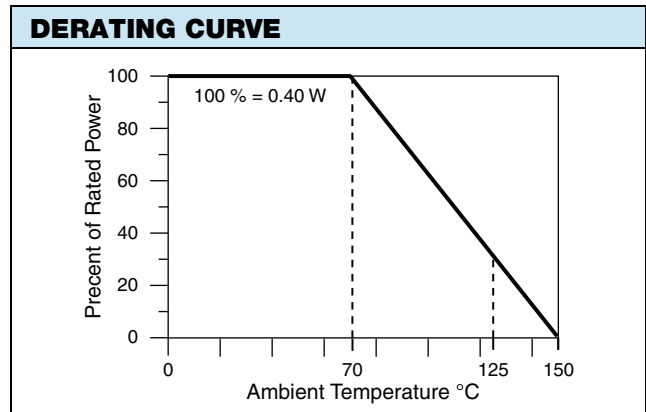
### STANDARD ELECTRICAL SPECIFICATIONS

TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	8	-
Resistance Range	2 k $\Omega$ to 50 k $\Omega$	-
TCR: Absolute	$\pm 25$ ppm/ $^{\circ}$ C	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
TCR: Tracking	$\pm 5$ ppm/ $^{\circ}$ C	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
Tolerance: Absolute	$\pm 0.1$ %	+ 25 $^{\circ}$ C
Tolerance: Ratio	$\pm 0.05$ %	+ 25 $^{\circ}$ C
Power Rating: Resistor	100 mW	Maximum at + 70 $^{\circ}$ C
Power Rating: Package	400 mW	Maximum at + 70 $^{\circ}$ C
Stability: Absolute	$\Delta R \pm 0.05$ %	2000 h at + 70 $^{\circ}$ C
Stability: Ratio	$\Delta R \pm 0.015$ %	2000 h at + 70 $^{\circ}$ C
Voltage Coefficient	< 0.1 ppm/V	-
Working Voltage	100 V max. not to exceed $\sqrt{P \times R}$	-
Operating Temperature Range	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C	-
Storage Temperature Range	- 55 $^{\circ}$ C to + 150 $^{\circ}$ C	-
Noise	< - 30 dB	-
Thermal EMF	0.08 $\mu$ V/ $^{\circ}$ C	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01$ %	1 year at + 25 $^{\circ}$ C
Shelf Life Stability: Ratio	$\Delta R \pm 0.002$ %	1 year at + 25 $^{\circ}$ C

DIMENSIONS AND IMPRINTING in inches and millimeters			
	<b>DIMENSION</b>	<b>INCHES</b>	<b>MILLIMETERS</b>
	A	0.157	3.99
	B	0.0165 ± 0.005	0.4 ± 0.06
	C	0.050	1.27
	D	0.195 max.	4.93
	E	0.008 ± 0.001	0.20 ± 0.03
	F	0.028 ± 0.001	0.71 ± 0.02
	G	0.239 ± 0.005	6.07 ± 0.13
	H	0.068 max.	1.73
	I	0.008 ± 0.002	0.22 ± 0.06
Ø	2° to 6°	2° to 6°	

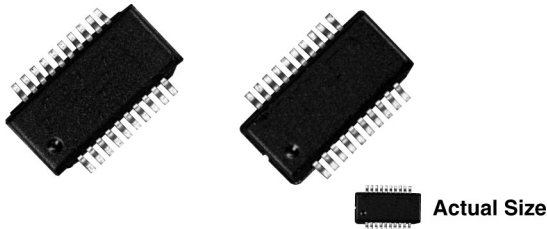
**Note**  
 • Marking - Vishay symbol, part number from ordering information

MECHANICAL SPECIFICATIONS	
Resistive Element	Passivated nichrome
Substrate Material	Silicon
Body	Molded epoxy
Terminals	Copper alloy
Lead (Pb)-free Option	100 % matte tin
Tin Lead Option	Sn90
Tin Lead and Lead (Pb)-free Finish	Plated



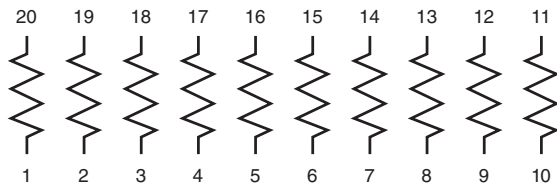
GLOBAL PART NUMBER INFORMATION															
New Global Part Numbering: ORNV50015001UF															
O	R	N	V	5	0	0	1	5	0	0	1	U	F		
O	R	N	T	V	5	0	0	1	5	0	0	1	U	F	
GLOBAL MODEL (4 or 5 digits)				RESISTANCE				(REF.) RESISTANCE				PACKAGING			
<b>ORNV</b> (Tin/lead)  <b>ORNTV</b> (Lead (Pb)-free) (e3)				<b>R<sub>1</sub></b> The first 3 digits are significant figures and the last digit specifies the number of zeros. Example: <b>5001 = 5 kΩ</b>				<b>R<sub>2</sub></b> The first 3 digits are significant figures and the last digit specifies the number of zeros. Example: <b>5001 = 5 kΩ</b>				TAPE AND REEL <b>T0</b> = 100 min., 100 mult <b>T1</b> = 1000 min., 1000 mult <b>T3</b> = 300 min., 300 mult <b>T5</b> = 500 min., 500 mult <b>TF</b> = Full reel 3000 <b>TS</b> = 100 min., 1 mult  <b>UF = TUBED</b>			

## Molded, 25 mil Pitch, Dual-In-Line Thin Film Resistor, Surface Mount Network



OSOP Series resistor networks feature a space saving 25 mil lead pitch versus the current 50 mil pitch standard. This allows users to reduce board space more than 50 % over current standards. The OSOP Series feature 10 isolated resistors in a 20 lead style available for immediate delivery in the standard values listed.

### SCHEMATIC



### FEATURES

- 0.068" (1.73 mm) maximum seated height
- Rugged molded case construction with no internal solder
- JEDEC MO-137 variation AD
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



**RoHS\***  
COMPLIANT  
HALOGEN  
**FREE**

### Note

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

### TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
TCR	25	5
	ABSOLUTE	RATIO
TOL.	0.1	0.05

### STANDARD RESISTANCE OFFERING (R<sub>1</sub> =)

500 Ω	10 kΩ
1 kΩ	20 kΩ
2 kΩ	50 kΩ
5 kΩ	100 kΩ

### Note

- Consult factory for additional values and schematics

STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	20	-
Resistance Range	500 Ω to 100 kΩ per resistor	-
TCR: Absolute	± 25 ppm/°C	- 55 °C to + 125 °C
TCR: Tracking	± 5 ppm/°C	- 55 °C to + 125 °C
Tolerance: Absolute	± 0.1 % to 1 %	+ 25 °C
Tolerance: Ratio	± 0.025 % to 0.5 %	+ 25 °C
Power Rating: Resistor	100 mW	Maximum at + 70 °C
Power Rating: Package	400 mW	Maximum at + 70 °C
Stability: Absolute	ΔR ± 0.05 %	2000 h at + 70 °C
Stability: Ratio	ΔR ± 0.015 %	2000 h at + 70 °C
Voltage Coefficient	< 0.1 ppm/V (typical)	-
Working Voltage	100 V max. not to exceed $\sqrt{P \times R}$	-
Operating Temperature Range	- 55 °C to + 125 °C	-
Storage Temperature Range	- 55 °C to + 150 °C	-
Noise	< - 30 dB	-
Thermal EMF	0.08 μV/°C	-
Shelf Life Stability: Absolute	ΔR ± 0.01 %	1 year at + 25 °C
Shelf Life Stability: Ratio	ΔR ± 0.002 %	1 year at + 25 °C

DIMENSIONS AND IMPRINTING in inches and millimeters			
	DIMENSION	INCHES	MILLIMETERS
	A	0.344	8.74
	B	0.154	3.91
	C	0.237	6.02
	D	0.025	0.635
	E	0.010 ± 0.002	0.25 ± 0.05
	F	0.062	1.58
	G	0.068	1.73
	H	0.010 ± 0.002	0.25 ± 0.05
	I	0.025	0.64
	J	0.057	1.47

MECHANICAL SPECIFICATIONS	
Resistive Element	Passivated nichrome
Substrate Material	Silicon
Body	Molded epoxy
Terminals	Copper alloy
Lead (Pb)-free Option	100 % matte tin
Tin Lead Option	Sn90
Tin Lead and Lead (Pb)-free Finish	Plated

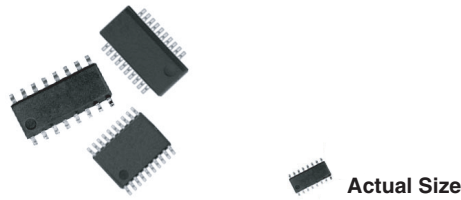
GLOBAL PART NUMBER INFORMATION																													
New Global Part Numbering: OSOPA1002BUF																													
<table border="0" style="width: 100%; text-align: center;"> <tr> <td>O</td><td>S</td><td>O</td><td>P</td><td>A</td><td>1</td><td>0</td><td>0</td><td>2</td><td>B</td><td>U</td><td>F</td> </tr> <tr> <td>O</td><td>S</td><td>O</td><td>P</td><td>T</td><td>A</td><td>1</td><td>0</td><td>0</td><td>3</td><td>A</td><td>T</td><td>1</td> </tr> </table>					O	S	O	P	A	1	0	0	2	B	U	F	O	S	O	P	T	A	1	0	0	3	A	T	1
O	S	O	P	A	1	0	0	2	B	U	F																		
O	S	O	P	T	A	1	0	0	3	A	T	1																	
GLOBAL MODEL (4 or 5 digits)	SCHEMATIC	RESISTANCE	TOLERANCE AND RATIO TOLERANCE	PACKAGING																									
<b>OSOP</b> (Tin Lead)  <b>OSOPT</b> (Lead (Pb)-free) (e3)	<b>A</b> = 10 nominally equal resistors with each resistor isolated from all others and wires directly across	First 3 digits are significant figures and the last digit specifies the number of zeroes to follow.  Example: 1002 = 10K 1003 = 100K	<table border="0"> <tr> <td>Abs. Tol.</td> <td>Ratio</td> </tr> <tr> <td><b>A</b> = 0.1 % <sup>(1)</sup></td> <td>0.05 %</td> </tr> <tr> <td><b>B</b> = 0.1 %</td> <td>0.1 %</td> </tr> <tr> <td><b>C</b> = 0.25 %</td> <td>0.1 %</td> </tr> <tr> <td><b>D</b> = 0.5 %</td> <td>0.1 %</td> </tr> <tr> <td><b>F</b> = 1 %</td> <td>0.5 %</td> </tr> <tr> <td><b>Z</b> = 0.1 % <sup>(1)</sup></td> <td>0.025 %</td> </tr> </table>	Abs. Tol.	Ratio	<b>A</b> = 0.1 % <sup>(1)</sup>	0.05 %	<b>B</b> = 0.1 %	0.1 %	<b>C</b> = 0.25 %	0.1 %	<b>D</b> = 0.5 %	0.1 %	<b>F</b> = 1 %	0.5 %	<b>Z</b> = 0.1 % <sup>(1)</sup>	0.025 %	TAPE AND REEL <b>T0</b> = 100 min., 100 mult <b>T1</b> = 1000 min., 1000 mult <sup>(2)</sup> <b>T3</b> = 300 min., 300 mult <b>T5</b> = 500 min., 500 mult <b>TF</b> = Full reel 2500 <b>TS</b> = 100 min., 1 mult  <b>UF</b> = TUBED											
Abs. Tol.	Ratio																												
<b>A</b> = 0.1 % <sup>(1)</sup>	0.05 %																												
<b>B</b> = 0.1 %	0.1 %																												
<b>C</b> = 0.25 %	0.1 %																												
<b>D</b> = 0.5 %	0.1 %																												
<b>F</b> = 1 %	0.5 %																												
<b>Z</b> = 0.1 % <sup>(1)</sup>	0.025 %																												
Historical Part Number example: OSOPA5000B (for reference purposes only)																													
OSOP	A	5000	B																										
SERIES	SCHEMATIC	RESISTANCE	TOLERANCE AND RATIO TOLERANCE																										

**Notes**
<sup>(1)</sup> Tolerance available 1K and up

<sup>(2)</sup> Preferred packaging code



### Molded, 25 mil or 50 mil Pitch, Dual-In-Line Thin Film Resistor, Surface Mount Network

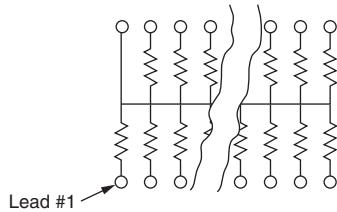


Vishay Dale Thin Film resistor networks are designed to be used in either analog or digital circuits. The use of thin film resistive elements within the network allows you to achieve an infinite number of very low noise and high stability circuits for industrial, medical and scientific instrumentation. Vishay Dale Thin Film resistor networks are packaged in molded plastic packages with sizes that are recognized throughout the world. The rugged packaging offers superior environmental protection and consistent dimensions for ease of placement with automatic SMT equipment. Vishay Dale Thin Film stocks many designs and values for off-the-shelf convenience. With Vishay Dale Thin Film you can depend on quality products delivered on time with service backing the product.

#### SCHEMATICS

##### 01 SCHEMATIC

Resistance Range:  
10 Ω to 47 kΩ



#### FEATURES

- Reduces total assembly costs
- Compatible with automatic surface mounting equipment
- UL 94 V-0 flame resistant
- Thin film tantalum nitride on silicon
- Choice of package sizes: VTSR (TSSOP) JEDEC MC-153, VSSR (SSOP or QSOP) JEDEC MS-137, VSOR (SOIC narrow) JEDEC MS-012
- Moisture sensitivity level 1 (per IPC/JEDEC STD-20C)
- Isolated/bussed/dual terminator/differential terminator circuits
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



RoHS COMPLIANT  
HALOGEN FREE

#### TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
TCR	100	NA
	ABSOLUTE	RATIO
TOL.	5, 2, 1	NA

#### RESISTORS WITH ONE PIN COMMON

The 01 circuit provides nominally equal resistors connected between a common pin and a discrete PC board pin.

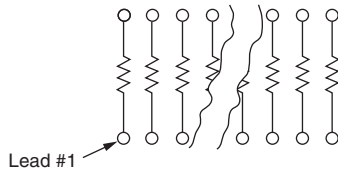
Commonly used in the following applications:

- MOS/ROM pull-up/-down
- Open collector pull-up
- "Wired OR" pull-up
- Power driven pull-up
- TTL input pull-down
- Digital pulse squaring
- TTL unused gate pull-up
- High speed parallel pull-up

Broad selection of standard values available

##### 03 SCHEMATIC

Resistance Range:  
10 Ω to 47 kΩ



#### ISOLATED RESISTORS

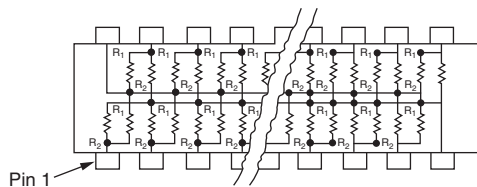
The 03 circuit provides nominally equal resistors isolated from all others and wired directly across.

Commonly used in the following applications:

- "Wired OR" pull-up
- Power driven pull-up
- Powergate pull-up
- Line termination
- Long-line impedance balancing
- LED current limiting
- ECL output pull-down
- TTL input pull-down

Broad selection of standard values available

##### 05 SCHEMATIC



#### DUAL-LINE TERMINATOR; PULSE SQUARING

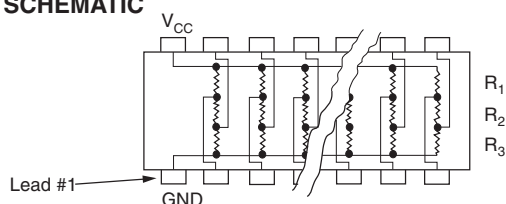
The 05 circuit contains pairs of resistors connected between ground and a common line. The junctions of these resistor pairs are connected to the input leads. The 05 circuits are designed for dual-line termination and pulse squaring.

Standard values are:

VSSR1605:  
R<sub>1</sub> = 220 Ω, R<sub>2</sub> = 330 Ω  
R<sub>1</sub> = 330 Ω, R<sub>2</sub> = 470 Ω

VSSR2005:  
R<sub>1</sub> = 220 Ω, R<sub>2</sub> = 330 Ω  
R<sub>1</sub> = 220 Ω, R<sub>2</sub> = 1.8 kΩ  
R<sub>1</sub> = 1.5 kΩ, R<sub>2</sub> = 3.3 kΩ

##### 47 SCHEMATIC



#### DIFFERENTIAL TERMINATOR

The 47 schematic consists of series resistor sections connected between V<sub>CC</sub> and ground. Each contains 3 resistors of 2 different resistance values.

Standard values are:

VSSR20 and VTSR20:  
R<sub>1</sub> = 270 Ω, R<sub>2</sub> = 120 Ω

VSSR16 and VTSR16:  
R<sub>1</sub> = 330 Ω, R<sub>2</sub> = 150 Ω  
R<sub>1</sub> = 330 Ω, R<sub>2</sub> = 220 Ω

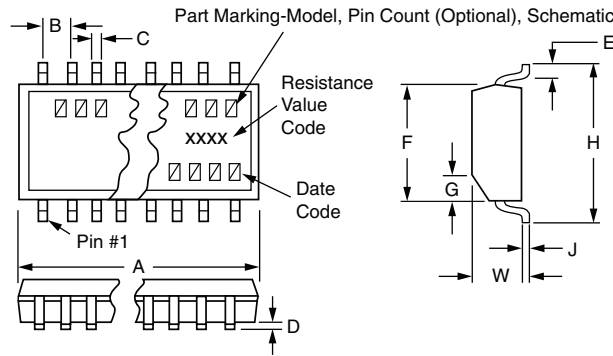




**STANDARD ELECTRICAL SPECIFICATIONS**

TEST	SPECIFICATIONS	CONDITIONS
Material	Tantalum nitride	-
Pin/Lead Number	16, 20, 24	-
Resistance Range	10 Ω to 47 kΩ	Per E-24 table
TCR: Absolute	± 100 ppm/°C	-55 °C to + 125 °C
TCR: Tracking	n/a	-
Tolerance: Absolute	± 5 % standard (± 2 % available) ± 1 % standard (check factory)	Per E-24 table Per E-96 table
Tolerance: Ratio	NA	-
Power Rating: Resistor	100 mW max.	At + 70 °C
Power Rating: Package	16 = 1.0 W, 20 = 1.2 W, 24 = 1.4 W	0 °C to + 70 °C
Stability: Absolute	-	-
Stability: Ratio	-	-
Voltage Coefficient	5 ppm/V (typical)	-
Working Voltage	50 V <sub>DC</sub>	-
Operating Temperature Range	- 55 °C to + 125 °C	-
Storage Temperature Range	- 55 °C to + 150 °C	-
Noise	< - 35 dB	-
Thermal EMF	-	-
Shelf Life Stability: Absolute	-	-
Shelf Life Stability: Ratio	-	-

**DIMENSIONS AND IMPRINTING** in inches (millimeters)



DIMENSION	VTSR-xxxx	VSSR-xxxx	VSOR-xxxx
A - 16 PIN	0.206 ± 0.003 (5.23 ± 0.08)	0.193 ± 0.004 (4.90 ± 0.010)	0.390 ± 0.010 (9.91 ± 0.25)
A - 20 PIN	0.256 ± 0.003 (6.50 ± 0.08)	0.341 ± 0.003 (8.66 ± 0.08)	NA
A - 24 PIN	0.306 ± 0.003 (7.77 ± 0.08)	0.341 ± 0.003 (8.66 ± 0.08)	NA
B (Ref.)	0.0256 (0.65)	0.025 (0.64)	0.050 (1.27)
C (Ref.)	0.0087 (0.22)	0.010 (0.25)	0.016 (0.41)
D	0.004 (0.10)	0.006 (0.15)	0.008 (0.20)
E (Typ.)	0.024 (0.61)	0.025 (0.64)	0.030 (0.76)
F	0.173 ± 0.003 (4.39 ± 0.08)	0.154 ± 0.003 (3.91 ± 0.08)	0.152 ± 0.003 (3.86 ± 0.08)
G	0.015 × 45° (0.38)	0.015 × 45° (0.38)	0.015 × 45° (0.38)
H	0.252 ± 0.005 (6.40 ± 0.13)	0.236 ± 0.008 (5.99 ± 0.20)	0.236 ± 0.005 (5.99 ± 0.13)
J (Ref.)	0.005 (0.13)	0.010 (0.25)	0.008 (0.20)
W	0.043 ± 0.005 (1.09 ± 0.13)	0.064 ± 0.005 (1.63 ± 0.13)	0.064 ± 0.005 (1.63 ± 0.13)

**MARKING**

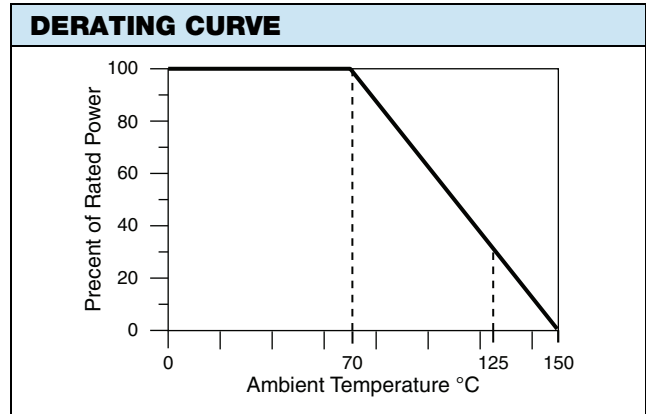
MODEL	PIN COUNT (Optional)	SCHEMATIC	RESISTANCE	RESISTANCE	DATE CODE
<b>VXXX</b>	<b>XX</b>	<b>XX</b>	<b>XXXX</b>	<b>XXX</b>	<b>XXXX</b>
VSOR	16	01, 03,	1 % RESISTANCE	<b>OR</b> 1 %, 2 %, 5 % RESISTANCE e.g.: 103 = 10K The first 2 digits are significant figures, the last digit specifies the number of zeros to follow.	
VSSR	20	05 or 47	e.g.: 43R2		
VTSR	24		4 digits are used to express ohmic values only less than 100 Ω. R is used to designate the decimal position		





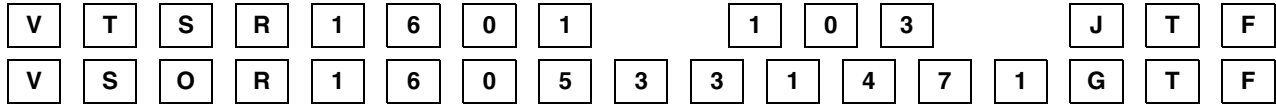
MECHANICAL SPECIFICATIONS	
Resistive Element	Tantalum nitride
Substrate Material	Silicon
Body	Molded epoxy
Terminals	Copper alloy
Plating	100 % matte tin
Lead Coplanarity	0.0005"
Marking Resistance to Solvents	Permanency testing per MIL-STD-202, method 215

PACKAGING INFORMATION			
MODEL	LEADS	TAPE AND REEL	TUBES
VTSR (TSSOP)	16	2500	94
	20	2500	74
	24	2500	62
VSSR (QSOP)	16	2500	98
	20	2500	55
	24	2500	55
VSOR (SOIC)	16	2500	48



**GLOBAL PART NUMBER INFORMATION**

New Global Part Numbering: **VTSR1601103JTF**

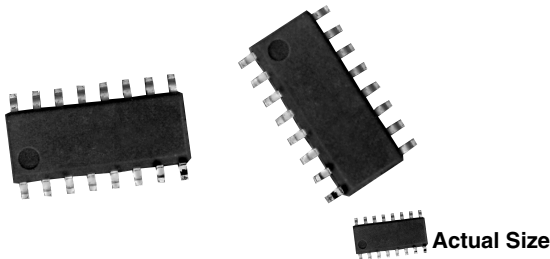


GLOBAL MODEL	PIN COUNT	SCHEMATIC	RESISTANCE (3, 4 or 6 digits)	TOLERANCE	PACKAGING
<b>VTSR</b> <b>VSSR</b> <b>VSOR</b> Lead (Pb)-free (e3) date code > 2705	<b>20</b> (not VSOR) <b>24</b> (not VSOR)	<b>01</b> (bussed) <b>03</b> (isolated)	XXX: ≥ 100R and all 1 %, 2 % and 5 % First 2 digits are significant figures. Last digit specifies number of zeros to follow. XXXX: < 100R 1 % First 3 digits are significant figures. Last digit specifies number of zeros to follow.	<b>F</b> = 1.0 % <b>G</b> = 2.0 % <b>J</b> = 5.0 %	<b>TAPE AND REEL</b> <b>TF</b> = Full reel 2500 <b>UF</b> = Tubed
	<b>16</b> (not VTSR) <b>20</b> (not VSOR)	<b>05</b> (terminator) <b>47</b> (terminator)	xxx xxx First 2 digits are significant figures. Last digit specifies number of zeros.	<b>G</b> = 2.0 % <b>J</b> = 5.0 %	

Historical Part Number example: **VSSR2001102GT/R** (for reference purposes only)

VSSR	20	01	102	G	T/R
MODEL	PIN COUNT	SCHEMATIC	RESISTANCE	TOLERANCE	PACKAGING

## Molded, 50 mil Pitch, Dual-In-Line Thin Film Resistor, Narrow Body, Surface Mount Network



The NOMC series features a standard 14 pins and 16 pins narrow body (0.150") small outline surface mount style. It can accommodate resistor networks to your particular application requirements. The networks can be constructed with passivated nichrome (standard), or tantalum nitride <sup>(1)</sup> resistor films to optimize performance.

**Note**

<sup>(1)</sup> Available upon request. Resistance value range and performance differs from passivated nichrome standard electrical specifications on datasheet, consult factory.

**FEATURES**

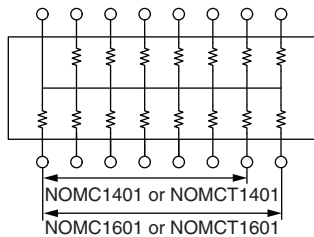
- Standard 14 pins and 16 pins counts (0.150" narrow body) JEDEC MS-012 variation AB and AC
- Rugged molded case construction
- Excellent long term ratio stability ( $\Delta R \pm 0.015\%$ )
- Low TCR tracking  $\pm 5$  ppm/°C
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition


**Note**

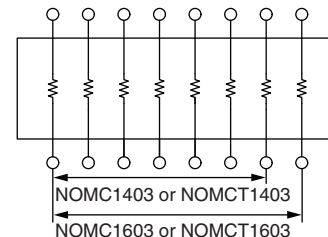
\* Pb containing terminations are not RoHS compliant, exemptions may apply

**TYPICAL PERFORMANCE**

	ABSOLUTE	TRACKING
TCR	25	5
	ABSOLUTE	RATIO
TOL.	0.10	0.05

**SCHEMATICS**


The 01 circuit provides a choice of 13 or 15 equal value resistors each connected between a common lead (14 or 16). Custom schematics available.



The 03 circuit provides a choice of 7 or 8 equal value resistors each connected between a common lead (14 or 16). Custom schematics available.

STANDARD RESISTANCE OFFERING (Equal Value Resistors)	
ISOLATED (03) SCHEMATIC	BUSSED (01) SCHEMATIC
1 kΩ	10 kΩ
2 kΩ	20 kΩ
5 kΩ	
10 kΩ	
20 kΩ	
100 kΩ	

**Note**

- Consult factory for additional values

STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome (standard) Tantalum nitride (available upon request)	-
Pin/Lead Number	14, 16	-
Resistance Range	100 Ω to 50 kΩ each resistor (bussed (01) schematic) 100 Ω to 100 kΩ each resistor (isolated (03) schematic)	-
TCR: Absolute	± 25 ppm/°C (standard)	- 55 °C to + 125 °C
TCR: Tracking	± 5 ppm/°C (typical)	- 55 °C to + 125 °C
Tolerance: Absolute	± 0.10 % to ± 1 %	+ 25 °C
Tolerance: Ratio	± 0.025 % to ± 0.1 %	+ 25 °C
Power Rating: Resistor	100 mW (typical) (03) schematic 50 mW ((01) schematic)	Maximum at + 70 °C
Power Rating: Package	400 mW/500 mW	Maximum at + 70 °C
Stability: Absolute	ΔR ± 0.05 %	2000 h at + 70 °C
Stability: Ratio	ΔR ± 0.015 %	2000 h at + 70 °C
Voltage Coefficient	< 0.1 ppm/V	-
Working Voltage	100 V max. not to exceed $\sqrt{P \times R}$	-
Operating Temperature Range	- 55 °C to + 125 °C	-
Storage Temperature Range	- 55 °C to + 150 °C	-
Noise	≤ - 30 dB	-
Thermal EMF	0.08 μV/°C	-
Shelf Life Stability: Absolute	ΔR ± 0.01 %	1 year at + 25 °C
Shelf Life Stability: Ratio	ΔR ± 0.002 %	1 year at + 25 °C

DIMENSIONS AND IMPRINTING in inches and millimeters				
DIMENSION	14		16	
	INCHES	MILLIMETERS	INCHES	MILLIMETERS
H	0.235	5.969	0.235	5.969
E	0.154	3.911	0.154	3.91
O	0.340	8.363	0.390	9.906
A	0.063	1.60	0.063	1.60
e	0.050	1.270	0.050	1.270
B	0.015	0.381	0.015	0.381
C	0.008	0.203	0.008	0.203
L	0.025	0.635	0.025	0.635
A1	0.006	0.152	0.006	0.152
h	0.015	0.381	0.015	0.381

MECHANICAL SPECIFICATIONS	
Resistive Element	Passivated nichrome
Substrate Material	Silicon
Body	Molded epoxy
Terminals	Copper alloy
Lead (Pb)-free Option	100 % matte tin
Tin Lead Option	Sn90
Tin Lead and Lead (Pb)-free Finish	Plated

**Note**

- Available upon request. Resistance value range and performance differs from passivated nichrome standard electrical specifications on datasheet, consult factory.



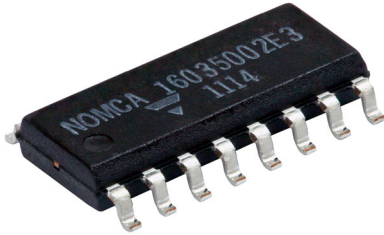
ORDERING INFORMATION CHECK LIST (Customs)	
Special requirements should be identified in advance, but as a minimum, you should have the following information ready.	
ELECTRICAL	MECHANICAL
1. Resistors, by value and tolerance 2. Reference resistor(s) and matching of which resistors to which reference resistors 3. Reference by ratio 4. Absolute temperature coefficient of resistivity 5. Temperature tracking of subordinate resistors to reference resistor(s) 6. Maximum operating voltage 7. Resistor power ratings 8. Operating temperature range	1. Maximum allowable seated height (from PC board to top of network) 2. Special marking concerns 3. Schematic pin out of package

GLOBAL PART NUMBER INFORMATION																
New Global Part Numbering: <b>NOMC16031002BUF</b>																
	N	O	M	C	1	6	0	3	1	0	0	2	B	U	F	
	N	O	M	C	T	1	4	0	3	1	0	0	3	Z	T	1
GLOBAL MODEL (4 or 5 digits)	PINS		SCHEMATIC		RESISTANCE			TOLERANCE AND RATIO TOLERANCE		PACKAGING						
<b>NOMC</b> (Tin Lead)  <b>NOMCT</b> (Lead (Pb)-free) (e3)	<b>14</b> <b>16</b>		<b>01</b> = 13 or 15 bussed equal value resistors  <b>03</b> = 7 or 8 isolated equal value resistors		First 3 digits are significant figures and the last digit specifies the number of zeros to follow.  Example: 1002 = 10K 1003 = 100K			Abs. Tol.      Ratio <b>A</b> = 0.1 % <sup>(1)</sup> 0.05 % <b>B</b> = 0.1 %        0.1 % <b>C</b> = 0.25 %      0.1 % <b>D</b> = 0.5 %        0.1 % <b>F</b> = 1 %            0.5 % <b>Z</b> = 0.1 % <sup>(1)</sup> 0.025 %		TAPE AND REEL <b>T0</b> = 100 min., 100 mult <b>T1</b> = 1000 min., 1000 mult <sup>(2)</sup> <b>T3</b> = 300 min., 300 mult <b>T5</b> = 500 min., 500 mult <b>TF</b> = Full reel 2500 <b>TS</b> = 100 min., 1 mult  <b>UF</b> = TUBED						
Historical Part Number example: <b>NOMC16031002Z</b> (for reference purposes only)																
<b>NOMC</b>		<b>16</b>		<b>03</b>		<b>1002</b>		<b>Z</b>								
SERIES		PINS		SCHEMATIC		RESISTANCE		TOLERANCE AND RATIO TOLERANCE								

**Notes**

- <sup>(1)</sup> Tolerance available 1K and up
- <sup>(2)</sup> Preferred packaging code

## Molded, 50 mil Pitch, Dual-In-Line Thin Film Resistor, Precision Automotive, AEC-Q200 Qualified, Networks



The NOMCA series features a standard 14 pin or 16 pin narrow body (0.150") small outline SMT package. The network is constructed with tantalum nitride resistor film on high purity alumina substrate for improved ESD and moisture protection. Custom schematics are available consult factory.

### FEATURES

- Standard 14 pins and 16 pins counts (0.150" narrow body) JEDEC MS-012 variation AB and AC
- Rugged molded case construction
- Excellent long term ratio stability ( $\Delta R \pm 0.015\%$ )
- Low TCR tracking  $\pm 5$  ppm/ $^{\circ}\text{C}$
- AEC-Q200 ESD rated 1 kV ( $< 10$  k $\Omega$ )
- AEC-Q200 ESD rated 2 kV ( $> 10$  k $\Omega$ )
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

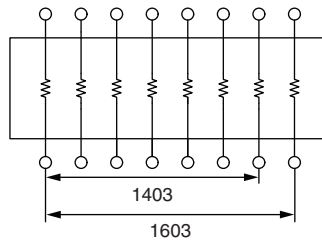


**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

### TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
TCR	25	5
	ABSOLUTE	RATIO
TOL.	0.10	0.05

### SCHEMATICS



The 03 circuit provides a choice of 7 or 8 equal value resistors each connected between a common lead (14 or 16). Custom schematics available.

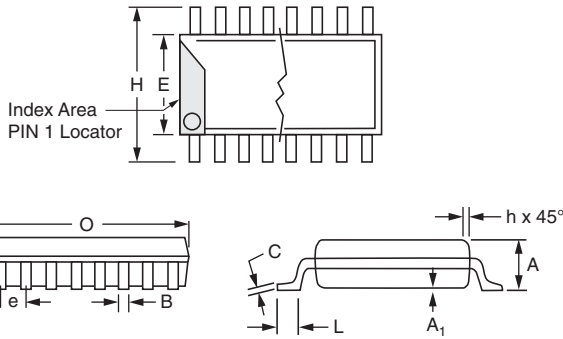
STANDARD RESISTANCE OFFERING (Equal Value Resistors)	
ISOLATED (03) SCHEMATIC	
	1 k $\Omega$
	2 k $\Omega$
	5 k $\Omega$
	10 k $\Omega$
	20 k $\Omega$
	50 k $\Omega$

#### Note

- Consult factory for additional values

STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Tantalum nitride (Ta <sub>2</sub> N)	-
Pin/Lead Number	14, 16	-
Resistance Range	1 kΩ to 50 kΩ each resistor	-
TCR: Absolute	± 25 ppm/°C (standard)	- 55 °C to + 125 °C
TCR: Tracking	± 5 ppm/°C (typical)	- 55 °C to + 125 °C
Tolerance: Absolute	± 0.10 % to ± 1 %	+ 25 °C
Tolerance: Ratio	± 0.05 % to ± 0.1 %	+ 25 °C
Power Rating: Resistor	100 mW (typical) (03) schematic	Maximum at + 70 °C
Power Rating: Package	400 mW/500 mW	Maximum at + 70 °C
Stability: Absolute	ΔR ± 0.05 %	1000 h at + 125 °C
Stability: Ratio	ΔR ± 0.015 %	1000 h at + 125 °C
Voltage Coefficient	< 0.1 ppm/V	-
Working Voltage	100 V max. not to exceed $\sqrt{P \times R}$	-
Operating Temperature Range	- 55 °C to + 125 °C	-
Storage Temperature Range	- 55 °C to + 150 °C	-
Noise	≤ - 30 dB	-
Thermal EMF	0.08 μV/°C	-
Shelf Life Stability: Absolute	ΔR ± 0.01 %	1 year at + 25 °C
Shelf Life Stability: Ratio	ΔR ± 0.002 %	1 year at + 25 °C

DIMENSIONS AND IMPRINTING in inches and millimeters				
DIMENSION	14		16	
	INCHES	MILLIMETERS	INCHES	MILLIMETERS
H	0.235	5.969	0.235	5.969
E	0.154	3.911	0.154	3.910
O	0.340	8.363	0.390	9.906
A	0.063	1.600	0.063	1.600
e	0.050	1.270	0.050	1.270
B	0.015	0.381	0.015	0.381
C	0.008	0.203	0.008	0.203
L	0.025	0.635	0.025	0.635
A <sub>1</sub>	0.006	0.152	0.006	0.152
h	0.015	0.381	0.015	0.381



MECHANICAL SPECIFICATIONS	
Resistive Element	Tantalum nitride (Ta <sub>2</sub> N)
Substrate Material	Ceramic
Body	Molded epoxy
Terminals	Copper alloy
Lead (Pb)-free Option	100 % matte tin plate or Ni/Pd/Au solder free option



**ORDERING INFORMATION CHECK LIST (Customs)**

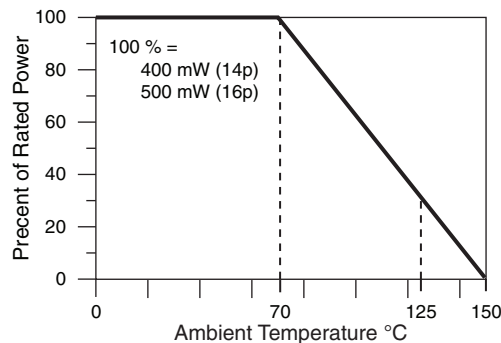
Special requirements should be identified in advance, but as a minimum, you should have the following information ready.

ELECTRICAL	MECHANICAL
1. Resistors, by value and tolerance 2. Reference resistor(s) and matching of which resistors to which reference resistors 3. Reference by ratio 4. Absolute temperature coefficient of resistivity 5. Temperature tracking of subordinate resistors to reference resistor(s) 6. Maximum operating voltage 7. Resistor power ratings 8. Operating temperature range	1. Maximum allowable seated height (from PC board to top of network) 2. Special marking concerns 3. Schematic pin out of package

**ENVIRONMENTAL TESTS (Vishay Performance vs. AEC-Q200 Requirements)**

ENVIRONMENTAL TEST	CONDITONS	LIMITS PER AQEC-Q200	TYPICAL VISHAY PERFORMANCE < 10K	TYPICAL VISHAY PERFORMANCE > 10K
Resistance Temperature Characteristic	- 55 °C to + 125 °C	± 25 ppm/°C	15 ppm/°C	15 ppm/°C
Max. Ambient Temperature at Rated Wattage		+ 70 °C	+ 70 °C	+ 70 °C
Max. Ambient Temperature at Power Derating		+ 150 °C	+ 150 °C	+ 150 °C
High Temperature Exposure $\Delta R$	MIL-STD-202, 108, 1000 h at 125 °C	± 0.20 %	0.005 %	0.012 %
Temperature Cycling $\Delta R$	JESD22, A104, 1000 cycles, - 55 °C to + 125 °C	± 0.25 %	0.004 %	0.004 %
Moisture Resistance $\Delta R$	MIL-STD-202 method 106	± 0.20 %	0.007 %	0.007 %
Biased Humidity $\Delta R$	MIL-STD-202, 103, 1000 h at 85 °C, 85 % RH, 10 % P	± 0.25 %	0.021 %	0.033 %
Life $\Delta R$	MIL-STD-202, 108, 1000 h at 125 °C	± 0.10 %	0.012 %	0.029 %
Mechanical Shock $\Delta R$	MIL-STD-202 method 213, condition C	± 0.25 %	0.001 %	0.001 %
Vibration $\Delta R$	MIL-STD-202 method 204, 10 Hz to 2 kHz	± 0.25 %	0.001 %	0.001 %
Resistance to Soldering Heat $\Delta R$	MIL-STD-202, 204, condition B	± 0.10 %	- 0.002 %	0.001 %
Electrostatic Discharg $\Delta R$	AEC-Q200-002 at 1 kV, human body	± 0.50 %	0.065 %	
	AEC-Q200-002 at 2 kV, human body	± 0.50 %		0.170 %
Solderability	J-STD-002 method B and B1	95 %	Acceptable	Acceptable
Terminal Strenght $\Delta R$	AEC-Q200-006 at 1 kg for 60 s		Acceptable	Acceptable
Flame Retardance	AEC-Q200-001 Para 4.0		Acceptable	Acceptable

**DERATING CURVE**





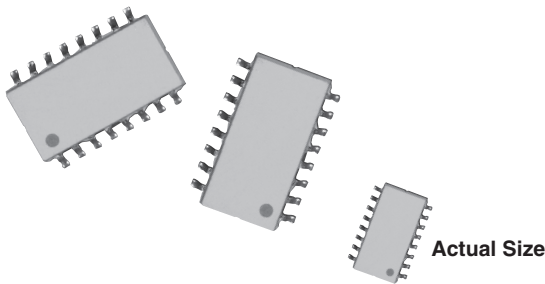
GLOBAL PART NUMBER INFORMATION															
New Global Part Numbering: <b>NOMCA14031002AT1</b>															
<b>N</b>	<b>O</b>	<b>M</b>	<b>C</b>	<b>A</b>	<b>1</b>	<b>4</b>	<b>0</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>A</b>	<b>T</b>	<b>1</b>
GLOBAL MODEL (4 or 5 digits)		PINS		SCHEMATIC		RESISTANCE			TOLERANCE AND RATIO TOLERANCE			PACKAGING			
<b>NOMCA</b> (Lead (Pb)-free) (e3)		<b>14</b> <b>16</b>		<b>03</b> = 7 or 8 isolated equal value resistors		First 3 digits are significant figures and the last digit specifies the number of zeros to follow.  Example: 1002 = 10K			Abs. Tol.      Ratio <b>A</b> = 0.1 % <sup>(1)</sup> 0.05 % <b>B</b> = 0.1 %        0.1 % <b>C</b> = 0.25 %      0.1 % <b>D</b> = 0.5 %        0.1 % <b>F</b> = 1 %            0.5 %			TAPE AND REEL <b>T0</b> = 100 min., 100 mult <b>T1</b> = 1000 min., 1000 mult <sup>(2)</sup> <b>T3</b> = 300 min., 300 mult <b>T5</b> = 500 min., 500 mult <b>TF</b> = Full reel 2500 <b>TS</b> = 100 min., 1 mult  <b>UF</b> = TUBED			

**Notes**

- (1) Tolerance available 1K and up
- (2) Preferred packaging code



# Molded, 50 mil Pitch Thin Film Resistor, Surface Mount Network



Vishay Dale Thin Film offers standard circuits in 16 pins in a medium body molded surface mount package. The networks are available over a resistance range of 100  $\Omega$  to 100 k $\Omega$ . The network features tight ratio tolerances and close TCR tracking. In addition to the standards shown, custom circuits are available upon request.

## FEATURES

- 0.090" (2.29 mm) maximum seated height
- Rugged, molded case construction (0.22" wide)
- Highly stable thin film ratio stability ( $\Delta R \pm 0.015\%$  at 70 °C for 2000 h)
- Low temperature coefficient,  $\pm 25$  ppm/°C (-55 °C to +125 °C)
- Wide resistance range 100  $\Omega$  to 100 k $\Omega$
- Isolated/bussed circuits
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



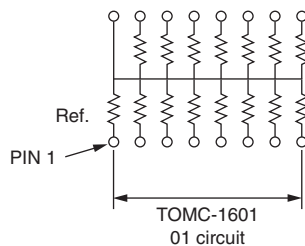
### Note

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

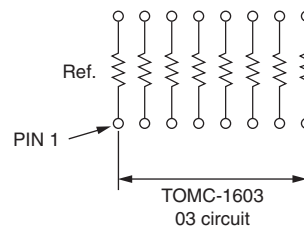
## TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
TCR	25	5
	ABSOLUTE	RATIO
TOL.	0.1	0.025

## SCHEMATIC



The 01 circuit provides 15 nominally equal resistors, each connected between a common lead (16) and a discrete PC board pin.

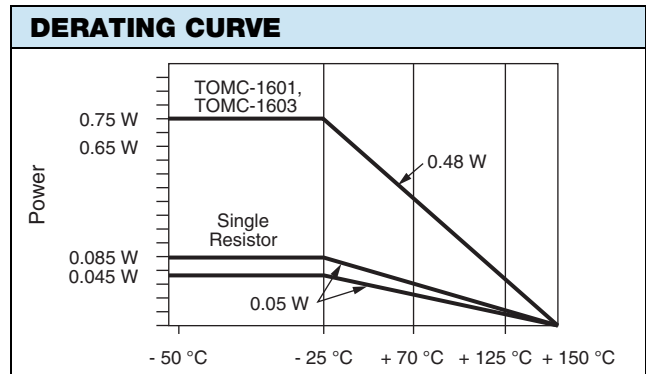


The 03 circuit provides a choice of 8 nominally equal resistors with each resistor isolated from all others and wired directly across.

STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	16	-
Resistance Range	100 $\Omega$ to 100 k $\Omega$ per resistor	-
TCR: Absolute	$\pm 25$ ppm/°C	-55 °C to +125 °C
TCR: Tracking	$\pm 5$ ppm/°C	-55 °C to +125 °C
Tolerance: Absolute	$\pm 0.1\%$ to 1%	+25 °C
Tolerance: Ratio	$\pm 0.025\%$ to 0.5%	+25 °C
Power Rating: Resistor	50 mW = PIN 16 common 100 mW = isolated	Maximum at +70 °C
Power Rating: Package	750 mW	Maximum at +70 °C
Stability: Absolute	$\Delta R \pm 0.05\%$	2000 h at +70 °C
Stability: Ratio	$\Delta R \pm 0.015\%$	2000 h at +70 °C
Voltage Coefficient	0.1 ppm/V	-
Working Voltage	100 V max. not to exceed $\sqrt{P \times R}$	-
Operating Temperature Range	-55 °C to +125 °C	-
Storage Temperature Range	-55 °C to +150 °C	-
Noise	< -30 dB	-
Thermal EMF	0.08 $\mu$ V/°C	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01\%$	1 year at +25 °C
Shelf Life Stability: Ratio	$\Delta R \pm 0.002\%$	1 year at +25 °C

DIMENSIONS AND IMPRINTING in inches and millimeters			
	<b>DIMENSION</b>	<b>INCHES</b>	<b>MILLIMETERS</b>
	A	0.350	8.89
	B	0.400	10.16
	C	0.440	11.176
	D	0.050	1.27
	E	0.018	0.457
	F	0.160	4.06
	G	0.08	2.03
	H	0.036	0.914
	J	0.22	5.59
	K	0.244	6.20
	L	0.30	7.52
	M	0.045	1.14
	N	0.003	0.076
P	0.005	1.27	
Q	0.008	0.203	
R	0.085	2.16	
S	0.003	0.076	

MECHANICAL SPECIFICATIONS	
<b>Resistive Element</b>	Passivated nichrome
<b>Substrate Material</b>	Silicon
<b>Body</b>	Molded epoxy
<b>Terminals</b>	Copper alloy
<b>Lead (Pb)-free Option</b>	100 % matte tin
<b>Tin Lead Option</b>	Sn85
<b>Tin Lead and Lead (Pb)-free Finish</b>	Plated

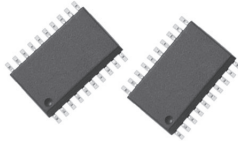


GLOBAL PART NUMBER INFORMATION															
New Global Part Numbering: TOMC16031002BUF															
T	O	M	C	1	6	0	3	1	0	0	2	B	U	F	
T	O	M	C	T	1	6	0	1	1	0	0	3	Z	T	1
GLOBAL MODEL (4 or 5 digits)	PINS	SCHEMATIC	RESISTANCE	TOLERANCE AND RATIO TOLERANCE	PACKAGING										
<b>TOMC</b> (Tin lead)	16	01 = 15 bussed equal resistors 03 = 7 or 8 isolated equal resistors	First 3 digits are significant figures and the last digit specifies the number of zeros to follow.  Example: 1002 = 10K 1003 = 100K	Abs. Tol.      Ratio A = 0.1 % <sup>(1)</sup> 0.05 % B = 0.1 %        0.1 % C = 0.25 %       0.1 % D = 0.5 %        0.1 % F = 1 %            0.5 % Z = 0.1 % <sup>(2)</sup> 0.025 %	<b>TAPE AND REEL</b> <b>T0</b> = 100 min., 100 mult <b>T1</b> = 1000 min., 1000 mult <sup>(3)</sup> <b>T3</b> = 300 min., 300 mult <b>T5</b> = 500 min., 500 mult <b>TF</b> = Full reel 2000 <b>TS</b> = 100 min., 1 mult <b>UF</b> = TUBED										
<b>TOMCT</b> (Lead (Pb)-free) (e3)															
Historical Part Number example: TOMC16011002Z (for reference purposes only)															
TOMC	16	01	1002	Z											
SERIES	NUMBER OF LEADS	SCHEMATIC	RESISTANCE	TOLERANCE AND RATIO TOLERANCE											

**Notes**

- (1) Tolerance available 250 and up
- (2) Tolerance available 1K and up
- (3) Preferred packaging code

## Molded, 50 mil Pitch, Dual In-Line Thin Film Resistor, Surface Mount Network



Actual Size

### FEATURES

- Rugged, molded case construction
- Reduces total assembly costs
- Saves board space
- Compatible with surface mounting equipment
- Uniform performance characteristics
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



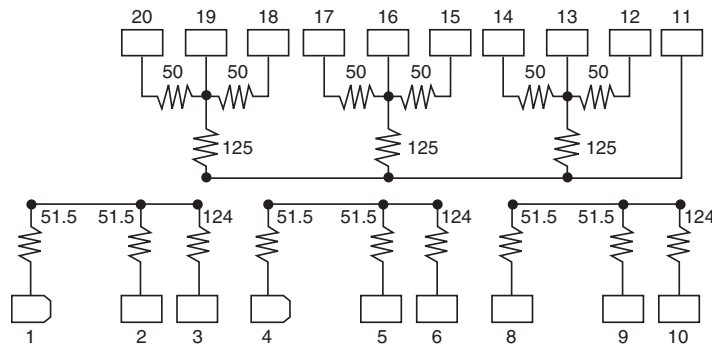
**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

### TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
<b>TCR</b>	<b>100</b>	<b>10</b>
	ABSOLUTE	RATIO
<b>TOL.</b>	<b>1, 2</b>	<b>0.5</b>

V.35 termination network used to insure signal integrity between transmitter and receiver sections of V.35 protocol.

### SCHEMATIC



### Notes

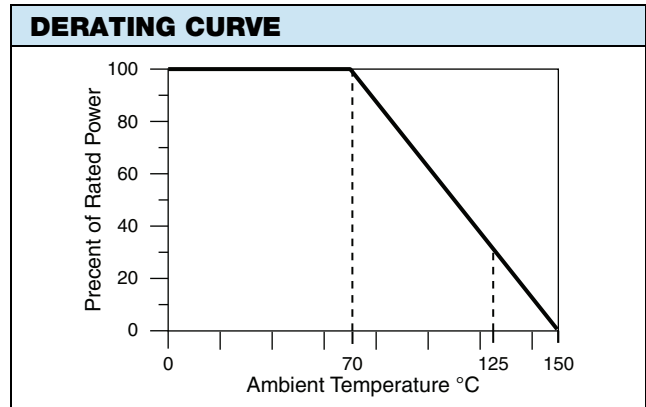
- Pad 7 does not exist
- PIN 7 is an open circuit

STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Tantalum nitride	-
Pin/Lead Number	20	-
Resistance Range	50 $\Omega$ to 125 $\Omega$	-
TCR: Absolute	$\pm 100$ ppm/ $^{\circ}$ C	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
TCR: Tracking	$\pm 10$ ppm/ $^{\circ}$ C	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
Tolerance: Absolute	$\pm 1$ %, $\pm 2$ %	$\pm 1$ %: 51.5 $\Omega$ and 124 $\Omega$ $\pm 2$ %: 50.0 $\Omega$ and 125 $\Omega$
Tolerance: Ratio	0.5 %	-
Power Rating: Resistor	-	-
Power Rating: Package	1.6 W	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
Stability: Absolute	-	-
Stability: Ratio	-	-
Voltage Coefficient	-	-
Working Voltage	-	-
Operating Temperature Range	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C	-
Storage Temperature Range	- 55 $^{\circ}$ C to + 150 $^{\circ}$ C	-
Noise	-	-
Thermal EMF	-	-
Shelf Life Stability: Absolute	-	-
Shelf Life Stability: Ratio	-	-

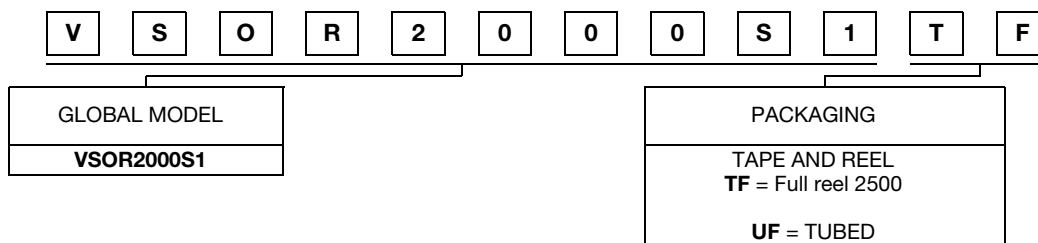
**DIMENSIONS AND IMPRINTING** in inches and millimeters

DIMENSION	INCHES	MILLIMETERS
A	0.500 ± 0.010	12.7 ± 0.25
B (Ref.)	0.050	1.27
C (Ref.)	0.016	0.41
D	0.008	0.20
E (Typ.)	0.030	0.75
F	0.293 ± 0.003	7.44 ± 0.08
G	0.025 x 45°	0.64 x 45°
H	0.406 ± 0.005	10.31 ± 0.13
J (Ref.)	0.010	0.25
W	0.100 ± 0.005	1.54 ± 0.13

MECHANICAL SPECIFICATIONS	
Resistive Material	Tantalum nitride
Substrate Material	Silicon
Body	Molded epoxy
Terminals	Copper alloy
Plating	Tin lead solder
Lead coplanarity	0.0005"
Marking Resistance to Solvents	Permanency testing per MIL-STD-202, method 215
Lead (Pb)-free	100 % matte tin Plated


**GLOBAL PART NUMBER INFORMATION**

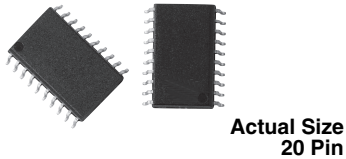
New Global Part Numbering: VSOR2000S1T1



Historical Part Number example: VSOR2000S1T/R (for reference purposes only)



# Molded, 50 mil Pitch, Dual In-Line Thin Film Resistor, Wide Body, Surface Mount Network



The WOMC series features a standard 16 pins and 20 pins wide body (0.30") small outline surface mount style that can accommodate resistor networks to your particular application requirements. The networks can be constructed with passivated nichrome, or tantalum nitride resistor films to optimize performance.

## FEATURES

- Standard 16 pins and 20 pins counts (0.300" wide body) JEDEC MS-013 variation AA and AC
- Rugged, molded case construction
- High stable in element ratio stability ( $\Delta R \pm 0.015\%$  at 70 °C for 2000 h)
- Leads copper alloy, solderable
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



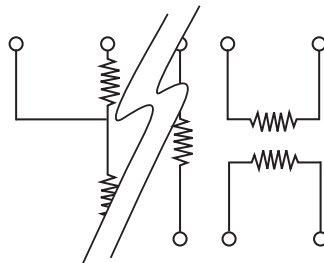
## Note

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

## TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
TCR	25	5
	ABSOLUTE	RATIO
TOL.	0.1	0.05

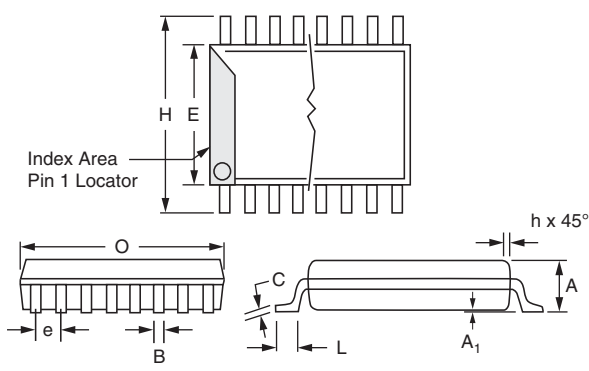
## SCHEMATIC



Custom schematics available  
Please contact factory

STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome or tantalum nitride	-
Pin/Lead Number	16, 20	-
Resistance Range	100 $\Omega$ to 500 k $\Omega$ total resistance	-
TCR: Absolute	$\pm 25$ ppm/ $^{\circ}$ C to $\pm 50$ ppm/ $^{\circ}$ C	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
TCR: Tracking	$\pm 5$ ppm/ $^{\circ}$ C (typical)	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
Tolerance: Absolute	$\pm 0.1\%$ to $\pm 1.0\%$	+ 25 $^{\circ}$ C
Tolerance: Ratio	$\pm 0.05\%$ to $\pm 0.1\%$	+ 25 $^{\circ}$ C
Power Rating: Resistor	100 mW (per element)	Maximum at + 70 $^{\circ}$ C
Power Rating: Package	500 mW	Maximum at + 70 $^{\circ}$ C
Stability: Absolute	$\Delta R \pm 0.05\%$	2000 h at + 70 $^{\circ}$ C
Stability: Ratio	$\Delta R \pm 0.015\%$	2000 h at + 70 $^{\circ}$ C
Voltage Coefficient	0.1 ppm/V	-
Working Voltage	100 V max. not to exceed $\sqrt{P \times R}$	-
Operating Temperature Range	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C	-
Storage Temperature Range	- 55 $^{\circ}$ C to + 150 $^{\circ}$ C	-
Noise	< - 30 dB	-
Thermal EMF	0.08 $\mu$ V/ $^{\circ}$ C	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01\%$	1 year at + 25 $^{\circ}$ C
Shelf Life Stability: Ratio	$\Delta R \pm 0.002\%$	1 year at + 25 $^{\circ}$ C

<b>DIMENSIONS AND IMPRINTING</b> in inches and millimeters				
DIMENSION	16		20	
	INCHES	MILLIMETERS	INCHES	MILLIMETERS
H	0.408	10.36	0.408	10.36
E	0.298	7.57	0.298	7.57
O	0.410	10.41	0.500	12.7
A	0.097	2.46	0.097	2.46
e	0.050	1.27	0.050	1.27
B	0.016	0.406	0.016	0.406
C	0.009	0.228	0.009	0.228
L	0.026	0.66	0.026	0.66
A <sub>1</sub>	0.007	0.177	0.007	0.177
h	0.015	0.381	0.015	0.381



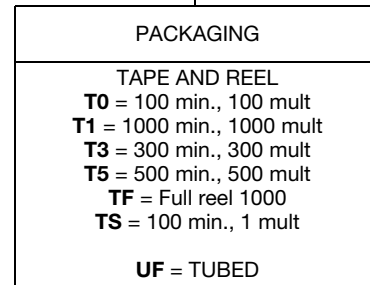
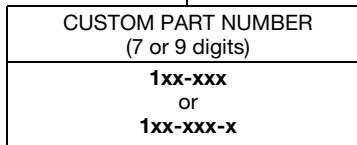
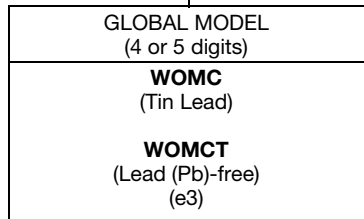
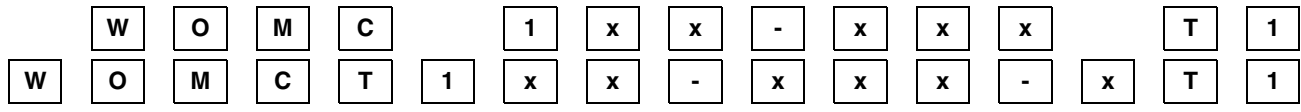
<b>MECHANICAL SPECIFICATIONS</b>	
Resistive Element	Passivated nichrome
Substrate Material	Silicon
Body	Molded epoxy
Terminals	Copper alloy
Lead (Pb)-free Option	100 % matte tin
Tin Lead Option	Sn90
Tin Lead and Lead (Pb)-free Finish	Plated

<b>ORDERING INFORMATION CHECK LIST (Customs)</b>	
Special requirements should be identified in advance, but as a minimum, you should have the following information ready.	
ELECTRICAL	MECHANICAL
1. Resistors, by value and tolerance 2. Reference resistor(s) and matching of which resistors to which reference resistors 3. Reference by ratio 4. Absolute temperature coefficient of resistivity 5. Temperature tracking of subordinate resistors to reference resistor(s) 6. Maximum operating voltage 7. Resistor power ratings 8. Operating temperature range	1. Maximum allowable seated height (from PC board to top of network) 2. Special marking concerns 3. Schematic pin out of package 4. Specify if lead (Pb)-free

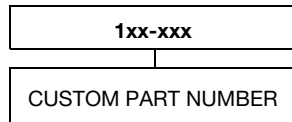


**GLOBAL PART NUMBER INFORMATION**

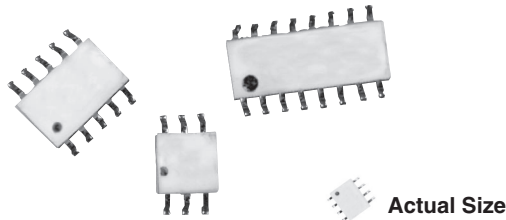
New Global Part Numbering: WOMC1xx-xxxT1



Historical Part Number example: 1xx-xxx (for reference purposes only)



## Sandwich, 50 mil Pitch, Dual In-Line Thin Film Resistor, Surface Mount Network



A dual-in-line monolithic ceramic sandwich in a variety of pin sizes (4 to 20) that allow higher resistance integration than traditional chip and wire molded construction. In addition, tighter resistance tolerances can be obtained over traditional molded networks due to the elimination of molding temperature and stress.

### FEATURES

- Lead (Pb)-free gold plated terminals standard
- Gold-to-gold terminations. External leads are attached directly to gold pads on the ceramic substrate by thermo-compression bonding (no internal solder)
- Tighter tolerances than molded standards (0.01 %)
- Ceramic package with no cavity
- Flexibility of lead variations to save PC board space
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



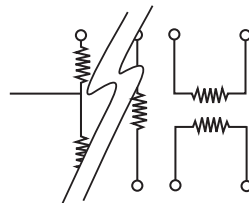
### Note

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

### TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
TCR	25	5
	ABSOLUTE	RATIO
TOL.	0.1	0.02

### SCHEMATIC



Custom schematics available  
Please consult factory

STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Tantalum nitride or passivated nichrome <sup>(1)</sup>	-
Pin/Lead Number	4 to 20	-
Resistance Range	100 Ω to 1.5 MΩ total	-
TCR: Absolute	± 25 ppm/°C to ± 50 ppm/°C	- 55 °C to + 125 °C
TCR: Tracking	± 5 ppm/°C (typical)	- 55 °C to + 125 °C
Tolerance: Absolute	± 0.05 % to ± 1.0 %	+ 25 °C
Tolerance: Ratio	± 0.02 % to ± 0.1 %	+ 25 °C
Power Rating: Resistor	100 mW	Per element at + 70 °C
Power Rating: Package	500 mW	Maximum at + 70 °C
Stability: Absolute	ΔR ± 0.1 %	2000 h at + 70 °C
Stability: Ratio	ΔR ± 0.03 %	2000 h at + 70 °C
Voltage Coefficient	0.1 ppm/V	-
Working Voltage	100 V max. not to exceed $\sqrt{P \times R}$	-
Operating Temperature Range	- 55 °C to + 125 °C	-
Storage Temperature Range	- 55 °C to + 150 °C	-
Noise	< - 30 dB	-
Thermal EMF	0.08 μV/°C	-
Shelf Life Stability: Absolute	ΔR ± 0.01 %	1 year at + 25 °C
Shelf Life Stability: Ratio	ΔR ± 0.002 %	1 year at + 25 °C

### Note

<sup>(1)</sup> Passivated nichrome is not standard film type for CSO series, consult factory if required



<b>DIMENSIONS AND IMPRINTING</b> in inches and millimeters			
	DIMENSION	INCHES	MILLIMETERS
	A	0.050	1.27
	B (Typ.)	0.015	0.38
	C	0.017 - 0.005 + 0.0010	0.432
	D (Max.)	0.157	3.99
	E	0.239	6.07
	F (Min.)	0.005	0.13
	G (Typ.)	0.006	0.15
	H (Max.)	0.070	1.72
	L (6 Pins)	0.150 ± 0.01	3.81
	L (8 Pins)	0.200 ± 0.01	5.08
	L (10 Pins)	0.250 ± 0.01	6.35
	L (12 Pins)	0.300 ± 0.01	7.62
	L (14 Pins)	0.350 ± 0.01	8.89
	L (16 Pins)	0.400 ± 0.01	10.16
	L (18 Pins)	0.450 ± 0.01	11.43
	L (20 Pins)	0.500 ± 0.01	12.70

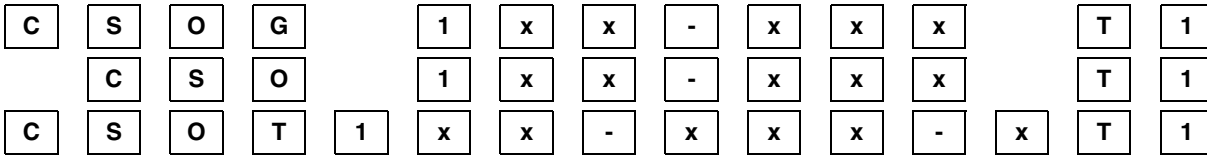
<b>MECHANICAL SPECIFICATIONS</b>	
<b>Resistive Element</b>	Passivated nichrome or tantalum nitride
<b>Body</b>	Ceramic
<b>Lead Coplanarity</b>	± 0.004
<b>Substrate Material</b>	Alumina
<b>Marking Resistance to Solvents</b>	Per MIL-PRF-83401
<b>Terminals</b>	Copper alloy
<b>Plating</b>	Nickel/gold
<b>Model CSOG - Lead (Pb)-free Standard</b>	Gold plated
<b>Model CSO - Tin/Lead Solder Coated Option</b>	Sn63
<b>Model CSOT - Lead (Pb)-free Solder Coated Option</b>	96.5 % Sn, 3.0 % Ag, 0.5 % Cu

<b>ORDERING INFORMATION CHECK LIST</b>	
Special requirements should be identified in advance, but as a minimum, you should have the following information ready.	
ELECTRICAL	MECHANICAL
<ol style="list-style-type: none"> <li>Resistors, by value and tolerance</li> <li>Reference resistor(s) and matching of which resistors to which reference resistors</li> <li>Reference by ratio</li> <li>Absolute temperature coefficient of resistivity</li> <li>Temperature tracking of subordinate resistors to reference resistor(s)</li> <li>Maximum operating voltage</li> <li>Resistor power ratings</li> <li>Operating temperature range</li> </ol>	<ol style="list-style-type: none"> <li>Maximum allowable seated height (from PC board to top of network)</li> <li>Special marking concerns</li> <li>Schematic pin out of package</li> <li>Specify if solder coated leads are required</li> </ol>



**GLOBAL PART NUMBER INFORMATION**

New Global Part Numbering: CSOG1xx-xxxT1



**GLOBAL MODEL**  
(3 or 4 digits)

**CSOG**  
(Lead (Pb)-free)  
(e4)

**CSO**  
(Tin Lead)

**CSOT**  
(Lead (Pb)-free)  
(e1)

**CUSTOM PART NUMBER**  
(7 or 9 digits)

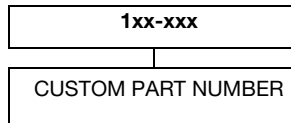
**1xx-xxx**  
**1xx-xxx-x**

**PACKAGING**

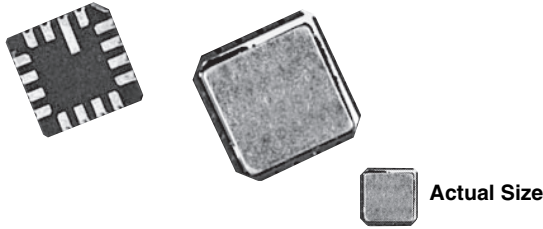
**TAPE AND REEL**  
**T0** = 100 min., 100 mult  
**T1** = 1000 min., 1000 mult  
**T3** = 300 min., 300 mult  
**T5** = 500 min., 500 mult  
**TF** = Full reel  
**TS** = 100 min., 1 mult

**UF** = TUBED

Historical Part Number example: 1xx-xxx (for reference purposes only)



# Hermetic, 50 mil Pitch, Leadless Thin Film Chip Resistor, Surface Mount Network



Vishay Dale Thin Film offers a wide resistance range in 16, 20, and 24 terminal hermetic leadless chip carriers. The standard circuits in the ohmic ranges listed below will utilize the outstanding wraparound terminations developed for chip resistors. Should one of the standards not fit your application, consult the applications engineering group as we may be able to meet your requirements.

## FEATURES

- High purity alumina substrate for high power dissipation
- Leach resistant terminations with nickel barrier
- 16, 20, 24 terminal gold plated wraparound true hermetic packaging
- Military/aerospace
- Hermetically sealed
- Isolated/bussed circuits
- Ideal for military/aerospace applications
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



**RoHS\***  
COMPLIANT  
HALOGEN  
**FREE**

## Note

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

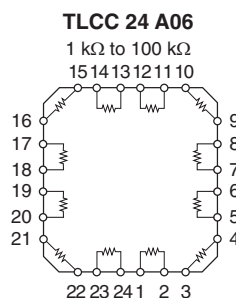
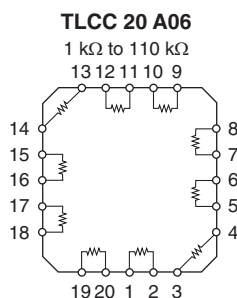
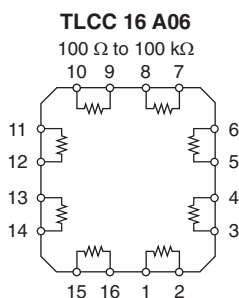
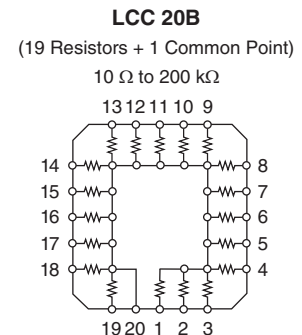
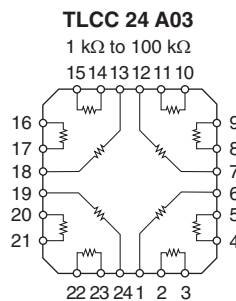
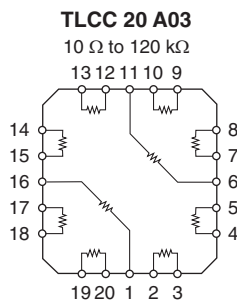
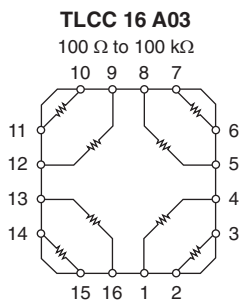
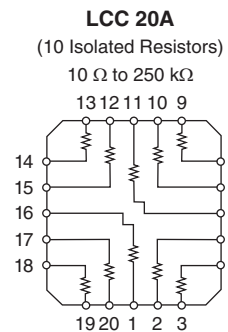
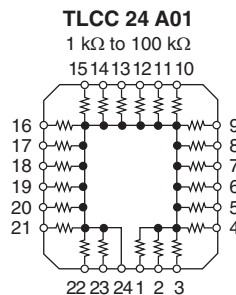
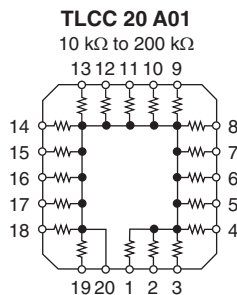
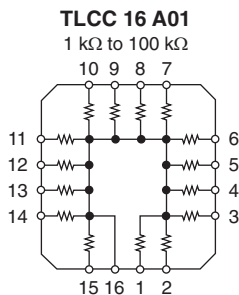
## TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
TCR	25	5
	ABSOLUTE	RATIO
TOL.	0.1	NA

## Note

- Resistance range: Noted on schematics

## SCHEMATIC



STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	16, 20, 24	-
Resistance Range	10 $\Omega$ to 250 k $\Omega$ per resistor	-
TCR: Absolute	$\pm 25$ ppm/ $^{\circ}$ C to $\pm 300$ ppm/ $^{\circ}$ C	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
TCR: Tracking	$\pm 5$ ppm/ $^{\circ}$ C	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
Tolerance: Absolute	$\pm 0.1$ % to $\pm 1.0$ %	+ 25 $^{\circ}$ C
Tolerance: Ratio	N/a	-
Power Rating: Resistor	50 mW max. = common circuits 100 mW max. = isolated circuits	Maximum at + 70 $^{\circ}$ C
Power Rating: Package	500 mW	Maximum at + 70 $^{\circ}$ C
Stability: Absolute	$\Delta R \pm 0.05$ %	2000 h at + 70 $^{\circ}$ C
Stability: Ratio	-	-
Voltage Coefficient	< 5 ppm/V (typical)	-
Working Voltage	100 V max. not to exceed $\sqrt{P \times R}$	-
Operating Temperature Range	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C	-
Storage Temperature Range	- 55 $^{\circ}$ C to + 150 $^{\circ}$ C	-
Noise	< - 30 dB	-
Thermal EMF	0.008 $\mu$ V/ $^{\circ}$ C	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01$ %	1 year at + 25 $^{\circ}$ C
Shelf Life Stability: Ratio	-	-

**Note**

- Tantalum nitride film is custom, consult factory

DIMENSIONS in inches and millimeters						
DIMENSION	16 PINS		20 PINS		24 PINS	
	INCHES	MILLIMETERS	INCHES	MILLIMETERS	INCHES	MILLIMETERS
A	0.050	1.27	0.050	1.27	0.050	1.27
B	0.300	7.26	0.350	8.89	0.400	10.16
C	0.300	7.26	0.350	8.89	0.400	10.16
D	0.077	1.96	0.077	1.96	0.077	1.96
E	0.025	0.635	0.025	0.635	0.025	0.635
F	0.050	1.27	0.050	1.27	0.050	1.27
G	0.040	1.02	0.040	1.02	0.040	1.02
H	0.020	0.508	0.020	0.508	0.020	0.508



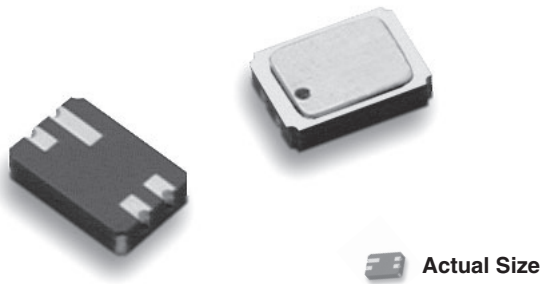
MECHANICAL SPECIFICATIONS	
Resistive Element	Passivated nichrome
Substrate Material	Alumina
Body	Ceramic
Terminals	Gold over nickel
Marking Resistance to Solvents	Per MIL-PRF-83401
Tin Lead Option	Sn63
Lead (Pb)-free Option	96.5 % Sn, 3.0 % Ag, 0.5 % Cu
Tin Lead and Lead (Pb)-free	Hot solder dip

GLOBAL PART NUMBER INFORMATION																	
New Global Part Numbering: TLCC20AE1002BUF																	
T	L	C	C	2	0	A	E	1	0	0	2	B	U	F			
T	L	C	C	T	1	6	A	0	1	K	1	0	0	3	K	U	F
GLOBAL MODEL (4 or 5 digits)	TERMINAL COUNT <sup>(1)</sup>	SCHEMATICS (4 or 5 digits)	TCR CHARACTERISTICS	RESISTANCE	TOLERANCE	PACKAGING											
<b>LCC</b> (Tin lead)	20	<b>A</b> = Isolated resistors <b>B</b> = Resistor to common bus	<b>E</b> = 25 ppm/°C <b>H</b> = 50 ppm/°C <b>K</b> = 100 ppm/°C <b>M</b> = 300 ppm/°C	First 3 digits are significant figures and the last digit specifies the number of zeros to follow.  Example: 10R0 = 10 Ω 12R5 = 12.5 Ω 1000 = 100 Ω 1001 = 1000 Ω	<b>B</b> = 0.1 % <b>D</b> = 0.5 % <b>F</b> = 1 % <b>G</b> = 2 % <b>J</b> = 5 % <b>K</b> = 10 % <b>S</b> = Special	TAPE AND REEL <b>T0</b> = 100 min., 100 mult <b>T1</b> = 1000 min., 1000 mult <b>T3</b> = 300 min., 300 mult <b>T5</b> = 500 min., 500 mult <b>TF</b> = Full reel 2000 <b>TS</b> = 100 min., 1 mult  <b>UF</b> = TUBED											
<b>LCCT</b> (Lead (Pb)-free) (e1)	20																
<b>TLCC</b> (Tin lead)	16 20 24	<b>A01</b> = Resistor to common bus <b>A03</b> = Isolated parallel resistor <b>A06</b> = Isolated adjacent resistor															
<b>TLCCCT</b> (Lead (Pb)-free) (e1)	16 20 24																
Historical Part Number example: LC20BK1003J (for reference purposes only)																	
LC	20	B	K	1003	J												
SERIES	PINS	SCHEMATIC	TCR CHARACTERISTIC	RESISTANCE	TOLERANCE												

Note

<sup>(1)</sup> LCC or LCCT only available in 20 pin size

# Hermetic, 50 mil Pitch, Leadless Thin Film Chip Resistor, Surface Mount Network



Vishay Dale Thin film offers a four terminal hermetic leadless chip carrier package with precision matched pair elements. The network features tight ratio tolerance and close tracking over a 100 Ω to 100 kΩ resistance range. For custom schematics and values contact applications engineering.

## FEATURES

- True hermetic construction
- Exceptional stability and performance characteristics ratio stability ( $\Delta R \pm 0.015\%$  at 70 °C for 2000 h)
- Nickel barrier terminations
- Military/aerospace
- Hermetically sealed
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



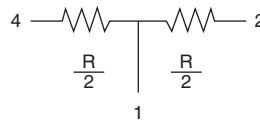
## Note

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

## TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
TCR	25	5
	ABSOLUTE	RATIO
TOL.	0.1	0.05

## SCHEMATIC



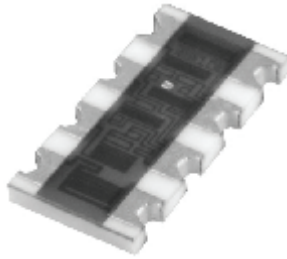
STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	4	-
Resistance Range	100 Ω to 100 kΩ	-
TCR: Absolute	$\pm 25$ ppm/°C (standard)	- 55 °C to + 125 °C
TCR: Tracking	$\pm 2$ ppm/°C (typical < 1 ppm /°C equal values)	- 55 °C to + 125 °C
Tolerance: Absolute	$\pm 0.1\%$ to $\pm 1.0\%$	+ 25 °C
Tolerance: Ratio	$\pm 0.05\%$ to $\pm 0.1\%$	+ 25 °C
Power Rating: Resistor	250 mW (per element)	Maximum at + 70 °C
Power Rating: Package	1000 mW	Maximum at + 70 °C
Stability: Absolute	$\Delta R \pm 0.05\%$	2000 h at + 70 °C
Stability: Ratio	$\Delta R \pm 0.015\%$	2000 h at + 70 °C
Voltage Coefficient	< 0.1 ppm/V	-
Working Voltage	100 V max. not to exceed $\sqrt{P \times R}$	-
Operating Temperature Range	- 55 °C to + 125 °C	-
Storage Temperature Range	- 55 °C to + 150 °C	-
Noise	< - 30 dB	-
Thermal EMF	0.08 μV/°C	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01\%$	1 year at + 25 °C
Shelf Life Stability: Ratio	$\Delta R \pm 0.002\%$	1 year at + 25 °C

DIMENSIONS in inches and millimeters			
<p style="text-align: center;"><b>BOTTOM VIEW</b></p>	DIMENSION	INCHES	MILLIMETERS
	A	0.155	3.937
	B	0.080	2.032
	C	0.225	5.715
	D	0.025 (typical)	0.635
	E	0.040	1.016
	F	0.070	1.778
	G	0.050	1.27

MECHANICAL SPECIFICATIONS	
Resistive Element	Passivated nichrome
Substrate Material	Alumina
Body	Ceramic
Terminals	Gold over nickel
Marking Resistance to Solvents	Per MIL-PRF-83401
Tin Lead Option	Sn63
Lead (Pb)-free Option	96.5 % Sn, 3.0 % Ag, 0.5 % Cu
Tin Lead and Lead (Pb)-free	Hot solder dip

GLOBAL PART NUMBER INFORMATION																											
New Global Part Numbering: <b>MPHK1003BUF</b>																											
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="border: 1px solid black; padding: 2px;">M</td> <td style="border: 1px solid black; padding: 2px;">P</td> <td style="border: 1px solid black; padding: 2px;">H</td> <td style="border: 1px solid black; padding: 2px;">K</td> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">3</td> <td style="border: 1px solid black; padding: 2px;">B</td> <td style="border: 1px solid black; padding: 2px;">U</td> <td style="border: 1px solid black; padding: 2px;">F</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">M</td> <td style="border: 1px solid black; padding: 2px;">P</td> <td style="border: 1px solid black; padding: 2px;">H</td> <td style="border: 1px solid black; padding: 2px;">T</td> <td style="border: 1px solid black; padding: 2px;">K</td> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">3</td> <td style="border: 1px solid black; padding: 2px;">A</td> <td style="border: 1px solid black; padding: 2px;">U</td> <td style="border: 1px solid black; padding: 2px;">F</td> </tr> </table>					M	P	H	K	1	0	0	3	B	U	F	M	P	H	T	K	1	0	0	3	A	U	F
M	P	H	K	1	0	0	3	B	U	F																	
M	P	H	T	K	1	0	0	3	A	U	F																
<b>GLOBAL MODEL</b> (3 or 4 digits)  <b>MPH</b> (Tin lead)  <b>MPHT</b> (Lead (Pb)-free) (e1)	<b>TCR CHARACTERISTIC</b>  <b>E</b> = 25 ppm/°C <b>H</b> = 50 ppm/°C <b>K</b> = 100 ppm/°C	<b>RESISTANCE</b>  First 3 digits are significant figures and the last digit specifies the number of zeros to follow.  Example: 1001 = 1K 1002 = 10K	<b>TOLERANCE AND RATIO TOLERANCE</b>  <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left;">Abs. Tol.</th> <th style="text-align: left;">Ratio</th> </tr> <tr> <td><b>A</b> = 0.1 %</td> <td>0.05 %</td> </tr> <tr> <td><b>B</b> = 0.1 %</td> <td>0.1 %</td> </tr> <tr> <td><b>C</b> = 0.25 %</td> <td>0.1 %</td> </tr> <tr> <td><b>D</b> = 0.5 %</td> <td>0.1 %</td> </tr> <tr> <td><b>F</b> = 1 %</td> <td>0.5 %</td> </tr> </table>	Abs. Tol.	Ratio	<b>A</b> = 0.1 %	0.05 %	<b>B</b> = 0.1 %	0.1 %	<b>C</b> = 0.25 %	0.1 %	<b>D</b> = 0.5 %	0.1 %	<b>F</b> = 1 %	0.5 %	<b>PACKAGING</b>  <b>TAPE AND REEL</b> <b>T0</b> = 100 min., 100 mult <b>T1</b> = 1000 min., 1000 mult <b>T3</b> = 300 min., 300 mult <b>T5</b> = 500 min., 500 mult <b>TF</b> = Full reel 2500 <b>TS</b> = 100 min., 1 mult  <b>UF</b> = TUBED											
Abs. Tol.	Ratio																										
<b>A</b> = 0.1 %	0.05 %																										
<b>B</b> = 0.1 %	0.1 %																										
<b>C</b> = 0.25 %	0.1 %																										
<b>D</b> = 0.5 %	0.1 %																										
<b>F</b> = 1 %	0.5 %																										
<b>Historical Part Number example: MPHE1001B (for reference purposes only)</b>																											
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; padding: 5px;"><b>MPH</b></td> </tr> <tr> <td style="text-align: center; padding: 5px;">SERIES</td> </tr> </table>	<b>MPH</b>	SERIES	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; padding: 5px;"><b>E</b></td> </tr> <tr> <td style="text-align: center; padding: 5px;">TCR CHARACTERISTIC</td> </tr> </table>	<b>E</b>	TCR CHARACTERISTIC	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; padding: 5px;"><b>1001</b></td> </tr> <tr> <td style="text-align: center; padding: 5px;">RESISTANCE</td> </tr> </table>	<b>1001</b>	RESISTANCE	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; padding: 5px;"><b>B</b></td> </tr> <tr> <td style="text-align: center; padding: 5px;">TOLERANCE AND RATIO TOLERANCE</td> </tr> </table>		<b>B</b>	TOLERANCE AND RATIO TOLERANCE															
<b>MPH</b>																											
SERIES																											
<b>E</b>																											
TCR CHARACTERISTIC																											
<b>1001</b>																											
RESISTANCE																											
<b>B</b>																											
TOLERANCE AND RATIO TOLERANCE																											

## High Precision Resistor Thin Film, Surface Mount Arrays



Product may not be to scale

PR arrays can be used in most applications requiring a matched pair (or set) of resistor elements. The networks provide 2 ppm/°C TCR tracking, a ratio tolerance as tight as 0.02 % and outstanding stability. They are available in 1 mm, 1.35 mm and 1.82 mm pitch.

### FEATURES

- Gold terminations over nickel barrier
- High stability passivated nichrome resistive layer
- Tight TCR (10 ppm/°C) and TCR tracking (to 2 ppm/°C)
- Very low noise and voltage coefficient < - 30 dB, 0.1 ppm/V typical
- Ratio tolerance to 0.02 %
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition

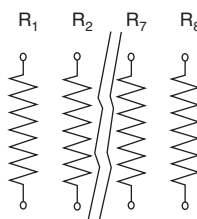


**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

### SCHEMATIC

Schematic A: Independent Resistors

Electrical Diagram



Number of Resistors: 2 to 8

$$R_1 = R_2 = \dots R_8$$

STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	-	-
Resistance Range	100 Ω to 200 kΩ (PR100) 100 Ω to 300 kΩ (PR135) 100 Ω to 1 MΩ (PR182)	-
TCR: Absolute	± 10 ppm/°C	- 55 °C to + 125 °C
TCR: Tracking	± 2 ppm/°C	- 55 °C to + 125 °C
Tolerance: Absolute	± 0.1 % to ± 10 %	-
Tolerance: Ratio	± 0.02 % to ± 0.1 %	-
Power Rating: Resistor	100 mW (PR100) 125 mW (PR135) 200 mW (PR182)	At + 70 °C
Power Rating: Package	-	-
Stability: Absolute	-	-
Stability: Ratio	-	-
Voltage Coefficient	≤ 0.1 ppm/V	-
Working Voltage	35 V (PR100) 75 V (PR135) 100 V (PR182)	-
Operating Temperature Range	- 55 °C to + 125 °C	-
Storage Temperature Range	- 55 °C to + 150 °C	-
Noise	≤ - 30 dB	-
Thermal EMF	-	-
Shelf Life Stability: Absolute	-	-
Shelf Life Stability: Ratio	-	-

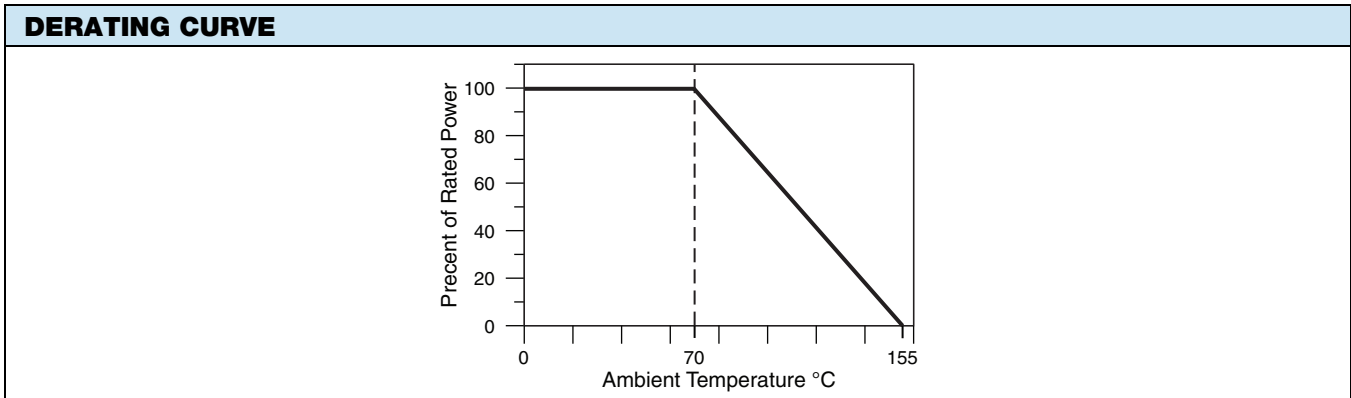


<b>DIMENSIONS</b> in mils				
	<b>DIMENSION</b>	<b>PR100</b>	<b>PR135</b>	<b>PR182</b>
	A	64 ± 6	72 ± 6	118 ± 6
	B	17	20.3	23.6
	C	30	43.3	61.8
	D	10	10	10
	E (1)	$E = (N \times F) \pm 8$	$E = (N \times F) \pm 8$	$E = (N \times F) \pm 8$
	F	40	53.3	71.8
	G	15	15	15

**Notes**

- (1) Where "N" = Number of resistors
- ± 2 mils unless specified

<b>MECHANICAL SPECIFICATIONS</b>	
<b>Substrate</b>	Alumina 99.6 %
<b>Technology</b>	Thin Film
<b>Film</b>	Passivated nichrome
<b>Terminations</b>	Solderable gold (Au) over nickel


**PACKAGING**

Waffle-pack or tape and reel

**MARKING**

On the primary package, printed information includes Vishay trademark series and model, schematic number of resistors, ohmic value, absolute tolerance, ratio tolerance, type of termination



GLOBAL PART NUMBER INFORMATION															
New Global Part Numbering: PR100A41002BBGTS															
P	R	1	0	0	A	4	1	0	0	2	B	B	G	T	S
GLOBAL MODEL	SCHEMATICS	NUMBER OF RESISTORS	RESISTANCE	ABSOLUTE TOLERANCE	RATIO TOLERANCE	TERMINATION	PACKAGING								
PR100 PR135 PR182	A = Isolated resistors	2 3 4 5 6 7 8	First 3 digits are significant figures and the last digit specifies the number of zeros to follow.  Example: 1000 = 100 Ω 1001 = 1000 Ω	B = 0.1 % C = 0.25 % D = 0.5 % F = 1 % G = 2 % J = 5 % K = 10 %	P = 0.02 % <sup>(1)</sup> W = 0.05 % <sup>(2)</sup> B = 0.1 % C = 0.25 % D = 0.5 % F = 1 %	G = Wraparound Au over Ni termination e4 epoxy solderable	WS = WAFFLE 100 min., 1 mult TS = TAPE AND REEL <sup>(3)</sup> 100 min., 1 mult T0 = 100 min., 100 mult T1 = 1000 min., 1000 mult T3 = 300 min., 300 mult T5 = 500 min., 500 mult								
Historical Part Number example: PR100A41002BBGT (for reference purposes only)															
PR100	A	4	1002	B	B	G	T								
SERIES	SCHEMATIC	NUMBER	RESISTANCE	ABSOLUTE TOLERANCE	RATIO TOLERANCE	TERMINATION	PACKAGING								

**Notes**

- (1) > 1 kΩ, max. 4 resistors
- (2) > 100 Ω, up to 8 resistors
- (3) Please refer to below table for tape and reel availability

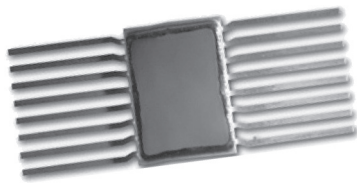
TAPE AND REEL AVAILABILITY			
NUMBER OF RESISTORS	PR100	PR135	PR182
2	Available	Available	Available
3	••	Available	••
4	Available	Available	Available
5	••	Available	Available
6	Available	Available	••
7	••	Available	••
8	Available	••	••

**Note**

•• Not available, consult factory



# Hermetic Flat Pack Thin Film Resistor, Surface Mount Network



Product may not be to scale

### FEATURES

- Military/aerospace
- Hermetically sealed
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



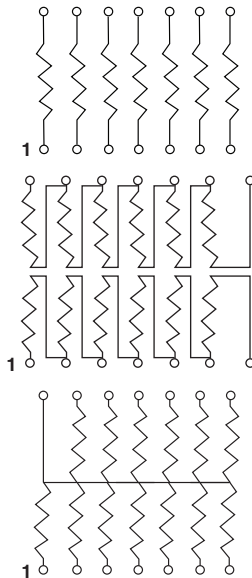
### Note

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

Vishay Dale Thin Film offers a broad line of precision resistor networks in hermetic Flat-Packs for surface mount requirements in military, space or other harsh environmental applications. These networks provide the long-term stability necessary to insure continuous specification and performance over the 20 years to 30 years life required for

space applications. The fabrication of these devices is performed under tight procedural and environmental controls to insure conformance to all 883C level H or K requirements. Custom configurations, values and tolerance combinations are available with fast turnaround.

### SCHEMATICS



FP200	
Number of Resistors	7, 8
Number of Leads	14, 16
Type Connection	Isolated
Values Available	500 Ω to 100 kΩ

FP201	
Number of Resistors	12, 14
Number of Leads	14, 16
Type Connection	Series
Values Available	500 Ω to 100 kΩ

FP202	
Number of Resistors	13, 15
Number of Leads	14, 16
Type Connection	Common
Values Available	500 Ω to 100 kΩ

STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	14, 16	-
Resistance Range	10 Ω to 1 MΩ (total)	-
TCR: Absolute	± 10 ppm/°C to 50 ppm/°C	-
TCR: Tracking	± 5 ppm/°C (standard)	-
Tolerance: Absolute	± 0.05 % to ± 1 %	-
Tolerance: Ratio	± 0.01 % to ± 0.1 %	-
Power Rating: Resistor	100 mW	-
Power Rating: Package	800 mW	70 °C
Stability: Absolute	ΔR ± 0.05 %	2000 h at + 70 °C
Stability: Ratio	ΔR ± 0.015 %	2000 h at + 70 °C
Voltage Coefficient	-	-
Working Voltage	100 V max. not to exceed $\sqrt{P \times R}$	-
Operating Temperature Range	- 55 °C to + 125 °C	-
Storage Temperature Range	- 55 °C to + 150 °C	-
Noise	-	-
Thermal EMF	-	-
Shelf Life Stability: Absolute	ΔR ± 0.01 %	1 year at + 25 °C
Shelf Life Stability: Ratio	ΔR ± 0.002 %	1 year at + 25 °C

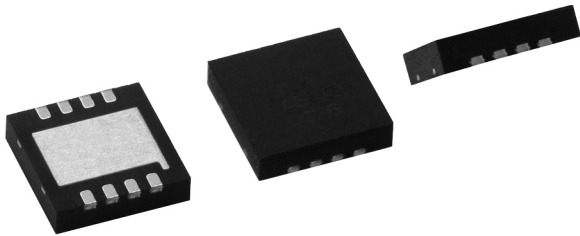
DIMENSIONS in inches (millimeters)					
FLAT-PAK FP200	DIMENSION	14 LEAD		16 LEAD	
		MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
	A	0.086 (2.18)	0.106 (2.69)	0.045 (1.14)	0.115 (2.92)
	b	0.015 (0.38)	0.019 (0.48)	0.015 (0.38)	0.019 (0.48)
	C	0.004 (0.10)	0.007 (0.18)	0.003 (0.08)	0.009 (0.23)
	D	0.373 (9.47)	0.383 (9.73)	-	0.440 (11.18)
	e	0.047 (1.19)	0.053 (1.35)	0.050 (1.27)	BSC
	E	0.250 (6.35)	0.260 (6.60)	0.245 (6.22)	0.285 (7.24)
	E <sub>1</sub>	-	0.290 (7.37)	-	0.315 (8.00)
	E <sub>2</sub>	0.158 (4.01)	0.172 (4.37)	0.130 (3.30)	-
	E <sub>3</sub>	0.030 (0.76)	-	0.030 (0.76)	-
	L	-	-	0.250 (6.35)	0.370 (9.40)
	Q	0.026 (0.66)	-	0.26 (0.66)	0.045 (1.14)
	S	-	0.045 (1.14)	-	0.045 (1.14)
	S <sub>1</sub>	0.005 (0.13)	-	0.005 (0.13)	-
	k	-	-	0.008 (0.20)	0.015 (0.38)

GLOBAL PART NUMBER INFORMATION																	
New Global Part Numbering: FP2001681001BFBCW																	
F	P	2	0	0	1	6	8	1	0	0	1	B	F	B	C	W	
F	P	2	0	2	1	6	1	3	1	0	0	1	B	F	B	C	W
GLOBAL MODEL	CASE SIZE	NUMBER OF RESISTORS (1 or 2 digits)	OHMIC VALUE	ABSOLUTE TOLERANCE	RATIO TOLERANCE	ABSOLUTE TCR	RATIO TCR	PACKAGING									
FP200	14 16	7 8	The first 3 digits are significant figures and the last digit specifies the number of zeros to follow. "R" designates the decimal point. Example: 10R0 = 10 Ω 1000 = 100 Ω 1001 = 1000 Ω	A = 0.05 % B = 0.1 % C = 0.2 % D = 0.5 % F = 1 % G = 2 % J = 5 % K = 10 % M = 20 %	B = 0.01 % C = 0.025 % D = 0.05 % F = 0.1 % H = 0.25 % J = 0.5 % K = 1 % X = Not applicable	A = 10 ppm/°C B = 25 ppm/°C D = 50 ppm/°C E = 100 ppm/°C	C = 2 ppm <sup>(1)</sup> D = 3 ppm <sup>(1)</sup> F = 5 ppm G = 10 ppm X = N/A	W = WAFFLE 100 min., 1 mult									
FP201	14 16	12 14															
FP202	14 16	13 16															
Historical Part Number example: FP2001681002BFBC (for reference purposes only)																	
FP200	16	8	1002	B	F	B	C										
MODEL	NUMBER OF LEADS	NUMBER OF RESISTORS	RESISTANCE	ABSOLUTE TOLERANCE	RATIO TOLERANCE	ABSOLUTE TCR	RATIO TCR										

**Note**

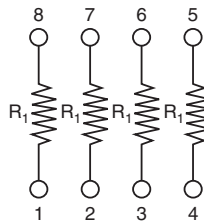
(1) Value dependent

## Dual Flat No Lead Molded Precision Thin Film Resistor Surface Mount Network



The DFN series of precision surface mount resistor networks feature isolated thin film precision resistors mounted in a 0.8 mm pitch 4 mm x 4 mm dual flat no lead package. The networks feature 50 % savings in board space over traditional SOIC packages. They are ideally suited for applications of unity gain operational amplifiers that require close TC tracking and tight ratio tolerances over temperature. Custom configurations are available upon request.

### SCHEMATIC



### FEATURES

- 0.8 mm lead pitch
- MSL level 1 per J-STD-020
- Low profile 1 mm seated height
- Small size 4 mm x 4 mm size 50 % board savings over SOIC packages
- Wide resistance range 100  $\Omega$  to 100 k $\Omega$  available
- Custom configurations available
- Low TCR  $\pm 25$  ppm, TCR tracking to  $\pm 3$  ppm
- Ratio tolerances to  $\pm 0.025$  %
- Compliant to RoHS Directive 2002/95/EC


**RoHS  
COMPLIANT**

### TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
TCR	25	3
	ABSOLUTE	RATIO
TOL.	0.1	0.05

### STANDARD RESISTANCE OFFERING ( $R_1 =$ )

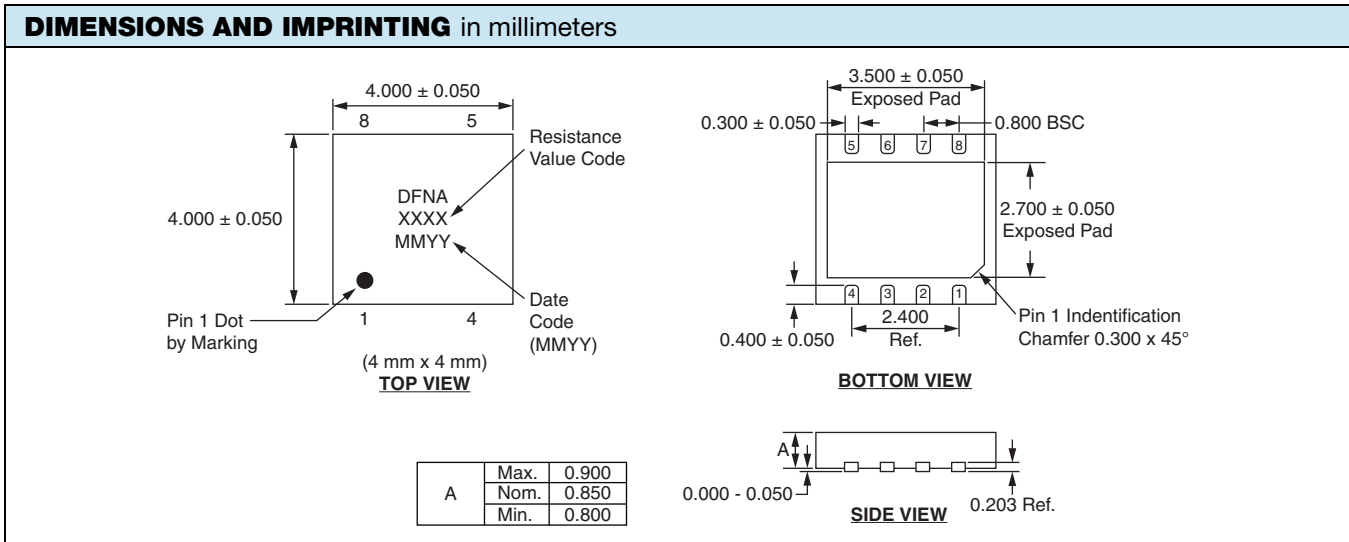
500 $\Omega$	10 k $\Omega$
1 k $\Omega$	20 k $\Omega$
2 k $\Omega$	50 k $\Omega$
4.99 k $\Omega$	100 k $\Omega$
5 k $\Omega$	

#### Note

- Consult factory for additional R values and schematics

### STANDARD ELECTRICAL SPECIFICATIONS

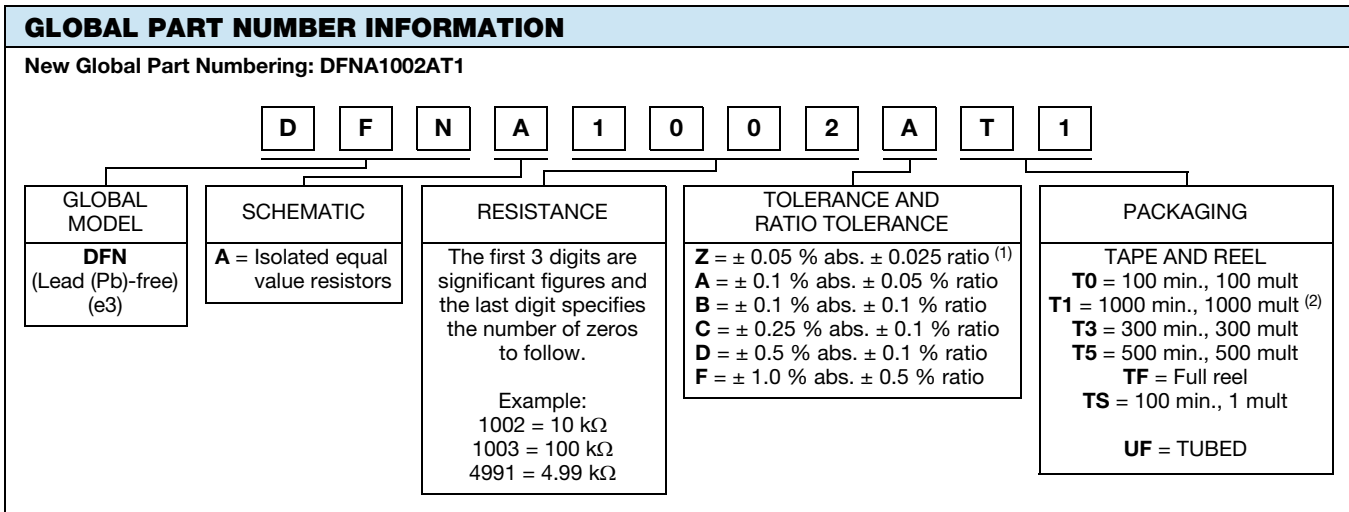
TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	8	-
Resistance Range	100 $\Omega$ to 100 k $\Omega$ per resistor	-
TCR: Absolute	$\pm 25$ ppm/ $^{\circ}$ C	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
TCR: Tracking	$\pm 3$ ppm/ $^{\circ}$ C	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
Tolerance: Absolute	$\pm 0.05$ % to $\pm 1.0$ %	+ 25 $^{\circ}$ C
Tolerance: Ratio	$\pm 0.025$ % to $\pm 0.5$ %	+ 25 $^{\circ}$ C
Power Rating: Resistor	100 mW	Maximum at + 70 $^{\circ}$ C
Power Rating: Package	100 mW x number of resistors	Maximum at + 70 $^{\circ}$ C
Stability: Absolute	$\Delta R \pm 0.05$ %	2000 h at + 70 $^{\circ}$ C
Stability: Ratio	$\Delta R \pm 0.015$ %	2000 h at + 70 $^{\circ}$ C
Voltage Coefficient	< 0.1 ppm/V	-
Working Voltage	100 V max. not to exceed $\sqrt{P \times R}$	-
Operating Temperature Range	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C	-
Storage Temperature Range	- 55 $^{\circ}$ C to + 150 $^{\circ}$ C	-
Noise	< - 30 dB	-
Thermal EMF	< 0.08 $\mu$ V/ $^{\circ}$ C	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01$ %	1 year at + 25 $^{\circ}$ C
Shelf Life Stability: Ratio	$\Delta R \pm 0.002$ %	1 year at + 25 $^{\circ}$ C



**Note**

- Contact factory for package outlines for higher pin count or custom configurations

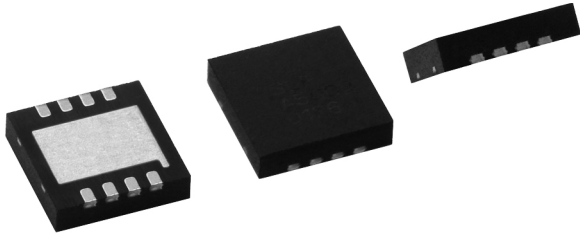
MECHANICAL SPECIFICATIONS	
Resistive Element	Passivated nichrome
Substrate Material	Silicon
Body	Molded epoxy
Terminals	Copper alloy
Plating	100 % matte tin
Marking Resistance to Solvents	Per MIL-PRF-914



**Notes**

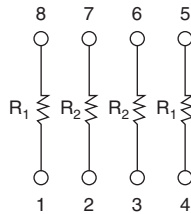
- <sup>(1)</sup> Tolerance available on 1 kΩ and up  
<sup>(2)</sup> Preferred packaging code

## Dual Flat No Lead Molded Precision Thin Film Divider, Surface Mount Resistor Network



The DFN series of thin film precision dividers surface mount resistor networks offer a wide ratio range that is listed in the standard resistance offering table. The 4 mm x 4 mm 0.8 mm pitch dual flat no lead package feature 50 % savings in board space over traditional SOIC packages. The DFN dividers are ideal for applications that require tight TC tracking and ratio tolerances over temperature.

### SCHEMATIC



### FEATURES

- 0.8 mm lead pitch
- MSL level 1 per J-STD-020
- Low profile 1 mm seated height
- Small size 4 mm x 4 mm size 50 % board savings over SOIC packages
- Low TCR  $\pm 25$  ppm, TCR tracking to  $\pm 5$  ppm
- Compliant to RoHS Directive 2002/95/EC


**RoHS  
COMPLIANT**

### TYPICAL PERFORMANCE

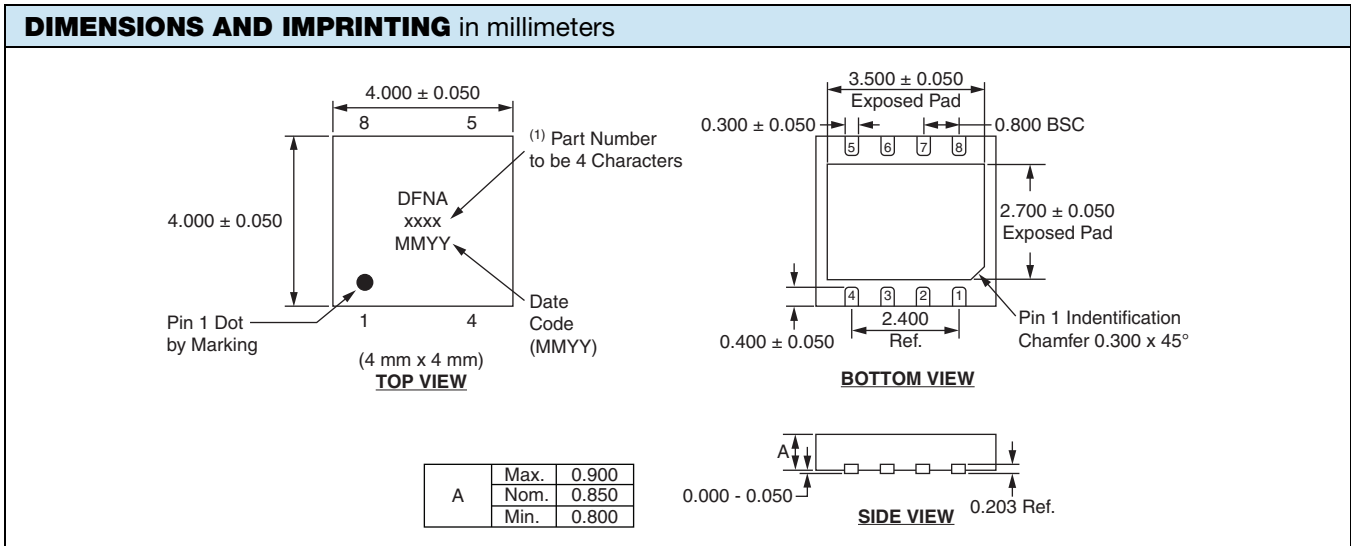
	ABSOLUTE	TRACKING
TCR	25	5
	ABSOLUTE	RATIO
TOL.	0.1	0.05

### STANDARD RESISTANCE OFFERING (R<sub>1</sub>/R<sub>2</sub>)

RATIO	R <sub>1</sub>	R <sub>2</sub>
100:1	100K	1K
50:1	50K	1K
25:1	25K	1K
20:1	20K	1K
10:1	10K	1K
5:1	10K	2K
2:1	10K	5K

### STANDARD ELECTRICAL SPECIFICATIONS

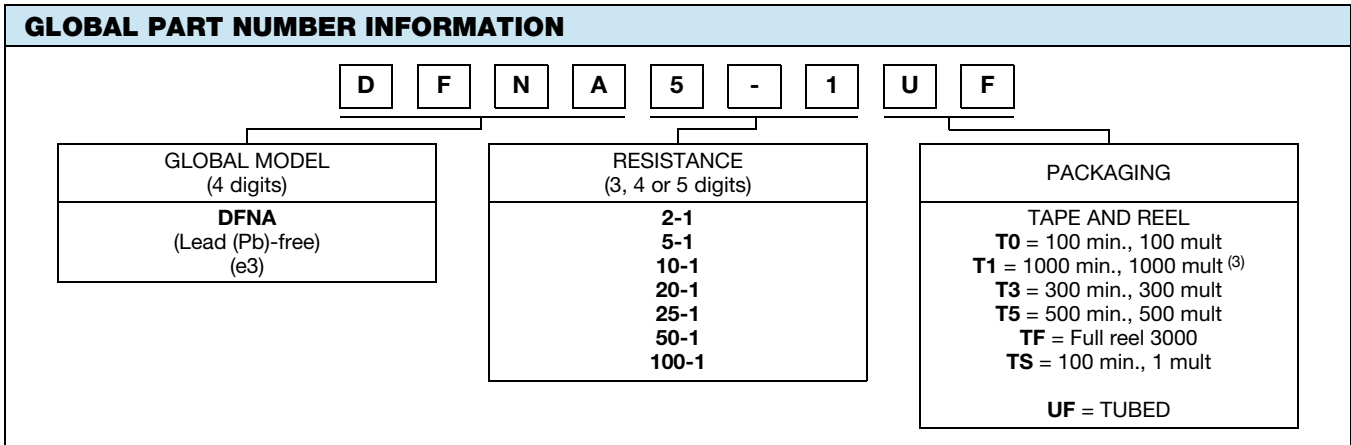
TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	8	-
Resistance Range	1000 $\Omega$ to 100 k $\Omega$ per element	-
TCR: Absolute	$\pm 25$ ppm/ $^{\circ}$ C	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
TCR: Tracking	$\pm 5$ ppm/ $^{\circ}$ C	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
Tolerance: Absolute	$\pm 0.1$ %	+ 25 $^{\circ}$ C
Tolerance: Ratio	$\pm 0.05$ %	+ 25 $^{\circ}$ C
Power Rating: Resistor	100 mW	Maximum at + 70 $^{\circ}$ C
Power Rating: Package	100 mW x number of resistors	Maximum at + 70 $^{\circ}$ C
Stability: Absolute	$\Delta R \pm 0.05$ %	2000 h at + 70 $^{\circ}$ C
Stability: Ratio	$\Delta R \pm 0.015$ %	2000 h at + 70 $^{\circ}$ C
Voltage Coefficient	< 0.1 ppm/V	-
Working Voltage	100 V max. not to exceed $\sqrt{P \times R}$	-
Operating Temperature Range	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C	-
Storage Temperature Range	- 55 $^{\circ}$ C to + 150 $^{\circ}$ C	-
Noise	< - 30 dB	-
Thermal EMF	< 0.08 $\mu$ V/ $^{\circ}$ C	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01$ %	1 year at + 25 $^{\circ}$ C
Shelf Life Stability: Ratio	$\Delta R \pm 0.002$ %	1 year at + 25 $^{\circ}$ C



**Notes**

- (1) 100-1 resistance ratio part marking to be 100-
- (2) Contact factory for package outlines for higher pin count or custom configurations

<b>MECHANICAL SPECIFICATIONS</b>	
Resistive Element	Passivated nichrome
Substrate Material	Silicon
Body	Molded epoxy
Terminals	Copper alloy
Plating	100 % matte tin
Marking Resistance to Solvents	Per MIL-PRF-914

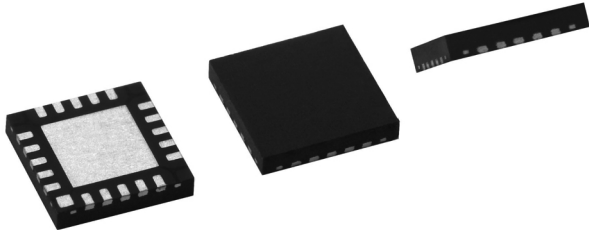


**Note**

- (3) Preferred packaging code



## Quad Flat No Lead Molded Precision Thin Film Resistor, Surface Mount Network



The QFN- series features a standard 20 pins quad flat no lead 5 mm x 5 mm 0.65 mm pitch package. The quad flat no lead package saves board space over traditional SOIC packages. Additional pin counts available, consult factory.

### FEATURES

- 0.65 mm lead pitch
- MSL level 1 per J-STD-020
- Low profile 1 mm seated height
- Small size 5 mm x 5 mm
- Low TCR  $\pm 25$  ppm, TCR tracking to  $\pm 5$  ppm
- Compliant to RoHS Directive 2002/95/EC

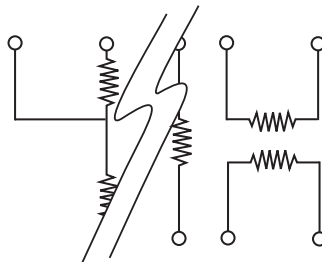


**RoHS**  
COMPLIANT

### TYPICAL PERFORMANCE

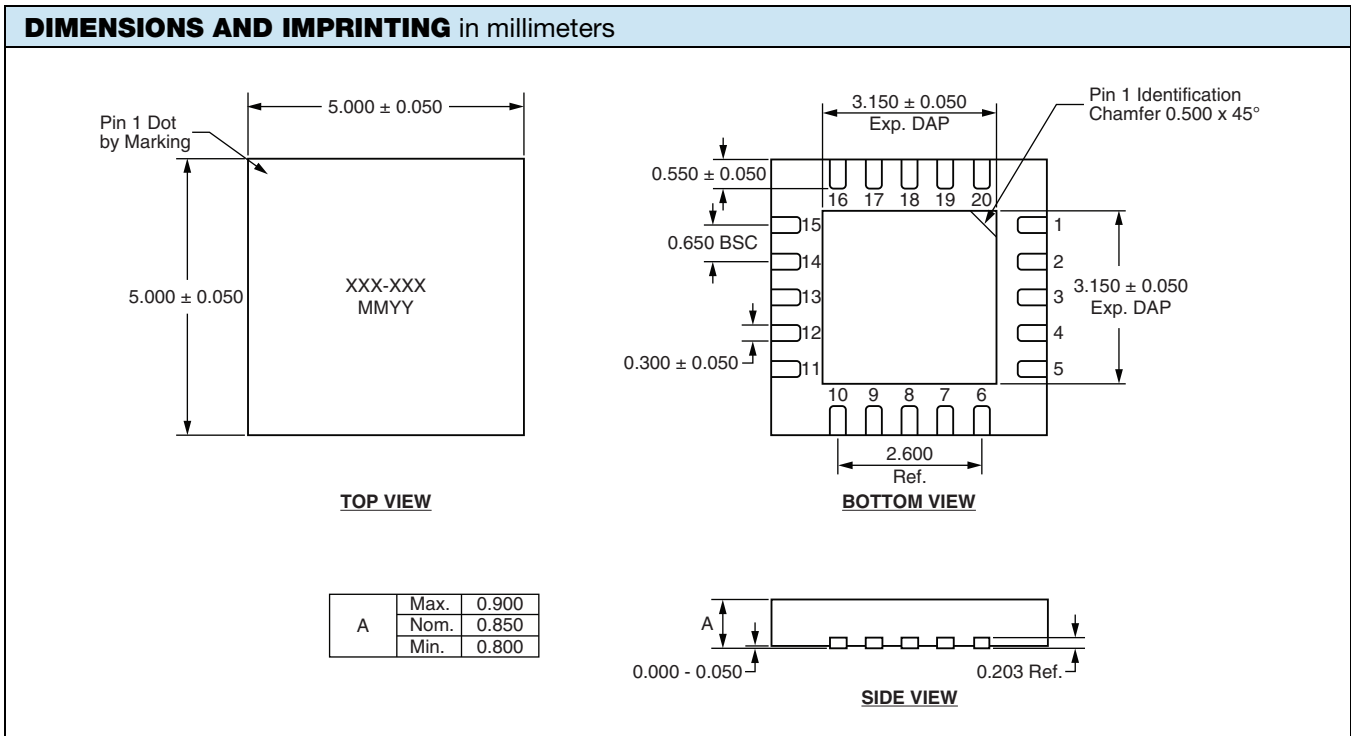
	ABSOLUTE	TRACKING
TCR	25	5
	ABSOLUTE	RATIO
TOL.	0.1	0.05

### SCHEMATIC



Custom schematics available  
Please consult factory

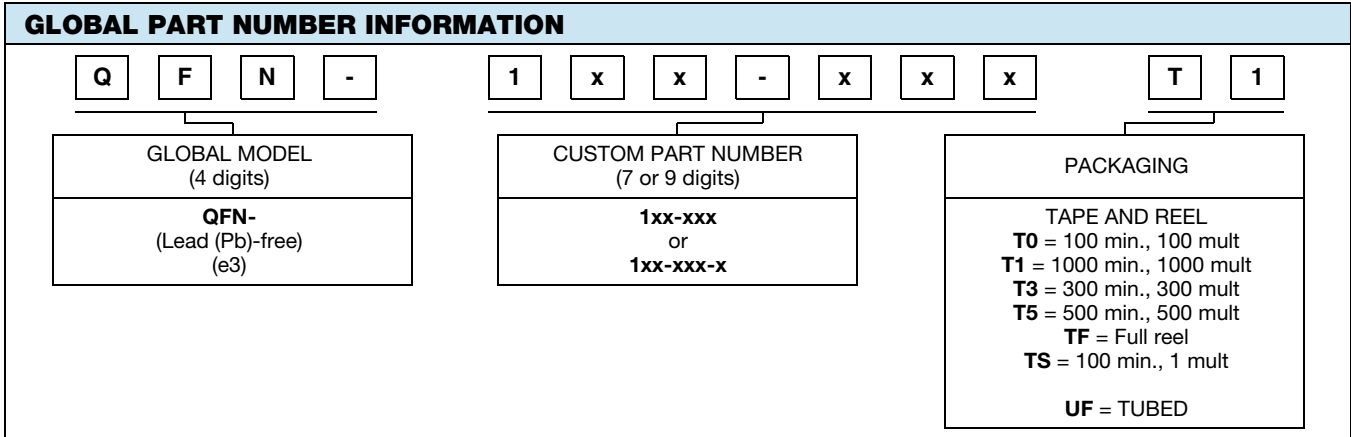
STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	20	-
Resistance Range	100 $\Omega$ (resistor) to 500 k $\Omega$ (total)	-
TCR: Absolute	$\pm 25$ ppm/ $^{\circ}\text{C}$ to $\pm 100$ ppm/ $^{\circ}\text{C}$	- 55 $^{\circ}\text{C}$ to + 125 $^{\circ}\text{C}$
TCR: Tracking	$\pm 5$ ppm/ $^{\circ}\text{C}$ (typical)	- 55 $^{\circ}\text{C}$ to + 125 $^{\circ}\text{C}$
Tolerance: Absolute	$\pm 0.1$ % to $\pm 1.0$ %	+ 25 $^{\circ}\text{C}$
Tolerance: Ratio	$\pm 0.05$ % to $\pm 0.1$ %	+ 25 $^{\circ}\text{C}$
Power Rating: Resistor	100 mW (per element)	Maximum at + 70 $^{\circ}\text{C}$
Power Rating: Package	500 mW	Maximum at + 70 $^{\circ}\text{C}$
Stability: Absolute	$\Delta R \pm 0.05$ %	2000 h at + 70 $^{\circ}\text{C}$
Stability: Ratio	$\Delta R \pm 0.015$ %	2000 h at + 70 $^{\circ}\text{C}$
Voltage Coefficient	0.1 ppm/V	-
Working Voltage	100 V max. not to exceed $\sqrt{P \times R}$	-
Operating Temperature Range	- 55 $^{\circ}\text{C}$ to + 125 $^{\circ}\text{C}$	-
Storage Temperature Range	- 55 $^{\circ}\text{C}$ to + 150 $^{\circ}\text{C}$	-
Noise	< - 30 dB	-
Thermal EMF	0.08 $\mu\text{V}/^{\circ}\text{C}$	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01$ %	1 year at + 25 $^{\circ}\text{C}$
Shelf Life Stability: Ratio	$\Delta R \pm 0.002$ %	1 year at + 25 $^{\circ}\text{C}$


**Note**

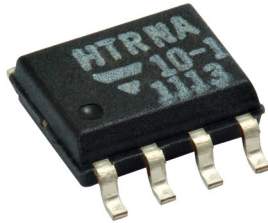
- Contact factory for package outlines for higher pin count or custom configurations

<b>MECHANICAL SPECIFICATIONS</b>	
<b>Resistive Element</b>	Passivated nichrome
<b>Substrate Material</b>	Silicon
<b>Body</b>	Molded epoxy
<b>Terminals</b>	Copper alloy
<b>Plating</b>	100 % matte tin
<b>Marking Resistance to Solvents</b>	Per MIL-PRF-914

<b>ORDERING INFORMATION CHECK LIST (Customs)</b>	
Special requirements should be identified in advance, but as a minimum, you should have the following information ready.	
<b>ELECTRICAL</b>	<b>MECHANICAL</b>
<ol style="list-style-type: none"> <li>1. Resistors, by value and tolerance</li> <li>2. Reference resistor(s) and matching of which resistors to which reference resistors</li> <li>3. Reference by ratio</li> <li>4. Absolute temperature coefficient of resistivity</li> <li>5. Temperature tracking of subordinate resistors to reference resistor(s)</li> <li>6. Maximum operating voltage</li> <li>7. Resistor power ratings</li> <li>8. Operating temperature range</li> </ol>	<ol style="list-style-type: none"> <li>1. Maximum allowable seated height (from PC board to top of network)</li> <li>2. Special marking concerns</li> <li>3. Schematic pin out of package</li> </ol>

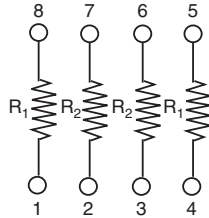


## Molded, 50 mil Pitch, High Temperature (215 °C); Thin Film Surface Mount, Dual-In-Line Resistor Network



HTRN series resistor networks feature four isolated resistors with standard 50 mil pitch lead spacing. HTRN is ideal to be used in oil/gas exploration industry, automotive under the hood applications, and aerospace engine control high temperature applications. The networks feature close TCR tracking and tight ratio tolerance and are ideally suited for unity gain operational amplifier circuitry. The standard resistance offering listed are available for immediate delivery.

### SCHEMATIC



### FEATURES

- Ratio tolerance to  $\pm 0.05\%$
- Ratio stability  $\pm 0.1\%$
- - 55 °C to 215 °C operating temperature range
- 0.068" (1.73 mm) maximum seated height
- Rugged molded case construction with no internal solder
- Low temperature coefficient ( $\pm 25$  ppm/°C)
- JEDEC MS-012 STD variation AA package
- Gold terminations for durable attach bonds
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

### TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
TCR	25	5
	ABSOLUTE	RATIO
TOL.	0.1	0.05

### STANDARD RESISTANCE OFFERING (R<sub>1</sub>/R<sub>2</sub>)

RATIO	R <sub>1</sub>	R <sub>2</sub>
100:1	100K	1K
50:1	50K	1K
25:1	25K	1K
20:1	20K	1K
10:1	10K	1K
5:1	10K	2K
2:1	10K	5K
4:1	4K	1K

#### Note

- Consult factory for additional values and schematics

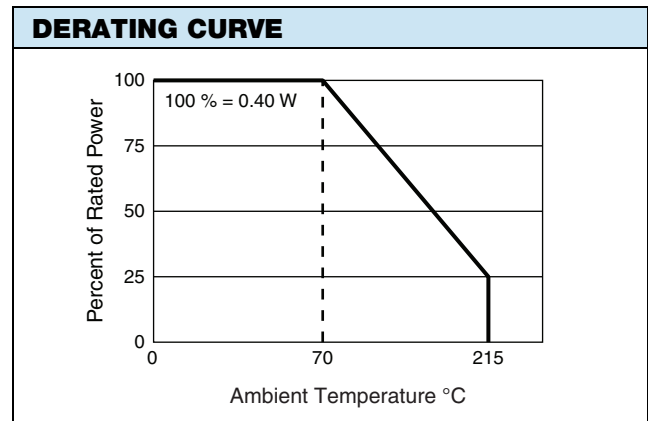
STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	8	-
Resistance Range	1000 $\Omega$ to 100 k $\Omega$ per resistor	-
TCR: Absolute	$\pm 25$ ppm/°C	- 55 °C to + 125 °C
TCR: Tracking	$\pm 5$ ppm/°C	- 55 °C to + 125 °C
Tolerance: Absolute	0.1 %	+ 25 °C
Tolerance: Ratio	0.05 %	+ 25 °C
Power Rating: Resistor	100 mW	Maximum at + 70 °C
Power Rating: Package	400 mW	Maximum at + 70 °C
Stability: Absolute	$\Delta R \pm 0.5\%$	2000 h at + 215 °C at 25 % rated power
Stability: Ratio	$\Delta R \pm 0.1\%$	2000 h at + 215 °C at 25 % rated power
Voltage Coefficient	0.1 ppm/V (typical)	-
Working Voltage	100 V max. not to exceed $\sqrt{P \times R}$	-
Operating Temperature Range	- 55 °C to + 215 °C	-
Storage Temperature Range	- 55 °C to + 215 °C	-
Noise	< - 30 dB	-
Thermal EMF	0.08 $\mu$ V/°C	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01\%$	1 year at + 25 °C
Shelf Life Stability: Ratio	$\Delta R \pm 0.002\%$	1 year at + 25 °C

DIMENSIONS AND IMPRINTING in inches and millimeters			
	<b>DIMENSION</b>	<b>INCHES</b>	<b>MILLIMETERS</b>
	A	0.157	3.99
	B	0.0165 ± 0.0025	0.4 ± 0.06
	C	0.050	1.27
	D	0.195 max.	4.93
	E	0.008 ± 0.001	0.20 ± 0.03
	F	0.028 ± 0.001	0.71 ± 0.02
	G	0.239 ± 0.005	6.07 ± 0.13
	H	0.068 max.	1.73
	I	0.008 ± 0.002	0.22 ± 0.06
Ø	2° to 6°	2° to 6°	

**Note**

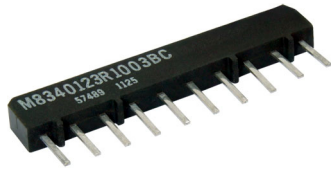
- Marking - Vishay symbol, part number from ordering information

MECHANICAL SPECIFICATIONS	
<b>Resistive Element</b>	Passivated nichrome
<b>Substrate Material</b>	Silicon
<b>Body</b>	Molded epoxy
<b>Terminals</b>	Copper
<b>Termination Finish</b>	Plated Ni/Pd/Au



GLOBAL PART NUMBER INFORMATION																							
New Global Part Numbering: HTRN5-1UF																							
H	T	R	N																				
5	-	1	U																				
F																							
<table border="1"> <thead> <tr> <th>GLOBAL MODEL (4 digits)</th> </tr> </thead> <tbody> <tr> <td>HTRN</td> </tr> </tbody> </table>	GLOBAL MODEL (4 digits)	HTRN	<table border="1"> <thead> <tr> <th>RESISTANCE (3, 4 or 5 digits)</th> </tr> </thead> <tbody> <tr><td>2-1</td></tr> <tr><td>4-1</td></tr> <tr><td>5-1</td></tr> <tr><td>10-1</td></tr> <tr><td>20-1</td></tr> <tr><td>25-1</td></tr> <tr><td>50-1</td></tr> <tr><td>100-1</td></tr> </tbody> </table>	RESISTANCE (3, 4 or 5 digits)	2-1	4-1	5-1	10-1	20-1	25-1	50-1	100-1	<table border="1"> <thead> <tr> <th>PACKAGING</th> </tr> </thead> <tbody> <tr> <td>TAPE AND REEL</td> </tr> <tr> <td><b>T0</b> = 100 min., 100 mult</td> </tr> <tr> <td><b>T1</b> = 1000 min., 1000 mult</td> </tr> <tr> <td><b>T3</b> = 300 min., 300 mult</td> </tr> <tr> <td><b>T5</b> = 500 min., 500 mult</td> </tr> <tr> <td><b>TF</b> = Full reel 3000</td> </tr> <tr> <td><b>TS</b> = 100 min., 1 mult</td> </tr> <tr> <td><b>UF</b> = TUBED</td> </tr> </tbody> </table>		PACKAGING	TAPE AND REEL	<b>T0</b> = 100 min., 100 mult	<b>T1</b> = 1000 min., 1000 mult	<b>T3</b> = 300 min., 300 mult	<b>T5</b> = 500 min., 500 mult	<b>TF</b> = Full reel 3000	<b>TS</b> = 100 min., 1 mult	<b>UF</b> = TUBED
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<b>TS</b> = 100 min., 1 mult																							
<b>UF</b> = TUBED																							

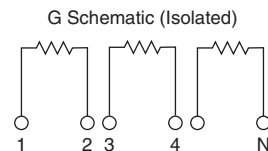
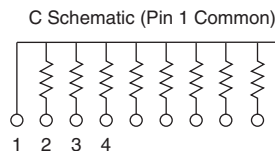
## Thin Film Resistor Network Military, MIL-PRF-83401 Qualified, Type RZ070, RZ080, RZ090, RZ210, RZ220, RZ230, Single-In-Line SIP



Qualified to meet MIL-PRF-83401 characteristic “R”, “V”, and “H”

These resistor networks are available in 6 pins, 8 pins, and 10 pins in schematic C and G styles. Custom circuits are not available. Schematic C and G only. They incorporate Vishay Dale Thin Film’s patented passivated nichrome film to give superior performance on temperature coefficient of resistance, thermal stability, noise, voltage coefficient, power handling and resistance stability. The leads are attached to the metallized alumina substrates by Thermo-Compression bonding. The body is molded thermoset plastic with gold plated copper alloy leads. This product will outperform all of the requirements of characteristic “R”, “V”, and “H” of MIL-PRF-83401.

### SCHEMATIC



### FEATURES

- MIL-PRF-83401 qualified (cage code 57489)
- Low Profile 0.195" (4.95 mm seated height)
- Characteristics R ( $\pm 25$  ppm), H, V, K, and M
- Hot fused tin/lead 60/40 solder dipped
- Rugged molded low profile construction with standoff
- 100 % screened to groups A MIL-PRF-83410 testing
- Tolerances to 0.1 %
- Isolated and bussed (schematic C and G)

### TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
TCR	25	5
	ABSOLUTE	RATIO
TOL.	0.1	0.1 to 0.05

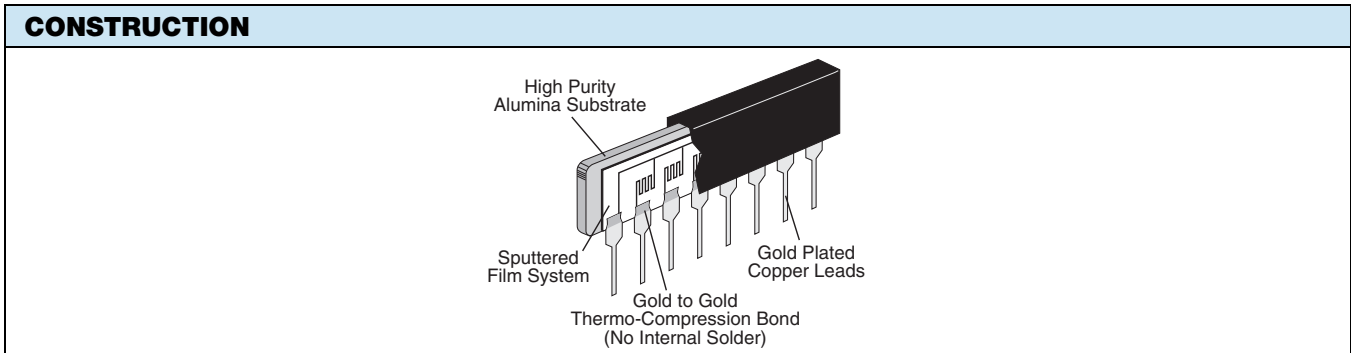
STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	6, 8, 10	-
Resistance Range	100 $\Omega$ to 200 k $\Omega$ per resistor	Tolerance dependent <sup>(2)</sup>
TCR: Absolute	$\pm 25$ ppm/ $^{\circ}$ C to 300 ppm/ $^{\circ}$ C	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C <sup>(1)</sup>
TCR: Tracking	$\pm 5$ ppm/ $^{\circ}$ C	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
Tolerance: Absolute	$\pm 0.1$ % to $\pm 5.0$ %	+ 25 $^{\circ}$ C
Tolerance: Ratio	$\pm 0.05$ % to R <sub>1</sub>	+ 25 $^{\circ}$ C
Power Rating: Resistor	0.06 mW to 0.120 mW (per element typical at + 25 $^{\circ}$ C) <sup>(1)</sup>	Maximum at + 70 $^{\circ}$ C
Power Rating: Package	0.18 W to 1.08 W <sup>(1)</sup>	Maximum at + 70 $^{\circ}$ C
Stability: Absolute	$\Delta R \pm 0.05$ %	2000 h at + 70 $^{\circ}$ C
Stability: Ratio	$\Delta R \pm 0.015$ %	2000 h at + 70 $^{\circ}$ C
Voltage Coefficient	< 0.1 ppm/V	-
Working Voltage	100 V	-
Operating Temperature Range	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C	-
Storage Temperature Range	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C	-
Noise	< - 30 dB	-
Thermal EMF	< 0.08 $\mu$ V/ $^{\circ}$ C	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01$ %	1 year at + 25 $^{\circ}$ C
Shelf Life Stability: Ratio	$\Delta R \pm 0.002$ %	1 year at + 25 $^{\circ}$ C

#### Notes

<sup>(1)</sup> Consult MIL-PRF-83401

<sup>(2)</sup> “H” characteristic 100  $\Omega$  to 100 k $\Omega$  resistance range at 0.1% best  
 “R” characteristic 250  $\Omega$  to 100 k $\Omega$  resistance range at 0.1% best  
 “R” characteristic 250  $\Omega$  to 200 k $\Omega$  resistance range at 1% best

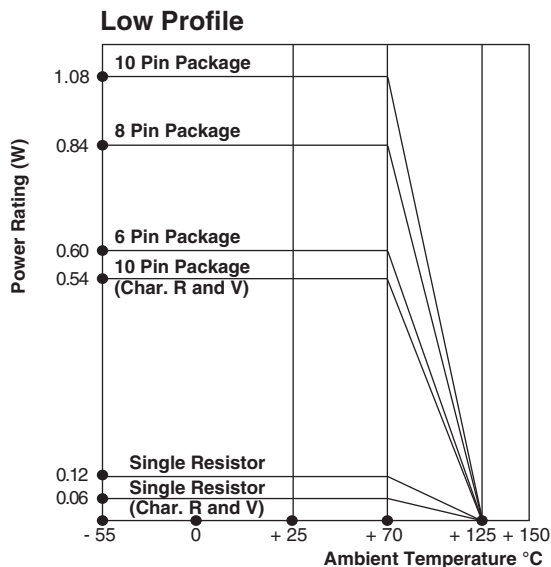
DIMENSIONS AND IMPRINTING in inches and millimeters			
	DIMENSION	INCHES	MILLIMETERS
	A	0.035	0.89
	B	0.040	1.02
	C	0.100 ± 0.005 non-accum.	2.54 ± 0.13
	D	0.019 ± 0.006 typical	0.48 ± 0.15
	E	0.187 ± 0.010	4.75 ± 0.25
	F	0.135	3.43
	G	0.095	2.41
	H	0.012 ± 0.004	0.31 ± 0.10
	L (6 Pins)	0.583 - 0.023/+ 0.01	14.81 - 0.584/+ 0.254
	L (8 Pins)	0.783 - 0.023/+ 0.01	19.89 - 0.584/+ 0.254
	L (10 Pins)	0.983 - 0.023/+ 0.01	24.97 - 0.584/+ 0.254



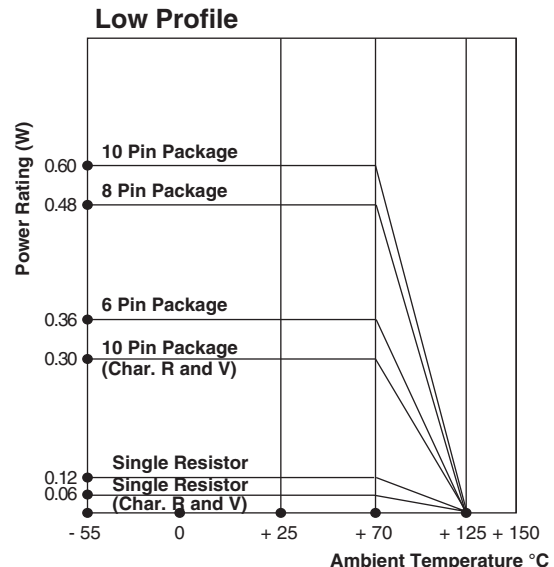
MECHANICAL SPECIFICATIONS	
Resistive Element	TAMELOX passivated nichrome
Substrate Material	Alumina
Body Molded	Epoxy
Terminals	Copper alloy
Plating/Solder	Nickel/gold/Sn63 fussed

**POWER DERATING**

C Schematic (Pin 1 Common Characteristic H)



G Schematic (Isolated Characteristic H)





GLOBAL PART NUMBER INFORMATION																	
New Global Part Numbering: M8340107H10R0BCUFV																	
M	8	3	4	0	1	0	7	H	1	0	R	0	B	C	U	F	V
<b>MODEL</b> (5 digits)	<b>SCHEMATIC</b> (2 digits)		<b>CHARACTERISTIC</b> (1 digit)		<b>RESISTANCE</b> (4 digits)			<b>TOLERANCE</b> (1 digit)		<b>SCHEMATIC</b> (1 digit)		<b>PACKAGING</b> (2 digits)		<b>VENDOR</b> (1 digit)			
<b>M83401</b> Single in-line resistor network low profile  <b>C83401</b> Non burn in screened network	07 = 6 pin 08 = 8 pin 09 = 10 pin  21 = 6 pin <sup>(1)</sup> 22 = 8 pin <sup>(1)</sup> 23 = 10 pin <sup>(1)</sup>		H = 50 ppm/°C V = 50ppm/°C/ 5 ppm/°C Track R = 25 ppm/°C K = 100 ppm/°C M = 300 ppm/°C		First 3 digits are significant figures and the last digit specifies the number of zeros to follow. (100 Ω to 100 kΩ) Examples: 1000 = 100 Ω 1001 = 1000 Ω			B = 0.1 % <sup>(3)</sup> D = 0.5 % <sup>(3)</sup> F = 1 % G = 2 % J = 5 %		C = Pin 1 common G = Isolated resistors		UF = Tubed UI = 100 min., 1 mult (item single lot date code) UP = 100 min., 1 mult (package unit single lot date)		V <sup>(2)</sup> = Vishay Dale Thin Film			

**Notes**

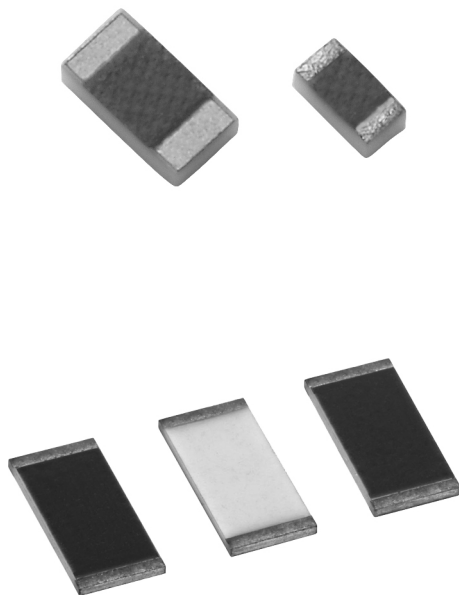
- (1) No internal solder
- (2) "V" is not required for characteristics R, H, and V, only required for K and M. Characteristics tolerance less than 1 %.
- (3) "H" characteristic 100 Ω to 100 kΩ resistance range at 0.1% best  
"R" characteristic 250 Ω to 100 kΩ resistance range at 0.1% best  
"R" characteristic 250 Ω to 200 kΩ resistance range at 1% best

MODEL	SCHEMATIC	CHARACTERISTIC	RESISTANCE RANGE	TOLERANCE	SCHEMATIC
M83401 C83401	07 = 6 pin (RZ070) 08 = 8 pin (RZ080) 09 = 10 pin (RZ090) 21 = 6 pin (RZ210) 22 = 8 pin (RZ220) 23 = 10 pin (RZ230)	H = 50 ppm/°C	100 to 100K	B, D, F, G, J	C, G
		V = 50 ppm/°C/ 5 ppm/°C track	250 to 100K	B, D, F, G, J	
			250 to 200K	F, G, J	
		R = 50 ppm/°C	250 to 100K	B, D, F, G, J	
			250 to 200K	F, G, J	
		K = 100 ppm/°C M = 300 ppm/°C	100 to 100K	B, D, F, G, J	





# Surface Mount Chips



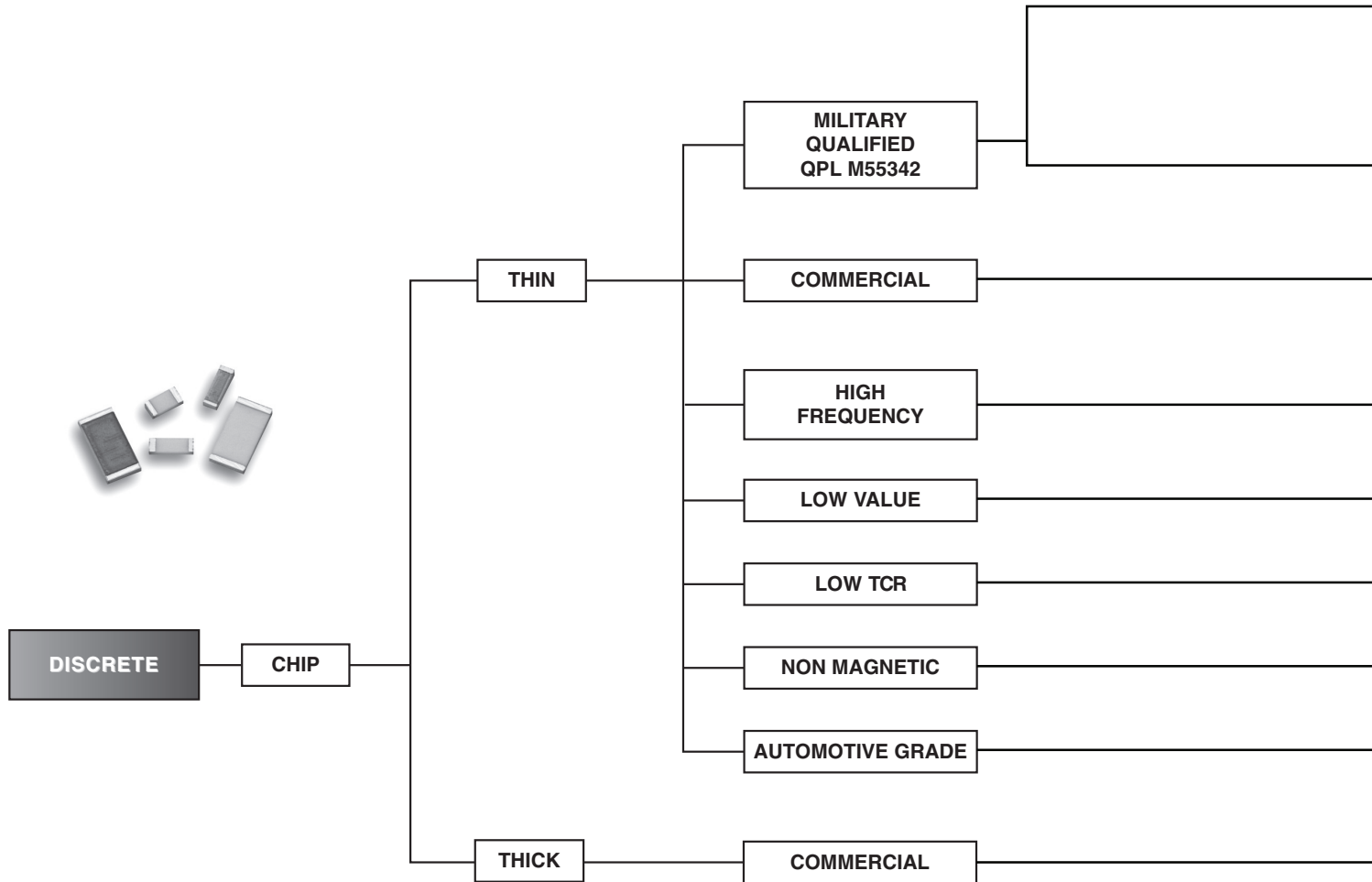
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# Thin Film Surface Mount Resistor Chips





Film Performance

M55342	
Case sizes	
01	02
03	04
05	06
07	08
09	10
11	12

PASSIVATED NICHROME



M55342, E ..... 58

D.S.C.C. Specifications 61

Case sizes	
0402	2512
0505	0603
0705	0805
1005	1010
1206	1505
2010	2208

PASSIVATED NICHROME



P-NS Series ..... 62

TANTALUM NITRIDE



PTN Series ..... 64

PAT Series ..... 81

Case sizes	
0402	0603
0805	1206

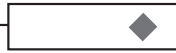
PASSIVATED NICHROME



FC Series ..... 73

Case sizes	
0402	0603
0505	0805
0705	1206
1005	2010
1505	1020
2512	

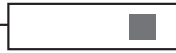
NICKEL ALLOY



L-NS Series ..... 67



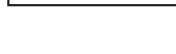
PLT Series ..... 79



PNM Series ..... 76

Case sizes	
0402	1505
0603	2010
0805	2512
1206	

TANTALUM NITRIDE



PAT Series ..... 81

Case sizes	
0402	0502
0504	0505
0603	0705
0805	1002
1005	1010
1206	1505
2208	2010
2512	

RUTHENIUM



M Series ..... 70

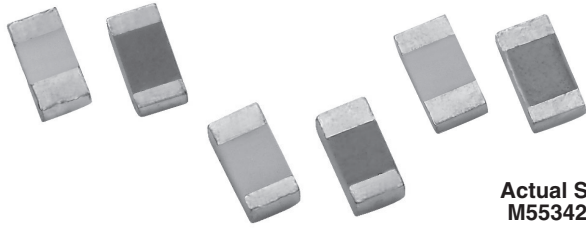
STANDARD PRODUCTS

Tape and Reel Specifications ..... 83

CUSTOM PRODUCTS

Performance Key			
	ABS		ABS
TCR	5	TCR	25
	ABS		ABS
TOL	0.02	TOL	0.1
	ABS		ABS
TCR	10	TCR	100
	ABS		ABS
TOL	0.02	TOL	1.0

## QPL MIL-PRF-55342 Qualified Thin Film Resistor, Surface Mount Chip

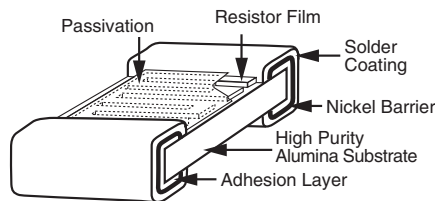


**Actual Size  
M55342/02**

Thin Film Mil chip resistors feature all sputtered wraparound termination for excellent adhesion and dimensional uniformity. They are ideal in applications requiring stringent performance requirements. Established reliability is assured through 100 % screening and extensive environmental lot testing. Wafer is sawed producing exact dimensions and clean, straight edges.

**Note**

- Specification changed by D.S.C.C. from MIL-R-55342 to MIL-PRF-55342

**CONSTRUCTION**

**FEATURES**

- Established reliability, “R” failure rate level (100 ppm), C = 2
- High purity alumina substrate 99.6 % purity
- Wraparound termination featuring a tenacious adhesion layer covered with an electroplated nickel barrier layer for + 150 °C operating conditions
- Very low noise and voltage coefficient (< - 25 dB, 0.5 ppm/V)
- Non-inductive
- Laser-trimmed tolerances ± 0.1 %
- Wraparound resistance less than 0.010 Ω typical
- In-lot tracking less than 5 ppm/°C
- Complete MIL-testing available in-house
- Antistatic waffle pack or tape and reel packaging available
- Military/aerospace/QPL

**GREEN**  
(5-2008)  
Available

**Note**

- \*\* Please see document “Vishay Material Category Policy”:  
[www.vishay.com/doc?99902](http://www.vishay.com/doc?99902)

**TYPICAL PERFORMANCE**

	ABSOLUTE
TCR	25
TOL.	0.1

**STANDARD ELECTRICAL SPECIFICATIONS**

TEST	SPECIFICATIONS	CONDITIONS
Material	Tamelox resistor film (passivated nichrome)	-
Resistance Range	10 Ω to 6.19 MΩ	-
TCR: Absolute	± 25 ppm/°C to ± 300 ppm/°C	- 55 °C to + 125 °C
Tolerance: Absolute	± 0.1 % to ± 10 %	+ 25 °C
Stability: Absolute	ΔR ± 0.02 %	2000 h at + 70 °C
Stability: Ratio	-	-
Voltage Coefficient	0.1 ppm/V	-
Working Voltage	30 V to 200 V	-
Operating Temperature Range	- 55 °C to + 125 °C	-
Storage Temperature Range	- 55 °C to + 150 °C	-
Noise	< - 25 dB	-
Shelf Life Stability: Absolute	ΔR ± 0.01 %	1 year at + 25 °C

**COMPONENT RATINGS**

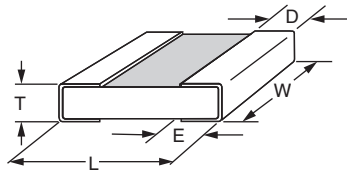
CASE SIZE	POWER RATING (mW)	WORKING VOLTAGE (V)	RESISTANCE RANGE (Ω) BY CHARACTERISTICS TOLERANCE			
			E (0.1 %)	E (1 %, 2 %, 5 %)	H, K, M (0.1 %)	H, K, M (1 %, 2 %, 5 %)
M55342/01	50	40	49.9 to 150K	49.9 to 150K	20 to 150K	20 to 150K
M55342/02	125	40	49.9 to 301K	49.9 to 301K	20 to 301K	20 to 301K
M55342/03	200	75	49.9 to 649K	49.9 to 649K	10 to 649K	10 to 649K
M55342/04	150	125	49.9 to 1.69M	49.9 to 1.69M	10 to 1.69M	10 to 1.69M
M55342/05	225	175	49.9 to 3.16M	49.9 to 3.16M	10 to 3.16M	10 to 3.16M
M55342/06	150	50	49.9 to 475K	49.9 to 475K	10 to 475K	10 to 475K
D55342/07	250	100	49.9 to 1.5M	49.9 to 1.5M	10 to 1.5M	10 to 1.5M
M55342/08	800	150	49.9 to 4.02M	49.9 to 4.02M	10 to 4.02M	10 to 4.02M
M55342/09	1000	200	49.9 to 6.19M	49.9 to 6.19M	10 to 6.19M	10 to 6.19M
M55342/10	500	75	49.9 to 1M	49.9 to 1M	49.9 to 1M	49.9 to 1M
M55342/11	50	30	49.9 to 100K	49.9 to 100K	20 to 100K	20 to 100K
M55342/12	100	50	49.9 to 258K	49.9 to 261K	10 to 258K	10 to 261K

**Note**

- Values listed are a guide, refer to MIL spec for value/tolerance allowance



**DIMENSIONS** in inches



CASE SIZE	TERM.	L	W	T	D	E
M55342/01	B	0.055 ± 0.006	0.025 ± 0.005	0.010 to 0.030	0.010 ± 0.005	0.015 ± 0.005
M55342/02	B	0.055 ± 0.006	0.050 ± 0.005	0.012 to 0.033	0.010 ± 0.005	0.015 ± 0.005
M55342/03	B	0.105 ± 0.007	0.050 ± 0.005	0.015 to 0.033	0.015 ± 0.005	0.015 ± 0.005
M55342/04	B	0.155 ± 0.007	0.050 ± 0.005	0.015 to 0.033	0.015 ± 0.005	0.015 ± 0.005
M55342/05	B	0.230 ± 0.007	0.075 ± 0.005	0.015 to 0.033	0.020 ± 0.005	0.020 ± 0.005
M55342/06	B	0.080 ± 0.006	0.050 ± 0.005	0.015 to 0.033	0.016 ± 0.008	0.015 ± 0.005
D55342/07	B	0.126 ± 0.008	0.063 ± 0.005	0.015 to 0.033	0.020 + 0.005/- 0.010	0.020 + 0.005/- 0.010
M55342/08	B	0.209 + 0.009/- 0.018	0.098 ± 0.005	0.015 to 0.033	0.020 ± 0.005	0.020 ± 0.005
M55342/09	B	0.259 + 0.009/- 0.015	0.124 ± 0.005	0.015 to 0.033	0.020 ± 0.005	0.020 ± 0.005
M55342/10	B	0.105 ± 0.007	0.100 ± 0.005	0.015 to 0.033	0.015 ± 0.005	0.015 ± 0.005
M55342/11	B	0.040 ± 0.005	0.025 ± 0.005	0.010 to 0.030	0.010 ± 0.005	0.015 ± 0.005
M55342/12	B	0.064 ± 0.006	0.032 ± 0.005	0.010 to 0.033	0.012 ± 0.005	0.015 ± 0.005

**ENVIRONMENTAL TESTS**

ENVIRONMENTAL TEST	MIL-PRF-55342 LIMITS (ΔR ±)	VISHAY PERFORMANCE (ΔR ±)
Thermal Shock	0.1 %	0.020 %
Low Temperature Operation	0.1 %	0.025 %
Short Time Overload	0.1 %	0.050 %
High Temperature Exposure	0.1 %	0.009 %
Resistance to Bonding	0.2 %	0.006 %
Moisture Resistance	0.2 %	0.004 %
TCR	± 25 ppm/°C	< 15 ppm/°C
Life (2000 h at + 70 °C)	0.5 %	0.02 %
Life (10 000 h at + 70 °C)	2.0 %	0.04 %

**MECHANICAL SPECIFICATIONS**

Resistive Element	Passivated nichrome
Substrate Material	Alumina
Chip Terminations	Solder over nickel
Fused Solder	SN 63

**FSCM CAGE # - 57489**



GLOBAL PART NUMBER INFORMATION																	
New Global Part Numbering: M55342E06B1C00RTS V																	
M	5	5	3	4	2	E	0	6	B	1	C	0	0	R	T	S	V
GLOBAL MODEL	TCR CHARACTERISTIC	CASE SIZE	TERMINATION	OHMIC VALUE			FAILURE RATE	PACKAGING			THIN FILM CODE <sup>(1)</sup>						
M55342 or D55342 (/07 size only)	E = 25 ppm/°C H = 50 ppm/°C K = 100 ppm/°C M = 300 ppm/°C	01 = 0502 02 = 0505 03 = 1005 04 = 1505 05 = 2208 06 = 0705 07 = 1206 08 = 2010 09 = 2512 10 = 1010 11 = 0402 12 = 0603	B = Solderable	Three digits and a letter. Letter identifies tolerance, acts as multiplier and decimal locator.  MULTIPLIER Tolerance 1 Ω 1 kΩ 1 MΩ 0.1 % A B C 1 % D E F 2 % G H T 5 % J K L 10 % M N P			M = 1.0 % per 1000 h P = 0.1 % per 1000 h R = 0.01 % per 1000 h C = Non ER version	<b>Standard Packaging:</b> <b>BS</b> = BULK 100 min., 1 mult <b>WS</b> = WAFFLE 100 min., 1 mult TAPE AND REEL <b>T0</b> = 100 min., 100 mult <b>T1</b> = 1000 min., 1000 mult <b>T3</b> = 300 min., 300 mult <b>T5</b> = 500 min., 500 mult <b>TF</b> = Full reel (2K, 4K, or 5K dependent on case size) per tape and reel document 60034 <b>TS</b> = 100 min., 1 mult <b>Special Packaging:</b> WAFFLE <b>WI</b> = 100 min., 1 mult (item single lot date code) <b>WP</b> = 100 min., 1 mult (package unit single lot date code) TAPE AND REEL <b>TI</b> = 100 min., 1 mult (item single lot date code) <b>TP</b> = 100 min., 1 mult (package unit single lot date code)			V for K and M TCR W/tolerance ≥ 1 %						
<b>Historical Part Number example: M55342K06B5E60R (for reference purposes only)</b>																	
M55342	K	06	B	5E60		R											
SERIES	TCR CHARACTERISTIC	CASE SIZE	TERMINATION	VALUE AND TOLERANCE		FAILURE RATE											

**Note**

<sup>(1)</sup> Only add a V at the end of part number to specify Vishay Dale Thin Film for K/M TCR and tolerance 1 % and higher



# QPL MIL-PRF-55342 Qualified Thin Film Resistor, Surface Mount Chip



Thin Film MIL-PRF-55342 established reliability "T" level chip resistors feature a thin film resistor element and with all sputtered wraparound terminations that provide excellent adhesion and dimensional uniformity. They are ideal in applications requiring stringent performance requirements. Established reliability is assured through 100 % screening and extensive environmental testing for every lot that includes complete 100 % group A, power conditioning and group B lot testing performed for T-level product assurance.

### FEATURES

- T-level (space) qualified
- Passes outgassing requirements of ASTM-E595 requirements
- TCR to  $\pm 25$  ppm/ $^{\circ}$ C
- Tolerances to  $\pm 0.1$  %
- 100 % power conditioning

### TYPICAL PERFORMANCE

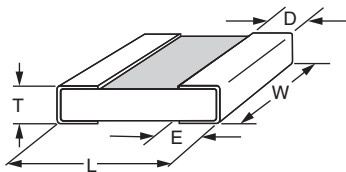
	ABSOLUTE
TCR	25
TOL.	0.1

STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Tamelox resistor film (passivated nichrome)	-
Resistance Range	100 $\Omega$ to 1.5 M $\Omega$	-
TCR: Absolute	25 ppm/ $^{\circ}$ C (E), 50 ppm/ $^{\circ}$ C (H)	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
Tolerance: Absolute	$\pm 0.1$ %	+ 25 $^{\circ}$ C
Stability: Absolute	$\Delta R \pm 0.02$ %	2000 h at + 70 $^{\circ}$ C
Voltage Coefficient	< 0.1 ppm/V	-
Working Voltage	40 V to 125 V	-
Operating Temperature Range	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C	-
Storage Temperature Range	- 55 $^{\circ}$ C to + 150 $^{\circ}$ C	-
Noise	< - 25 dB	-
Thermal EMF	< 0.1 $\mu$ V/ $^{\circ}$ C	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01$ %	1 year at + 25 $^{\circ}$ C

COMPONENT RATINGS						
CASE SIZE	MAX. WORKING VOLTAGE (V)	POWER RATING (mW)	RESISTANCE RANGE ( $\Omega$ ) BY CHARACTERISTICS TOLERANCE			
			E (0.1 %)	E (1 %, 2 %, 5 %)	H, K, M (0.1 %)	H, K, M (1 %, 2 %, 5 %)
M55342/02	40	125	49.9 to 301K	49.9 to 301K	20 to 301K	20 to 301K
M55342/03	75	200	49.9 to 649K	49.9 to 649K	10 to 649K	10 to 649K
M55342/04	125	150	49.9 to 1.69M	49.9 to 1.69M	10 to 1.69M	10 to 1.69M
M55342/06	50	150	49.9 to 475K	49.9 to 475K	10 to 475K	10 to 475K
D55342/07	100	250	49.9 to 1.5M	49.9 to 1.5M	10 to 1.5M	10 to 1.5M
M55342/10	75	500	49.9 to 1M	49.9 to 1M	49.9 to 1M	49.9 to 1M



**DIMENSIONS** in inches



CASE SIZE	TERM.	L	W	T	D	E
M55342/02	B	0.055 ± 0.006	0.050 ± 0.003	0.012 to 0.033	0.010 ± 0.005	0.015 ± 0.005
M55342/03	B	0.105 ± 0.007	0.050 ± 0.003	0.015 to 0.033	0.015 ± 0.005	0.015 ± 0.005
M55342/04	B	0.155 ± 0.007	0.050 ± 0.003	0.015 to 0.033	0.015 ± 0.005	0.015 ± 0.005
M55342/06	B	0.080 ± 0.006	0.050 ± 0.003	0.015 to 0.033	0.016 ± 0.008	0.015 ± 0.005
D55342/07	B	0.126 ± 0.008	0.063 ± 0.005	0.015 to 0.033	0.020 + 0.005/- 0.010	0.020 + 0.005/- 0.010
M55342/10	B	0.105 ± 0.007	0.100 ± 0.005	0.015 to 0.033	0.015 ± 0.005	0.015 ± 0.005

**ENVIRONMENTAL TESTS**

ENVIRONMENTAL TEST	MIL-PRF-55342 LIMITS (ΔR ±)	VISHAY PERFORMANCE (ΔR ±)
Thermal Shock	0.10 %	0.02 %
Low Temperature Operation	0.10 %	0.03 %
Short Time Overload	0.10 %	0.05 %
High Temperature Exposure	0.10 %	0.01 %
Resistance to Bonding	0.20 %	0.01 %
Moisture Resistance	0.20 %	0.04 %
TCR	± 25 ppm/°C	< 15 ppm/°C
Life (2000 h at + 70 °C)	0.05 %	0.02 %
Life (10 000 h at + 70 °C)	2.00 %	0.04 %

**MECHANICAL SPECIFICATIONS**

Resistive Element	Passivated nichrome
Substrate Material	Alumina
Chip Terminations	Solder over nickel
Fused Solder	SN 63





GLOBAL PART NUMBER INFORMATION																	
Global Part Numbering: M55342E06B1C00TTS																	
M	5	5	3	4	2	E	0	7	B	1	C	0	0	T	T	S	V
MODEL	TCR CHARACTERISTIC	CASE SIZE	TERMINATION	OHMIC VALUE				PRODUCT LEVEL DESIGNATOR	PACKAGING				VENDOR				
M55342 or D55342 (/07 size only)	E = 25 ppm/°C > 100 Ω H = 50 ppm/°C K = 100 ppm/°C (1) M = 300 ppm/°C (1)	02 = 0505 03 = 1005 04 = 1505 06 = 0705 07 = 1206 10 = 1010	B = Solderable	Three digits and a letter. Letter identifies tolerance, acts as multiplier and decimal locator.  MULTIPLIER Tolerance 1 Ω 1 kΩ 1 MΩ 0.1 % A B C 1 % D E F 2 % G H T 5 % J K L 10 % M N P				T = Space level	BS = BULK 1 min., 1 mult  WAFFLE PACK WS = WAFFLE 25 min., 1 mult WI = 25 min., 1 mult (item single lot date code) WP = 25 min., 1 mult (package unit single lot date code)  TAPE AND REEL TO = 100 min., 100 mult T1 = 1000 min., 1000 mult T3 = 300 min., 300 mult T5 = 500 min., 500 mult TF = Full reel TS = 100 min., 1 mult TI = 100 min., 1 mult (item single lot date code) TP = 100 min., 1 mult (package unit single lot date code)				V = Vishay Thin Film (1)				

**Notes**

(1) For K and M TCR ≥ 1 % tolerance add a V at end of part number to specify Vishay Thin Film vs. Dale Thick Film. E.g.: M55342K06B1F00TWSV

- Consult factory for additional case size qualification pending



### D.S.C.C. Specifications (Formerly DESC)

Vishay Thin Film (Niagara Falls) is listed on the following D.S.C.C. specifications:

<b>D.S.C.C. SPECIFICATIONS SURFACE MOUNT RESISTOR NETWORKS</b>	
06018	3 PIN Surface Mount SOT-23 Voltage Divider
87012	16 PIN Surface Mount Gull Wing Resistor Network
87014	16 PIN Leadless Chip Carrier
87015	28 PIN Leadless Chip Carrier
87016	20 PIN Leadless Chip Carrier
87017	20 PIN Leadless Chip Carrier THICK FILM
87018	16 PIN Leadless Chip Carrier
87025	8 PIN DIP HERMETIC
87032	10 PIN SIP

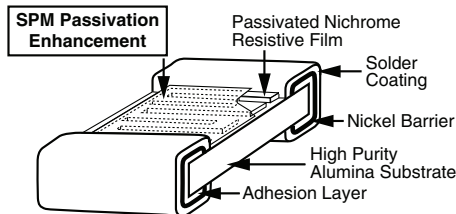
<b>D.S.C.C. SPECIFICATIONS SURFACE MOUNT CHIP RESISTORS</b>	
87011	Zero Ohm Wraparound Chip (1010 Size)
90047	Zero Ohm Wraparound Chip (2208 Size)
90048	Zero Ohm Wraparound Chip (0805 Size)
90049	Zero Ohm Wraparound Chip (1005 Size)
90092	Zero Ohm Wraparound Chip (1505 Size)
94011	Zero Ohm Wraparound Chip (1206 Size)
94012	0505 MOISTURE RESISTANT PTN Wraparound Chip Resistor (0505 Size)
94013	1005 MOISTURE RESISTANT PTN Wraparound Chip Resistor (1005 Size)
94014	2208 MOISTURE RESISTANT PTN Wraparound Chip Resistor (2208 Size)
94015	0705 MOISTURE RESISTANT PTN Wraparound Chip Resistor (0705 Size)
94016	1206 MOISTURE RESISTANT PTN Wraparound Chip Resistor (1206 Size)
94017	2010 MOISTURE RESISTANT PTN Wraparound Chip Resistor (2010 Size)
94018	2512 MOISTURE RESISTANT PTN Wraparound Chip Resistor (2512 Size)
94019	1010 MOISTURE RESISTANT PTN Wraparound Chip Resistor (1010 Size)
94025	0502 MOISTURE RESISTANT PTN Wraparound Chip Resistor (0502 Size)
94026	1505 MOISTURE RESISTANT PTN Wraparound Chip Resistor (1505 Size)
04008	0402 MOISTURE RESISTANT PTN Wraparound Chip Resistor (0402 Size)
04009	0603 MOISTURE RESISTANT PTN Wraparound Chip Resistor (0603 Size)
02008	Low and High Values, 1.0 M $\Omega$ to 10 M $\Omega$ (1206 Size)
02010	Low Values, 0.1 $\Omega$ to 1 $\Omega$ (1206 Size)
03022	Low Values, 0.1 $\Omega$ to 1 $\Omega$ (0603 Size)

## Commercial Thin Film Resistor, Surface Mount Chip


 Actual Size  
0505

For applications requiring low noise, stability, low temperature coefficient of resistance, and low voltage coefficient, all Vishay's proven precision thin film wraparound resistors will meet your exact requirements. Manufactured with the same material and processes as QPL and manufactured in a QPL facility.

### CONSTRUCTION



### FEATURES

- Moisture resistant (SPM) special passivation method
- Non-standard values available
- Pre-tinned terminations over nickel barrier (gold available)
- Very low noise and voltage coefficient (< -35 dB, 0.1 ppm/V)
- Non-inductive
- Laser-trimmed tolerances to 0.02 %
- In-lot tracking less than 5 ppm/°C
- Epoxy bondable termination available
- Sulfur resistant (per ASTM B809-95 humid vapor test)
- Compliant to RoHS Directive 2002/95/EC


**RoHS\***  
COMPLIANT

**GREEN**  
(5-2008)  
Available

### Notes

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

\*\* Please see document "Vishay Material Category Policy":  
[www.vishay.com/doc?99902](http://www.vishay.com/doc?99902)

### TYPICAL PERFORMANCE

	ABSOLUTE
TCR	25
TOL.	0.1

### STANDARD ELECTRICAL SPECIFICATIONS

TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Resistance Range	10 Ω to 6.19 MΩ	-
TCR: Absolute	± 10 ppm/°C to 100 ppm/°C	- 55 °C to + 125 °C
Tolerance: Absolute	± 0.02 % to ± 5 %	+ 25 °C
Stability: Absolute	ΔR ± 0.02 %	2000 h at 70 °C
Stability: Ratio	-	-
Voltage Coefficient	0.1 ppm/V (typical)	-
Working Voltage	75 V to 200 V	-
Operating Temperature Range	- 55 °C to + 125 °C	-
Storage Temperature Range	- 55 °C to + 150 °C	-
Noise	< - 35 dB (typical)	-
Shelf Life Stability: Absolute	ΔR ± 0.01 %	1 year at + 25 °C

### COMPONENT RATINGS

CASE SIZE <sup>(1)</sup>	POWER RATING (mW)	WORKING VOLTAGE (V)	RESISTANCE RANGE (Ω)	
			≥ 0.1 %	< 0.1 %
0402	50	75	25 to 100K	250 to 100K
0502	100	75	20 to 150K	250 to 150K
0505	150	75	20 to 301K	250 to 301K
0603	150	75	10 to 261K	250 to 261K
0705	250	100	10 to 475K	250 to 475K
0805	250	100	10 to 475K	250 to 475K
1005	250	100	10 to 649K	250 to 649K
1010	500	150	50 to 1M	250 to 1M
1206	400	200	10 to 1.5M <sup>(2)</sup>	250 to 1M
1505	400	150	10 to 1M	250 to 1M
2208	800	150	10 to 3.16M <sup>(2)</sup>	250 to 1M
2010	800	200	10 to 4.02M <sup>(2)</sup>	250 to 1M
2512	1000	200	10 to 6.19M <sup>(2)</sup>	250 to 1M

### Notes

<sup>(1)</sup> 0705 and 0805 are the same (only use 0805 when ordering)

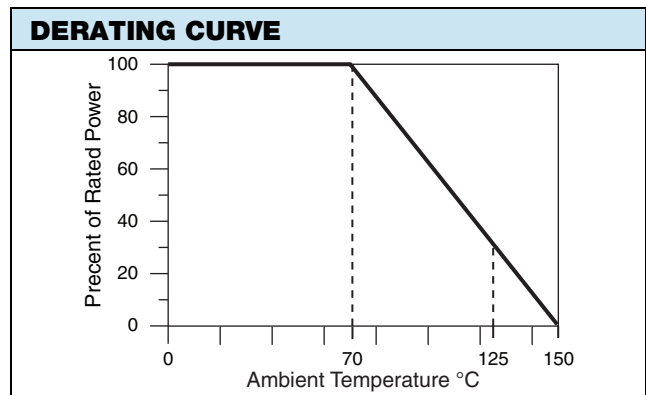
<sup>(2)</sup> Values > 1M best TCR ± 25 ppm/°C

DIMENSIONS in inches						
CASE SIZE	TERM	L	W	T	D	E
0402	B	0.042 ± 0.008	0.022 ± 0.005	0.012 to 0.033	0.010 ± 0.005	0.010 ± 0.005
0502	B	0.055 ± 0.006	0.025 ± 0.005	0.012 to 0.033	0.010 ± 0.005	0.015 ± 0.005
0505	B	0.055 ± 0.006	0.050 ± 0.005	0.012 to 0.033	0.010 ± 0.005	0.015 ± 0.005
0603	B	0.064 ± 0.006	0.032 ± 0.005	0.020 max.	0.012 ± 0.005	0.015 ± 0.005
0705, 0805 <sup>(1)</sup>	B	0.080 ± 0.006	0.050 ± 0.005	0.015 to 0.033	0.016 ± 0.008	0.015 ± 0.005
1005	B	0.105 ± 0.007	0.050 ± 0.005	0.015 to 0.033	0.015 ± 0.005	0.015 ± 0.005
1010	B	0.105 ± 0.007	0.100 ± 0.005	0.015 to 0.033	0.015 ± 0.005	0.015 ± 0.005
1206	B	0.126 ± 0.008	0.063 ± 0.005	0.015 to 0.033	0.020 + 0.005/- 0.010	0.020 + 0.005/- 0.010
1505	B	0.155 ± 0.007	0.050 ± 0.005	0.015 to 0.033	0.015 ± 0.005	0.015 ± 0.005
2010	B	0.209 ± 0.009	0.098 ± 0.005	0.015 to 0.033	0.020 ± 0.005	0.020 ± 0.005
2208	B	0.230 ± 0.007	0.075 ± 0.005	0.015 to 0.033	0.020 ± 0.005	0.020 ± 0.005
2512	B	0.259 ± 0.009	0.124 ± 0.005	0.015 to 0.033	0.020 ± 0.005	0.020 ± 0.005

**Note**

<sup>(1)</sup> 0705 and 0805 are the same (only use 0805 when ordering)

ENVIRONMENTAL TESTS		
ENVIRONMENTAL TEST	10 kΩ ΔR ± (%)	100 kΩ ΔR ± (%)
Thermal Shock	0.02	0.02
Short Time Overload	0.01	0.01
Low Temperature Operation	0.01	0.01
Resistance to Solder Heat	0.04	0.03
Moisture Resistance	0.02	0.01
High Temperature Exposure	0.03	0.06
Load Life (10 000 h, + 70 °C)	0.05	0.05
TCR	± 25 ppm/°C	± 25 ppm/°C



### GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: P-1206E1002BBS

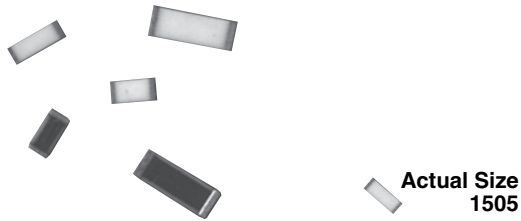
P	-	1	2	0	6	E	1	0	0	2	B	B	T	S
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GLOBAL MODEL	CASE SIZE	TCR CHARACTERISTIC	RESISTANCE	TOLERANCE	TERMINATION	PACKAGING
P-	0402 0502 0505 0603 0805 1005 1010 1206 1505 2208 2010 2512	Y = ± 10 ppm/°C <sup>(2)</sup> D = ± 15 ppm/°C E = ± 25 ppm/°C H = ± 50 ppm/°C K = ± 100 ppm/°C  <b>Note</b> <sup>(2)</sup> > 250 Ω	The first 3 digits are significant figures and the last digit specifies the number of zeros to follow. "R" designates the decimal point.  Example: 10R0 = 10 Ω 1001 = 1 kΩ 1002 = 10 kΩ	<b>Q</b> = ± 0.02 % <sup>(3)</sup> <b>A</b> = ± 0.05 % <sup>(3)</sup> <b>B</b> = ± 0.1 % <b>D</b> = ± 0.5 % <b>F</b> = ± 1 % <b>G</b> = ± 2 % <b>J</b> = ± 5 %  <b>Note</b> <sup>(3)</sup> For values ≥ 250 Ω	<b>B</b> = Wraparound Sn/Pb solder 63 % Sn/37 % Pb w/ nickel barrier <b>G</b> = Wraparound Au over Ni (gold) termination epoxy bondable RoHS compliant - e4 <b>S</b> = Wraparound lead (Pb)-free solder 96.5 % Sn/3.0 % Ag/0.5 % Cu RoHS compliant - e1	<b>BS</b> = BULK 100 min., 1 mult <b>WS</b> = WAFFLE 100 min., 1 mult <b>TAPE AND REEL</b> <b>T0</b> = 100 min., 100 mult <b>T1</b> = 1000 min., 1000 mult <sup>(4)</sup> <b>T3</b> = 300 min., 300 mult <b>T5</b> = 500 min., 500 mult <b>TF</b> = Full reel <b>TS</b> = 100 min., 1 mult  <b>Note</b> <sup>(4)</sup> Preferred packaging code

**Historical Part Number Example: P0805H6801BBT (for reference purposes only)**

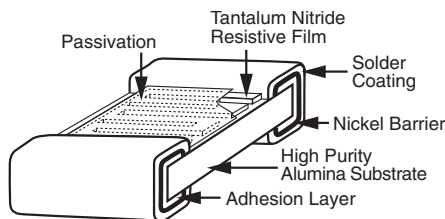
P	0805	H	6801	B	B	T
STYLE	CASE SIZE	TCR CHARACTERISTIC	OHMIC VALUE	TOLERANCE	TERMINATION	PACKAGING

## Commercial Thin Film Chip Resistor, Surface Mount Chip



These chip resistors are available in both “top side” and “wraparound” termination styles in a variety of sizes. They incorporate self passivated, enhanced Tantalum Nitride films, to give superior performance on moisture resistance, voltage coefficient, power handling and resistance stability. The terminations consist of an adhesion layer, a leach resistant nickel barrier, and solder coating. This product will out-perform all requirements of characteristic E of MIL-PRF-55342.

### CONSTRUCTION



### FEATURES

- Moisture resistant
- High purity alumina substrate
- Non-standard values available
- Will pass + 85 °C, 85 % relative humidity and 10 % rated power
- 100 % visual inspected per MIL-PRF-55342
- Non-inductive
- Very low noise and voltage coefficient (< - 30 dB)
- Laser-trimmed tolerances to ± 0.1 %
- Wraparound resistance less than 10 mΩ
- Epoxy bondable termination available
- Sulfur resistant (per ASTM B809-95 humid vapor test)
- Material categorization: For definitions please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS\***  
COMPLIANT

**GREEN**  
(5-2008)  
Available

### Note

\* Lead (Pb)-containing terminations are not RoHS-compliant. Exemptions may apply.

### TYPICAL PERFORMANCE

	ABSOLUTE
TCR	25
TOL.	0.1

### STANDARD ELECTRICAL SPECIFICATIONS

TEST	SPECIFICATIONS	CONDITIONS
Material	Tantalum nitride	-
Resistance Range	10 Ω to 3 MΩ	-
TCR: Absolute	± 25 ppm/°C to ± 100 ppm/°C	- 55 °C to + 125 °C
Tolerance: Absolute	± 0.1 % to ± 5 %	+ 25 °C
Stability: Absolute	ΔR ± 0.03 %	2000 h at 70 °C
Stability: Ratio	-	-
Voltage Coefficient	0.1 ppm/V	-
Working Voltage	75 V to 200 V	-
Operating Temperature Range	- 55 °C to + 125 °C	-
Storage Temperature Range	- 55 °C to + 150 °C	-
Noise	< - 30 dB	-
Shelf Life Stability: Absolute	-	-

### COMPONENT RATINGS

CASE SIZE <sup>(1)</sup>	POWER RATING (mW)	WORKING VOLTAGE (V)	RESISTANCE RANGE (Ω)
0402	50	75	20 to 51.1K
0502	100	75	20 to 65K
0505	150	75	20 to 130K
0603	150	75	10 to 120K
0705	200	100	10 to 301K
0805	200	100	10 to 301K
1005	250	100	10 to 360K
1010	500	150	50 to 600K
1206	400	200	10 to 1M
1505	400	150	10 to 1M
2208	750	150	10 to 1.75M
2010	800	200	10 to 2M
2512	1000	200	10 to 3M

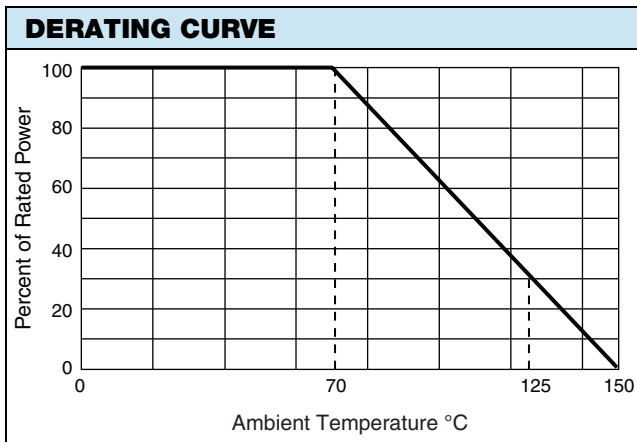
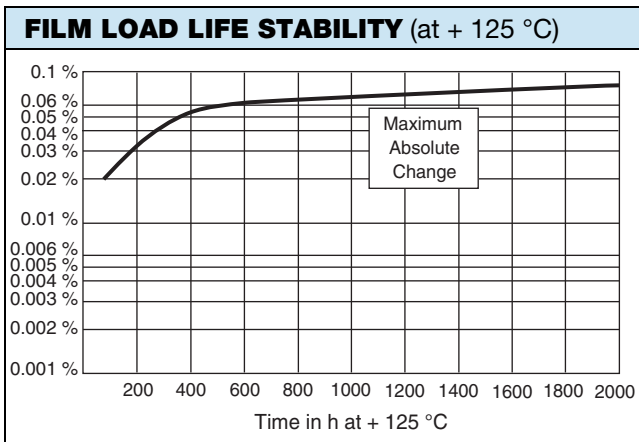
### Note

<sup>(1)</sup> 0705 and 0805 are the same (only use 0805 when ordering)

<b>DIMENSIONS</b> in inches					
CASE SIZE	L	W	T	D	E
0402	0.042 ± 0.008	0.022 ± 0.005	0.012 to 0.033	0.010 ± 0.005	0.010 ± 0.005
0502	0.055 ± 0.006	0.025 ± 0.005	0.012 to 0.033	0.010 ± 0.005	0.015 ± 0.005
0505	0.055 ± 0.006	0.050 ± 0.005	0.012 to 0.033	0.010 ± 0.005	0.015 ± 0.005
0603	0.064 ± 0.006	0.032 ± 0.005	0.020 max.	0.012 ± 0.005	0.015 ± 0.005
0705, 0805 <sup>(1)</sup>	0.080 ± 0.006	0.050 ± 0.005	0.015 to 0.033	0.015 ± 0.005	0.015 ± 0.005
1005	0.105 ± 0.007	0.050 ± 0.005	0.015 to 0.033	0.015 ± 0.005	0.015 ± 0.005
1010	0.105 ± 0.007	0.100 ± 0.005	0.015 to 0.033	0.015 ± 0.005	0.015 ± 0.005
1206	0.126 ± 0.008	0.063 ± 0.005	0.015 to 0.033	0.020 ± 0.005 / - 0.010	0.020 ± 0.005 / - 0.010
1505	0.155 ± 0.007	0.050 ± 0.005	0.015 to 0.033	0.015 ± 0.005	0.015 ± 0.005
2010	0.209 ± 0.009	0.098 ± 0.005	0.015 to 0.033	0.020 ± 0.005	0.020 ± 0.005
2208	0.230 ± 0.007	0.075 ± 0.005	0.015 to 0.033	0.020 ± 0.005	0.020 ± 0.005
2512	0.259 ± 0.009	0.124 ± 0.005	0.015 to 0.033	0.020 ± 0.005	0.020 ± 0.005

**Note**
<sup>(1)</sup> 0705 and 0805 are the same (only use 0805 when ordering)

<b>ENVIRONMENTAL TESTS</b> (Vishay Performance vs. MIL-PRF-55342 Requirements)		
ENVIRONMENTAL TEST	LIMITS MIL-PRF-55342 CHARACTERISTIC "E"	TYPICAL VISHAY PERFORMANCE
Resistance Temperature Characteristic	± 25 ppm/°C	± 15 ppm/°C
Max. Ambient Temp. at Rated Wattage	+ 70 °C	+ 70 °C
Max. Ambient Temp. at Power Derating	+ 150 °C	+ 150 °C
Thermal Shock $\Delta R$	± 0.1 %	± 0.040 %
Low Temperature Operation $\Delta R$	± 0.1 %	± 0.001 %
Short Time Overload $\Delta R$	± 0.10 %	± 0.002 %
High Temperature Exposure $\Delta R$	± 0.1 %	± 0.04 %
Resistance to Soldering Heat $\Delta R$	± 0.2 %	± 0.008 %
Moisture Resistance $\Delta R$	± 0.2 %	± 0.004 %
Life + 70 °C at 1000 h $\Delta R$	± 0.50 %	± 0.02 %
Insulation Resistance	10 000 $\Omega$ minimum	> 100 000 M $\Omega$



### GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: **PTN1206E1002BBT1**

<b>P</b>	<b>T</b>	<b>N</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>6</b>	<b>E</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>B</b>	<b>B</b>	<b>T</b>	<b>1</b>
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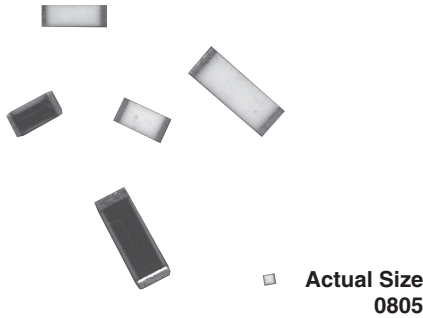
GLOBAL MODEL	CASE SIZE	TCR CHARACTERISTIC	RESISTANCE	TOLERANCE	TERMINATION	PACKAGING
<b>PTN</b>	<b>0402</b> <b>0502</b> <b>0505</b> <b>0603</b> <b>0805</b> <b>1005</b> <b>1010</b> <b>1206</b> <b>1505</b> <b>2208</b> <b>2010</b> <b>2512</b>	<b>E</b> = ± 25 ppm/°C <b>H</b> = ± 50 ppm/°C <b>K</b> = ± 100 ppm/°C	The first 3 digits are significant figures and the last digit specifies the number of zeros to follow. "R" designates the decimal point.  Example: 10R0 = 10 Ω 1000 = 100 Ω 1001 = 1 kΩ	<b>B</b> = ± 0.1 % <b>D</b> = ± 0.5 % <b>F</b> = ± 1 % <b>G</b> = ± 2 % <b>J</b> = ± 5 %	<b>B</b> = Wraparound Sn/Pb solder Sn63 w/nickel barrier <b>G</b> = Wraparound Au over Ni (gold) termination epoxy bondable RoHS compliant - e4 <b>S</b> = Wraparound lead (Pb)-free solder 96.5 % Sn/3.0 % Ag/0.5 % Cu RoHS compliant - e1	<b>BS</b> = BULK 100 min., 1 mult <b>WS</b> = WAFFLE 100 min., 1 mult <b>W0</b> = WAFFLE 100 min., 100 mult  TAPE AND REEL <b>T0</b> = 100 min., 100 mult <b>T1</b> = 1000 min., 1000 mult <sup>(1)</sup> <b>T3</b> = 300 min., 300 mult <b>T5</b> = 500 min., 500 mult <b>TF</b> = Full reel <b>TS</b> = 100 min., 1 mult

Historical Part Number example: **PTN0805H8801BBT** (for reference purposes only)

<b>PTN</b>	<b>0805</b>	<b>H</b>	<b>8801</b>	<b>B</b>	<b>B</b>	<b>T</b>
STYLE	CASE SIZE	TCR CHARACTERISTIC	OHMIC VALUE	TOLERANCE	TERMINATION	PACKAGING

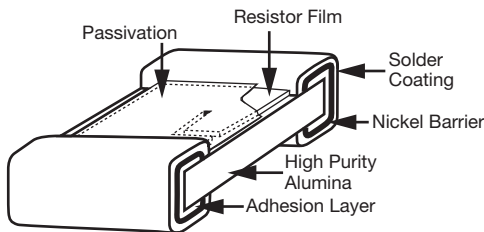
**Note**  
<sup>(1)</sup> Preferred packaging code

## Low Value (0.03 Ω to 10 Ω) Thin Film Resistor, Surface Mount Chip



With extremely low resistances and high power capabilities, Vishay's proven and unique ultra-low value resistors can be used in your hybrid or surface mount applications. These resistors are available with solderable or weldable terminations.

### CONSTRUCTION



### FEATURES

- Homogeneous **nickel alloy film**
- No inductance for high frequency application
- Alumina substrates for high power handling capability (2 W maximum power rating)
- Pre-soldered or gold terminations
- Epoxy bondable termination available
- Sulfur resistant (per ASTM B809-95 humid vapor test)
- Compliant to RoHS Directive 2002/95/EC



**RoHS\***  
COMPLIANT  
**GREEN**  
(5-2008)  
Available

### Notes

- \* Pb containing terminations are not RoHS compliant, exemptions may apply
- \*\* Please see document "Vishay Material Category Policy": [www.vishay.com/doc?99902](http://www.vishay.com/doc?99902)

### TYPICAL PERFORMANCE

◆	ABSOLUTE
TCR	300
TOL.	1.0

### VALUE AND MINIMUM TOLERANCE

VALUE (Ω)	MINIMUM TOLERANCE
0.1	± 2.0 %
0.25	± 1.0 %
0.5	± 1.0 %
1.0	± 1.0 %
2.0	± 1.0 %
10.0	± 1.0 %
< 0.1	20 %

### STANDARD ELECTRICAL SPECIFICATIONS

TEST	SPECIFICATIONS	CONDITIONS
<b>Material</b>	Nickel alloy	-
<b>Resistance Range</b>	0.03 Ω to 10 Ω	-
<b>TCR: Absolute</b>	± 300 ppm/°C	- 55 °C to + 125 °C
<b>Tolerance: Absolute</b>	1 % to 20 % (value dependent)	-
<b>Stability: Absolute</b>	-	-
<b>Stability: Ratio</b>	-	-
<b>Voltage Coefficient</b>	-	-
<b>Working Voltage</b>	-	-
<b>Operating Temperature Range</b>	- 55 °C to + 125 °C	-
<b>Storage Temperature Range</b>	- 55 °C to + 150 °C	-
<b>Noise</b>	< - 35 dB (typical)	-
<b>Shelf Life Stability: Absolute</b>	-	-

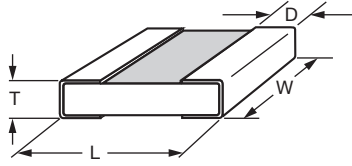
### COMPONENT RATINGS

CASE SIZE <sup>(1)</sup>	POWER RATING (mW)	RESISTANCE RANGE (Ω)
0505	125	0.05 to 5.0
0603	125	0.10 to 5.0
0705	200	0.10 to 6.0
0805	200	0.10 to 6.0
1005	250	0.15 to 10.0
1020	1000	0.03 to 3.0
1206	330	0.10 to 10.0
1505	500	0.25 to 10.0
2010	1000	0.17 to 10.0
2512	2000	0.18 to 10.0

### Notes

- Resistor values beyond ranges shall be reviewed by the factory
- <sup>(1)</sup> 0705 and 0805 are the same (only use 0805 when ordering)



**DIMENSIONS** in inches and millimeters


CASE SIZE	SIZE							
	L		W		T		D	
	INCHES	MILLIMETERS	INCHES	MILLIMETERS	INCHES	MILLIMETERS	INCHES	MILLIMETERS
	+ 0.010/- 0.005	+ 0.25/- 0.13	± 0.005	± 0.13	MAX.		+ 0.010/- 0.005	+ 0.25/- 0.13
0505	0.050	1.27	0.050	1.27	0.020	0.51	0.016	0.41
0603	0.064	1.65	0.032	0.81	0.020	0.51	0.012	0.30
0705, 0805 <sup>(1)</sup>	0.075	1.91	0.050	1.27	0.020	0.51	0.021	0.53
1005	0.100	2.54	0.050	1.27	0.030	0.76	0.021	0.53
1020	0.100	2.54	0.200	5.08	0.030	0.76	0.015	0.38
1206	0.126	3.20	0.063	1.60	0.030	0.76	0.020	0.51
1505	0.150	3.81	0.050	1.27	0.030	0.76	0.021	0.53
2010	0.200	5.08	0.100	2.54	0.030	0.76	0.019	0.48
2512	0.250	6.35	0.125	3.18	0.030	0.76	0.019	0.48

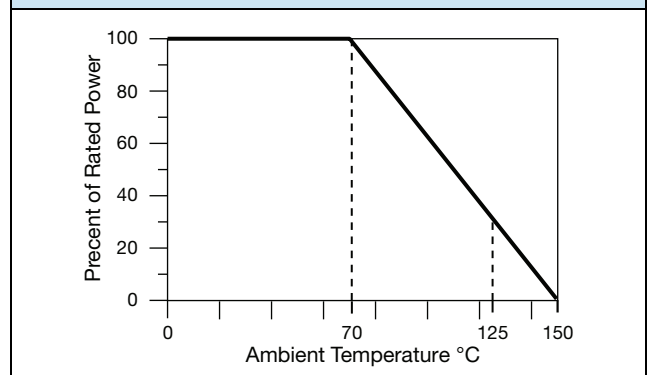
**Note**
<sup>(1)</sup> 0705 and 0805 are the same (only use 0805 when ordering)

**MECHANICAL SPECIFICATIONS**

Resistive Element	Nickel alloy
Substrate Material	Alumina
Terminals	Pre-soldered or gold
Lead (Pb)-free Option	96.5 % Sn, 3.0 % Ag, 0.5 % Cu
Tin/Lead Option	Sn63
Lead (Pb)-free Finish and Tin/Lead	Hot solder dip

**ENVIRONMENTAL TESTS**

ENVIRONMENTAL TEST	1 Ω ΔR ± %
Thermal Shock	0.06
Short Term Overload	0.06
Low Temperature Operation	0.03
Resistance to Solder Heat	0.05
Moisture Resistance	0.35
High Temp. Exposure	0.35
Load Life (2000 h at + 70 °C)	0.40
TCR	± 235 ppm/°C

**DERATING CURVE**


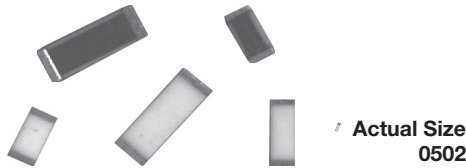


GLOBAL PART NUMBER INFORMATION														
New Global Part Numbering: L-1206M1R00GBT1														
L	-	1	2	0	6	M	1	R	0	0	G	B	T	1
GLOBAL MODEL	CASE SIZE	TCR CHARACTERISTICS	OHMIC VALUE	TOLERANCE	TERMINATION	PACKAGING								
L- = Low value wraparound chip resistor	0505 0603 0805 <sup>(1)</sup> 1005 1020 1206 1505 2010 2512	M = 300 ppm/°C N = 350 ppm/°C O = 400 ppm/°C P = 500 ppm/°C	First 3 digits are significant figures and the last digit specifies the number of zeros to follow. "R" designates the decimal point.  Example: 0R10 = 0.1 Ω 1R60 = 1.6 Ω	F = 1 % G = 2 % H = 3 % J = 5 % K = 10 % L = 20 %	B = Wraparound Sn/Pb solder 63 % Sn/37 % Pb w/ nickel barrier G = Wraparound Au over Ni (gold) termination epoxy bondable RoHS compliant - e4 W = Top side wire bondable Au (gold) RoHS compliant - e4 S = Wraparound lead (Pb)-free solder 96.5 % Sn/3.0 % Ag/ 0.5 % Cu RoHS compliant - e1	BS = BULK 100 min., 1 mult WS = WAFFLE 100 min., 1 mult  TAPE AND REEL T0 = 100 min., 100 mult T1 = 1000 min., 1000 mult <sup>(1)</sup> T3 = 300 min., 300 mult T5 = 500 min., 500 mult TF = Full reel TS = 100 min., 1 mult								
Historical Part Number Example: L1206M1R00HBT (for reference purposes only)														
L	1206	M	1R00	H	B	T								
STYLE	CASE SIZE	TCR CHARACTERISTICS	OHMIC VALUE	TOLERANCE	TERMINATION	PACKAGING								

**Note**

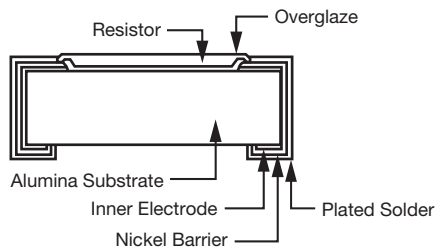
<sup>(1)</sup> Preferred packaging code

## Commercial Thick Film Resistor, Surface Mount Chip



Utilizing proven expertise in thick and thin film resistors to satisfy your manufacturing needs, Vishay provides a high rel chip with the same reliability and stability found in military grade resistors. These chips are available in the widest range of sizes, values, and performance characteristics.

### CONSTRUCTION



### FEATURES

- High purity alumina substrate for high power dissipation (2 W max.)
- Wraparound terminations featuring a thin film adhesion layer covered with a leach resistant nickel barrier layer for + 150 °C operating conditions
- High speed laser trimming for high volume requirements
- Ruthenium based cermet thick film for dependable performance
- Fired-on glass passivation
- Tape and reel packaging standard; static-free waffle pack available
- Active trim and 0 Ω chips
- Sulfur resistant (per ASTM B809-95 humid vapor test)
- Compliant to RoHS Directive 2002/95/EC



**RoHS\***  
COMPLIANT

**GREEN**  
(5-2008)  
Available

### Notes

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

\*\* Please see document "Vishay Material Category Policy":  
[www.vishay.com/doc?99902](http://www.vishay.com/doc?99902)

### TYPICAL PERFORMANCE

	ABSOLUTE
◆	
TCR	100
TOL.	1

### STANDARD ELECTRICAL SPECIFICATIONS

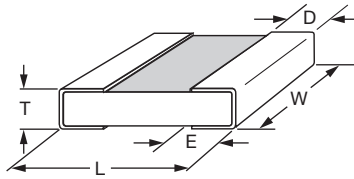
TEST	SPECIFICATIONS	CONDITIONS
<b>Material</b>	Ruthenium	-
<b>Resistance Range</b>	10 Ω to 25 MΩ	-
<b>TCR: Absolute</b>	± 100 ppm/°C to ± 300 ppm/°C	- 55 °C to + 125 °C
<b>Tolerance: Absolute</b>	± 1 % to ± 10 %	-
<b>Stability: Absolute</b>	ΔR ± 0.15 %	-
<b>Stability: Ratio</b>	-	-
<b>Voltage Coefficient</b>	-	-
<b>Working Voltage</b>	25 V to 200 V	-
<b>Operating Temperature Range</b>	- 55 °C to + 125 °C	-
<b>Storage Temperature Range</b>	- 55 °C to + 150 °C	-
<b>Noise</b>	< - 35 dB (typical)	-
<b>Shelf Life Stability: Absolute</b>	-	-

### COMPONENT RATINGS

CASE SIZE <sup>(1)</sup>	POWER RATING (mW)	WORKING VOLTAGE (V)	RESISTANCE RANGE (Ω)
0402	100	25	10 to 10M
0502	100	25	10 to 25M
0504	125	40	10 to 25M
0505	125	40	10 to 25M
0603	150	40	10 to 25M
0705	200	50	10 to 25M
0805	200	50	10 to 25M
1005	250	75	10 to 25M
1010	500	75	10 to 25M
1206	330	100	10 to 25M
1505	350	100	10 to 25M
2010	1000	175	10 to 25M
2208	750	150	10 to 25M
2512	2000	200	10 to 25M

### Notes

- Consult factory for nominals above 25 MΩ
- (1) 0705 and 0805 are the same (only use 0805 when ordering)

**DIMENSIONS** in inches


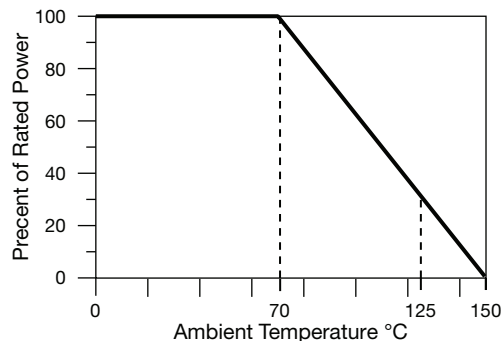
CASE SIZE	TERM	L	W	T	D	E
0402	B	0.042 ± 0.006	0.022 ± 0.005	0.010 to 0.033	0.010 ± 0.005	0.010 ± 0.005
0502	B	0.055 ± 0.005	0.025 ± 0.005	0.020 max.	0.010 ± 0.005	0.015 ± 0.005
0504	B	0.055 ± 0.005	0.040 ± 0.005	0.020 ± 0.005	0.010 ± 0.005	0.010 ± 0.005
0505	B	0.055 ± 0.006	0.050 ± 0.005	0.012 to 0.033	0.010 ± 0.005	0.015 ± 0.005
0603	B	0.064 ± 0.006	0.032 ± 0.005	0.010 to 0.033	0.012 ± 0.005	0.015 ± 0.005
0705, 0805 <sup>(1)</sup>	B	0.080 ± 0.006	0.050 ± 0.005	0.015 to 0.033	0.015 ± 0.005	0.015 ± 0.005
1005	B	0.105 ± 0.007	0.050 ± 0.005	0.015 to 0.033	0.020 ± 0.005	0.020 ± 0.005
1010	B	0.105 ± 0.007	0.100 ± 0.005	0.015 to 0.033	0.015 ± 0.005	0.015 ± 0.005
1206	B	0.126 ± 0.008	0.063 ± 0.005	0.015 to 0.033	0.020 + 0.005/- 0.010	0.020 + 0.005/- 0.010
1505	B	0.155 ± 0.007	0.050 ± 0.005	0.015 to 0.033	0.020 ± 0.005	0.020 ± 0.005
2010	B	0.197 ± 0.006	0.098 ± 0.005	0.015 to 0.033	0.015 ± 0.005	0.015 ± 0.005
2208	B	0.230 ± 0.007	0.075 ± 0.005	0.015 to 0.033	0.015 ± 0.005	0.015 ± 0.005
2512	B	0.250 ± 0.006	0.124 ± 0.005	0.015 to 0.033	0.020 ± 0.005	0.020 ± 0.005

**Note**

<sup>(1)</sup> 0705 and 0805 are the same (only use 0805 when ordering)

**ENVIRONMENTAL TESTS**

ENVIRONMENTAL TEST	10 Ω ΔR ± (%)	100 kΩ ΔR ± (%)
Thermal Shock	0.02	0.03
Short Term Overload	0.02	0.02
Low Temperature Operation	0.03	0.04
Resistance to Solder Heat	0.06	0.02
Moisture Resistance	0.10	0.08
High Temperature Exposure	0.02	0.02

**DERATING CURVE**


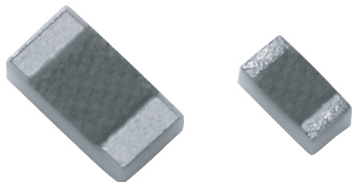


GLOBAL PART NUMBER INFORMATION														
New Global Part Numbering: M-1206K5001GBT1														
M	-	1	2	0	6	K	5	0	0	1	G	B	T	1
GLOBAL MODEL	CASE SIZE	TCR CHARACTERISTIC	RESISTANCE	TOLERANCE	TERMINATION	PACKAGING								
M- = High rel cermet thick film wraparound	0402 0502 0504 0505 0603 0805 1005 1010 1206 1505 2010 2208 2512	K = 100 ppm/°C M = 300 ppm/°C X = 0 Ω jumper	First 3 digits are significant figures and the last digit specifies the number of zeros to follow. "R" designates the decimal point.  Example: 10R0 = 10 Ω 1002 = 10 kΩ	F = 1 % G = 2 % J = 5 % K = 10 %  N = Not trimmed	B = Wraparound tin/lead plated solder S = Wraparound lead (Pb)-free plated solder G = Epoxy bondable	BS = BULK 100 min., 1 mult WS = WAFFLE 100 min., 1 mult  TAPE AND REEL T0 = 100 min., 100 mult T1 = 1000 min., 1000 mult <sup>(1)</sup> T3 = 300 min., 300 mult T5 = 500 min., 500 mult TF = Full reel TS = 100 min., 1 mult								
Historical Part Number example: M0505K1003JBT (for reference purposes only)														
M	0505	K	1003	J	B	T								
STYLE	CASE SIZE	TCR CHARACTERISTIC	OHMIC VALUE	TOLERANCE	TERMINATION	PACKAGING								

**Note**

(1) Preferred packaging code

## High Frequency (up to 20 GHz) Resistor, Thin Film Surface Mount Chip



FC series chip resistors are designed with low internal reactance. They function as almost pure resistors on a very high range of frequencies. The specialized laser edge trimming allows for precision tolerances to 0.1 %.

### FEATURES

- Small standard size 0402 case size
- Edge trimmed block resistors
- Alumina substrate high purity (99.6 %)
- Ohmic range (10  $\Omega$  to 1000  $\Omega$ )
- Small internal reactance (< 10 m $\Omega$ )
- Low TCR (down to  $\pm 25$  ppm/ $^{\circ}$ C)
- Epoxy bondable termination available
- Compliant to RoHS Directive 2002/95/EC



**RoHS\***  
COMPLIANT

**GREEN**  
(5-2008)  
Available

### Notes

- \* Pb containing terminations are not RoHS compliant, exemptions may apply
- \*\* Please see document "Vishay Material Category Policy":  
[www.vishay.com/doc?99902](http://www.vishay.com/doc?99902)

### APPLICATIONS

- Low noise amplifiers
- Attenuation
- Line termination

STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Resistance Range	10 $\Omega$ to 1000 $\Omega$	Case size dependent
TCR: Absolute	$\pm 25$ ppm/ $^{\circ}$ C (standard) ( $\geq 50$ $\Omega$ ) to $\pm 100$ ppm/ $^{\circ}$ C	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
Tolerance: Absolute	$\pm 0.1$ % to $\pm 5.0$ %	+ 25 $^{\circ}$ C
Stability: Absolute	$\Delta R \pm 0.02$ %	2000 h at 70 $^{\circ}$ C
Stability: Ratio	-	-
Voltage Coefficient	0.1 ppm/V	-
Working Voltage	30 V to 75 V	-
Operating Temperature Range	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C	-
Storage Temperature Range	- 55 $^{\circ}$ C to + 150 $^{\circ}$ C	-
Noise	< - 35 dB	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01$ %	1 year at + 25 $^{\circ}$ C

COMPONENT RATINGS			
CASE SIZE	POWER RATING (mW)	WORKING VOLTAGE (V)	RESISTANCE RANGE ( $\Omega$ )
0402	50	30	16 to 1000
0505	125	37	20 to 1000
0603	125	50	10 to 1000
0805	200	50	10 to 1000
1005	250	75	10 to 1000
1206	330	75	10 to 1000

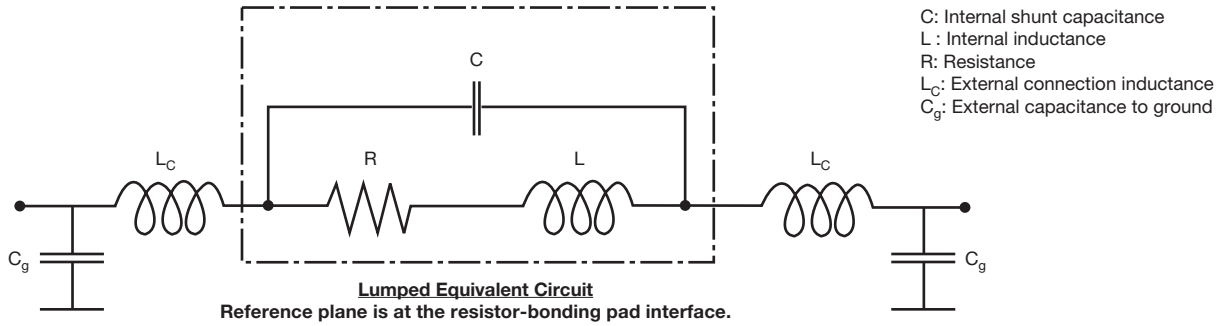
DIMENSIONS in inches (millimeters)						
CASE SIZE	LENGTH	WIDTH W (± 0.005)	THICKNESS TYPICAL	TOP PAD D (± 0.005)	BOTTOM PAD E (± 0.005)	
0402	0.042 ± 0.008 (1.067 ± 0.203)	0.022 (0.559)	0.015 (0.381)	0.010 (0.254)	0.010 (0.254)	
0505	0.055 ± 0.006 (1.397 ± 0.152)	0.050 (1.270)	0.015 (0.381)	0.010 (0.254)	0.015 (0.381)	
0603	0.064 ± 0.006 (1.626 ± 0.152)	0.032 (0.813)	0.015 (0.381)	0.012 (0.305)	0.015 (0.381)	
0805	0.080 ± 0.006 (2.032 ± 0.152)	0.050 (1.270)	0.015 (0.381)	0.016 ± 0.008 (0.406 ± 0.203)	0.015 (0.381)	
1005	0.105 ± 0.008 (2.667 ± 0.203)	0.050 (1.270)	0.015 (0.381)	0.015 (0.381)	0.015 (0.381)	
1206	0.126 ± 0.008 (3.200 ± 0.203)	0.063 (1.600)	0.015 (0.381)	0.020 + 0.005/- 0.010 (0.508 + 0.127/- 0.254)		

MECHANICAL SPECIFICATIONS	
Resistive Element	Passivated nichrome
Substrate Material	Alumina
Terminations	Pre-soldered or gold
Lead (Pb)-free Option	96.5 % Sn, 3.0 % Ag, 0.5 % Cu
Tin/Lead Option	Sn63
Lead (Pb)-free Finish and Tin/Lead	Hot solder dip

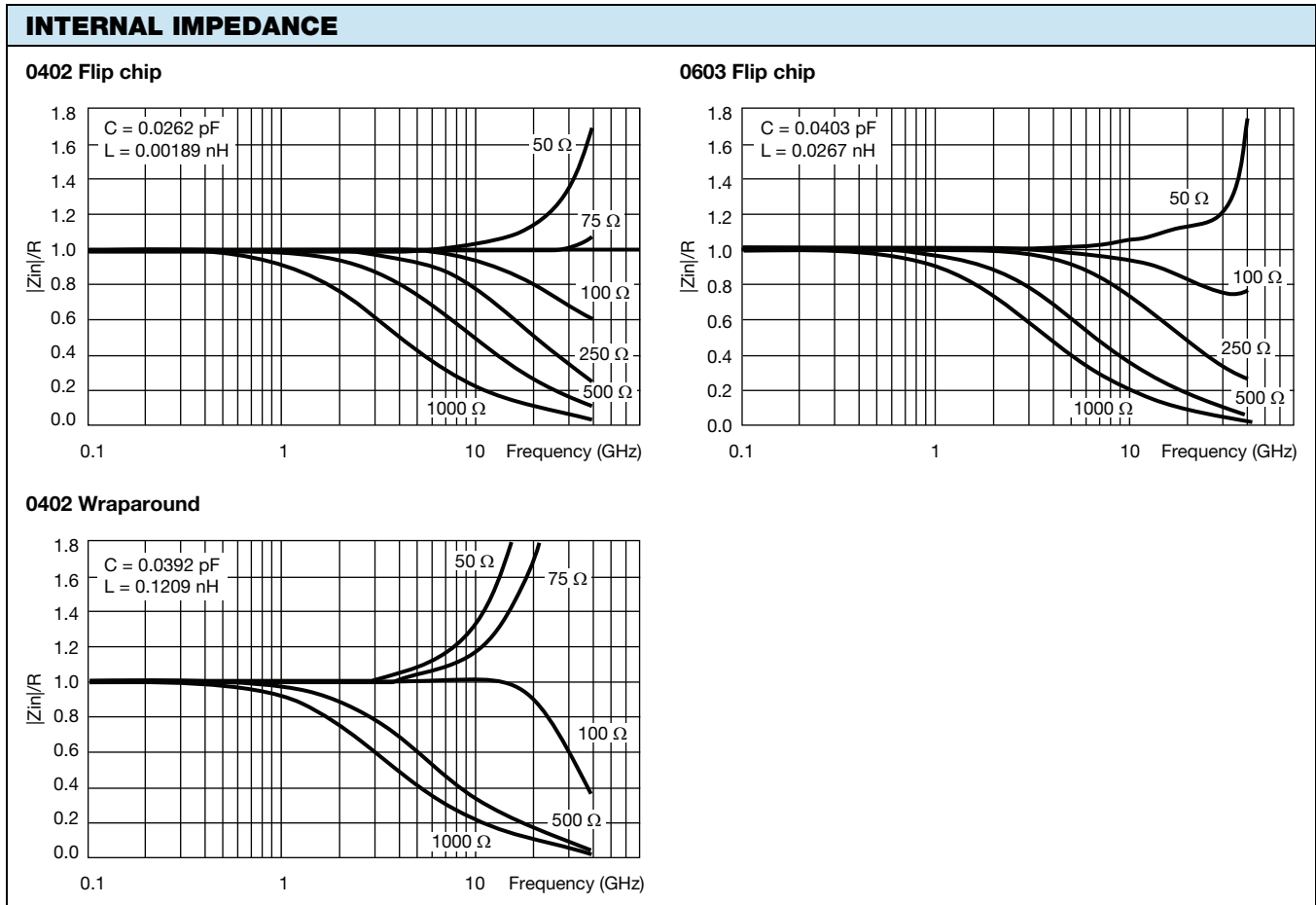
GLOBAL PART NUMBER INFORMATION						
New Global Part Numbering: FC1206E1001BBT S						
GLOBAL MODEL	CASE SIZE	TCR CHARACTERISTIC	RESISTANCE	TOLERANCE	TERMINATION (1, 2 or 3 digits)	PACKAGING
FC	0402 0505 0603 0805 1005 1206	E = 25 ppm/°C H = 50 ppm/°C K = 100 ppm/°C	The first 3 digits are significant figures and the last digit specifies the number of zeros to follow. "R" designates the decimal point.  Example: 10R0 = 10 Ω 1000 = 100 Ω 1001 = 1 kΩ	B = 0.1 % D = 0.5 % F = 1 % G = 2 % J = 5 %	T = Top sided Au (gold) term Au over Ni epoxy bondable RoHS compliant - e4 B = Wraparound Sn/Pb solder 63 % Sn/37 % Pb w/nickel barrier G = Wraparound Au over Ni (gold) termination epoxy bondable RoHS compliant - e4 TB = Top sided Sn/Pb solder 63 % Sn/37 % Pb w/nickel barrier TBS = Top sided lead (Pb)-free solder w/nickel barrier RoHS compliant - e1 S = Wraparound lead (Pb)-free solder 96.5 % Sn/3.0 % Ag/0.5 % Cu RoHS compliant - e1	BS = BULK 100 min., 1 mult WS = WAFFLE 100 min., 1 mult  TAPE AND REEL T0 = 100 min., 100 mult T1 = 1000 min., 1000 mult <sup>(1)</sup> T3 = 300 min., 300 mult T5 = 500 min., 500 mult TF = Full reel TS = 100 min., 1 mult
Historical Part Number example: FC1206E1001BBT (for reference purposes only)						
FC	1206	E	1001	B	B	T
SERIES	CASE SIZE	TCR CHARACTERISTIC	RESISTANCE	TOLERANCE	TERMINATION	PACKAGING

**Note**
<sup>(1)</sup> Preferred packaging code

**TYPICAL HIGH FREQUENCY PERFORMANCE ELECTRICAL MODEL AND TESTING**



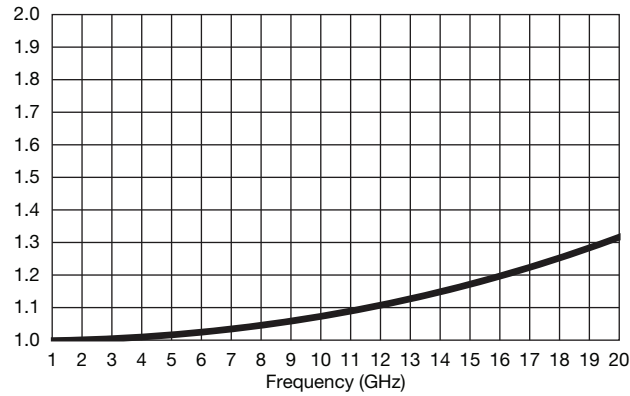
The lumped circuit above was used to model the data at the bonding pad-resistor reference plane. High frequency testing was performed by Modelithics, Inc. on parts mounted to quartz test boards. Quartz test boards were chosen to minimize the contribution of the board effects at high frequencies. Future testing will be performed on various industry standard board types. Vishay in partnership with Modelithics, Inc. will develop substrate scalable models for the FC series resistors. These models will be available for industry standard design software packages and will allow the designer to accurately model their wireless and microwave printed boards.



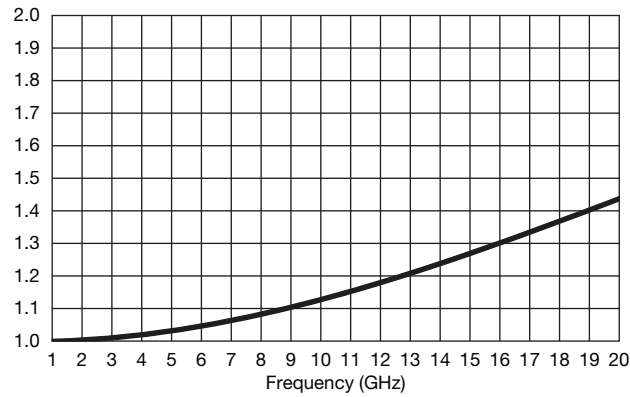




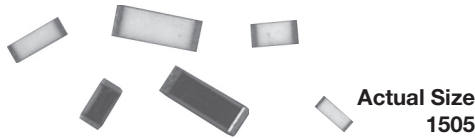
**VSWR FC Series 0402 size 50 Ω**



**VSWR FC Series 0402 size 100 Ω**

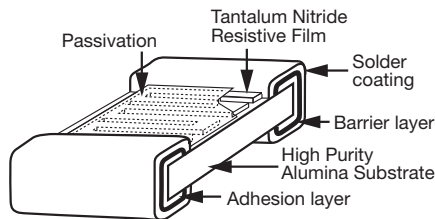


## Precision Thin Film Non-Magnetic Resistor, Surface Mount Chip, $\pm 25$ ppm/ $^{\circ}$ C, Tolerances to 0.1 %



These devices eliminate materials that would disturb magnetic fields applications such as in MRI magnetic resonance imaging machines. The PNM series chip resistor has been carefully engineered with non-magnetic materials to eliminate the effects of these stray magnetic fields on circuit performance, thereby resulting in simplified shielding requirements and improved sound quality in audio applications. Providing signal conditioning without distortion from magnetic fields.

### CONSTRUCTION



### FEATURES

- Non-magnetic
- Moisture resistant
- High purity alumina substrate
- Non-standard values available
- Will pass + 85  $^{\circ}$ C, 85 % relative humidity and 10 % rated power
- 100 % visual inspected per MIL-PRF-55342
- Very low noise and voltage coefficient (< - 30 dB)
- Non-inductive
- Laser-trimmed tolerances to  $\pm 0.1$  %
- Wraparound resistance less than 10 m $\Omega$
- Sulfur resistant (per ASTM B809-95 humid vapor test)
- Halogen-free according to IEC 61249-2-21 definition
- Compliant to RoHS Directive 2002/95/EC



**RoHS\***  
COMPLIANT  
HALOGEN  
**FREE**  
Available

### Note

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

### TYPICAL PERFORMANCE

	ABSOLUTE
TCR	25
TOL.	0.1

### STANDARD ELECTRICAL SPECIFICATIONS

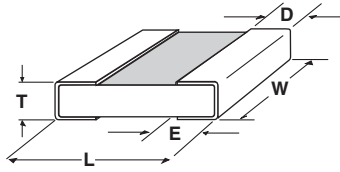
TEST	SPECIFICATIONS	CONDITIONS
<b>Material</b>	Tantalum nitride	-
<b>Resistance Range</b>	10 $\Omega$ to 3 M $\Omega$	-
<b>TCR: Absolute</b>	$\pm 25$ ppm/ $^{\circ}$ C to $\pm 100$ ppm/ $^{\circ}$ C	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
<b>Tolerance: Absolute</b>	$\pm 0.1$ % to $\pm 1.0$ %	+ 25 $^{\circ}$ C
<b>Stability: Absolute</b>	$\Delta R \pm 0.03$ %	-
<b>Stability: Ratio</b>	-	-
<b>Voltage Coefficient</b>	0.1 ppm/V	-
<b>Working Voltage</b>	75 V to 200 V	-
<b>Operating Temperature Range</b>	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C	-
<b>Storage Temperature Range</b>	- 55 $^{\circ}$ C to + 150 $^{\circ}$ C	-
<b>Noise</b>	< - 30 dB	-
<b>Shelf Life Stability: Absolute</b>	-	-

### COMPONENT RATINGS

CASE SIZE <sup>(1)</sup>	POWER RATING (mW)	WORKING VOLTAGE (V)	RESISTANCE RANGE ( $\Omega$ )
0402	50	75	20 to 35K
0502	100	75	20 to 65K
0505	150	75	20 to 130K
0603	150	75	10 to 100K
0805	200	100	10 to 301K
0705	200	100	10 to 301K
1005	250	100	10 to 301K
1010	500	150	50 to 600K
1206	400	200	10 to 1M
1505	400	150	10 to 1M
2208	750	150	10 to 1.75M
2010	800	200	10 to 2M
2512	1000	200	10 to 3M

### Note

<sup>(1)</sup> 0705 and 0805 are the same (only use 0805 when ordering)

**DIMENSIONS** in inches


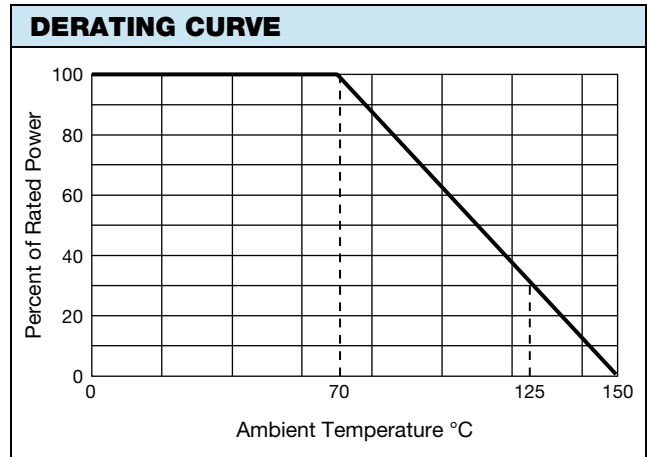
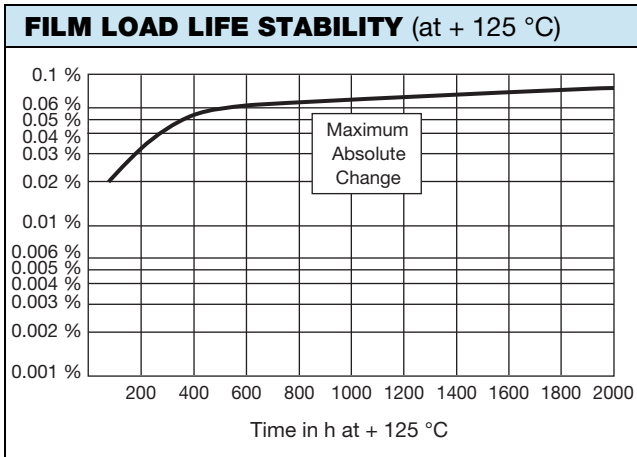
CASE SIZE	L	W	T	D	E
0402	0.042 ± 0.008	0.022 ± 0.005	0.012 to 0.033	0.010 ± 0.005	0.010 ± 0.005
0502	0.055 ± 0.006	0.025 ± 0.005	0.012 to 0.033	0.010 ± 0.005	0.015 ± 0.005
0505	0.055 ± 0.006	0.050 ± 0.005	0.012 to 0.033	0.010 ± 0.005	0.015 ± 0.005
0603	0.064 ± 0.006	0.032 ± 0.005	0.020 Max.	0.012 ± 0.005	0.015 ± 0.005
0705, 0805 <sup>(1)</sup>	0.080 ± 0.006	0.050 ± 0.005	0.015 to 0.033	0.015 ± 0.005	0.015 ± 0.005
1005	0.105 ± 0.007	0.050 ± 0.005	0.015 to 0.033	0.015 ± 0.005	0.015 ± 0.005
1010	0.105 ± 0.007	0.100 ± 0.005	0.015 to 0.033	0.015 ± 0.005	0.015 ± 0.005
1206	0.126 ± 0.008	0.063 ± 0.005	0.015 to 0.033	0.020 + 0.005/- 0.010	0.020 + 0.005/- 0.010
1505	0.155 ± 0.007	0.050 ± 0.005	0.015 to 0.033	0.015 ± 0.005	0.015 ± 0.005
2010	0.209 ± 0.009	0.098 ± 0.005	0.015 to 0.033	0.020 ± 0.005	0.020 ± 0.005
2208	0.230 ± 0.007	0.075 ± 0.005	0.015 to 0.033	0.020 ± 0.005	0.020 ± 0.005
2512	0.259 ± 0.009	0.124 ± 0.005	0.015 to 0.033	0.020 ± 0.005	0.020 ± 0.005

**Note**

<sup>(1)</sup> 0705 and 0805 are the same (only use 0805 when ordering)

**ENVIRONMENTAL TESTS** (Vishay Performance vs. MIL-PRF-55342 Requirements)

ENVIRONMENTAL TEST	LIMITS MIL-PRF-55342 CHARACTERISTIC "H"	TYPICAL VISHAY PERFORMANCE
Resistance Temperature Characteristic	± 50 ppm/°C	± 35 ppm/°C
Max. Ambient Temperature at Rated Wattage	+ 70 °C	+ 70 °C
Max. Ambient Temperature at Power Derating	+ 150 °C	+ 150 °C
Thermal Shock $\Delta R$	± 0.25 %	± 0.040 %
Low Temperature Operation $\Delta R$	± 0.25 %	± 0.005 %
Short Time Overload $\Delta R$	± 0.10 %	± 0.010 %
High Temperature Exposure $\Delta R$	± 0.20 %	± 0.150 %
Resistance to Bonding Exposure $\Delta R$	± 0.25 %	± 0.005 %
Moisture Resistance $\Delta R$	± 0.40 %	± 0.029 %
Life + 70 °C at 1000 hours $\Delta R$	± 0.50 %	± 0.03 %
Insulation Resistance	10 000 Ω minimum	> 100 000 MΩ



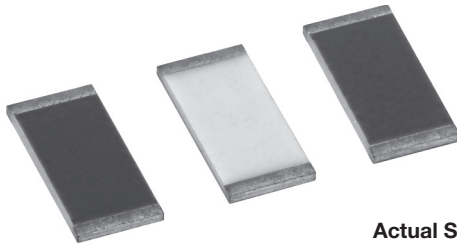
### GLOBAL PART NUMBER INFORMATION

<b>P</b>	<b>N</b>	<b>M</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>6</b>	<b>E</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>B</b>	<b>B</b>	<b>T</b>	<b>1</b>
GLOBAL MODEL	CASE SIZE	TCR CHARACTERISTIC	RESISTANCE			TOLERANCE	TERMINATION			PACKAGING					
PNM Non-magnetic resistor	0402 0502 0505 0603 0805 1005 1010 1206 1505 2208 2010 2512	E = ± 25 ppm/°C H = ± 50 ppm/°C K = ± 100 ppm/°C	The first 3 digits are significant figures and the last digit specifies the number of zeros to follow. "R" designates the decimal point.  Example: 10R0 = 10 Ω 1000 = 100 Ω 1001 = 1 kΩ			B = ± 0.1 % D = ± 0.5 % F = ± 1 % G = ± 2 % J = ± 5 %	B = Wraparound Sn/Pb solder 63 % Sn/ 37 % Pb S = Wraparound lead (Pb)-free solder 96.5 % Sn/3.0 % Ag/ 0.5 % Cu RoHS compliant - e1			BS = BULK 100 min., 1 mult WS = WAFFLE 100 min., 1 mult  TAPE AND REEL T0 = 100 min., 100 mult T1 = 1000 min., 1000 mult <sup>(1)</sup> T3 = 300 min., 300 mult T5 = 500 min., 500 mult TF = Full reel TS = 100 min., 1 mult					

**Note**

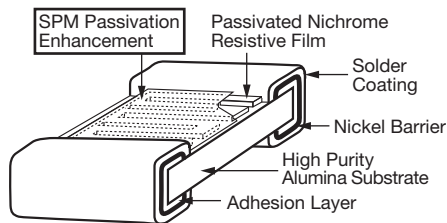
(1) Preferred packaging code

## Precision Low TCR Thin Film Resistor, Surface Mount Chip, ± 5 ppm/°C TCR, 0.01 % Tolerance


**Actual Size 0603**

Vishay's proven precision thin film wraparound resistors will meet your exact requirements. These resistors are ideal for precision applications requiring low noise, stability, ultra low temperature coefficient of resistance, and low voltage coefficient. The chip resistors are available in any resistance ohmic value in the range specified below.

### CONSTRUCTION



### FEATURES

- TCR of ± 5 ppm/°C standard
- Tolerances to ± 0.01 %
- Anti corrosion resistant film with (SPM) special passivation method
- Stable film and performance characteristics ( $\Delta R \pm 0.04\%$  at 70 °C, 10 000 h)
- Non-standard resistance values available
- Very low noise and voltage coefficient (< - 30 dB, 0.1 ppm/V)
- UL 94 V-0 flame resistant
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



### Note

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

### TYPICAL PERFORMANCE

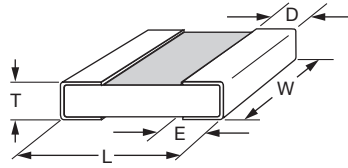
	ABSOLUTE
TCR	5
TOL.	0.01

### STANDARD ELECTRICAL SPECIFICATIONS

TEST	SPECIFICATIONS	CONDITIONS
<b>Material</b>	Passivated nichrome	-
<b>Resistance Range</b>	100 Ω to 775 kΩ	-
<b>TCR: Absolute</b>	± 5 ppm/°C	- 55 °C to + 125 °C
<b>Tolerance: Absolute</b>	± 0.1 % to ± 0.01 %	+ 25 °C
<b>Stability: Absolute</b>	$\Delta R \pm 0.02\%$	2000 h at 70 °C
<b>Stability: Ratio</b>	-	-
<b>Voltage Coefficient</b>	± 0.1 ppm/V (typical)	-
<b>Working Voltage</b>	75 V to 200 V	-
<b>Operating Temperature Range</b>	- 55 °C to + 125 °C	-
<b>Storage Temperature Range</b>	- 55 °C to + 150 °C	-
<b>Noise</b>	< - 35 dB (typical)	-
<b>Shelf Life Stability: Absolute</b>	$\Delta R \pm 0.01\%$	1 year at + 25 °C

### COMPONENT RATINGS

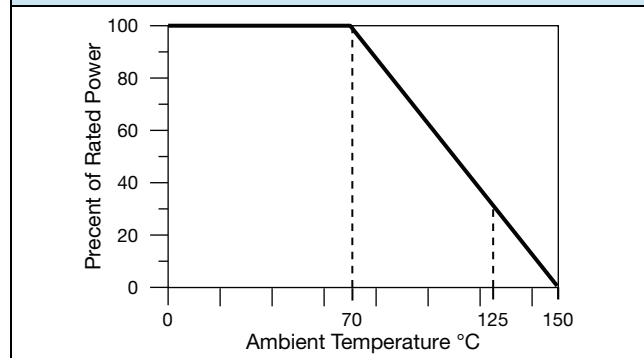
CASE SIZE	POWER RATING (mW)	WORKING VOLTAGE (V)	RESISTANCE RANGE (Ω)
0603	150	75	100 to 130K
0805	250	100	100 to 260K
1206	400	200	100 to 775K

**DIMENSIONS** in inches


CASE SIZE	TERM	L	W	T	D	E
0603	B	0.064 ± 0.006	0.032 ± 0.005	0.020 max.	0.012 ± 0.005	0.015 ± 0.005
0805	B	0.080 ± 0.006	0.050 ± 0.005	0.015 to 0.033	0.016 ± 0.008	0.015 ± 0.005
1206	B	0.126 ± 0.008	0.063 ± 0.005	0.015 to 0.033	0.020 + 0.005/- 0.010	0.020 + 0.005/- 0.010

**ENVIRONMENTAL TESTS - TYPICAL**

ENVIRONMENTAL TEST	10 kΩ ΔR ± (%)	100 kΩ ΔR ± (%)
Thermal Shock	0.02	0.02
Short Time Overload	0.01	0.01
Low Temperature Operation	0.01	0.01
Resistance to Solder Heat	0.01	0.01
Moisture Resistance	0.02	0.02
High Temperature Exposure	0.02	0.02
Load Life (10 000 h, + 70 °C)	0.04	0.04
TCR	± 5 ppm/°C	± 5 ppm/°C

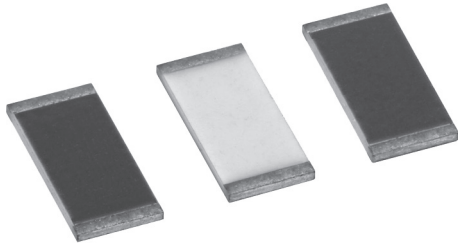
**DERATING CURVE**

**GLOBAL PART NUMBER INFORMATION**

GLOBAL MODEL	CASE SIZE	TCR CHARACTERISTIC	RESISTANCE	TOLERANCE	TERMINATION	PACKAGING
PLT	0603 0805 1206	Z = ± 5 ppm/°C	The first 3 digits are significant figures and the last digit specifies the number of zeros to follow. "R" designates the decimal point.  Example: 1001 = 1 kΩ 2500 = 250 Ω  Special values with more than 4 significant figures, use a R for value below 1 kΩ and a K for values greater than 1 kΩ to signify a decimal point.  982R6 = 982.6 Ω 532R41 = 532.41 Ω	L = ± 0.01 % Q = ± 0.02 % A = ± 0.05 % B = ± 0.1 %	B = Wraparound Sn/Pb solder w/Ni barrier (63 % Sn/37 % Pb w/ nickel barrier)  S = Wraparound lead (Pb)-free solder 96.5 % Sn/3.0 % Ag/ 0.5 % Cu RoHS compliant - e1	WS = WAFFLE PACK  TAPE AND REEL T0 = 100 min., 100 mult T1 = 1000 min., 1000 mult <sup>(1)</sup> T3 = 300 min., 300 mult T5 = 500 min., 500 mult TF = Full reel TS = 100 min., 1 mult

**Note**

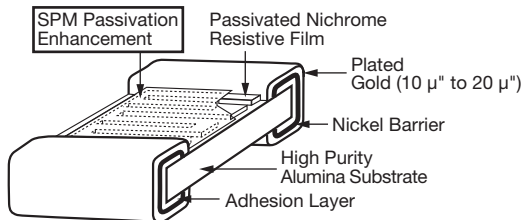
(1) Preferred packaging code

## Precision Low TCR High Temperature Thin Film Resistor, Surface Mount Chip, $\pm 5$ ppm/°C TCR, 0.02 % Tolerance



Vishay's proven precision thin film wraparound resistors will meet your exact requirements. These resistors are ideal for use in oil industry precision applications requiring low noise, long term stability under high temperature, ultra low temperature coefficient of resistance, and low voltage coefficient. The chip resistors are available in any resistance ohmic value in the range specified below.

### CONSTRUCTION



### FEATURES

- - 55 °C to 215 °C operating temperature range
- TCR of  $\pm 5$  ppm/°C standard
- Tolerances to  $\pm 0.02$  %
- Anti corrosion resistant film with (SPM) special passivation method
- Stable film and performance characteristics
- 0.5 % max. at 2000 h, 215 °C, 25 % rated power
- Non-standard resistance values available
- Very low noise and voltage coefficient (< - 30 dB, 0.1 ppm/V)
- UL 94 V-0 flame resistant
- Gold terminations (10  $\mu$ " to 20  $\mu$ " )
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS\***  
COMPLIANT  
HALOGEN  
**FREE**

### Note

\* Lead (Pb)-containing terminations are not RoHS-compliant. Exemptions may apply.

### TYPICAL PERFORMANCE

	ABSOLUTE
TCR	5
TOL.	0.02

### STANDARD ELECTRICAL SPECIFICATIONS

TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Resistance Range	250 $\Omega$ to 3 M $\Omega$	-
TCR: Absolute	$\pm 5$ ppm/°C	- 55 °C to + 125 °C
Tolerance: Absolute	$\pm 0.1$ % to $\pm 0.02$ %	+ 25 °C
Stability: Absolute	$\Delta R \pm 0.5$ %	2000 h at 215 °C, 25 % rated power
Stability: Ratio	-	-
Voltage Coefficient	$\pm 0.1$ ppm/V (typical)	-
Working Voltage	100 V to 200 V	-
Operating Temperature Range	- 55 °C to + 215 °C	-
Storage Temperature Range	- 55 °C to + 215 °C	-
Noise	< - 35 dB (typical)	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01$ %	1 year at + 25 °C

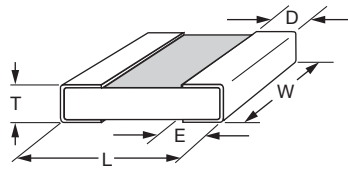
### COMPONENT RATINGS

CASE SIZE	POWER RATING (mW)	WORKING VOLTAGE (V)	RESISTANCE RANGE ( $\Omega$ )
0805	250 at 70 °C	100	250 to 260K
1206	400 at 70 °C	200	500 to 775K
2010	800 at 70 °C	200	500 to 2M
2512	1000 at 70 °C	200	500 to 3M

### Note

- Consult factory for additional case size

**DIMENSIONS** in inches

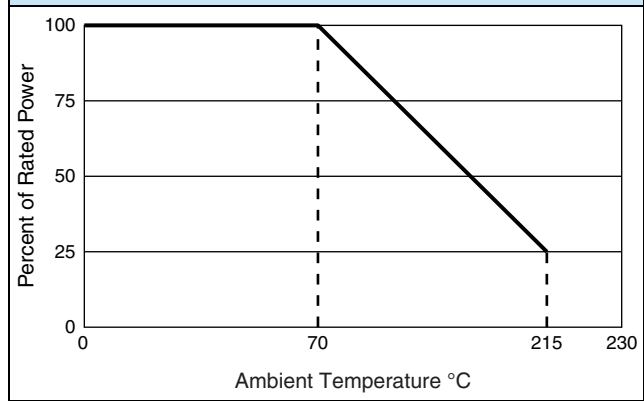


CASE SIZE	TERM	L	W	T	D	E
0805	G	0.080 ± 0.006	0.050 ± 0.005	0.015 to 0.033	0.016 ± 0.008	0.015 ± 0.005
1206	G	0.126 ± 0.008	0.063 ± 0.005	0.015 to 0.033	0.020 + 0.005/- 0.010	0.020 + 0.005/- 0.010
2010	G	0.209 ± 0.009	0.098 ± 0.005	0.015 to 0.033	0.020 ± 0.005	0.020 ± 0.005
2512	G	0.259 ± 0.009	0.124 ± 0.005	0.015 to 0.033	0.020 ± 0.005	0.020 ± 0.005

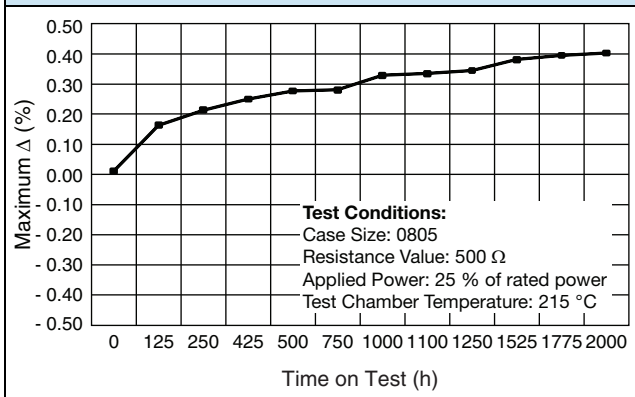
**ENVIRONMENTAL TESTS - TYPICAL**

ENVIRONMENTAL TEST	10 kΩ ΔR ± (%)	100 kΩ ΔR ± (%)
Thermal Shock	0.02	0.02
Short Time Overload	0.01	0.01
Low Temperature Operation	0.01	0.01
Resistance to Solder Heat	0.01	0.01
Moisture Resistance	0.02	0.02
High Temperature Exposure	0.02	0.02
Load Life (25 % Power, 2000 h, + 215 °C)	0.5	0.5
TCR	± 5 ppm/°C	± 5 ppm/°C

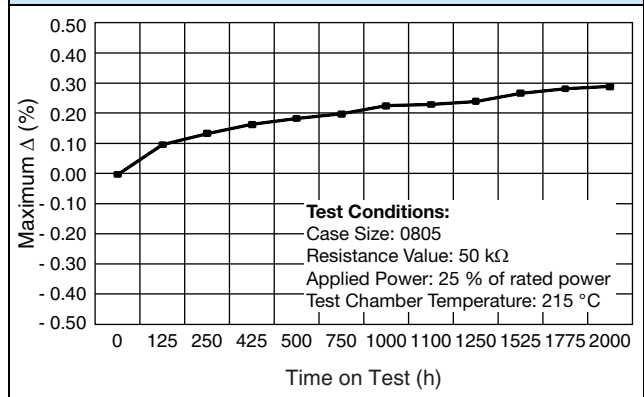
**DERATING CURVE**



**PLTT0805 500 Ω STABILITY TEST RESULTS**



**PLTT0805 50 kΩ STABILITY TEST RESULTS**



**Note**

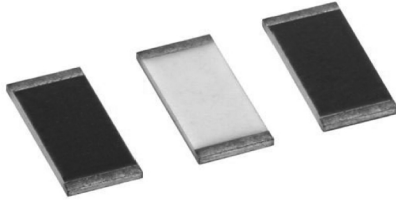
- Performance obtained with following mounting conditions  
PCB: Polyimide IPC-7831A STD land patterns  
Solder paste: PbSnAg (93.5/5/1.5)





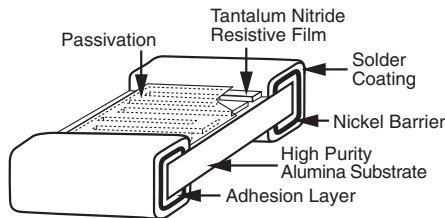
GLOBAL PART NUMBER INFORMATION																
P	L	T	T	0	8	0	5	Z	1	0	0	1	Q	G	T	1
GLOBAL MODEL	CASE SIZE	TCR CHARACTERISTIC	RESISTANCE	TOLERANCE	TERMINATION	PACKAGING										
PLTT	0805 1206 2010 2512	Z = ± 5 ppm/°C	<p>The first 3 digits are significant figures and the last digit specifies the number of zeros to follow. "R" designates the decimal point.</p> <p>Example:  <b>1001</b> = 1 kΩ  <b>2500</b> = 250 Ω</p> <p>Special values with more than 4 significant figures, use a R for value below 1 kΩ and a K for values greater than 1 kΩ to signify a decimal point.</p> <p><b>982R6</b> = 982.6 Ω  <b>532R41</b> = 532.41 Ω</p>	<p><b>Q</b> = ± 0.02 %  <b>A</b> = ± 0.05 %  <b>B</b> = ± 0.1 %  <b>D</b> = ± 0.5 %  <b>F</b> = ± 1 %  <b>G</b> = ± 2 %</p>	<p><b>G</b> = Wraparound Gold over Ni barrier (10 μ" min. Au)</p>	<p><b>WS</b> = WAFFLE  <b>WI</b> = 100 min./1mult (item single lot date code)  <b>WP</b> = 100 min./1mult (package unit single lot date code)</p> <p><b>TAPE AND REEL</b>  <b>T1</b> = 1000 min., 100 mult  <b>T5</b> = 500 min., 500 mult  <b>TF</b> = Full reel  <b>TS</b> = 100 min., 1 mult  <b>TI</b> = 100 min./1mult (item single lot date code)  <b>TP</b> = 100 min., 1 mult (package unit single lot date code)</p>										

## Precision Automotive Thin Film Chip Resistors, AEC-Q200 Qualified, 2 kV ESD Rating



These chip resistors are available in wraparound terminations styles in 8 case sizes. They incorporate self passivated enhanced tantalum nitride resistor film to give superior performance on moisture resistance, electrostatic discharge, voltage coefficient, power handling and resistance stability. The terminations consist of an adhesion layer, a leach resistant nickel barrier, and solder coating (lead (Pb)-free). This product will out-perform all requirements of AEC-Q200.

### CONSTRUCTION



### FEATURES

- Resistance range: 10  $\Omega$  to 3 M $\Omega$
- AEC-Q200 qualified
- AEC-Q200 ESD rated class 1C (2 kV)
- Laser trimmed to any value
- Moisture resistant to MIL-STD-202, method 202
- Tantalum nitride resistor film on high purity alumina substrate
- 100 % visual inspected per MIL-PRF-55342
- Laser-trimmed tolerances to  $\pm 0.1$  %
- Load life stability < 0.05 % at 1000 h at 70  $^{\circ}$ C
- Very low noise and voltage coefficient (< - 30 dB, < 0.1 ppm/V)
- Sulfur resistant (per ASTM B809-95 humid vapor test)
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT  
**GREEN**  
(5-2008)

### TYPICAL PERFORMANCE

	ABSOLUTE
TCR	<b>25</b>
TOL.	<b>0.1</b>

### STANDARD ELECTRICAL SPECIFICATIONS

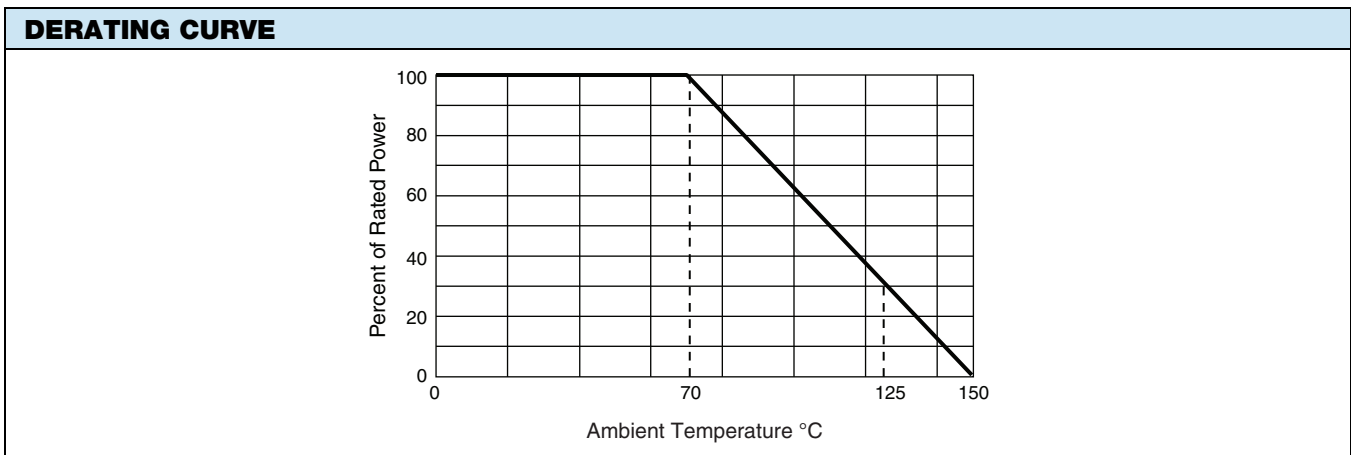
TEST	SPECIFICATIONS	CONDITIONS
<b>Material</b>	Tantalum nitride	-
<b>Resistance Range</b>	10 $\Omega$ to 3 M $\Omega$	-
<b>TCR: Absolute</b>	$\pm 25$ ppm/ $^{\circ}$ C to $\pm 100$ ppm/ $^{\circ}$ C	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
<b>Tolerance: Absolute</b>	$\pm 0.1$ % to $\pm 1.0$ %	+ 25 $^{\circ}$ C
<b>Stability: Absolute</b>	$\pm 0.05$ %	2000 h at 70 $^{\circ}$ C rated power
<b>Stability: Ratio</b>	Not applicable	-
<b>Voltage Coefficient</b>	Less than 0.1 ppm/V	-
<b>Working Voltage</b>	75 V to 200 V	-
<b>Operating Temperature Range</b>	- 55 $^{\circ}$ C to + 150 $^{\circ}$ C	-
<b>Storage Temperature Range</b>	- 55 $^{\circ}$ C to + 150 $^{\circ}$ C	-
<b>Noise</b>	< - 30 dB	-
<b>Shelf Life Stability: Absolute</b>	100 ppm	1 year at 25 $^{\circ}$ C

### COMPONENT RATINGS

CASE SIZE	POWER RATING (mW)	WORKING VOLTAGE (V)	RESISTANCE RANGE ( $\Omega$ )
0402	50	75	20 to 35K
0603	150	75	10 to 80K
0805	200	100	10 to 301K
1206	400	200	10 to 1M
1505	400	150	10 to 1M
2208	750	150	10 to 1.75M
2010	800	200	10 to 2M
2512	1000	200	10 to 3M

DIMENSIONS in inches					
CASE SIZE	L	W	T	D	E
0402	0.042 ± 0.008	0.022 ± 0.005	0.015 ± 0.003	0.010 ± 0.005	0.010 ± 0.005
0603	0.064 ± 0.006	0.032 ± 0.005	0.015 ± 0.003	0.012 ± 0.005	0.015 ± 0.005
0805	0.080 ± 0.006	0.050 ± 0.005	0.015 ± 0.003	0.015 ± 0.005	0.015 ± 0.005
1206	0.126 ± 0.008	0.063 ± 0.005	0.015 ± 0.003	0.020 ± 0.005, - 0.010	0.020 ± 0.005, - 0.010
1505	0.155 ± 0.007	0.050 ± 0.005	0.015 ± 0.003	0.015 ± 0.005	0.015 ± 0.005
2010	0.209 ± 0.009	0.098 ± 0.005	0.015 ± 0.003	0.020 ± 0.005	0.020 ± 0.005
2208	0.230 ± 0.007	0.075 ± 0.005	0.015 ± 0.003	0.020 ± 0.005	0.020 ± 0.005
2512	0.259 ± 0.009	0.124 ± 0.005	0.015 ± 0.003	0.020 ± 0.005	0.020 ± 0.005

ENVIRONMENTAL TESTS (Vishay Performance vs. AEC-Q200 Requirements)				
ENVIRONMENTAL TEST		CONDITIONS	LIMITS PER AEC-Q200	TYPICAL VISHAY PERFORMANCE
Resistance Temperature Characteristic		- 55 °C to + 125 °C	± 50 ppm/°C	± 35 ppm/°C
Max. Ambient Temp. at Rated Wattage			+ 70 °C	+ 70 °C
Max. Ambient Temp. at Power Derating			+ 150 °C	+ 150 °C
High Temperature Storage	ΔR	MIL-STD-202, 108, 1000 h at 125 °C	± 0.1 %	+ 0.016 %
Temperature Cycling	ΔR	JESD22, JA-104, 1000 cycles, - 55 °C to + 125 °C	± 0.15 %	+ 0.013 %
Moisture Resistance	ΔR	MIL-STD-202, 106	± 0.20 %	+ 0.0010 %
Biased Humidity	ΔR	MIL-STD-202, 103, 1000 h at 85 °C, 85 % RH, 10 % P	± 0.10 %	+ 0.004 %
Life	ΔR	MIL-STD-202, 108 at 125 °C, 1000 h	± 0.1 %	+ 0.0220 %
Mechanical Shock	ΔR	MIL-STD-202, method 213, condition C	± 0.1 %	+ 0.004 %
Vibration	ΔR	MIL-STD-202 method 204, 10 Hz to 2 kHz	± 0.1 %	+ 0.0030 %
Resistance to Soldering Heat	ΔR	MIL-STD-202, 204, condition B	± 0.10 %	+ 0.0150 %
Electrostatic Discharge	ΔR	AEC-Q200-002 at 2 kV, human body	± 0.10 %	- 0.032 %
Solderability	Visual	J-STD-002, method B and B1	95 %	Acceptable
Terminal Strength	ΔR	AEC-Q200-006 at 1 kg for 60 s	± 0.10 %	+ 0.009 %
Flame Retardance	Visual	AEC-Q200-001 para 4.0		Acceptable



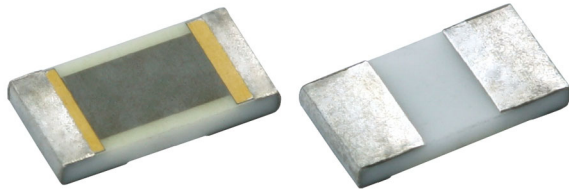


GLOBAL PART NUMBER INFORMATION															
New Global Part Numbering: PAT1206E1002BST1															
P	A	T	1	2	0	6	E	1	0	0	2	B	S	T	1
GLOBAL MODEL	CASE SIZE	TCR CHARACTERISTIC		RESISTANCE		TOLERANCE		TERMINATION		PACKAGING					
PAT	0402 0603 0805 1206 1505 2010 2208 2512	E = ± 25 ppm/°C H = ± 50 ppm/°C K = ± 100 ppm/°C		The first 3 digits are significant figures and the last digit specifies the number of zeros to follow. "R" designates the decimal point.  Example: 10R0 = 10 Ω 1000 = 100 Ω 1002 = 10 kΩ		B = ± 0.1 % D = ± 0.5 % F = ± 1.0 % G = ± 2.0 % J = ± 5.0 %		S = Wraparound lead (Pb)-free solder w/nickel barrier		TAPE AND REEL T1 = 1000 min., 1000 mult <sup>(1)</sup> TF = Full reel TS = 100 min., 1 mult					

Note

(1) Preferred packaging code

## High Power Thin Film Wraparound Chip Resistor



PHP series chip resistors are designed with enlarged backside terminations to reduce the thermal resistance between the topside resistor layer and the solder joint on the end users circuit board.

Actual power handling capability is limited by the end user mounting process. As with any high power chip resistor the ability to remove the generated heat is critical to the overall performance of the device.

### FEATURES

- High purity ceramic substrate
- Power rating to 2.5 W
- Resistance range 10  $\Omega$  to 30 k $\Omega$
- Resistor tolerance to  $\pm 0.1$  %
- TCR to  $\pm 25$  ppm/ $^{\circ}$ C
- Flame resistant UL 94 V-0

### APPLICATIONS

- Power supplies
- Power switching
- Braking system
- Test and measurement equipment
- Motor deflection circuits

### TYPICAL PERFORMANCE

	ABSOLUTE
TCR	25
TOL.	0.1

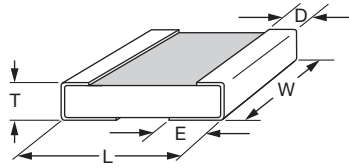
STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Nichrome	-
Resistance Range	10 $\Omega$ to 30 k $\Omega$	-
TCR: Absolute	25 ppm/ $^{\circ}$ C, 50 ppm/ $^{\circ}$ C (standard) and, 100 ppm/ $^{\circ}$ C	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
Tolerance: Absolute	0.1 %, 0.5 %, 1.0 % and, 5.0 %	+ 25 $^{\circ}$ C
Power Rating: Resistor	1206: 1.0 W, 2512: 2.5 W <sup>(1)</sup>	Maximum at + 70 $^{\circ}$ C
Stability: Absolute	$\Delta R$ 0.1 %	2000 h at + 70 $^{\circ}$ C
Stability: Ratio	Not applicable	-
Voltage Coefficient	< 0.1 ppm/V	-
Working Voltage	1206: 100 V, 2512: 200 V	-
Operating Temperature Range	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C	-
Storage Temperature Range	- 55 $^{\circ}$ C to + 150 $^{\circ}$ C	-
Noise	< - 30 dB	-
Shelf Life Stability: Absolute	$\pm 0.01$ %	1 year at + 25 $^{\circ}$ C

COMPONENT RATINGS			
CASE SIZE	POWER RATING (mW)	WORKING VOLTAGE (V)	RESISTANCE RANGE ( $\Omega$ )
1206	1000 <sup>(1)</sup>	100	10 to 30K
2512	2500 <sup>(1)</sup>	200	10 to 30K

#### Note

<sup>(1)</sup> Dependent on component mounting by user

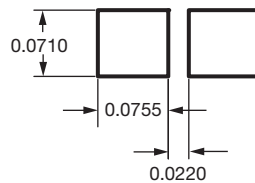
ENVIRONMENTAL TESTS (Vishay Performance vs. MIL-PRF-55342 Requirements)		
ENVIRONMENTAL TEST	LIMITS MIL-PRF-55342 CHARACTERISTIC "E"	TYPICAL VISHAY PERFORMANCE
Resistance Temperature Characteristic	$\pm 25$ ppm/ $^{\circ}$ C	$\pm 15$ ppm/ $^{\circ}$ C
Maximum Ambient Temperature at Rated Wattage	+ 70 $^{\circ}$ C	+ 70 $^{\circ}$ C
Maximum Ambient Temperature at Power Derating	+ 150 $^{\circ}$ C	+ 150 $^{\circ}$ C
Thermal Shock	$\pm 0.1$ %	$\pm 0.04$ %
Low Temperature Operation	$\pm 0.1$ %	$\pm 0.001$ %
Short Time Overload	$\pm 0.1$ %	$\pm 0.003$ %
High Temperature Exposure	$\pm 0.1$ %	$\pm 0.030$ %
Resistance to Soldering Heat	$\pm 0.2$ %	$\pm 0.007$ %
Moisture Resistance	$\pm 0.2$ %	$\pm 0.002$ %
Life at + 70 $^{\circ}$ C for 2000 h	$\pm 0.5$ %	$\pm 0.100$ %

**DIMENSIONS** in inches


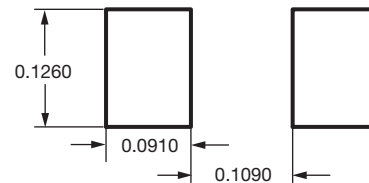
CASE SIZE	LENGTH	WIDTH W ( $\pm 0.005$ )	THICKNESS MIN./MAX.	TOP PAD D ( $\pm 0.005$ )	BOTTOM PAD E ( $\pm 0.005$ )
1206	0.126 $\pm$ 0.008	0.063	0.015/0.033	0.020 + 0.005/- 0.010	0.040
2512	0.259 + 0.009/- 0.015	0.124	0.015/0.033	0.02	0.050

**LAND PATTERN DIMENSIONS** in inches

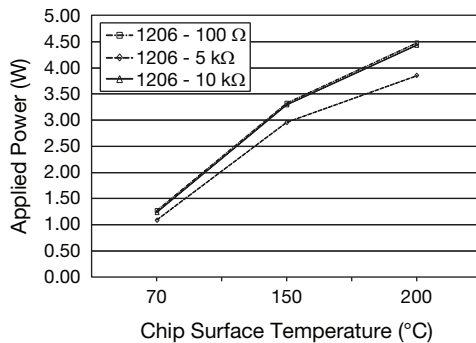
PHP Land Pattern for 1206 Case Size



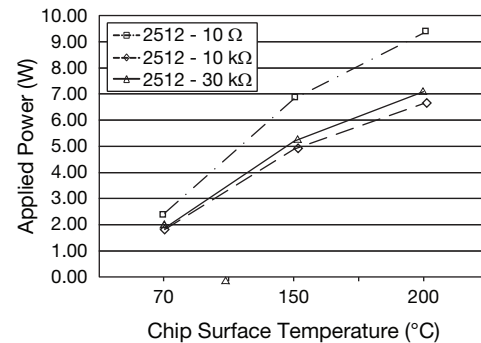
PHP Land Pattern for 2512 Case Size


**STANDARD MATERIAL SPECIFICATIONS**

Resistive Element	Nichrome
Substrate Material	Alumina (Al <sub>2</sub> O <sub>3</sub> )
Terminations (Tin/Lead)	Tin/lead solder over nickel barrier
Terminations (Lead (Pb)-free)	Tin/silver/copper (Sn96.5Ag3.0Cu0.5) solder over nickel barrier

**PHP CHIP TEMP. VS. APPLIED POWER**

**Notes**

- Chip surface temperature measured using FLIR A40 thermal imaging system with an approximate test card surface temperature of 25 °C.
- Thermal imaging was conducted under ambient conditions resulting in a steady state test card surface temperature of 85 °C over the full range of power levels.
- Thermal imaging and load life testing was conducted mounting one device to 2" x 3" test cards with 2.5 mil copper plating on both surfaces. Thermal vias on 120 mil centers were utilized for heat transfer between surfaces of the test card.

**PHP CHIP TEMP. VS. APPLIED POWER**

**Notes**

- Chip surface temperature measured using FLIR A40 thermal imaging system with an approximate test card surface temperature of 25 °C.

Case Size	2512	2512	2512
Resistance Value	Up to 10 Ω	Up to 10 kΩ	Up to 30 kΩ
Temperature	Power (W)		
70	2.44	1.81	1.87
150	6.82	4.89	5.19
200	9.33	6.63	7.09



GLOBAL PART NUMBER INFORMATION																
P	H	P	0	1	2	0	6	E	1	0	0	2	B	B	T	1
GLOBAL MODEL	SUBSTRATE	CASE SIZE	TCR	RESISTANCE	TOLERANCE	TERMINATION	PACKAGING									
PHP	0 = Alumina	1206 2512	<b>E</b> = ± 25 ppm/°C <b>H</b> = ± 50 ppm/°C <b>K</b> = ± 100 ppm/°C	The first 3 digits are significant figures and the last digit specifies the number of zeros to follow. "R" designates the decimal point.  Example: 10R0 = 10 Ω 1000 = 100 Ω 1001 = 1 kΩ	<b>B</b> = ± 0.1 % <b>D</b> = ± 0.5 % <b>F</b> = ± 1.0 % <b>G</b> = ± 2.0 % <b>J</b> = ± 5.0 %	<b>B</b> = Wraparound Sn/Pb solder w/nickel barrier  <b>S</b> = Wraparound lead (Pb)-free solder SAC-305 RoHS compliant - e1	<b>BS</b> = BULK 100 min., 1 mult <b>WS</b> = WAFFLE 100 min., 1 mult <b>WI</b> = WAFFLE (item single lot day code) 100 min., 1 mult  TAPE AND REEL <b>T1</b> = 1000 min., 1000 mult <b>T5</b> = 500 min., 500 mult <b>TF</b> = Full reel <b>TS</b> = 100 min., 1 mult <b>TI</b> = 100 min., 1 mult (item single lot date code) <b>TP</b> = 100 min., 1 mult (package unit single lot date)									

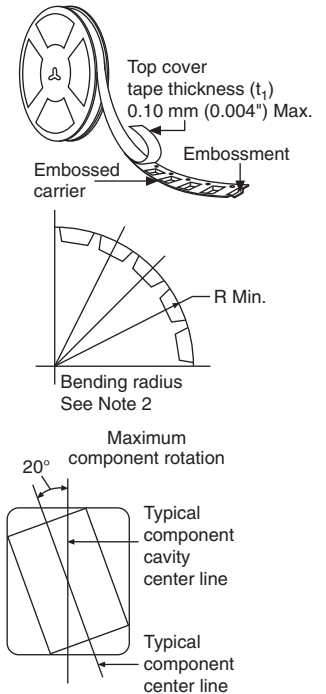
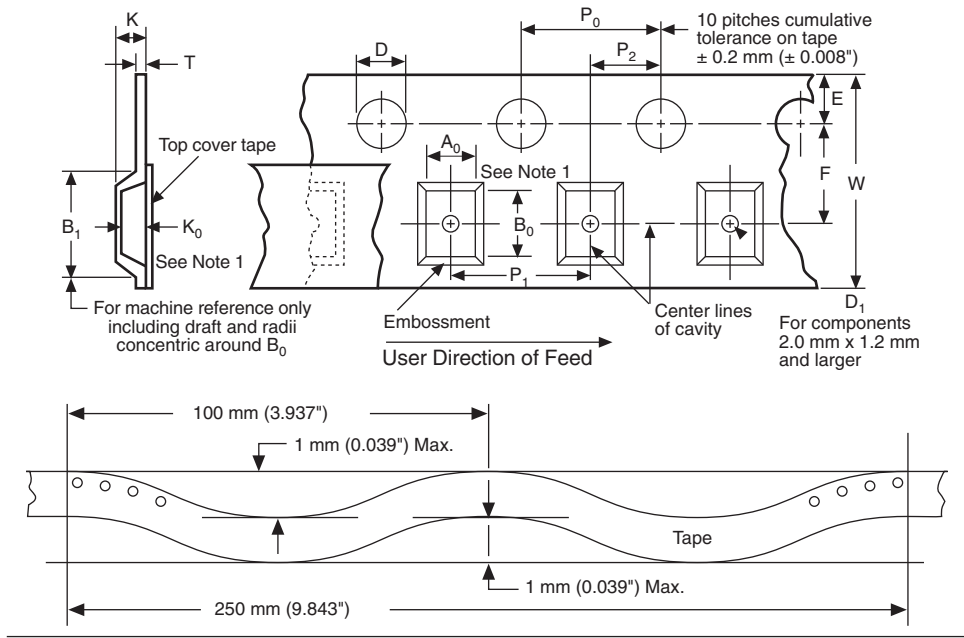
### 8 mm, 12 mm, 16 mm and 24 mm Embossed Conductive Tape Conforming to EIA-481

**Note**

- Chip resistor quantities less than 1000 pieces are typically packaged in bulk or waffle packs unless specified at time of order entry.

**8, 12, 16 AND 24 mm EMBOSSED TAPE DIMENSIONS**

**DIAGRAMS**



**8, 12, 16 AND 24 MM EMBOSSED TAPE DIMENSIONS** in millimeters (inches)

**Constant Dimensions**

TAPE SIZE	D	E	P <sub>0</sub>	T (max.)	A <sub>0</sub> B <sub>0</sub> K <sub>0</sub>	P <sub>2</sub>
8, 12	1.50 + 0.10/- 0.00	1.75 ± 0.10	4.00 ± 0.10	0.40	See note 1	2.00 ± 0.05

TAPE SIZE	B <sub>1</sub> (max.)	D <sub>1</sub> (min.)	F	P <sub>1</sub>	R (min.) see note 2	K	W	A <sub>0</sub> B <sub>0</sub> K <sub>0</sub>
8 mm 1/2 Pitch 8 mm	4.55 (0.179) see requirements	1.00 (0.039)	3.50 ± 0.10 (0.138 ± 0.004)	2.0 ± 0.10 (0.079 ± 0.004) see requirements	25 (0.984)	2.50 max. (0.098)	8.00 (0.315)	See note 1
12 mm 12 mm Double Pitch	8.20 (0.323)	1.50 (0.059)	5.50 ± 0.05 (0.217 ± 0.002)	4.00 ± 0.10 (0.157 ± 0.004) 8.00 ± 0.10 (0.315 ± 0.004)	30 (1.181)	6.50 max. (0.256) see requirements	12.00 ± 0.30 (0.472 ± 0.012)	
16 mm	12.10 (0.476)	1.50 (0.059)	7.50 ± 0.10 (0.295 ± 0.004)	4.00 ± 0.10 (0.157 ± 0.004) 8.00 ± 0.10 (0.315 ± 0.004) 12.00 ± 0.10 (0.472 ± 0.004)	30 (1.181)	8.00 (0.315)	16.30 (0.642)	See note 1
24 mm	20.10 (0.791)		11.50 ± 0.10 (0.453 ± 0.004)	4.00 ± 0.10 (0.157 ± 0.004) to 20.00 ± 0.10 (0.787 ± 0.004) in 4.00 (0.157) increments		12.00 (0.472)	24.30 (0.957)	

**Notes**

- (1) A<sub>0</sub> B<sub>0</sub> K<sub>0</sub> are determined by component size. The clearance between the component and the cavity must be within 0.05 mm (0.002") min., to 0.50 mm (0.020") max. for 8 mm tape, and 0.05 mm (0.002") min. to 0.65 mm (0.026") max. for 12 mm tape. The component cannot rotate more than 20° within the determined cavity, see above diagram.
- (2) Tape and components shall pass around radius "R" without damage





<b>VISHAY THIN FILM (NIAGARA FALLS) STANDARD TAPE AND REEL SPECIFICATIONS</b>						
<b>CASE SIZE OR STYLE</b>	<b>SIZE</b>	<b>TAPE SIZE</b>	<b>MAX. QTY./REEL</b>	<b>LEADER LENGTH (MIN.)</b>	<b>CAVITY SIZE</b>	<b>REEL SIZE</b>
0402	40 x 20	8 mm	5000	400 mm	0.045 x 0.024	7"
0502	50 x 25	8 mm	5000	400 mm	0.061 x 0.035	7"
0603	63 x 32	8 mm	5000	400 mm	0.075 x 0.045	7"
0504	50 x 40	8 mm	5000	400 mm	0.052 x 0.054	7"
0505	50 x 50	8 mm	5000	400 mm	0.052 x 0.054	7"
0705	75 x 50	8 mm	5000	400 mm	0.060 x 0.080	7"
1002	100 x 25	N/A	N/A	N/A	N/A	N/A
1005	100 x 50	8 mm	4000 <sup>(1)</sup>	400 mm	0.058 x 0.112	7"
1010	100 x 100	8 mm	4000	400 mm	0.110 x 0.114	7"
1020	100 x 200	12 mm	3000	400 mm	0.110 x 0.220	13"
1206	126 x 63	8 mm	4000	400 mm	0.075 x 0.139	7"
1505	150 x 50	12 mm	4000	400 mm	0.089 x 0.168	7"
2010	200 x 100	12 mm	2000	400 mm	0.111 x 0.220	7"
2208	225 x 75	12 mm	2000	400 mm	0.085 x 0.243	7"
2512	250 x 125	12 mm	2000	400 mm	0.140 x 0.290	7"
<b>STYLE</b>	<b>TYPE</b>					
DFN	8 PAD 4 mm SQ.	12 mm	3000	400 mm	0.172 x 0.172	13"
ORN	8 PIN SOIC	12 mm	3000	400 mm	0.254 x 0.202	13"
HTRN						
TOMC	16 PIN SOIC	24 mm	2000	400 mm	0.323 x 0.457	13"
MP	SC70	8 mm	4000	400 mm	0.095 x 0.095	7"
MPM	SOT-23	8 mm	4000	400 mm	0.122 x 0.106	7"
MPD	SOT-143	8 mm	4000	400 mm	0.122 x 0.106	7"
MPH	4 PIN LCC	12 mm	2500	400 mm	0.165 x 0.230	13"
TLCC/LCC	16 PIN LCC	16 mm	2000	400 mm	0.330 x 0.327	13"
TLCC/LCC	20 PIN LCC	16 mm	2000	400 mm	0.408 x 0.405	13"
WOMC	16/18/20 PIN SOIC	24 mm	1000	400 mm	0.431 x 0.524	13"
NOMC	14 PIN SOIC	16 mm	2500	400 mm	0.258 x 0.351	13"
NOMCA						
NOMC	16 PIN SOIC	16 mm	2500	400 mm	0.256 x 0.404	13"
NOMCA						
OSOP	20 PIN SSOP	16 mm	2500	400 mm	0.258 x 0.315	13"
<b>SILNET STYLE</b>	<b>TYPE</b>					
VSOR	16 PIN SOIC	12 mm	2500	400 mm	0.252 x 0.205	13"
VSORC	20 PIN SOIC	24 mm	1000	400 mm	0.429 x 0.524	13"
VSOR2000S1	20 PIN SOIC	24 mm	1000	400 mm	0.429 x 0.524	13"
VSSR	16 PIN QSOP	12 mm	2500	400 mm	0.252 x 0.205	13"
	20 PIN QSOP	16 mm	2500	400 mm	0.256 x 0.374	13"
	24 PIN QSOP	16 mm	2500	400 mm	0.256 x 0.374	13"
VSSRC	20 PIN QSOP	16 mm	2500	400 mm	0.256 x 0.374	13"
VTSR	16 PIN TSSOP	24 mm	2500	400 mm	0.252 x 0.205	13"
	20 PIN TSSOP	24 mm	2500	400 mm	0.256 x 0.374	13"
	24 PIN TSSOP	24 mm	2500	400 mm	0.256 x 0.374	13"
VTSRC	20 PIN TSSOP	24 mm	2500	400 mm	0.256 x 0.374	13"

**Note**

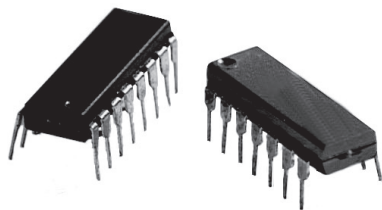
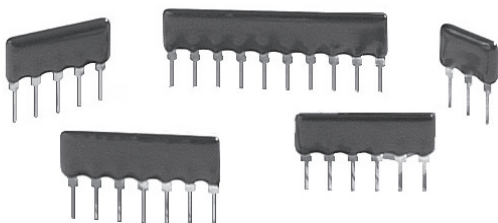
(1) M-1005 series 5000 pieces max. per reel



<b>VISHAY THIN FILM (NIAGARA FALLS) STANDARD WAFFLE PACK SPECIFIED (2 inch x 2 inch)</b>		
<b>CASE SIZE</b>	<b>SIZE OR STYLE</b>	<b>NUMBER OF CELLS</b>
0402	(40 x 20)	400
0502	(50 x 20)	400
0504	(50 x 40)	400
0505	(50 x 50)	400
0603	(60 x 30)	100
0705	(70 x 50)	100
1005	(100 x 50)	100
1010	(100 x 100)	100
1206	(126 x 63)	100
1505	(150 x 50)	90
2208	(225 x 75)	72
2010	(200 x 100)	49
2512	(250 x 125)	25



# Through Hole Networks



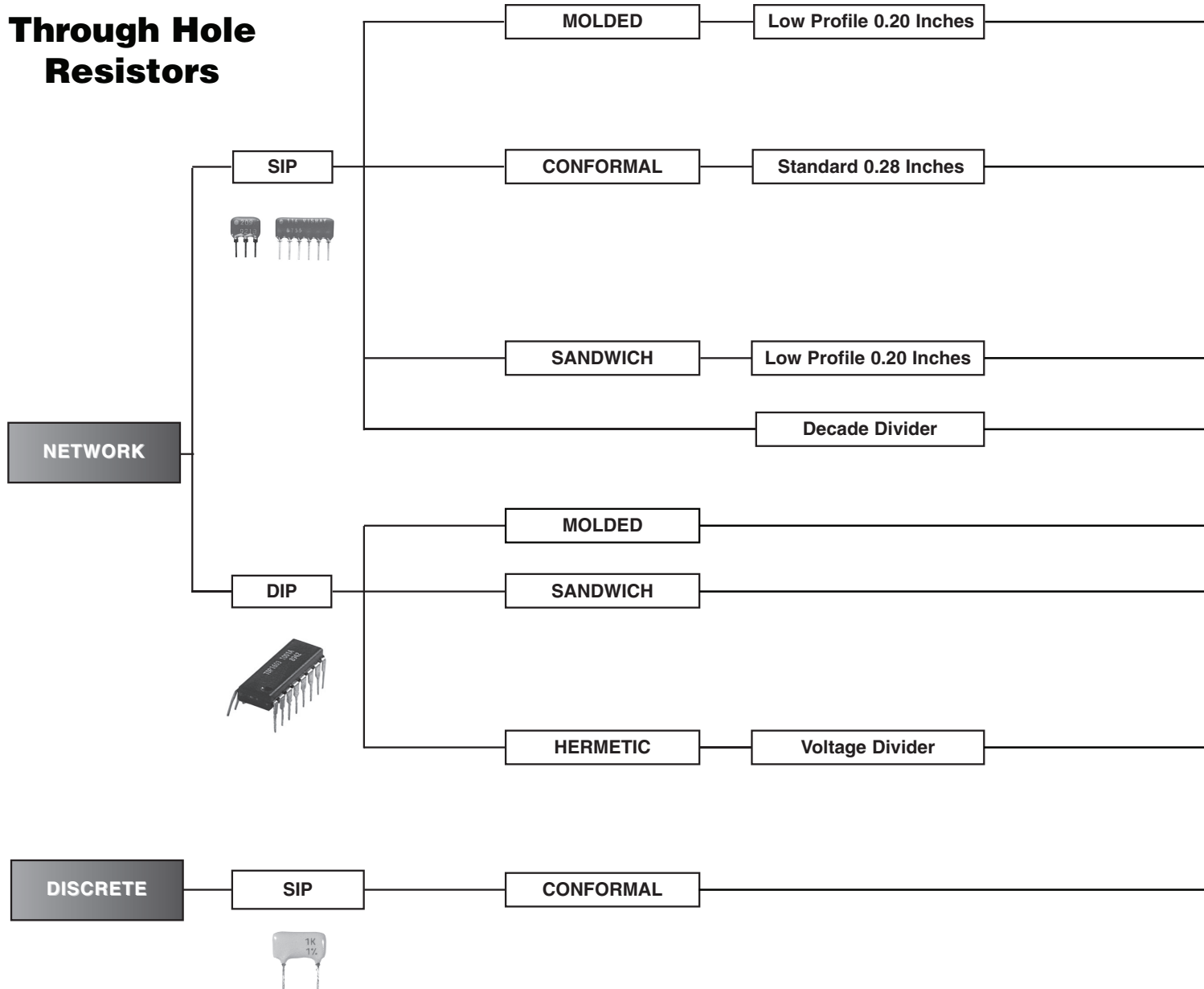
## Contents

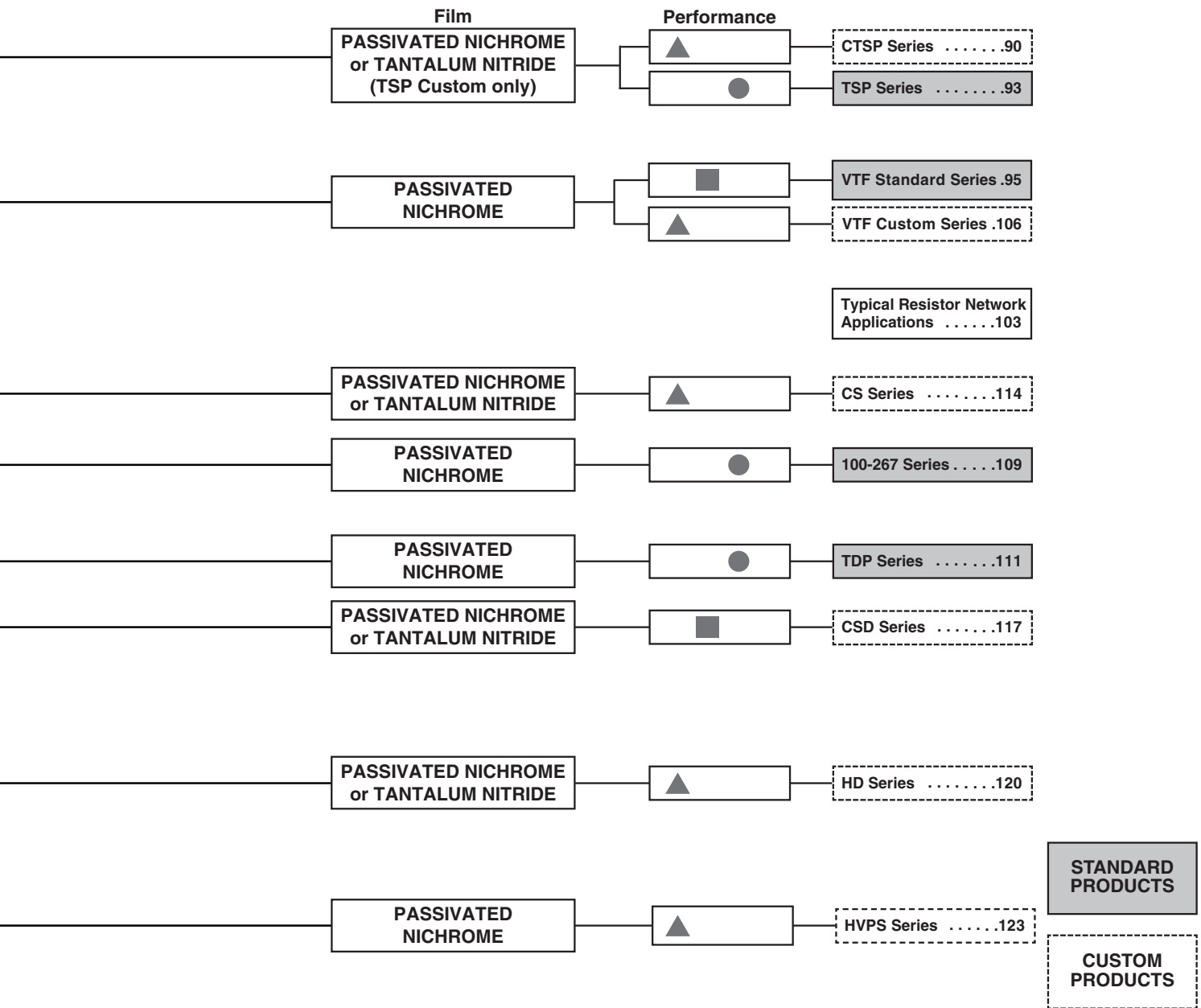
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VTF (Custom).....	125
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# Thin Film Through Hole Resistors

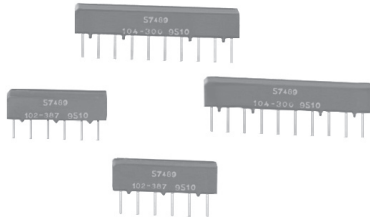




**Performance Key**

▲	■	●	◆																																
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><th>ABS</th><th>TRACKING</th></tr> <tr><td>10</td><td>2</td></tr> <tr><th>ABS</th><th>RATIO</th></tr> <tr><td>0.05</td><td>0.01</td></tr> </table>	ABS	TRACKING	10	2	ABS	RATIO	0.05	0.01	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><th>ABS</th><th>TRACKING</th></tr> <tr><td>10</td><td>2</td></tr> <tr><th>ABS</th><th>RATIO</th></tr> <tr><td>0.1</td><td>0.025</td></tr> </table>	ABS	TRACKING	10	2	ABS	RATIO	0.1	0.025	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><th>ABS</th><th>TRACKING</th></tr> <tr><td>25</td><td>2</td></tr> <tr><th>ABS</th><th>RATIO</th></tr> <tr><td>0.1</td><td>0.1</td></tr> </table>	ABS	TRACKING	25	2	ABS	RATIO	0.1	0.1	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><th>ABS</th><th>TRACKING</th></tr> <tr><td>50</td><td>5</td></tr> <tr><th>ABS</th><th>RATIO</th></tr> <tr><td>1.0</td><td>0.025</td></tr> </table>	ABS	TRACKING	50	5	ABS	RATIO	1.0	0.025
ABS	TRACKING																																		
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1.0	0.025																																		
TCR	TCR	TCR	TCR																																
TOL	TOL	TOL	TOL																																

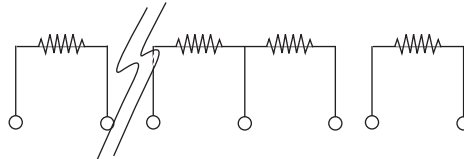
## Molded, Commercial, Single In-Line Thin Film Resistor, Through Hole Network (Custom)



Designed to meet MIL-PRF-83401 characteristic “V” and “H”

Military grade networks designed to meet MIL-PRF-83401 characteristics “V” and “H” available in 6 pins, 8 pins and 10 pins sizes in high and low profile. The molded style features a direct thermal compression bonded lead attachment in a rugged molded construction.

### SCHEMATIC



Custom schematics available. Please consult factory.

### FEATURES

- Lead (Pb)-free gold plated terminals standard
- Gold to gold terminations (no internal solder)
- Exceptional ratio stability over time and temperature ( $\Delta R \pm 0.015\%$  2000 h at 70 °C)
- Rugged low profile molded case 6 pins, 8 pins, and 10 pins available
- Compatible with automatic insertion equipment
- Compliant to RoHS Directive 2002/95/EC



**RoHS\***  
COMPLIANT

### Note

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

### TYPICAL PERFORMANCE

▲	ABSOLUTE	TRACKING
	TCR	10
TOL.	ABSOLUTE	RATIO
	0.05	0.025

STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	6, 8, 10	-
Resistance Range	20 $\Omega$ to 500 k $\Omega$ total	-
TCR: Absolute	$\pm 10$ ppm/°C to $\pm 25$ ppm/°C	-55 °C to +125 °C
TCR: Tracking	$\pm 2$ ppm/°C (typical less 1 ppm/°C equal values)	-55 °C to +125 °C
Tolerance: Absolute	$\pm 0.05\%$ to $\pm 0.5\%$	+25 °C
Tolerance: Ratio	$\pm 0.025\%$ to 0.1 %	+25 °C
Power Rating: Resistor	100 mW (per element typical at +25 °C)	Maximum at +70 °C
Power Rating: Package	500 mW	Maximum at +70 °C
Stability: Absolute	$\Delta R \pm 0.05\%$	2000 h at +70 °C
Stability: Ratio	$\Delta R \pm 0.015\%$	2000 h at +70 °C
Voltage Coefficient	< 0.0015 ppm/V	-
Working Voltage	100 V	-
Operating Temperature Range	-55 °C to +125 °C	-
Storage Temperature Range	-55 °C to +150 °C	-
Noise	< -30 dB	-
Thermal EMF	< 0.08 $\mu$ V/°C	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01\%$	1 year at +25 °C
Shelf Life Stability: Ratio	$\Delta R \pm 0.002\%$	1 year at +25 °C

### Note

- Tantalum Nitride film is custom, consult factory

<b>DIMENSIONS AND IMPRINTING</b> in inches and millimeters			
	DIMENSION	INCHES	MILLIMETERS
	A	0.035	0.89
	B	0.040	1.02
	C	0.100 ± 0.005 non-accum.	2.54 ± 0.13
	D	0.019 ± 0.006 typical	0.48 ± 0.15
	E	0.187 ± 0.010	4.75 ± 0.25
	F	0.135	3.43
	G	0.095	2.41
	H	0.012 ± 0.004	0.31 ± 0.10
	L (6 Pins)	0.583 ± 0.015	14.81 ± 0.38
	L (8 Pins)	0.783 ± 0.015	19.89 ± 0.38
	L (10 Pins)	0.983 ± 0.015	24.97 ± 0.38

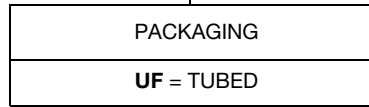
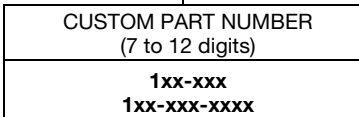
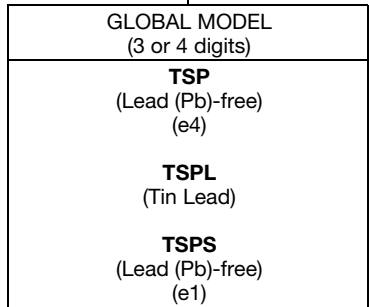
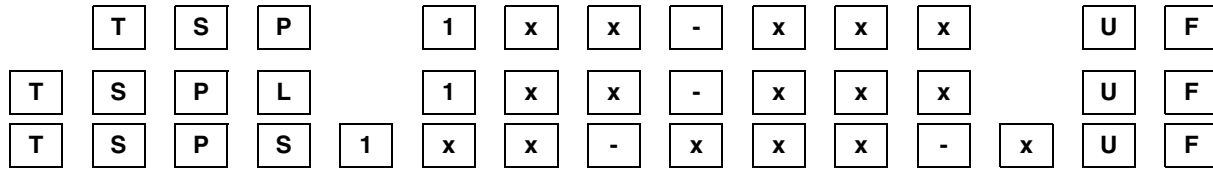
<b>MECHANICAL SPECIFICATIONS</b>	
<b>Resistive Element</b>	Passivated nichrome or tantalum nitride
<b>Substrate Material</b>	Alumina
<b>Body Molded</b>	Epoxy
<b>Terminals</b>	Copper alloy
<b>Plating</b>	Nickel/gold
<b>Model TSP - Lead (Pb)-free Standard</b>	Gold plated
<b>Model TSPS - Lead (Pb)-free Solder Coated Option</b>	Sn63
<b>Model TSPL - Tin/Lead Solder Coated Option</b>	Sn96.5, Ag3.0, Cu0.5
<b>Tin/Lead and Lead (Pb)-free Finish</b>	Hot solder dip

<b>ORDERING INFORMATION CHECK LIST (Customs)</b>	
Special requirements should be identified in advance, but as a minimum, you should have the following information ready.	
ELECTRICAL	MECHANICAL
<ol style="list-style-type: none"> <li>Resistors, by value and tolerance</li> <li>Reference resistor(s) and matching of which resistors to which reference resistors</li> <li>Resistance by ratio</li> <li>Absolute temperature coefficient of resistivity</li> <li>Temperature tracking of subordinate resistors to reference resistor(s)</li> <li>Maximum operating voltage</li> <li>Resistor power ratings</li> <li>Operating temperature range</li> </ol>	<ol style="list-style-type: none"> <li>Maximum allowable seated height (from PC board to top of network)</li> <li>Special marking concerns</li> <li>Schematic pin out of package</li> <li>Specify if solder coated terminals are required</li> </ol>
For additional assistance refer to Vishay Thin Film's guide to understanding Thin Film precision. Resistor networks or application engineering. All standard products may be ordered directly from Vishay Thin Film.	

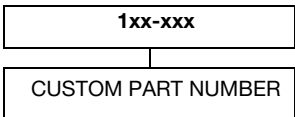


**GLOBAL PART NUMBER INFORMATION**

New Global Part Numbering: TSP1xx-xxxUF

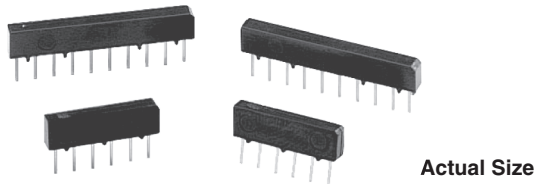


Historical Part Number example: 1xx-xxx (for reference purposes only)





## Molded, Commercial, Single In-Line Thin Film Resistor, Through Hole Network (Standard)



Actual Size

Designed to meet MIL-PRF-83401 characteristic "V" and "H"

These resistor networks are available in 6 pins, 8 pins and 10 pins styles in both standard and custom circuits. They incorporate Vishay Dale Thin Film's patented passivated nichrome film to give superior performance on temperature coefficient of resistance, thermal stability, noise, voltage coefficient, power handling and resistance stability. The leads are attached to the metallized alumina substrates by Thermo-Compression bonding. The body is molded thermoset plastic with gold plated copper alloy leads. This product will outperform all of the requirements of characteristic "V" and "H" of MIL-PRF-83401.

### FEATURES

- Lead (Pb)-free gold plated terminals standard
- Gold to gold terminations (no internal solder)
- Exceptional ratio stability over time and temperature ( $\Delta R \pm 0.015\%$  2000 h at 70 °C)
- Rugged low profile molded case 6 pins, 8 pins, and 10 pins available
- Compatible with automatic insertion equipment
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



**RoHS\***  
COMPLIANT  
HALOGEN  
**FREE**

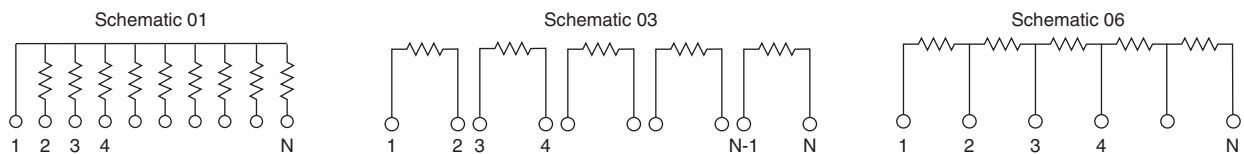
### Note

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

### TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
TCR	25	2
	ABSOLUTE	RATIO
TOL.	0.1	0.05

### SCHEMATIC



### STANDARD ELECTRICAL SPECIFICATIONS

TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	6, 8, 10	-
Resistance Range	100 Ω to 200 kΩ per resistor	-
TCR: Absolute	± 25 ppm/°C (standard)	- 55 °C to + 125 °C
TCR: Tracking	± 2 ppm/°C (typical less 1 ppm/°C equal values) <sup>(1)</sup>	- 55 °C to + 125 °C
Tolerance: Absolute	± 0.1 % to ± 1.0 %	+ 25 °C
Tolerance: Ratio	± 0.05 % to ± 0.1 % to R <sub>1</sub>	+ 25 °C
Power Rating: Resistor	0.100 W (per element typical at + 25 °C)	Maximum at + 70 °C
Power Rating: Package	0.500 W	Maximum at + 70 °C
Stability: Absolute	$\Delta R \pm 0.05\%$	2000 h at + 70 °C
Stability: Ratio	$\Delta R \pm 0.015\%$	2000 h at + 70 °C
Voltage Coefficient	< 0.1 ppm/V	-
Working Voltage	100 V	-
Operating Temperature Range	- 55 °C to + 125 °C	-
Storage Temperature Range	- 55 °C to + 125 °C	-
Noise	< - 30 dB	-
Thermal EMF	< 0.08 μV/°C	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01\%$	1 year at + 25 °C
Shelf Life Stability: Ratio	$\Delta R \pm 0.002\%$	1 year at + 25 °C

### Note

<sup>(1)</sup> Consult factory for TCR tracking specifications 01 schematic

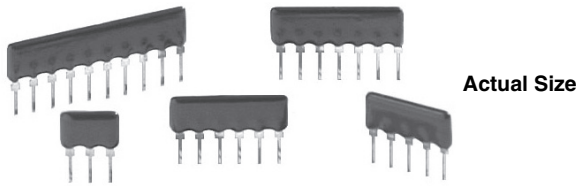
DIMENSIONS AND IMPRINTING in inches and millimeters			
	<b>DIMENSION</b>	<b>INCHES</b>	<b>MILLIMETERS</b>
	A	0.035	0.89
	B	0.040	1.02
	C	0.100 ± 0.005 non-accum.	2.54 ± 0.13
	D	0.019 ± 0.006 typical	0.48 ± 0.15
	E	0.187 ± 0.010	4.75 ± 0.25
	F	0.135	3.43
	G	0.095	2.41
	H	0.012 ± 0.004	0.31 ± 0.10
	L (6 Pins)	0.583 ± 0.015	14.81 ± 0.38
L (8 Pins)	0.783 ± 0.015	19.89 ± 0.38	
L (10 Pins)	0.983 ± 0.015	24.97 ± 0.38	

CONSTRUCTION	

MECHANICAL SPECIFICATIONS	
<b>Resistive Element</b>	Passivated nichrome or tantalum nitride
<b>Substrate Material</b>	Alumina
<b>Body Molded</b>	Epoxy
<b>Terminals</b>	Copper alloy
<b>Plating</b>	Nickel/gold
<b>Model TSP - Lead (Pb)-free Standard</b>	Gold plated
<b>Model TSPS - Lead (Pb)-free Solder Coated Option</b>	Sn63
<b>Model TSPL - Tin/Lead Solder Coated Option</b>	Sn96.5, Ag3.0, Cu0.5
<b>Tin/Lead and Lead (Pb)-free Finish</b>	Hot solder dip

GLOBAL PART NUMBER INFORMATION																				
New Global Part Numbering: TSP6011002BUF																				
T	S	P	6	0	1	1 0 0 2 B U F														
T	S	P	S	1	0	0 1 1 0 0 2 C U F														
<b>GLOBAL MODEL</b> (3 or 4 digits)	<b>PIN COUNT</b> (1 or 2 digits)	<b>SCHEMATICS</b>	<b>TCR CHARACTERISTICS</b>	<b>RESISTANCE</b>	<b>TOLERANCE AND RATIO TOLERANCE</b>															
TSP (Lead (Pb)-free) (e4) TSPL (Tin/lead) TSPS (Lead (Pb)-free) (e1)	6 8 10	01 <sup>(1)</sup> = 5, 7 or 9 resistors with Pin 1 common 03 = 3, 4 or 5 isolated resistors 06 = 5, 7 or 9 series connected	R = ± 25 ppm/°C <sup>(2)</sup> H = ± 50 ppm/°C K = ± 100 ppm/°C <b>Note</b> <sup>(2)</sup> 01 Schematic greater than 250 Ω only	First 3 digits are significant figures and the last digit specifies the number of zeroes to follow. e.g.: 1001 = 1K 1002 = 10K	<table border="1"> <tr> <th colspan="2">TOLERANCE AND RATIO TOLERANCE</th> </tr> <tr> <td>Absolute</td> <td>Ratio</td> </tr> <tr> <td>A = 0.1 %<sup>(3)</sup></td> <td>0.05 %</td> </tr> <tr> <td>B = 0.1 %</td> <td>0.1 %</td> </tr> <tr> <td>C = 0.25 %</td> <td>0.1 %</td> </tr> <tr> <td>D = 0.5 %</td> <td>0.1 %</td> </tr> <tr> <td>F = 1.0 %</td> <td>0.5 %</td> </tr> </table>		TOLERANCE AND RATIO TOLERANCE		Absolute	Ratio	A = 0.1 % <sup>(3)</sup>	0.05 %	B = 0.1 %	0.1 %	C = 0.25 %	0.1 %	D = 0.5 %	0.1 %	F = 1.0 %	0.5 %
TOLERANCE AND RATIO TOLERANCE																				
Absolute	Ratio																			
A = 0.1 % <sup>(3)</sup>	0.05 %																			
B = 0.1 %	0.1 %																			
C = 0.25 %	0.1 %																			
D = 0.5 %	0.1 %																			
F = 1.0 %	0.5 %																			
<b>PACKAGING</b> UF = Tubed																				
<b>Note</b> <sup>(1)</sup> Consult factory for TCR tracking specifications 01 schematic																				
<b>Note</b> <sup>(3)</sup> Tol. available on 1K and up only. R <sub>1</sub> is reference resistor.																				
<b>Historical Part Number example: TSP803R1001F (for reference purposes only)</b>																				
TSP	8	03	R	1001	F															
SERIES	PINS	SCHEMATIC	TCR CHARACTERISTIC	RESISTANCE	TOLERANCE AND RATIO TOLERANCE															

## Conformal, Single In-Line Thin Film Resistor, Through Hole Network (Standard)



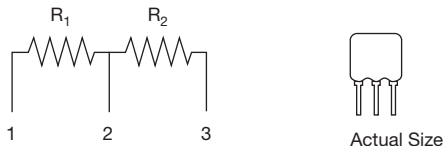
Vishay Dale Thin Film resistor networks are designed to be used in analog circuits in conjunction with operational amplifiers. Engineers can use these circuits to achieve an infinite number of very low noise and high stability circuits for industrial, medical and scientific instrumentation.

This family of standard resistor networks will continually be expanded with new and innovative designs, and Vishay Dale Thin Film stocks most designs in house for off-the-shelf convenience. However, if you can not find the standard network you need, call applications engineering at (716) 283-4025, as we may be able to meet your requirements with a semicustom “match” for a quick delivery.

For standard networks with tighter specifications, or for custom networks, contact Applications Engineering at the above number. For a quick review of typical applications, request Vishay’s guide to understanding and using thin film precision networks.

### SCHEMATIC

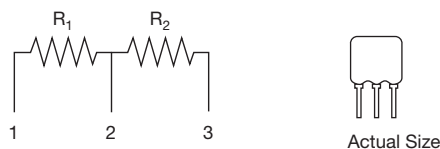
$$R_1 = R_2$$



L = Total length = 0.320" (8.13 mm) max.  
 H = Seated height = 0.280" (7.11 mm) max.  
 Except PN 218 where seated height = 0.342" (8.69 mm) max.

$$R_1 + R_2 = 10K, 100K, 1M$$

$$\frac{R_1 + R_2}{R_2} = 10$$



L = Total length = 0.320" (8.13 mm) max.  
 H = Seated height = 0.280" (7.11 mm) max.  
 Except PN 281 where seated height = 0.362" (9.19 mm) max.

### FEATURES

- Off-the-shelf delivery
- Wide variety of standards
- Small size (SIP)
- Standard designs - no NRE
- Low capacitance < 0.1 pF/PIN
- Flame resistant (UL 94 V-0 rating)
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



**RoHS\***  
 COMPLIANT  
 HALOGEN  
**FREE**

### Note

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

### TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
TCR	10	2
	ABSOLUTE	RATIO
TOL.	0.1	0.02

Complete electrical specifications at the end of schematics.

### TWO EQUAL RESISTORS

#### ORDERING INFORMATION ( $R_1 =$ )

1K: VTF209BX	50K: VTF214BX
2K: VTF210BX	100K: VTF215BX
5K: VTF211BX	200K: VTF216BX
10K: VTF212BX	500K: VTF217BX
20K: VTF213BX	1M: VTF218BX

Lead (Pb)-free option add “S” after part number, e.g: VTF209SBX

### RATIO DIVIDER 10:1

#### ORDERING INFORMATION ( $R_1 + R_2 =$ )

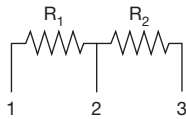
9K + 1K = 10K: VTF280BX
90K + 10K = 100K: VTF193BX
900K + 100K = 1M: VTF281BX

Lead (Pb)-free option add “S” after part number, e.g: VTF280SBX



$R_1 = 100K, 1M$

$$\frac{R_1}{R_2} = 10$$



Actual Size

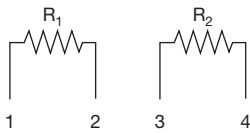
L = Total length = 0.320" (8.13 mm) max.  
H = Seated height = 0.280" (7.11 mm) max.  
Except PN 283 where seated height = 0.362" (9.19 mm) max.

### DIVIDER NETWORK 10:1

#### ORDERING INFORMATION ( $R_1 =$ )

100K: VTF363BX
1M: VTF1104BX

$R_1 = R_2$



Actual Size

L = Total length = 0.420" (10.67 mm) max.  
H = Seated height = 0.280" (7.11 mm) max.

### TWO EQUAL RESISTORS - ISOLATED

#### ORDERING INFORMATION ( $R_1 =$ )

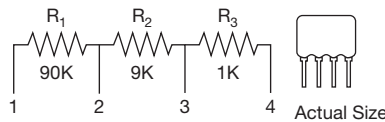
1K: VTF365BX	50K: VTF1000BX
2K: VTF997BX	100K: VTF348BX
5K: VTF998BX	200K: VTF1105BX
10K: VTF363BX	500K: VTF1106BX
20K: VTF1104BX	1M: VTF1103BX
25K: VTF999BX	

Lead (Pb)-free option add "S" after part number, e.g: VTF209SBX

$R_1 + R_2 + R_3 = 100K$

$$\frac{R_1 + R_2 + R_3}{R_3} = 100$$

$$\frac{R_1 + R_2 + R_3}{R_2 + R_3} = 10$$



Actual Size

L = Total length = 0.420" (10.67 mm) max.  
H = Seated height = 0.280" (7.11 mm) max.

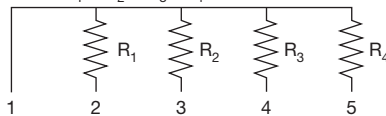
### RATIO DIVIDER 10:1 AND 100:1

#### ORDERING INFORMATION ( $R_1 + R_2 + R_3 =$ )

100K: VTF330BX
----------------

Lead (Pb)-free option add "S" after part number, e.g: VTF330SBX

$R_1 = R_2 = R_3 = R_4 = 10K, 100K$



Actual Size

L = Total length = 0.520" (13.21 mm) max.  
H = Seated height = 0.280" (7.11 mm) max.

### FOUR EQUAL RESISTORS ONE COMMON

#### ORDERING INFORMATION ( $R_1 =$ )

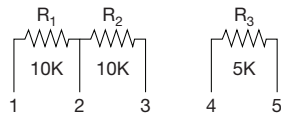
10K: VTF366BX
100K: VTF367BX

Lead (Pb)-free option add "S" after part number, e.g: VTF366SBX

$R_1 = 10K$

$$\frac{R_2}{R_1} = 1$$

$$R_3 = \frac{R_1 \times R_2}{R_1 + R_2}$$



Actual Size

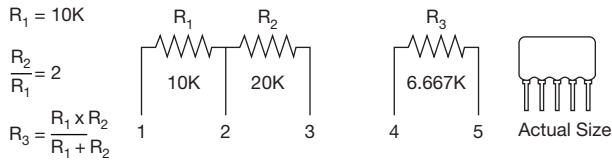
L = 0.520 (13.21 mm), H = 0.280 (7.11 mm) max.

### DIVIDER NETWORK 2:1

#### ORDERING INFORMATION

VTF1087BX
-----------

Lead (Pb)-free option add "S" after part number, e.g: VTF1087SBX



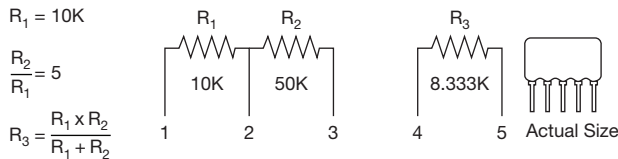
L = 0.520" (13.21 mm), H = 0.280" (7.11 mm) max.

### DIVIDER NETWORK 2:1

#### ORDERING INFORMATION

VTF1088BX

Lead (Pb)-free option add "S" after part number, e.g: VTF1088SBX



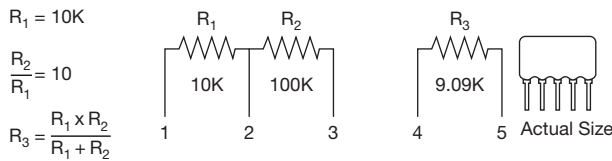
L = 0.520" (13.21 mm), H = 0.280" (7.11 mm) max.

### DIVIDER NETWORK 5:1

#### ORDERING INFORMATION

VTF1089BX

Lead (Pb)-free option add "S" after part number, e.g: VTF1089SBX



Note:  
• R<sub>2</sub> TCR Tracking 3 ppm/°C

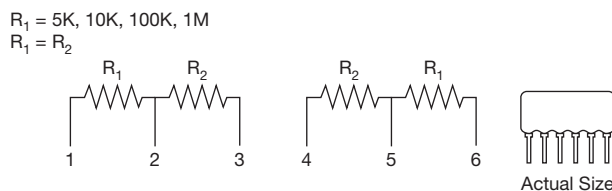
L = 0.520" (13.21 mm), H = 0.280" (7.11 mm) max.

### DIVIDER NETWORK 10:1

#### ORDERING INFORMATION

VTF1090BX

Lead (Pb)-free option add "S" after part number, e.g: VTF1090SBX



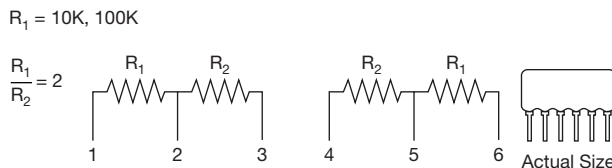
L = Total length = 0.620" (15.75 mm) max.  
H = Seated height = 0.280" (7.11 mm) max.  
Except PN 287 seated height = 0.362" (9.19 mm) max.

### DIVIDER NETWORK 1:1

#### ORDERING INFORMATION (R<sub>1</sub> =)

5K: VTF225BX
10K: VTF286BX
100K: VTF219BX
1M: VTF287BX

Lead (Pb)-free option add "S" after part number, e.g: VTF225SBX



L = Total length = 0.620" (15.75 mm) max.  
H = Seated height = 0.280" (7.11 mm) max.

### DIVIDER NETWORK 2:1

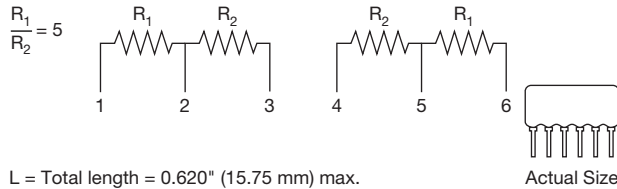
#### ORDERING INFORMATION (R<sub>1</sub> =)

10K: VTF1009BX
100K: VTF1010BX

Lead (Pb)-free option add "S" after part number, e.g: VTF1009SBX



R<sub>1</sub> = 10K, 100K



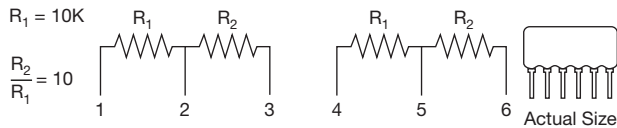
L = Total length = 0.620" (15.75 mm) max.  
H = Seated height = 0.280" (7.11 mm) max.

### DIVIDER NETWORK 5:1

#### ORDERING INFORMATION (R<sub>1</sub> =)

10K: VTF1007BX
100K: VTF1008BX

Lead (Pb)-free option add "S" after part number, e.g: VTF1007SBX



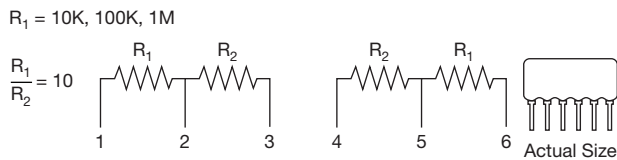
L = Total length = 0.620" (15.75 mm) max.  
H = Seated height = 0.280" (7.11 mm) max.

### DIVIDER NETWORK 10:1

#### ORDERING INFORMATION (R<sub>1</sub> =)

10K: VTF220BX
---------------

Lead (Pb)-free option add "S" after part number, e.g: VTF220SBX



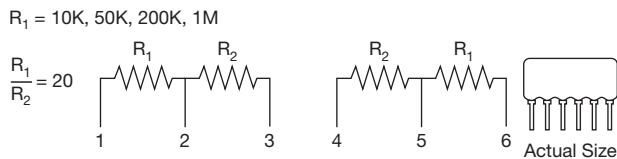
L = Total length = 0.620" (15.75 mm) max.  
H = Seated height = 0.280" (7.11 mm) max.  
Except PN 285 seated height = 0.320" (8.13 mm) max.

### DIVIDER NETWORK 10:1

#### ORDERING INFORMATION (R<sub>1</sub> =)

10K: VTF328BX
100K: VTF284BX
1M: VTF285BX

Lead (Pb)-free option add "S" after part number, e.g: VTF328SBX



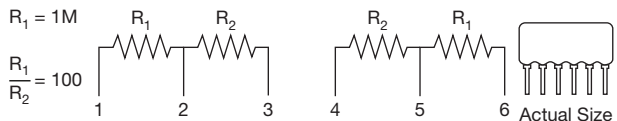
L = Total length = 0.620" (15.75 mm) max.  
H = Seated height = 0.280" (7.11 mm) max.

### DIVIDER NETWORK 20:1

#### ORDERING INFORMATION (R<sub>1</sub> =)

10K: VTF1073BX
50K: VTF1074BX
200K: VTF1107BX
1M: VTF1108BX

Lead (Pb)-free option add "S" after part number, e.g: VTF1073SBX



R<sub>1</sub> = 1M

$\frac{R_1}{R_2} = 100$

### DIVIDER NETWORK 100:1

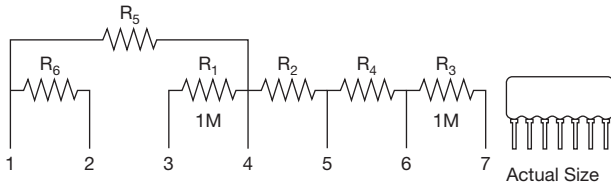
#### ORDERING INFORMATION (R<sub>1</sub> =)

1M: VTF1109BX
---------------

Lead (Pb)-free option add "S" after part number, e.g: VTF1109SBX



Common mode  
 Division ratio 250, 100, 50  
 $R_1 = R_3 = 1M$   
 $R_2 = 4K, 10K, 20K$   
 $R_4 = 3.984K, 9.901K, 19.608K$   
 $R_5 = 900K, 950K, 975K$   
 $R_6 = 100K, 50K, 25K$



L = Total length = 0.720" (18.29 mm) max.  
 H = Seated height = 0.360" (9.14 mm) max.  
 Maximum voltage to pins 3 and 7 is 300 V

### SIX RESISTOR NETWORK

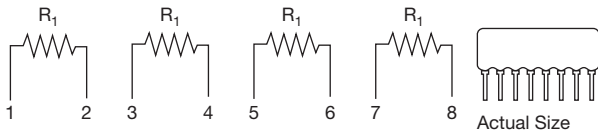
(Designed for unity gain/high common mode voltage rejection differential amplifier)

#### ORDERING INFORMATION ( $R_1/R_2 =$ )

Devision Ratio = 250: VTF442BX
100: VTF443BX
50: VTF444BX

Lead (Pb)-free option add "S" after part number, e.g: VTF442SBX

$R_1 = 1K, 10K, 25K, 50K, 100K$



L = Total length = 0.820" (20.83 mm) max.  
 H = Seated height = 0.280" (7.11 mm) max.

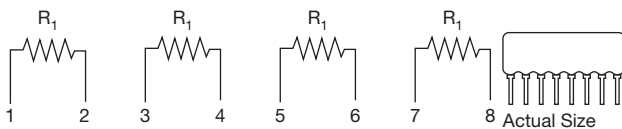
### FOUR EQUAL RESISTORS ISOLATED

#### ORDERING INFORMATION ( $R_1 =$ )

1K: VTF329BX
2K: VTF1001BX
5K: VTF1002BX
10K: VTF158BX
25K: VTF1003BX
50K: VTF1004BX
100K: VTF288BX

Lead (Pb)-free option add "S" after part number, e.g: VTF329SBX

$R_1 = 1K, 10K, 100K$



Absolute tolerance = 0.1 %  
 Ratio tolerance = 0.1 %  
 L = Total length = 0.820" (20.83 mm) max.  
 H = Seated height = 0.280" (7.11 mm) max.

### FOUR EQUAL RESISTORS ISOLATED

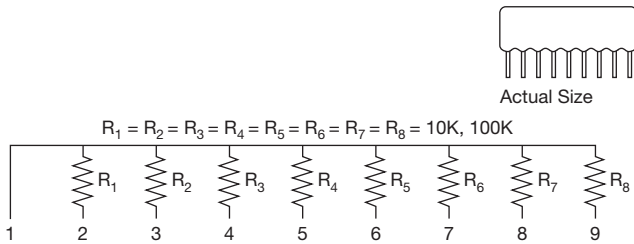
#### ORDERING INFORMATION ( $R_1 =$ )

1K: VTF1005BX
10K: VTF1006BX
100K: VTF1137BX

Lead (Pb)-free option add "S" after part number, e.g: VTF1005SBX



### EIGHT EQUAL RESISTORS ONE COMMON



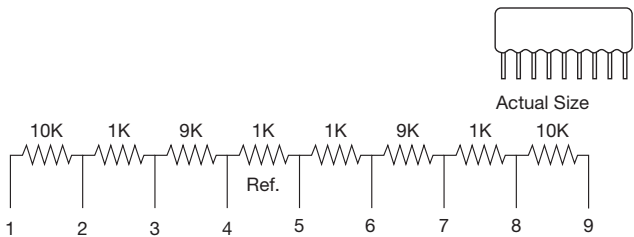
L = Total length = 0.920" (23.37 mm) max.  
 H = Seated height = 0.280" (7.11 mm) max.

ORDERING INFORMATION (R <sub>1</sub> =)
10K: VTF368BX
100K: VTF369BX

Lead (Pb)-free option add "S" after part number, e.g: VTF368SBX

### EIGHT RESISTOR NETWORK

(Designed for instrument amplifier with shield driver)



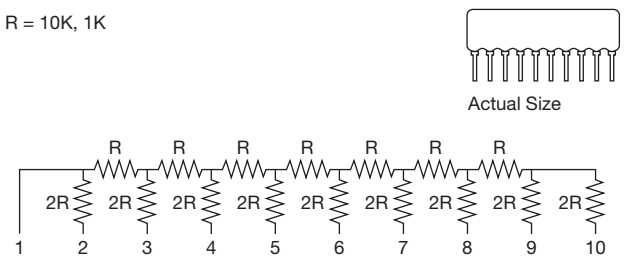
L = Total length = 0.920" (23.37 mm) max.  
 H = Seated height = 0.280" (7.11 mm) max.

ORDERING INFORMATION
VTF272BX

Lead (Pb)-free option add "S" after part number, e.g: VTF272SBX

### EIGHT BIT R/2R LADDER NETWORK

R = 10K, 1K



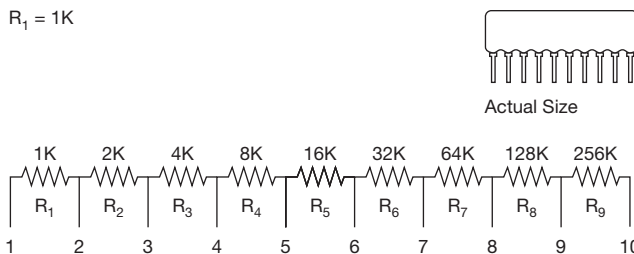
L = Total length = 1.020" (25.91 mm) max.  
 H = Seated height = 0.280" (7.11 mm) max.

ORDERING INFORMATION (R =)
(± 1/2 LSB)
10K: VTF1072BX
100K: VTF267BX

Lead (Pb)-free option add "S" after part number, e.g: VTF1072SBX

### RESISTANCE DOUBLER

R<sub>1</sub> = 1K



ORDERING INFORMATION
VTF1011BX

Lead (Pb)-free option add "S" after part number, e.g: VTF1011SBX

Absolute tolerance = ± 0.1 %  
 Ratio tolerance = ± 0.1 %  
 TCR tracking = ± 3 ppm/°C  
 L = Total length = 1.02" (25.91 mm) max.  
 H = Seated height = 0.280" (7.11 mm) max.





STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	3 to 10	-
Resistance Range	100 Ω to 2 MΩ total	-
TCR: Absolute	± 10 ppm/°C <sup>(1)</sup>	0 °C to + 70 °C
TCR: Tracking	± 2 ppm/°C <sup>(1)</sup>	0 °C to + 70 °C
Tolerance: Absolute	± 0.1 %	+ 25 °C
Tolerance: Ratio	± 0.02 %	+ 25 °C
Power Rating: Resistor	100 mW	-
Power Rating: Package	500 mW	-
Stability: Absolute	ΔR ± 0.05 %	2000 h at + 70 °C
Stability: Ratio	ΔR ± 0.015 %	2000 h at + 70 °C
Voltage Coefficient	± 0.01 ppm/V	-
Working Voltage	100 V	-
Operating Temperature Range	0 °C to + 70 °C	-
Storage Temperature Range	- 55 °C to + 125 °C	-
Noise	< - 35 dB	-
Thermal EMF	< 0.1 μV/°C	-
Shelf Life Stability: Absolute	ΔR ± 0.01 %	1 year at + 25 °C
Shelf Life Stability: Ratio	ΔR ± 0.002 %	1 year at + 25 °C

Note

<sup>(1)</sup> TCR over - 55 °C to + 125 °C ± 20 ppm/°C absolute, ± 3 ppm/°C tracking

DIMENSIONS AND IMPRINTING in inches and millimeters			
	DIMENSION	INCHES	MILLIMETERS
	A	0.125 min.	3.17
B	0.010 min.	0.25	
C	0.100	2.54 typ.	
D	0.020 typ.	0.48 ± 0.15	
E	0.100 max.	2.54	
F	0.010 typ.	0.25	

Note

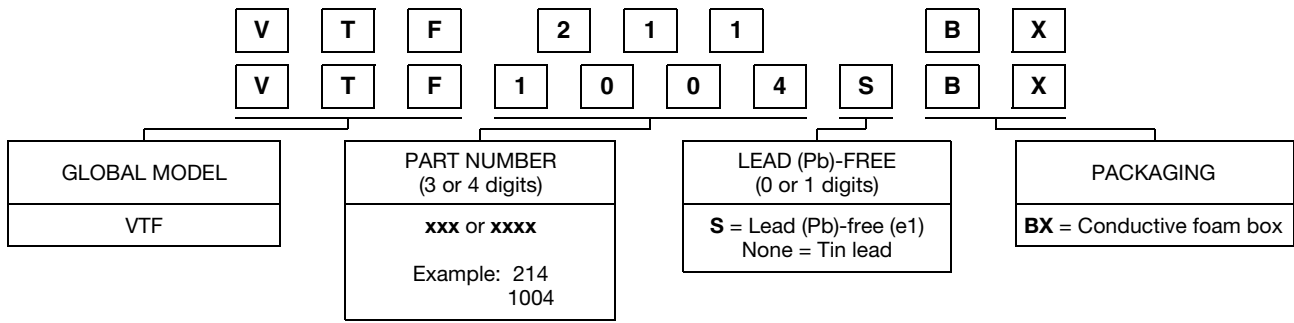
• “L” and “H” (length and height) dimensions for each model are found alongside the schematic drawing

MECHANICAL SPECIFICATIONS	
Resistive Element	Passivated nichrome
Substrate Material	Alumina
Body	Epoxy coated
Terminals	Copper alloy
Tin/Lead Option	Sn60 - Sn63
Lead (Pb)-free Option	Sn96.5, Ag3.0, Cu0.5
Tin/Lead and Lead (Pb)-free Finish	Hot solder dip



### GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: VTF211BX



Historical Part Number example: VTF 211 (for reference purposes only)

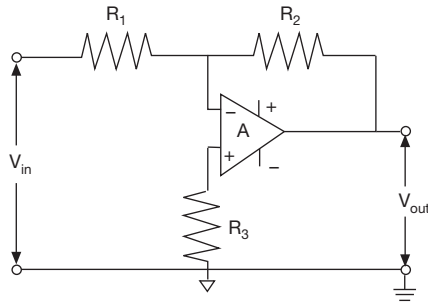


## Typical Resistor Network Applications

The following are circuit diagrams of operational amplifiers and their use of standard resistor networks. These diagrams are supplied to illustrate typical resistor network applications using Vishay Thin Film's standard precision, low noise, stable resistor networks.

### CIRCUIT DIAGRAMS

#### Inverting Amplifier with I<sub>OFF</sub> Compensation

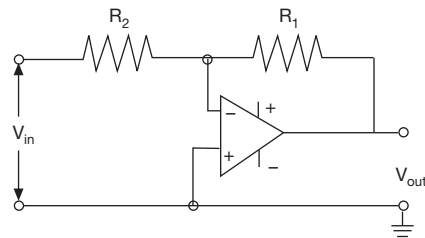


$$A = \frac{V_0}{V_{in}} = \frac{R_2}{R_1}$$

For A = 1 Use VTF1087  
 For A = 2 Use VTF1088  
 For A = 5 Use VTF1089  
 For A = 10 Use VTF1090

$$R_3 = \frac{R_1 \times R_2}{R_1 + R_2}$$

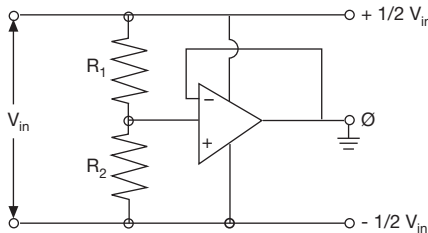
#### Inverting Amplifier



$$A = \frac{V_0}{V_{in}} = \frac{R_1}{R_2}$$

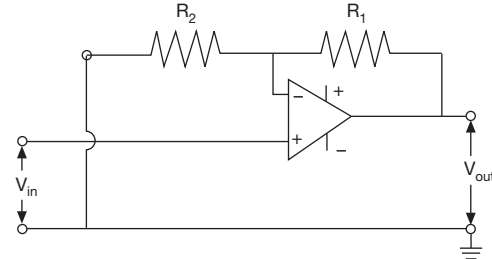
For A = 1 Use VTF209 thru 218  
 For A = 10 Use VTF282 thru 283

#### Power Supply Voltage Splitter



$R_1 = R_2$   
 $R_1 = 50K$  Use VTF214  
 $R_1 = 100K$  Use VTF215  
 $R_1 = 200K$  Use VTF216  
 $R_1 = 500K$  Use VTF217  
 $R_1 = 1M$  Use VTF218

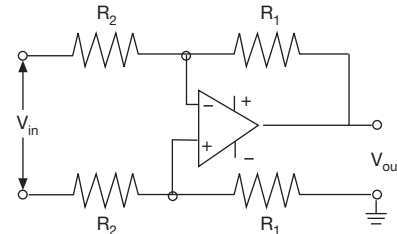
#### Non Inverting Amplifier



$$A = \frac{V_0}{V_{in}} = \frac{R_1 + R_2}{R_2}$$

For A = 10 Use VTF193, 280 and 281  
 For A = 2 Use VTF209 thru 218  
 For A = 11 Use VTF282 or 283

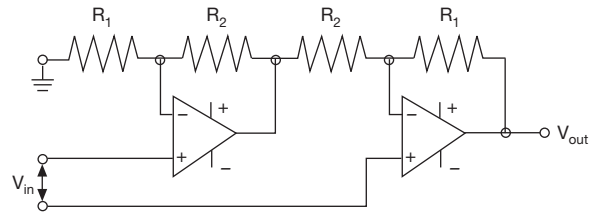
#### Differential Input Amplifier



$$A = \frac{R_1}{R_2}$$

For A = 20  
 $R_1 = 10K$  Use VTF1073  
 $R_1 = 50K$  Use VTF1074  
 For A = 10  
 $R_1 = 10K$  Use VTF328  
 $R_1 = 100K$  Use VTF284  
 $R_1 = 1M$  Use VTF285  
 For A = 5  
 $R_1 = 10K$  Use VTF1007  
 $R_1 = 100K$  Use VTF1008  
 For A = 2  
 $R_1 = 10K$  Use VTF1009  
 $R_1 = 100K$  Use VTF1010  
 For A = 1  
 $R_1 = 5K$  Use VTF225  
 $R_1 = 10K$  Use VTF286  
 $R_1 = 100K$  Use VTF219  
 $R_1 = 1M$  Use VTF287

#### Two Operational Instrumentation Amplifier

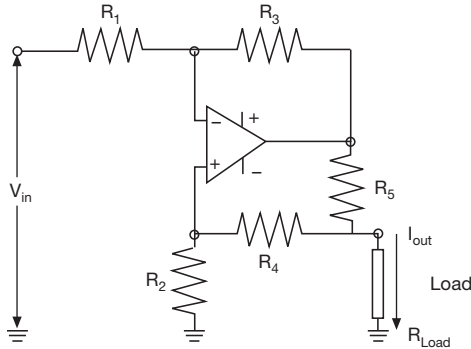


GAIN at  $1 + \frac{R_1}{R_2} = 10$

$R_1 + R_2 = 10K$  Use VTF280  
 $R_1 + R_2 = 100K$  Use VTF193  
 $R_1 + R_2 = 1M$  Use VTF281

### CIRCUIT DIAGRAMS

#### Current Driver



$$I_{out} = V_{in} \frac{(R_1 + R_2)R_5}{R_3 + R_4 + R_5 + R_1 + R_2}$$

$$I_{out} \text{ at } \frac{V_{in}}{R_5} \text{ for } R_1 = R_2 = R_3 = R_4 = R$$

$$\text{Max } I_L = \frac{V_{0 \text{ MAX}}}{R_5 + R_L}$$

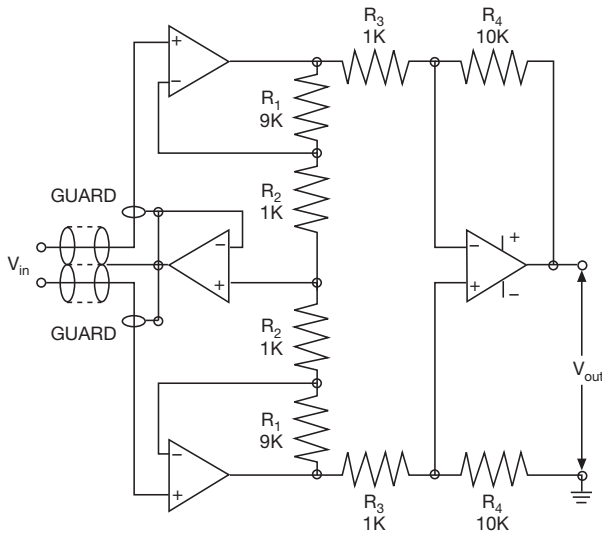
$$I_{out} \text{ at } V_{in} \left( \frac{1}{R_5} + \frac{1}{2R} \right) \text{ and}$$

$$\text{If } R \text{ is large then, } I_{out} \text{ at } \frac{V_{in}}{R_5}$$

For  $R_1, R_2, R_3, R_4$   
 100K Use VTF219  
 1 M Use VTF287

**Note**  
 • OP-AMP must be able to carry the desired output current.

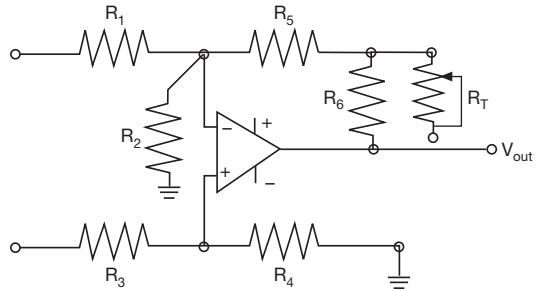
#### Instrumentation Amplifier with Guard Driver



$$A = \frac{R_4}{R_3} \left( 1 + \frac{R_1}{R_2} \right) = 100 \quad \text{Use VTF272}$$

**Note**  
 • OP-AMP references AD713, LTC1058, RMAX479

#### High Common Mode Voltage Rejection Unity Gain Differential Amplifier



$$\frac{R_1}{R_2} = \text{CMV Rejection Ratio} = \text{CMVRR}$$

$$R_1 = R_3 = 1 \text{ M}\Omega$$

Optional External CMVRR Trim

$$R_T = 2R_6$$

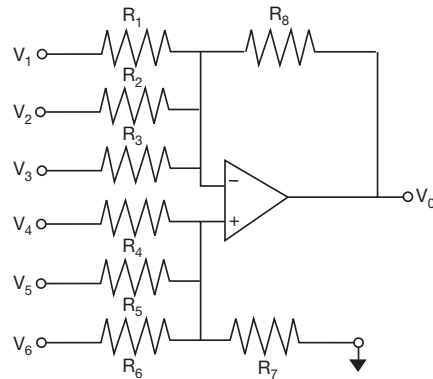
CMVRR = 250	Use VTF442
= 100	Use VTF443
= 50	Use VTF444

$R_6 = 1 \text{ M}$	Use VTF442
$= 1 \text{ M}$	Use VTF443
$= 1 \text{ M}$	Use VTF444

**Note**

• With optional adjustment (RT) over 120 dB, common mode voltage rejection is possible.

#### Adder - Subtractor



If  $R_1$  thru  $R_6 = R$  and  $R_7 = R_8 = R_1$  then

$$V_0 = \frac{R_1}{R} \times (V_1 + V_2 + V_3 - V_4 - V_5 - V_6)$$

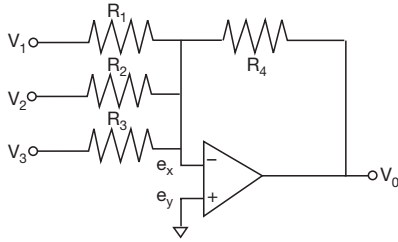
$R_1$ thru $R_4 = 10 \text{ K}$	Use VTF366
$R_1$ thru $R_4 = 100 \text{ K}$	Use VTF367

**Notes**

- (1) Unused source inputs must be grounded
- (2) Circuit assumes the source impedance of all voltage sources are buffered or low (impedance adds to input resistors)

### CIRCUIT DIAGRAMS

#### Non Inverting Two Input Adder



$$\frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3} - \frac{V_0}{R_4} = 0$$

If  $R_1 = R_2 = R_3$  then

$$V_1 + V_2 + V_3 = \frac{R_4}{R_1} \times V_0$$

$$\text{A GAIN} = \frac{R_4}{R_1}$$

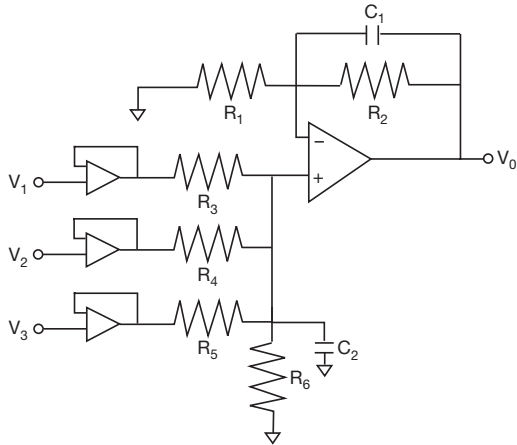
$R_1$  thru  $R_4 = 10K$  Use VTF366

$R_1$  thru  $R_4 = 100K$  Use VTF367

#### Note

- Potential at two inputs of OP-AMP are always equal.  $e_x = e_y$

#### Three Adder Buffer Input Non Inverting



Networks for  $R_1$  and  $R_2$  use VTF212, 213 or 215

For  $R_3, R_4, R_5$  and  $R_6$  use VTF366 or 367 where

$$R_3 = R_4 = R_5 = R_6$$

#### Note

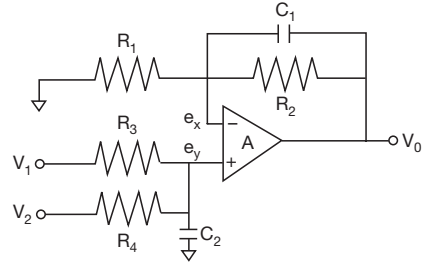
- Capacitor values should be determined for desired cut off frequency and  $R_2 C_1 = \frac{1}{4} R_3 C_2$ .

For amplifier use AD713, LT1058 or RMAX479 these contain all four OP-AMP in one package.

For best results all unused inputs should be grounded.

**These diagrams are supplied to illustrate typical resistor network applications. Vishay assumes no responsibility for specific use of performance.**

#### Two Input Adder



Always two inputs of OP-AMP at same potential  $e_x = e_y$

$$\frac{V_1 - e_y}{R_3} = \frac{V_2 - e_y}{R_4} = 0 \quad e_x = \frac{V_0 R_1}{R_1 + R_2} = e_y$$

$$\text{If } R_3 = R_4 \text{ the } V_1 + V_2 = 2e_y = \frac{2V_0 R_1}{R_1 + R_2}$$

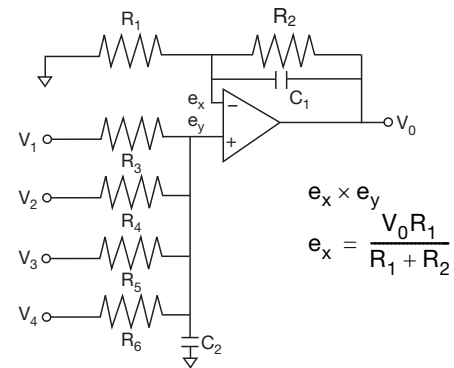
If we make  $R_1 = R_2$  then  $V_1 + V_2 = V_0$  VTF215, 216, 218 or 218

If we make  $3R_1 = R_2$  then  $V_1 + V_2 = \frac{V_0}{5}$  VTF193 or 281

#### Notes

- Circuit assumes the source impedance is very low or incorporated in  $R_1$  and  $R_2$
- Unused inputs should be grounded otherwise equations will not hold true
- $C_1$  and  $C_2$  should be chosen  $R_2 C_2 = \frac{R_3 R_4}{R_3 + R_4} C_1$

#### Four Input Adder



$$e_x \times e_y$$

$$e_x = \frac{V_0 R_1}{R_1 + R_2}$$

$$\frac{V_1 - e_x}{R_3} + \frac{V_2 - e_x}{R_4} + \frac{V_3 - e_x}{R_5} + \frac{V_4 - e_x}{R_6} = 0$$

If  $R_3 = R_4 = R_5 = R_6$  then

$$V_1 + V_2 + V_3 + V_4 = 4e_x = \frac{4V_0 R_1}{R_1 + R_2}$$

If we use VTF280 for  $R_1 + R_2$  and VTF367 for  $R_3, R_4, R_5$  and  $R_6$  then

$$V_1 + V_2 + V_3 + V_4 = \frac{4V_0}{10} = \frac{V_0}{2.5} \text{ or } A = 2.5$$

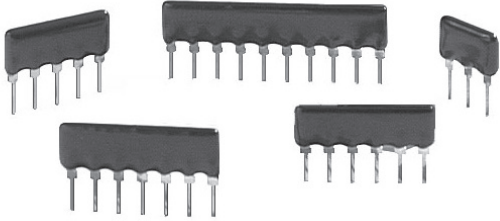
or for  $R_1, R_2$  use VTF212

$$V_1 + V_2 + V_3 + V_4 = \frac{4V_0}{2} = 2V_0 \text{ or } A = 0.5$$

#### Notes

- Unused source inputs must be grounded
- Circuit assumes the source impedance of all voltage sources are buffered or low (impedance adds to input resistors)

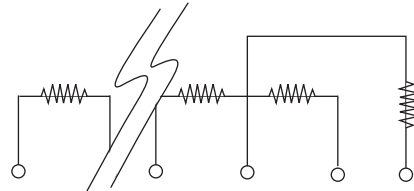
## Conformal, Single In-Line Thin Film Resistor, Through Hole Network (Custom)



Wirewound or metal film performance in a space saving package.

SIP networks available in 3 pins to 10 pins sizes can obtain important performance parameters in an economical, mass producible style. SIPs take up the least amount of board space and are the easiest possible configuration to hand-insert into printed circuit boards. Standard pin centers are 0.100". Passivation coatings plus a conformal coating of epoxy protect the active element from the outside environment.

### SCHEMATIC



Custom schematics available.  
Please consult factory.

### FEATURES

- Minimal PC board space
- Standard 100 mil centers
- Exceptional ratio stability over time and temperature ( $\Delta R \pm 0.015\%$  at  $+70\text{ }^\circ\text{C}$  at 2000 h)
- Integrated construction
- Conformal coating flame resistant (UL 94 V-0 rating)
- Compliant to RoHS Directive 2002/95/EC



**RoHS\***  
COMPLIANT

### Note

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

### TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
<b>TCR</b>	<b>10</b>	<b>2</b>
	ABSOLUTE	RATIO
<b>TOL.</b>	<b>0.05</b>	<b>0.02</b>

STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
<b>Material</b>	Passivated nichrome	-
<b>Pin/Lead Number</b>	3 to 10	-
<b>Resistance Range</b>	100 $\Omega$ to 2 M $\Omega$ total	-
<b>TCR: Absolute</b>	$\pm 10$ ppm/ $^\circ\text{C}$ to $\pm 25$ ppm/ $^\circ\text{C}$	- 55 $^\circ\text{C}$ to + 125 $^\circ\text{C}$
<b>TCR: Tracking</b>	$\pm 2$ ppm/ $^\circ\text{C}$ to $\pm 5$ ppm/ $^\circ\text{C}$	- 55 $^\circ\text{C}$ to + 125 $^\circ\text{C}$
<b>Tolerance: Absolute</b>	$\pm 0.05\%$ to $\pm 1.0\%$	+ 25 $^\circ\text{C}$
<b>Tolerance: Ratio</b>	$\pm 0.01\%$ to $\pm 0.5\%$	+ 25 $^\circ\text{C}$
<b>Power Rating: Resistor</b>	0.100 W (per element)	Maximum at + 70 $^\circ\text{C}$
<b>Power Rating: Package</b>	-	Maximum at + 70 $^\circ\text{C}$
<b>Stability: Absolute</b>	$\Delta R \pm 0.05\%$	2000 h at + 70 $^\circ\text{C}$
<b>Stability: Ratio</b>	$\Delta R \pm 0.015\%$	2000 h at + 70 $^\circ\text{C}$
<b>Voltage Coefficient</b>	< 0.1 ppm/V	-
<b>Working Voltage</b>	100 V	-
<b>Operating Temperature Range</b>	- 55 $^\circ\text{C}$ to + 125 $^\circ\text{C}$	-
<b>Storage Temperature Range</b>	- 55 $^\circ\text{C}$ to + 125 $^\circ\text{C}$	-
<b>Noise</b>	< - 30 dB	-
<b>Thermal EMF</b>	< 0.10 $\mu\text{V}/^\circ\text{C}$	-
<b>Shelf Life Stability: Absolute</b>	$\Delta R \pm 0.01\%$	1 year at + 25 $^\circ\text{C}$
<b>Shelf Life Stability: Ratio</b>	$\Delta R \pm 0.002\%$	1 year at + 25 $^\circ\text{C}$

DIMENSIONS AND IMPRINTING in inches and millimeters			
	<b>DIMENSION</b>	<b>INCHES</b>	<b>MILLIMETERS</b>
	A	0.058 typ.	1.47 typ.
	B	0.100 typ.	2.54 typ.
	C	0.020 ± 0.003	0.51 ± 0.08
	D	0.125 min.	3.18 min.
	E	0.110 max.	2.79 max.
	F	0.010 typ.	0.25 typ.
	L (3 Pins)	0.320	8.13
	L (4 Pins)	0.420	10.67
	L (5 Pins)	0.520	13.21
	L (6 Pins)	0.620	15.75
	L (7 Pins)	0.720	18.29
	L (8 Pins)	0.820	20.83
	L (9 Pins)	0.920	23.37
L (10 Pins)	1.020	25.91	
H (3 Pins)	0.280 <sup>(1)</sup>	7 <sup>(1)</sup>	
H (4 Pins)			
H (5 Pins)			
H (6 Pins)			
H (7 Pins)			
H (8 Pins)			
H (9 Pins)			
H (10 Pins)			

**Note**
<sup>(1)</sup> H dimension, R-value and schematic dependent

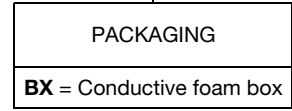
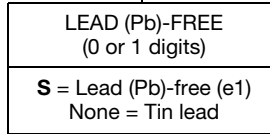
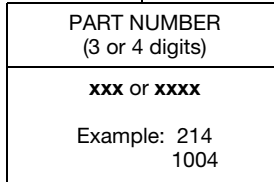
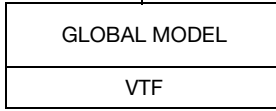
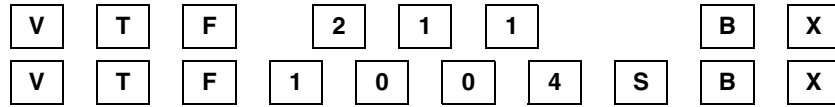
MECHANICAL SPECIFICATIONS	
<b>Resistive Element</b>	Passivated nichrome
<b>Substrate Material</b>	Alumina
<b>Body</b>	Epoxy coated
<b>Terminals</b>	Copper alloy
<b>Tin/Lead Option</b>	Sn60 - Sn63
<b>Lead (Pb)-free Option</b>	Sn96.5, Ag3.0, Cu0.5
<b>Tin/Lead and Lead (Pb)-free Finish</b>	Hot solder dip

ORDERING INFORMATION CHECK LIST (Customs)	
Special requirements should be identified in advance, but as a minimum, you should have the following information ready.	
<b>ELECTRICAL</b>	<b>MECHANICAL</b>
1. Resistors, by value and tolerance 2. Reference resistor(s) and matching of which resistors to which reference resistors 3. Resistance by ratio 4. Absolute temperature coefficient of resistivity 5. Temperature tracking of subordinate resistors to reference resistor(s) 6. Maximum operating voltage 7. Resistor power ratings 8. Operating temperature range	1. Maximum allowable seated height (from PC board to top of network) 2. Special marking concerns 3. Schematic pin out of package 4. Specify if lead (Pb)-free
For additional assistance refer to Vishay Thin Film's guide to understanding Thin Film precision. Resistor networks or application engineering. All standard products may be ordered directly from Vishay Thin Film.	

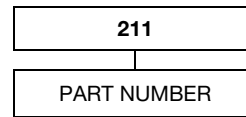
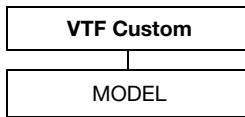


### GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: VTF211BX



Historical Part Number example: VTF Custom 211 (for reference purposes only)





## Decade Divider, Single In-Line, Thin Film Divider, Through Hole Resistor Network



Precision resistor networks comprised of series-connected decade values are provided in single-in-line style with edgemounted leads on 100 mil centers. Integrated thin film construction, laser-trimmed to extremely tight tolerances, insures exceptionally close tracking over temperature and throughout operating life, in either voltage division or current monitoring mode. Voltage coefficient and noise are extremely low. Designers gain several advantages over the use of discrete resistor sets, including smaller size, better overall tracking, greater reliability, and lower cost.

### FEATURES

- Tight ratio tolerance (0.01 %)
- 5 decade ratio divider
- High voltage capability (300 V)
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



**RoHS\***  
COMPLIANT  
HALOGEN  
**FREE**

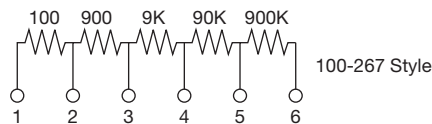
### Note

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

### TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
TCR	25	5
	ABSOLUTE	RATIO
TOL.	0.1	0.01

### SCHEMATIC



### STANDARD ELECTRICAL SPECIFICATIONS

TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	6	-
Resistance Range	100 Ω to 1 MΩ total	-
TCR: Absolute	± 25 ppm/°C	0 °C to + 70 °C
TCR: Tracking	± 5 ppm/°C	0 °C to + 70 °C
Tolerance: Absolute	± 0.1 %	+ 25 °C
Tolerance: Ratio	± 0.01 % to ± 0.1 %	+ 25 °C
Power Rating: Resistor	0.100 W	Maximum at + 70 °C
Power Rating: Package	0.500 W	Maximum at + 70 °C
Stability: Absolute	1000 ppm	2000 h at + 70 °C
Stability: Ratio	200 ppm	2000 h at + 70 °C
Voltage Coefficient	0.1 ppm/V	-
Working Voltage	300 V	-
Operating Temperature Range	0 °C to + 70 °C	-
Storage Temperature Range	- 55 °C to + 125 °C	-
Noise	- 20 dB	-
Thermal EMF	0.08 μV/°C	-
Shelf Life Stability: Absolute	ΔR ± 0.01 %	1 year at + 25 °C
Shelf Life Stability: Ratio	ΔR ± 0.002 %	1 year at + 25 °C

DIMENSIONS AND IMPRINTING in inches and millimeters			
	DIMENSION	INCHES	MILLIMETERS
	A	0.100 max.	2.54
	B	0.620 max.	15.78
	C	0.350 max.	8.89
	D	0.125 min.	0.25
	E	0.010 typ.	2.54
	F	0.020 typ.	0.51
G	0.1 (5 x) typ.	2.54	

PART NUMBER 100-	267-T	267-Q	267-A	267-B
Ratio Tolerance <sup>(1)</sup>	0.01 %	0.025 %	0.05 %	0.1 %
Voltage Rating	300 V			
Noise Index	< - 30 dB			

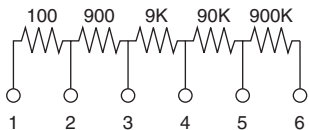
**Note**
<sup>(1)</sup> Excluding the 100 Ω

$$\frac{R1 + R2 + R3 + R4}{RT} = \frac{100 \text{ k}\Omega}{1 \text{ M}\Omega} = 0.1$$

$$\frac{R1 + R2 + R3}{RT} = \frac{10 \text{ k}\Omega}{1 \text{ M}\Omega} = 0.01$$

$$\frac{R1 + R2}{RT} = \frac{1 \text{ k}\Omega}{1 \text{ M}\Omega} = 0.001$$

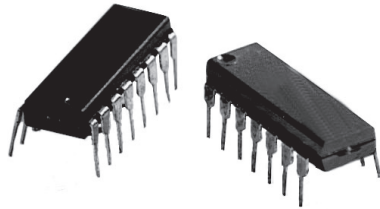
$$R1 = 100 \Omega \pm 0.1 \%$$



MECHANICAL SPECIFICATIONS	
Resistive Element	Passivated nichrome
Substrate Material	Alumina
Body	Conformal coated
Terminals	Copper alloy
Marking Resistance to Solvents	Per MIL-PRF-83401
Tin/Lead Option	Sn60 - Sn63
Lead (Pb)-free Option	Sn96.5, Ag3.0, Cu0.5
Tin/Lead and Lead (Pb)-free Finish	Hot solder dip

GLOBAL PART NUMBER INFORMATION																													
New Global Part Numbering: VTF100-267TUF																													
<table border="1"> <tr> <td>V</td><td>T</td><td>F</td><td>1</td><td>0</td><td>0</td><td>-</td><td>2</td><td>6</td><td>7</td><td>T</td><td>B</td><td>X</td> </tr> <tr> <td>V</td><td>T</td><td>F</td><td>1</td><td>0</td><td>0</td><td>S</td><td>-</td><td>2</td><td>6</td><td>7</td><td>T</td><td>B</td><td>X</td> </tr> </table>	V	T	F	1	0	0	-	2	6	7	T	B	X	V	T	F	1	0	0	S	-	2	6	7	T	B	X		
V	T	F	1	0	0	-	2	6	7	T	B	X																	
V	T	F	1	0	0	S	-	2	6	7	T	B	X																
<table border="1"> <tr> <td>SERIES MODEL (10 or 11 digits)</td> </tr> <tr> <td><b>VTF100-267</b> (Tin lead)</td> </tr> <tr> <td><b>VTF100S-267</b> (Lead (Pb)-free) (e1)</td> </tr> </table>	SERIES MODEL (10 or 11 digits)	<b>VTF100-267</b> (Tin lead)	<b>VTF100S-267</b> (Lead (Pb)-free) (e1)	<table border="1"> <tr> <td>TOLERANCE (1 digit)</td> </tr> <tr> <td><b>T</b> = 0.01 % ratio</td> </tr> <tr> <td><b>Q</b> = 0.025 % ratio</td> </tr> <tr> <td><b>A</b> = 0.05 % ratio</td> </tr> <tr> <td><b>B</b> = 0.1 % ratio</td> </tr> </table>	TOLERANCE (1 digit)	<b>T</b> = 0.01 % ratio	<b>Q</b> = 0.025 % ratio	<b>A</b> = 0.05 % ratio	<b>B</b> = 0.1 % ratio	<table border="1"> <tr> <td>PACKAGING (2 digits)</td> </tr> <tr> <td><b>BX</b> = Boxed</td> </tr> </table>	PACKAGING (2 digits)	<b>BX</b> = Boxed																	
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PACKAGING (2 digits)																													
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Historical Part Number example: 100-267Q (for reference purposes only)																													
<table border="1"> <tr> <td>100</td> </tr> <tr> <td>SERIES</td> </tr> </table>	100	SERIES	<table border="1"> <tr> <td>267</td> </tr> <tr> <td>MODEL</td> </tr> </table>	267	MODEL	<table border="1"> <tr> <td>Q</td> </tr> <tr> <td>TOLERANCE</td> </tr> </table>	Q	TOLERANCE																					
100																													
SERIES																													
267																													
MODEL																													
Q																													
TOLERANCE																													

# Molded, Dual-In-Line Thin Film Resistor, Through Hole Network



Actual Size

Vishay Dale Thin Film offers two standard circuits in a 14 pins and 16 pins molded dual-in-line over a 100 Ω to 100 kΩ resistance range. The networks feature ratio tolerance to 0.05 % with a TCR tracking of 5 ppm/°C.

## FEATURES

- Standard rugged, molded case construction (14 pins and 16 pins)
- Highly stable thin film (500 ppm at + 70 °C at 2000 h)
- Low temperature coefficient ( $\pm 25$  ppm/°C)
- Compatible with automatic insertion equipment
- Standard isolated pin one common schematic
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



**RoHS\***  
COMPLIANT  
HALOGEN  
**FREE**

## Note

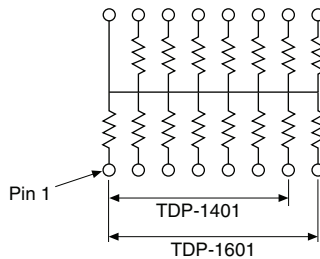
\* Pb containing terminations are not RoHS compliant, exemptions may apply

## TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
TCR	25	5
	ABSOLUTE	RATIO
TOL.	0.1	0.05

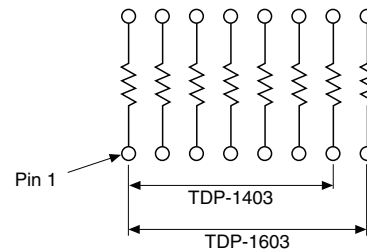
## SCHEMATIC

### Schematic TDP01



Models: TDP1401 and TDP1601  
13 or 15 resistors with one pin common

### Schematic TDP03



Models: TDP1403 and TDP1603  
7 or 8 isolated resistors

## STANDARD ELECTRICAL SPECIFICATIONS

TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	14, 16	-
Resistance Range	100 Ω to 100 kΩ	-
TCR: Absolute	$\pm 25$ ppm/°C	- 55 °C to + 125 °C
TCR: Tracking	$\pm 5$ ppm/°C	- 55 °C to + 125 °C
Tolerance: Absolute	$\pm 0.1$ %	+ 25 °C
Tolerance: Ratio	$\pm 0.05$ % to $\pm 0.5$ %	+ 25 °C
Power Rating: Resistor	0.05 W/resistor = 01 circuit 0.10 W/resistor = 03 circuit	at + 25 °C
Power Rating: Package	0.8 W/package	Maximum at + 70 °C
Stability: Absolute	$\Delta R \pm 0.05$ %	2000 h at + 70 °C
Stability: Ratio	$\Delta R \pm 0.015$ %	2000 h at + 70 °C
Voltage Coefficient	< 1 ppm/V (typical)	-
Working Voltage	100 V	-
Operating Temperature Range	- 55 °C to + 125 °C	-
Storage Temperature Range	- 55 °C to + 150 °C	-
Noise	< - 30 dB	-
Thermal EMF	0.08 μV/°C	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01$ %	1 year at + 25 °C
Shelf Life Stability: Ratio	$\Delta R \pm 0.002$ %	1 year at + 25 °C

**DIMENSIONS AND IMPRINTING** in inches and millimeters

	DIMENSION	INCHES	MILLIMETERS
	A	0.755	19.18
	B	0.250	6.35
	C	0.075	1.91
	D	0.100	2.54
	E	0.018	0.46
	F	0.060	1.52
	G	0.025	0.64
	H	0.190	4.83
	J	0.130	3.30
	K	0.320	8.13
	L	0.310	7.87
	M	0.010	0.25
		A	0.755
B		0.250	6.35
C		0.025	0.64
D		0.100	2.54
E		0.018	0.46
F		0.060	1.52
G		0.025	0.64
H		0.190	4.83
J		0.130	3.30
K		0.320	8.13
L		0.310	7.87
M		0.010	0.25



MECHANICAL SPECIFICATIONS	
Resistive Element	Passivated nichrome
Substrate Material	Alumina
Body	Conformal coated
Terminals	Copper alloy
Tin/Lead Option	Sn90
Lead (Pb)-free Option	100 % matte tin
Tin/Lead and Lead (Pb)-free Finish	Hot solder dip

### GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: TDP14031002B U F

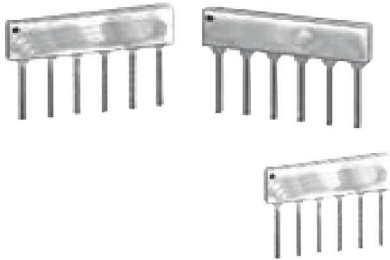
T	D	P	1	4	0	3	1	0	0	2	B	U	F	
T	D	P	T	1	6	0	3	1	0	0	3	A	U	F

GLOBAL MODEL (3 or 4 digits)	PINS	SCHEMATICS	RESISTANCE	TOLERANCE AND RATIO TOLERANCE	PACKAGING												
<b>TDP</b> (Tin lead)  <b>TDPT</b> (Lead (Pb)-free) (e3)	<b>14</b>  <b>16</b>	<b>01</b> = 13 or 15 resistors with 1 common pin  <b>03</b> = 7 or 8 isolated resistors	First 3 digits are significant figures and the last digit specifies the number of zeroes to follow.  e.g.: 1001 = 1K 1002 = 10K	<table border="1"> <thead> <tr> <th>Absolute</th> <th>Ratio</th> </tr> </thead> <tbody> <tr> <td><b>A</b> = ± 0.1 % <sup>(1)</sup></td> <td>± 0.05 %</td> </tr> <tr> <td><b>B</b> = ± 0.1 %</td> <td>± 0.1 %</td> </tr> <tr> <td><b>C</b> = ± 0.25 %</td> <td>± 0.1 %</td> </tr> <tr> <td><b>D</b> = ± 0.5 %</td> <td>± 0.1 %</td> </tr> <tr> <td><b>F</b> = ± 1.0 %</td> <td>± 0.5 %</td> </tr> </tbody> </table>	Absolute	Ratio	<b>A</b> = ± 0.1 % <sup>(1)</sup>	± 0.05 %	<b>B</b> = ± 0.1 %	± 0.1 %	<b>C</b> = ± 0.25 %	± 0.1 %	<b>D</b> = ± 0.5 %	± 0.1 %	<b>F</b> = ± 1.0 %	± 0.5 %	<b>UF</b> = Tubed
Absolute	Ratio																
<b>A</b> = ± 0.1 % <sup>(1)</sup>	± 0.05 %																
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<b>D</b> = ± 0.5 %	± 0.1 %																
<b>F</b> = ± 1.0 %	± 0.5 %																

Historical Part Number example: TDP14031001F (for reference purposes only)

TDP	14	03	1001	F
SERIES	PINS	SCHEMATIC	RESISTANCE	TOLERANCE AND RATIO TOLERANCE

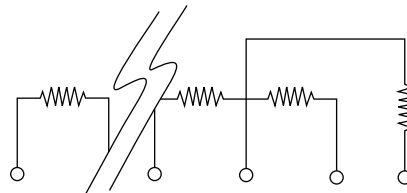
## Ceramic Sandwich, Single-In-Line Thin Film Resistor, Through Hole Network (Low Profile 0.20 Custom)



Actual Size

Vishay Dale Thin Film presents a design concept in precision thin film resistor networks. The essence of this new concept is the marriage of two principle design elements . . . a unique resistive film, having electrical properties comparable to those of wire-wound resistors, and a rugged, low cost, ceramic package and an almost limitless variety of sizes and configurations.

### SCHEMATIC



Custom schematics available.  
Please consult factory.

### FEATURES

- Gold-to-gold terminations. External leads are attached directly to gold pads on the ceramic substrate by thermo-compression bonding (no internal solder)
- Low profile (0.200 min.)
- Custom pin-outs available
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



**RoHS\***  
COMPLIANT  
HALOGEN  
**FREE**

### Note

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

### TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
<b>TCR</b>	<b>25</b>	<b>2</b>
	ABSOLUTE	RATIO
<b>TOL.</b>	<b>0.05</b>	<b>0.01</b>

STANDARD ELECTRICAL SPECIFICATIONS			
TEST	SPECIFICATIONS		CONDITIONS
Material	Passivated nichrome	Tantalum nitride	-
Pin/Lead Number	3 to 10		-
Resistance Range	20 Ω to 2000 kΩ (total)	20 Ω to 500 kΩ (total)	-
TCR: Absolute	± 10 ppm/°C to ± 25 ppm/°C	± 50 ppm/°C to ± 100 ppm/°C	- 55 °C to + 125 °C
TCR: Tracking	± 2 ppm/°C	± 5 ppm/°C	- 55 °C to + 125 °C
Tolerance: Absolute	± 0.05 % to ± 1.0 %		+ 25 °C
Tolerance: Ratio	± 0.01 % to ± 0.5 %	± 0.02 % to ± 0.5 %	+ 25 °C
Power Rating: Resistor	100 mW (per element)		Typical at + 25 °C
Power Rating: Package	-		-
Stability: Absolute	ΔR ± 0.05 %	ΔR ± 0.1 %	2000 h at + 70 °C
Stability: Ratio	ΔR ± 0.015 %	ΔR ± 0.02 %	2000 h at + 70 °C
Voltage Coefficient	< 0.1 ppm/V	< 0.1 ppm/V	-
Working Voltage	100 V		-
Operating Temperature Range	- 55 °C to + 125 °C		-
Storage Temperature Range	- 55 °C to + 150 °C		-
Noise	< - 30 dB		-
Thermal EMF	< 0.08 μV/°C		-
Shelf Life Stability: Absolute	ΔR ± 0.01 %		1 year at + 25 °C
Shelf Life Stability: Ratio	ΔR ± 0.002 %		1 year at + 25 °C

<b>DIMENSIONS AND IMPRINTING</b> in inches and millimeters			
	<b>DIMENSION</b>	<b>INCHES</b>	<b>MILLIMETERS</b>
	A	0.100 typ. <sup>(1)</sup>	2.54 typ.
	B	0.020 ± 0.002 typ.	0.51 ± 0.05 typ.
	C	0.125 min.	3.17 min.
	D	0.100 max.	2.54 max.
	E	0.010	0.25
	L (3 Pins)	0.320	8.13
	L (4 Pins)	0.420	10.67
	L (5 Pins)	0.520	13.21
	L (6 Pins)	0.620	15.75
	L (7 Pins)	0.720	18.25
	L (8 Pins)	0.820	20.83
	L (9 Pins)	0.920	23.37
	L (10 Pins)	1.020	25.91
	H (3 Pins)	0.200 <sup>(2)</sup>	7.11 <sup>(2)</sup>
H (4 Pins)			
H (5 Pins)			
H (6 Pins)			
H (7 Pins)			
H (8 Pins)			
H (9 Pins)			
H (10 Pins)			

**Notes**
<sup>(1)</sup> Non-accum.

<sup>(2)</sup> Resistance value and schematic dependent. By occupying more than one 0.100 inch square, higher values are available.

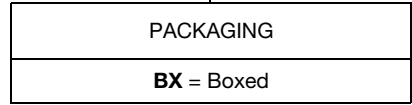
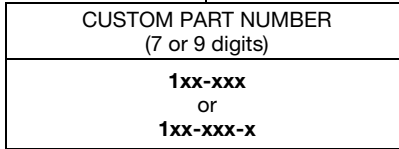
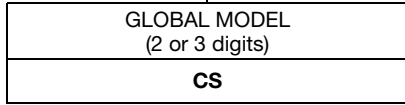
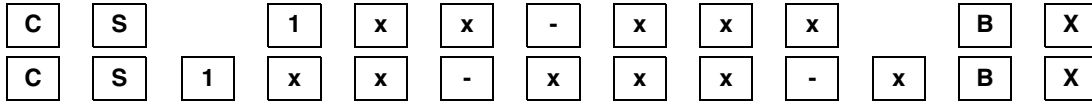
<b>MECHANICAL SPECIFICATIONS</b>	
<b>Resistive Element</b>	Passivated nichrome or tantalum nitride
<b>Substrate Material</b>	Alumina
<b>Body</b>	Ceramic
<b>Terminals</b>	Copper alloy
<b>Plating</b>	Gold
<b>Tin/Lead Option</b>	Sn63
<b>Lead (Pb)-free Option</b>	Sn96.5, Ag3.0, Cu0.5
<b>Tin/Lead and Lead (Pb)-free Finish</b>	Hot solder dip

<b>ORDERING INFORMATION CHECK LIST</b>	
Special requirements should be identified in advance, but as a minimum, you should have the following information ready.	
<b>ELECTRICAL</b>	<b>MECHANICAL</b>
1. Resistors, by value and tolerance 2. Reference resistor(s) and matching of which resistors to which reference resistors 3. Resistance by ratio 4. Absolute temperature coefficient of resistivity 5. Temperature tracking of subordinate resistors to reference resistor(s) 6. Maximum operating voltage 7. Resistor power ratings 8. Operating temperature range	1. Maximum allowable seated height (from PC board to top of network) 2. Special marking concerns 3. Schematic pin out of package 4. Specify if lead (Pb)-free
For additional assistance refer to Vishay Dale Thin Film's guide to understanding Thin Film precision. Resistor networks or application engineering. All standard products may be ordered directly from Vishay Dale Thin Film.	

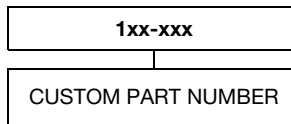


**GLOBAL PART NUMBER INFORMATION**

New Global Part Numbering: CS1xx-xxxBX

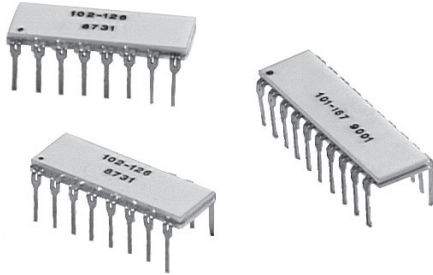


Historical Part Number example: 1xx-xxx (for reference purposes only)





## Ceramic Sandwich, Dual-In-Line Thin Film Resistor, Through Hole Network (Custom)



A dual-in-line monolithic ceramic package in a variety of sizes and configurations. A rugged, low cost packaging technique with 4 leads to 20 leads that allows higher resistance integration than chip and wire ceramic packages.

### FEATURES

- Gold-to-gold terminations. External leads are attached directly to gold pads on the ceramic substrate by thermo-compression bonding (no internal solder)
- Monolithic construction
- Ceramic package with no cavity. 4 pins to 20 pins.
- Flexibility of lead variations to save PC board space
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



**RoHS\***  
COMPLIANT  
HALOGEN  
**FREE**

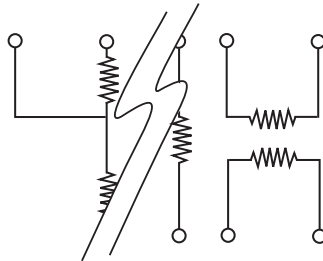
### Note

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

### TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
<b>TCR</b>	<b>10</b>	<b>2</b>
	ABSOLUTE	RATIO
<b>TOL.</b>	<b>0.1</b>	<b>0.02</b>

### SCHEMATIC



Custom schematics available.  
Please consult factory

STANDARD ELECTRICAL SPECIFICATIONS			
TEST	SPECIFICATIONS		CONDITIONS
Material	Passivated nichrome	Tantalum nitride <sup>(1)</sup>	-
Pin/Lead Number	4 to 20		-
Resistance Range	100 Ω to 5 MΩ total		-
TCR: Absolute	± 10 ppm/°C	± 25 ppm/°C to ± 100 ppm/°C	- 55 °C to + 125 °C
TCR: Tracking	± 2 ppm/°C	± 5 ppm/°C	- 55 °C to + 125 °C
Tolerance: Absolute	± 0.1 % to ± 1.0 %		+ 25 °C
Tolerance: Ratio	± 0.01 % to ± 0.1 %		+ 25 °C
Power Rating: Resistor	100 mW (per element (typical))		Maximum at + 70 °C
Power Rating: Package	500 mW		Maximum at + 70 °C
Stability: Absolute	1000 ppm		2000 h at + 70 °C
Stability: Ratio	300 ppm		2000 h at + 70 °C
Voltage Coefficient	0.1 ppm/V		-
Working Voltage	100 V		-
Operating Temperature Range	- 55 °C to + 125 °C		-
Storage Temperature Range	- 55 °C to + 125 °C		-
Noise	< - 30 dB		-
Thermal EMF	< 0.1 μV/°C		-
Shelf Life Stability: Absolute	ΔR ± 0.01 %		1 year at + 25 °C
Shelf Life Stability: Ratio	ΔR ± 0.002 %		1 year at + 25 °C

### Note

<sup>(1)</sup> Tantalum nitride film is custom

<b>DIMENSIONS AND IMPRINTING</b> in inches and millimeters			
	<b>DIMENSION</b>	<b>INCHES</b>	<b>MILLIMETERS</b>
	A	0.260 max.	6.61
	B	0.050	1.27
	C	0.160 typical	4.06
	D	0.080	2.03
	E	0.125	3.18
	F	0.125 min.	3.18
	G	0.01	0.254
	H	0.325	8.25
	I	0.100	2.54
	J	0.020	0.51
	L (4 Pins)	0.220	5.59
	L (6 Pins)	0.320	8.13
	L (8 Pins)	0.420	10.67
	L (10 Pins)	0.520	13.21
	L (12 Pins)	0.620	15.75
	L (14 Pins)	0.720	18.29
L (16 Pins)	0.820	20.83	
L (18 Pins)	0.920	23.37	
L (20 Pins)	1.020	25.91	

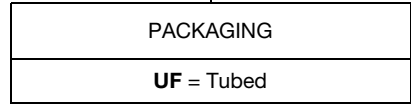
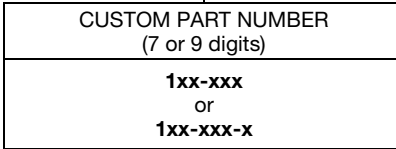
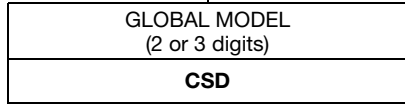
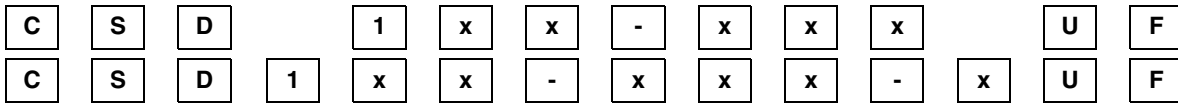
<b>MECHANICAL SPECIFICATIONS</b>	
<b>Resistive Element</b>	Passivated nichrome or tantalum nitride
<b>Substrate Material</b>	Alumina
<b>Body</b>	Ceramic
<b>Terminals</b>	Copper alloy
<b>Plating</b>	Gold
<b>Tin/Lead Option</b>	Sn63
<b>Lead (Pb)-free Option</b>	Sn96.5, Ag3.0, Cu0.5
<b>Tin/Lead and Lead (Pb)-free Finish</b>	Hot solder dip

<b>ORDERING INFORMATION CHECK LIST</b>	
Special requirements should be identified in advance, but as a minimum, you should have the following information ready.	
<p><b>ELECTRICAL</b></p> <ol style="list-style-type: none"> <li>Resistors, by value and tolerance</li> <li>Reference resistor(s) and matching of which resistors to which reference resistors</li> <li>Resistance by ratio</li> <li>Absolute temperature coefficient of resistivity</li> <li>Temperature tracking of subordinate resistors to reference resistor(s)</li> <li>Maximum operating voltage</li> <li>Resistor power ratings</li> <li>Operating temperature range</li> </ol>	<p><b>MECHANICAL</b></p> <ol style="list-style-type: none"> <li>Maximum allowable seated height (from PC board to top of network)</li> <li>Special marking concerns</li> <li>Schematic pin out of package</li> <li>Specify if lead (Pb)-free</li> </ol>
<p>For additional assistance refer to Vishay Dale Thin Film's guide to understanding Thin Film precision. Resistor networks or application engineering. All standard products may be ordered directly from Vishay Dale Thin Film.</p>	

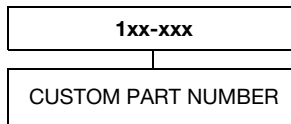


**GLOBAL PART NUMBER INFORMATION**

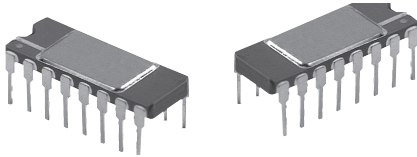
New Global Part Numbering: CSD1xx-xxxUF



Historical Part Number example: 1xx-xxx (for reference purposes only)



## Hermetic, Dual-In-Line Thin Film Resistor, Through Hole Network (Custom)

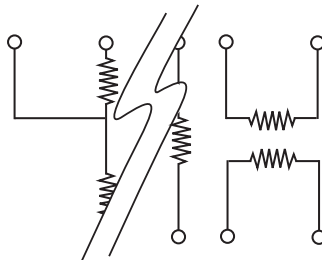


Designed to meet or exceed MIL-PRF-83401 characteristic "C"

The most advanced thin film technology is put to work in the manufacture of exceptionally stable, precision thin film resistor networks in a variety of popular hermetic-type packages. These networks are based on the utilization of a resistive film possessing outstanding stability throughout board assembly and equipment life.

Manufacturing is performed under rigid process control by a team of specialists having many years experience in the design, fabrication and automatic laser adjustment of several hundred different precision thin film resistor networks. Circuits are designed for specific customer requirements and manufactured according to highly standardized procedures. Testing is conducted in one of the most completely equipped laboratories in the industry.

### SCHEMATIC



Custom schematics available.  
Please consult factory.

### FEATURES

- True hermetic construction
- Standard 8 pins, 14 pins, 16 pins, 18 pins, 20 pins packages
- Chip and wire construction
- Exceptional stability over time and temperature (500 ppm at + 70 °C at 2000 h)
- Military/aerospace
- Hermetically sealed
- Ideal for military/aerospace applications
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



**RoHS\***  
COMPLIANT  
HALOGEN  
**FREE**

### Note

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

### TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
<b>TCR</b>	<b>10</b>	<b>2</b>
	ABSOLUTE	RATIO
<b>TOL.</b>	<b>0.02</b>	<b>0.01</b>

### STANDARD ELECTRICAL SPECIFICATIONS

TEST	SPECIFICATIONS		CONDITIONS
<b>Material</b>	Passivated nichrome	Tantalum nitride <sup>(1)</sup>	-
<b>Pin/Lead Number</b>	8 to 20		-
<b>Resistance Range</b>	50 Ω to 1500 kΩ (total)	50 Ω to 300 kΩ (total)	-
<b>TCR: Absolute</b>	± 10 ppm/°C to ± 25 ppm/°C		- 55 °C to + 125 °C
<b>TCR: Tracking</b>	± 2 ppm/°C (typical less 1 ppm/°C equal values)		- 55 °C to + 125 °C
<b>Tolerance: Absolute</b>	± 0.02 % to ± 1.0 %		+ 25 °C
<b>Tolerance: Ratio</b>	± 0.01 % to ± 0.5 %		+ 25 °C
<b>Power Rating: Resistor</b>	100 mW (per element (typical))		+ 25 °C
<b>Power Rating: Package</b>	-		-
<b>Stability: Absolute</b>	500 ppm		2000 h at + 70 °C
<b>Stability: Ratio</b>	150 ppm		2000 h at + 70 °C
<b>Voltage Coefficient</b>	< 0.1 ppm/V		-
<b>Working Voltage</b>	100 V		-
<b>Operating Temperature Range</b>	- 55 °C to + 125 °C		-
<b>Storage Temperature Range</b>	- 55 °C to + 150 °C		-
<b>Noise</b>	< - 30 dB		-
<b>Thermal EMF</b>	< 0.10 μV/°C		-
<b>Shelf Life Stability: Absolute</b>	ΔR ± 0.01 %		1 year at + 25 °C
<b>Shelf Life Stability: Ratio</b>	ΔR ± 0.002 %		1 year at + 25 °C

### Note

<sup>(1)</sup> Tantalum nitride film is custom

<b>DIMENSIONS AND IMPRINTING</b> in inches and millimeters			
	DIMENSION	INCHES	MILLIMETERS
	A	0.295	7.49
	B	0.310 ± 0.010	7.88 ± 0.25
	C	0.035 ± 0.010	0.89 ± 0.25
	D	0.100 non-accum.	2.54
	E	0.018 ± 0.002	0.46 ± 0.05
	F	0.130 typical	3.30
	G	0.130 max.	3.30
	H	0.300 typical	7.62
	I	0.010 typical	0.25
	L (8 Pins)	0.528	13.41
	L (14 Pins)	0.710	18.03
	L (16 Pins)	0.810	20.57
L (18 Pins)	0.910	23.11	
L (20 Pins)	1.010	25.65	

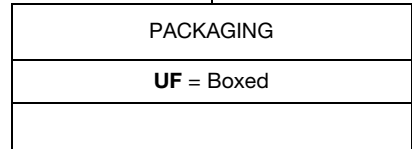
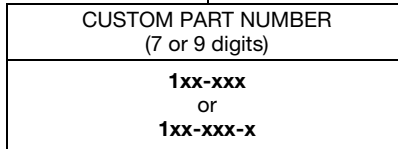
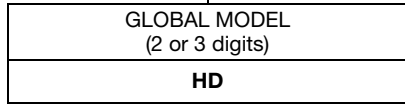
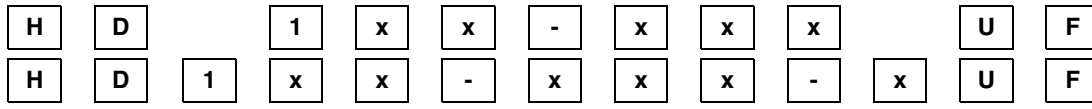
<b>MECHANICAL SPECIFICATIONS</b>	
<b>Resistive Element</b>	Passivated nichrome or tantalum nitride
<b>Substrate Material</b>	Alumina
<b>Body</b>	Ceramic
<b>Terminals</b>	Copper alloy
<b>Tin/Lead Option</b>	Sn63
<b>Lead (Pb)-free Option</b>	Sn96.5, Ag3.0, Cu0.5
<b>Tin/Lead and Lead (Pb)-free Finish</b>	Hot solder dip

<b>ORDERING INFORMATION CHECK LIST</b>	
Special requirements should be identified in advance, but as a minimum, you should have the following information ready.	
ELECTRICAL	MECHANICAL
<ol style="list-style-type: none"> <li>Resistors, by value and tolerance</li> <li>Reference resistor(s) and matching of which resistors to which reference resistors</li> <li>Resistance by ratio</li> <li>Absolute temperature coefficient of resistivity</li> <li>Temperature tracking of subordinate resistors to reference resistor(s)</li> <li>Maximum operating voltage</li> <li>Resistor power ratings</li> <li>Operating temperature range</li> </ol>	<ol style="list-style-type: none"> <li>Maximum allowable seated height (from PC board to top of network)</li> <li>Special marking concerns</li> <li>Schematic pin out of package</li> <li>Specify if lead (Pb)-free</li> </ol>
For additional assistance refer to Vishay Dale Thin Film's guide to understanding Thin Film precision. Resistor networks or application engineering. All standard products may be ordered directly from Vishay Dale Thin Film.	

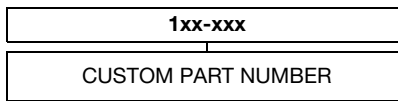


**GLOBAL PART NUMBER INFORMATION**

New Global Part Numbering: HD1xx-xxxUF



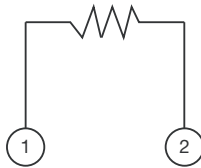
Historical Part Number example: 1xx-xxx (for reference purposes only)



## High Value Precision SIP Thin Film Resistor, Through Hole Network



### SCHEMATIC



### FEATURES

- High nominal precision resistors (value range 50K to 10M)
- Highly accurate resistance tolerance (up to  $\pm 0.01\%$ )
- Conformal coating flame resistant (UL 94 V-0) rating
- Ultra low TCR ( $\pm 5$  ppm/ $^{\circ}$ C)
- High voltage
- Flame resistant (UL 94 V-0 rating)
- High voltage rating to 300 V
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition

### Note

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

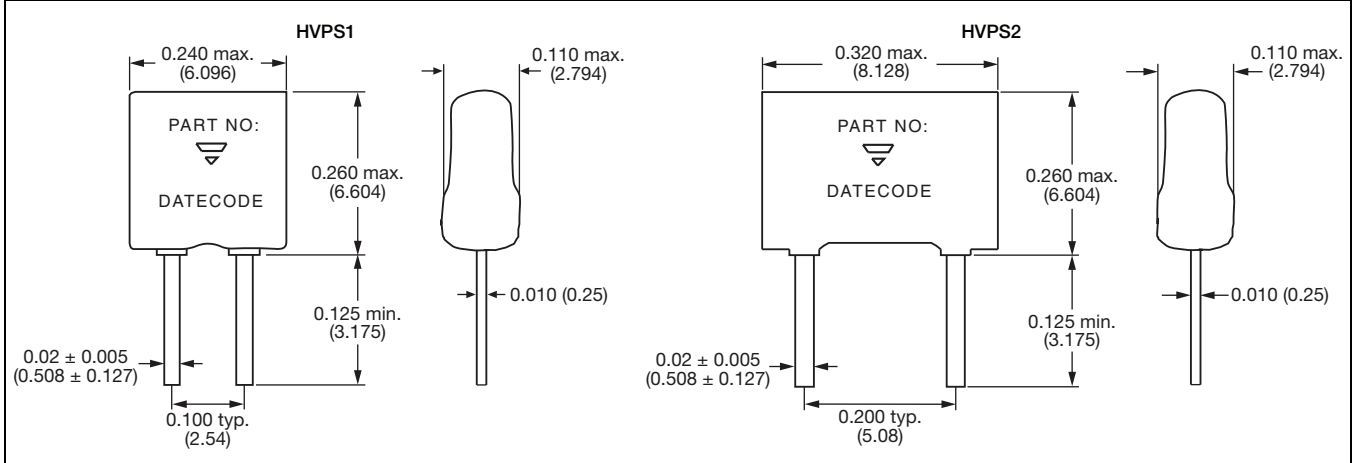


**RoHS\***  
COMPLIANT  
HALOGEN  
**FREE**

### APPLICATIONS

- Precise instrumentation (medical, test etc.)
- Precision amplifiers

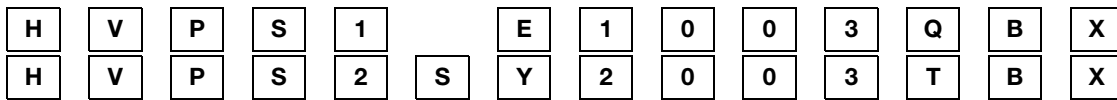
STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Pin/Lead Number	2	-
Resistance Range	50 000 $\Omega$ to 5000 k $\Omega$ (HVPS1) 100 000 $\Omega$ to 10 000 k $\Omega$ (HVPS2)	-
TCR: Absolute	5 ppm/ $^{\circ}$ C to 25 ppm/ $^{\circ}$ C	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C
TCR: Tracking	-	-
Tolerance: Absolute	$\pm 0.01\%$ to $\pm 1.0\%$	Maximum at + 70 $^{\circ}$ C
Tolerance: Ratio	-	-
Power Rating: Resistor	125 mW (HVPS1) 250 mW (HVPS2)	-
Power Rating: Package	-	-
Stability: Absolute	$\Delta R \pm 0.05\%$	2000 h at + 70 $^{\circ}$ C
Stability: Ratio	-	-
Voltage Coefficient	< 1.0 ppm/V	-
Working Voltage	250 V (HVPS1) 300 V (HVPS2)	-
Operating Temperature Range	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C	-
Storage Temperature Range	-	-
Noise	< - 30 dB	-
Thermal EMF	< 0.1 $\mu$ V/ $^{\circ}$ C	-
Shelf Life Stability: Absolute	$\Delta R \pm 0.01\%$	1 year at + 25 $^{\circ}$ C
Shelf Life Stability: Ratio	-	-

**DIMENSIONS AND IMPRINTING** in inches (millimeters)

**MECHANICAL SPECIFICATIONS**

Resistive Element	Passivated nichrome
Substrate Material	Alumina
Body	Epoxy coated
Terminals	Copper alloy
Tin/Lead Option	Sn60 - Sn63
Lead (Pb)-free Option	Sn96.5, Ag3.0, Cu0.5
Tin/Lead and Lead (Pb)-free Finish	Hot solder dip

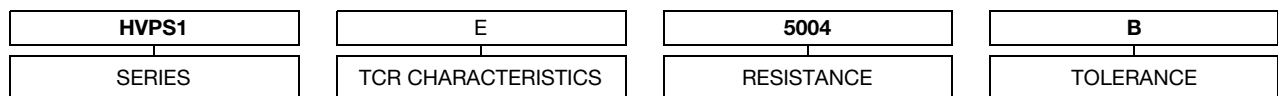
**GLOBAL PART NUMBER INFORMATION**

New Global Part Numbering: HVPS1E1003QBX



<b>GLOBAL MODEL</b> (3 or 4 digits)  <b>HVPS1</b> <b>HVPS2</b> (Tin lead)  <b>HVPS1S</b> <b>HVPS2S</b> (Lead (Pb)-free) (e1)	<b>TCR</b>  <b>E</b> = 25 ppm/°C <b>D</b> = 15 ppm/°C <b>Y</b> = 10 ppm/°C <b>Z</b> = 5 ppm/°C	<b>RESISTANCE</b>  First 3 digits are significant figures. Last digit specifies the number of zeroes to follow. e.g.: 1001 = 1K 1002 = 10K 1005 = 10M	<b>TOLERANCE</b>  <b>A</b> = 0.05 % <b>B</b> = 0.1 % <b>D</b> = 0.5 % <b>F</b> = 1.0 % <b>Q</b> = 0.02 % <b>T</b> = 0.01 %	<b>PACKAGING</b>  <b>BX</b> = Conductive foam box
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Historical Part Number example: HVPS1E5004B (for reference purposes only)



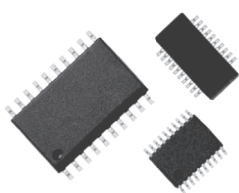




# RC Networks

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VSSRC1284.....	159
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# Thin Film RC Surface Mount Networks

## RC NETWORKS

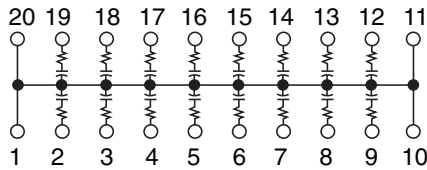
**Performance Key**

	TCR	TOLERANCE
RESISTOR	200	5%
	TCC	TOLERANCE
CAPACITOR	200	10%

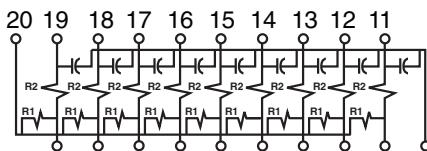
  

	TCR	TOLERANCE
RESISTOR	200	10%
	TCC	TOLERANCE
CAPACITOR	200	20%

### Schematic AB 4 Terminal Common



### Schematic 1284



## Termination Network

### Schematic AB

25 MIL PITCH

50 MIL PITCH

3 TERMINAL

### Schematic AC

25 MIL PITCH

50 MIL PITCH

### IEEE 1284 Parallel Port Terminator

25 MIL PITCH

## T-Filter Network

### Schematic AA

3 TERMINAL

25 MIL PITCH

50 MIL PITCH

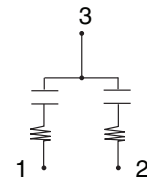
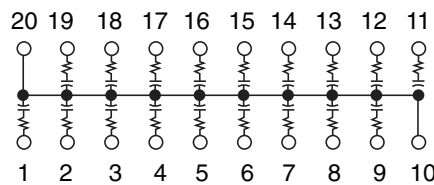
### Schematic AD

3 TERMINAL

25 MIL PITCH

50 MIL PITCH

### Schematic AC 2 Terminal Common





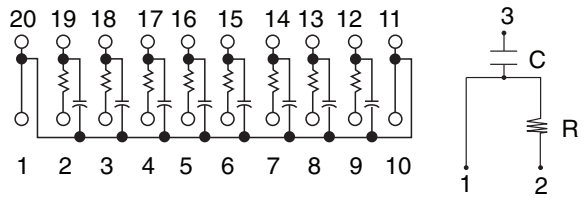
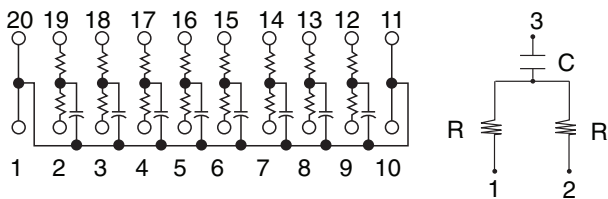
Package Body Width	Performance	
SSOP/QSOP Narrow (0.150 Inches)	■	VSSRC20-AB .....128
TSSOP Medium (0.173 Inches)	■	VTSRC20-AB .....128
SOIC Wide (0.300 Inches)	■	VSORC20-AB .....128
SOT-23	■	VR .....143
SSOP/QSOP Narrow (0.150 Inches)	■	VSSRC20-AC .....131
TSSOP Medium (0.173 Inches)	■	VTSRC20-AC .....131
SOIC Wide (0.300 Inches)	■	VSORC20-AC .....131
SSOP Narrow (0.150 Inches)	■	VSSRC1284 ..... 140
QSOP Narrow (0.150 Inches)	■	VSSX1284 .....146
SOT-23	■	VR .....143
SSOP/QSOP Narrow (0.150 Inches)	▲	VSSRC20-AA .....134
TSSOP Medium (0.173 Inches)	▲	VTSRC20-AA .....134
SOIC Wide (0.300 Inches)	▲	VSORC20-AA .....134
SOT-23	■	VR .....143
SSOP/QSOP Narrow (0.150 Inches)	▲	VSSRC20-AD .....137
TSSOP Medium (0.173 Inches)	▲	VTSRC20-AD .....137
SOIC Wide (0.300 Inches)	▲	VSORC20-AD .....137
		E-TABLES .....153

STANDARD PRODUCTS

CUSTOM PRODUCTS

**Schematic AA**

**Schematic AD**





## 25 mil or 50 mil Pitch, Termination Thin Film Surface Mount Resistor/Capacitor Network

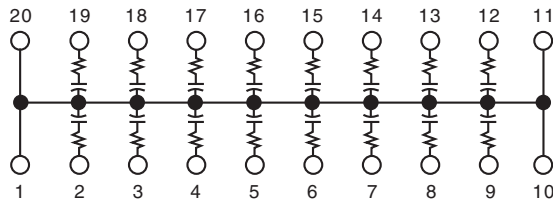


Small outline, surface mount, EMI/RFI reduction

If your design calls for the elimination of transmission line effects on high speed data lines Vishay Thin Film's integrated RC network, schematic AB is the answer. The planar design of our single die thin film networks offer low noise and predictable component behavior over a wide frequency range. Care must be taken when choosing matching networks that their frequency response matches that of the transmission line. Our product will reduce total assembly costs through surface mount technology, reduced component count and improved performance characteristics.

Available packages SOIC, SSOP and TSSOP.

### SCHEMATIC AB



### FEATURES

- Resistors and capacitors on a single chip
- Saves board space
- Reduces total assembly costs
- Uniform performance characteristics
- Compatible with automatic surface mounting equipment
- UL 94 V-0 flame resistant
- Rugged, molded case construction
- Compliant to RoHS Directive 2002/95/EC



### TYPICAL PERFORMANCE

	TCR	TOL.
RESISTOR	200	10
	TCC	TOL.
CAPACITOR	200	20

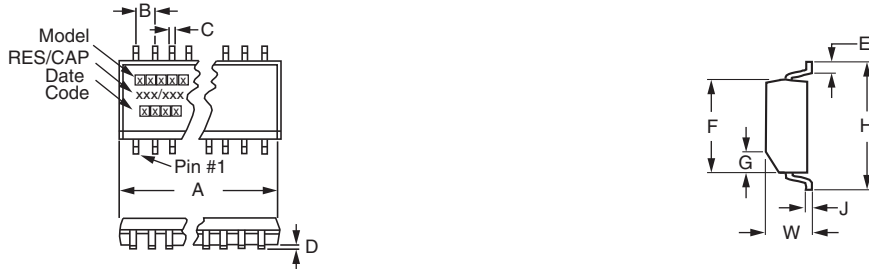
### STANDARD VALUES

MODELS			R (Ω)	C (pF)
VSORC	VSSRC	VTSRC		
	X		47	33

STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Tantalum nitride on silicon	-
Pin/Lead Number	20	-
Resistance Range	10 Ω to 750 Ω	-
TCR: Absolute	± 200 ppm/°C	0 °C to + 70 °C
TCR: Tracking	± 10 ppm/°C	-
Tolerance: Absolute	± 10 % standard (R), ± 20 % standard (C)	At 1 MHz and V <sub>RMS</sub> over + 10 °C to + 70 °C
Power Rating: Resistor	100 mW	-
Power Rating: Package	(T)SSOP: 1 W	See derating curve
	SOIC: 1.2 W	
Stability: Ratio	± 2 %	1000 h at + 70 °C
Operating Temperature Range	0 °C to + 70 °C	-
Storage Temperature Range	- 55 °C to + 125 °C	-
Capacitance Range	10 pF to 150 pF for TSSOP	-
	10 pF to 250 pF for SOIC/SSOP	
ESD Protection	> 2 kV	MIL-STD-883, method 3015
Breakdown Voltage	35 V to 50 V	-



**DIMENSIONS** in inches and millimeters



DIMENSION	JEDEC M0-153AC, VT SRC20-AB		JEDEC M0-137AD, VSSRC20-AB		JEDEC MS-013AC, VSORC20-AB	
	INCHES	MILLIMETERS	INCHES	MILLIMETERS	INCHES	MILLIMETERS
A	0.256 ± 0.003	6.5 ± 0.08	0.344 max.	8.74 max.	0.500 ± 0.010	12.7 ± 0.25
B (ref.)	0.025	0.65	0.025	0.64	0.050	1.27
C (ref.)	0.0087	0.22	0.010	0.25	0.016	0.41
D	0.004	0.10	0.006	0.15	0.008	0.20
E (typ.)	0.024	0.61	0.025	0.64	0.030	0.76
F	0.173 ± 0.003	4.39 ± 0.08	0.154 ± 0.003	3.9	0.293 ± 0.003	7.44
G	0.015 x 45°	0.38	0.015 x 45°	0.38	0.025 x 45°	0.64
H	0.252 ± 0.005	6.4 ± 0.13	0.236 ± 0.008	6.0 ± 0.20	0.406 ± 0.005	10.31
J (ref.)	0.005	0.13	0.010	0.25	0.010	0.25
W	0.043 ± 0.005	1.09 ± 0.13	0.064 ± 0.005	1.6	0.100 ± 0.005	2.59

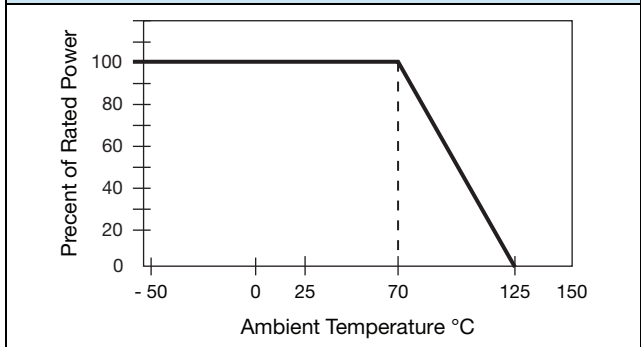
**IMPRINTING**

<b>VSORC, VSSRC, VT SRC</b>	<b>20</b>	<b>AB</b>	<b>XXX</b>	<b>/</b>	<b>XXX</b>
MODEL	PIN COUNT	SCHEMATIC	RESISTANCE Code: e.g. 100 = 10 W	/	CAPACITANCE Code: e.g. 101 = 100 pF
		XXXX			
		Date code			Optional marking

**MECHANICAL SPECIFICATIONS**

<b>Resistive Element</b>	Tantalum nitride
<b>Substrate Material</b>	Silicon
<b>Body</b>	Molded epoxy
<b>Terminals</b>	Copper alloy
<b>Plating</b>	100 % matte Sn
<b>Lead Coplanarity</b>	0.0005"
<b>Marking Resistance to Solvents</b>	Permanency testing per MIL-STD-202, method 215

**DERATING CURVE**



**PACKAGING INFORMATION**

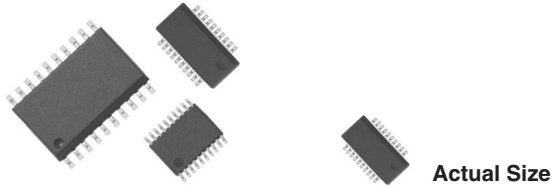
MODEL	LEADS	TAPE AND REEL	TUBES
JEDEC M0-153AC, VT SRC (TSSOP)	20	2500	74
JEDEC M0-137AD, VSSRC (SSOP)	20	2500	55
JEDEC MS-013AC, VSORC (SOIC)	20	1000	38



GLOBAL PART NUMBER INFORMATION																
New Global Part Numbering: VSORC20AB330470TF																
V	S	O	R	C	2	0	A	B	3	3	0	4	7	0	T	F
GLOBAL MODEL				NUMBER OF LEADS/ SCHEMATICS				RESISTANCE AND TOLERANCE/ CAPACITANCE AND TOLERANCE				PACKAGING				
VSORC VTSRC VSSRC				20AB				xxxxyy First 2 digits are significant figures. Last digit specifies number of zeros to follow.  K = 10 % resistance tol. fixed M = 20 % capacitor tol. fixed				UF = TUBED  TAPE AND REEL TF = Full reels				
Historical Part Number Example: VSORC20AB330K470MT/R (for reference purposes only)																
VSORC		20		AB		330K		470M		T/R						
MODEL		NUMBER OF LEADS		SCHEMATIC		RESISTANCE		TOLERANCE		PACKAGING						



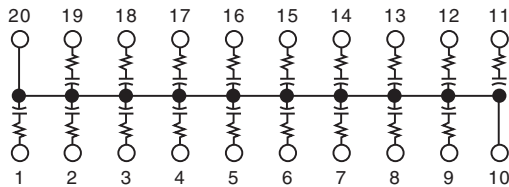
## 25 mil or 50 mil Pitch, Termination Thin Film Surface Mount Resistor/Capacitor Network



Small outline, surface mount, EMI/RFI reduction, terminator networks

Vishay Thin Film's termination RC network Schematic AC, can support 18 data lines reducing overall cost. Impedance matching of transmission lines is easily done using VTF thin film integrated RC networks. Our product is designed with all components integrated within a single die. It is then packaged in JEDEC standard plastic packages. The use of surface mount technology offers improved design capability through reduced parasitic inductance and capacitance. Available packages SOIC, SSOP and TSSOP.

### SCHEMATIC AC



### FEATURES

- Resistors and capacitors on a single chip
- Saves board space
- Reduces total assembly costs
- Uniform performance characteristics
- Compatible with automatic surface mounting equipment
- UL 94 V-0 flame resistant
- Rugged, molded case construction
- Compliant to RoHS Directive 2002/95/EC



### TYPICAL PERFORMANCE

	TCR	TOLERANCE
<b>RESISTOR</b>	200	10
	TCC	TOLERANCE
<b>CAPACITOR</b>	200	20

### STANDARD VALUES

MODELS			R (Ω)	C (pF)
VSORC	VSSRC	VTSRC		
X			50	220
	X		50	250
	X		75	56
X			100	100

STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Tantalum nitride on silicon	-
Pin/Lead Number	20	-
Resistance Range	10 Ω to 750 Ω	-
TCR: Absolute	± 200 ppm/°C	0 °C to + 70 °C
TCR: Tracking	± 10 ppm/°C	-
Tolerance: Absolute	± 10 % standard (R), ± 20 % standard (C)	At 1 MHz and V <sub>RMS</sub> over + 10 °C to + 70 °C
Power Rating: Resistor	100 mW	-
Power Rating: Package	(T)SSOP: 1 W, SOIC: 1.2 W	See derating curve
Stability: Ratio	± 2 %	1000 h
Operating Temperature Range	0 °C to + 70 °C	-
Storage Temperature Range	- 55 °C to + 125 °C	-
Capacitance Range	TSSOP: 10 pF to 150 pF, SOIC/SSOP: 10 pF to 250 pF	-
ESD Protection	> 2 kV	MIL-STD-883, method 3015
Breakdown Voltage	35 V to 50 V	-



**DIMENSIONS** in inches and millimeters



DIMENSION	JEDEC M0-153AC, VT SRC20-AC		JEDEC M0-137AD, VSSRC20-AC		JEDEC MS-013AC, VSORC20-AC	
	INCHES	MILLIMETERS	INCHES	MILLIMETERS	INCHES	MILLIMETERS
A	0.256 ± 0.003	6.5 ± 0.08	0.344 max.	8.74 max.	0.500 ± 0.010	12.7 ± 0.25
B (ref.)	0.025	0.65	0.025	0.64	0.050	1.27
C (ref.)	0.0087	0.22	0.010	0.25	0.016	0.41
D	0.004	0.10	0.006	0.15	0.008	0.20
E (typ.)	0.024	0.61	0.025	0.64	0.030	0.76
F	0.173 ± 0.003	4.39 ± 0.08	0.154 ± 0.003	3.9	0.293 ± 0.003	7.44
G	0.015 x 45°	0.38	0.015 x 45°	0.38	0.025 x 45°	0.64
H	0.252 ± 0.005	6.4 ± 0.13	0.236 ± 0.008	6.0 ± 0.20	0.406 ± 0.005	10.31
J (ref.)	0.005	0.13	0.010	0.25	0.010	0.25
W	0.043 ± 0.005	1.09 ± 0.13	0.064 ± 0.005	1.6	0.100 ± 0.005	2.59

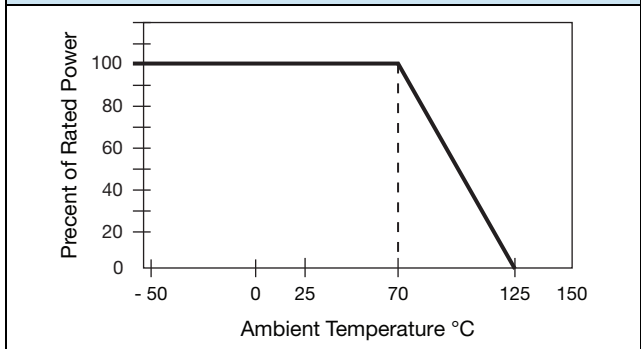
**IMPRINTING**

<b>VSORC, VSSRC, VT SRC</b>	<b>20</b>	<b>AC</b>	<b>XXX</b>	<b>/</b>	<b>XXX</b>
MODEL	PIN COUNT	SCHEMATIC	RESISTANCE Code: e.g. 100 = 10 Ω	/	CAPACITANCE Code: e.g. 101 = 100 pF
		XXXX Date code			Optional marking

**MECHANICAL SPECIFICATIONS**

<b>Resistive Element</b>	Tantalum nitride
<b>Substrate Material</b>	Silicon
<b>Body</b>	Molded epoxy
<b>Terminals</b>	Copper alloy
<b>Plating</b>	100 % matte Sn
<b>Lead Coplanarity</b>	0.0005"
<b>Marking Resistance to Solvents</b>	Permanency testing per MIL-STD-202, method 215

**DERATING CURVE**



**PACKING INFORMATION**

MODEL	LEADS	TAPE AND REEL	TUBES
JEDEC M0-153AC, VT SRC (TSSOP)	20	2500	74
JEDEC M0-137AD, VSSRC (SSOP)	20	2500	55
JEDEC MS-013AC, VSORC (SOIC)	20	1000	38

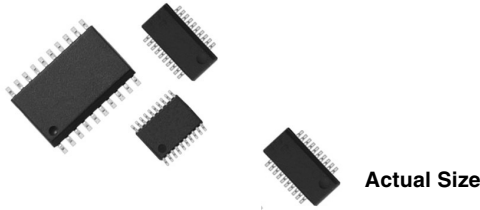




GLOBAL PART NUMBER INFORMATION																
New Global Part Numbering: VSSRC20AC330470TF																
V	S	S	R	C	2	0	A	C	3	3	0	4	7	0	T	F
GLOBAL MODEL				NUMBER OF LEADS/ SCHEMATICS				RESISTANCE AND TOLERANCE/ CAPACITANCE AND TOLERANCE				PACKAGING				
VSSRC VTSRC VSORC				20AC				xxxxyy First 2 digits are significant figures. Last digit specifies number of zeros to follow.  K = 10 % resistance tol. fixed M = 20 % capacitor tol. fixed				UF = TUBED  TAPE AND REEL TF = Full reels				
Historical Part Number example: VSSRC20AC330K470MT/R (for reference purposes only)																
VSSRC		20		AC		330K		470M		T/R						
MODEL		NUMBER OF LEADS		SCHEMATIC		RESISTANCE		TOLERANCE		PACKAGING						



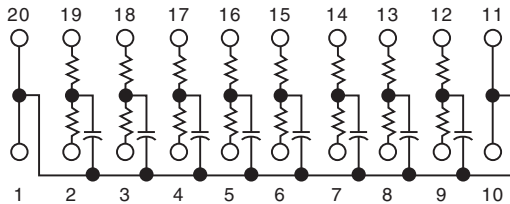
## 25 mil or 50 mil Pitch, T-Filter Thin Film Surface Mount Resistor/Capacitor Network



Small outline, surface mount, EMI/RFI reduction

Vishay Thin Film's T-filter network is an integrated thin film network on a single die. Noise suppression is at a maximum with the use of thin film technology. The T-filter network, schematic AA is designed to suppress EMI/RFI noise with such applications as I/O ports of personal computers and peripherals, workstations and local area networks. With a rugged molded case to protect the circuit from the environment and an integrated thin film network this product is your choice when reduced size, improved accuracy and surface mount capability are your goals. Available packages SOIC, SSOP and TSSOP.

### SCHEMATIC AA



### FEATURES

- Resistors and capacitors on a single chip
- Saves board space
- Reduces total assembly costs
- Uniform performance characteristics
- UL 94 V-0 flame resistant
- Rugged, molded case construction
- VTSRC - JEDEC M0-153AC
- VSSRC - JEDEC M0-137AD
- VSORC - JEDEC MS-013AC
- Compliant to RoHS Directive 2002/95/EC



### TYPICAL PERFORMANCE

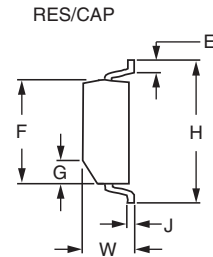
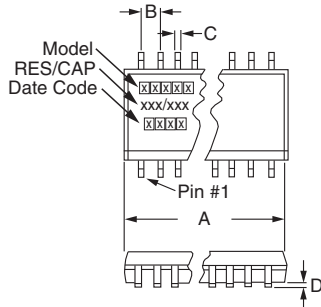
	TCR	TOLERANCE
<b>RESISTOR</b>	200	10 %
	TCC	TOLERANCE
<b>CAPACITOR</b>	200	20 %

### STANDARD VALUES

MODELS			R (Ω)	C (pF)
VSORC	VSSRC	VTSRC		
	X		10	100
	X		25	200
X			100	390

### STANDARD ELECTRICAL SPECIFICATIONS

TEST	SPECIFICATIONS	CONDITIONS
Material	Tantalum nitride on silicon	-
Pin/Lead Number	20	-
Resistance Range	10 Ω to 750 Ω	-
TCR: Absolute	± 200 ppm/°C	0 °C to + 70 °C
TCR: Tracking	± 10 ppm/°C	-
Tolerance: Absolute	± 10 % standard (R), ± 20 % standard (C)	At 1 MHz and V <sub>RMS</sub> over + 10 °C to + 70 °C
Power Rating: Resistor	100 mW	-
Power Rating: Package	(T)SSOP: 1 W, SOIC: 1.2 W	See derating curve
Stability: Ratio	± 2 %	1000 h
Operating Temperature Range	0 °C to + 70 °C	-
Storage Temperature Range	- 55 °C to + 125 °C	-
Capacitance Range	TSSOP: 10 pF to 150 pF, SOIC/SSOP: 10 pF to 250 pF	-
ESD Protection	> 2 kV	MIL-STD-883, method 3015
Breakdown Voltage	35 V to 50 V	-

**DIMENSIONS** in inches and millimeters


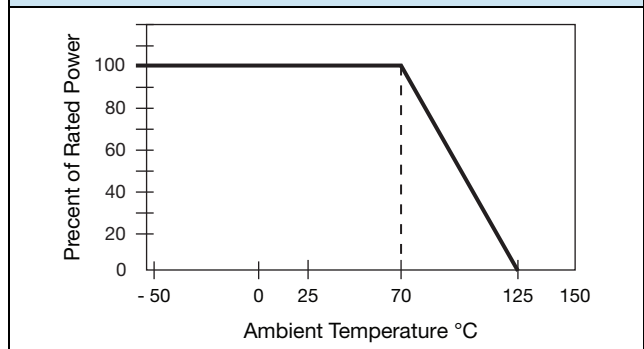
DIMENSION	JEDEC M0-153AC, VTSRC20-AA		JEDEC M0-137AD, VSSRC20-AA		JEDEC MS-013AC, VSORC20-AA	
	INCHES	MILLIMETERS	INCHES	MILLIMETERS	INCHES	MILLIMETERS
A	0.256 ± 0.003	6.5 ± 0.08	0.344 max.	8.74 max.	0.500 ± 0.010	12.7 ± 0.25
B (ref.)	0.025	0.65	0.025	0.64	0.050	1.27
C (ref.)	0.0087	0.22	0.010	0.25	0.016	0.41
D	0.004	0.10	0.006	0.15	0.008	0.20
E (typ.)	0.024	0.61	0.025	0.64	0.030	0.76
F	0.173 ± 0.003	4.39 ± 0.08	0.154 ± 0.003	3.9	0.293 ± 0.003	7.44
G	0.015 x 45°	0.38	0.015 x 45°	0.38	0.025 x 45°	0.64
H	0.252 ± 0.005	6.4 ± 0.13	0.236 ± 0.008	6.0 ± 0.20	0.406 ± 0.005	10.31
J (ref.)	0.005	0.13	0.010	0.25	0.010	0.25
W	0.043 ± 0.005	1.09 ± 0.13	0.064 ± 0.005	1.6	0.100 ± 0.005	2.59

**IMPRINTING**

VSORC, VSSRC, VTSRC	20	AA	XXX	/	XXX
MODEL	PIN COUNT	SCHEMATIC	RESISTANCE Code: e.g. 100 = 10 W	/	CAPACITANCE Code: e.g. 101 = 100 pF
		XXXX Date code			Optional marking

**MECHANICAL SPECIFICATIONS**

Resistive Element	Tantalum nitride
Substrate Material	Silicon
Body	Molded epoxy
Terminals	Copper alloy
Plating	100 % matte Sn
Lead Coplanarity	0.0005"
Marking Resistance to Solvents	Permanency testing per MIL-STD-202, method 215

**DERATING CURVE**

**PACKING INFORMATION**

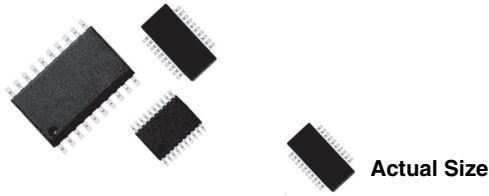
MODEL	LEADS	TAPE AND REEL	TUBES
JEDEC M0-153AC, VTSRC (TSSOP)	20	2500	74
JEDEC M0-137AD, VSSRC (SSOP)	20	2500	55
JEDEC MS-013AC, VSORC (SOIC)	20	1000	38



GLOBAL PART NUMBER INFORMATION																
New Global Part Numbering: VTSRC20AA330470TF																
V	T	S	R	C	2	0	A	A	3	3	0	4	7	0	T	F
GLOBAL MODEL				NUMBER OF LEADS/ SCHEMATICS				RESISTANCE AND TOLERANCE/ CAPACITANCE AND TOLERANCE				PACKAGING				
VTSRC VSSRC VSORC				20AA				xxxxyy First 2 digits are significant figures. Last digit specifies number of zeros to follow.  K = 10 % resistance tol. fixed M = 20 % capacitor tol. fixed				UF = TUBED  TAPE AND REEL TF = Full reels				
Historical Part Number example: VTSRC20AA330K470MT/R (for reference purposes only)																
VTSRC	20	AA	330K	470M	T/R											
MODEL	NUMBER OF LEADS	SCHEMATIC	RESISTANCE	TOLERANCE	PACKAGING											

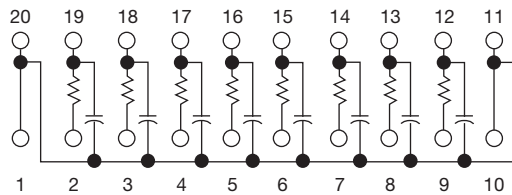


## 25 mil or 50 mil Pitch, T-Filter Thin Film Surface Mount Resistor/Capacitor Network



Small outline, surface mount, EMI/RFI reduction, T-filter networks  
 Vishay Thin Film's schematic AD is designed as an 8 channel filter for use with personal computer and peripheral 110 ports such as SCSI ports. The use of single die technology for filtering minimizes space and allows for more freedom in routing. With a rugged molded case to protect the circuit from the environment and an integrated thin film network this product is your choice when reduced size, improved accuracy and surface mount capability are your goals.  
 Available packages SOIC, SSOP and TSSOP.

### SCHEMATIC AD



### FEATURES

- Resistors and capacitors on a single chip
- Saves board space
- Reduces total assembly costs
- Uniform performance characteristics
- Compatible with automatic surface mounting equipment
- UL 94 V-0 flame resistant
- Rugged, molded case construction
- Compliant to RoHS Directive 2002/95/EC



### TYPICAL PERFORMANCE

	TCR	TOLERANCE
RESISTOR	200	10
	TCC	TOLERANCE
CAPACITOR	200	20

### STANDARD VALUES

MODELS			R ( $\Omega$ )	C (pF)
VSORC	VSSRC	VTSRC		
	X		33	47

STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Tantalum nitride on silicon	-
Pin/Lead Number	20	-
Resistance Range	10 $\Omega$ to 750 $\Omega$	-
TCR: Absolute	$\pm 200$ ppm/ $^{\circ}$ C	0 $^{\circ}$ C to + 70 $^{\circ}$ C
TCR: Tracking	$\pm 10$ ppm/ $^{\circ}$ C	-
Tolerance: Absolute	$\pm 10$ % standard (R), $\pm 20$ % standard (C)	At 1 MHz and $V_{RMS}$ over + 10 $^{\circ}$ C to + 70 $^{\circ}$ C
Power Rating: Resistor	100 mW	-
Power Rating: Package	(T)SSOP: 1 W, SOIC: 1.2 W	See derating curve
Stability: Ratio	$\pm 2$ %	1000 h
Operating Temperature Range	0 $^{\circ}$ C to + 70 $^{\circ}$ C	-
Storage Temperature Range	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C	-
Capacitance Range	TSSOP: 10 pF to 150 pF, SOIC/SSOP: 10 pF to 250 pF	-
ESD Protection	> 2 kV	MIL-STD-883, method 3015
Breakdown Voltage	35 V to 50 V	-



**DIMENSIONS** in inches and millimeters



DIMENSION	JEDEC M0-153AC, VT SRC20-AD		JEDEC M0-137AD, VSSRC20-AD		JEDEC MS-013AC, VSORC20-AD	
	INCHES	MILLIMETERS	INCHES	MILLIMETERS	INCHES	MILLIMETERS
A	0.256 ± 0.003	6.5 ± 0.08	0.344 max.	8.74 max.	0.500 ± 0.010	12.7 ± 0.25
B (ref.)	0.025	0.65	0.025	0.64	0.050	1.27
C (ref.)	0.0087	0.22	0.010	0.25	0.016	0.41
D	0.004	0.10	0.006	0.15	0.008	0.20
E (typ.)	0.024	0.61	0.025	0.64	0.030	0.76
F	0.173 ± 0.003	4.39 ± 0.08	0.154 ± 0.003	3.9	0.293 ± 0.003	7.44
G	0.015 x 45°	0.38	0.015 x 45°	0.38	0.025 x 45°	0.64
H	0.252 ± 0.005	6.4 ± 0.13	0.236 ± 0.008	6.0 ± 0.20	0.406 ± 0.005	10.31
J (ref.)	0.005	0.13	0.010	0.25	0.010	0.25
W	0.043 ± 0.005	1.09 ± 0.13	0.064 ± 0.005	1.6	0.100 ± 0.005	2.59

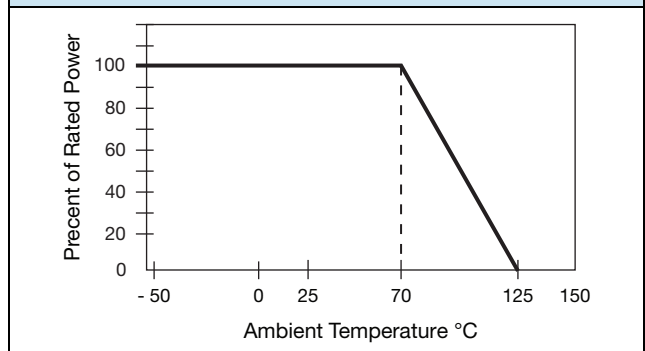
**IMPRINTING**

<b>VSORC, VSSRC, VT SRC</b>	<b>20</b>	<b>AD</b>	<b>XXX</b>	<b>/</b>	<b>XXX</b>
MODEL	PIN COUNT	SCHEMATIC	RESISTANCE Code: e.g. 100 = 10 Ω	<b>/</b>	CAPACITANCE Code: e.g. 101 = 100 pF
		XXXX Date code			Optional marking

**MECHANICAL SPECIFICATIONS**

<b>Resistive Element</b>	Tantalum nitride
<b>Substrate Material</b>	Silicon
<b>Body</b>	Molded epoxy
<b>Terminals</b>	Copper alloy
<b>Plating</b>	100 % matte Sn
<b>Lead Coplanarity</b>	0.0005"
<b>Marking Resistance to Solvents</b>	Permanency testing per MIL-STD-202, method 215

**DERATING CURVE**



**PACKING INFORMATION**

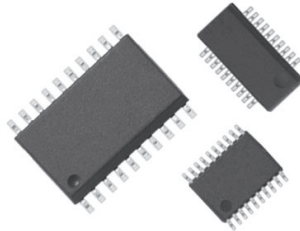
MODEL	LEADS	TAPE AND REEL	TUBES
JEDEC M0-153AC, VT SRC (TSSOP)	20	2500	74
JEDEC M0-137AD, VSSRC (SSOP)	20	2500	55
JEDEC MS-013AC, VSORC (SOIC)	20	1000	38



GLOBAL PART NUMBER INFORMATION																
New Global Part Numbering: VTSRC20AD330470TF																
V	T	S	R	C	2	0	A	D	3	3	0	4	7	0	T	F
GLOBAL MODEL				NUMBER OF LEADS/ SCHEMATICS				RESISTANCE AND TOLERANCE/ CAPACITANCE AND TOLERANCE				PACKAGING				
VSSRC VTSRC VSORC				20AD				xxxxyy  First 2 digits are significant figures. Last digit specifies number of zeros to follow.  K = 10 % resistance tol. fixed M = 20 % capacitor tol. fixed				UF = TUBED  TAPE AND REEL TF = Full reels				
Historical Part Number example: VTSRC20AD330K470MT/R (for reference purposes only)																
VTSRC		20		AD		330K		470M		T/R						
MODEL		NUMBER OF LEADS		SCHEMATIC		RESISTANCE		TOLERANCE		PACKAGING						



# 25 mil Pitch Thin Film Surface Mount Resistor/Capacitor Network



IEEE 1284 parallel port termination network

## FEATURES

- Rugged, molded case construction JEDEC MO-137AD
- Reduces total assembly costs
- Saves board space
- Compatible with automatic surface mounting equipment
- Uniform performance characteristics
- Resistors and capacitors on a single chip
- UL 94 V-0 flame resistant
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition

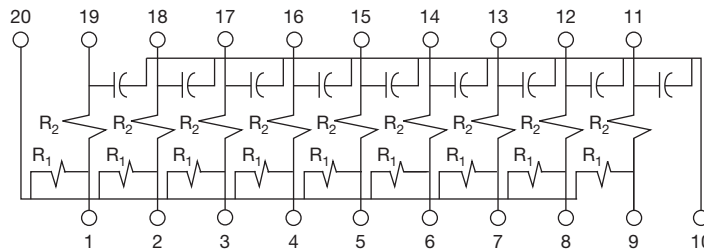


RoHS COMPLIANT HALOGEN FREE

## TYPICAL PERFORMANCE

	TCR	TOLERANCE
<b>RESISTOR</b>	200	10
	TCC	TOLERANCE
<b>CAPACITOR</b>	200	20

## SCHEMATIC



STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Tantalum nitride	-
Pin/Lead Number	20	-
Resistance Range	10 Ω to 10 kΩ	-
TCR: Absolute	± 200 ppm/°C	-
TCR: Tracking	-	-
Tolerance: Absolute	± 10 % (R <sub>1</sub> and R <sub>2</sub> ), ± 20 % (C)	At 1 MHz and V <sub>RMS</sub> over + 10 °C to + 70 °C
Power Rating: Resistor	100 mW	-
Power Rating: Package	1 W	-
Stability: Ratio	-	-
Operating Temperature Range	-	-
Storage Temperature Range	-	-
Capacitance Range	27 pF to 220 pF	Based on number of resistors
ESD Protection	> 2 kV	MIL-STD-883, method 3015
Breakdown Voltage	25 V	-



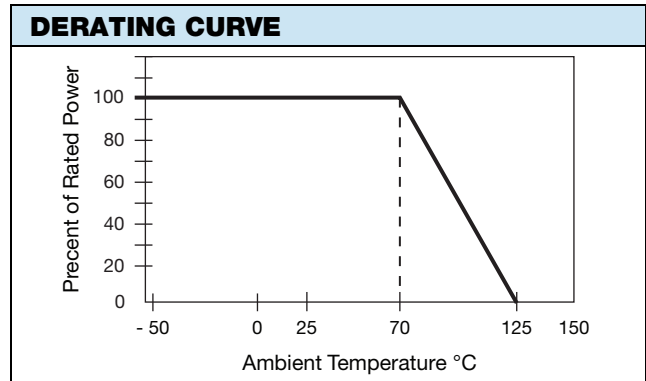
DIMENSIONS in inches and millimeters		
DIMENSION	MODEL VSSRC1284	
	INCHES	
	MINIMUM	MAXIMUM
A	0.344 max.	8.74 max.
B (ref.)	0.025	0.64
C (ref.)	0.010	0.25
D	0.006	0.15
E (typ.)	0.025	0.64
F	0.154 ± 0.003	3.85 ± 0.08
G	0.015 x 45°	0.38 x 45°
H	0.236 ± 0.008	5.9 ± 0.20
J (ref.)	0.010	0.25
W	0.064 ± 0.005	1.64 ± 0.13

**Note**

- Mold flash not included in body dimensions

IMPRINTING	
VSSRC1284-X	
Date code	-X = Molded version number from table below

MECHANICAL SPECIFICATIONS	
Resistive Element	Tantalum nitride
Substrate Material	Silicon
Body	Molded epoxy
Terminals	Copper alloy
Plating	100 % matte Sn
Lead Coplanarity	0.0005"
Marking Resistance to Solvents	Permanency testing per MIL-STD-202, method 215



STANDARD VALUES			
AVAILABLE MODELS	R <sub>1</sub> ± 10 % (Ω)	R <sub>2</sub> ± 10 % (Ω)	C ± 20 % (pF)
VSSRC1284-1	2.2K	33	220
VSSRC1284-2	4.7K	33	180
VSSRC1284-3	1K	33	180
VSSRC1284-4	4.7K	10	180
VSSRC1284-5	4.7K	27	33
VSSRC1284-6	4.7K	270	33
VSSRC1284-7	10K	10	27



**GLOBAL PART NUMBER INFORMATION**

New Global Part Numbering: VSSRC1284-1TF

V S S R C 1 2 8 4 - 1 T F

GLOBAL MODEL  
VSSRC1284

VALUE  
-1  
-2  
-3  
-4  
-5  
-6  
-7

PACKAGING  
UF = TUBED  
TAPE AND REEL  
TF = Full reels

Historical Part Number example: VSSRC1284-1T/R (for reference purposes only)

VSSRC1284  
MODEL

-1  
VALUE

T/R  
PACKAGING

## Molded, SOT-23 Thin Film Surface Mount Resistor/Capacitor Network



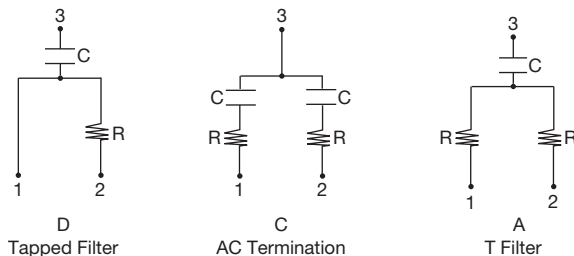
Vishay's R/C Network, packaged in the standard SOT-23, can be strategically placed on your PC board to do localized filtering. The R/C Network can be located at the point of emission before transients are carried through the design.

The sophisticated process of integrating the Resistor and Capacitor on a single substrate provides you with higher performance and more consistent results over discrete components. A real estate savings will also be gained.

Applications include EMI/RFI suppression and AC termination. These networks, in the SOT-23, along with Vishay's high component count R Networks and R/C Networks in a variety of standard IC packages, provides you with the exact solution for your redesign or new design.

Visit our website for the total picture on available R Networks and R/C Networks from our guaranteed stock program.

### SCHEMATIC



### FEATURES

- Resistor and capacitor **integrated** into a Thin Film network
- Filters at the source of emissions
- More consistent performance characteristics than discretés
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

### TYPICAL PERFORMANCE

	TCR	TOLERANCE
<b>RESISTOR</b>	200	10
	TCC	TOLERANCE
<b>CAPACITOR</b>	200	20

### VR TOOLED VALUES (1)

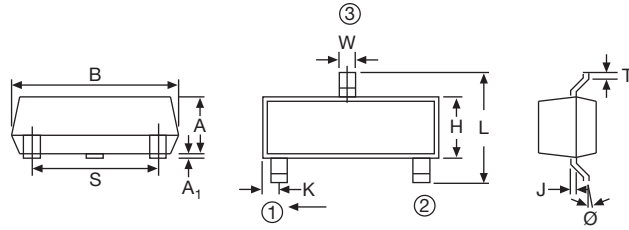
SCHEMATIC	R ( $\Omega$ )	C (pF)
D	33	47
C	47	47
A	100	80

#### Note

- Consult application engineering for custom values

### STANDARD ELECTRICAL SPECIFICATIONS

TEST	SPECIFICATIONS	CONDITIONS
<b>Material</b>	Tantalum nitride	-
<b>Pin/Lead Number</b>	3	-
<b>Resistance Range</b>	10 $\Omega$ to 500 $\Omega$	-
<b>TCR: Absolute</b>	$\pm 200$ ppm/ $^{\circ}$ C	0 $^{\circ}$ C to + 70 $^{\circ}$ C
<b>TCR: Tracking</b>	-	-
<b>Tolerance: Absolute</b>	$\pm 10$ % standard (R), $\pm 20$ % standard (C)	At 1 MHz and $V_{RMS}$ over + 10 $^{\circ}$ C to + 70 $^{\circ}$ C
<b>Power Rating: Resistor</b>	100 mW	-
<b>Power Rating: Package</b>	1 W	at + 70 $^{\circ}$ C
<b>Stability: Ratio</b>	-	-
<b>Operating Temperature Range</b>	0 $^{\circ}$ C to + 70 $^{\circ}$ C	-
<b>Storage Temperature Range</b>	- 55 $^{\circ}$ C to + 125 $^{\circ}$ C	-
<b>Capacitance Range</b>	10 pF to 80 pF	-
<b>ESD Protection</b>	-	-
<b>Breakdown Voltage</b>	25 V to 45 V	-

**DIMENSIONS** in inches and millimeters


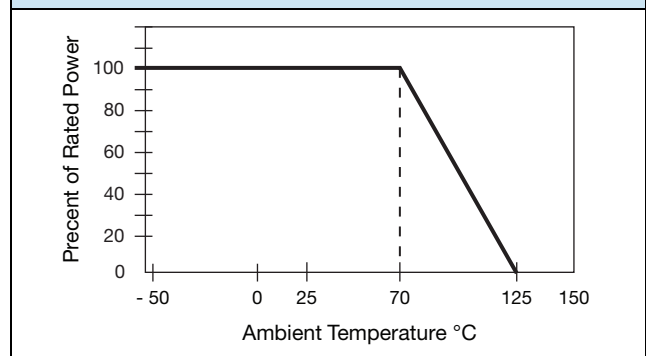
DIMENSION	JEDEC STANDARD TO-236			
	INCHES		MILLIMETERS	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
A	0.027	0.040	0.70	1.02
A <sub>1</sub>	0.001	0.004	0.02	0.15
B	0.105	0.120	2.67	3.04
S	0.071	0.079	1.80	2.00
W	0.015	0.021	0.38	0.54
L	0.083	1.03	2.10	2.64
H	0.047	0.055	1.20	1.40
T	0.050	0.157	0.13	0.40
J	0.003	0.008	0.089	0.15
K	0.017	0.022	0.44	0.55
Ø	0	8°	0	8°

**IMPRINTING**

	SCHEMATIC
VRA	AA
VRC	AC
VRD	AD

**MECHANICAL SPECIFICATIONS**

Resistive Element	Tantalum nitride
Capacitive Material	Thin film
Substrate Material	Silicon
Body	Molded epoxy
Terminals	Copper alloy
Plating	100 % matte Sn
Lead Coplanarity	0.0005"
Marking Resistance to Solvents	Permanency testing per MIL-STD-202, method 215

**DERATING CURVE**

**PACKAGING INFORMATION**

MODEL	LEADS	TAPE AND REEL
VR	3	3000



GLOBAL PART NUMBER INFORMATION				
New Global Part Numbering: VRD330K470MTF				
V	R	D	3	3
0	K	4	7	0
M	T	F		
GLOBAL MODEL	SCHEMATICS	RESISTANCE AND TOLERANCE/ CAPACITANCE AND TOLERANCE		PACKAGING
VR	D = Tapped filter C = AC termination A = T filter	xxxK/yyyM  First 2 digits are significant figures. Last digit specifies number of zeros to follow e.g. 330K/470M = 330 W 10 % 47 pF 20 % K = 10 % M = 20 %		UF = TUBED  TAPE AND REEL TF = Full reels
Historical Part Number example: VRD330K479MT/R (for reference purposes only)				
VR	D	330K	470M	T/R
MODEL	SCHEMATIC	RESISTANCE	TOLERANCE	PACKAGING

## 25 mil Pitch, IEEE 1284 Termination Thin Film Surface Mount Resistor, Capacitor, Diode



Product is pictured larger than actual size to show detail

Vishay has upgraded the standard IEEE 1284 Thin Film technology Network, incorporating diodes for protecting the inputs/outputs from electro-static discharge (ESD).

The sophisticated circuit is housed in a standard QSOP, 28-pin package.

Uses include ECP/EPP parallel port terminations for PC peripherals, notebooks, desktops, workstations and servers. This is a guaranteed stock part.

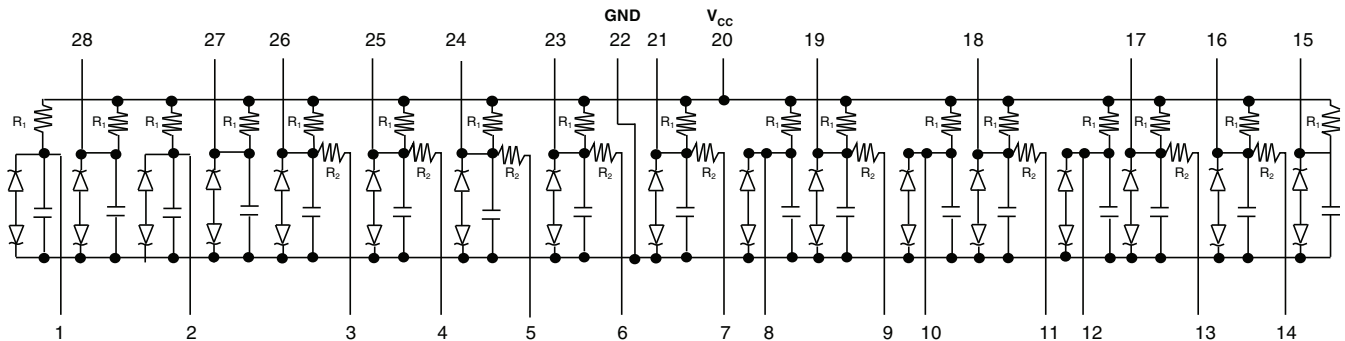
### FEATURES

- One sophisticated, integrated Thin Film technology solution
- Up-graded IEEE 1284 parallel port termination, pull-up with the addition of diodes for filtering on the parallel port
- Standard QSOP package (28 pins) - JEDEC MO-137AF
- 17 terminating lines
- Reduces total cost
- Increase board utilization
- Better performance over discretes
- Compliant to RoHS Directive 2002/95/EC



**RoHS**  
COMPLIANT

### SCHEMATIC



STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Polysilicon/thin film on silicon	-
Pin/Lead Number	28	-
Resistance Range	-	-
TCR: Absolute	-	-
TCR: Tracking	-	-
Tolerance: Absolute	$\pm 10\%$ (R), $\pm 20\%$ (C)	-
Power Rating: Resistor	100 mW	-
Power Rating: Package	1 W	-
Stability: Ratio	-	-
Operating Temperature Range	0 °C to + 70 °C	-
Storage Temperature Range	- 65 °C to + 150 °C	-
Capacitance Range	-	-
ESD Protection	See table	-
Breakdown Voltage	-	-
Signal clamp voltage	(+) clamp > 6 V; (-) clamp < - 6 V	-
Maximum leakage current at V <sub>CC</sub>	1 $\mu$ A	Maximum at 25 °C

ESD PROTECTION		
	MAXIMUM	MINIMUM
Peak Discharge Voltage at any I/O, Human Body Model, Method 3015 <sup>(1)</sup>	+ 8 kV	- 4 kV
In System Protection HBM <sup>(2)</sup>	+ 15 kV	- 8 kV
In System Protection, IEC 1000-4-2, Level 2 <sup>(2)(3)</sup>	+ 8 kV	- 4 kV
Channel Clamp Voltage at 8 kV ESD Pulses, HBM <sup>(1)(2)</sup>	+ 30 V	- 30 V

**Notes**

- Human body model per MIL-STD-883, method 3015  $C_{Discharge} = 100 \text{ pF}$ ,  $R_{Discharge} = 1.5 \text{ k}\Omega$  pin 20 at 5 V and pin 22 at ground.
- Pin 22 grounded, pin 20 to  $V_{CC}$  all other pins are open. ESD contact discharge between ground and pins 1, 2, 8, 10, 12, 15, 16, 17, 18, 19, 21, 23 through 28, one at a time.
- Standard IEC 1000-4-2 with  $C_{Discharge} = 150 \text{ pF}$ ,  $R_{Discharge} = 330 \text{ }\Omega$  pin 20 at 5 V and pin 22 at ground.

DIMENSIONS in inches and millimeters			
	DIMENSION	INCHES	MILLIMETERS
	A	0.068	1.727
	A1	0.008	0.203
	B	0.012	0.305
	C	0.010	0.254
	D	0.394	10.008
	E	0.157	3.988
	e	0.025	0.635
	H	0.244	6.198
	h	0.016	0.406
	L	0.038	0.889
	a°		8

**Note**

- Mold flash not included in body dimensions.  
JEDEC MO-137 package

MECHANICAL SPECIFICATIONS	
R/C Element	Polysilicon/thin film
Substrate Material	Silicon
Body	Molded epoxy
Terminals	Copper alloy
Plating	100 % matte Sn
Lead Coplanarity	0.005"
Marking Resistance to Solvents	MIL-STD-202, method 15
Flammability	UL 94 V-0

STANDARD VALUES			
AVAILABLE MODELS	R <sub>1</sub> ( $\Omega$ )	R <sub>2</sub> ( $\Omega$ )	C (pF)
VSSX1284A	4.7K	33	180
VSSX1284B	2.2K	33	220

GLOBAL PART NUMBER INFORMATION												
Global Part Numbering: VSSX1284ATF												
<table border="1" style="margin: auto;"> <tr> <td>V</td><td>S</td><td>S</td><td>X</td><td>1</td><td>2</td><td>8</td><td>4</td><td>A</td><td>T</td><td>F</td> </tr> </table>	V	S	S	X	1	2	8	4	A	T	F	
V	S	S	X	1	2	8	4	A	T	F		
<table border="1" style="margin: auto;"> <tr> <td>GLOBAL MODEL</td> </tr> <tr> <td>VSSX1284A or VSSX1284B</td> </tr> </table>	GLOBAL MODEL	VSSX1284A or VSSX1284B	<table border="1" style="margin: auto;"> <tr> <td>PACKAGING</td> </tr> <tr> <td>UF = TUBED</td> </tr> <tr> <td>TAPE AND REEL</td> </tr> <tr> <td>TF = Full reels</td> </tr> </table>	PACKAGING	UF = TUBED	TAPE AND REEL	TF = Full reels					
GLOBAL MODEL												
VSSX1284A or VSSX1284B												
PACKAGING												
UF = TUBED												
TAPE AND REEL												
TF = Full reels												



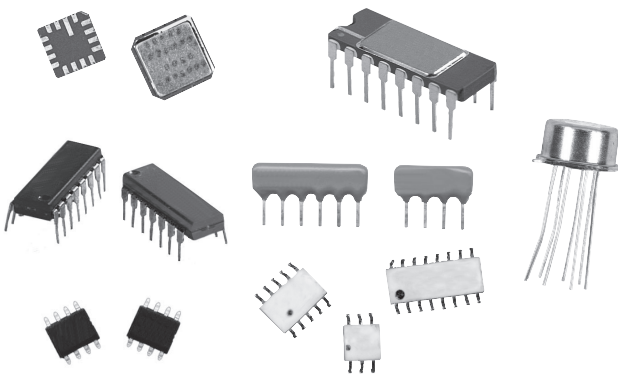




# Prototyping

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## How To Use Order Via Quick-Chip

### 1. SALES REPRESENTATIVE OR DISTRIBUTOR

- Receives request for products needing urgent delivery
- Offers Quick-Chip program to customer
- Enters RFQ to Vishay via partners/SAP
- RFQ must include SAP part number of product needed, quantity required, and desired lead time

### 2. VISHAY MARKETING

- Adds Quick-Chip line item lot charge and lead time to quote (LOTCHG-VTFQCKCHIP)
- Returns RFQ to sales representative or distributor
- Quote is valid for 48 h

### 3. SALES REPRESENTATIVE OR DISTRIBUTOR

- Delivers quote to customer and obtains a purchase order
- Phones customer service with purchase order and enters order and faxes PO information

### 4. CUSTOMER SERVICE

- Enters the order on SAP with reference to the quote
- Contacts Vishay Thin Film planning to ensure capacity and availability

### 5. VISHAY THIN FILM PLANNING

- Schedules the order
- Order is built and shipped

#### Note

- The clock starts when the order is entered on SAP and stops when product is shipped

The main families included in the program are listed below. However, Quick-Chip service can be requested on any Vishay Thin Film Resistor.

#### Products offered for the 10-day Quick-Chip program:

P- Thin film precision wraparound chip resistor P ns series

PTN Thin film tantalum nitride wraparound chip resistor

#### Product offered for the 15-day Quick Chip program:

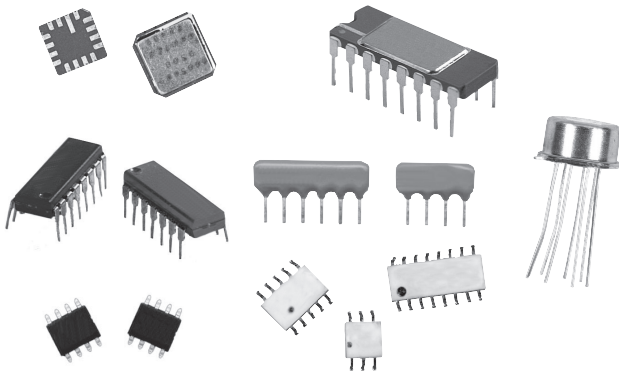
M55342 MILITARY QPL CHIP RESISTOR

M55342/01	M55342/07
M55342/02	M55342/08
M55342/03	M55342/09
M55342/04	M55342/10
M55342/05	M55342/11
M55342/06	M55342/12

L- Low value (0.03 Ω to 10 Ω) wraparound chip resistor



### Guidelines



#### FEATURES

- Custom thin film networks in 2 weeks
- No NRE charges typical
- Available in both moisture resistant tantalum nitride and passivated nichrome resistor film
- 72 h express on some formats
- Compliant to RoHS Directive 2002/95/EC



**RoHS\***  
COMPLIANT

#### Note

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

#### TYPICAL PERFORMANCE

	ABSOLUTE	TRACKING
TCR	25	5
	ABSOLUTE	RATIO
TOL.	0.05	0.02

All these packages are standard. Other packages available on request.

Our superior engineering capabilities enable us to provide the industry's shortest delivery for prototypes. Let Vishay Quick-Net® speed your prototypes to qualification. Quick-Net high quality networks are available in a variety of package formats, including single-in-line (SIP), hermetic DIP, flatpack and leadless chip carriers. The networks are available with either tantalum nitride or passivated nichrome resistor film.

#### SCHEMATIC



STANDARD ELECTRICAL SPECIFICATIONS		
TEST	SPECIFICATIONS	CONDITIONS
Material	Passivated nichrome	-
Resistance Range	100 Ω to 55 kΩ/200 Ω to 120 kΩ/400 Ω to 250 kΩ	Based on fil sheet resistance
TCR: Absolute	± 25 ppm/°C	- 55 °C to + 125 °C
TCR: Tracking	± 5 ppm/°C	-
Tolerance: Absolute	± 0.1 % to ± 1.0 %	-
Tolerance: Ratio	± 0.01 % to ± 0.1 %	Values over 1 kΩ
Power Rating: Resistor	25 mW	-
Operating Temperature Range	- 55 °C to + 125 °C	-

#### Note

- Consult factory for specifications

ORDERING INFORMATION
Copy, fill out and fax the form on the following page to send your prototype specifications to the Quick-Net team. Or call (716) 283-4025 to discuss your requirements with a member of the Quick-Net team.



Fax Form
Custom Thin Film Networks in 2 weeks with no NRE charges

For your Quick-Net Prototype, fill out this form and FAX to Vishay at (716) 283-5932, or call and talk to a Vishay engineer at (716) 283-4025.

DATE: FROM:
NUMBER OF PAGES:
TO: Vishay Quick-Net Team
2160 Liberty Dr.
Niagara Falls, NY 14304 USA
PHONE:
FAX NO.: (716) 283-59352 FAX:

Table with columns: YOUR PART NUMBER, VISHAY P.N., QUANTITY REQUIRED, Package Type, Max. Resistors per Package, Your Resistor Count, Your Package Choice, Quantity Required. Includes a list of package types like Single-In-Line, Hermetic DIP, and Lead Flatpack.

Notes

- (1) 72 h express service available, consult factory.
(2) Resistance range may be expanded by adding resistors in series, however the number of resistors per package will decrease.

Schematic and Specifications section. Includes fields for SCHEMATIC, REFERENCE RESISTOR IS, TO, and SPECIFICATIONS (Quick-Net's Best, Best Ratio Tolerance, Best Absolute Tolerance, Best TCR Tracking, Maximum Wattage).



### E6, E12, E24, and E96

E6
1.0
1.5
2.2
3.3
4.7
6.8

E12
1.0
1.2
1.5
1.8
2.2
2.7
3.3
3.9
4.7
5.6
6.8
8.2

E24	
1.0	1.1
1.2	1.3
1.5	1.6
1.8	2.0
2.2	2.4
2.7	3.0
3.3	3.6
3.9	4.3
4.7	5.0
5.1	5.6
6.2	6.8
7.5	8.2
9.1	

E96								
1.00	1.02	1.05	1.07	1.10	1.13	1.15	1.18	1.21
1.24	1.27	1.30	1.33	1.37	1.40	1.43	1.47	1.50
1.54	1.58	1.62	1.65	1.69	1.74	1.78	1.82	1.87
1.91	1.96	2.00	2.05	2.10	2.15	2.21	2.26	2.32
2.37	2.43	2.49	2.55	2.61	2.67	2.74	2.80	2.87
2.94	3.01	3.09	3.16	3.24	3.32	3.40	3.48	3.57
3.65	3.74	3.83	3.92	4.02	4.12	4.22	4.32	4.42
4.53	4.64	4.75	4.87	4.99	5.11	5.23	5.36	5.49
5.62	5.76	5.90	6.04	6.19	6.34	6.49	6.65	6.81
6.98	7.15	7.32	7.50	7.68	7.87	8.06	8.25	8.45
8.66	8.87	9.09	9.31	9.53	9.76			



## Application Guide Form

Vishay Thin Film Reference # \_\_\_\_\_

Name \_\_\_\_\_ Title \_\_\_\_\_

Company \_\_\_\_\_ Division \_\_\_\_\_ Dept \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Phone \_\_\_\_\_ Fax \_\_\_\_\_

Expected Usage Per Year \_\_\_\_\_ Timing: Prototypes \_\_\_\_\_ Production \_\_\_\_\_

Application \_\_\_\_\_ Hermetic Sealed  Yes  No

Drawing # (attach if possible) \_\_\_\_\_ Package Choises (DWG #) 1st \_\_\_\_\_ 2nd \_\_\_\_\_

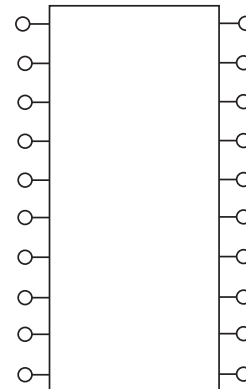
Special Testing \_\_\_\_\_ Operating Temperature Range \_\_\_\_\_

Vishay Thin Film's unique thin film technology can be used to give the circuit designer a range of technical alternatives in the development and performance of precision resistor networks.

If you require a quotation on a specific custom resistor network, please use the guide below, listing your requirements of concern. Our engineering expertise, combined with our state of the art resources and proven record of performance are available to assist you. We may be contacted at:

**Vishay Thin Film**  
 2160 Liberty Drive  
 Niagara Falls, NY 14304  
 Phone(716) 283-4025  
 Fax(716) 283-5932

### SCHEMATIC



RESISTOR NUMBER	RESISTOR VALUE (Ω)	ABSOLUTE ACCURACY ± %	ABSOLUTE TCR ± ppm/°C	RATIO			MAX. VOLTAGE		POWER MAX. W
				ACCURACY ± %	TCR ± ppm/°C	REFERENCE RESISTOR	PEAK V	RMS V	



# RESISTORS

## Vishay Dale Thin Film



### VISHAY PRODUCTS

#### SEMICONDUCTORS:

Rectifiers • High-Power Diodes and Thyristors • Small-Signal Diodes • Zener and Suppressor Diodes • FETs • Optoelectronics ICs • Modules

#### PASSIVE COMPONENTS:

Resistive Products • Magnetics • Capacitors

### WORLD HEADQUARTERS

Vishay Intertechnology, Inc. | 63 Lancaster Avenue Malvern, PA 19355-2143 | USA

Visit [www.vishay.com](http://www.vishay.com) for product information or select below for a current list of sales offices, representatives, and distributors.

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