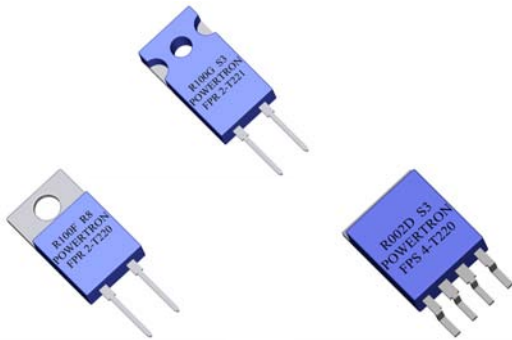


FPR FPS 2/4-T220 T221

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	

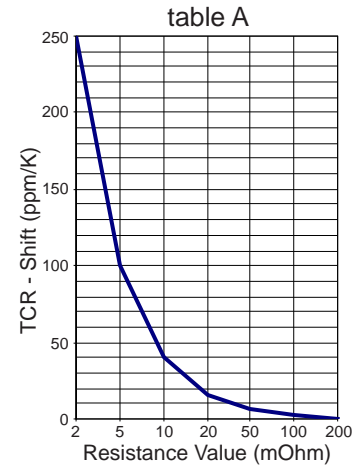
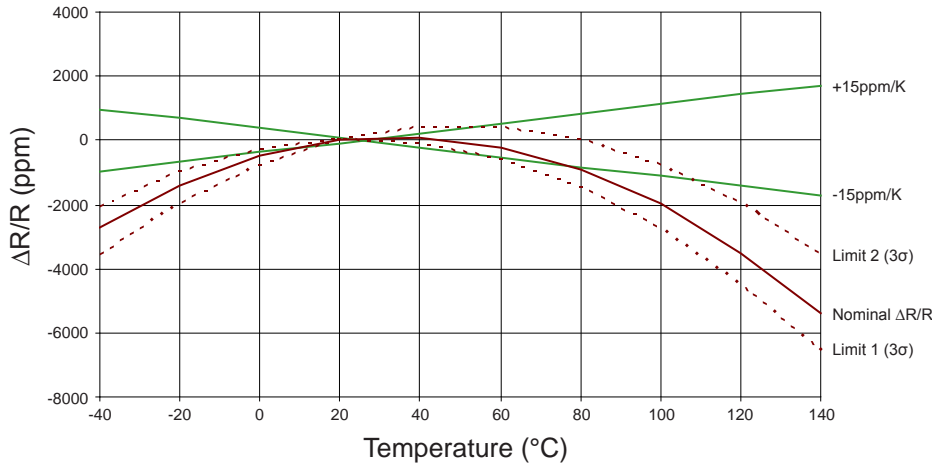
Ordering Information

Part Number - Resistance - Contact - Tolerance

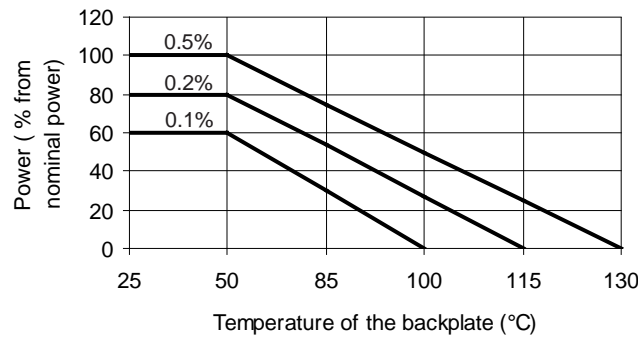
FPS 4-T220 0.01 Ohms C 0.1%

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 :

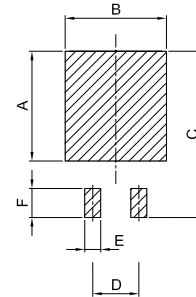
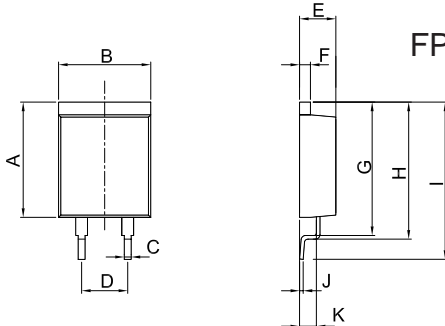
$$R_{0H} = \frac{T_{MAX} - (P \times R_{0R}) - T_A}{P}$$

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

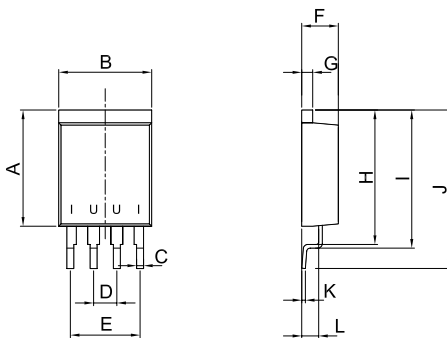
FPS 2-T220



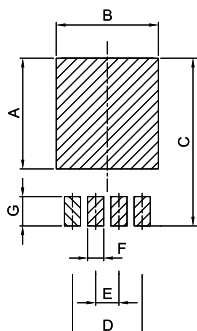
Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	12.70	0.2	0.50	0.008
B	10.16	0.2	0.40	0.008
C	0.76	0.1	0.03	0.004
D	5.08	0.1	0.20	0.004
E	4.00	0.1	0.16	0.004
F	1.20	0.1	0.05	0.004
G	14.60	0.2	0.57	0.008
H	15.00	0.2	0.59	0.008
I	17.33	0.2	0.68	0.008
J	0.40	0.1	0.02	0.004
K	1.85	0.1	0.07	0.004

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



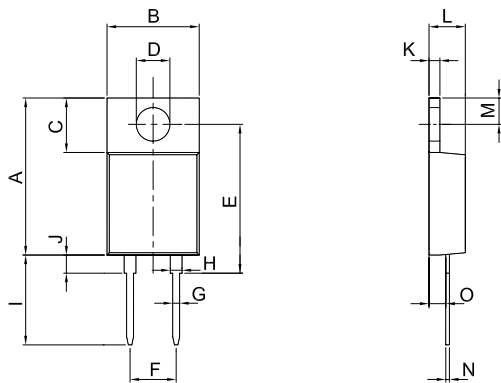
Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	12.70	0.2	0.50	0.008
B	10.16	0.2	0.40	0.008
C	0.76	0.1	0.03	0.004
D	2.54	0.1	0.10	0.004
E	7.62	0.1	0.30	0.004
F	4.00	0.1	0.16	0.004
G	1.20	0.1	0.05	0.004
H	14.60	0.2	0.57	0.008
I	15.00	0.2	0.59	0.008
J	17.33	0.2	0.68	0.008
K	0.40	0.1	0.02	0.004
L	1.85	0.1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

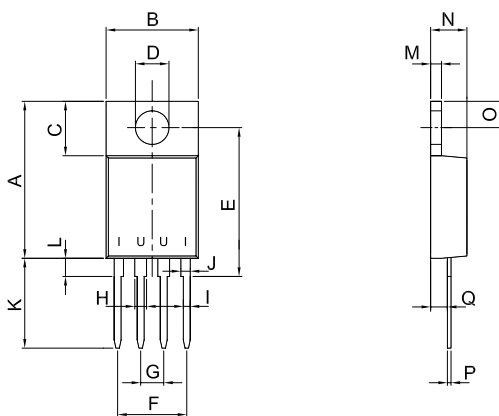
SPECIFICATIONS (continued)

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

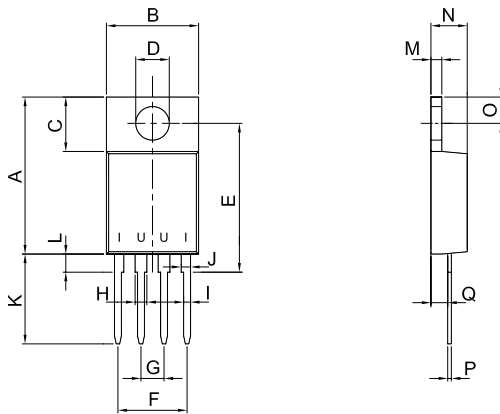
FPR 4-T220



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

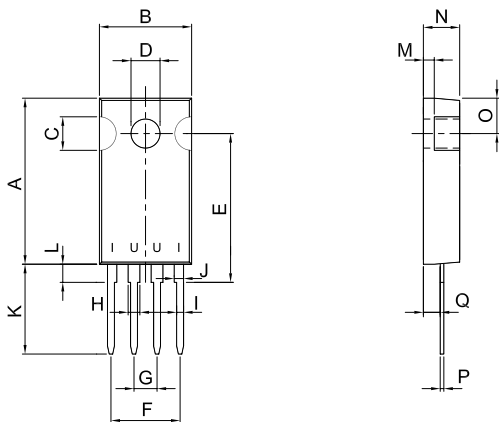
SPECIFICATIONS (continued)

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

USR UNR 2-T220 / T220B / T221

USS UNS 2-T220

Precision Foil Resistors



- Resistances from 0.5Ohm to 150kOhms
- Power Rating to 10Watt
- Resistance Tolerances to $\pm 0.01\%$
- TCR to $\pm 3\text{ppm/K}$
- Load Stability to 0.01%
- TO-220 Housing
- Convenient SMD D2Pak Available



SPECIFICATIONS

Type	USR / USS	UNR / UNS
Resistance Range	0.5 Ohms to 150 kOhms	0.5 Ohms to 5 kOhms
Power rating free air 70°C (R<50R0) free air 70°C (R>50R0) with heatsink (R<50R0) with heatsink (R>50R0)	1.5W 1.0W 10W 6W	1.5W 1.0W 15W 10W
Thermal Resistance Rthj-c R<50R0 R>50R0	10.8 K/W 18.8 K/W	6.8 K/W 10.8 K/W
Tolerances from 0.5 Ohms from 10.0 Ohms from 25.0 Ohms from 50.0 Ohms	0.1% / 0.25% / 0.5% / 1% 0.05% / 0.1% / 0.25% / 0.5% / 1% 0.02% / 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)	
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	2	
Max. Torque	1.0 Nm	
Notes	Specially designed for applications with fast changing electrical load	

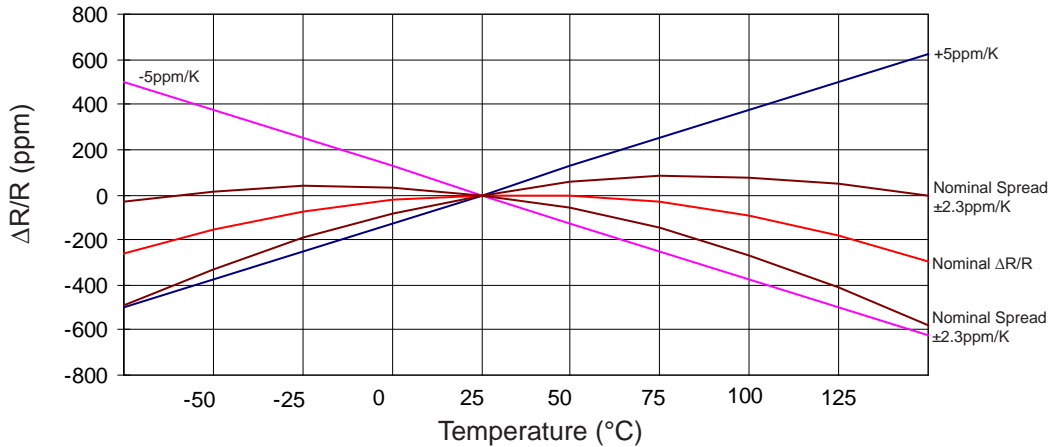
Ordering Information

Part Number - Resistance - Contact - Tolerance - TCR

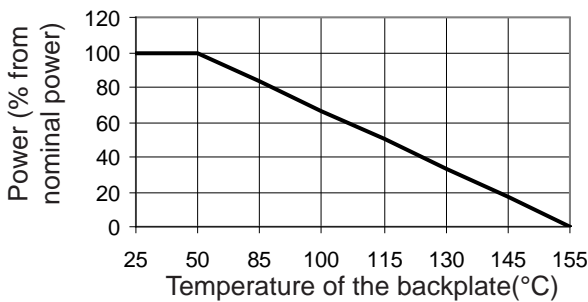
UNR 2-T220B 5.7kOhms C 0.5% 3ppm

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.

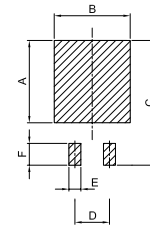
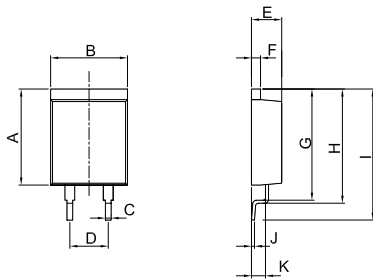
To specify an appropriate heatsink use the following formula :

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

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 2-T220 / UNS 2-T220



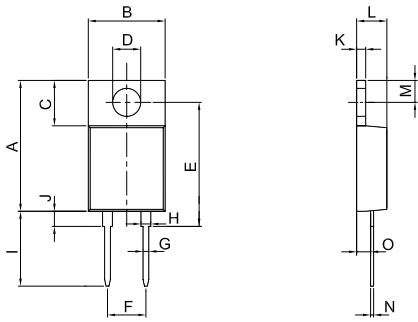
Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	12.70	0.2	0.50	0.008
B	10.16	0.2	0.40	0.008
C	0.76	0.1	0.03	0.004
D	5.08	0.1	0.20	0.004
E	4.00	0.1	0.16	0.004
F	1.20	0.1	0.05	0.004
G	14.60	0.2	0.57	0.008
H	15.00	0.2	0.59	0.008
I	17.33	0.2	0.68	0.008
J	0.40	0.1	0.02	0.004
K	1.85	0.1	0.07	0.004

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

SPECIFICATIONS (continued)

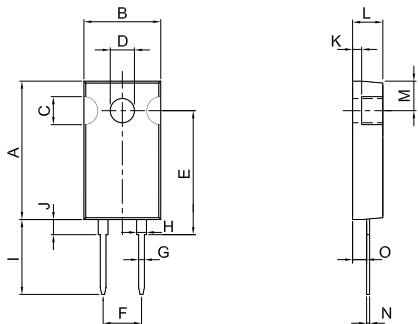
Dimensions

USR 2-T220B / UNR 2-T220B



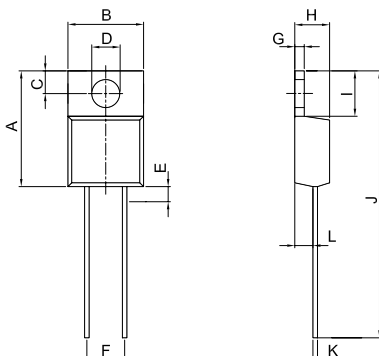
Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	17.30	0.2	0.68	0.008
B	10.16	0.2	0.40	0.008
C	6.00	0.1	0.24	0.004
D	Ø3.7	0.1	Ø0.146	0.004
E	16.40	0.2	0.65	0.008
F	5.08	0.1	0.20	0.004
G	0.76	0.1	0.03	0.004
H	1.30	0.1	0.05	0.004
I	10.00	0.2	0.39	0.008
I (C-Contact)	13.80	0.2	0.54	0.008
J	2.00	0.1	0.08	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

USR 2-T221 / UNR 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	Ø3.2	0.1	Ø0.126	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

USR 2-T220 / UNR 2-T220

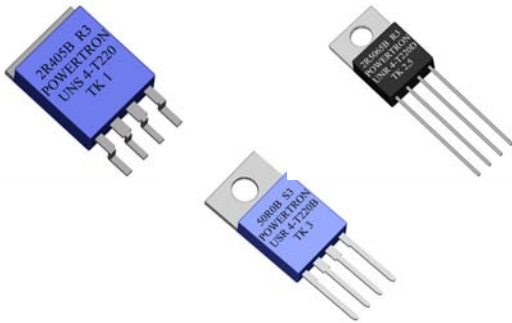


Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	15.30	0.2	0.60	0.008
B	10.00	0.2	0.39	0.008
C	2.80	0.1	0.11	0.004
D	Ø3.7	0.1	Ø0.146	0.004
E	2.00	0.1	0.08	0.004
F	5.08	0.1	0.20	0.004
G	1.27	0.1	0.05	0.004
H	4.60	0.1	0.18	0.004
I	6.00	0.2	0.24	0.008
J	35.30	2.0	1.39	0.079
K	Ø0.6	0.1	Ø0.02	0.004
L	2.41	0.1	0.09	0.004

USR UNR 4-T220 / T220B

USS UNS 4-T220

Precision Shunt Resistors



- Resistances from 0.20hm 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	

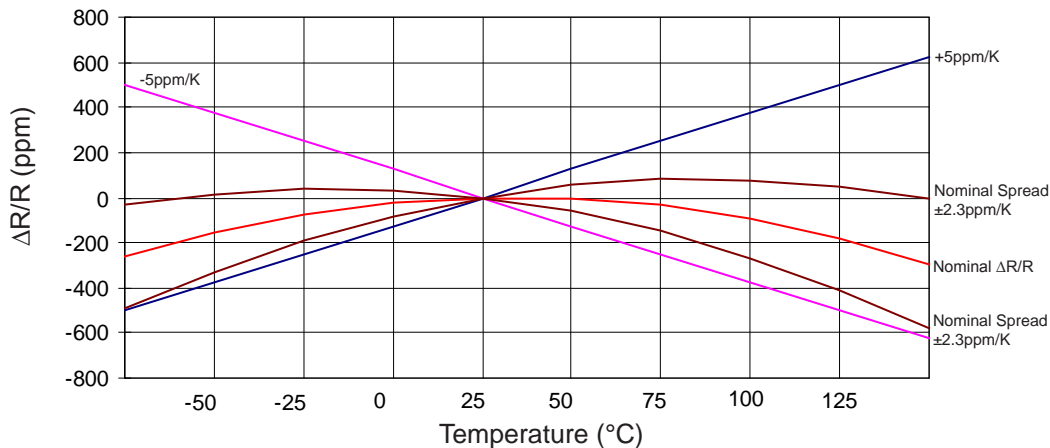
Ordering Information

Part Number - Resistance - Contact - Tolerance - TCR

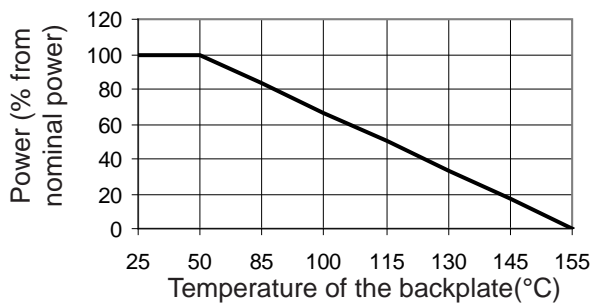
UNR 2-T220B 5.7kOhms C 0.5% 3ppm

SPECIFICATIONS (continued)

Temperature Coefficient



Derating



Power Rating Notes -

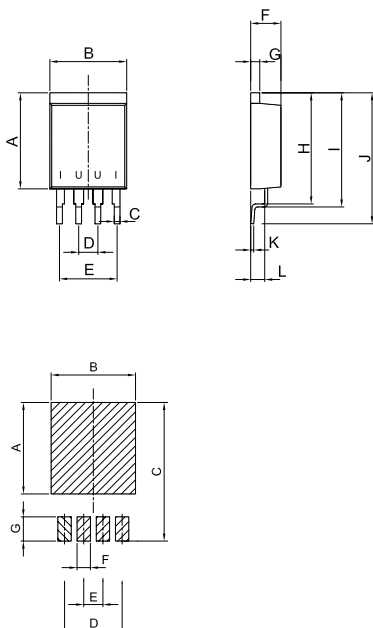
The U-Series Resistors must be attached to a suitable heatsink. The maximum internal resistor temperature is 155°C. To specify an appropriate heatsink use the following formula :

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

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



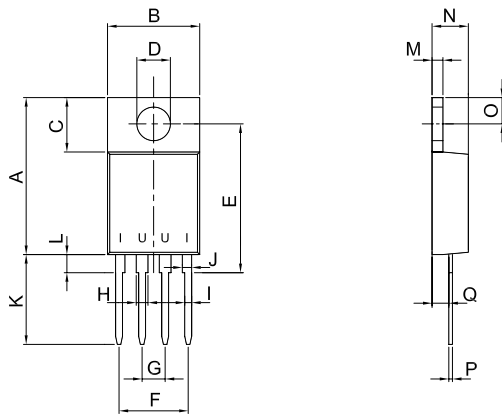
Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	12.70	0.2	0.50	0.008
B	10.16	0.2	0.40	0.008
C	0.76	0.1	0.03	0.004
D	2.54	0.1	0.10	0.004
E	7.62	0.1	0.30	0.004
F	4.00	0.1	0.16	0.004
G	1.20	0.1	0.05	0.004
H	14.60	0.2	0.57	0.008
I	15.00	0.2	0.59	0.008
J	17.33	0.2	0.68	0.008
K	0.40	0.1	0.02	0.004
L	1.85	0.1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

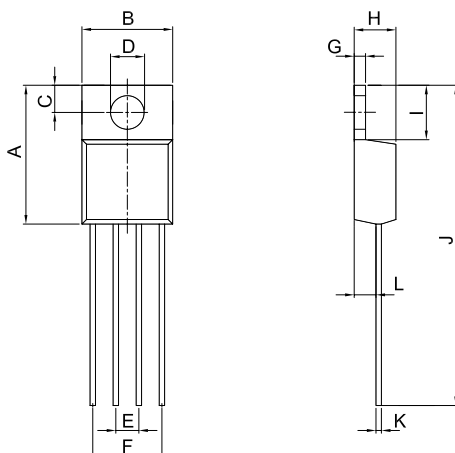
Dimensions

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

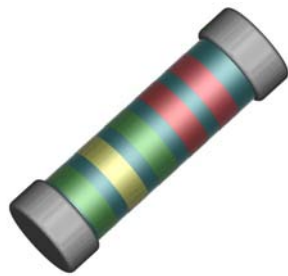
USR 4-T220 / UNR 4-T220



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

MFM Series

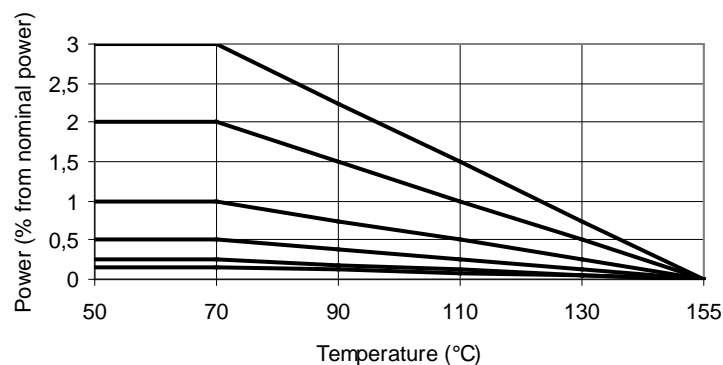
Film Resistors



- Resistances from 10Ohms to 22MOhms
- Power Rating to 1Watts
- Resistance Tolerances to $\pm 0.05\%$
- TCR's to $\pm 50\text{ppm/K}$
- Convenient RN Type Package Styles

SPECIFICATIONS

Type	MFM55	MFM60	MFM65
DIN	0204	0207	
Resistance Range	10 Ohms to 10MOhms		10 Ohms to 22 MOhms
Power rating (70°C)	0.25W	0.50W	1.0W
Tolerances	0.05% / 0.1% / 0.25% / 0.5% / 1% / 5%		
Temperature Coefficient	5 / 10 / 15 / 25 / 50ppm/K		
Operating Voltage (Umax)	250V	300V	350V
Operating Temperature Range	-55 to 125°C		
Insulation Resistance	>1G		
Insulation Voltage	300V	600V	700V

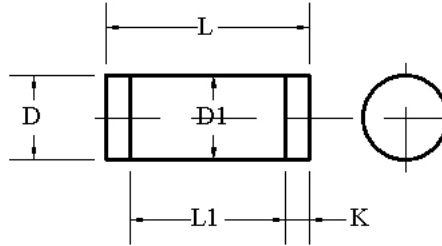


Ordering Information

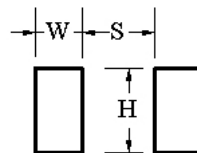
Part Number - Resistance - Tolerance
MFM55 100 kOhms 0.5%

SPECIFICATIONS (continued)

Dimensions



Type	Dimension	mm	tol. (±mm)	inches	tol. (±inches)
MFM55	L	3.50	0.2	0.14	0.008
	L1	1.60	0.2	0.06	0.008
	D	1.30	0.2	0.05	0.008
	K	0.80	0.1	0.03	0.004
	D1	1.05	0.1	0.04	0.004
MFM60	L	5.50	0.2	0.22	0.008
	L1	3.50	0.2	0.14	0.008
	D	2.10	0.2	0.08	0.008
	K	1.00	0.1	0.04	0.004
	D1	1.60	0.1	0.06	0.004
MFM65	L	5.90	0.2	0.23	0.008
	L1	3.90	0.2	0.15	0.008
	D	2.10	0.2	0.08	0.008
	K	1.20	0.1	0.05	0.004
	D1	1.60	0.1	0.06	0.004



Type	Dimension	mm	tol. (±mm)	inches	tol. (±inches)
MFM55	S	1.60	0.2	0.06	0.008
	W	2.50	0.2	0.10	0.008
	H	2.50	0.2	0.10	0.008
MFM60	S	2.60	0.2	0.10	0.008
	W	2.50	0.2	0.10	0.008
	H	2.50	0.2	0.10	0.008
MFM65	S	2.80	0.2	0.11	0.008
	W	2.80	0.2	0.11	0.008
	H	2.80	0.2	0.11	0.008

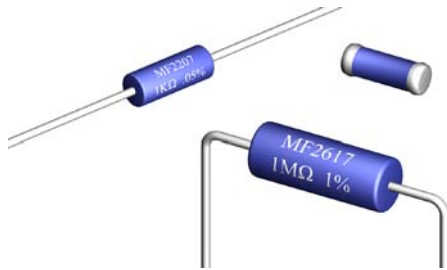
Ordering Information

MFM70 1 MOhms 5%

MFM55 100 kOhms 0.5%

MF2000 Series

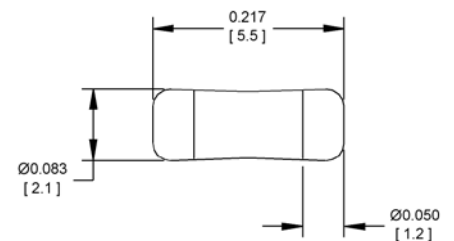
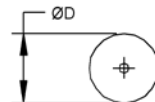
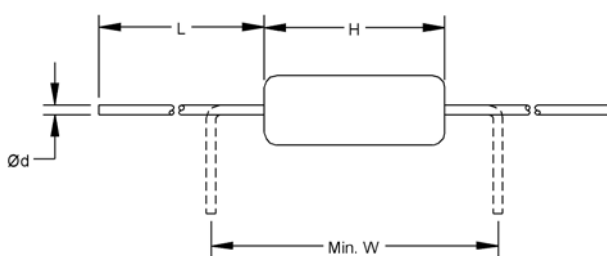
Precision / Metal Film Resistors



- Resistances from 1 to 10MOhms
- Power Rating 0.4 to 0.65Watts
- Resistance Tolerances to $\pm 0.05\%$
- TCR's to $\pm 3\text{ppm/K}$
- Very Low Inductance
- Matched Sets Available
- E192 Values in Stock

SPECIFICATIONS

Type	Power Rating Watts @ 70°C	Resistance Range (Ω)	Maximum Voltage	H _(MAX)	D _(MAX)	d $\pm 0.002^*$ [$\pm 0.05\text{mm}$]	L _(MIN)	W _(MIN)	RN Size
MFM2207	0.40	1 to 5M	300	(See MFM2207 Drawing)					-
MF2207	0.40	1 to 10M	300	0.260 [6.5]	0.100 [2.5]	0.028 [0.7]	1.20 [30]	0.300 [7.5]	RN55
MF2617	0.65	3 to 10M	500	0.600 [15.2]	0.230 [5.8]	0.032 [0.8]	1.20 [30]	0.690 [17.5]	RN65



MF2207

Specification	Value
Resistance Range	1 Ohms to 10MOhms
Tolerances	$\pm 0.05\%$ to $\pm 1\%$
Temperature Coefficient	(See Charts)
Temperature Range	-25°C to +125°C (TC $\geq 25\text{ppm/K}$) -10°C to +85°C (TC $< 25\text{ppm/K}$)
Insulation Resistance	>10000 MOhms
Climatic Category	55/125/56
Max Soldering Temperature	+260°C / 10s
Voltage Coefficient	< 5ppm/V

SPECIFICATIONS (continued)

MF2207 TCR / Tolerance / Resistance Chart

TCR (\pm ppm/K)	Resistances Available at These Tolerances				
	$\pm 0.05\%$	$\pm 0.1\%$	$\pm 0.25\%$	$\pm 0.5\%$	$\pm 1\%$
5	50 - 250K	10 - 500K	10 - 500K	10 - 500K	-
10	50 - 510K	5 - 1M	5 - 1M	5 - 1M	-
15	50 - 510K	5 - 1.5M	5 - 1.5M	5 - 2M	1 - 2M
25	50 - 510K	5 - 1.5M	5 - 3M	2 - 5M	1 - 5M
50	50 - 510K	5 - 2M	3 - 3M	2 - 5M	1 - 5M

MF2207 TCR / Tolerance / Resistance Chart

TCR (\pm ppm/K)	Resistances Available at These Tolerances				
	$\pm 0.05\%$	$\pm 0.1\%$	$\pm 0.25\%$	$\pm 0.5\%$	$\pm 1\%$
3	50 - 120K	30 - 200K	30 - 200K	30 - 200K	-
5	50 - 250K	10 - 500K	10 - 500K	10 - 500K	-
10	50 - 510K	5 - 1M	50 - 1M	50 - 1M	-
15	50 - 510K	5 - 1.5M	5 - 2M	5 - 2M	1 - 2M
25	50 - 510K	5 - 3M	2 - 3M	2 - 5M	1 - 5M
50	50 - 510K	5 - 3M	2 - 3M	2 - 10M	1 - 10M

MF2617 TCR / Tolerance / Resistance Chart

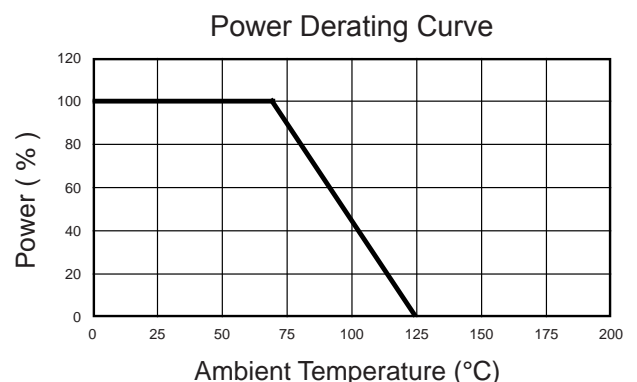
TCR (\pm ppm/K)	Resistances Available at These Tolerances				
	$\pm 0.05\%$	$\pm 0.1\%$	$\pm 0.25\%$	$\pm 0.5\%$	$\pm 1\%$
10	240 - 250K	100 - 250K	50 - 250K	20 - 510K	20 - 510K
15	240 - 250K	100 - 250K	50 - 250K	20 - 510K	20 - 510K
25	240 - 510K	100 - 1M	50 - 2M	20 - 5M	10 - 5M
50	100 - 510K	50 - 10M	10 - 10M	5 - 10M	3 - 10M

Ordering Information

Part Number - Resistance - Tolerance - TCR

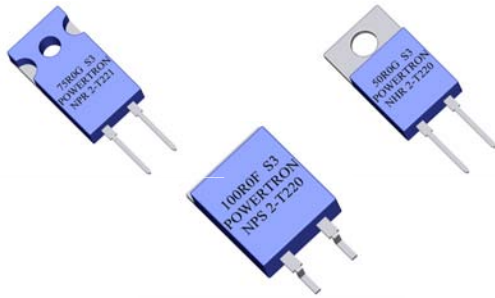
Example: MF2207 1.1 kOhm 0.05% 5ppm

(Note: If no TCR is specified / the highest value will be supplied)



NPR NPS 2-T220 T221 NHR NHS 2-T220 T221

Power Resistors



- Resistances from 0.02Ohm to 100kOhms
- Power Rating to 50Watt
- Resistance Tolerances to $\pm 1\%$
- TCR to $\pm 50\text{ppm/K}$
- Load Stability to 0.5%
- TO-220 Housing
- Convenient SMD D2Pak Available



SPECIFICATIONS

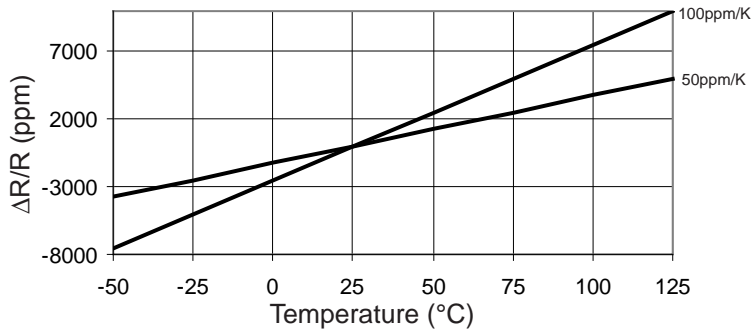
Type	NPR / NPS	NHR / NHS
Resistance Range	0.02 Ohms to 100kOhms	0.02 Ohms to 15kOhms
Power rating free air 70°C with heatsink	1.5 W 30 W	1.5 W 50 W
Thermal Resistance Rthj-c	3.5 K/W	2.1 K/W
Tolerances from 0.02 Ohms from 1.0 Ohms	2% / 5% 1% / 2% / 5%	
Stability	0.5%	
Temperature Coefficient 0.02 to 0.049 Ohms 0.05 to 0.099 Ohms 0.1 Ohms to 100 kOhms	$\pm 600\text{ ppm/K}$ $\pm 300\text{ ppm/K}$ $\pm 100\text{ ppm/K}$ upon request $\pm 50\text{ ppm/K}$	
Voltage Proof	2.0 kVDC	1.5 kVDC
Max. Voltage depending on resistance value		
Operating Temperature Range	-40 to 155°C	
Resistor Material	Thick Film	
Substrate	Al_2O_3	
Housing	Epoxy or PPS	
Connector Material	Cu tinned	
Terminals	2	
Max. Torque	T220: 1 Nm T221: 0.8 Nm	

Ordering Information

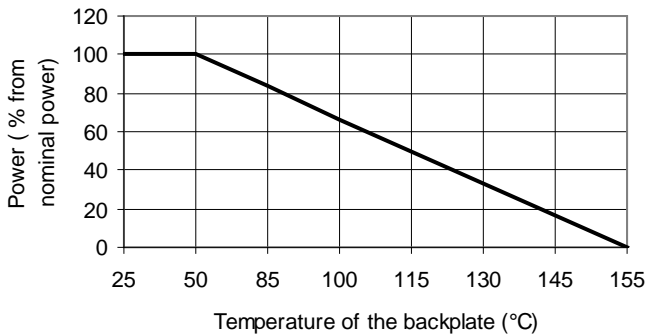
Part Number - Resistance - Contact - Tolerance
NHR 2-T221 C 1.1 kOhms 1%

SPECIFICATIONS (continued)

Temperature Coefficient



Derating



Power Rating Notes -

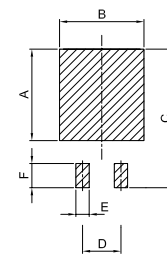
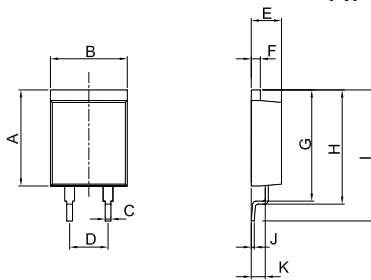
The NPR / NHR Series Resistors must be attached to a suitable heatsink. The maximum internal resistor temperature is 155°C. To specify an appropriate heatsink use the following formula :

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

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

NPS / NHS 2-T220

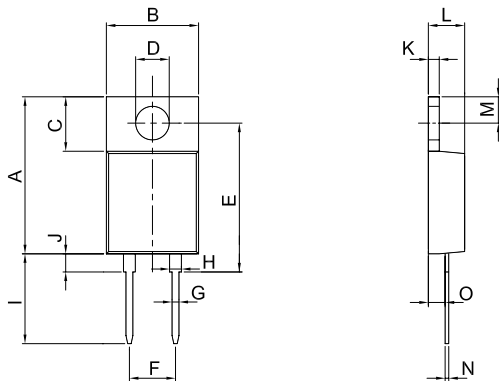


Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	12.70	0.2	0.50	0.008
B	10.16	0.2	0.40	0.008
C	0.76	0.1	0.03	0.004
D	5.08	0.1	0.20	0.004
E	4.00	0.1	0.16	0.004
F	1.20	0.1	0.05	0.004
G	14.60	0.2	0.57	0.008
H	15.00	0.2	0.59	0.008
I	17.33	0.2	0.68	0.008
J	0.40	0.1	0.02	0.004
K	1.85	0.1	0.07	0.004

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

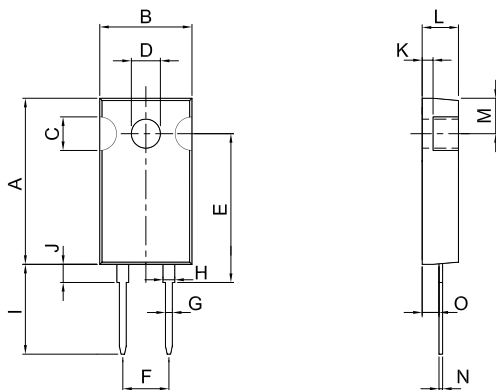
SPECIFICATIONS (continued)

NPR / NHR 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	∅3.7	0.1	∅0.146	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

NPR / NHR 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

HVS Series

High Resistance / Thick Film Chip Resistors



- Resistances from 100k to 1T Ohms
- Power Rating 0.125 to 1 Watt
- Resistance Tolerances to $\pm 5\%$
- TCR's to ± 50 ppm/K
- Non-Magnetic (contact PtAg)
- High Value Thick Film Resistance Element
- Sizes: 0805 / 1206 / 2512

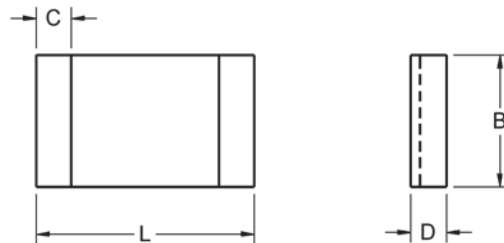
SPECIFICATIONS

Type	0805	1206	2512
Power Rating (W)	0.125	0.25	1.0
Working Voltage (VAC)	Untrimmed 600	1000	3000
Resistance Range (Ω)	Tolerances Available (%) Temperature Coefficients Available (\pm ppm/K) Voltage Coefficient (ppm / V) Other specifications available upon request		
100k - 100M	5% 50 <50ppm/V	5% 50 <50ppm/V	5% 50 <10ppm/V
>100M - 1G	5% 100 <250ppm/V	5% 100 <100ppm/V	5% 100 <25ppm/V
>1G - 10G	5% 100 <500ppm/V	5% 100 <250ppm/V	5% 100 <100ppm/V
>10G - 100G	10% 500 <1000ppm/V	10% 500 <1000ppm/V	5% 500 <250ppm/V
>100G - 1T	10% 1000 <2000ppm/V	10% 1000 <2000ppm/V	5% 1000 <500ppm/V

¹W @ 70 °C / 0W @ 155 °C

SPECIFICATIONS (continued)

Specification	Value		
Temperature Range	-55°C to +155°C		
Climactic Category	55 / 155 / 56		
Solderability	250°C / 3s (up to 6 month after shipment resp. at storage in Nitrogen)		
Max. Soldering Temperature	260°C / 10s		
Long Term Stability	Max ΔR		
	<1 GΩ	1 GΩ - 10 GΩ	>10 GΩ
Storage 125°C / 1000h	±0.5%	±1%	±2%
Maximum Voltage / 1000h	±0.5%	±1%	±2%



Type	Dimensions			
	L	B	D	C
0805	0.080 +0.006 / -0.002 [2.0 +0.15 / -0.05]	0.050 +0.006 / -0.002 [1.25 +0.15 / -0.05]	0.016 +0.006 / -0.002 [0.4 +0.15 / -0.05]	0.012 +0.008 / -0.004 [0.3 +0.2 / -0.1]
1206	0.126 +0.006 / -0.002 [3.2 +0.15 / -0.05]	0.060 +0.008 / -0.002 [1.5 +0.2 / -0.05]	0.016 +0.006 / -0.002 [0.4 +0.15 / -0.05]	0.012 +0.008 / -0.004 [0.3 +0.2 / -0.1]
2512	0.250 +0.006 / -0.002 [6.3 +0.15 / -0.05]	0.138 +0.008 / -0.002 [3.5 +0.2 / -0.05]	0.024 +0.006 / -0.002 [0.6 +0.15 / -0.05]	0.035 ±0.008 [0.9 ±0.2]

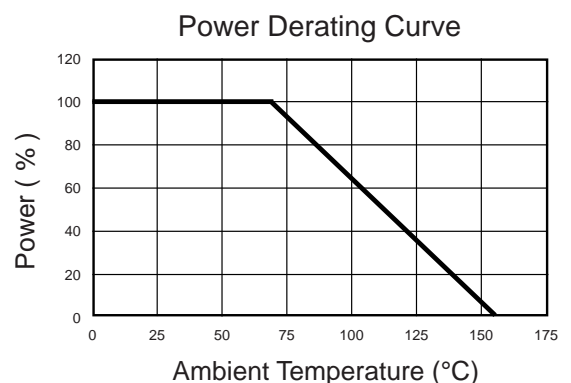
Packaging:

Bulk or Tape & Reel per IEC 286-3 / EIA 481-1-A

Tape width 8mm / Reel Diameter 180 or 330mm

Minimum quantity Bulk / 100 pieces per value

Minimum quantity Tape & Reel / 1000 pieces per value



Ordering Information

Part Number - Resistance - Tolerance - TCR - Packaging

Example: HVS 2512 10GOhms 10% 500ppm Tape

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

NPS 2-T126

Power SMD Resistors



- Resistances from 0.025Ohm to 10kOhms
- Power Rating to 25Watt
- Resistance Tolerances to $\pm 1\%$
- TCR to $\pm 100\text{ppm/K}$
- Load Stability to 0.5%
- TO-126 Housing (D-Pak)
- Solder Reflow Secure at 260°C / 20s



SPECIFICATIONS

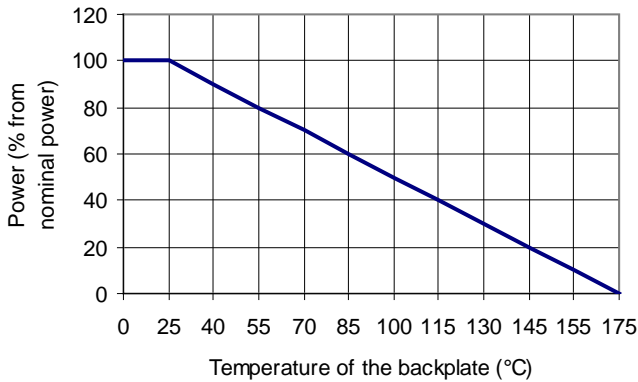
Type	NPS 2-T126			
Terminals	2			
Resistance Range	0.025 to 0.049Ohms	0.05 to 0.099Ohms	0.1 to 0.99Ohms	1Ohms to 10kOhms
Power Rating (with heatsink)	25 W			
Thermal Resistance Rthj-c	6.0 K/W			
Tolerances (others upon request)	2% / 5%		1% / 2% / 5%	
Stability	0.5%			
Temperature Coefficient (TCR 50ppm upon request)	± 500 ppm/K	± 400 ppm/K	± 300 ppm/K	± 100 ppm/K
Voltage Proof	2.0 kV DC			
Operating Temperature	-40°C to 175°C			
Resistor Material	Thick Film			
Substrate	Al ₂ O ₃			
Housing	Epoxy			
Connector Material	Cu / Ni-flash / lead-free tinned			
Reflow soldering	lead-free soldering 260°C / 20s			

Ordering Information

Part Number - Resistance - Tolerance
NPS 2-T126 1.1 Ohms 1%

SPECIFICATIONS (continued)

Derating



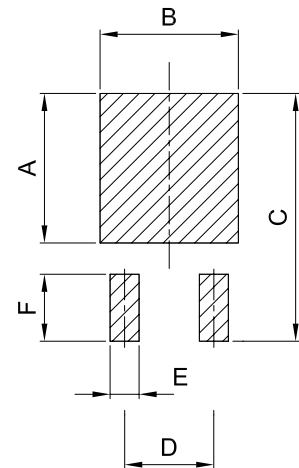
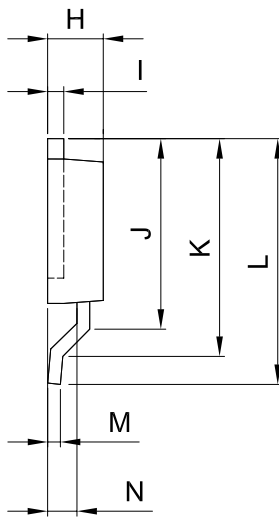
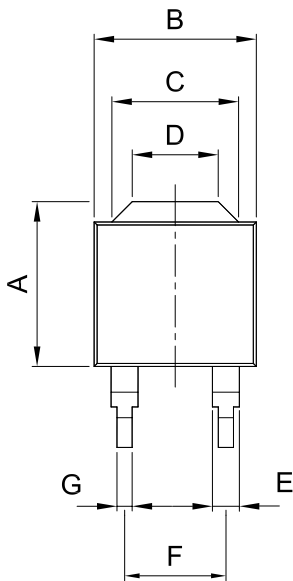
Power Rating Notes -

The NPS Series Resistors must be attached to a suitable heat-sink. The maximum internal resistor temperature is 175°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

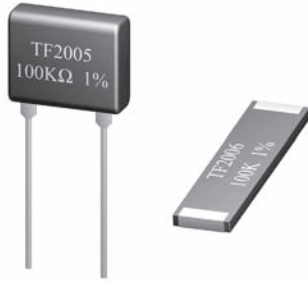


Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	8.26	0.2	0.33	0.008
B	8.13	0.2	0.32	0.008
C	6.35	0.1	0.25	0.004
D	4.31	0.1	0.17	0.004
E	1.35	0.1	0.05	0.004
F	5.08	0.1	0.20	0.004
G	0.76	0.1	0.03	0.004
H	2.79	0.1	0.11	0.004
I	0.8	0.1	0.03	0.004
J	9.55	0.2	0.38	0.008
K	10.92	0.2	0.43	0.008
L	12.32	0.2	0.49	0.008
M	0.6	0.1	0.02	0.004
N	1.47	0.1	0.06	0.004

Dimension	mm	inches
A	8.51	0.335
B	7.87	0.310
C	14.1	0.555
D	5.08	0.200
E	1.65	0.065
F	3.81	0.150

TF2000 Series

Thick Film Resistors



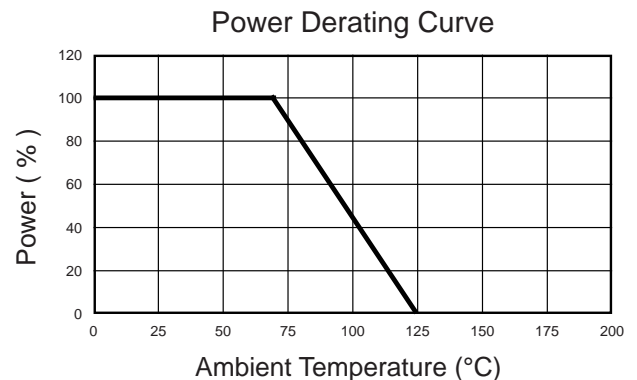
- Resistances from 100 to 20GOhms
- Power Rating 0.125 to 3Watts
- Resistance Tolerances to $\pm 1\%$
- TCR's to $\pm 100\text{ppm/K}$
- Voltage Ratings to 20KV
- Voltage Coefficient : 50ppm/V (MAX)
- Thick Film Resistance Element



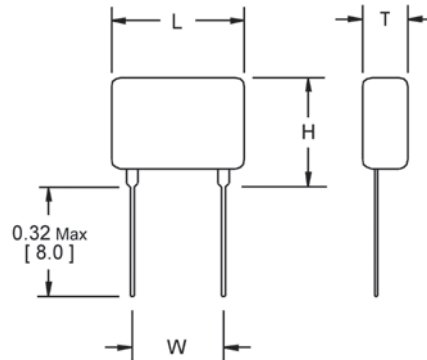
SPECIFICATIONS

Type	2003	2004	2005	2006	2007	2009
Power Rating (W @ 70 °C)	0.125	0.25	0.40	0.70	1.5	3.0
Working Voltage (rms)	100	250	750	2000	10000	20000
Available Resistances at each Tolerance Tolerance 0.5% upon request						
$\pm 1\%$	100 - 10M	10k - 10M	10k - 22M	100k - 100M	100k - 100M	100K - 100M
$\pm 2\%$	100 - 25M	10k - 100M	10k - 200M	100k - 250M	100k - 500M	100K - 500M
$\pm 5\%$	100 - 150M	10k - 250M	10k - 500M	100k - 1G	100k - 2G	100K - 2G
$\pm 10\%$	100 - 500M	10k - 1G	10k - 10G	100k - 10G	100k - 10G	100K - 20G
Available Resistances at each Temperature Coefficient						
$\pm 100\text{ ppm/K}$	$\leq 25\text{M}$	$\leq 50\text{M}$	$\leq 250\text{M}$	$\leq 250\text{M}$	$\leq 250\text{M}$	$\leq 250\text{M}$
$\pm 250\text{ ppm/K}$	$> 25\text{M}$	$> 50\text{M}$	$> 250\text{M}$	$> 250\text{M}$	$> 250\text{M}$	$> 250\text{M}$

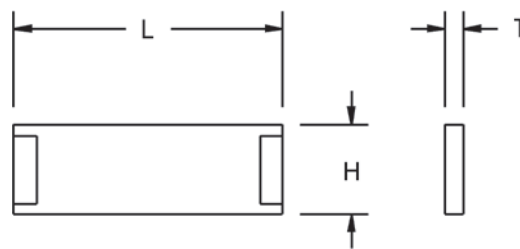
Specification	Value
Resistance Range	100 Ohms to 20G Ohms
Tolerances	$\pm 1\%$ to $\pm 10\%$
Temperature Coefficient	$\pm 100\text{ppm/K}$ / $\pm 250\text{ppm/K}$
Temperature Range	-55°C to $+125^\circ\text{C}$
Insulation Resistance	$> 10000\text{ MOhms}$
Shelf Life Stability	1% / 5 Years
Climatic Category	55/125/56
Max Soldering Temperature	$+260^\circ\text{C}$ / 10s
Voltage Coefficient	$< 5\text{ppm/V}$



SPECIFICATIONS (continued)



Type	H (MAX)	L (MAX)	T (MAX)	W ±0.015" [±0.4mm]
TF2003	0.236 [6.0]	0.197 [5.0]	0.100 [2.5]	0.100 [2.5]
TF2004	0.236 [6.0]	0.287 [7.3]	0.100 [2.5]	0.200 [5.1]
TF2005	0.236 [6.0]	0.492 [12.5]	0.100 [2.5]	0.400 [10.2]
TF2006	0.236 [6.0]	0.886 [22.5]	0.100 [2.5]	0.800 [20.3]
TF2007	0.354 [9.0]	1.535 [39.0]	0.100 [2.5]	1.400 [35.6]
TF2009	0.354 [9.0]	3.071 [78.0]	0.100 [2.5]	2.900 [73.7]



Type	H (MAX)	L (MAX)	T (MAX)
TFC2004	0.153 [3.9]	0.260 [6.6]	0.032 [0.8]
TFC2005	0.153 [3.9]	0.465 [11.8]	0.032 [0.8]
TFC2006	0.153 [3.9]	0.866 [22.0]	0.032 [0.8]
TFC2007	0.26 [6.6]	1.512 [38.4]	0.032 [0.8]

Ordering Information

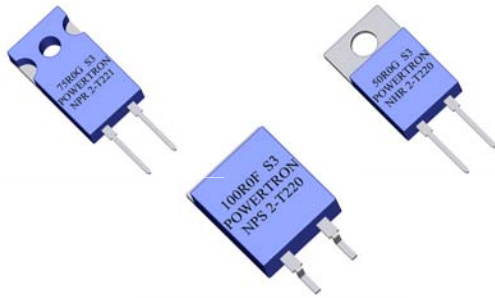
Part Number - Resistance - Tolerance - TCR

Example: TF2009 100 MOhms 2% 100ppm

(Note: If no TCR is specified / the highest value will be supplied)

NPR NPS 2-T220 T221 NHR NHS 2-T220 T221

Power Resistors



- Resistances from 0.02Ohm to 100kOhms
- Power Rating to 50Watt
- Resistance Tolerances to $\pm 1\%$
- TCR to $\pm 50\text{ppm/K}$
- Load Stability to 0.5%
- TO-220 Housing
- Convenient SMD D2Pak Available



SPECIFICATIONS

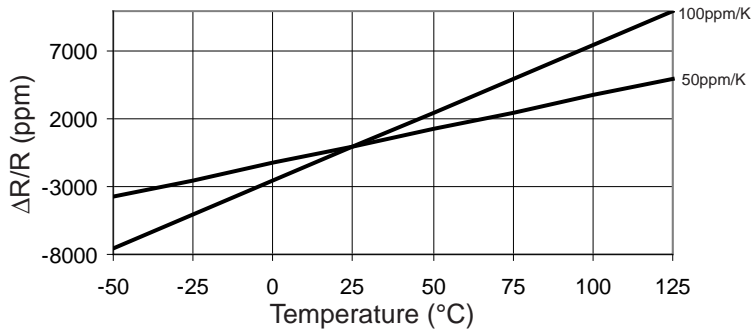
Type	NPR / NPS	NHR / NHS
Resistance Range	0.02 Ohms to 100kOhms	0.02 Ohms to 15kOhms
Power rating free air 70°C with heatsink	1.5 W 30 W	1.5 W 50 W
Thermal Resistance Rthj-c	3.5 K/W	2.1 K/W
Tolerances from 0.02 Ohms from 1.0 Ohms	2% / 5% 1% / 2% / 5%	
Stability	0.5%	
Temperature Coefficient 0.02 to 0.049 Ohms 0.05 to 0.099 Ohms 0.1 Ohms to 100 kOhms	$\pm 600\text{ ppm/K}$ $\pm 300\text{ ppm/K}$ $\pm 100\text{ ppm/K}$ upon request $\pm 50\text{ ppm/K}$	
Voltage Proof	2.0 kVDC	1.5 kVDC
Max. Voltage depending on resistance value		
Operating Temperature Range	-40 to 155°C	
Resistor Material	Thick Film	
Substrate	Al_2O_3	
Housing	Epoxy or PPS	
Connector Material	Cu tinned	
Terminals	2	
Max. Torque	T220: 1 Nm T221: 0.8 Nm	

Ordering Information

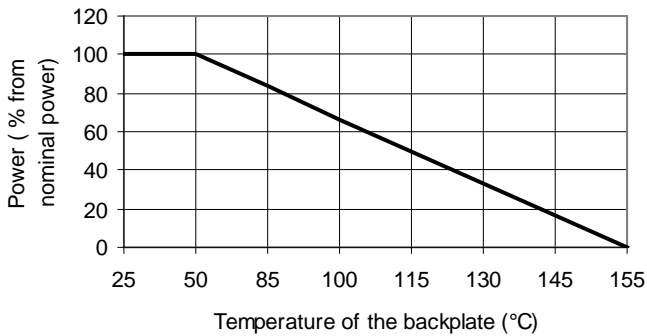
Part Number - Resistance - Contact - Tolerance
NHR 2-T221 C 1.1 kOhms 1%

SPECIFICATIONS (continued)

Temperature Coefficient



Derating



Power Rating Notes -

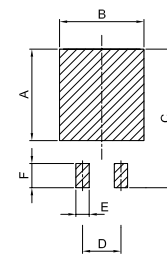
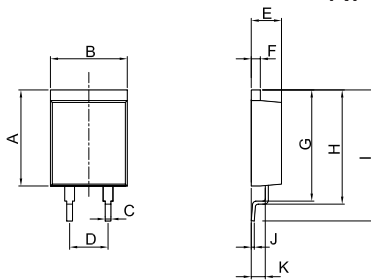
The NPR / NHR Series Resistors must be attached to a suitable heatsink. The maximum internal resistor temperature is 155°C. To specify an appropriate heatsink use the following formula :

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

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

NPS / NHS 2-T220

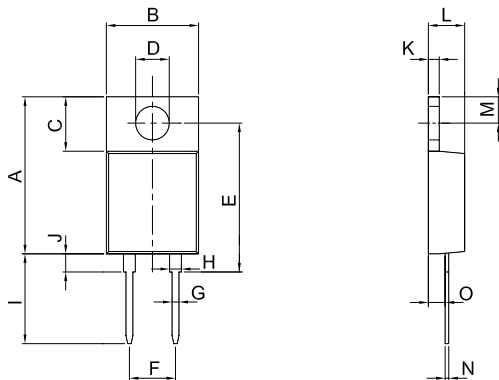


Dimension	mm	tol. (±mm)	inches	tol. (±inches)
A	12.70	0.2	0.50	0.008
B	10.16	0.2	0.40	0.008
C	0.76	0.1	0.03	0.004
D	5.08	0.1	0.20	0.004
E	4.00	0.1	0.16	0.004
F	1.20	0.1	0.05	0.004
G	14.60	0.2	0.57	0.008
H	15.00	0.2	0.59	0.008
I	17.33	0.2	0.68	0.008
J	0.40	0.1	0.02	0.004
K	1.85	0.1	0.07	0.004

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

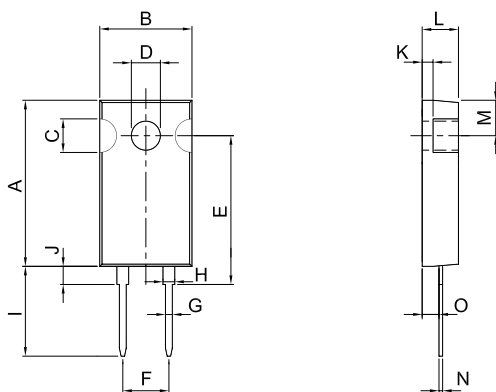
SPECIFICATIONS (continued)

NPR / NHR 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

NPR / NHR 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	Ø3.2	0.1	Ø0.126	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



- Resistances from 0.1Ohm to 100MOhms
- Power Rating 0.35 to 2Watts
- Resistance Tolerances to $\pm 0.5\%$
- TCR's to $\pm 50\text{ppm/K}$
- Improved Pulse Rating on Un-trimmed parts
- Thick Film Resistance Element
- Sizes: 1210 / 1216 / 2010 / 2040 / 2512 / 4020



SPECIFICATIONS

Type	1210	1216	2010	2040	2512 (M) ²	4020 (M) ²	
Power Rating (W) ¹	0.35	0.5	0.75	2.0	1.5	2.0	
Working Voltage (VAC)	Trimmed	200	200	250	250	300 (1000)	500 (4000)
	Untrimmed	600	600	900	900	1200 (2000)	1500 (6000)
Resistance Range (Ω)	Tolerances Available (%) Temperature Coefficients Available (\pm ppm/K) ³						
0.1 Ω - <1 Ω	5% to 20% 250	5% to 20% 250	5% to 20% 250	5% to 20% 250	5% to 20% 250	5% to 20% 250	
1 Ω - <100 Ω	1% to 20% 100 / 250	1% to 20% 100 / 250	1% to 20% 100 / 250	1% to 20% 100 / 250	1% to 20% 100 / 250	1% to 20% 100 / 250	
100 Ω - 100M	1% to 20% 50 / 100	1% to 20% 50 / 100	1% to 20% 50 / 100	1% to 20% 50 / 100	0.5% to 20% 50 / 100	0.5% to 20% 50 / 100	

¹ W @ 70 °C / 0W @ 155 °C

(Note: Solder pads must be of sufficient size to dissipate power)

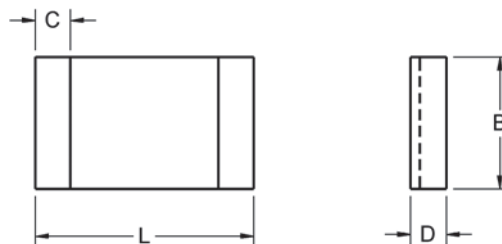
² (M) Meander structure with higher working voltage.

³ 50 PPM : +25°C to +125°C

Specification	Value
Temperature Range	-55°C to +155°C
Climactic Category	55 / 155 / 56
Solderability	250°C / 3s
Max. Soldering Temperature	260°C / 10s

SPECIFICATIONS (continued)

Long Term Stability	Max ΔR	
	<10Ω	10Ω - 100M
Storage 125°C / 1000h	±1%	±0.5%
Storage 155°C / 1000h	±2%	±1%
Load Life / P=70% / 70°C / 1000h	±2%	±1%
Short term overload	±0.5%	±0.25%
Humidity / 96%RH / 40°C / 56 days	±1%	±0.5%



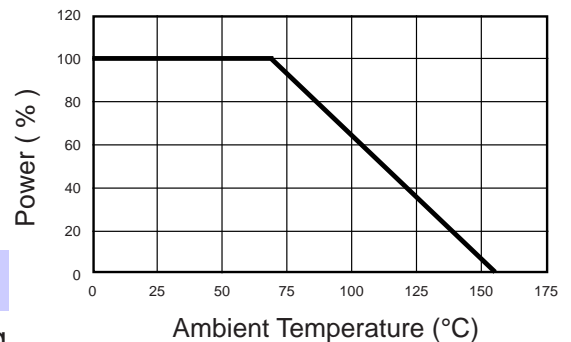
Type	Dimensions			
	L	B	D	C
CRW 1210	0.126 +0.008 / -0.002 [3.2 +0.2 / -0.05]	0.098 +0.008 / -0.002 [2.5 +0.2 / -0.05]	0.020 +0.008 / -0.004 [0.5 +0.2 / -0.1]	0.032 ±0.008 [0.8 ±0.2]
CRW 1216	0.126 +0.008 / -0.002 [3.2 +0.2 / -0.05]	0.160 +0.008 / -0.002 [4.1 +0.2 / -0.05]	0.020 +0.008 / -0.004 [0.5 +0.2 / -0.1]	0.032 ±0.008 [0.8 ±0.2]
CRW 2010	0.200 +0.008 / -0.002 [5.1 +0.2 / -0.05]	0.098 +0.008 / -0.002 [2.5 +0.2 / -0.05]	0.024 +0.008 / -0.004 [0.6 +0.2 / -0.1]	0.047 ±0.008 [1.2 ±0.2]
CRW 2040	0.200 +0.008 / -0.002 [5.1 +0.2 / -0.05]	0.400 +0.008 / -0.002 [10.2 +0.2 / -0.05]	0.024 +0.008 / -0.004 [0.6 +0.2 / -0.1]	0.047 ±0.008 [1.2 ±0.2]
CRW 2512	0.250 +0.006 / -0.002 [6.3 +0.15 / -0.05]	0.138 +0.008 / -0.002 [3.5 +0.2 / -0.05]	0.024 +0.006 / -0.002 [0.6 +0.15 / -0.05]	0.035 ±0.008 [0.9 ±0.2]
CRW 4020	0.400 +0.006 / -0.002 [10.2 +0.15 / -0.05]	0.200 +0.008 / -0.002 [5.1 +0.2 / -0.05]	0.024 +0.006 / -0.002 [0.6 +0.15 / -0.05]	0.035 ±0.008 [0.9 ±0.2]

Packaging:

Bulk or Blister tape to IEC 60286-3

Tape width 8mm / Reel Diameter 180 or 330mm
 Minimum quantity Bulk / 100 pieces per value
 Minimum quantity Tape & Reel / 1000 pieces per value

Power Derating Curve



Ordering Information

Part Number - Resistance - Tolerance - TCR - Packaging

Example: CRW 2040 50 Ohm 5% 100ppm Tape

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

CRS Series

Thick Film Chip Resistors



- Resistances from 0.10Ohm to 500MOhms
- Power Rating 0.1 to 0.25Watt
- Resistance Tolerances to $\pm 0.5\%$
- TCR's to ± 50 ppm/K
- Thick Film Resistance Element
- Sizes: 0504 / 0603 / 0805 / 1206

SPECIFICATIONS

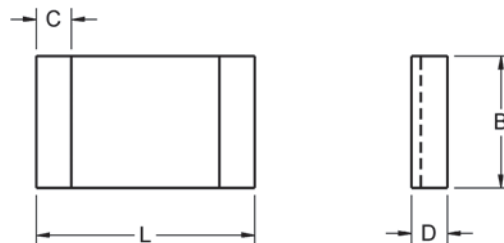
Type		0504	0603	0805	1206
Power Rating (W) ¹		0.10	0.10	0.125	0.25
Working Voltage (VAC)	Trimmed	50	75	100	200
	Untrimmed	150	220	300	600
Resistance Range (Ω)		Tolerances Available (%) Temperature Coefficients Available (\pm ppm/K) ² (lower TCR upon request)			
0.1 Ω - <1 Ω		-	10% to 20% 250	5% to 20% 250	5% to 20% 250
1 Ω - <10 Ω		5% to 20% 100 / 250	5% to 20% 100 / 250	2% to 20% 100 / 250	2% to 20% 100 / 250
10 Ω - <100 Ω		2% to 10% 100	1% to 10% 100	1% to 10% 50 / 100	1% to 10% 50 / 100
100 Ω - 1M		1% to 10% 50 / 100	1% to 10% 50 / 100	0.5% to 10% 50 / 100	0.5% to 10% 50 / 100
>1M - 10M		1% to 10% 50 / 100	1% to 10% 50 / 100	0.5% to 10% 50 / 100	0.5% to 10% 50 / 100
>10M - 100M		2% to 20% 100 / 250	1% to 20% 50 / 100	0.5% to 20% 50 / 100	0.5% to 20% 50 / 100
>100M - 500M		-	5% to 20% 100 / 250	2% to 20% 100 / 250	2% to 20% 100 / 250

¹W @ 70 °C / 0W @ 155 °C
²50 PPM : +25 °C to +125 °C

Specification	Value
Temperature Range	-55°C to +155°C
Climactic Category	55 / 155 / 56
Solderability	250°C / 3s
Max. Soldering Temperature	260°C / 10s

SPECIFICATIONS (continued)

Long Term Stability	Max ΔR		
	<10 Ω	10 Ω - 100M	>100M
Storage 125°C / 1000h	$\pm 1\%$	$\pm 0.5\%$	$\pm 1\%$
Storage 155°C / 1000h	$\pm 2\%$	$\pm 1\%$	$\pm 2\%$
Load Life / P=70% / 70°C / 1000h	$\pm 1\%$	$\pm 0.5\%$	$\pm 1\%$
Short term overload	$\pm 0.5\%$	$\pm 0.25\%$	$\pm 0.5\%$
Humidity / 96%RH / 40°C / 56 days	$\pm 1\%$	$\pm 0.5\%$	$\pm 1\%$



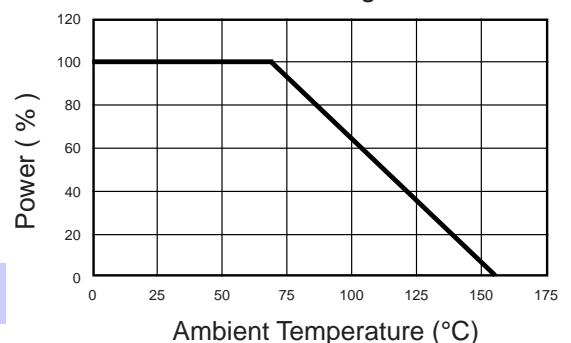
Type (larger sizes upon request)	Dimensions			
	L	B	D	C
CRS 0504	0.050 +0.006 / -0.002 [1.25 +0.15 / -0.05]	0.040 +0.006 / -0.002 [1.0 +0.15 / -0.05]	0.012 +0.006 / -0.002 [0.3 +0.15 / -0.05]	0.008 +0.008 / -0.004 [0.2 +0.2 / -0.1]
CRS 0603	0.060 +0.006 / -0.002 [1.5 +0.15 / -0.05]	0.030 +0.006 / -0.002 [0.8 +0.15 / -0.05]	0.016 +0.006 / -0.002 [0.4 +0.15 / -0.05]	0.008 +0.008 / -0.004 [0.2 +0.2 / -0.1]
CRS 0805	0.080 +0.006 / -0.002 [2.0 +0.15 / -0.05]	0.050 +0.006 / -0.002 [1.25 +0.15 / -0.05]	0.016 +0.006 / -0.002 [0.4 +0.15 / -0.05]	0.012 +0.008 / -0.004 [0.3 +0.2 / -0.1]
CRS 1206	0.126 +0.006 / -0.002 [3.2 +0.15 / -0.05]	0.060 +0.008 / -0.002 [1.5 +0.2 / -0.05]	0.016 +0.006 / -0.002 [0.4 +0.15 / -0.05]	0.012 +0.008 / -0.004 [0.3 +0.2 / -0.1]

Packaging:

Bulk or Blister tape to IEC 60286-3

Tape width 8mm / Reel Diameter 180 or 330mm
 Minimum quantity Bulk / 100 pieces per value
 Minimum quantity Tape & Reel / 1000 pieces per value

Power Derating Curve



Ordering Information

Part Number - Resistance - Tolerance - TCR - Packaging

Example: CRS 0603 1 Ohm 5% 100ppm Tape

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

CLS Series

Current Sensing Chip Resistor

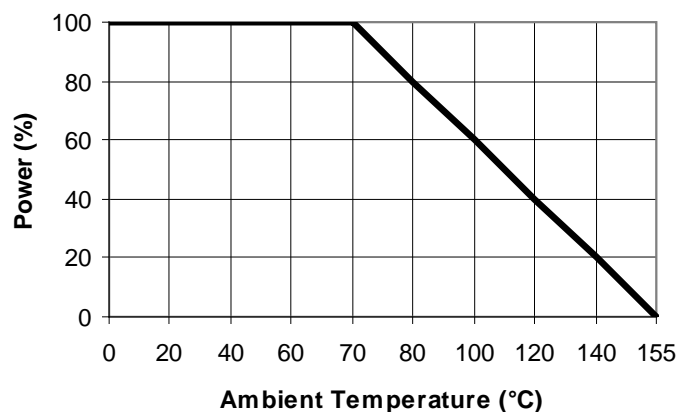


- Resistances from 0.01 to 10hms
- Power Rating 0.06 to 1 Watt
- Resistance Tolerances to $\pm 1\%$
- TCR's to ± 150 ppm/K
- Alumina Substrate for High Power Dissipation
- Sizes: 0402 / 0603 / 0805 / 1206 / 2010 / 2512

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)

CHR Series

Non-magnetic Chip Resistors



- Resistances from 10hm to 10MOhms
- Power Rating 0.05 to 0.25Watt
- Resistance Tolerances to $\pm 0.5\%$
- TCR's to ± 50 ppm/K
- Non-Magnetic (contact PtAg)
- Suitable for Glueing or Soldering
- Sizes: 0402 / 0504 / 0603 / 0805 / 1206
- High Temperature Applications possible



SPECIFICATIONS

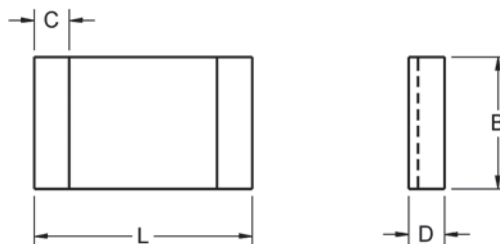
Type (larger sizes upon request)	0402	0504	0603	0805	1206	
Power Rating (W) ¹	0.05	0.10	0.10	0.125	0.25	
Working Voltage (VAC)	Trimmed	30	50	75	100	200
	Untrimmed	100	150	220	300	600
Resistance Range (Ω)	Tolerances Available (%) Temperature Coefficients Available (\pm ppm/K) (lower TCR upon request)					
1 Ω - <10 Ω	10% to 20% 100 / 250	5% to 20% 100 / 250	5% to 20% 100 / 250	5% to 20% 100 / 250	5% to 20% 100 / 250	
10 Ω - <100 Ω	5% to 10% 50 / 100	2% to 10% 50 / 100	2% to 10% 50 / 100	1% to 10% 50 / 100	1% to 10% 50 / 100	
100 Ω - 1M	1% to 10% 50 / 100	1% to 10% 50 / 100	1% to 10% 50 / 100	0.5% to 10% 50 / 100	0.5% to 10% 50 / 100	
>1M - 10M	5% to 20% 50 / 100	1% to 10% 50 / 100	1% to 10% 50 / 100	1% to 10% 50 / 100	1% to 10% 50 / 100	

¹W @ 70 °C / 0W @ 155 °C

Specification	Value
Temperature Range	-55°C to +155°C (extended range up to 250°C upon request)
Climactic Category	55 / 155 / 56
Solderability	250°C / 3s (up to 6 month after shipping resp. at storage in Nitrogen)
Max. Soldering Temperature	260°C / 10s

SPECIFICATIONS (continued)

Long Term Stability	Max ΔR	
	<10 Ω	10 Ω - 10M
Storage 125°C / 1000h	$\pm 1\%$	$\pm 0.5\%$
Storage 155°C / 1000h	$\pm 2\%$	$\pm 1\%$
Load Life / P=70% / 70°C / 1000h	$\pm 1\%$	$\pm 0.5\%$
Short term overload	$\pm 0.5\%$	$\pm 0.25\%$
Humidity / 96%RH / 40°C / 56 days	$\pm 1\%$	$\pm 0.5\%$



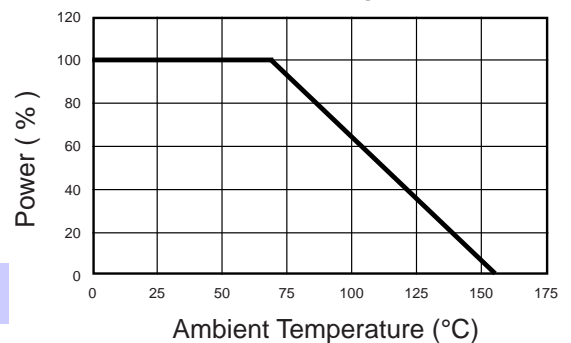
Type	Dimensions			
	L	B	D	C
CHR 0402	0.040 ± 0.006 [1.04 ± 0.15]	0.020 ± 0.006 [0.5 ± 0.15]	0.012 ± 0.002 [0.3 ± 0.05]	0.004 $+0.004 / -0.002$ [0.1 $+0.1 / -0.05$]
CHR 0504	0.050 $+0.006 / -0.002$ [1.25 $+0.15 / -0.05$]	0.040 $+0.006 / -0.002$ [1.0 $+0.15 / -0.05$]	0.012 $+0.006 / -0.002$ [0.3 $+0.15 / -0.05$]	0.008 $+0.008 / -0.004$ [0.2 $+0.2 / -0.1$]
CHR 0603	0.060 $+0.006 / -0.002$ [1.5 $+0.15 / -0.05$]	0.030 $+0.008 / -0.002$ [0.8 $+0.2 / -0.05$]	0.016 $+0.006 / -0.002$ [0.4 $+0.15 / -0.05$]	0.008 $+0.008 / -0.004$ [0.2 $+0.2 / -0.1$]
CHR 0805	0.080 $+0.006 / -0.002$ [2.0 $+0.15 / -0.05$]	0.050 $+0.006 / -0.002$ [1.25 $+0.15 / -0.05$]	0.016 $+0.006 / -0.002$ [0.4 $+0.15 / -0.05$]	0.012 $+0.008 / -0.004$ [0.3 $+0.2 / -0.1$]
CHR 1206	0.126 $+0.006 / -0.002$ [3.2 $+0.15 / -0.05$]	0.060 $+0.008 / -0.002$ [1.5 $+0.2 / -0.05$]	0.016 $+0.006 / -0.002$ [0.4 $+0.15 / -0.05$]	0.012 $+0.008 / -0.004$ [0.3 $+0.2 / -0.1$]

Packaging:

Bulk or Blister tape to IEC 60286-3

- Tape width 8mm / Reel Diameter 180 or 330mm
- Minimum quantity Bulk / 100 pieces per value
- Minimum quantity Tape & Reel / 1000 pieces per value

Power Derating Curve



Ordering Information

Part Number - Resistance - Tolerance - TCR - Packaging

Example: CHR 0603 10 kOhms 5% 50ppm Tape

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

CLR Series

Thick Film Chip Resistor



- Resistances from 1 to 10MOhms
- Power Rating 0.05 to 1 Watt
- Resistance Tolerances to $\pm 1\%$
- TCR's to ± 100 ppm/K
- Sizes: 0201 / 0402 / 0603 / 0805 / 1206 / 1210 / 2010 and 2512

SPECIFICATIONS

Type	CLR0201	CLR0402	CLR0603	CLR0805	CLR1206	CLR1210	CLR2010	CLR2512
Power Rating (W) at 70°C	0.05	0.06	0.1	0.125	0.25	0.3	0.5	1.0
Resistance Range (Ω) (E24 and E96)	10 to 1M	1 to 10M						
Tolerances	1% / 5%							
Temperature Coefficient (depending on value)	± 100 to ± 200							
Max. Operating Voltage (V)	15	50	50	150	200	200	200	200
Dimensions (LxW) mm [inches]	0.60 x 0.30 [0.02 x 0.01]	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]	3.10 x 2.50 [0.12 x 0.10]	5.00 x 2.50 [0.20 x 0.10]	6.30 x 3.20 [0.25 x 0.12]
Packaging (pcs) Tape and Reel	10,000		5,000				4,000	

Test	Specification	Test Method
Temperature Coefficient of Resistance	see above	JIS-C-5202 5.2 / IEC 60115-1 4.8 +25/-55/+25/+125, +155/+25°C
Thermal Shock	$\pm(1.0\%+0.05\Omega)$	MIL-STD-202F, Method 107 -55°C~125,155°C,5 cycles
Short Time Overload	$\pm(2.0\%+0.05\Omega)$	MIL-R-55342D 4.7.5 RCWV*2.5 or Max Overloading Voltage, 5 seconds
High Temperature Exposure	$\pm(2.0\%+0.05\Omega)$	MIL-R-55342D 4.7.6 1000 hours @ +125°C without load
Load Life	$\pm(3.0\%+0.05\Omega)$	MIL-STD-202F M108 RCWV, 70°C, 1.5 hours on, 0.5 hours off total 1000~1048 hours
Resistance to Soldering Heat	$\pm(1.0\%+0.05\Omega)$	MIL-R-55342D 4.7.7 260 \pm 5°C, 10 \pm 1seconds
Moisture Resistance	$\pm(2.0\%+0.05\Omega)$	MIL-STD-202F, Method 103 40°C, 90~95%RH, 1000 hours
Low Temperature Operation	$\pm(1.0\%+0.05\Omega)$	MIL-R-55342D 4.7.4 1hour, -55°C, followed by 45 minutes of RCWV
Bending Strength	$\pm(1.0\%+0.05\Omega)$	JIS-C-5202 6.1.4 5 mm deflection in either direction, 10 seconds
Solderability	95% min coverage	MIL-STD-202F-Method 208H 235 \pm 5°C,2 \pm 0.5seconds

Ordering Information

Part Number - Resistance - Tolerance - TCR - Packaging

Example: CLR 2010 100Ohms 1%

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

CHM Series

High Resistance / Thick Film Chip Resistors



- Resistances from 100k to 10T Ohms
- Power Rating 0.05 to 1.5 Watt
- Resistance Tolerances to $\pm 0.25\%$
- TCR's to ± 25 ppm/K
- Non-Magnetic (contact PtAg)
- High Value Thick Film Resistance Element
- Sizes: 0402 / 0603 / 0805 / 1206 / 1210 / 2010 / 2512 / 4020



SPECIFICATIONS

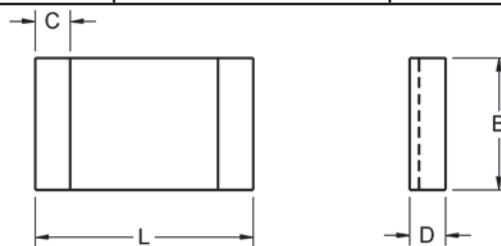
Type	0402	0603	0805	1206	1210	2010	2512	4020	
Power Rating (W)	0.05	0.10	0.125	0.25	0.35	0.5	1.0	1.5	
Working Voltage (VAC)	Trimmed	30	75	200	600	1000	1500	2000	4000
	Untrimmed	100	220	600	1000	1200	2000	3000	6000
Resistance Range (Ω)	Tolerances Available (%) Temperature Coefficients Available (\pm ppm/K) Voltage Coefficient (ppm / V)								
100k - 100M	5% to 20% 50 / 100 <500ppm/V	2% to 20% 50 / 100 <100ppm/V	0.5% to 10% 25 / 50 / 100 <50ppm/V	0.5% to 10% 25 / 50 / 100 <50ppm/V	0.5% to 10% 25 / 50 / 100 <25ppm/V	0.5% to 10% 25 / 50 / 100 <10ppm/V	0.25% to 10% 25 / 50 / 100 <5ppm/V		
>100M - 1G	5% to 20% 250 / 500 <1000ppm/V	5% to 20% 100 / 250 <500ppm/V	2% to 20% 50 / 100 / 250 <250ppm/V	2% to 20% 50 / 100 / 250 <100ppm/V	1% to 10% 25 / 50 / 100 <50ppm/V	1% to 10% 25 / 50 / 100 <25ppm/V	1% to 10% 25 / 50 / 100 <10ppm/V		
>1G - 10G	10% to 30% 1000 / 2000 <2000ppm/V	5% to 30% 500 / 1000 <2000ppm/V	5% to 20% 100 / 250 <500ppm/V	5% to 20% 100 / 250 <250ppm/V	2% to 20% 50 / 100 <100ppm/V	2% to 20% 50 / 100 <100ppm/V	2% to 20% 50 / 100 <25ppm/V		
>10G - 100G	-	10% to 30% 1000 / 2000 <10000ppm/V	10% to 30% 500 / 1000 <1000ppm/V	10% to 30% 500 / 1000 <1000ppm/V	5% to 20% 500 / 1000 <500ppm/V	5% to 20% 100 / 250 <250ppm/V	5% to 20% 100 / 250 <100ppm/V		
>100G - 1T	-	-	10% to 30% 1000 / 2000 <2000ppm/V	10% to 30% 1000 / 2000 <2000ppm/V	10% to 30% 500 / 1000 <1000ppm/V	5% to 20% 250 / 500 <500ppm/V	5% to 20% 250 / 500 <250ppm/V		
>1T - 10T	-	-	-	10% to 30% 2000 <3000ppm/V	10% to 30% 1000 / 2000 <2000ppm/V	10% to 30% 500 / 1000 <1000ppm/V	10% to 30% 500 / 1000 <1000ppm/V		

¹W @ 70 °C / 0W @ 155 °C

SPECIFICATIONS (continued)

Specification	Value		
Temperature Range	-55°C to +155°C (extended range up to 250°C upon request)		
Climactic Category	55 / 155 / 56		
Solderability	250°C / 3s (up to 6 month after shipment resp. at storage in Nitrogen)		
Max. Soldering Temperature	260°C / 10s		
Long Term Stability	Max ΔR		
	<1 GΩ	1 GΩ - 10 GΩ	>10 GΩ
Storage 125°C / 1000h	±0.5%	±1%	±2%
Maximum Voltage / 1000h	±0.5%	±1%	±2%

Type	Dimensions			
	L	B	D	C
CHM 0402	0.041 ±0.002 [1.04 ±0.05]	0.020 ±0.002 [0.50 ±0.05]	0.012 ±0.002 [0.3 ±0.05]	0.012 +0.008 / -0.004 [0.1 +0.1 / -0.05]
CHM 0603	0.059 +0.006 / -0.002 [1.5 +0.15 / -0.05]	0.032 +0.006 / -0.002 [0.80 +0.15 / -0.05]	0.016 +0.006 / -0.002 [0.4 +0.15 / -0.05]	0.008 +0.008 / -0.004 [0.2 +0.2 / -0.1]
CHM 0805	0.080 +0.006 / -0.002 [2.0 +0.15 / -0.05]	0.050 +0.006 / -0.002 [1.25 +0.15 / -0.05]	0.016 +0.006 / -0.002 [0.4 +0.15 / -0.05]	0.012 +0.008 / -0.004 [0.3 +0.2 / -0.1]
CHM 1206	0.126 +0.006 / -0.002 [3.2 +0.15 / -0.05]	0.060 +0.008 / -0.002 [1.5 +0.2 / -0.05]	0.016 +0.006 / -0.002 [0.4 +0.15 / -0.05]	0.012 +0.008 / -0.004 [0.3 +0.2 / -0.1]
CHM 1210	0.126 +0.006 / -0.002 [3.2 +0.15 / -0.05]	0.098 +0.008 / -0.002 [2.5 +0.2 / -0.05]	0.020 +0.006 / -0.002 [0.5 +0.15 / -0.05]	0.032 ±0.008 [0.8 ±0.2]
CHM 2010	0.20 +0.008 / -0.002 [5.1 +0.2 / -0.05]	0.098 +0.008 / -0.002 [2.5 +0.2 / -0.05]	0.024 +0.006 / -0.002 [0.6 +0.15 / -0.05]	0.05 ±0.008 [1.2 ±0.2]
CHM 2512	0.250 +0.006 / -0.002 [6.3 +0.15 / -0.05]	0.138 +0.008 / -0.002 [3.5 +0.2 / -0.05]	0.024 +0.006 / -0.002 [0.6 +0.15 / -0.05]	0.035 ±0.008 [0.9 ±0.2]
CHM 4020	0.40 +0.006 / -0.002 [10.20 +0.15 / -0.05]	0.20 +0.008 / -0.002 [5.1 +0.2 / -0.05]	0.024 +0.006 / -0.002 [0.6 +0.15 / -0.05]	0.035 ±0.008 [0.9 ±0.2]



Packaging:

Bulk or Tape & Reel per IEC 286-3 / EIA 481-1-A

Tape width 8mm / Reel Diameter 180 or 330mm

Minimum quantity Bulk / 100 pieces per value

Minimum quantity Tape & Reel / 1000 pieces per value

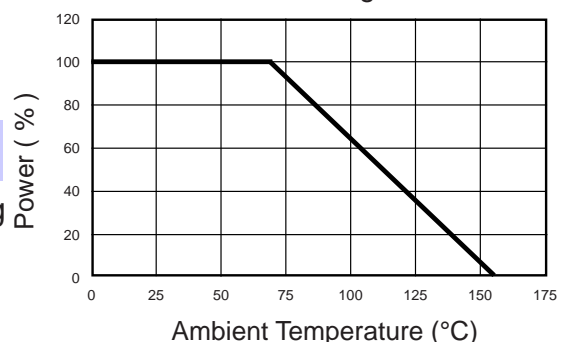
Ordering Information

Part Number - Resistance - Tolerance - TCR - Packaging

Example: CHM 2512 10GOhms 10% 50ppm Tape

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

Power Derating Curve





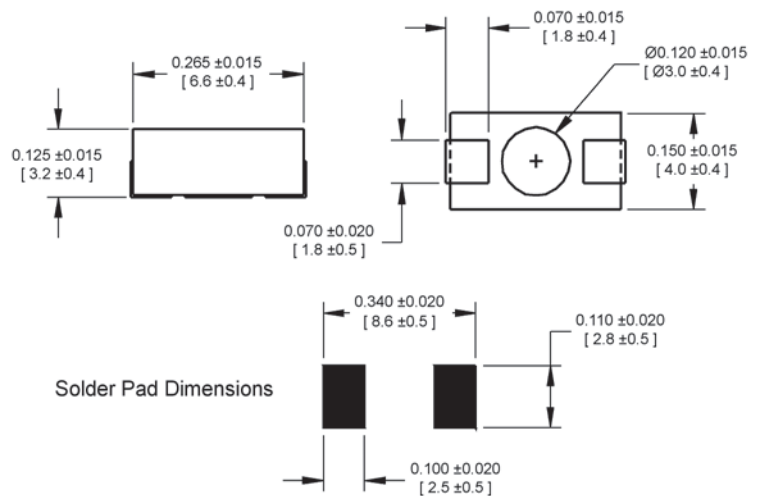
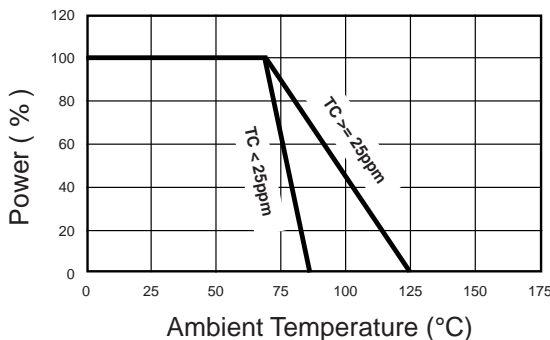
- Resistances from 50 to 3MΩ
- Tolerance to $\pm 0.1\%$
- TCR's to $\pm 5\text{ppm/K}$
- Very Low Inductance
- Excellent Long Term Stability

SPECIFICATIONS

Specification	Value
Resistance Range	50Ω to 3MΩ
Power Rating	1W ($T_{\text{Ambient}} = 70^{\circ}\text{C}$)
Temperature Range	-25°C to +125°C (TC $\geq 25\text{ppm/K}$) -10°C to +85°C (TC $< 25\text{ppm/K}$)
Dielectric Strength	750 VAC
Insulation Resistance	>1000 MΩ / Dry
Voltage Coefficient	0.5 ppm/V (Max)

TCR ($\pm\text{ppm/K}$)	Resistances Available at these Tolerances				
	$\pm 0.05\%$	$\pm 0.10\%$	$\pm 0.25\%$	$\pm 0.50\%$	$\pm 1\%$
5	50Ω - 250KΩ	10Ω - 250KΩ	10Ω - 250KΩ	10Ω - 250KΩ	-
10	50Ω - 510KΩ	10Ω - 510KΩ	10Ω - 510KΩ	10Ω - 510KΩ	-
15	50Ω - 510KΩ	10Ω - 1MΩ	10Ω - 1.5MΩ	10Ω - 1.5MΩ	10Ω - 1.5MΩ
25	50Ω - 510KΩ	10Ω - 1MΩ	10Ω - 1.5MΩ	5Ω - 2MΩ	5Ω - 2MΩ
50	50Ω - 510KΩ	5Ω - 1MΩ	3Ω - 1.5MΩ	2Ω - 2MΩ	1Ω - 3MΩ

Power Derating Curve



Ordering Information

Part Number - Resistance - Tolerance - TCR

Example: SF-2 200 kΩ 0.1% 5ppm

CMF Series

Precision Chip Resistors



- Resistances from 5.1Ohm to 10MOhms
- Power Rating 0.065 to 0.75 Watts
- Resistance Tolerances to $\pm 0.05\%$
- TCR's to ± 5 ppm/K
- Extreme Low Noise
- Precision / Thin Film Resistance Element
- Sizes: 0603 / 0805 / 1206 / 1210 / 2512

SPECIFICATIONS

Type	0603	0805	1206
Power Rating (W) ¹	0.065	0.125	0.25
Working Voltage (VAC)	75	100	200
Resistance Range (Ω)	Tolerances Available (%) Temperature Coefficients Available (\pm ppm/K) ²		
5.1 Ω - <10 Ω	-	-	1% 50
10 Ω - <47 Ω	0.1% to 1% 25 / 50	0.1% to 1% 25 / 50	0.1% to 1% 25 / 50
47 Ω - <100 Ω	0.1% to 1% 10 / 15 / 25 / 50	0.1% to 1% 10 / 15 / 25 / 50	0.1% to 1% 10 / 15 / 25 / 50
100 Ω - 332k	0.1% to 1% 5 / 10 / 15 / 25 / 50	0.05% to 1% 5 / 10 / 15 / 25 / 50	0.05% to 1% 5 / 10 / 15 / 25 / 50
>332k - 1M	-	0.1% to 1% 10 / 15 / 25 / 50	0.05% to 1% 10 / 15 / 25 / 50
>1M - 2M	-	-	0.25% to 1% 50
>2M - 10M	-	-	-

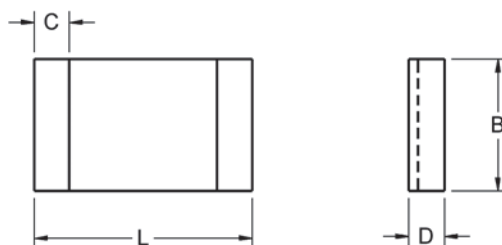
¹ W @ 70 °C / 0W @ 125 °C

² 5 / 10 / 15 PPM : +25 °C to +85 °C

³ 1000V Available / contact factory

SPECIFICATIONS (continued)

Specification	Value	
Temperature Range	-55°C to +125°C	
Climactic Category	55 / 125 / 56	
Solderability	250°C / 3s	
Max. Soldering Temperature	260°C / 10s	
Long Term Stability	Max ΔR	
	< 47Ω	47Ω - 10 MΩ
Storage 125°C / 1000h	±0.25%	±0.15%
Load Life / P=70% / 70°C / 1000h	±0.25%	±0.1%
Humidity / 96%RH / 40°C / 56 days	±0.5%	±0.15%



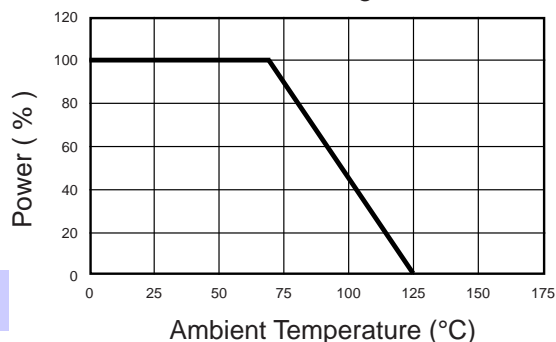
Type	Dimensions			
	L	B	D	C
CMF 0603	0.063 ±0.004 [1.6 ±0.1]	0.030 ±0.004 [0.8 ±0.1]	0.018 ±0.004 [0.45 ±0.1]	0.012 ±0.008 [0.3 ±0.2]
CMF 0805	0.080 ±0.004 [2.0 ±0.1]	0.050 ±0.004 [1.25 ±0.1]	0.022 ±0.004 [0.55 ±0.1]	0.016 ±0.008 [0.4 ±0.2]
CMF 1206	0.126 ±0.008 [3.2 ±0.2]	0.063 ±0.006 [1.6 ±0.15]	0.022 ±0.004 [0.55 ±0.1]	0.020 ±0.008 [0.5 ±0.2]

Packaging:

Bulk or Blister tape to IEC 60286-3

- Tape width 8mm / Reel Diameter 180 or 330mm
- Minimum quantity Bulk / 100 pieces per value
- Minimum quantity Tape & Reel / 1000 pieces per value

Power Derating Curve



Ordering Information

Part Number - Resistance - Tolerance - TCR - Packaging

Example: CMF 0603 10 kOhms 0.1% 10ppm Tape

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

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)

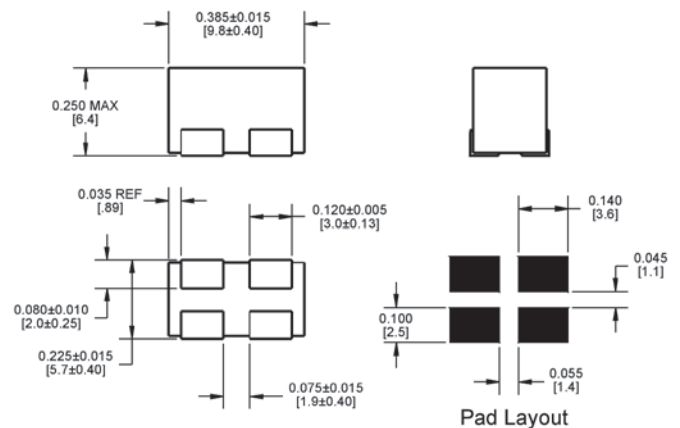
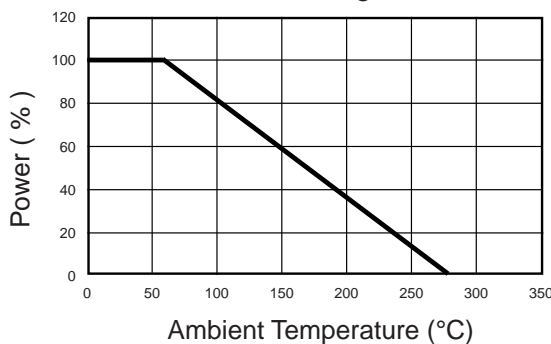
SPECIFICATIONS

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%

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

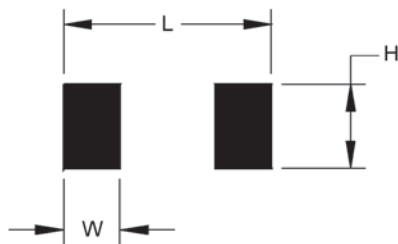
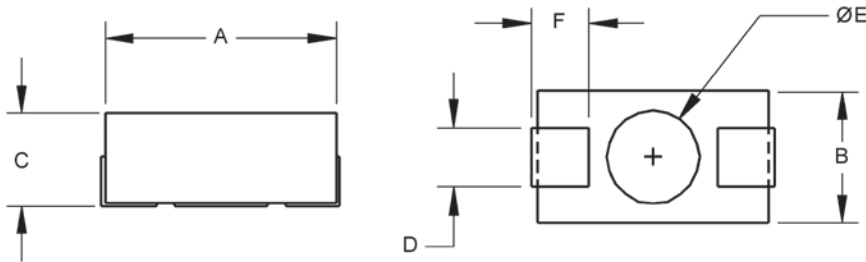
Type	Power Rating Watts @ 70°C	Resistance ¹ Range (Ω)	Maximum Working Voltage
S-1	0.5	0.01 to 400	33
S-2	1	0.005 to 3k	58
S-4	2	0.01 to 15k	127
S-3	3	0.01 to 25k	150
S-5	4	0.01 to 50k	212
SL-2	1	0.005 to 0.05	0.31
SL-4	2	0.005 to 0.07	0.45

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

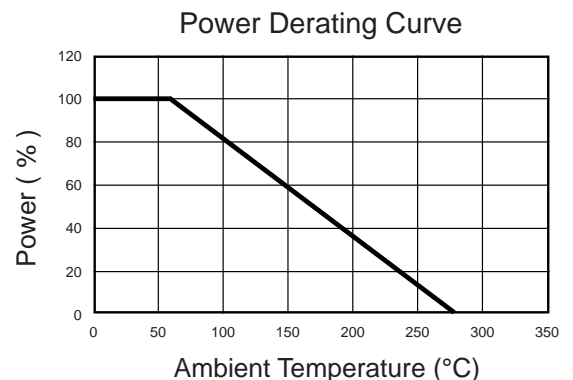
Specification	Value
Tolerances	S: $\pm 0.01\%$ to $\pm 5\%$ SL: $\pm 0.1\%$ to $\pm 5\%$
Temperature Coefficient	S: $>10\Omega$: $\pm 20\text{ppm/K}$ S: 1Ω to 10Ω : $\pm 50\text{ppm/K}$ S: $<1\Omega$: Call Factory SL: $\pm 120\text{ppm/K}$
Temperature Range	-55°C to $+275^\circ\text{C}$
Dielectric Strength	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



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%