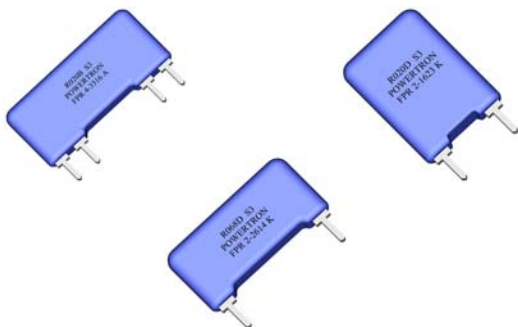


FPR 2-1617 1623 2614

FPR 4-3316

Precision Shunt Resistors



- Resistances from 0.001Ohm to 100Ohms
- Power Rating to 2Watt
- Resistance Tolerances to $\pm 0.1\%$
- TCR to $\pm 15\text{ppm/K}$
- Load Stability to 0.1%

SPECIFICATIONS

Type	FPR 2-1617	FPR 2-1623	FPR 2-2614	FPR 4-3316
Resistance Range	0.01 to 50 Ohms	0.01 to 100 Ohms		0.001 to 100 Ohms
Power rating (70°C)	1 W	2 W		
Tolerances from 0.001 Ohms from 0.005 Ohms from 0.01 Ohms from 0.02 Ohms from 1.0 Ohms	0.5% / 1% / 2% / 5% 0.25% / 0.5% / 1% / 2% / 5% 0.1% / 0.25% / 0.5% / 1% / 2% / 5%			1% / 2% 0.5% / 1% / 2% 0.25% / 0.5% / 1% 0.1% / 0.25% / 0.5%
Stability	0.1% / 0.2% / 0.5% (depends on stress)			
Temperature Coefficient	R > 0.2 Ohms $\pm 15\text{ppm/K}$ (20 to 60°C) R \leq 0.2 Ohms TCR see table A next page			$\pm 15\text{ppm/K}$ (20 to 60°C)
Insulation Resistance	> 10 GOhm			
Thermal EMF	< 0.1 $\mu\text{V/K}$			
Operating Temperature Range	-40 to 130°C			
Resistor Material	CuNiMn-Foil			
Substrate	anodized aluminium			
Housing	Epoxy sintered			
Connector Material	Cu tinned			
Terminals	2			4

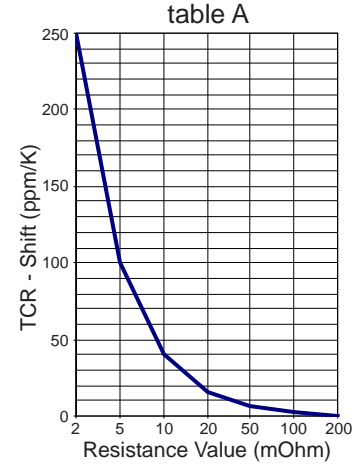
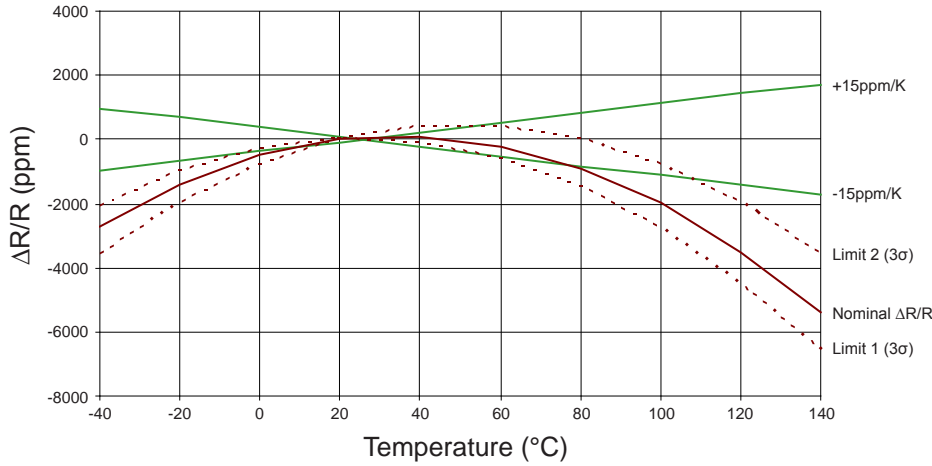
Ordering Information

Part Number - Resistance - Contact - Tolerance

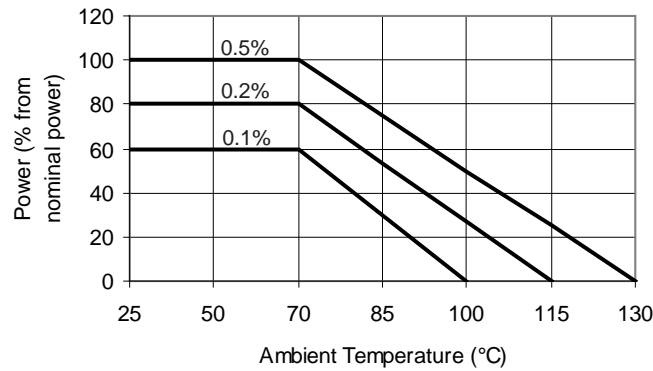
FPR 4-3316 0.01 Ohms A 1.0%

SPECIFICATIONS (continued)

Temperature Coefficient

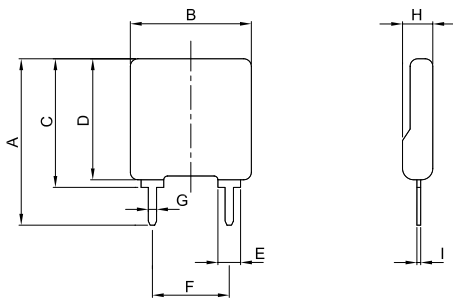


Derating



Dimensions

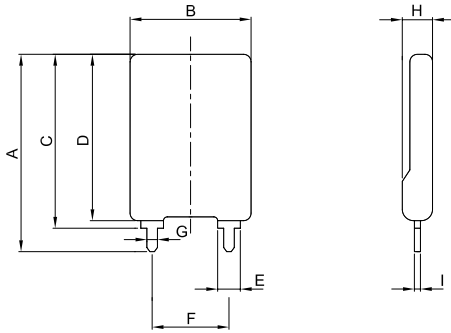
FPR 2-1617



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	22.00	0.2	0.87	0.008
B	16.00	0.2	0.63	0.008
C	17.00	0.2	0.67	0.008
D	16.00	0.2	0.63	0.008
E	3.00	0.1	0.12	0.004
F	10.16	0.2	0.40	0.008
G(A-Contact)	1.50	0.1	0.06	0.004
G(K-Contact)	1.10	0.1	0.04	0.004
H	4.30	0.2	0.17	0.008
I (A-Contact)	0.80	0.1	0.03	0.004
I (K-Contact)	0.50	0.1	0.02	0.004

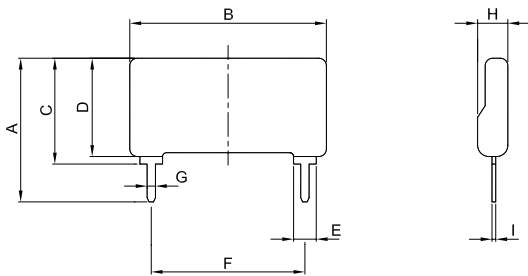
SPECIFICATIONS (continued)

FPR 2-1623



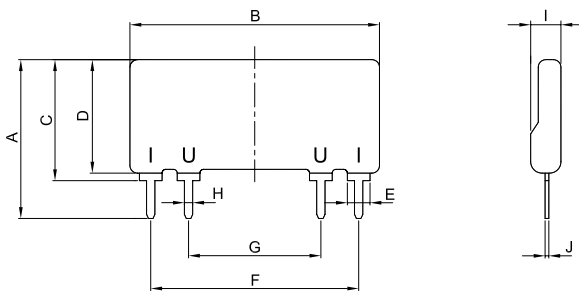
Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	26.10	0.2	1.03	0.008
B	16.00	0.2	0.63	0.008
C	23.00	0.2	0.91	0.008
D	22.00	0.2	0.87	0.008
E	3.00	0.1	0.12	0.004
F	10.16	0.2	0.40	0.008
G(B-Contact)	1.40	0.1	0.06	0.004
H	4.30	0.2	0.17	0.008
I (B-Contact)	0.80	0.1	0.03	0.004

FPR 2-2614



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	19.00	0.2	0.75	0.008
B	26.00	0.2	1.02	0.008
C	14.00	0.2	0.55	0.008
D	13.00	0.2	0.51	0.008
E	3.00	0.1	0.12	0.004
F	20.32	0.2	0.80	0.008
G(A-Contact)	1.50	0.1	0.06	0.004
G(K-Contact)	1.10	0.1	0.04	0.004
H	4.30	0.2	0.17	0.008
I (A-Contact)	0.80	0.1	0.03	0.004
I (K-Contact)	0.50	0.1	0.02	0.004

FPR 4-3316



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	21.00	0.2	0.83	0.008
B	33.00	0.2	1.30	0.008
C	16.00	0.2	0.63	0.008
D	15.00	0.2	0.59	0.008
E	3.00	0.1	0.12	0.004
F	27.50	0.2	1.08	0.008
G	17.50	0.2	0.69	0.008
H(A-Contact)	1.50	0.1	0.06	0.004
H(K-Contact)	1.10	0.1	0.04	0.004
I	4.30	0.2	0.17	0.008
J(A-Contact)	0.80	0.1	0.03	0.004
J(K-Contact)	0.50	0.1	0.02	0.004



- Resistances from 0.001 Ohm to 500 Ohms
- Power Rating to 2500 Watt
- Resistance Tolerances to $\pm 0.1\%$
- TCR to $\pm 15\text{ppm/K}$
- Load Stability to 0.1%
- Very Low Inductance ($< 50\text{nH}$)

SPECIFICATIONS

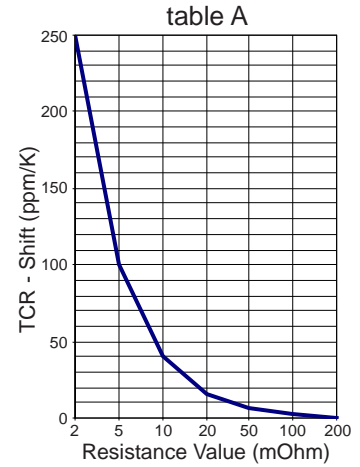
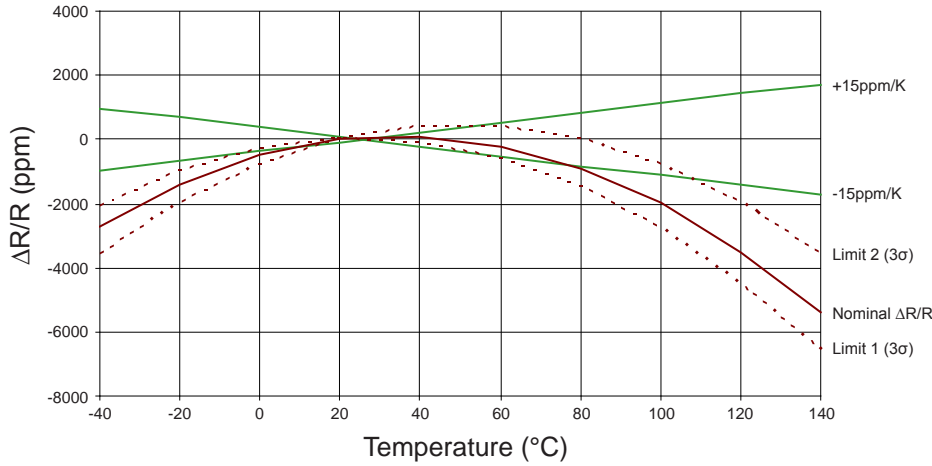
Type	8065	80110	80216	80320	80370
Resistance Range	0.001 to 400 Ohms	0.001 to 500 Ohms			
Power rating free air 25°C with heatsink	24 W 350 W	32 W 600 W	60 W 1200 W	80 W 2000 W	90 W 2500 W
Thermal Resistance Rthj-c	0.16 K/W	0.09 K/W	0.04 K/W	0.026 K/W	0.022 K/W
Tolerances (4 terminal version) from 0.001 Ohms from 0.01 Ohms from 0.02 Ohms	0.5% / 1% / 2% / 5% 0.25% / 0.5% / 1% / 2% / 5% 0.1% / 0.25% / 0.5% / 1% / 2% / 5%				
Tolerances (2 terminal version)	0.5% / 1% / 2% / 5%				
Stability	0.1% / 0.2% / 0.5% (depends on stress)				
Temperature Coefficient (4 terminal version)	$\pm 15\text{ppm/K}$ (20 to 60°C) from $R \leq 0.02$ Ohms $\pm 20\text{ppm/K}$ (20 to 60°C) from $R \leq 0.01$ Ohms $\pm 30\text{ppm/K}$ (20 to 60°C)				
Temperature Coefficient (2 terminal version)	$\pm 15\text{ppm/K}$ (20 to 60°C) $\pm 50\text{ppm/K}$ (-40 to 130°C) $R \leq 0.2$ Ohms TCR see table A next page				
Max. Current	60 A upon request special cable up to 250 A				
Inductivity	< 50 nH				
Capacity against housing	500 pF	850 pF	1.7 nF	2.5 nF	2.9 nF
Insulation Strength	1.5 kVDV (higher upon request)				
Thermal EMF	$< 0.1\mu\text{V/K}$				
Operating Temperature Range	-40 to 130°C				
Resistor Material	CuNiMn-Foil				
Substrate	anodized aluminium				
Housing	anodized aluminium				
Connector Material	Cu-Cable / 4mm ² / 500mm length (other upon request / AWG possible)				
Terminals	2 or 4				

Ordering Information

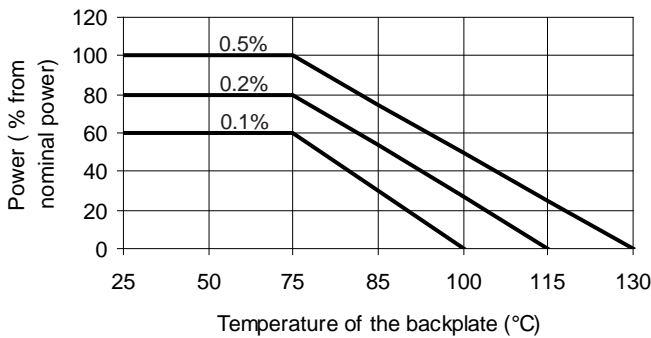
Part Number - Resistance - Contact - Tolerance
FHR 4-80216 1.0 Ohms D 1%

SPECIFICATIONS (continued)

Temperature Coefficient



Derating



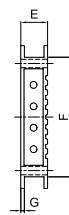
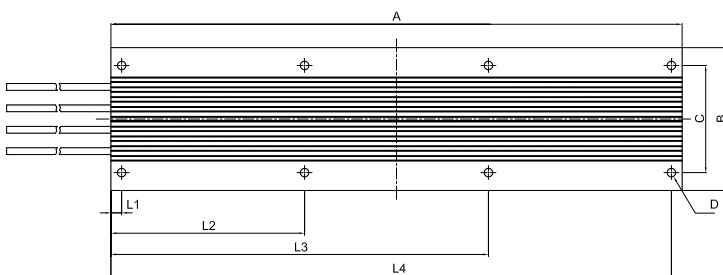
Power Rating Notes -

The FHR Series Resistors must be attached to a suitable heat-sink. The maximum internal resistor temperature is 130°C. To specify an appropriate heatsink use the following formula :

$$R_{0H} = \frac{T_{MAX} - (P \times R_{0R}) - T_A}{P}$$

Where: R_{0H} = Thermal Resistance of Heatsink (K/W)
 R_{0R} = Thermal Resistance of Resistor (K/W)
 T_{MAX} = Maximum Temperature of Resistor
 T_A = Ambient Temperature of Heatsink (°C)
 P = Power Through Resistor (W)

Dimensions



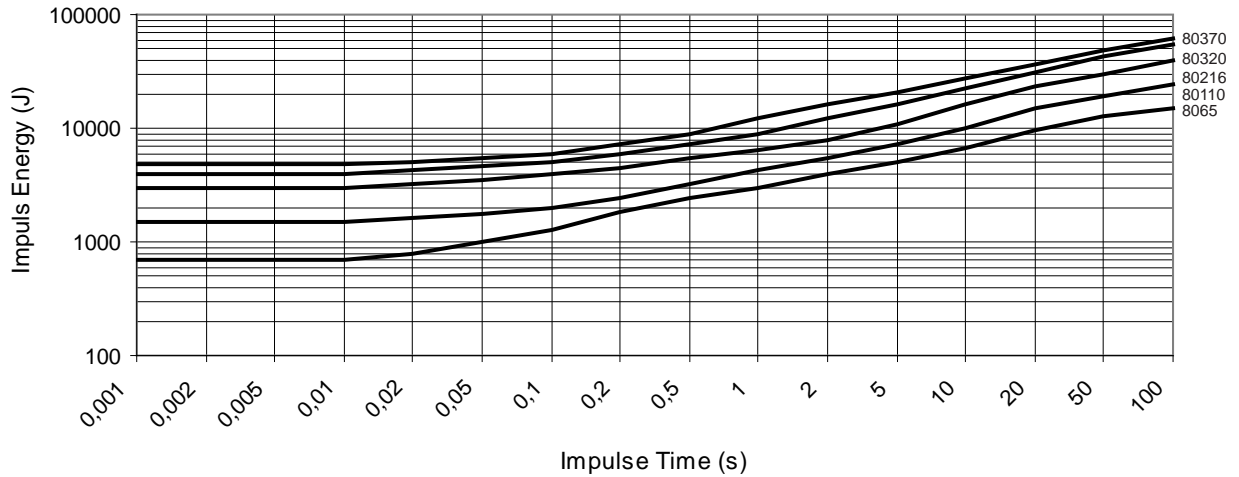
Dimension	mm	tol. (±mm)	inches	tol. (±inches)
B	80.00	0.3	3.15	0.012
C	60.00	0.3	2.36	0.012
D	∅4.75	0.2	∅0.19	0.008
E	15.00	0.2	0.59	0.008
F	67.00	0.3	2.64	0.012
G	2.00	0.1	0.08	0.004

Dimension	8065 mm	80110 mm	80216 mm	80320 mm	80370 mm	tol. (±mm)	8065 inches	80110 inches	80216 inches	80320 inches	80370 inches	tol. (±inches)
A	65.00	110.00	216.00	320.00	370.00	0.3	2.56	4.33	8.50	12.60	14.57	0.012
L1	6.00	6.00	6.00	6.00	6.00	0.3	0.24	0.24	0.24	0.24	0.24	0.012
L2	59.00	104.00	108.00	108.50	125.50	0.3	2.32	4.09	4.25	4.27	4.94	0.012
L3			210.00	211.50	244.50	0.3			8.27	8.33	9.63	0.012
L4				314.00	364.00	0.3				12.36	14.33	0.012

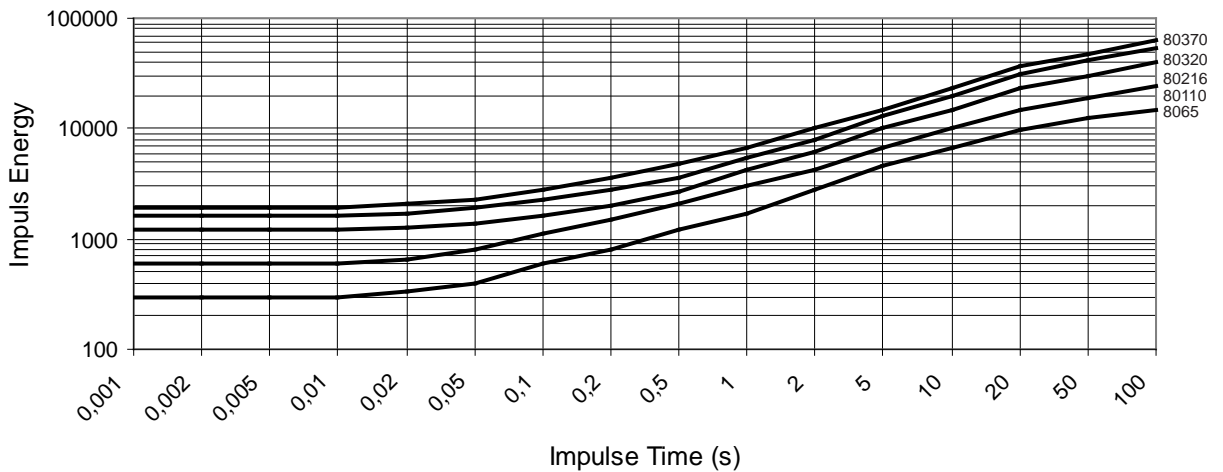
SPECIFICATIONS (continued)

Stability against Impulses
Reference values without heatsink

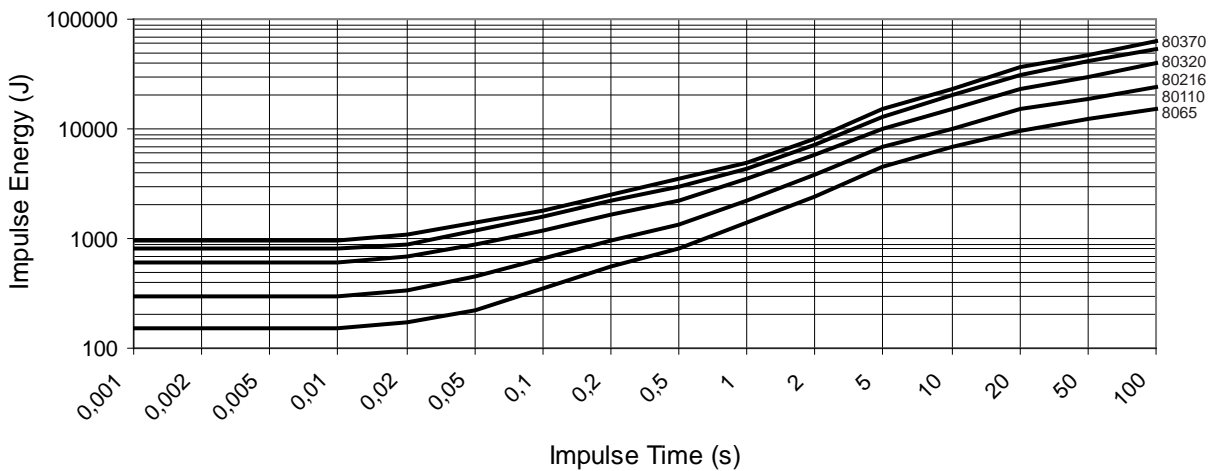
Resistance value R001 to R002



Resistance value R002 to R005



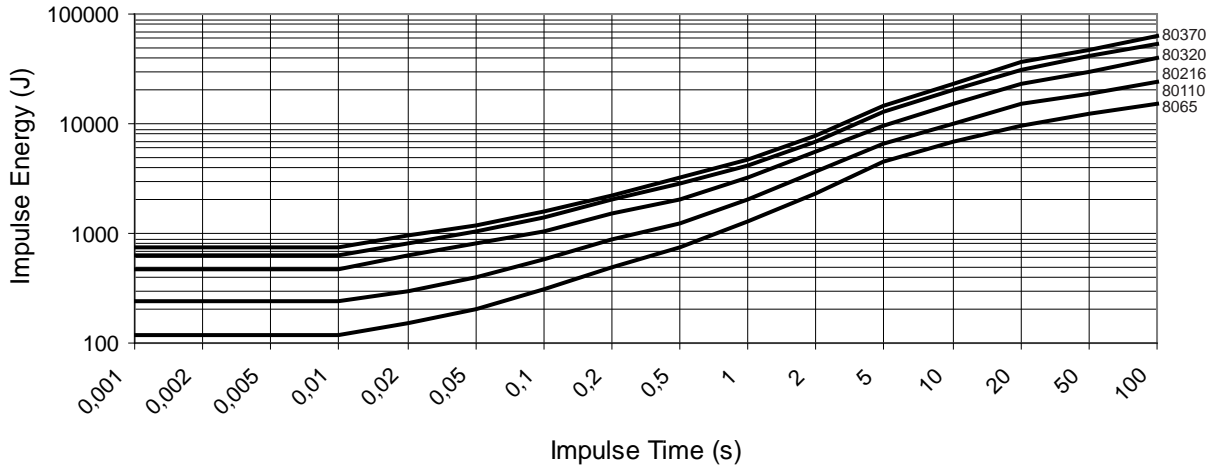
Resistance value R005 to R01



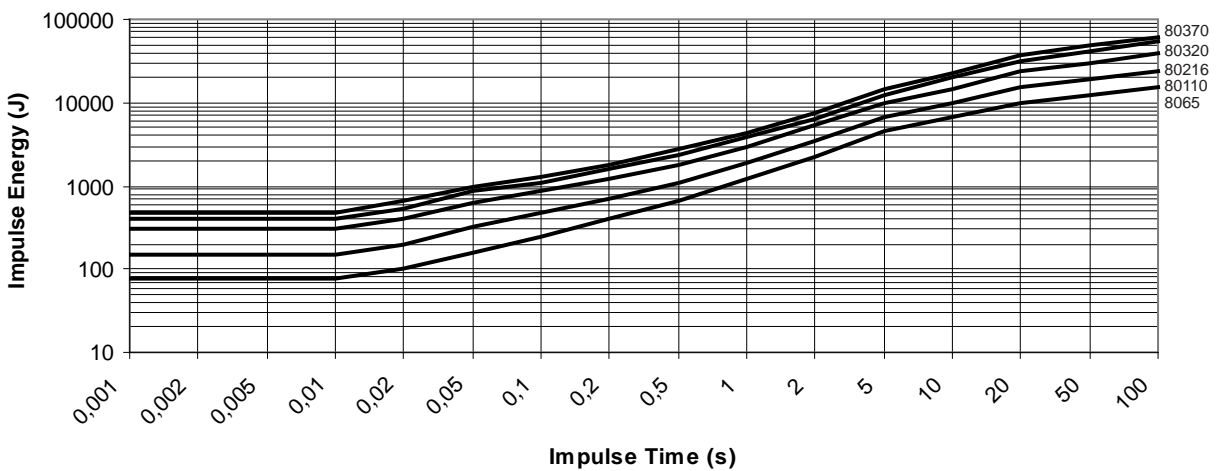
SPECIFICATIONS (continued)

Stability against Impulses
Reference values without heatsink

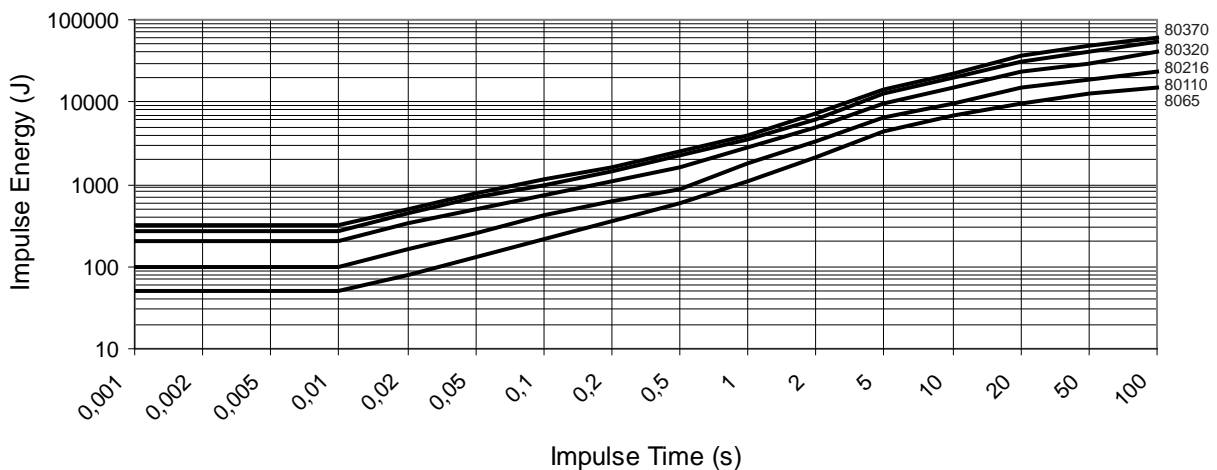
Resistance value R01 to R1



Resistance value R1 to 1R



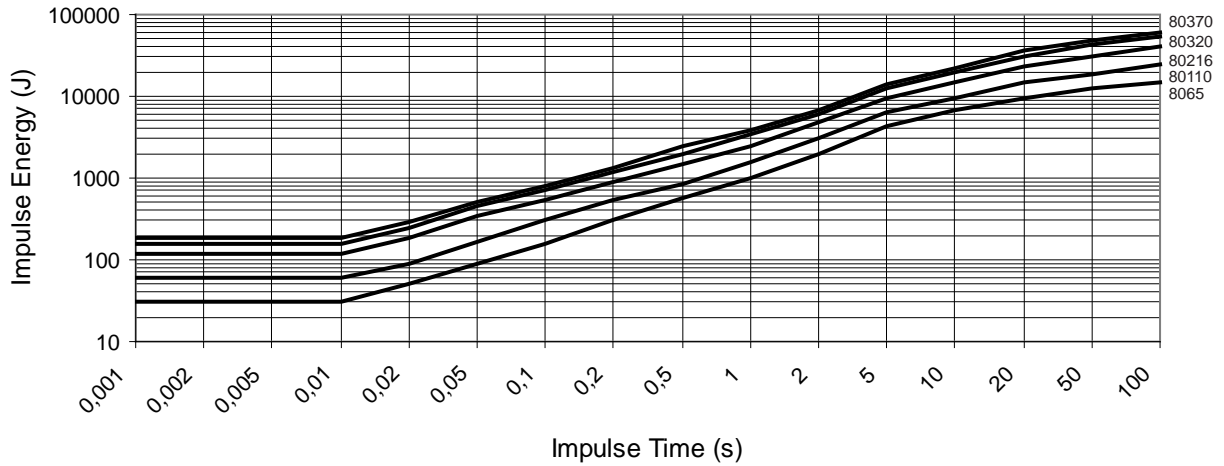
Resistance value 1R to 10R



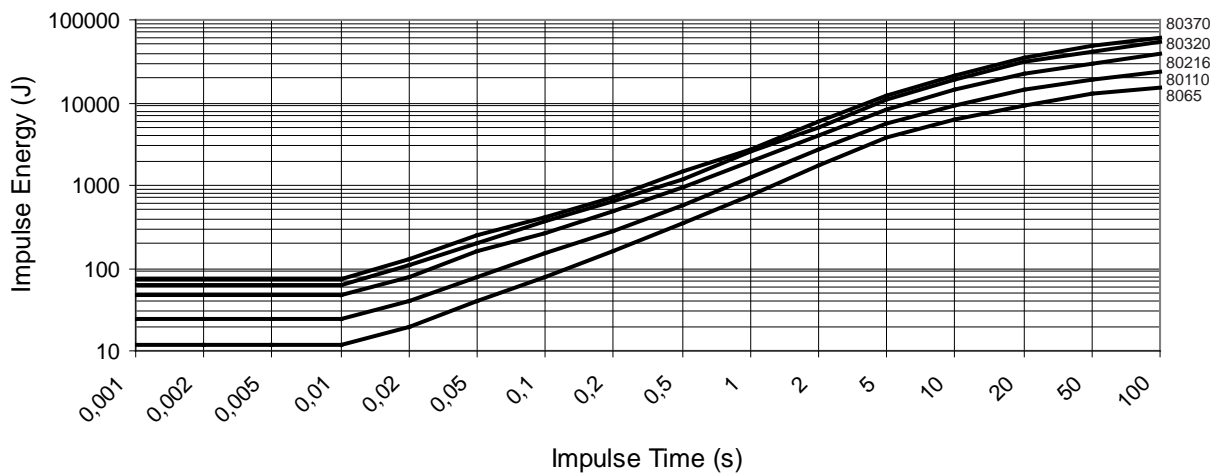
SPECIFICATIONS (continued)

Stability against Impulses
Reference values without heatsink

Resistance value 10R to 100R



Resistance value 100R to 500R



Lead Variations

Standard:	Lead D	from to 60 A	isolated round cable (Cu / tinned)
optional:	Lead H1	from to 70 A	isolated Cu - flat cable
	Lead H2	from to 85 A	isolated Cu - flat cable
	Lead H3	from to 100 A	isolated Cu - flat cable
	Lead H4	from to 120 A	isolated Cu - flat cable
	Lead H5	from to 150 A	isolated Cu - flat cable
	Lead H6	from to 250 A	isolated Cu - flat cable

FPR 2-T218

Precision Shunt Resistors

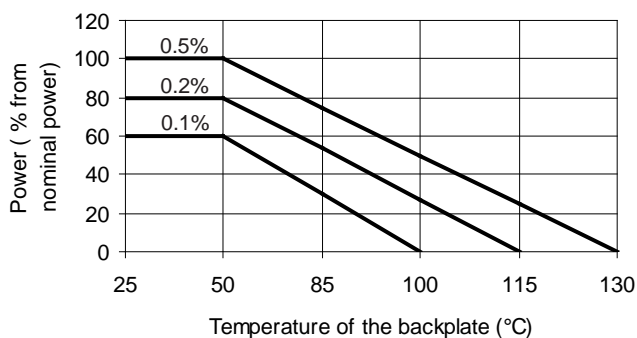


- Resistances from 0.002Ohm to 50Ohms
- Power Rating to 30Watt
- Resistance Tolerances to $\pm 0.25\%$
- TCR to $\pm 15\text{ppm/K}$
- Load Stability to 0.1%
- TO-218 (TO-247) Housing

SPECIFICATIONS

Type	FPR 2-T218
Resistance Range	0.002 to 50 Ohms
Power rating free air 70°C with heatsink	2 W 30 W
Thermal Resistance Rthj-c	2.5 K/W
Tolerances from 0.002 Ohms from 0.01 Ohms from 0.02 Ohms	1% / 2% / 5% 0.5% / 1% / 2% / 5% 0.25% / 0.5% / 1% / 2% / 5%
Stability	0.1% / 0.2% / 0.5% (depends on stress)
Temperature Coefficient	R > 0.2 Ohms $\pm 15\text{ppm/K}$ (20 to 60°C) R \leq 0.2 Ohms TCR see table A next page
Voltage Proof	300 VDC
Thermal EMF	< 0.1 $\mu\text{V/K}$
Operating Temperature Range	-40 to 130°C
Resistor Material	CuNiMn-Foil
Substrate	anodized aluminium
Housing	PPS
Connector Material	Cu tinned
Terminals	2
Max. Torque	1 Nm

Derating



Power Rating Notes -

The FPR Series Resistors must be attached to a suitable heat-sink. The maximum internal resistor temperature is 130°C.

To specify an appropriate heatsink use the following formula :

$$R_{0H} = \frac{T_{MAX} - (P \times R_{0R}) - T_A}{P}$$

Where: R_{0H} = Thermal Resistance of Heatsink (K/W)
 R_{0R} = Thermal Resistance of Resistor (K/W)
 T_{MAX} = Maximum Temperature of Resistor
 T_A = Ambient Temperature of Heatsink (°C)
 P = Power Through Resistor (W)

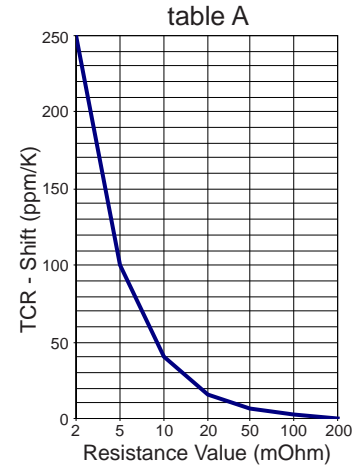
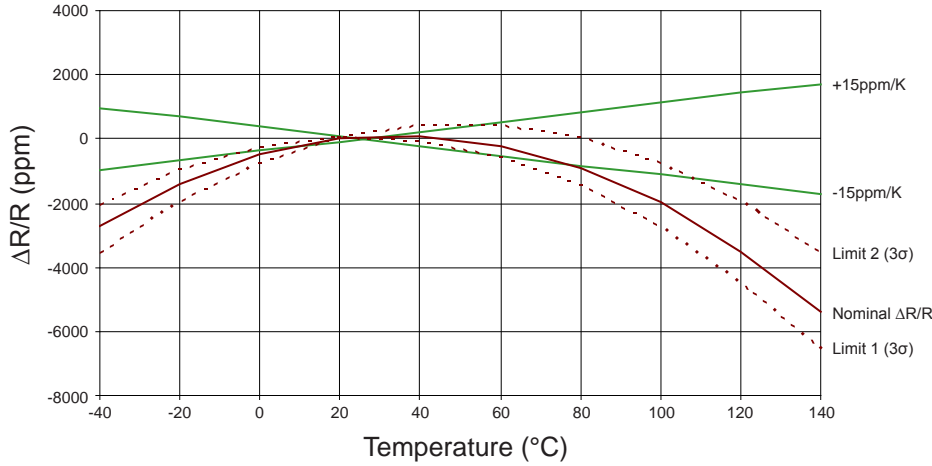
Ordering Information

Part Number - Resistance - Contact - Tolerance

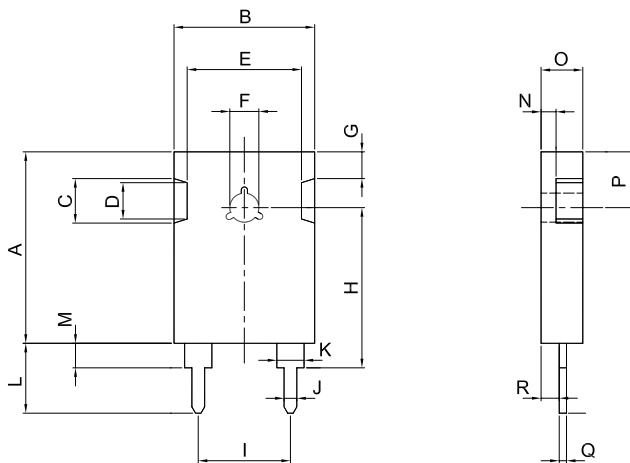
FPR 2-T218 0.068 Ohms A 0.5%

SPECIFICATIONS (continued)

Temperature Coefficient



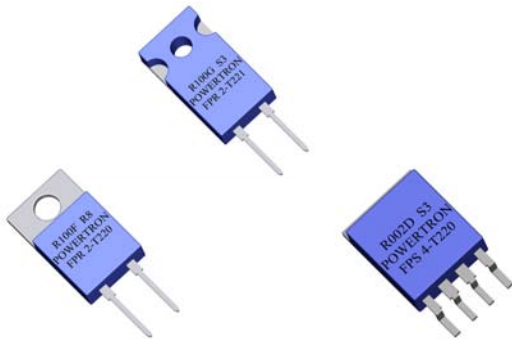
Dimensions



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	21.10	0.2	0.83	0.008
B	15.50	0.2	0.61	0.008
C	4.90	0.1	0.19	0.004
D	4.00	0.1	0.16	0.004
E	12.60	0.2	0.50	0.008
F	∅3.2	0.1	∅0.13	0.004
G	2.95	0.1	0.12	0.004
H (A-Contact)	17.65	0.2	0.69	0.008
H (B-Contact)	16.85	0.2	0.66	0.008
H (C-Contact)	17.75	0.2	0.70	0.008
I	10.16	0.2	0.40	0.008
J	1.40	0.1	0.06	0.004
K	3.00	0.1	0.12	0.004
L (A-Contact)	7.70	0.2	0.30	0.008
L (B-Contact)	5.00	0.2	0.20	0.008
L (C-Contact)	14.50	0.2	0.57	0.008
M (A-Contact)	2.70	0.1	0.11	0.004
M (B-Contact)	1.90	0.1	0.07	0.004
M (C-Contact)	2.80	0.1	0.11	0.004
N	1.65	0.1	0.06	0.004
O	4.60	0.1	0.18	0.004
P	6.15	0.2	0.24	0.008
Q	0.80	0.1	0.03	0.004
R	2.00	0.1	0.08	0.004

FPR FPS 2/4-T220 T221

Precision Power Shunt Resistors



- Resistances from 0.002Ohm to 50Ohms
- Power Rating to 15Watt
- Resistance Tolerances to $\pm 0.1\%$
- TCR to $\pm 15\text{ppm/K}$
- Load Stability to 0.1%
- TO-220 Housing
- Convenient SMD D2Pak Available

SPECIFICATIONS

Type	FPR 2-T220 T221	FPS 2-T220	FPR 4-T220 T221	FPS 4-T220
Resistance Range	0.002 to 50 Ohms			
Power rating free air 70°C with heatsink	1.5 W 15 W			
Thermal Resistance Rthj-c	4.8 K/W			
Tolerances from 0.002 Ohms from 0.01 Ohms from 0.1 Ohms	2% / 5% 1% / 2% / 5% 0.5% / 1% / 2% / 5%		1% / 2% / 5% 0.1% / 0.25% / 0.5% / 1% / 2% / 5% 0.1% / 0.25% / 0.5% / 1% / 2% / 5%	
Stability	0.1% / 0.2% / 0.5% (depends on stress)			
Temperature Coefficient	$\pm 15\text{ppm/K}$ (20 to 60°C) $\pm 50\text{ppm/K}$ (-40 to 130°C) $R \leq 0.2$ Ohms TCR see table A next page		$\pm 15\text{ppm/K}$ (20 to 60°C) $\pm 50\text{ppm/K}$ (-40 to 130°C)	
Max. Current	50 A			
Voltage Proof	300 VDC			
Thermal EMF	< 0.1 $\mu\text{V/K}$			
Operating Temperature Range	-40 to 130°C			
Resistor Material	CuNiMn-Foil			
Substrate	Al_2O_3 or anodized aluminium			
Housing	Epoxy or PPS			
Connector Material	Cu tinned			
Terminals	2		4	
Max. torque	1 Nm / T221: 0.8 Nm		1 Nm / T221: 0.8 Nm	

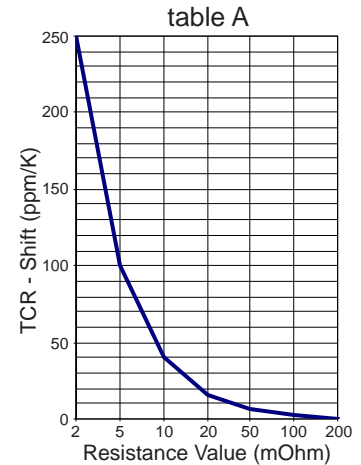
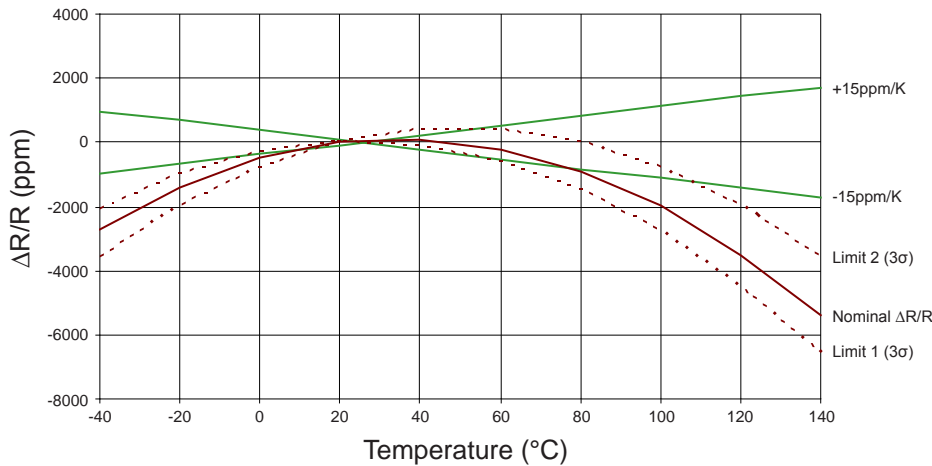
Ordering Information

Part Number - Resistance - Contact - Tolerance

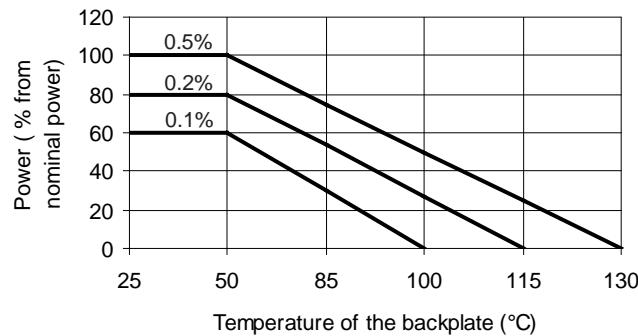
FPS 4-T220 0.01 Ohms C 0.1%

SPECIFICATIONS (continued)

Temperature Coefficient



Derating



Power Rating Notes -

The FPR Series Resistors must be attached to a suitable heat-sink. The maximum internal resistor temperature is 130°C. To specify an appropriate heatsink use the following formula :

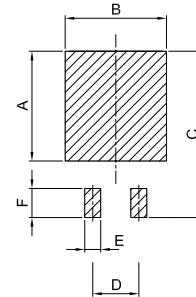
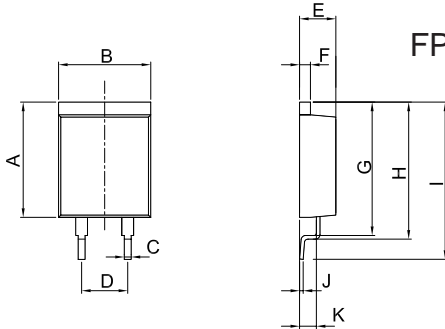
$$R_{0H} = \frac{T_{MAX} - (P \times R_{0R}) - T_A}{P}$$

Where: R_{0H} = Thermal Resistance of Heatsink (K/W)
 R_{0R} = Thermal Resistance of Resistor (K/W)
 T_{MAX} = Maximum Temperature of Resistor
 T_A = Ambient Temperature of Heatsink (°C)
 P = Power Through Resistor (W)

SPECIFICATIONS (continued)

Dimensions

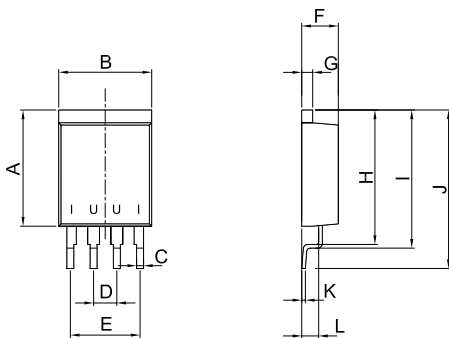
FPS 2-T220



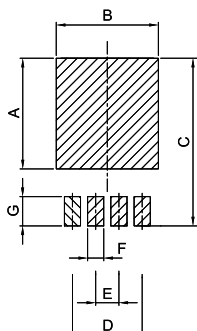
Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	12.70	0.2	0.50	0.008
B	10.16	0.2	0.40	0.008
C	0.76	0.1	0.03	0.004
D	5.08	0.1	0.20	0.004
E	4.00	0.1	0.16	0.004
F	1.20	0.1	0.05	0.004
G	14.60	0.2	0.57	0.008
H	15.00	0.2	0.59	0.008
I	17.33	0.2	0.68	0.008
J	0.40	0.1	0.02	0.004
K	1.85	0.1	0.07	0.004

Dimension	mm	inches
A	12.10	0.476
B	11.16	0.439
C	18.33	0.722
D	5.08	0.200
E	1.76	0.069
F	3.20	0.126

FPS 4-T220



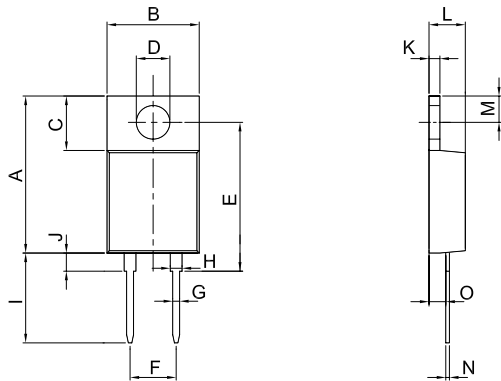
Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	12.70	0.2	0.50	0.008
B	10.16	0.2	0.40	0.008
C	0.76	0.1	0.03	0.004
D	2.54	0.1	0.10	0.004
E	7.62	0.1	0.30	0.004
F	4.00	0.1	0.16	0.004
G	1.20	0.1	0.05	0.004
H	14.60	0.2	0.57	0.008
I	15.00	0.2	0.59	0.008
J	17.33	0.2	0.68	0.008
K	0.40	0.1	0.02	0.004
L	1.85	0.1	0.07	0.004



Dimension	mm	inches
A	12.10	0.476
B	11.16	0.439
C	18.33	0.722
D	7.62	0.300
E	2.54	0.100
F	1.76	0.069
G	3.20	0.126

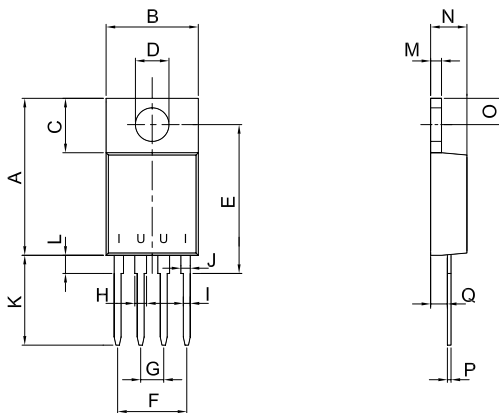
SPECIFICATIONS (continued)

FPR 2-T220



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	17.30	0.2	0.68	0.008
B	10.16	0.2	0.40	0.008
C	6.00	0.1	0.24	0.004
D	Ø3.7	0.1	Ø0.146	0.004
E	16.40	0.2	0.65	0.008
F	5.08	0.1	0.20	0.004
G	0.76	0.1	0.03	0.004
H	1.30	0.1	0.05	0.004
I	10.00	0.2	0.39	0.008
I (C-Contact)	13.80	0.2	0.54	0.008
J	2.00	0.1	0.08	0.004
K	1.20	0.1	0.05	0.004
L	4.00	0.1	0.16	0.004
M	2.90	0.1	0.11	0.004
N	0.40	0.1	0.02	0.004
O	1.85	0.1	0.07	0.004

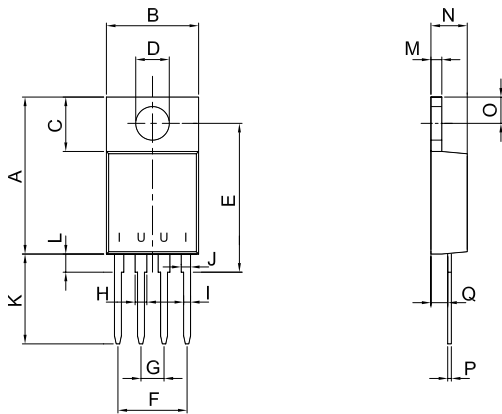
FPR 4-T220



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	17.30	0.2	0.68	0.008
B	10.16	0.2	0.40	0.008
C	6.00	0.1	0.24	0.004
D	Ø3.7	0.1	Ø0.146	0.004
E	16.40	0.2	0.65	0.008
F	7.62	0.2	0.30	0.008
G	2.54	0.1	0.10	0.004
H	1.30	0.1	0.05	0.004
I	0.76	0.1	0.03	0.004
J	1.03	0.1	0.04	0.004
K	10.00	0.2	0.39	0.008
K (C-Contact)	13.80	0.2	0.54	0.008
L	2.00	0.1	0.08	0.004
M	1.20	0.1	0.05	0.004
N	4.00	0.1	0.16	0.004
O	2.90	0.1	0.11	0.004
P	0.40	0.1	0.02	0.004
Q	1.85	0.1	0.07	0.004

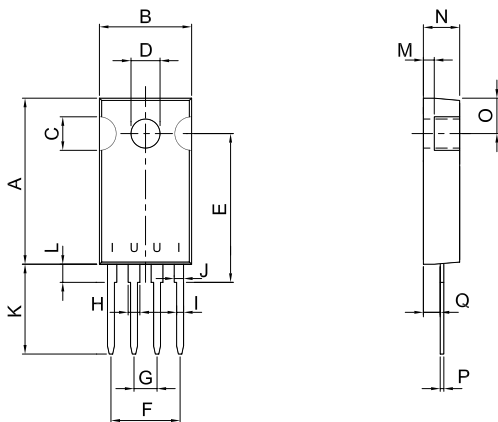
SPECIFICATIONS (continued)

FPR 2-T221



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	18.30	0.2	0.72	0.008
B	10.16	0.2	0.40	0.008
C	3.70	0.1	0.15	0.004
D	∅3.2	0.1	∅0.126	0.004
E	16.40	0.2	0.65	0.008
F	5.08	0.1	0.20	0.004
G	0.76	0.1	0.03	0.004
H	1.30	0.1	0.05	0.004
I	10.00	0.2	0.39	0.008
I (C-Contact)	13.80	0.2	0.54	0.008
J	2.00	0.1	0.08	0.004
K	1.20	0.1	0.05	0.004
L	4.00	0.1	0.16	0.004
M	3.90	0.1	0.15	0.004
N	0.40	0.1	0.02	0.004
O	1.85	0.1	0.07	0.004

FPR 4-T221



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	18.30	0.2	0.72	0.008
B	10.16	0.2	0.40	0.008
C	3.70	0.1	0.15	0.004
D	∅3.2	0.1	∅0.126	0.004
E	16.40	0.2	0.65	0.008
F	7.62	0.2	0.30	0.008
G	2.54	0.1	0.10	0.004
H	1.30	0.1	0.05	0.004
I	0.76	0.1	0.03	0.004
J	1.03	0.1	0.04	0.004
K	10.00	0.2	0.39	0.008
K (C-Contact)	13.80	0.2	0.54	0.008
L	2.00	0.1	0.08	0.004
M	1.20	0.1	0.05	0.004
N	4.00	0.1	0.16	0.004
O	3.90	0.1	0.15	0.004
P	0.40	0.1	0.02	0.004
Q	1.85	0.1	0.07	0.004

FHR 2-3025 3818

FHR 4-3825 3825H 4618

Precision Shunt Resistors



- Resistances from 0.001Ohm to 100Ohms
- Power Rating to 50Watt
- Resistance Tolerances to $\pm 0.1\%$
- TCR to $\pm 10\text{ppm/K}$
- Very Low Inductance

SPECIFICATIONS

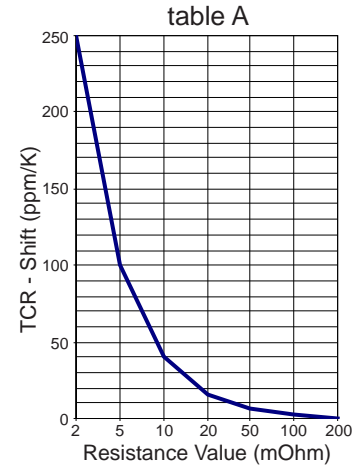
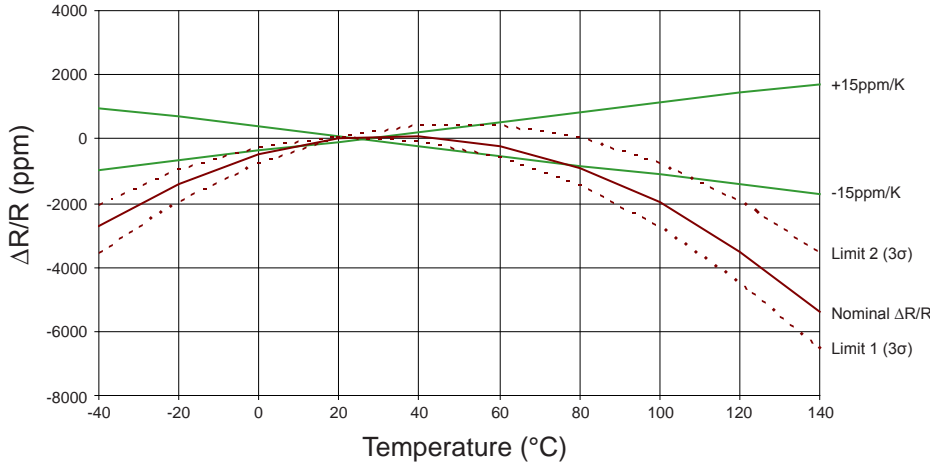
Type	FHR 2-3025 FHR 2-3818	FHR 4-3825 FHR 4-3525H FHR 4-4618
Resistance Range	0.010 to 100Ohms	0.001 to 100Ohms
Power rating free air 70°C for 3825H with heatsink	3 W 40 W	3 W 5 W 50 W
Thermal Resistance Rthj-c	2.0 K/W	1.6 K/W
Tolerances from 0R001 from 0R005 from 0R01 from 0R02	0.5% / 1% / 2% / 5% 0.25% / 0.5% / 1% / 2% / 5%	1% / 2% / 5% 0.5% / 1% / 2% / 5% 0.1% / 0.25% / 0.5% / 1% / 2% / 5% 0.1% / 0.25% / 0.5% / 1% / 2% / 5%
Stability	0.1% / 0.2% / 0.5% (depends on stress)	
Temperature Coefficient Standard	$\pm 15\text{ppm/K}$ (20 to 60°C) $R \leq 0R2$ TCR see table A next page	$\pm 15\text{ppm/K}$ (20 to 60°C) $\pm 25\text{ppm/K}$ (20 to 60°C) for contact F
Option 1		$\pm 10\text{ppm/K}$ (20 to 60°C) (only contact A and K)
Max. Current	150 A / 200 A for contact F	
Voltage Proof	500 VDC	
Thermal EMF	< 0.1 $\mu\text{V/K}$	
Operating Temperature Range	-40 to 130°C	
Resistor Material	CuNiMn-Foil	
Substrate	anodized aluminium	
Housing	Epoxy	
Connector Material	Cu tinned	
Terminals	2	4
Max. torque	1 Nm	

Ordering Information

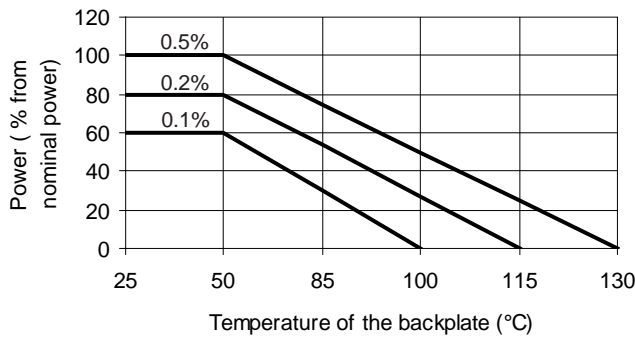
Part Number - Resistance - Contact - Tolerance
FHR 4-4618 0.050 Ohms A 1%

SPECIFICATIONS (continued)

Temperature Coefficient



Derating



Power Rating Notes -

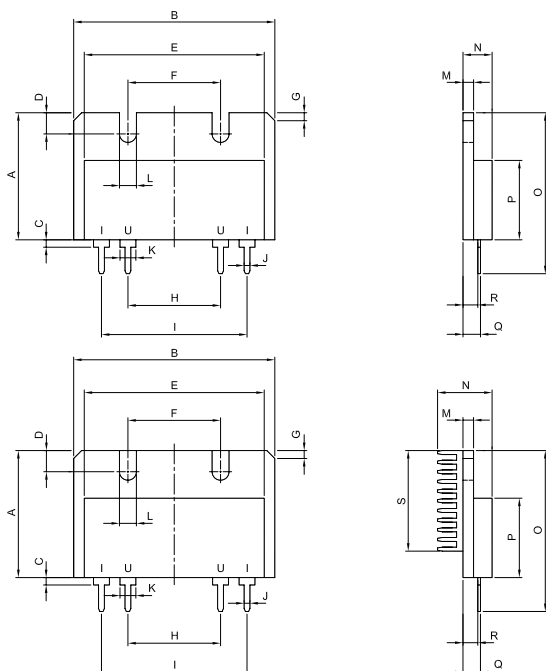
The FHR Series Resistors must be attached to a suitable heat-sink. The maximum internal resistor temperature is 130°C. To specify an appropriate heatsink use the following formula :

$$R_{0H} = \frac{T_{MAX} - (P \times R_{0R}) - T_A}{P}$$

Where: R_{0H} = Thermal Resistance of Heatsink (K/W)
 R_{0R} = Thermal Resistance of Resistor (K/W)
 T_{MAX} = Maximum Temperature of Resistor
 T_A = Ambient Temperature of Heatsink (°C)
 P = Power Through Resistor (W)

Dimensions

FHR 4-3825 / FHR 4-3825H



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	24.00	0.2	0.94	0.008
B	38.00	0.3	1.50	0.012
C	1.40	0.4	0.06	0.016
D	4.00	0.1	0.16	0.004
E	34.00	0.3	1.34	0.012
F	17.50	0.2	0.69	0.008
G	1.5x45°	0.1	0.06x45°	0.004
H	17.50	0.2	0.69	0.008
I	27.50	0.2	1.08	0.008
J (A-Contact)	1.50	0.1	0.06	0.004
J (K-Contact)	1.10	0.1	0.04	0.004
K	3.00	0.1	0.12	0.004
L	3.20	0.1	0.13	0.004
M	2.00	0.1	0.08	0.004
N	max.5.5	0.2	max.0.22	0.008
N (Variante H)	max.10.3	0.2	max.0.4	0.008
O	30.40	0.4	1.20	0.016
P	15.00	0.2	0.59	0.008
Q (A-Contact)	3.60	0.1	0.14	0.004
Q (K-Contact)	3.30	0.1	0.13	0.004
R	2.80	0.1	0.11	0.004
S (Variante H)	19.00	0.2	0.75	0.008

FHR 2-3025 3818

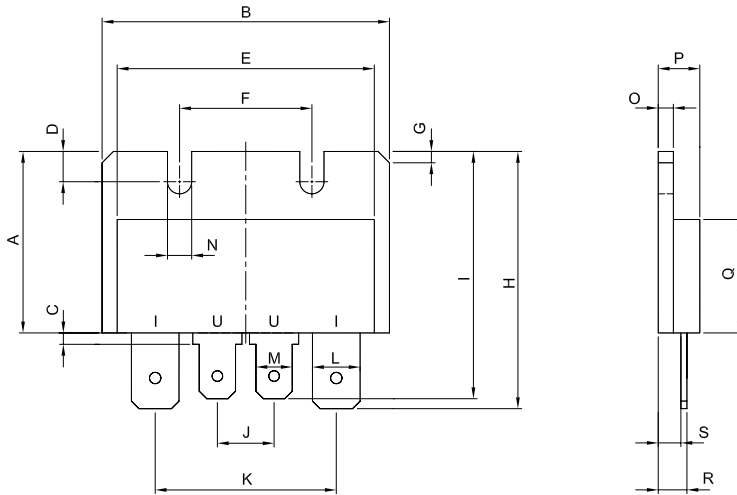
FHR 4-3825 3825H 4618

Precision Shunt Resistors



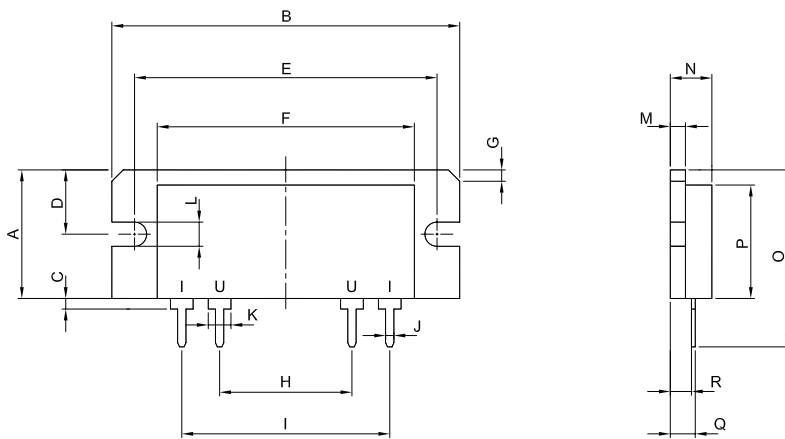
SPECIFICATIONS (continued)

FHR 4-3825F



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	24.00	0.2	0.94	0.008
B	38.00	0.3	1.50	0.012
C	1.50	0.2	0.06	0.008
D	4.00	0.1	0.16	0.004
E	34.00	0.3	1.34	0.012
F	17.50	0.2	0.69	0.008
G	1.5x45°	0.1	0.06x45°	0.004
H	34.00	0.2	1.34	0.008
I	32.70	0.2	1.29	0.008
J	7.50	0.2	0.30	0.008
K	24.00	0.2	0.94	0.008
L	6.30	0.2	0.25	0.008
M	4.80	0.1	0.19	0.004
N	3.20	0.1	0.13	0.004
O	2.00	0.1	0.08	0.004
P	6.00	0.2	0.24	0.008
Q	15.00	0.2	0.59	0.008
R	4.10	0.7	0.16	0.028
S	3.30	0.7	0.13	0.028

FHR 4-4618



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	17.00	0.1	0.67	0.004
B	46.00	0.3	1.81	0.012
C	1.40	0.4	0.06	0.016
D	8.50	0.2	0.33	0.008
E	40.00	0.3	1.57	0.012
F	34.00	0.3	1.34	0.012
G	1.5x45°	0.1	0.06x45°	0.004
H	17.50	0.2	0.69	0.008
I	27.50	0.2	1.08	0.008
J (A-Contact)	1.50	0.1	0.06	0.004
J (K-Contact)	1.10	0.1	0.04	0.004
K	3.00	0.1	0.12	0.004
L	3.20	0.1	0.13	0.004
M	2.00	0.1	0.08	0.004
N	max.5.5	0.2	max.0.22	0.008
O	23.40	0.4	0.92	0.016
P	15.00	0.2	0.59	0.008
Q (A-Contact)	3.60	0.1	0.14	0.004
Q (K-Contact)	3.30	0.1	0.13	0.004
R	2.80	0.2	0.11	0.008

FHR 2-3025 3818

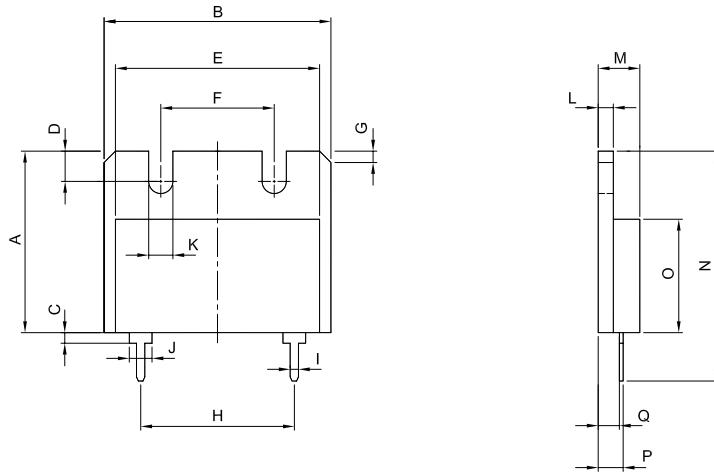
FHR 4-3825 3825H 4618

Precision Shunt Resistors



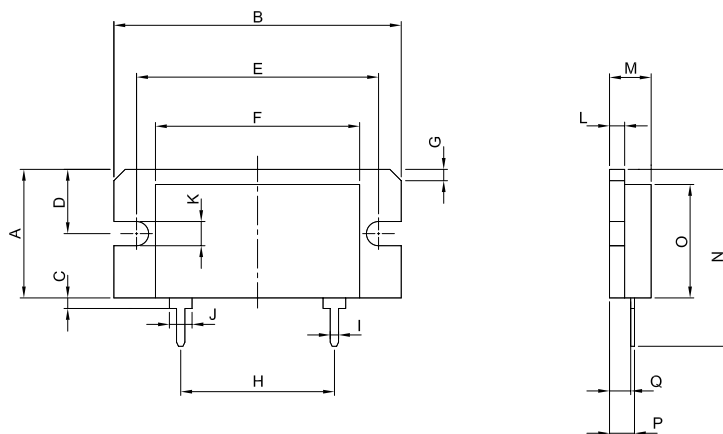
SPECIFICATIONS (continued)

FHR 2-3025



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	24.00	0.2	0.94	0.008
B	30.00	0.2	1.18	0.008
C	1.40	0.4	0.06	0.016
D	4.00	0.1	0.16	0.004
E	27.00	0.2	1.06	0.008
F	15.00	0.2	0.59	0.008
G	1.5x45°	0.1	0.06x45°	0.004
H	20.32	0.2	0.80	0.008
I (A-Contact)	1.50	0.1	0.06	0.004
I (K-Contact)	1.10	0.1	0.04	0.004
J	1.10	0.1	0.04	0.004
K	3.20	0.1	0.13	0.004
L	2.00	0.1	0.08	0.004
M	max.5.5	0.2	max.0.22	0.008
N	30.40	0.4	1.20	0.016
O	15.00	0.2	0.59	0.008
P (A-Contact)	3.60	0.1	0.14	0.004
P (K-Contact)	3.30	0.1	0.13	0.004
Q	2.80	0.2	0.11	0.008

FHR 2-3818



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	17.00	0.2	0.67	0.008
B	38.00	0.3	1.50	0.012
C	1.40	0.4	0.06	0.016
D	8.50	0.2	0.33	0.008
E	32.00	0.3	1.26	0.012
F	27.00	0.2	1.06	0.008
G	1.5x45°	0.1	0.06x45°	0.004
H	20.32	0.2	0.80	0.008
I (A-Contact)	1.50	0.1	0.06	0.004
I (K-Contact)	1.10	0.1	0.04	0.004
J	1.10	0.1	0.04	0.004
K	3.20	0.1	0.13	0.004
L	2.00	0.1	0.08	0.004
M	max.5.5	0.2	max.0.22	0.008
N	23.40	0.4	0.92	0.016
O	15.00	0.2	0.59	0.008
P (A-Contact)	3.60	0.1	0.14	0.004
P (K-Contact)	3.30	0.1	0.13	0.004
Q	2.80	0.2	0.11	0.008

FHR 2-3025 3818
FHR 4-3825 3825H 4618
 Precision Shunt Resistors



- Resistances from 0.001Ohm to 100Ohms
- Power Rating to 50Watt
- Resistance Tolerances to $\pm 0.1\%$
- TCR to $\pm 10\text{ppm/K}$
- Very Low Inductance

SPECIFICATIONS

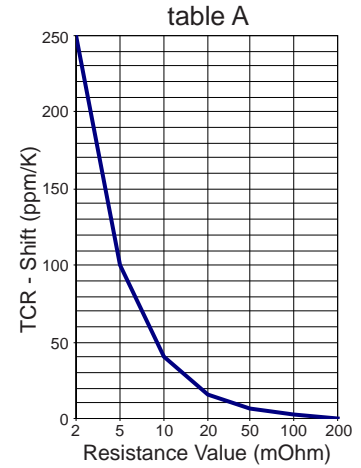
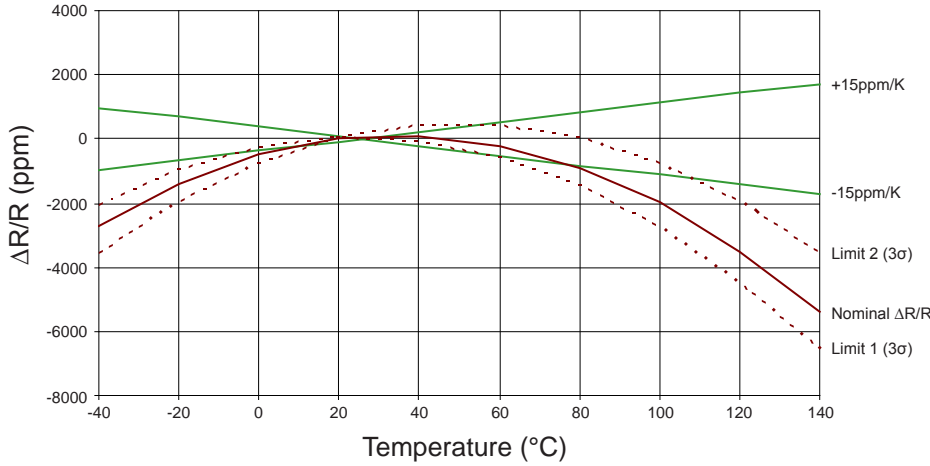
Type	FHR 2-3025 FHR 2-3818	FHR 4-3825 FHR 4-3525H FHR 4-4618
Resistance Range	0.010 to 100Ohms	0.001 to 100Ohms
Power rating free air 70°C for 3825H with heatsink	3 W 40 W	3 W 5 W 50 W
Thermal Resistance Rthj-c	2.0 K/W	1.6 K/W
Tolerances from 0R001 from 0R005 from 0R01 from 0R02	0.5% / 1% / 2% / 5% 0.25% / 0.5% / 1% / 2% / 5%	1% / 2% / 5% 0.5% / 1% / 2% / 5% 0.1% / 0.25% / 0.5% / 1% / 2% / 5% 0.1% / 0.25% / 0.5% / 1% / 2% / 5%
Stability	0.1% / 0.2% / 0.5% (depends on stress)	
Temperature Coefficient Standard Option 1	$\pm 15\text{ppm/K}$ (20 to 60°C) R \leq 0R2 TCR see table A next page	$\pm 15\text{ppm/K}$ (20 to 60°C) $\pm 25\text{ppm/K}$ (20 to 60°C) for contact F $\pm 10\text{ppm/K}$ (20 to 60°C) (only contact A and K)
Max. Current	150 A / 200 A for contact F	
Voltage Proof	500 VDC	
Thermal EMF	< 0.1 μ V/K	
Operating Temperature Range	-40 to 130°C	
Resistor Material	CuNiMn-Foil	
Substrate	anodized aluminium	
Housing	Epoxy	
Connector Material	Cu tinned	
Terminals	2	4
Max. torque	1 Nm	

Ordering Information

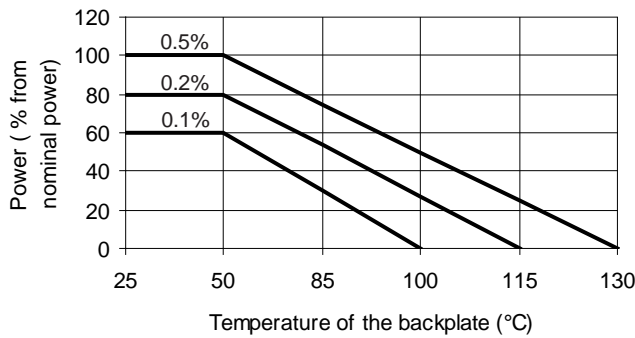
Part Number - Resistance - Contact - Tolerance
 FHR 4-4618 0.050 Ohms A 1%

SPECIFICATIONS (continued)

Temperature Coefficient



Derating



Power Rating Notes -

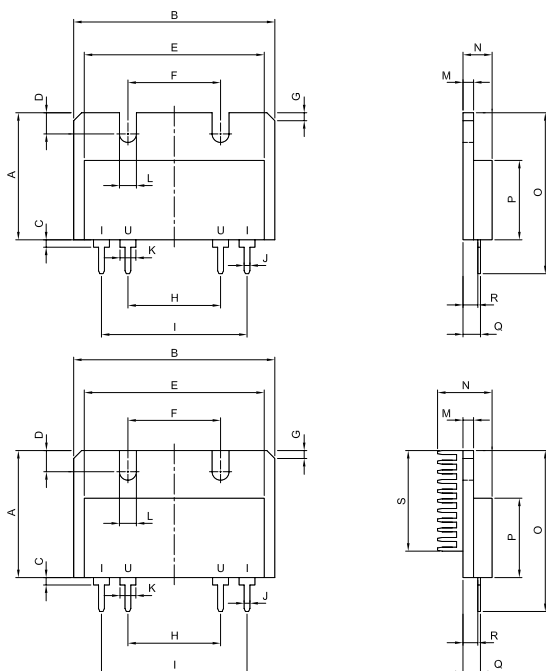
The FHR Series Resistors must be attached to a suitable heat-sink. The maximum internal resistor temperature is 130°C. To specify an appropriate heatsink use the following formula :

$$R_{0H} = \frac{T_{MAX} - (P \times R_{0R}) - T_A}{P}$$

Where: R_{0H} = Thermal Resistance of Heatsink (K/W)
 R_{0R} = Thermal Resistance of Resistor (K/W)
 T_{MAX} = Maximum Temperature of Resistor
 T_A = Ambient Temperature of Heatsink (°C)
 P = Power Through Resistor (W)

Dimensions

FHR 4-3825 / FHR 4-3825H



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	24.00	0.2	0.94	0.008
B	38.00	0.3	1.50	0.012
C	1.40	0.4	0.06	0.016
D	4.00	0.1	0.16	0.004
E	34.00	0.3	1.34	0.012
F	17.50	0.2	0.69	0.008
G	1.5x45°	0.1	0.06x45°	0.004
H	17.50	0.2	0.69	0.008
I	27.50	0.2	1.08	0.008
J (A-Contact)	1.50	0.1	0.06	0.004
J (K-Contact)	1.10	0.1	0.04	0.004
K	3.00	0.1	0.12	0.004
L	3.20	0.1	0.13	0.004
M	2.00	0.1	0.08	0.004
N	max.5.5	0.2	max.0.22	0.008
N (Variante H)	max.10.3	0.2	max.0.4	0.008
O	30.40	0.4	1.20	0.016
P	15.00	0.2	0.59	0.008
Q (A-Contact)	3.60	0.1	0.14	0.004
Q (K-Contact)	3.30	0.1	0.13	0.004
R	2.80	0.1	0.11	0.004
S (Variante H)	19.00	0.2	0.75	0.008

FHR 2-3025 3818

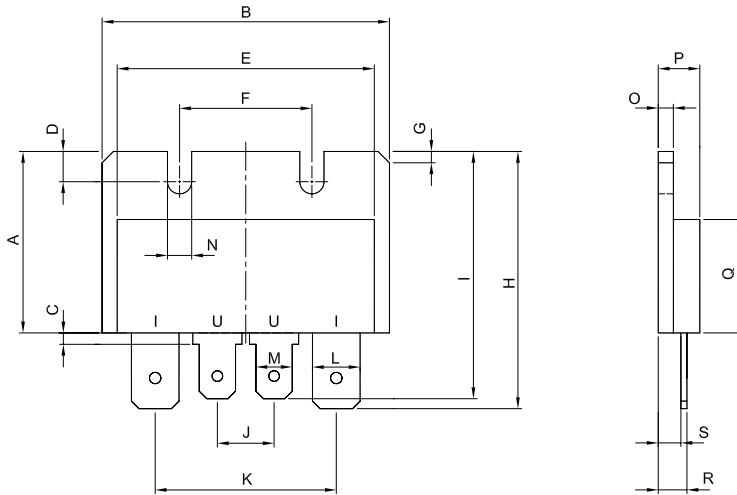
FHR 4-3825 3825H 4618

Precision Shunt Resistors



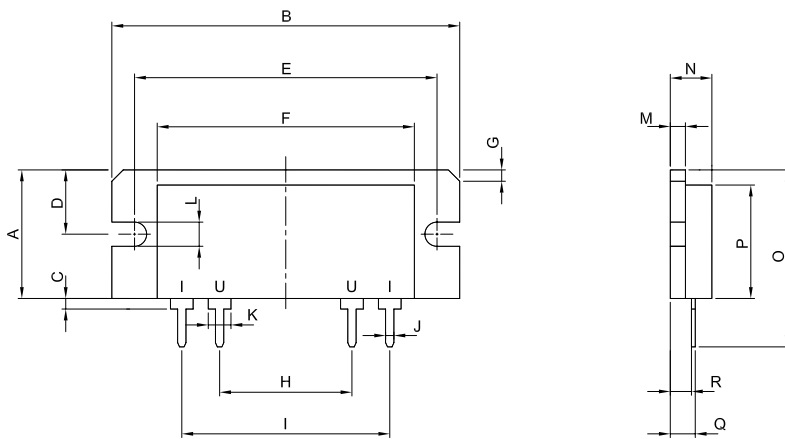
SPECIFICATIONS (continued)

FHR 4-3825F



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	24.00	0.2	0.94	0.008
B	38.00	0.3	1.50	0.012
C	1.50	0.2	0.06	0.008
D	4.00	0.1	0.16	0.004
E	34.00	0.3	1.34	0.012
F	17.50	0.2	0.69	0.008
G	1.5x45°	0.1	0.06x45°	0.004
H	34.00	0.2	1.34	0.008
I	32.70	0.2	1.29	0.008
J	7.50	0.2	0.30	0.008
K	24.00	0.2	0.94	0.008
L	6.30	0.2	0.25	0.008
M	4.80	0.1	0.19	0.004
N	3.20	0.1	0.13	0.004
O	2.00	0.1	0.08	0.004
P	6.00	0.2	0.24	0.008
Q	15.00	0.2	0.59	0.008
R	4.10	0.7	0.16	0.028
S	3.30	0.7	0.13	0.028

FHR 4-4618



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	17.00	0.1	0.67	0.004
B	46.00	0.3	1.81	0.012
C	1.40	0.4	0.06	0.016
D	8.50	0.2	0.33	0.008
E	40.00	0.3	1.57	0.012
F	34.00	0.3	1.34	0.012
G	1.5x45°	0.1	0.06x45°	0.004
H	17.50	0.2	0.69	0.008
I	27.50	0.2	1.08	0.008
J (A-Contact)	1.50	0.1	0.06	0.004
J (K-Contact)	1.10	0.1	0.04	0.004
K	3.00	0.1	0.12	0.004
L	3.20	0.1	0.13	0.004
M	2.00	0.1	0.08	0.004
N	max.5.5	0.2	max.0.22	0.008
O	23.40	0.4	0.92	0.016
P	15.00	0.2	0.59	0.008
Q (A-Contact)	3.60	0.1	0.14	0.004
Q (K-Contact)	3.30	0.1	0.13	0.004
R	2.80	0.2	0.11	0.008

FHR 2-3025 3818

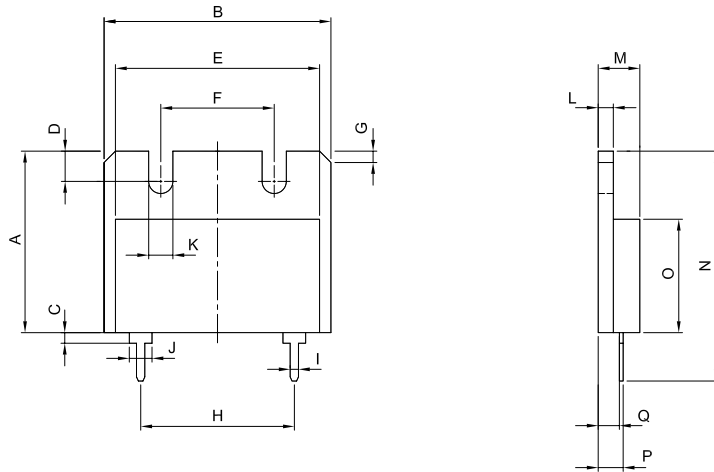
FHR 4-3825 3825H 4618

Precision Shunt Resistors



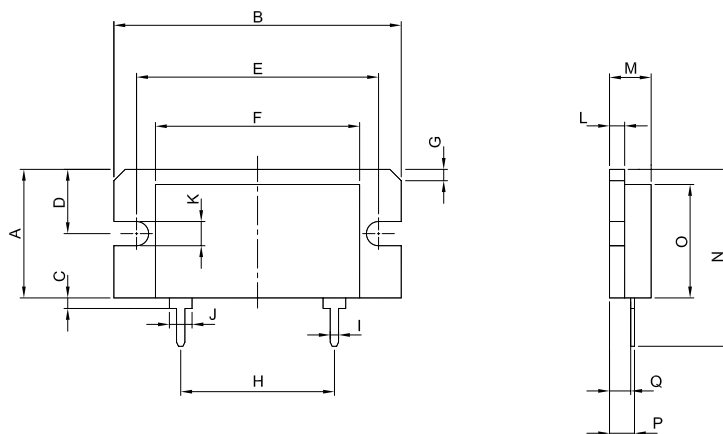
SPECIFICATIONS (continued)

FHR 2-3025



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	24.00	0.2	0.94	0.008
B	30.00	0.2	1.18	0.008
C	1.40	0.4	0.06	0.016
D	4.00	0.1	0.16	0.004
E	27.00	0.2	1.06	0.008
F	15.00	0.2	0.59	0.008
G	1.5x45°	0.1	0.06x45°	0.004
H	20.32	0.2	0.80	0.008
I (A-Contact)	1.50	0.1	0.06	0.004
I (K-Contact)	1.10	0.1	0.04	0.004
J	1.10	0.1	0.04	0.004
K	3.20	0.1	0.13	0.004
L	2.00	0.1	0.08	0.004
M	max.5.5	0.2	max.0.22	0.008
N	30.40	0.4	1.20	0.016
O	15.00	0.2	0.59	0.008
P (A-Contact)	3.60	0.1	0.14	0.004
P (K-Contact)	3.30	0.1	0.13	0.004
Q	2.80	0.2	0.11	0.008

FHR 2-3818

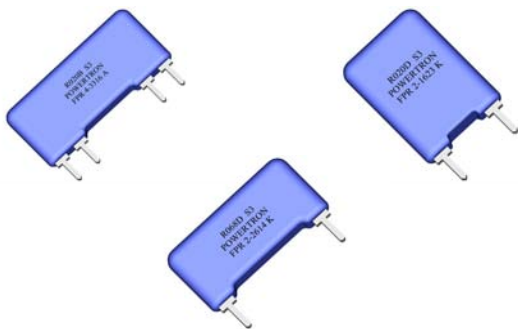


Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	17.00	0.2	0.67	0.008
B	38.00	0.3	1.50	0.012
C	1.40	0.4	0.06	0.016
D	8.50	0.2	0.33	0.008
E	32.00	0.3	1.26	0.012
F	27.00	0.2	1.06	0.008
G	1.5x45°	0.1	0.06x45°	0.004
H	20.32	0.2	0.80	0.008
I (A-Contact)	1.50	0.1	0.06	0.004
I (K-Contact)	1.10	0.1	0.04	0.004
J	1.10	0.1	0.04	0.004
K	3.20	0.1	0.13	0.004
L	2.00	0.1	0.08	0.004
M	max.5.5	0.2	max.0.22	0.008
N	23.40	0.4	0.92	0.016
O	15.00	0.2	0.59	0.008
P (A-Contact)	3.60	0.1	0.14	0.004
P (K-Contact)	3.30	0.1	0.13	0.004
Q	2.80	0.2	0.11	0.008

FPR 2-1617 1623 2614

FPR 4-3316

Precision Shunt Resistors



- Resistances from 0.001Ohm to 100Ohms
- Power Rating to 2Watt
- Resistance Tolerances to $\pm 0.1\%$
- TCR to $\pm 15\text{ppm/K}$
- Load Stability to 0.1%

SPECIFICATIONS

Type	FPR 2-1617	FPR 2-1623	FPR 2-2614	FPR 4-3316
Resistance Range	0.01 to 50 Ohms	0.01 to 100 Ohms		0.001 to 100 Ohms
Power rating (70°C)	1 W	2 W		
Tolerances from 0.001 Ohms from 0.005 Ohms from 0.01 Ohms from 0.02 Ohms from 1.0 Ohms	0.5% / 1% / 2% / 5% 0.25% / 0.5% / 1% / 2% / 5% 0.1% / 0.25% / 0.5% / 1% / 2% / 5%			1% / 2% 0.5% / 1% / 2% 0.25% / 0.5% / 1% 0.1% / 0.25% / 0.5%
Stability	0.1% / 0.2% / 0.5% (depends on stress)			
Temperature Coefficient	R > 0.2 Ohms $\pm 15\text{ppm/K}$ (20 to 60°C) R \leq 0.2 Ohms TCR see table A next page			$\pm 15\text{ppm/K}$ (20 to 60°C)
Insulation Resistance	> 10 GOhm			
Thermal EMF	< 0.1 $\mu\text{V/K}$			
Operating Temperature Range	-40 to 130°C			
Resistor Material	CuNiMn-Foil			
Substrate	anodized aluminium			
Housing	Epoxy sintered			
Connector Material	Cu tinned			
Terminals	2			4

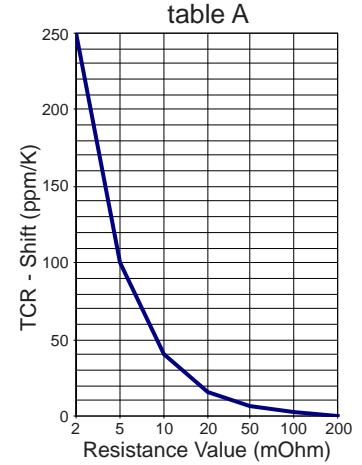
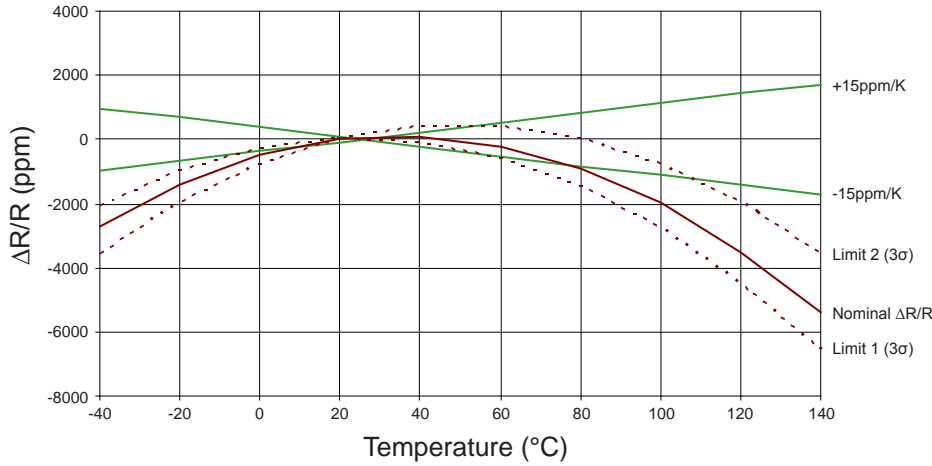
Ordering Information

Part Number - Resistance - Contact - Tolerance

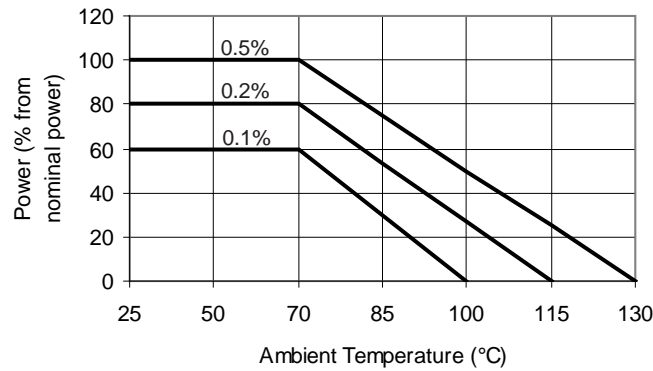
FPR 4-3316 0.01 Ohms A 1.0%

SPECIFICATIONS (continued)

Temperature Coefficient

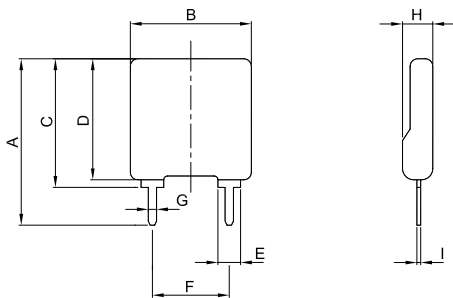


Derating



Dimensions

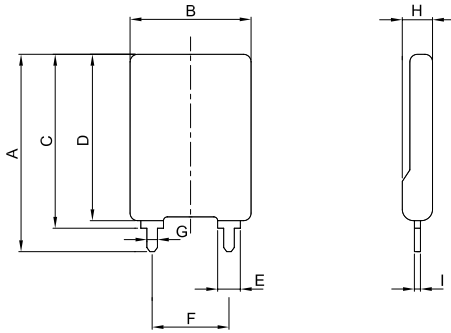
FPR 2-1617



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	22.00	0.2	0.87	0.008
B	16.00	0.2	0.63	0.008
C	17.00	0.2	0.67	0.008
D	16.00	0.2	0.63	0.008
E	3.00	0.1	0.12	0.004
F	10.16	0.2	0.40	0.008
G(A-Contact)	1.50	0.1	0.06	0.004
G(K-Contact)	1.10	0.1	0.04	0.004
H	4.30	0.2	0.17	0.008
I (A-Contact)	0.80	0.1	0.03	0.004
I (K-Contact)	0.50	0.1	0.02	0.004

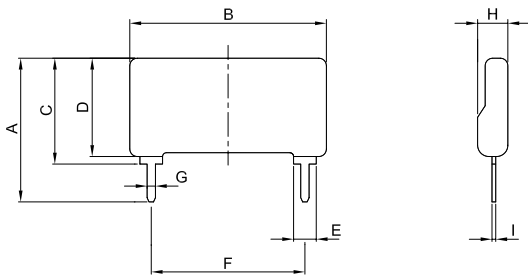
SPECIFICATIONS (continued)

FPR 2-1623



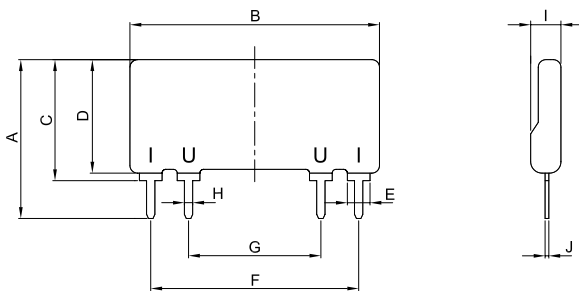
Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	26.10	0.2	1.03	0.008
B	16.00	0.2	0.63	0.008
C	23.00	0.2	0.91	0.008
D	22.00	0.2	0.87	0.008
E	3.00	0.1	0.12	0.004
F	10.16	0.2	0.40	0.008
G(B-Contact)	1.40	0.1	0.06	0.004
H	4.30	0.2	0.17	0.008
I (B-Contact)	0.80	0.1	0.03	0.004

FPR 2-2614



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	19.00	0.2	0.75	0.008
B	26.00	0.2	1.02	0.008
C	14.00	0.2	0.55	0.008
D	13.00	0.2	0.51	0.008
E	3.00	0.1	0.12	0.004
F	20.32	0.2	0.80	0.008
G(A-Contact)	1.50	0.1	0.06	0.004
G(K-Contact)	1.10	0.1	0.04	0.004
H	4.30	0.2	0.17	0.008
I (A-Contact)	0.80	0.1	0.03	0.004
I (K-Contact)	0.50	0.1	0.02	0.004

FPR 4-3316



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	21.00	0.2	0.83	0.008
B	33.00	0.2	1.30	0.008
C	16.00	0.2	0.63	0.008
D	15.00	0.2	0.59	0.008
E	3.00	0.1	0.12	0.004
F	27.50	0.2	1.08	0.008
G	17.50	0.2	0.69	0.008
H(A-Contact)	1.50	0.1	0.06	0.004
H(K-Contact)	1.10	0.1	0.04	0.004
I	4.30	0.2	0.17	0.008
J(A-Contact)	0.80	0.1	0.03	0.004
J(K-Contact)	0.50	0.1	0.02	0.004

FPR FNR 2-T227 4-T227

Foil Power Resistors



- Resistances from 0.001 Ohm to 100 Ohms
- Power Rating to 80 Watt
- Resistance Tolerances to $\pm 0.1\%$
- TCR to $\pm 15 \text{ ppm/K}$
- Load Stability to 0.1%

SPECIFICATIONS

Type	FPR 2-T227	FPR 4-T227	FNR 2-T227	FNR 4-T227
Terminals	2	4 (kelvin connection)	2	4 (kelvin connection)
Resistance Range	0.01 to 100 Ohms	0.001 to 100 Ohms	0.01 to 100 Ohms	0.001 to 100 Ohms
Power Rating (with heatsink)	60W		80W	
Thermal Resistance Rthj-c	1.3 K/W		1.0 K/W	
Tolerances	0.1% / 1% / 2% / 5% (others upon request)			
Stability	0.1% / 0.2% / 0.5% (depends on stress)			
Temperature Coefficient	$\pm 15 \text{ ppm/K}$ (20 to 60°C) from $R < 0.02 \text{ Ohms}$ $\pm 20 \text{ ppm/K}$ (20 to 60°C) FPR 2-T227 / FNR 2-T227 TK Shift depends from resistance value (see graph next page)			
Voltage Proof	2.5 kV DC			
Thermal EMF	$< 1 \mu\text{V/K}$			
Max. Current	50A (higher upon request)			
Operating Temperature	-40°C to 130°C			
Resistor Material	Metalfoil CuNiMn (DIN 17471)			
Substrate	Al ₂ O ₃		AlN	
Housing	Epoxy			
Connector Material	Cu / tinned or nickel plated			
Max. Torque	backplate: 1.5Nm terminals: 1.3 Nm			

Ordering Information

Part Number - Resistance - Tolerance
FPR 2-T227 1.1 Ohms 1%

SPECIFICATIONS (continued)

Temperature Coefficient

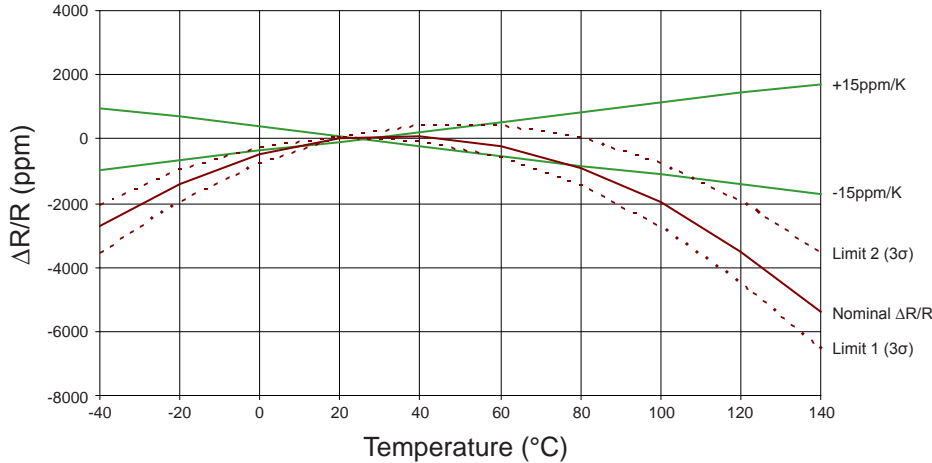
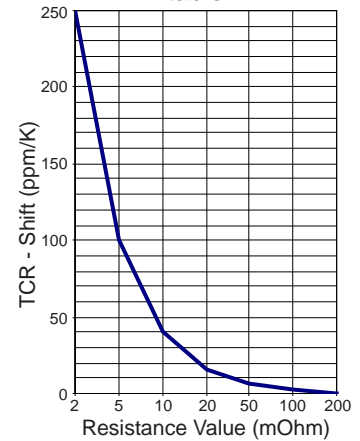
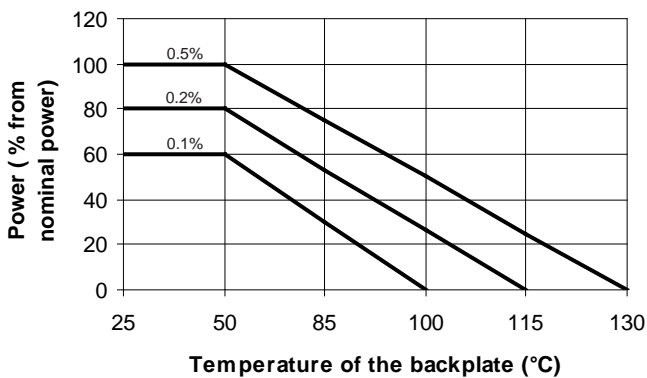


table A



Derating and Stability



Power Rating Notes -

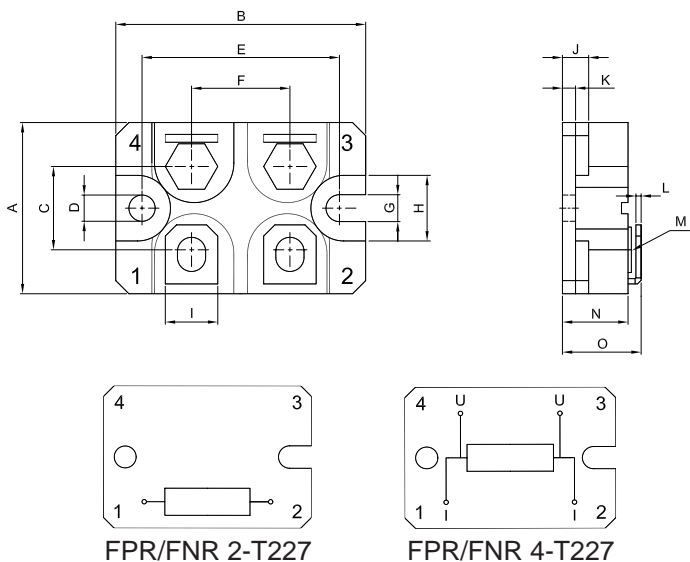
The FPR/FNR Series Foil Resistors must be attached to a suitable heatsink. The maximum internal resistor temperature is 130°C for a 0.5% stability part.

To specify an appropriate heatsink use the following formula :

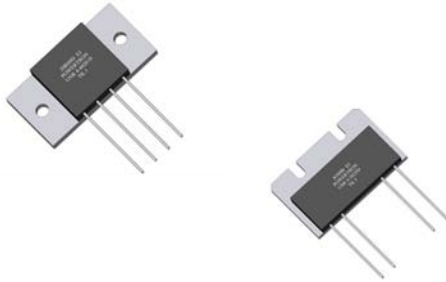
$$R_{\theta H} = \frac{T_{MAX} - (P \times R_{\theta R}) - T_A}{P}$$

Where: $R_{\theta H}$ = Thermal Resistance of Heatsink (K/W)
 $R_{\theta R}$ = Thermal Resistance of Resistor (K/W)
 T_{MAX} = Maximum Temperature of Resistor
 T_A = Ambient Temperature of Heatsink (°C)
 P = Power Through Resistor (W)

Dimensions and Attachment Variations



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	26	0.5	1.02	0.020
B	38	0.5	1.50	0.020
C	12.7	0.2	0.50	0.008
D	4	0.2	0.16	0.008
E	30	0.2	1.18	0.008
F	15	0.2	0.59	0.008
G	4.1	0.2	0.16	0.008
H	10	0.2	0.39	0.008
I	8	0.2	0.31	0.008
J	4	0.2	0.16	0.008
K	2	0.2	0.08	0.008
L	0.8	0.1	0.03	0.004
M	M4		M4	
N	10	0.2	0.39	0.008
O	11.9	0.2	0.47	0.008



- Resistances from 0.05Ohm to 500Ohms
- Power Rating to 50Watt
- Resistance Tolerances to $\pm 0.01\%$
- TCR to $\pm 1\text{ppm/K}$
- Load Stability to 0.01%

SPECIFICATIONS

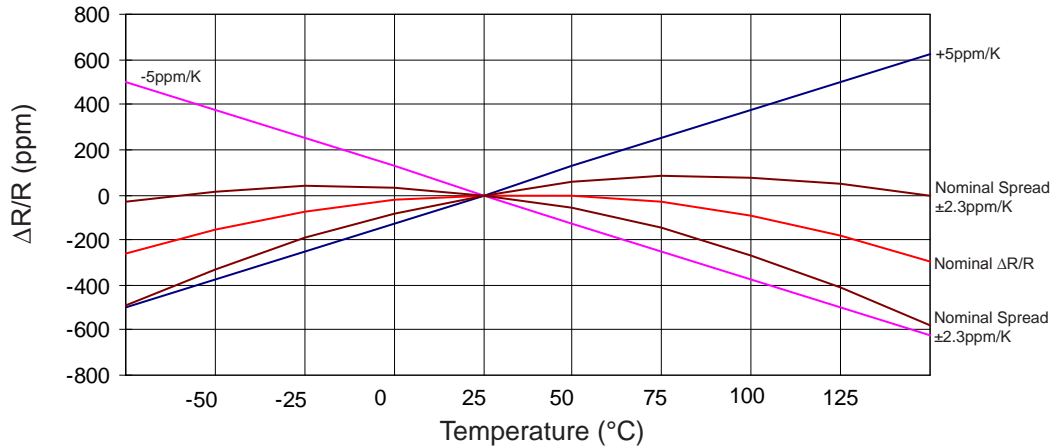
Type	USR 4-3425 3825	USR 4-4020	UNR 4-3425 3825	UNR 4-4020
Resistance Range	0.05 to 500 Ohms other resistance values upon request / power rating depending on resistance value			0.05 to 400 Ohms
Power rating free air 70°C for 3825H with heatsink	3 W 5 W 30 W	2.5 W 30 W	3 W 5 W 50 W	2.5 W 50 W
Thermal Resistance Rthj-c	3.5 K/W	3.6 K/W	2.1 K/W	2.2 K/W
Tolerances from 0.05 Ohms from 10.0 Ohms from 50.0 Ohms	0.1% / 0.25% / 0.5% / 1% 0.05% / 0.1% / 0.25% / 0.5% / 1% 0.01% / 0.02% / 0.05% / 0.1% / 0.25% / 0.5% / 1%			
Stability	0.01%			
Shelf Life Stability	25ppm / ΔR after 1 year 50ppm / ΔR after 3 year			
Temperature Coefficient	max. $\pm 5\text{ppm/K}$ (-55 to 155°C) typ. $\pm 3\text{ppm/K}$ (-55 to 125°C) upon request $\pm 1\text{ppm/K}$ (0 to 60°C)			
Voltage Proof	750 VDC			
max. Current	15 A			
Thermal EMF	< 0.1 $\mu\text{V/K}$			
Operating Temperature Range	-55 to 155°C			
Resistor Material	NiCr-Foil			
Substrate	Al ₂ O ₃		AlN	
Housing	Epoxy + Al-heatsink			
Connector Material	Cu tinned			
Terminals	4			
Max. Torque	1.0 Nm			
Notes	Specially designed for applications with fast changing electrical load			

Ordering Information

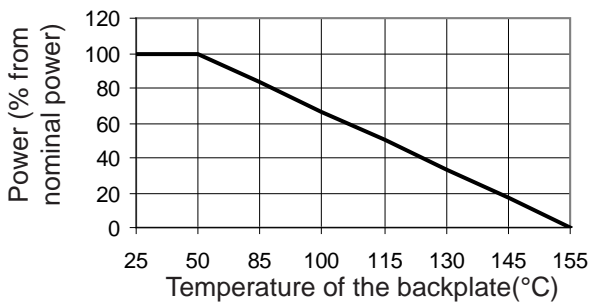
Part Number - Resistance - Contact - Tolerance - TCR
 USR 4-3825H 10Ohms D 0.5% 3ppm

SPECIFICATIONS (continued)

Temperature Coefficient



Derating



Power Rating Notes -

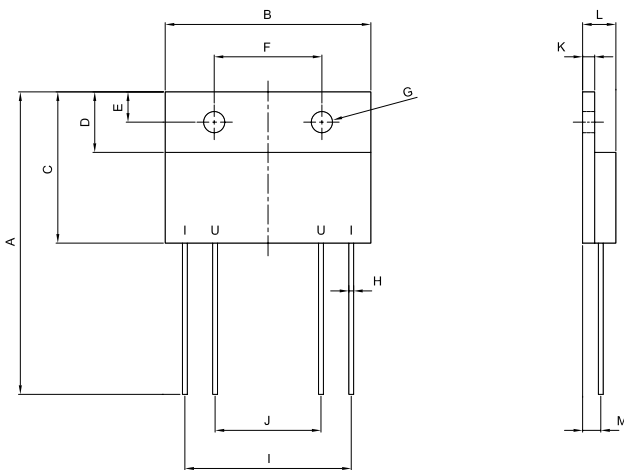
The U-Series Resistors must be attached to a suitable heatsink. The maximum internal resistor temperature is 155°C. To specify an appropriate heatsink use the following formula :

$$R_{0H} = \frac{T_{MAX} - (P \times R_{0R}) - T_A}{P}$$

Where: R_{0H} = Thermal Resistance of Heatsink (K/W)
 R_{0R} = Thermal Resistance of Resistor (K/W)
 T_{MAX} = Maximum Temperature of Resistor
 T_A = Ambient Temperature of Heatsink (°C)
 P = Power Through Resistor (W)

Dimensions

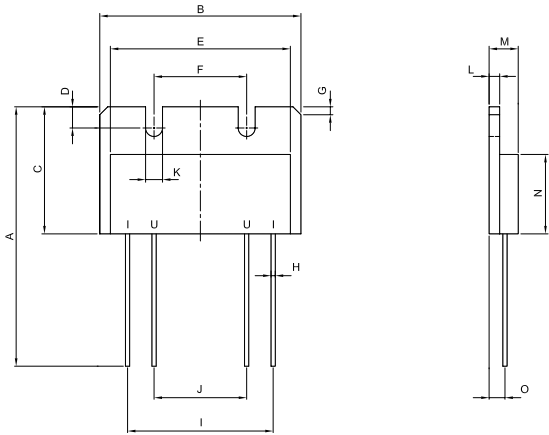
USR 4-3425 / UNR 4-3425



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	50.00	2.0	1.97	0.079
B	34.00	0.3	1.34	0.012
C	25.00	0.2	0.98	0.008
D	10.00	0.2	0.39	0.008
E	5.00	0.1	0.20	0.004
F	17.80	0.2	0.70	0.008
G	∅3.50	0.1	∅0.14	0.004
H	∅0.8	0.1	∅0.031	0.004
I	27.50	0.2	1.08	0.008
J	17.50	0.2	0.69	0.008
K	2.00	0.1	0.08	0.004
L	5.50	0.1	0.22	0.004
M	3.00	0.2	0.12	0.008

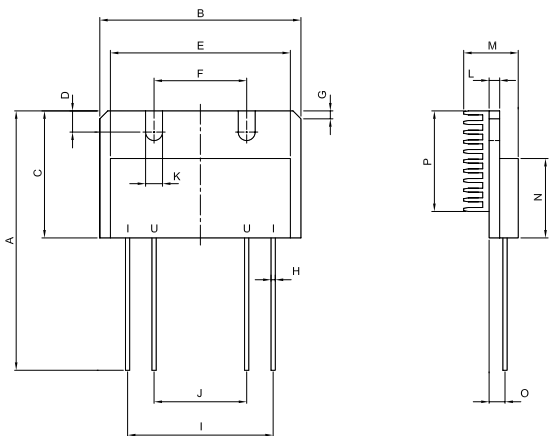
SPECIFICATIONS (continued)

USR 4-3825 / UNR 4-3825



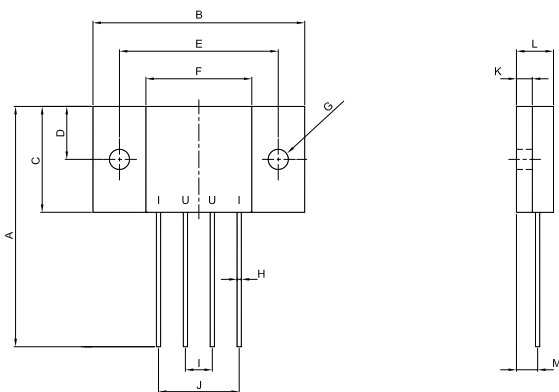
Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	49.00	2.0	1.93	0.079
B	38.00	0.3	1.50	0.012
C	24.00	0.2	0.94	0.008
D	4.00	0.1	0.16	0.004
E	34.00	0.3	1.34	0.012
F	17.50	0.2	0.69	0.008
G	1.5x45°	0.1	0.6x45°	0.004
H	∅0.8	0.1	∅0.031	0.004
I	27.50	0.2	1.08	0.008
J	17.50	0.2	0.69	0.008
K	∅3.2	0.1	∅0.126	0.004
L	2.00	0.1	0.08	0.004
M	5.50	0.1	0.22	0.004
N	15.00	0.2	0.59	0.008
O	3.00	0.2	0.12	0.008

USR 4-3825H / UNR 4-3825H



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	49.00	2.0	1.93	0.079
B	38.00	0.3	1.50	0.012
C	24.00	0.2	0.94	0.008
D	4.00	0.1	0.16	0.004
E	34.00	0.3	1.34	0.012
F	17.50	0.2	0.69	0.008
G	1.5x45°	0.1	0.6x45°	0.004
H	∅0.8	0.1	∅0.031	0.004
I	27.50	0.2	1.08	0.008
J	17.50	0.2	0.69	0.008
K	∅3.2	0.1	∅0.126	0.004
L	2.00	0.1	0.08	0.004
M	max.10.3	0.2	max.0.4	0.008
N	15.00	0.2	0.59	0.008
O	3.00	0.2	0.12	0.008
P	19.00	0.2	0.75	0.008

USR 4-4020 / UNR 4-4020



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	45.40	2.0	1.79	0.079
B	40.00	0.3	1.57	0.012
C	20.00	0.2	0.79	0.008
D	10.00	0.2	0.39	0.008
E	30.00	0.2	1.18	0.008
F	20.00	0.2	0.79	0.008
G	∅3.80	0.1	∅0.15	0.004
H	∅0.8	0.1	∅0.031	0.004
I	5.08	0.1	0.20	0.004
J	15.24	0.2	0.60	0.008
K	3.00	0.1	0.12	0.004
L	7.00	0.1	0.28	0.004
M	4.00	0.1	0.16	0.004

UHN 2-3825D

Precision Shunt Resistors



- Resistances from 50Ohm
- Power Rating to 30Watt
- Resistance Tolerances to $\pm 1\%$
- TCR to $\pm 5\text{ppm/K}$
- Load Stability to 0.01%
- Customized Resistance Values
- Twin Resistor Construction

SPECIFICATIONS

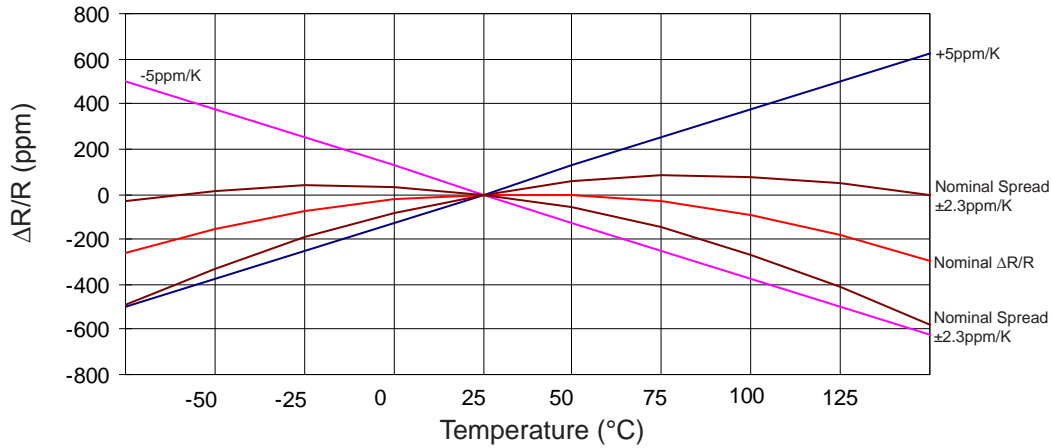
Type	UHN 2-3825D
Resistance Range	50 Ohms (2x) Other values upon request
Power rating free air 70°C with heatsink	3 W 30 W
Thermal Resistance Rthj-c	3.5 K/W
Tolerances	1% (0.1% difference between the two resistances) Other tolerances upon request
Stability	0.01%
Temperature Coefficient	max. $\pm 5\text{ppm/K}$ (-55 to 155°C)
Voltage Proof	500 VDC
max. Current	15 A
Thermal EMF	$< 0.1\mu\text{V/K}$
Operating Temperature Range	-55 to 155°C
Resistor Material	NiCr-Foil
Substrate	Al_2O_3
Housing	Epoxy + Al-heatsink
Connector Material	Cu tinned
Terminals	3
Max. Torque	1.0 Nm

Ordering Information

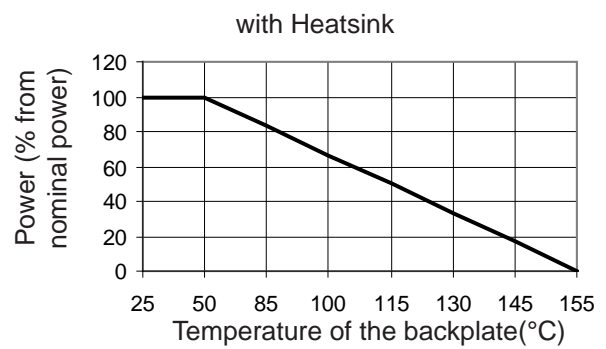
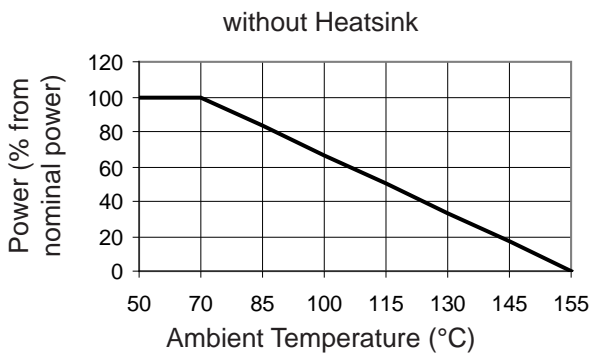
Part Number - Resistance - Tolerance
UHN 2-3825D 50Ohms-50Ohms 0.5%

SPECIFICATIONS (continued)

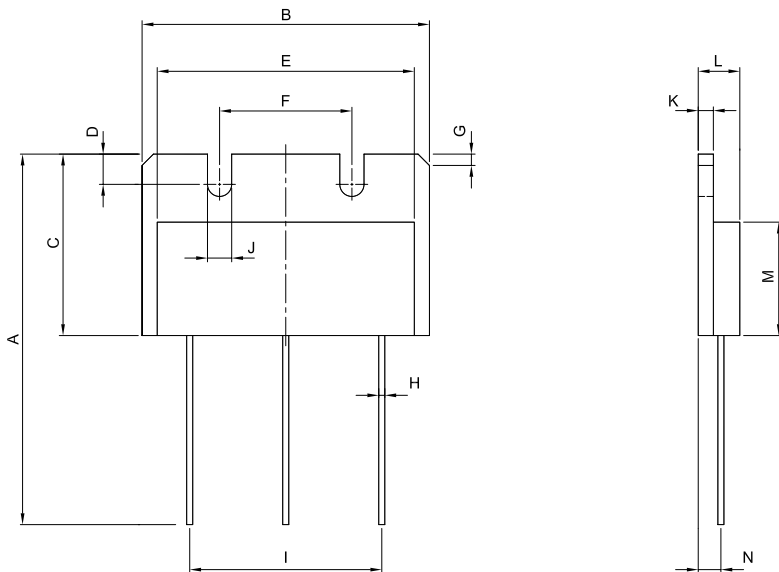
Temperature Coefficient



Derating



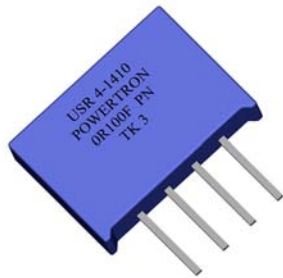
Dimensions



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	49.00	2.0	1.93	0.079
B	38.00	0.3	1.50	0.012
C	24.00	0.2	0.94	0.008
D	4.00	0.1	0.16	0.004
E	34.00	0.3	1.34	0.012
F	17.50	0.2	0.69	0.008
G	1.5x45°	0.1	0.6x45°	0.004
H	∅0.8	0.1	∅0.031	0.004
I	25.40	0.2	1.00	0.008
J	∅3.2	0.1	∅0.126	0.004
K	2.00	0.1	0.08	0.004
L	5.50	0.1	0.22	0.004
M	15.00	0.2	0.59	0.008
N	3.00	0.2	0.12	0.008

USR UNR 4-1410

Precision Shunt Resistors



- Resistances from 0.1Ohm to 100Ohms
- Power Rating to 0.8Watt
- Resistance Tolerances to $\pm 0.01\%$
- TCR to $\pm 1\text{ppm/K}$
- Load Stability to 0.01%

SPECIFICATIONS

Type	USR 4-1410	UNR 4-1410
Resistance Range	0.1 to 100 Ohms	
Power rating (70°C)	0.8 W	
Tolerances from 0.1 Ohms from 10.0 Ohms from 50.0 Ohms	0.1% / 0.25% / 0.5% / 1% 0.05% / 0.1% / 0.25% / 0.5% / 1% 0.01% / 0.02% / 0.05% / 0.1% / 0.25% / 0.5% / 1%	
Stability	0.01%	
Temperature Coefficient	max. $\pm 5\text{ppm/K}$ (-55 to 155°C) typ. $\pm 3\text{ppm/K}$ (-55 to 125°C) upon request $\pm 1\text{ppm/K}$ (0 to 60°C)	
Insulation Resistance	> 10 GOhm	
Thermal EMF	< 0.1 $\mu\text{V/K}$	
Operating Temperature Range	-55 to 155°C	
Resistor Material	NiCr-Foil	
Substrate	Al ₂ O ₃	AlN
Housing	PBTP / Epoxy	
Connector Material	Cu tinned	
Terminals	4	
Notes	Specially designed for applications with fast changing electrical load	

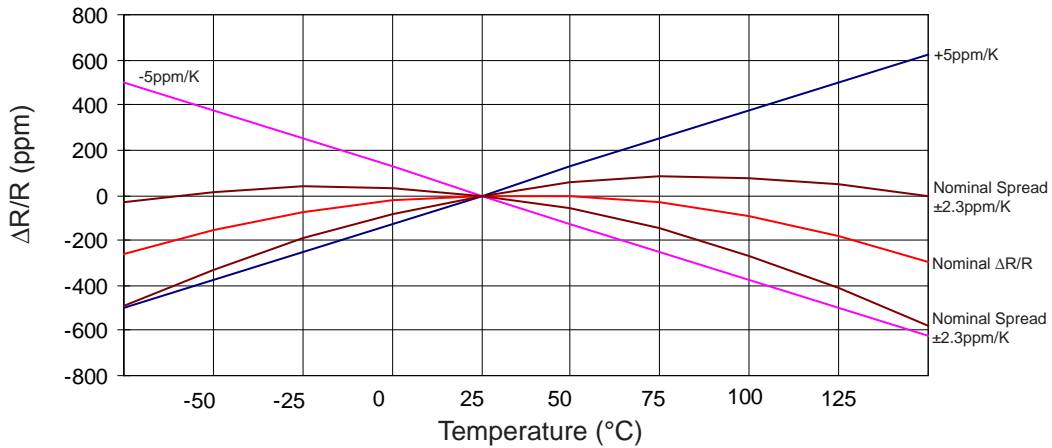
Ordering Information

Part Number - Resistance - Tolerance - TCR

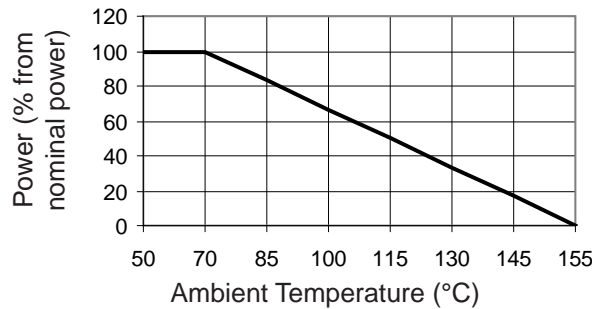
UNR 4-1410 0.1Ohms 0.5% 3ppm

SPECIFICATIONS (continued)

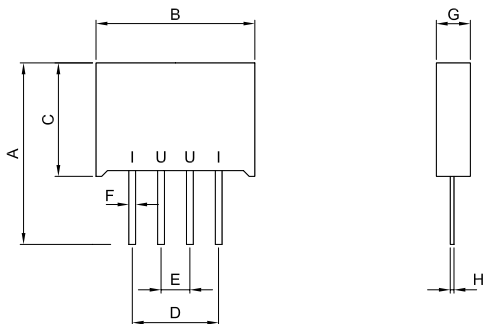
Temperature Coefficient



Derating



Dimensions

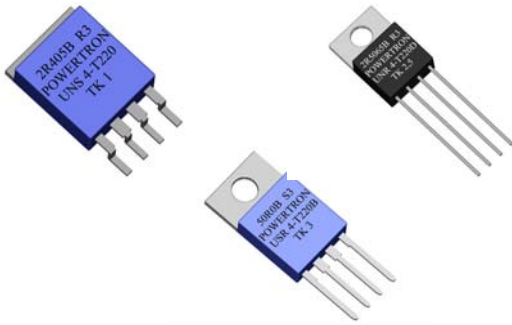


Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	16.00	1.0	0.63	0.039
B	14.00	0.2	0.55	0.008
C	10.00	0.2	0.39	0.008
D	7.62	0.1	0.30	0.004
E	2.54	0.1	0.10	0.004
F	0.50	0.1	0.02	0.004
G	3.00	0.1	0.12	0.004
H	0.25	0.1	0.01	0.004

USR UNR 4-T220 / T220B

USS UNS 4-T220

Precision Shunt Resistors



- Resistances from 0.2Ohm to 80Ohms
- Power Rating to 15Watt
- Resistance Tolerances to $\pm 0.01\%$
- TCR to $\pm 1\text{ppm/K}$
- Load Stability to 0.01%

SPECIFICATIONS

Type	USR / USS	UNR / UNS
Resistance Range	0.2 to 80 Ohms	
Power rating free air 70°C with heatsink	1.5W 10W	1.5W 15W
Thermal Resistance Rthj-c	10.8 K/W	6.8 K/W
Tolerances from 0.5 Ohms from 10.0 Ohms from 50.0 Ohms	0.1% / 0.25% / 0.5% / 1% 0.05% / 0.1% / 0.25% / 0.5% / 1% 0.01% / 0.02% / 0.05% / 0.1% / 0.25% / 0.5% / 1%	
Stability	0.01%	
Shelf Life Stability	25ppm / ΔR after 1 year 50ppm / ΔR after 3 year	
Temperature Coefficient	max. $\pm 5\text{ppm/K}$ (-55 to 155°C) typ. $\pm 3\text{ppm/K}$ (-55 to 125°C) upon request $\pm 1\text{ppm/K}$ (0 to 60°C)	
Voltage Proof	1 kVDC	
Thermal EMF	< 0.1 $\mu\text{V/K}$	
Operating Temperature Range	-55 to 155°C	
Resistor Material	NiCr-Foil	
Substrate	Al ₂ O ₃	AlN
Housing	Epoxy + Cu heatsink nickel plated	
Connector Material	Cu tinned	
Terminals	4	
Max. Torque	1.0 Nm	
Notes	Specially designed for applications with fast changing electrical load	

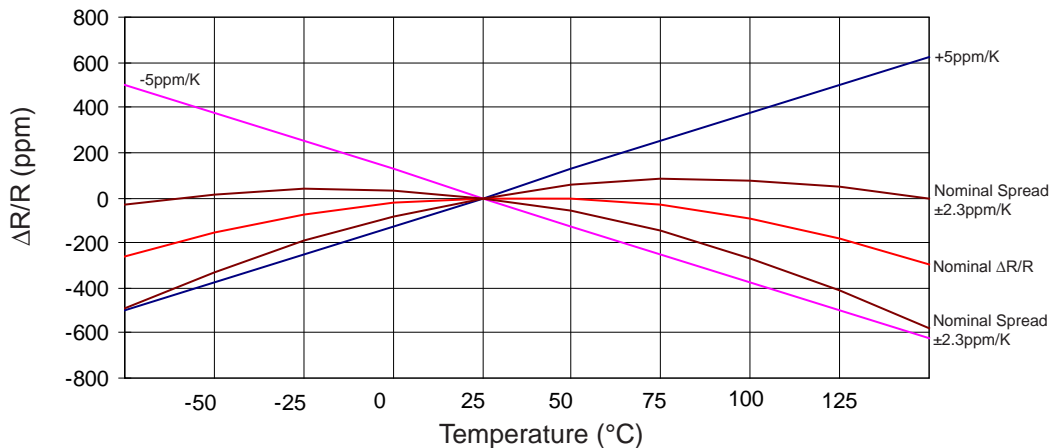
Ordering Information

Part Number - Resistance - Contact - Tolerance - TCR

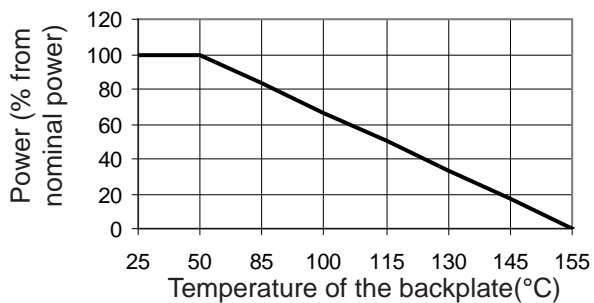
UNR 2-T220B 5.7kOhms C 0.5% 3ppm

SPECIFICATIONS (continued)

Temperature Coefficient



Derating



Power Rating Notes -

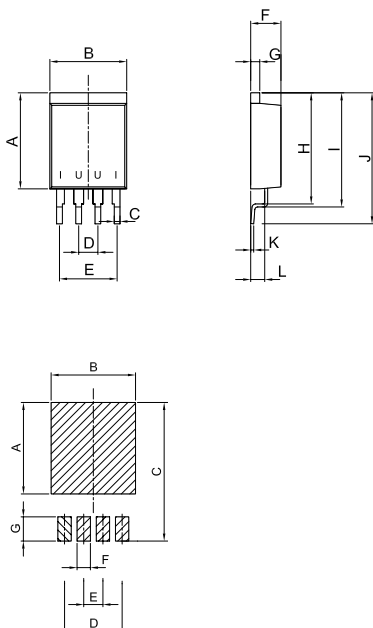
The U-Series Resistors must be attached to a suitable heatsink. The maximum internal resistor temperature is 155°C. To specify an appropriate heatsink use the following formula :

$$R_{0H} = \frac{T_{MAX} - (P \times R_{0R}) - T_A}{P}$$

Where: R_{0H} = Thermal Resistance of Heatsink (K/W)
 R_{0R} = Thermal Resistance of Resistor (K/W)
 T_{MAX} = Maximum Temperature of Resistor
 T_A = Ambient Temperature of Heatsink (°C)
 P = Power Through Resistor (W)

Dimensions

USS 4-T220 / UNS 4-T220



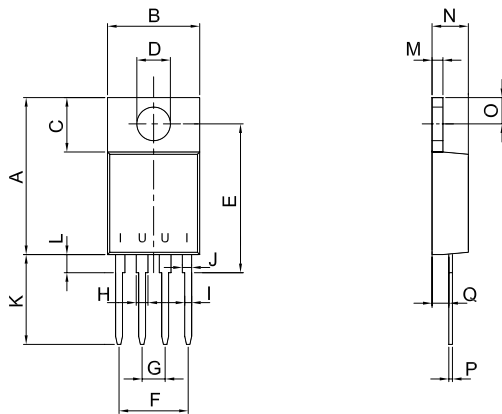
Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	12.70	0.2	0.50	0.008
B	10.16	0.2	0.40	0.008
C	0.76	0.1	0.03	0.004
D	2.54	0.1	0.10	0.004
E	7.62	0.1	0.30	0.004
F	4.00	0.1	0.16	0.004
G	1.20	0.1	0.05	0.004
H	14.60	0.2	0.57	0.008
I	15.00	0.2	0.59	0.008
J	17.33	0.2	0.68	0.008
K	0.40	0.1	0.02	0.004
L	1.85	0.1	0.07	0.004

Dimension	mm	inches
A	12.10	0.476
B	11.16	0.439
C	18.33	0.722
D	7.62	0.300
E	2.54	0.100
F	1.76	0.069
G	3.20	0.126

SPECIFICATIONS (continued)

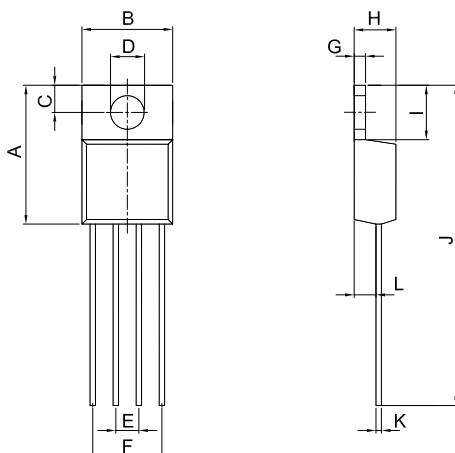
Dimensions

USR 4-T220B / UNR 4-T220B



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	17.30	0.2	0.68	0.008
B	10.16	0.2	0.40	0.008
C	6.00	0.1	0.24	0.004
D	∅3.7	0.1	∅0.146	0.004
E	16.40	0.2	0.65	0.008
F	7.62	0.2	0.30	0.008
G	2.54	0.1	0.10	0.004
H	1.30	0.1	0.05	0.004
I	0.76	0.1	0.03	0.004
J	1.03	0.1	0.04	0.004
K	10.00	0.2	0.39	0.008
K (C-Contact)	13.80	0.2	0.54	0.008
L	2.00	0.1	0.08	0.004
M	1.20	0.1	0.05	0.004
N	4.00	0.1	0.16	0.004
O	2.90	0.1	0.11	0.004
P	0.40	0.1	0.02	0.004
Q	1.85	0.1	0.07	0.004

USR 4-T220 / UNR 4-T220



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	15.30	0.2	0.60	0.008
B	10.00	0.2	0.39	0.008
C	2.80	0.1	0.11	0.004
D	∅3.7	0.1	∅0.146	0.004
E	2.54	0.1	0.10	0.004
F	7.62	0.1	0.30	0.004
G	1.27	0.1	0.05	0.004
H	4.60	0.1	0.18	0.004
I	6.00	0.2	0.24	0.008
J	35.30	2.0	1.39	0.079
K	∅0.6	0.1	∅0.02	0.004
L	2.41	0.1	0.09	0.004

USR 4-1414

Precision Shunt Resistors



- Resistances from 0.50Ohm to 100Ohms
- Power Rating to 25Watt
- Resistance Tolerances to $\pm 0.01\%$
- TCR to $\pm 1\text{ppm/K}$
- Load Stability to 0.01%

SPECIFICATIONS

Type	USR 4-1414
Resistance Range	0.5 to 100 Ohms
Power rating free air 70°C with heatsink	0.8 W 25 W
Thermal Resistance Rthj-c	< 4.2 K/W
Tolerances from 0.5 Ohms from 1.0 Ohms	0.1% / 0.25% / 0.5% / 1% 0.01% / 0.02% / 0.05% / 0.1% / 0.25% / 0.5% / 1%
Stability	0.01%
Temperature Coefficient	max. $\pm 5\text{ppm/K}$ (-55 to 155°C) typ. $\pm 3\text{ppm/K}$ (-55 to 125°C) upon request $\pm 1\text{ppm/K}$ (0 to 60°C)
Voltage Proof	1.5 kVDC
Thermal EMF	< 0.1 $\mu\text{V/K}$
Operating Temperature Range	-55 to 155°C
Resistor Material	NiCr-Foil
Substrate	Al ₂ O ₃ upon request: AlN
Housing	Plastic / Epoxy
Connector Material	Cu tinned
Terminals	4

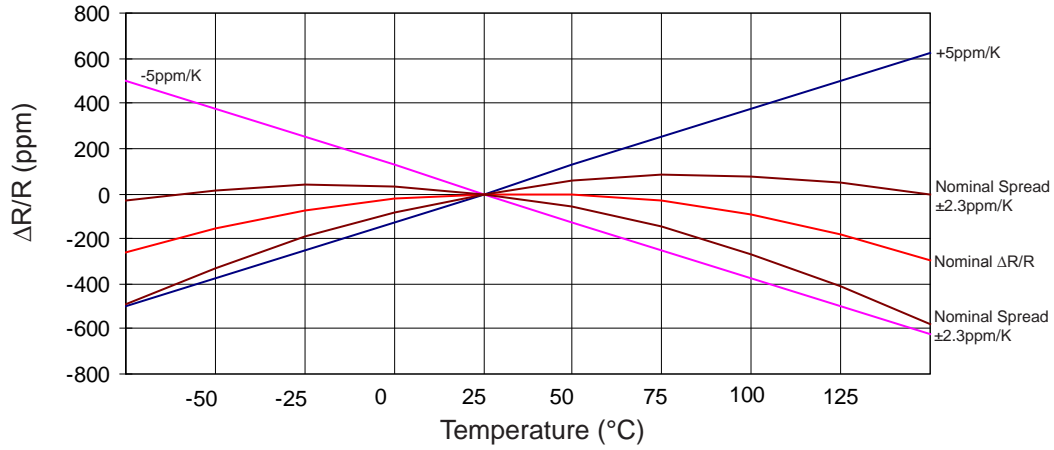
Ordering Information

Part Number - Resistance - Tolerance - TCR

USR 4-1414 0.50Ohms 0.5% 1ppm

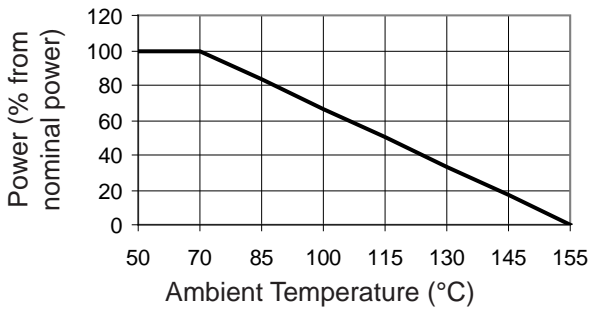
SPECIFICATIONS (continued)

Temperature Coefficient

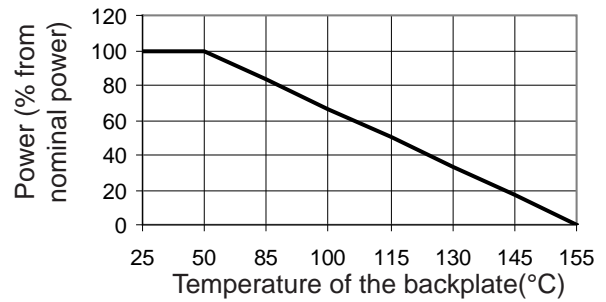


Derating

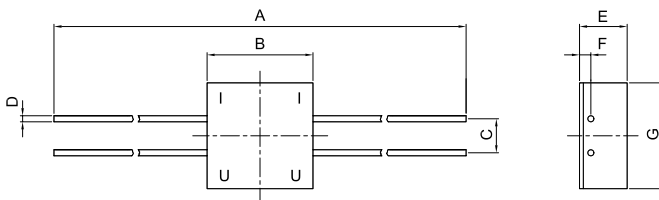
without Heatsink



with Heatsink



Dimensions

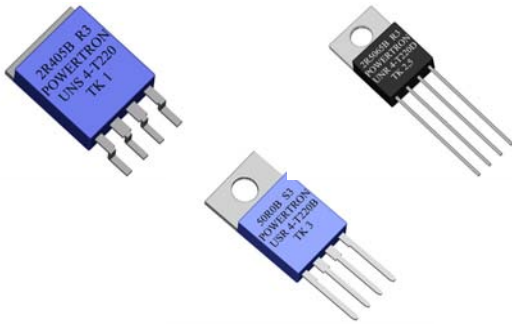


Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	94.00	0.5	3.70	0.020
B	14.00	0.2	0.55	0.008
C	4.50	0.1	0.18	0.004
D	∅0.80	0.1	∅0.03	0.004
E	6.30	0.2	0.25	0.008
F	1.50	0.2	0.06	0.008
G	14.00	0.2	0.55	0.008

USR UNR 4-T220 / T220B

USS UNS 4-T220

Precision Shunt Resistors



- Resistances from 0.2Ohm to 80Ohms
- Power Rating to 15Watt
- Resistance Tolerances to $\pm 0.01\%$
- TCR to $\pm 1\text{ppm/K}$
- Load Stability to 0.01%

SPECIFICATIONS

Type	USR / USS	UNR /UNS
Resistance Range	0.2 to 80 Ohms	
Power rating free air 70°C with heatsink	1.5W 10W	1.5W 15W
Thermal Resistance Rthj-c	10.8 K/W	6.8 K/W
Tolerances from 0.5 Ohms from 10.0 Ohms from 50.0 Ohms	0.1% / 0.25% / 0.5% / 1% 0.05% / 0.1% / 0.25% / 0.5% / 1% 0.01% / 0.02% / 0.05% / 0.1% / 0.25% / 0.5% / 1%	
Stability	0.01%	
Shelf Life Stability	25ppm / ΔR after 1 year 50ppm / ΔR after 3 year	
Temperature Coefficient	max. $\pm 5\text{ppm/K}$ (-55 to 155°C) typ. $\pm 3\text{ppm/K}$ (-55 to 125°C) upon request $\pm 1\text{ppm/K}$ (0 to 60°C)	
Voltage Proof	1 kVDC	
Thermal EMF	< 0.1 $\mu\text{V/K}$	
Operating Temperature Range	-55 to 155°C	
Resistor Material	NiCr-Foil	
Substrate	Al ₂ O ₃	AlN
Housing	Epoxy + Cu heatsink nickel plated	
Connector Material	Cu tinned	
Terminals	4	
Max. Torque	1.0 Nm	
Notes	Specially designed for applications with fast changing electrical load	

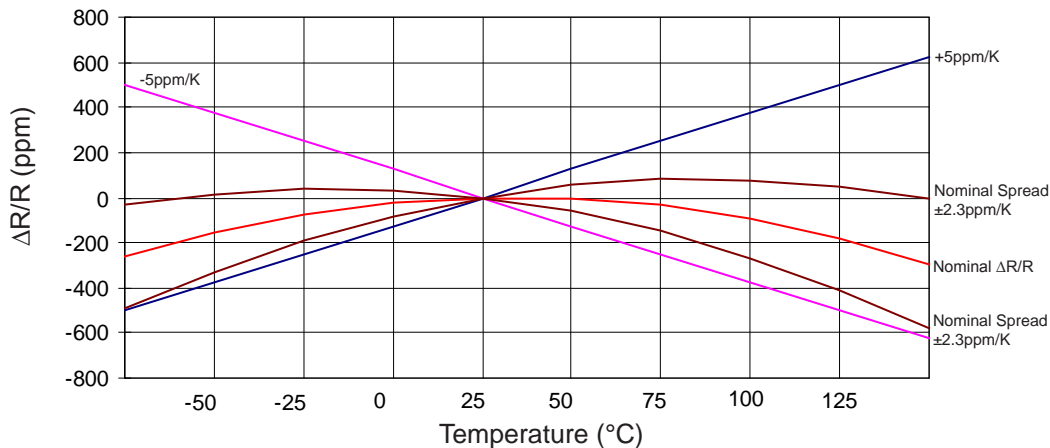
Ordering Information

Part Number - Resistance - Contact - Tolerance - TCR

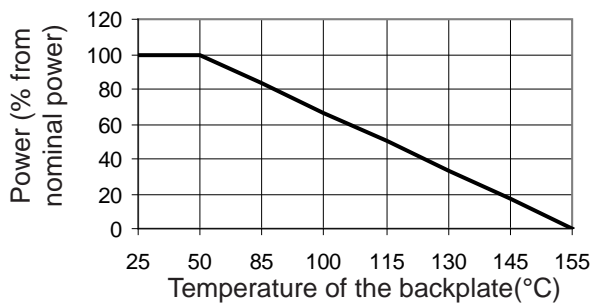
UNR 2-T220B 5.7kOhms C 0.5% 3ppm

SPECIFICATIONS (continued)

Temperature Coefficient



Derating



Power Rating Notes -

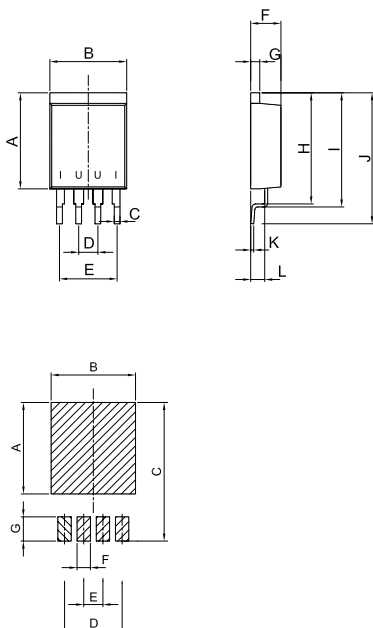
The U-Series Resistors must be attached to a suitable heatsink. The maximum internal resistor temperature is 155°C. To specify an appropriate heatsink use the following formula :

$$R_{0H} = \frac{T_{MAX} - (P \times R_{0R}) - T_A}{P}$$

Where: R_{0H} = Thermal Resistance of Heatsink (K/W)
 R_{0R} = Thermal Resistance of Resistor (K/W)
 T_{MAX} = Maximum Temperature of Resistor
 T_A = Ambient Temperature of Heatsink (°C)
 P = Power Through Resistor (W)

Dimensions

USS 4-T220 / UNS 4-T220



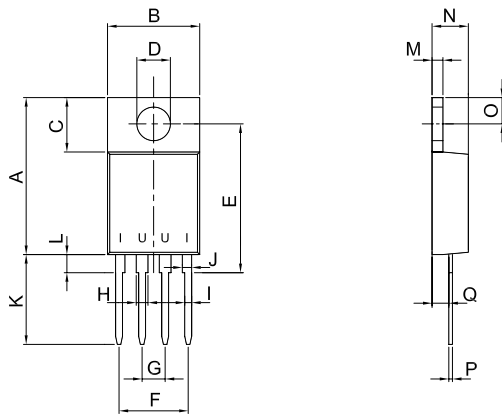
Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	12.70	0.2	0.50	0.008
B	10.16	0.2	0.40	0.008
C	0.76	0.1	0.03	0.004
D	2.54	0.1	0.10	0.004
E	7.62	0.1	0.30	0.004
F	4.00	0.1	0.16	0.004
G	1.20	0.1	0.05	0.004
H	14.60	0.2	0.57	0.008
I	15.00	0.2	0.59	0.008
J	17.33	0.2	0.68	0.008
K	0.40	0.1	0.02	0.004
L	1.85	0.1	0.07	0.004

Dimension	mm	inches
A	12.10	0.476
B	11.16	0.439
C	18.33	0.722
D	7.62	0.300
E	2.54	0.100
F	1.76	0.069
G	3.20	0.126

SPECIFICATIONS (continued)

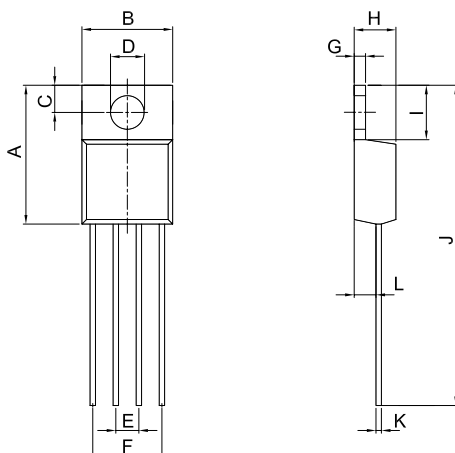
Dimensions

USR 4-T220B / UNR 4-T220B



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	17.30	0.2	0.68	0.008
B	10.16	0.2	0.40	0.008
C	6.00	0.1	0.24	0.004
D	∅3.7	0.1	∅0.146	0.004
E	16.40	0.2	0.65	0.008
F	7.62	0.2	0.30	0.008
G	2.54	0.1	0.10	0.004
H	1.30	0.1	0.05	0.004
I	0.76	0.1	0.03	0.004
J	1.03	0.1	0.04	0.004
K	10.00	0.2	0.39	0.008
K (C-Contact)	13.80	0.2	0.54	0.008
L	2.00	0.1	0.08	0.004
M	1.20	0.1	0.05	0.004
N	4.00	0.1	0.16	0.004
O	2.90	0.1	0.11	0.004
P	0.40	0.1	0.02	0.004
Q	1.85	0.1	0.07	0.004

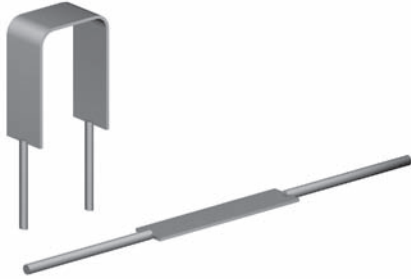
USR 4-T220 / UNR 4-T220



Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	15.30	0.2	0.60	0.008
B	10.00	0.2	0.39	0.008
C	2.80	0.1	0.11	0.004
D	∅3.7	0.1	∅0.146	0.004
E	2.54	0.1	0.10	0.004
F	7.62	0.1	0.30	0.004
G	1.27	0.1	0.05	0.004
H	4.60	0.1	0.18	0.004
I	6.00	0.2	0.24	0.008
J	35.30	2.0	1.39	0.079
K	∅0.6	0.1	∅0.02	0.004
L	2.41	0.1	0.09	0.004

MS Series

Bare Metal Element Resistors

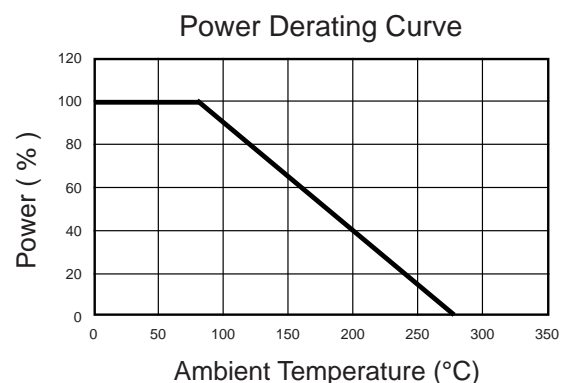
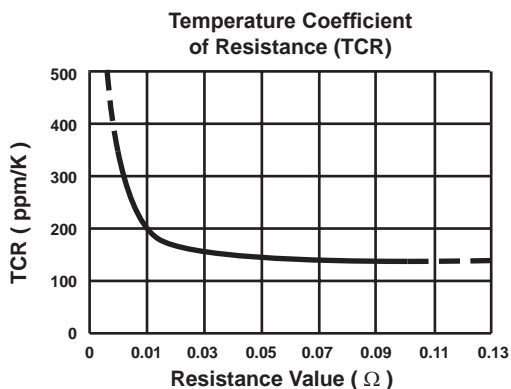
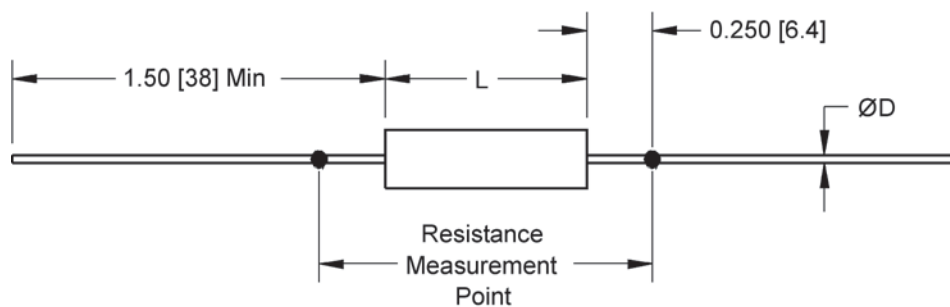


- Resistances from 0.005 to 0.10 Ohms
- Tolerance to $\pm 1\%$
- Resistance Wire TCR: $\pm 20 \text{ ppm/K}$
- For Current Sensing and Shunt Applications
- All Welded Construction
- Low Inductance ($< 10 \text{ nH}$)
- Economical Bare Metal Element

SPECIFICATIONS

Type	Power Rating Watts @ 85°C	Resistance Range (Ω) ¹	Tolerances	TCR (ppm/K)	Dimensions	
					L +0.040 / -0.020" [+1.0 / -0.5mm]	D ± 0.002 " [$\pm 0.05 \text{ mm}$]
MS-1	1	0.005 to 0.10	$\pm 1\%$ / $\pm 5\%$	See Chart	Consult Riedon	0.032 [0.8] 0.040 [1.0]
MS-3	3	0.005 to 0.10	$\pm 1\%$ / $\pm 5\%$	See Chart	Consult Riedon	0.040 [1.0]
MS-5	5	0.005 to 0.05	$\pm 1\%$ / $\pm 5\%$	See Chart	Consult Riedon	0.040 [1.0]

¹ Call Factory for Other Resistances



Ordering Information

Part Number - Resistance - Tolerance - TCR (If not standard)

Example: MS-3 0.05 Ohm 1%

UP Series

Current Sensing Resistors



- Resistances from 0.0005 to 0.05 Ohms
- Tolerance to $\pm 0.05\%$
- Power Rating to 5 Watts
- Low Temperature Coefficient
- For Current Sensing and Shunt Applications
- Low inductance
- All Welded Construction

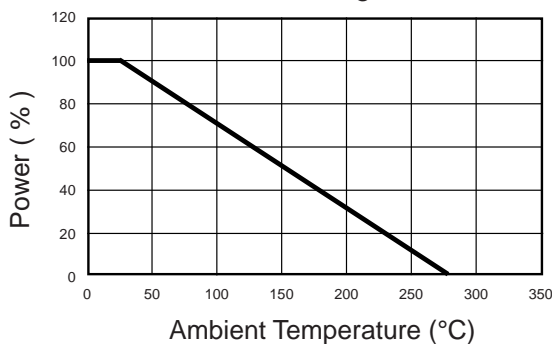


SPECIFICATIONS

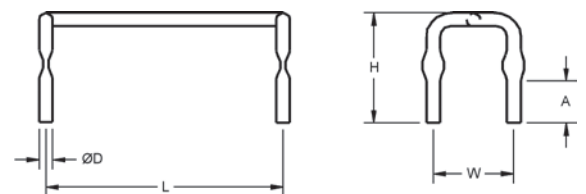
Type	Power Rating W @ 25°C	Resistance Range	L ± 0.020 [± 0.5]	W ± 0.020 [± 0.5]	H ± 0.04 [± 1.0]	A ± 0.020 [± 0.5]	B (Max)	D ± 0.002 [± 0.05]
UP-1	1	0.001 to 0.05	0.700 [17.8]	0.200 [5.1]	0.275 [7.0]	0.115 [2.9]	-	0.040 / 0.051 [1.0 / 1.3]
UP-2	5	0.0005 to 0.002	1.00 [25.4]	0.250 [6.4]	0.440 [11.2]	0.220 [5.6]	1.400 [35.6]	0.081 [2.1]
UP-3	3.5	0.003 to 0.05	1.00 [25.4]	0.250 [6.4]	0.375 [9.5]	0.115 [2.9]	-	0.051 [1.3]

Specification	Value
Tolerances	$\pm 0.05\%$ to $\pm 5\%$ (1% Standard)
Temperature Coefficient	± 90 ppm/K (Call Factory for Others)
Temperature Range	-55°C to +275°C
Inductance	<10 nH
Short Time Overload	5X Rated Power / 5s

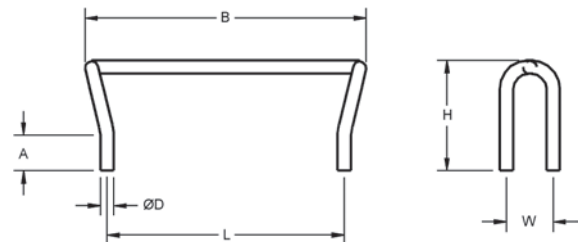
Power Derating Curve



UP-1 / UP-3



UP-2



Ordering Information

Part Number - Resistance - Tolerance - TCR (If not standard)

Example: UP-2 0.001 Ohm 1%

MSR Series

Bare Metal Element Resistors



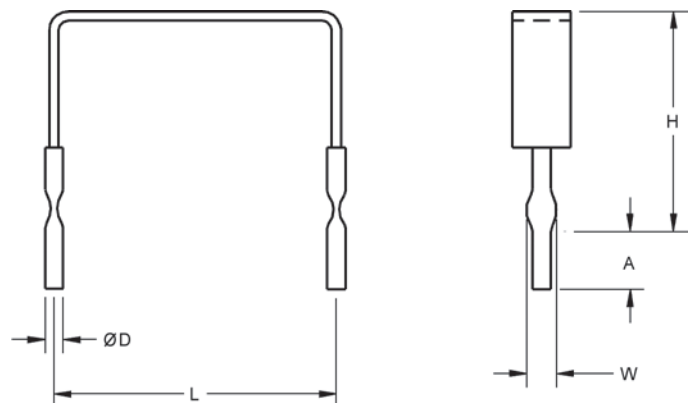
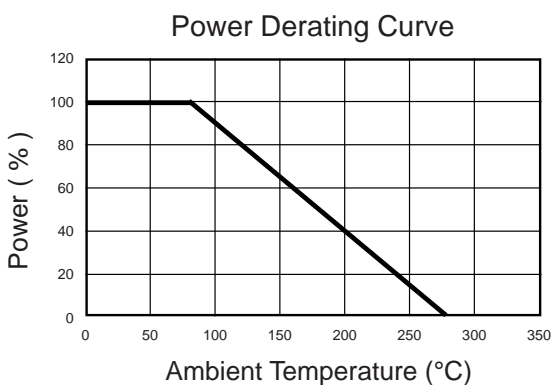
- Resistances from 0.005 to 0.100Ohms
- Tolerance to $\pm 1\%$
- Resistance Wire TCR: $\pm 20\text{ppm/K}$
- For Current Sensing and Shunt Applications
- All Welded Construction
- Low Inductance ($<10\text{nH}$)
- Economical Bare Metal Element



SPECIFICATIONS

Type	Power Rating Watts @ 85°C	Resistance Range (Ω) ¹	Tolerances	Dimensions				
				L +0.040 / -0.020" [+1.0 / -0.5mm]	H ± 0.100 " [$\pm 2.5\text{mm}$]	D ± 0.002 " [$\pm 0.05\text{mm}$]	W +0.010 / -0.005" [+0.25 / -0.13mm]	A ± 0.030 " [$\pm 0.8\text{mm}$]
MSR-1	1	0.005, 0.01, 0.02, 0.025, 0.03, 0.04, 0.05, 0.1	$\pm 1\%$ / $\pm 5\%$	0.450 [11.4]	0.200 [5.1]	0.040 [1.0]	0.065 [1.7]	0.125 [3.2]
MSR-3	3	0.005, 0.01, 0.015, 0.02, 0.025, 0.03, 0.04, 0.05; 0.1	$\pm 1\%$ / $\pm 5\%$	0.600 [15.2]	1.0 [25.4] MAX	0.040 [1.0]	0.065 [1.7]	0.125 [3.2]
MSR-5	5	0.005, 0.01, 0.015, 0.02, 0.025, 0.03, 0.05; 0.1	$\pm 1\%$ / $\pm 5\%$	0.800 [20.3]	1.0 [25.4] MAX	0.040 [1.0]	0.065 [1.7]	0.125 [3.2]

¹ Call Factory for Other Resistances



Ordering Information

Part Number - Resistance - Tolerance

Example: MSR-3 0.100Ohm 1%

MT Series

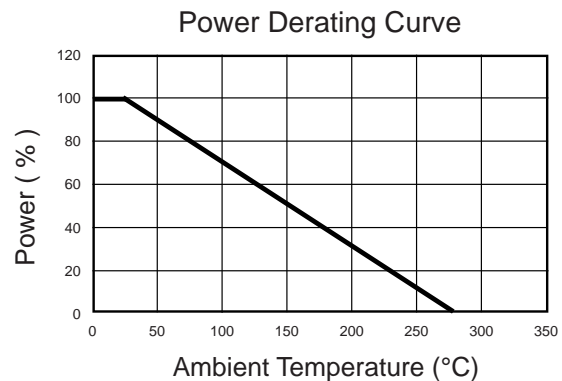
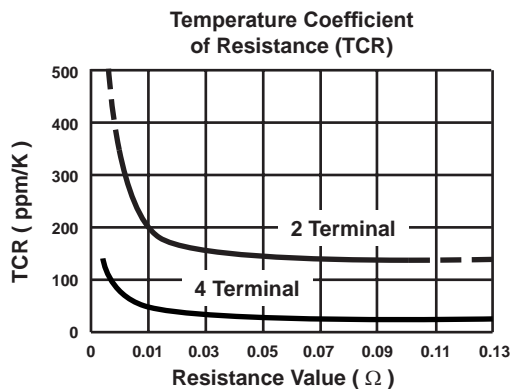
Low Ohm Power Resistors



- Resistances from 0.003 to 0.10 Ohms
- Tolerance to $\pm 0.1\%$
- TCR's to ± 20 ppm/K (Four Terminal Version)
- For Current Sensing and Shunt Applications
- All Welded Construction
- Low Inductance (<10nH)
- Four Terminal Versions Available (Consult Factory)

SPECIFICATIONS

Specification	Value	
Resistance Range	0.003 to 0.10 Ohms	
Tolerances	2 Terminal: $\pm 1\%$ / $\pm 5\%$ (Contact Factory for Others) 4 Terminal: $\pm 0.1\%$ / $\pm 0.5\%$ / $\pm 1\%$ / $\pm 5\%$ (Contact Factory for Others)	
Temperature Coefficient	See Chart Below	
Inductance	<10nH	
Dielectric Strength	1000VAC (500VAC for MT-1A and MT-2A)	
Insulation Resistance	>1000 MOhms / Dry	
Environmental Performance (MIL-STD 202)	ΔR	Test Conditions
Load Life	$\pm 1\%$	70°C / 90 min ON / 30 min OFF / 1000 hr
Moisture Resistance	$\pm 1\%$	40°C / 90-95% RH / DC 0.1W / 1000 hr
Temperature Cycling	$\pm 1\%$	-40°C for 30 min / +125°C for 30 min / 1000 hr
Short Term Overload	$\pm 1\%$	5X rated power for 5 seconds



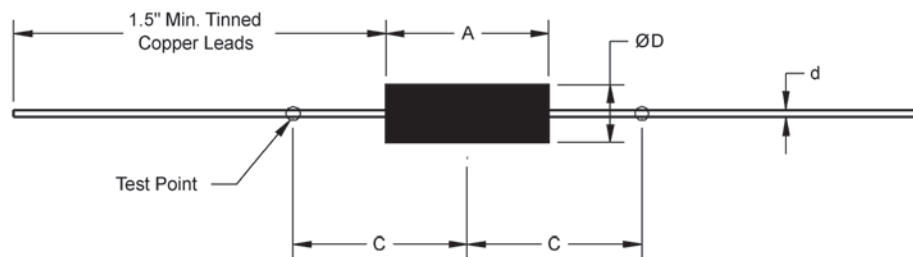
Ordering Information

Part Number - Resistance - Tolerance - TCR (if not standard) - 4T (if desired)
 Example: MT-5 0.01 Ohm 1% 4T

SPECIFICATIONS (continued)

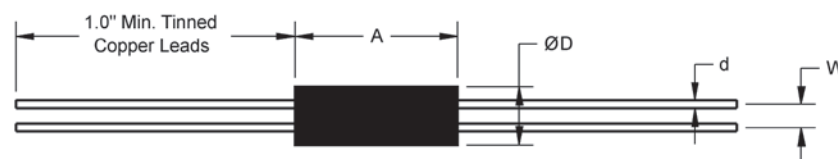
Type	Power Rating Watts @ 25°C	Dimensions				
		A ±0.020" [±0.5mm]	D ±0.020" [±0.5mm]	C ±0.020" [±0.5mm]	d ±0.002" [±0.05mm]	W (4T) ±0.010" [±0.3mm]
MT-1A	1	0.430 [10.9]	0.120 [3.0]	0.590 [15.0]	0.025 [0.6]	-
MT-2A	2	0.430 [10.9]	0.120 [3.0]	0.590 [15.0]	0.032 [0.8]	-
MT-2B	3	0.580 [14.7]	0.200 [5.1]	0.665 [16.9]	0.032 [0.8]	-
MT-2C	3	0.500 [12.7]	0.250 [6.4]	0.625 [15.9]	0.032 [0.8]	-
MT-3	4	0.600 [15.2]	0.250 [6.4]	0.675 [17.1]	0.032 [0.8]	0.125 [3.2]
MT-4	4.5	0.750 [19.1]	0.250 [6.4]	0.750 [19.1]	0.040 [1.0]	0.125 [3.2]
MT-5	5	0.890 [22.6]	0.335 [8.5]	0.820 [20.8]	0.040 [1.0]	0.125 [3.2]
MT-6	6	1.055 [26.8]	0.395 [10.0]	0.903 [22.9]	0.040 [1.0]	0.125 [3.2]
MT-10	10	1.755 [44.58]	0.355 [9.02]	1.338 [34.0]	0.040 [1.0]	0.125 [3.2]

Two Terminal



Terminal Strength: 10lb Pull Test

Four Terminal (4T)



CLS Series

Current Sensing Chip Resistor

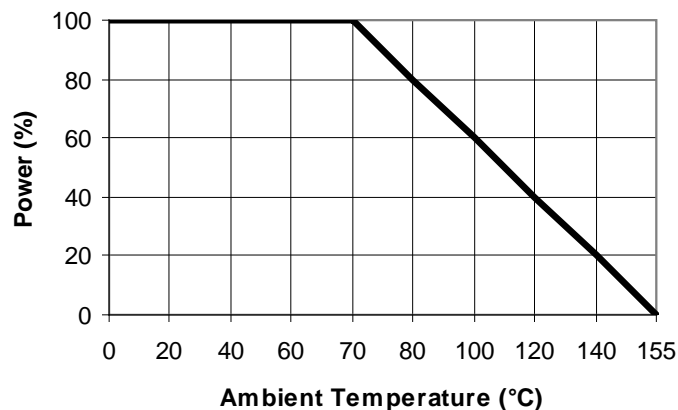


- Resistances from 0.01 to 10hms
- Power Rating 0.06 to 1 Watt
- Resistance Tolerances to $\pm 1\%$
- TCR's to ± 150 ppm/K
- Alumina Substrate for High Power Dissipation
- Sizes: 0402 / 0603 / 0805 / 1206 / 2010 / 2512

SPECIFICATIONS

Type	CLS0402	CLS0603	CLS0805	CLS1206	CLS2010	CLS2512
Power Rating (W) at 70°C	0.0625	0.1	0.125	0.25	0.5	1.0
Resistance Range (Ω)	0.05 to 1.0	0.02 to 1.0		0.01 to 1.0		
Tolerances	1% / 2% / 5%					
Temperature Coefficient (depending on value)	± 200 to ± 400 ppm	± 200 to ± 600 ppm ± 100 ppm upon request				
Operating Temperature range	-55 to +155°C					
Dimensions (LxW) mm [inches]	1.00 x 0.50 [0.04 x 0.02]	1.60 x 0.80 [0.06 x 0.03]	2.00 x 1.25 [0.08 x 0.05]	3.10 x 1.55 [0.12 x 0.06]	5.00 x 2.50 [0.20 x 0.10]	6.30 x 3.10 [0.25 x 0.12]
Packaging (pcs) Tape and Reel	10,000	5,000			4,000	

Power Derating Curve

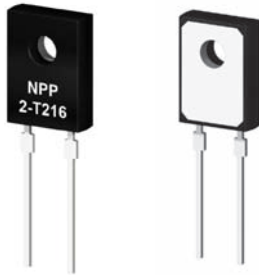


Ordering Information

Part Number - Resistance - Tolerance - TCR - Packaging

Example: CLS 2512 0.500Ohms 1%

(Note: if no TCR is specified: The highest value will be supplied)



- Resistances from 0.01 to 51K Ohms
- Power Rating to 20Watt
- Resistance Tolerances to $\pm 0.05\%$
- TCR to $\pm 5\text{ppm/K}$
- TO-126 Housing
- Convenient SMD DPak Available
- Low Inductance ($< 50\text{nH}$)



SPECIFICATIONS

Type	Power Rating		Thermal Resistance	Resistance Range ³		Tolerances	Temperature Coefficients
	Heatsink ¹	Free Air ²		Min	Max		
NPR 2-T126	20W	1W	5.9K/W	0.01 Ω	51K Ω	$\pm 1\%$ (R>0.1 Ω) $\pm 5\%$	$\pm 50\text{ppm/K}$ (R>10 Ω) $\pm 100\text{ppm/K}$ (R>0.1 Ω) $\pm 250\text{ppm/K}$
NPP 2-T126	5W	0.5W	6.0K/W	0.1 Ω	51K Ω	$\pm 0.05\%$ / $\pm 0.1\%$ / $\pm 0.25\%$ (R>5 Ω) $\pm 0.5\%$ (R>1 Ω) / $\pm 1\%$ (R>0.1 Ω) $\pm 2\%$ / $\pm 5\%$	± 5 / $\pm 10\text{ppm/K}$ (R>1 Ω) $\pm 25\text{ppm/K}$ (R>0.1 Ω) $\pm 100\text{ppm/K}$

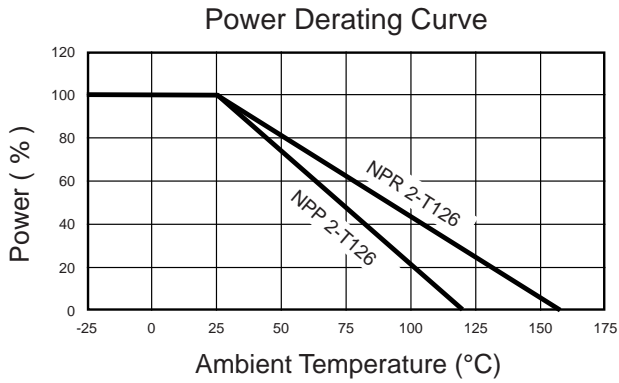
¹ Power rating based on 25°C Flange Temperature

² Power rating based on 25°C Ambient Temperature

³ Consult Factory for Higher or Lower Values

Specification	Value	
Maximum Current	25A	
Temperature Range	-55°C to +155°C : NPP 2T126 -55°C to +120°C : NPR 2-T126	
Dielectric Strength	2000 VAC	
Max. Operating Voltage	500 V	
Insulation Resistance	>1000 Meg-Ohm	
Environmental Performance	ΔR	Test Conditions
Load Life	$\pm 1\%$	25°C / 90 min ON / 30 min OFF / 1000 hr
Humidity Resistance	$\pm 1\%$	40°C / 90-95% RH / DC 0.1W / 1000 hr
Temperature Cycle	$\pm 0.25\%$	-55°C for 30 min / +155°C for 30 min / 1000 hr
Solder Heat	$\pm 0.1\%$	+350°C / 3s
Vibration	$\pm 0.25\%$	

SPECIFICATIONS (continued)



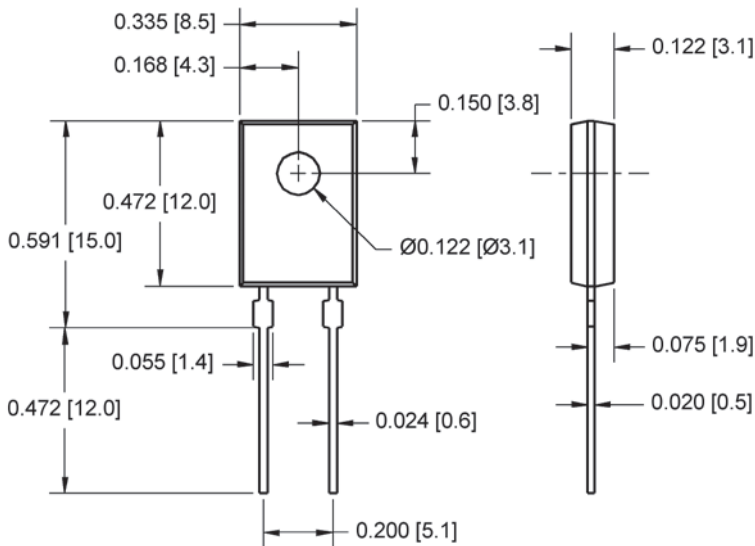
Power Rating Notes -

The NPR 2-T126 Series Foil Resistors must be attached to a suitable heatsink. The maximum internal resistor temperature is 155°C (120°C for the NPP 2-T126).

To specify an appropriate heatsink use the following formula :

$$R_{\theta H} = \frac{T_{MAX} - (P \times R_{\theta R}) - T_A}{P}$$

Where: $R_{\theta H}$ = Thermal Resistance of Heatsink (K/W)
 $R_{\theta R}$ = Thermal Resistance of Resistor (K/W)
 T_{MAX} = Maximum Temperature of Resistor
 T_A = Ambient Temperature of Heatsink (°C)
 P = Power Through Resistor (W)



Mounting Notes -

The NPR 2-T126 Series Film Resistors must be attached to a suitable heatsink. Mount resistor using thermal grease to a clean / flat surface. Use a compression washer to provide 150 to 300 pounds (665 to 1330N) of mounting force. Torque mounting screw to 8 in-lbs (0.9 Nm).

Ordering Information

Part Number - Resistance - Tolerance - TCR

Example: NPR 2-T126 0.5 Ohm 1% 100ppm

S & SL Series

Surface Mount Wirewound Resistors



- Resistance: 0.005 to 50kOhms
- High Power: to 4Watts
- Tolerance to $\pm 0.01\%$
- Low Temperature Coefficient to $\pm 20\text{ppm/K}$
- Superior Surge Handling Capability
- Reel Packaging
- Non-Inductive Windings are Available (Type SN)

SPECIFICATIONS

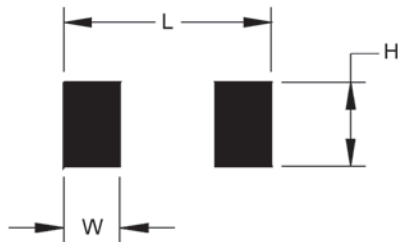
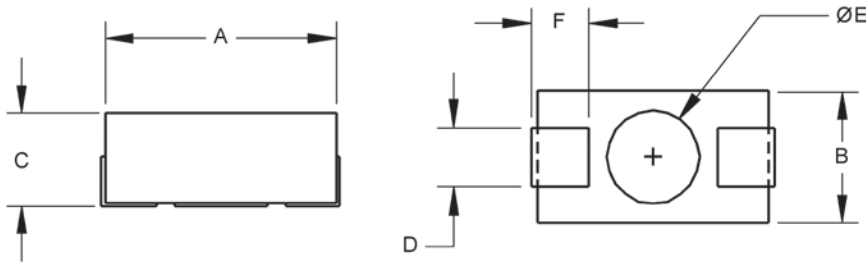
Type	Power Rating Watts @ 70°C	Resistance ¹ Range (Ω)	Maximum Working Voltage
S-1	0.5	0.01 to 400	33
S-2	1	0.005 to 3k	58
S-4	2	0.01 to 15k	127
S-3	3	0.01 to 25k	150
S-5	4	0.01 to 50k	212
SL-2	1	0.005 to 0.05	0.31
SL-4	2	0.005 to 0.07	0.45

¹ For non-inductive windings / divide maximum resistance by 2

Specification	Value
Tolerances	S: $\pm 0.01\%$ to $\pm 5\%$ SL: $\pm 0.1\%$ to $\pm 5\%$
Temperature Coefficient	S: $>10\Omega$: $\pm 20\text{ppm/K}$ S: 1Ω to 10Ω : $\pm 50\text{ppm/K}$ S: $<1\Omega$: Call Factory SL: $\pm 120\text{ppm/K}$
Temperature Range	-55°C to $+275^\circ\text{C}$
Dielectric Strength	S: 1000 VAC SL: 500 VAC
Insulation Resistance	>1000 MOhms / Dry
Reel / Tape Width (mm)	S-1: 12 / S-2: 16 / S-4: 24 / S-5: 32 / SL-2: 16 / SL-4: 24
Environmental Performance (MIL-STD 202)	ΔR
Dielectric	$\pm 0.5\% + 0.05\Omega$
Load Life	$\pm 1\% + 0.05\Omega$
Storage	$\pm 0.5\% + 0.05\Omega$
Moisture Resistance	$\pm 1\% + 0.05\Omega$
Thermal Shock	$\pm 0.5\% + 0.05\Omega$
5X Overload (5s)	$\pm 0.5\% + 0.05\Omega$
Shock	$\pm 0.5\% + 0.05\Omega$

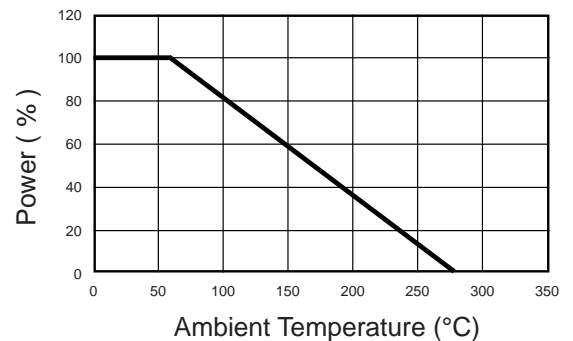
SPECIFICATIONS (continued)

Type	Dimensions						Stand-Off		Footprint		
	A ±0.015" [±0.4mm]	B ±0.015" [±0.4mm]	C ±0.015" [±0.4mm]	D ±0.015" [±0.4mm]	F ±0.015" [±0.4mm]	Lead Thick- ness ±0.002" [±0.05mm]	E ±0.015" [±0.4mm]	Height ±0.005" [±0.13mm]	W ±0.015" [±0.4mm]	H ±0.015" [±0.4mm]	L ±0.015" [±0.4mm]
S-1	0.190 [4.8]	0.130 [3.3]	0.110 [2.8]	0.060 [1.5]	0.040 [1.0]	0.006 [0.15]	0.100 [2.5]	0.005 [0.13]	0.062 [1.6]	0.100 [2.5]	0.250 [6.4]
S-2	0.260 [6.6]	0.155 [3.9]	0.125 [3.2]	0.070 [1.8]	0.070 [1.8]	0.006 [0.15]	0.120 [3.0]	0.005 [0.13]	0.096 [2.4]	0.112 [2.8]	0.337 [8.6]
S-4	0.450 [11.4]	0.250 [6.4]	0.180 [4.6]	0.120 [3.0]	0.100 [2.5]	0.006 [0.15]	0.190 [4.8]	0.005 [0.13]	0.155 [3.9]	0.230 [5.8]	0.540 [13.7]
S-3	0.625 [15.9]	0.270 [6.9]	0.250 [6.4]	0.120 [3.0]	0.135 [3.4]	0.006 [0.15]	0.150 [3.8]	0.005 [0.13]	0.200 [5.1]	0.150 [3.8]	0.700 [17.8]
S-5	0.820 [20.8]	0.295 [7.5]	0.280 [7.1]	0.150 [3.8]	0.190 [4.8]	0.006 [0.15]	0.245 [6.2]	0.005 [0.13]	0.220 [5.6]	0.250 [6.4]	0.900 [22.9]
SL-2	0.260 [6.6]	0.155 [3.9]	0.100 [2.5]	0.070 [1.8]	0.070 [1.8]	0.006 [0.15]	0.120 [3.0]	0.005 [0.13]	0.096 [2.4]	0.112 [2.8]	0.337 [8.6]
SL-4	0.450 [11.4]	0.250 [6.4]	0.100 [2.5]	0.120 [3.0]	0.100 [2.5]	0.006 [0.15]	0.190 [4.8]	0.005 [0.13]	0.155 [3.9]	0.230 [5.8]	0.540 [13.7]



Solder Pad Dimensions

Power Derating Curve



Ordering Information

For Non-Inductive Windings / insert the letter "N" (i.e. SN-4)
 Part Number - Resistance - Tolerance - TCR (If not standard)
 Example: S-4 100 Ohm 1%

SC-2

Four Terminal / Surface Mount Wirewound Resistors



- Resistances from 0.005 to 1kOhms
- Tolerance to $\pm 0.005\%$
- TCR's to $\pm 5\text{ppm/K}$
- Superior Surge Handling Capability
- Up to 25A Current
- Reel Packaging
- Non-Inductive Windings are Available (Type SCN)

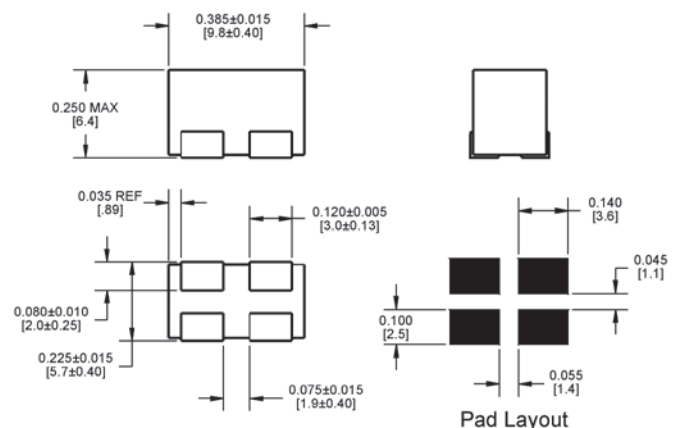
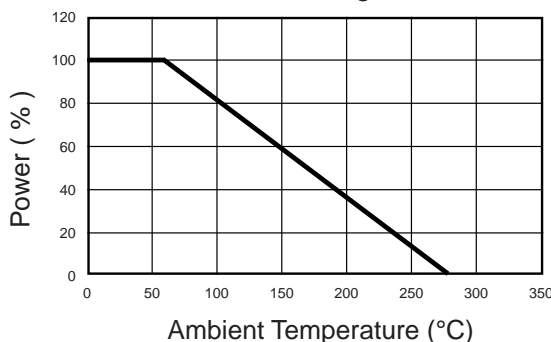
SPECIFICATIONS

Type	Power Rating Watts @ 70°C	Maximum Current	Resistance Range (Ω)	Minimum Tolerance ¹	Minimum TC ¹
SC-2	2W	25A	0.005 to 1 1 to 10 10 to 100 >100	$\pm 0.1\%$ $\pm 0.05\%$ $\pm 0.01\%$ $\pm 0.005\%$	$\pm 30\text{ppm/K}$ $\pm 20\text{ppm/K}$ $\pm 10\text{ppm/K}$ $\pm 5\text{ppm/K}$

¹ Contact Factory for others.

Specification	Value	
Temperature Range	-55°C to +275°C	
Dielectric Strength	1000 VAC	
Insulation Resistance	>1000 MOhms / Dry	
Environmental Performance (MIL-STD 202)	ΔR	Test Conditions
Load Life	$\pm 1\%$	70°C / 90 min ON / 30 min OFF / 1000 hr
Moisture Resistance	$\pm 1\%$	40°C / 90-95% RH / DC 0.1W / 1000 hr
Temperature Cycling	$\pm 0.5\%$	-40°C for 30 min / +125°C for 30 min / 1000 hr
Short Term Overload	$\pm 0.5\%$	5X rated power for 5 seconds

Power Derating Curve



Ordering Information

For Non-Inductive Windings / insert the letter "N" (i.e. SCN-2)
 Part Number - Resistance - Tolerance - TCR (If not standard)
 Example: SC-2 1 Ohm 0.1%