

# IRC PRODUCT SELECTION GUIDE

The complete line of resistive products.





# IRC CAPABILITIES

For over 50 years IRC has been on the cutting edge of Resistor Technology. With the years of manufacturing experience, the commitment to quality, the dedication to service and now the addition of Welwyn Electronics (U.K.) IRC has re-established itself as one of the leading influences in today's and tomorrow's electronic industry.

## DISTRIBUTION

IRC offers a broad network of franchised distributors, both local and national, to provide immediate delivery for all your needs. Large inventories in commercial and military metal film, wirewounds, surface mount devices, and commodities are readily available to ship at your convenience. All products in our general catalog may be purchased through distribution. For the IRC distributor nearest you consult the last page of this catalog.

## SERVICE

To be successful in today's market, it takes more than high quality and competitive prices. Outstanding service is a must. IRC is a broad line supplier supported by a corporate network of franchised distributors who maintain large inventories for quick delivery. We have qualified engineers to help you with your simplest discrete resistor needs to the most complex custom network designs in your application. These services along with JIT "Just In Time" programs, planned stock, GRID "Guaranteed Resistor Item Delivery" and quick responses from a competent customer service and sales staff that can be reached, cost free, by dialing 1-800-255-4IRC. We set high goals for service and are constantly striving to improve.





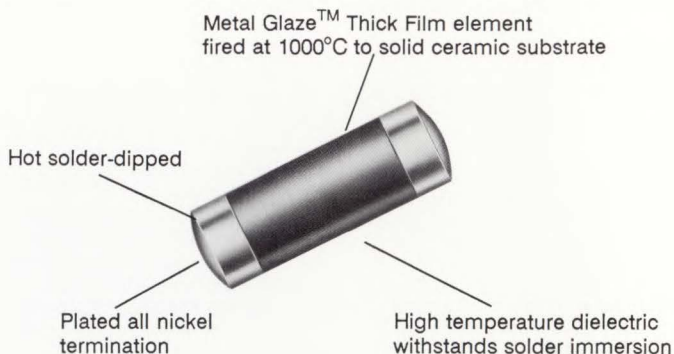
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# 1/8W RG CHIP RESISTORS

## CHP SERIES

- Metal Glaze™ Technology from IRC RG resistor line. Proven reliability for over 15 years.
- Low TCR - 50 and < 100 ppm/°C
- ±0.5%, ±1% tolerance
- Standard size 3.2 x 1.5mm (0.126 x 0.057").
- Compatible with chip placement equipment from Dynapert, Universal, Excellon, Phillips, and others.
- Hot solder-dipped nickel contacts withstand prolonged (>60 sec) immersion in solder with no de-wetting of contacts.
- Bonds to circuit boards with standard techniques using adhesives or solder paste.
- Packaging in bulk or 8mm tape reels, taping per EIA-RS481, 7" or 13" diameter.



### SPECIFICATIONS

Resistance Range: 3Ω to 5.1 Meg\*, plus zero-ohm jumpers.  
 Tolerance: 0.5%, 1%.  
 Temperature Coefficient:  
 < 100 ppm/°C and 50 ppm/°C.  
 (300 ppm above 2.2 meg).  
 Rated Wattage: 1/8W @ 70°C†.  
 Rated Continuous Working Voltage:  
 $\sqrt{.25 \times R}$  or 200V, which ever is less.  
 Maximum Overload Voltage: 400V.  
 Temperature Range -55°C to +150°C.  
 Insulation Resistance: 10,000 Meg min.  
 Derate to zero at 150°C.

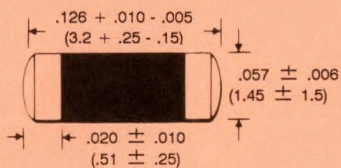
\*Consult factory for other resistance values and other temperature coefficients.

†CHP1/8 is dual-rated to 1/4W due to superior thermal impedance of cylindrical design. Operating life @1/4W 70°C shows actual ΔR change of <0.2% after 20,000 hours.

### COMPARISON WITH MELF CHIP RESISTORS

RG chips are smaller in size than MELF chips, use thick-film technology rather than carbon films, and have plated nickel terminations, not pressed-on end caps. RG chips are available in standard 8mm tape.

### DIMENSIONS - IN AND (MM)



### COMPARISON WITH CURRENT RECTANGULAR CHIPS

Thick film technology is used in manufacturing of RG chips and rectangular chips. Both have the same standard outline of 3.2 x 1.6mm. Both are available in standard 8mm tape which current chip placement equipment uses.

The RG chip's visible difference is its miniaturized cylindrical shape which makes it somewhat thicker than many resistor chips. This difference poses no problem however in handling, or in placement of the chips onto glue-

-dotted PCB's by current available chip inserters since they handle both types.

A major advantage of the RG chip design is its unsurpassed solderability. It is the only resistor chip to offer all nickel contacts. They are completely silver-free... are hot solder dipped, and provide maximum assurance of reliable solder connections without problems of leaching or de-wetting.

Some other advantages include low TCR, 1/4W rating capability. All of these technological features are part of the RG family of precision resistors, which has had a proven record of performance for over 15 years

### PERFORMANCE DATA

Standard Test	Maximum ΔR
Thermal Shock:	± 0.5%
Low-Temperature Operation:	± 0.25%
Short-Time Overload:	± 1% (± .25% for R ≤ 100K ohm or E ≤ 100V)
High-Temperature Exposure:	± 0.5%
Resistance to Bonding Exposure	± 0.25%
Resistance to Solder Immersion:	± 2% 60 sec at 270°C
Solderability:	95% min. coverage 60 sec at 270°C
Moisture Resistance:	± 0.5%
Life Test:	± 1%
Terminal Adhesion Strength:	± 1%, No mechanical damage
Resistance to Board Bending:	± 1%, No mechanical damage

### HOW TO ORDER

Sample Part Number **CHP1/8 - 100 - 2203 - F - BLK**

IRC Type \_\_\_\_\_

Temperature Coefficient \_\_\_\_\_

Resistance \_\_\_\_\_

Packaging Code  
BLK for Bulk, CST for tape.

Tolerance  
D = 0.5%, F = 1%, G = 2%, J = 5%

1st 3 significant figures plus  
4th digit multiplier  
Examples: 2203 = 220,000 ohms  
51R0 = 51.0 ohms

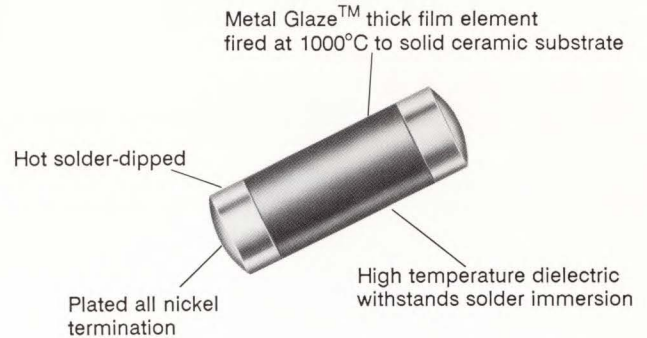




# 1/4W to 2W RG POWER-CHIP RESISTORS

## CHP SERIES

- 70% smaller than leaded discretes
- Hot solder -dipped nickel contacts withstand prolonged (> 60 sec.) immersion in solder with no de-wetting of contacts
- Metal Glaze™ Technology from IRC's RG resistor line. Proven reliability for over 15 years
- Low TCR - < 100 ppm/°C
- Packaging in bulk or tape reels
- Bonds to circuit boards with standard techniques using adhesives or solder paste



RG Power-chip resistors are a part of the RG product family of precision resistors which has now been in production for over 15 years. In leaded form, these resistors are qualified to MIL-R-39017 level S and to MIL-R-39017. The chip resistor utilizes the core element from this series, but with modified contacts, and with added dielectric coating.

This extremely stable glaze system is coupled with a cylindrical configuration to provide reliable performance and good thermal impedance with a "footprint" which is 70% smaller than for equivalent leaded discretes.

A major advantage of the RG chip design is its unsurpassed solderability. It is the only resistor chip to offer all nickel contacts. They are completely silver-free...are hot solder dipped, and provide maximum assurance of reliable solder connections with out problems of leaching or de-wetting. End caps are not used.

A Metal Glaze™ element has been fused at 1000°C to a solid aluminum oxide core.

Two and one-half years of cycling operation has been completed at 1/4W 70°C for the CHP1/8 with ΔR below 0.2% (20,000 hours).

### SPECIFICATIONS

W** 70°C	IRC Type	TCR* PPM/°C	Tolerance*	Resistance†	Voltage Rating‡	Max. V
1/4W	CHP1/8	< 100	1%, 2%, 5%	1Ω to 5.1 MegΩ	200	400
1/2W	CHP1	< 100	1%, 2%, 5%	1Ω to 5.1 MegΩ	350	700
1W	CHP1	< 100	1%, 2%, 5%	1Ω to 5.1 MegΩ	350	700
Surge	CHP2	< 100	1%, 2%, 5%	1Ω to 5.1 MegΩ	500	1000

### PACKAGING

**CHP1/8** - Bulk or 8mm tape (2500 pcs. on 7" reel, 10,000 pcs. on 13" reel)

**CHP1** - Bulk or 12mm tape (1500 pcs. on 7" reel, 5000 pcs. on 13" reel)

**CHP2** - Bulk or 24mm tape (400 pcs. on 7" reel, 1500 pcs. on 13" reel)

Temperature Range: -55°C to +150°C.  
Derate to zero at 150°C.

\*Contact factory for tighter tolerance and TCRs; 300 ppm/°C 2.2MΩ and above.

\*\*Ratings are on epoxy-glas in static air. CHP2 surge chip is rated 2W @ 25°C.

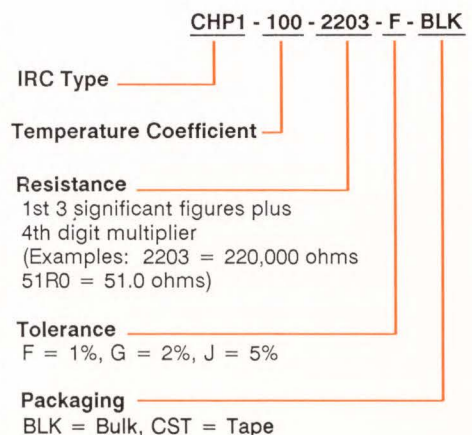
†Zerohm chips also available. Wirewound chips = 0.1Ω and above also available. (Factory)

‡Recommended continuous working voltage =  $\sqrt{P \times R}$ , but not higher than voltage shown in this column.

### DIMENSIONS

IRC Type	Size			
		L	W	C
CHP1/8		.126 <sup>+0.010</sup> / <sub>-0.005</sub> (3.2 <sup>+0.25</sup> / <sub>-.15</sub> )	.057 ± .006 (1.45 ± .15)	.020 ± .010 (.51 ± .25)
CHP1		.251 ± 0.01 (6.38 ± .25)	.079 ± .006 (2.01 ± .15)	.040 ± .010 (1.02 ± .25)
CHP2		.367 ± .010 (9.32 ± .25)	.105 ± .006 (2.67 ± .15)	.050 ± .010 (1.27 ± .25)

### HOW TO ORDER



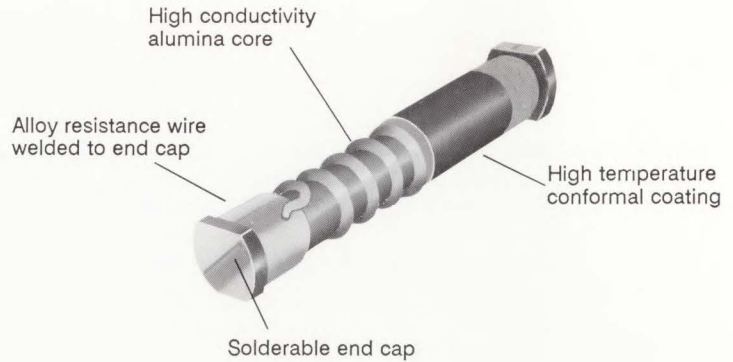




# SURFACE MOUNTED WIREWOUND RESISTORS

## AS-SM SERIES

- Flat-cap design
- 3 watt rated at 25°C, 2 watt\* at 70°C
- ±5%, ±3%, ±1%, ±0.5%, ±0.25% tolerances
- 0.1 ohm to 1.5K ohm resistance values\*\*
- Resistance wire TCR ±20 ppm/°C (specials up to ±5500 ppm/°C)
- Packaged in bulk or on 24 mm embossed carrier tape
- AS-SM1 available 2Q88. Consult factory



### APPLICATIONS

Power applications to 3 watts.  
Current sensing.  
Surge and pulse applications.

### FEATURES

Heat conducting ceramic core.  
Alloy resistance wire, welded to caps.  
Solderable end caps (60/40 plated).  
Cap standoffs to minimize peak PC board temperatures.  
Conformal dielectric coating.

### RECOMMENDED SOLDER PADS

Pads 6.4 mm x 6.4 mm min.  
(.252" x .252" min)  
9.5 mm between pads (.375")  
Runners 3.2 mm wide (.126")  
On epoxy - glass boards

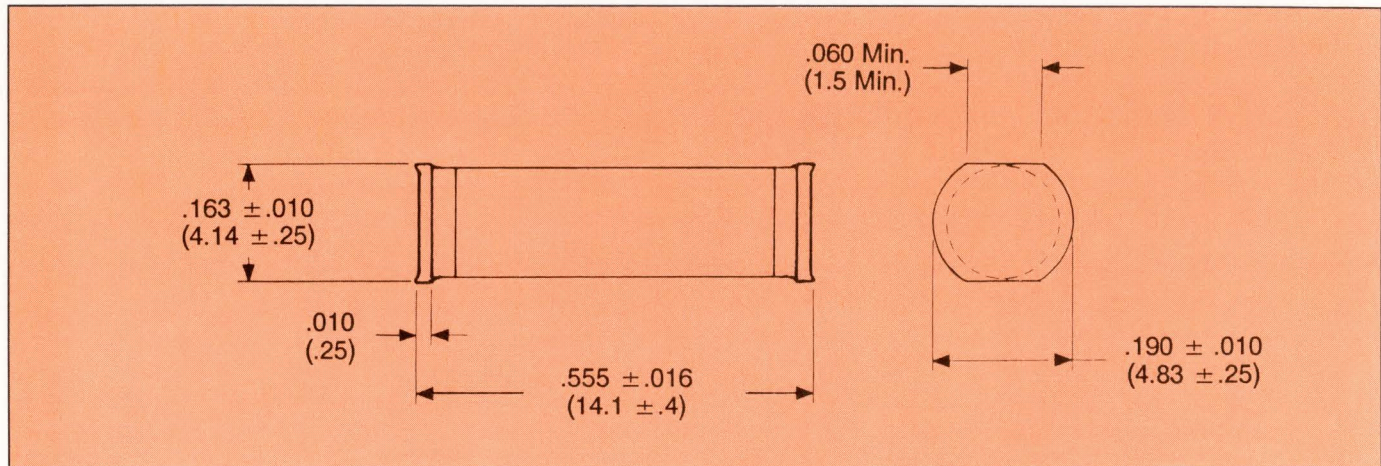
### SPECIFICATIONS

IRC Type	IRC Power Rating* (watts)	Voltage Rating (volts)	Available Resistance (ohms)**		
			0.25% Tol	0.50% - 1% Tol	3% - 5% Tol
AS-SM3	3W @ 25°C 2W @ 70°C	185	2.5Ω - 1.5KΩ	1Ω - 1.5KΩ	0.1Ω - 1.5KΩ

\*For operation to 3W at 70°C contact factory for conditions.

\*\*For resistance values below 0.1 ohms, contact factory.

### DIMENSIONS



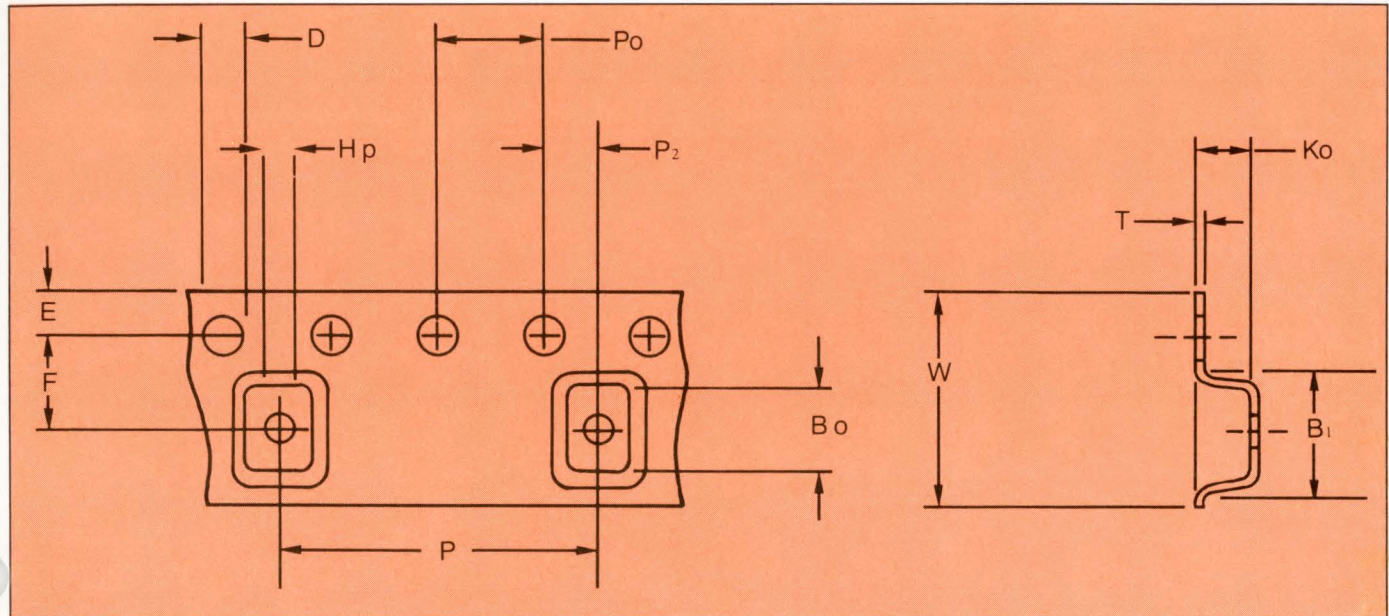
\*Manufactured in Barbados



## ENVIRONMENTAL TESTING

Load Life 1000 Hours	Moisture Resistance	Typical Max. $\Delta R(\pm\%)$				Shock	Vibration
		Temp. Cycle	Short Time Overload	Low Temp. Operation	Solder Heat		
1.0	1.0	0.5	0.5	0.5	0.25	0.5	0.5

## TAPE PACKAGING DIMENSIONS



Draft Angle	P <sub>0</sub>	P <sub>2</sub>	T	B <sub>1</sub>	W	P	D	E	F	H <sub>p</sub>	K <sub>0</sub>	A <sub>0</sub>	B <sub>0</sub>
18° Max 5° Min	.157 (4.0)	.079 (2.0)	.013 Max (0.33 Max)	.605 Max (15.4 Max)	.945 (24.0)	.473 (12.0)	.059 (1.5)	.069 (1.75)	.453 (11.5)	.069 (1.5) Min .071 (1.8) Max	.178 (4.52)	.172 (4.37)	.555 (14.1)

## PACKAGING

Bulk or 24 mm tape.  
1400 pcs. on 13" reel.

## HOW TO ORDER

Sample Part Number: AS-SM3 27Ω ±.25%

IRC Type

Resistance Value

Expressed in ohms  
(Standard EIA/MIL Values)

Tolerance

±5%, ±3%, ±1%, ±.5%  
±.25%

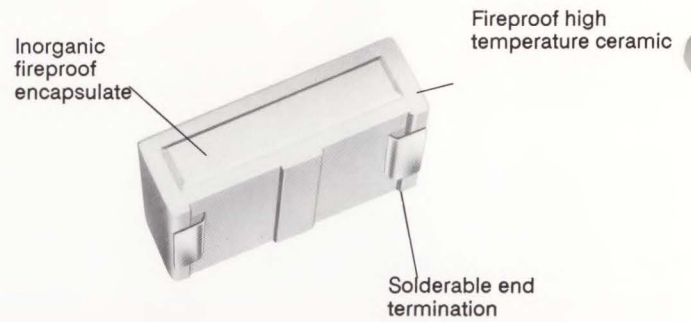




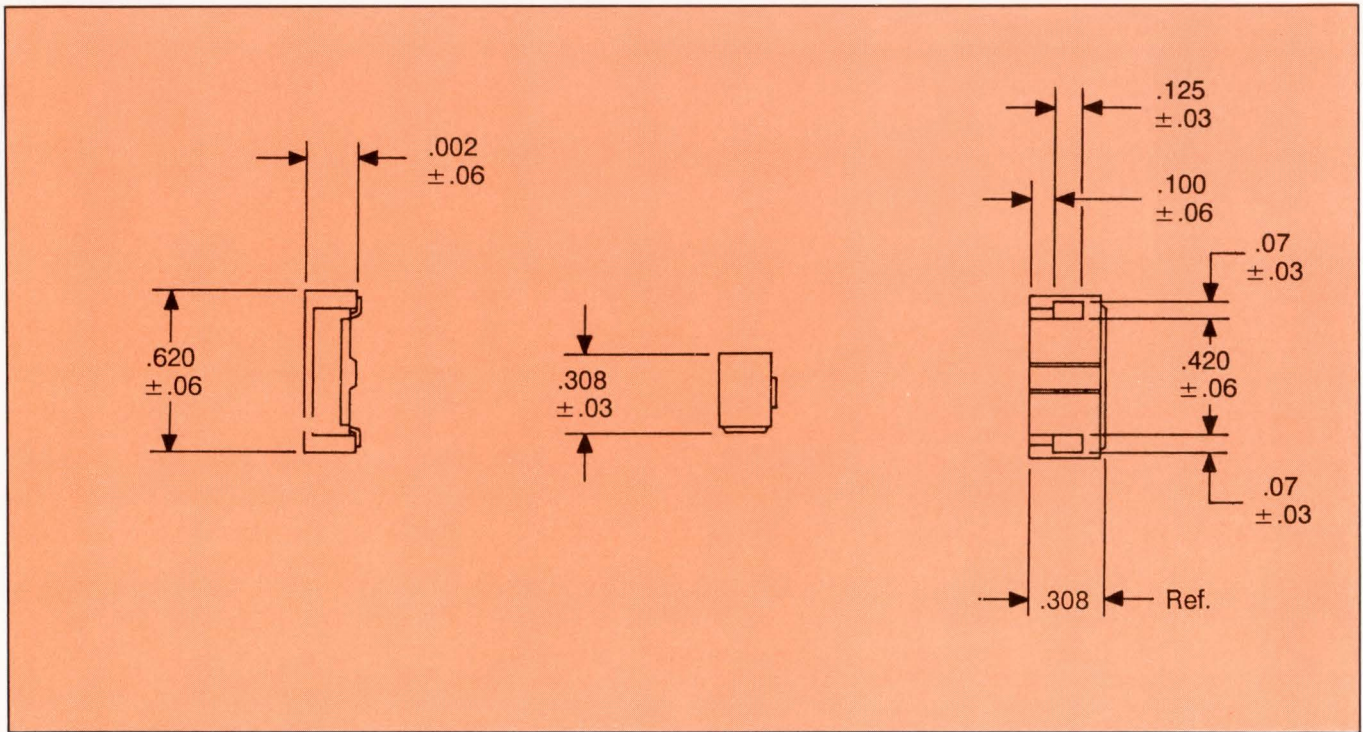
# WIREWOUND SURFACE MOUNT RESISTORS

## LPW-SM SERIES

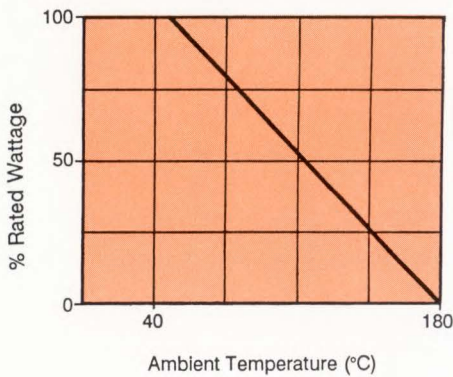
- 2 watts rated
- $\pm 1\%$ ,  $\pm 2\%$ ,  $\pm 5\%$  tolerance
- .01 ohm to .5 ohm
- 30 ppm TCR available
- Packaged in embossed carrier tape



### DIMENSIONS

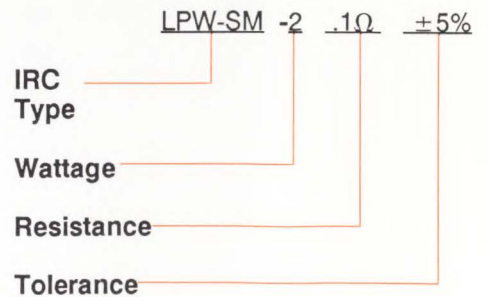


### POWER DERATING



### HOW TO ORDER

Sample Part Number:

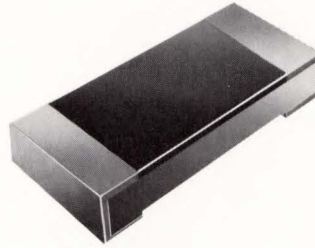






# FLAT CHIP RESISTORS

## CHF SERIES\*



- Glass coated
- 1%, 2%, 5%, tolerance
- 200 ppm/°C. TC 100 ppm for 1%
- 1/10W thru 1W @ 70°C
- 1Ω to 10 Megohm
- 1/10W, 1/8W Zerohm

### SPECIFICATIONS

**Power Rating:**

1/10W, 1/8W, 1/4W, 1/2W, 1W @ 70°C

Temperature Range: -55°C to +125°C

**Resistance Range:**

1/10W 1% 100Ω - 510K

5% 1Ω - 5.6M

1/8W 1% 10Ω - 1M

5% 1Ω - 10M

1/4W 5% 10Ω - 1M

1/2W 5% 10Ω - 1M

1W 5% 10Ω - 1M

Tolerance: 1%, 2%, 5%

Temperature Coefficient:

300 ppm/°C, 200 ppm/°C, 100 ppm/°C

Working Voltage:

100V for 1/10W, 200V for 1/8W, 1/4W, 1/2W, 1W

Max. Overload Voltage:

200V for 1/10W, 400V for 1/8W, 1/4W, 1/2W, 1W

Materials of Construction:

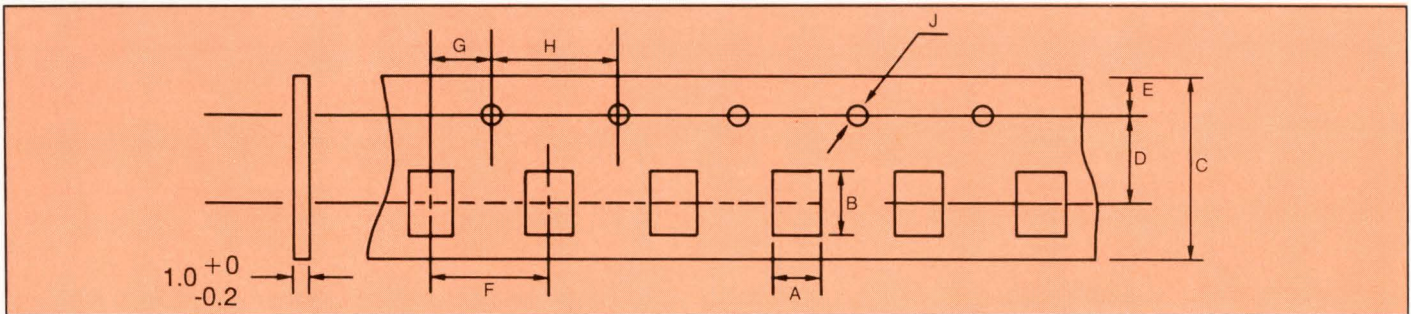
Glass coated thick film element on 96% alumina substrate

Terminations: 60/40 solder-plated nickel barrier layer over palladium-silver.

### ENVIRONMENTAL PERFORMANCE

Standard Test	Max ΔR (+0.1 ohm)
Load Life (1000 hrs.)	± 3.0%
Terminal Strength chip mounted in center of 90mm long board deflected 5mm so as to exert pull on chip contacts for 10 sec.	± 1.0% no cracking or damage
Moisture Resistance (10 cycles, 240 hrs) 95% R.H.	± 2.0%
Temperature Cycle (-55°C/150°C 5 cycles)	± 1.0%
Effect of Solder (270°C, 10 sec.)	± 1.0%
Short Time Overload 5 sec @ $V = 2.5 \times \sqrt{PxR}$ V < 200 V for 1/10W V < 400 V for 1/8W	± 2.0%
Low Temperature Operation @ -55°C 1000 hrs.	± 1.0%
Solderability 5 sec., 230°C	95% min. coverage

### TAPE PACKAGING DIMENSIONS

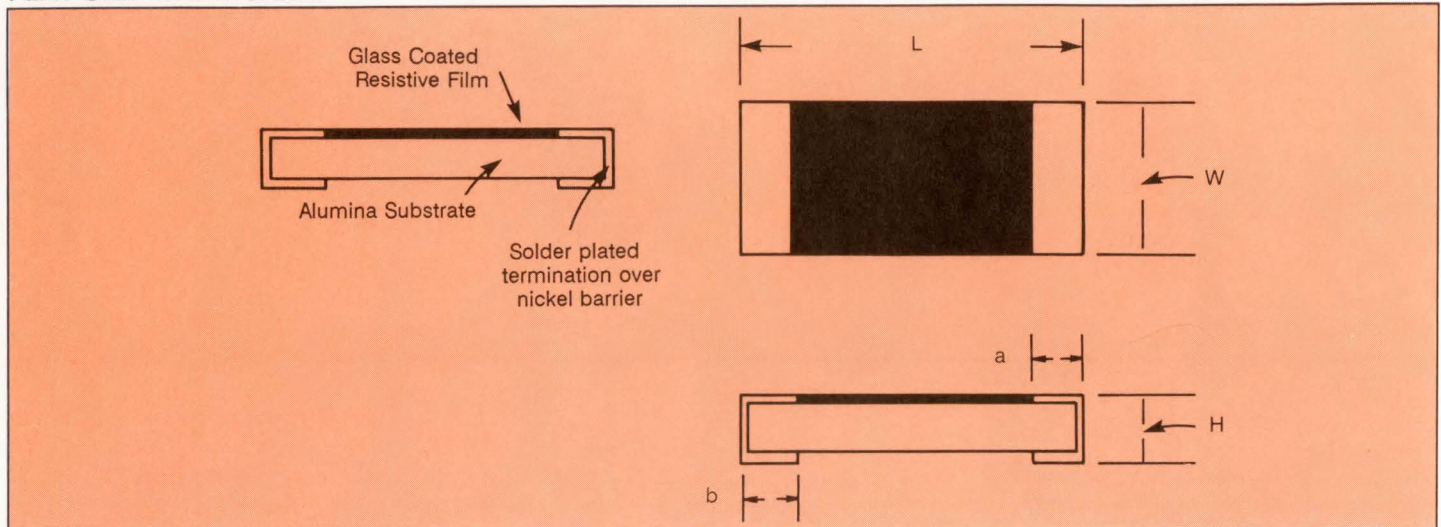


Type	A	B	C	D	E	F	G	H	J
CHF 1/10	1.65 ± 0.2	2.4 ± 0.2	8.0 ± 0.2	3.5 ± 0.05	1.75 ± 0.1	4.0 ± 0.1	2.0 ± 0.1	4.0 ± 0.1	1.45 ± 0.05
CHF 1/8	2.0 ± 0.2	3.5 ± 0.2							
CHF 1/4	3.0 ± 0.2	3.5 ± 0.2							
CHF 1/2	3.0 ± 0.2	5.5 ± 0.2							
CHF 1	4.0 ± 0.2	6.8 ± 0.2							

\*Made in the Far East



## FLAT CHIP DIMENSIONS



Type	L in mm	W in mm	H in mm	a in mm	b in mm
CHF 1/10	0.079 ± 0.008 2.0 ± 0.2	0.049 ± 0.008 1.25 ± 0.2	0.020 ± 0.004 0.5 ± 0.1	0.016 ± .008 0.4 ± 0.2	.012 +.008 -.004 0.3 +0.2 -.01
CHF 1/8	0.126 ± 0.008 3.2 ± 0.2	0.063 ± 0.008 1.6 ± 0.2	0.024 ± 0.004 0.6 ± 0.1	0.020 ± .008 0.5 ± 0.2	.012 +.008 -.004 0.3 +0.2 -.01
CHF 1/4	0.126 ± 0.008 3.2 ± 0.2	0.098 ± 0.008 2.5 ± 0.2	0.024 ± 0.004 0.6 ± 0.1	0.020 ± .008 0.5 ± 0.2	.012 ±.008 0.3 ±0.2
CHF 1/2	0.200 ± 0.008 5.1 ± 0.2	0.098 ± 0.008 2.5 ± 0.2	0.024 ± 0.004 0.6 ± 0.1	0.023 ± .008 0.6 ± 0.2	.012 ±.008 0.3 ±0.2
CHF 1	0.256 ± 0.008 6.5 ± 0.2	0.126 ± 0.008 3.2 ± 0.2	0.024 ± 0.004 0.6 ± 0.1	0.023 ± .008 0.6 ± 0.2	.012 ±.008 0.3 ±0.2

### HOW TO ORDER

Sample Part Number

CHF1/8 - 200 - 2203 - J - T

IRC Type

Temperature Coefficient

Resistance

1st 3 significant figures plus 4th digit multiplier  
(Examples: 2203 = 220,000 ohms 51R0 = 51.0 ohms)

Tolerance

J = 5%, G = 2%, F = 1%

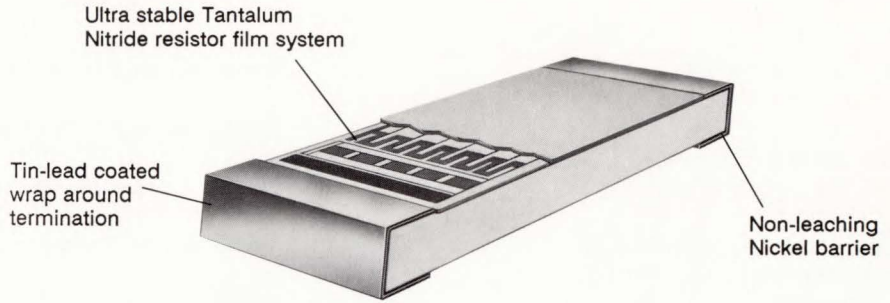
Packaging





# TANFILM FLAT CHIP RESISTORS

## PFC SERIES



- Performance exceeds MIL-R-55342 Characteristic H and EIA-STD-IS-30
- Passivated TaNFilm element
- Wrap around termination

- 8 mm reel packaging standard
- TC to 25 ppm/°C standard
- Tol. to .1% standard
- Termination contains non-leaching barrier

The IRC TaNFilm Precision Chip Resistor provides the high temperature and ultra stable performance of our Tantalum Nitride Resistive Film System in the International Standard 1206 sized chip resistor configuration.

Materials and processes have been selected to insure that the initial precision is maintained in

the harshest surface mount soldering environment. In addition, the unique characteristics of our passivated, Tantalum Nitride film insure ongoing environmental and long term life stability surpassing all MIL-R-55342 requirements by a wide margin. Wrap around termination with a leach resistant nickel barrier under a solder coating en-

ures high integrity solder connections to all circuit board technologies under surface mount soldering techniques.

Standard packaging is 8 mm tape and reel per EIA Standard RS481. The packaging materials provide ESD protection. Anti Static bulk packaging is also available.

### ORDERING INFORMATION

Sample Standard Part Number:

<u>Model</u>	<u>Terminal Designator</u>	<u>Characteristic</u>	<u>Resistance Code</u>	<u>Tolerance</u>	<u>Packaging Code</u>
W1206	R	03	1001	B	B

<u>Model</u>	<u>Terminal Designator</u>	<u>Characteristic</u>	<u>Resistance</u>	<u>Tolerance</u>	<u>Packaging</u>
Model 1206 size Precision Flat Chip Resistor	R = Hot solder dipped U = Solder plated		STD. Mil Code 1001 = 1000	Code % B = ±0.1% D = ±0.5% F = ±1.0%	Code T = Tape B = Bulk

<u>Code</u>	<u>Classification</u>	<u>TCR(ppm/°C)</u>
01	Commercial	± 100
02	Commercial	± 50
03	Commercial	± 25





**PFC SPECIFICATIONS**

Resistance Values:  
50 ohm to 50K ohm

Resistance Tolerances:  
±1.0%, ±0.5%, and ±0.1%

Temperature Coefficient of Resistance:  
±100ppm/°C,  
±50 ppm/°C, ±25 ppm/°C

Temperature Range: -65°C TO +150°C

Power Rating: 125 mw @ 70°C

Noise: Less than -25 db

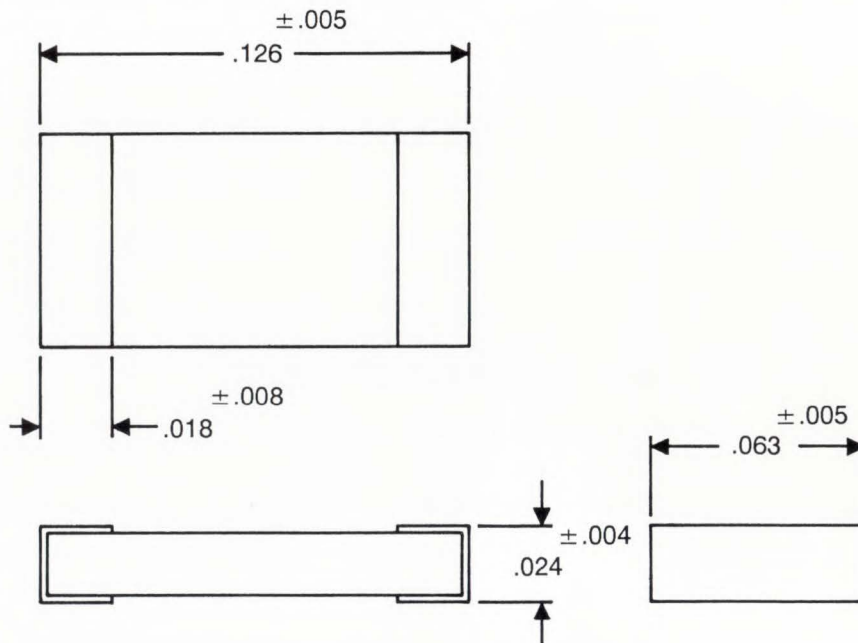
Termination: Solder over nickel

Substrate: 99.5% alumina

**PERFORMANCE DATA**

Environment	ΔR per MIL-R-55342 Char. H	ΔR per EIA IS-30 Char. E	PFC 1206 Performance	
			Typical	Maximum
Thermal Shock	.25%	.25%	.05%	.10%
Low Temperature Operation	.25%	.25%	.02%	.10%
Short Time Overload	.10%	.25%	.02%	.05%
High Temp Exposure	.20%	.25%	.05%	.10%
Effects of Solder	.25%	.25%	.03%	.10%
Moisture Resistance	.4%	.25%	.03%	.10%
Life	.5%	.25%	.05%	.10%

**DIMENSIONS**





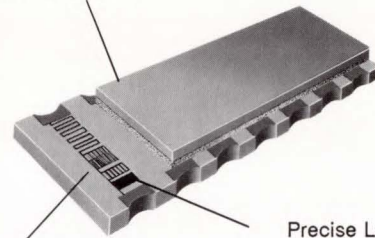


**TANFILM  
SMALL OUTLINE  
LEADLESS RESISTOR  
NETWORK**

**SON SERIES**

- Designed for Surface Mount Assemblies
- Superior temperature performance
- Absolute TC to  $\pm 25$  ppm/ $^{\circ}$ C
- Tracking to 2 ppm/ $^{\circ}$ C
- Full military screening available
- Increased component density
- Ultra precision
- Absolute tolerance to .05%
- Ratios to .01%
- Compatible with standard SO footprint

Monolithic construction eliminates vulnerable wirebond termination



Precise Laser Trimming

The Tantalum Nitride resistor film system is a refractory metal that is self passivating

IRC's TaNFilm Small Outline Leadless Resistor Networks - the latest design in resistor networks. This network is ideally suited for applications requiring precision, long term reliability and stability in a small area. Its monolithic construction eliminates vulnerable terminations such as wire bonds or solder connections. The SON package is ideal for the latest surface mount production reflow techniques. The TaNFilm SON Network provides all the unique qualities of our other

TaNFilm package configuration. Testing has demonstrated performance exceeding MIL-R-83401 characteristic H.

By eliminating the fragile chip and wire bond technique, IRC's TaNFilm has enhanced the resistor network reliability. Precise laser trimming enables us to achieve extremely close tolerance and tight ratios. Our in-house CAD system and photoetch process makes custom circuit configurations and multiple

resistance values easily achievable. The tantalum nitride resistor film system is a refractory metal that is self passivating providing extreme temperature capabilities and superior environmental characteristics that surpass military requirements. For surface mounted resistor network applications requiring reliability, stability, accuracy and low noise characteristics in the latest leadless configurations, specify the IRC SON resistor network.

**SPECIFICATIONS**

Resistance Ranges:  
L959, L989 & L999:  
50 ohm to 100K ohm  
L954, L987 & L998:  
50 ohm to 50K ohm  
Higher resistance values available.

Temperature Coefficient of Resistance:  
 $\pm 25$  ppm/ $^{\circ}$ C,  $\pm 50$  ppm/ $^{\circ}$ C,  
 $\pm 100$  ppm/ $^{\circ}$ C and  
 $-100 \pm 50$  ppm/ $^{\circ}$ C

Resistance Tolerances:  
 $\pm .1\%$ ,  $\pm .5\%$ ,  $\pm 1\%$   
and  $\pm 2\%$  standard,  
 $\pm .05\%$  available

TCR Tracking:  
5 ppm/ $^{\circ}$ C standard  
2 ppm/ $^{\circ}$ C available

Temperature Range:  
 $-55^{\circ}$ C to  $150^{\circ}$ C

Noise: Less than -25dB

Power Rating @  $70^{\circ}$ C:

Model	Wattage	
	Resistor	Network
L959 & L954	.1	.4
L987 & L989	.1	.7
L998 & L999	.1	.8

Terminations:  
Gold over nickel over copper

Substrate Material:  
99.5% pure alumina ceramic

Construction:  
Ceramic "sandwich" package

4 thru 24 terminals available

Custom circuits and special screening available.

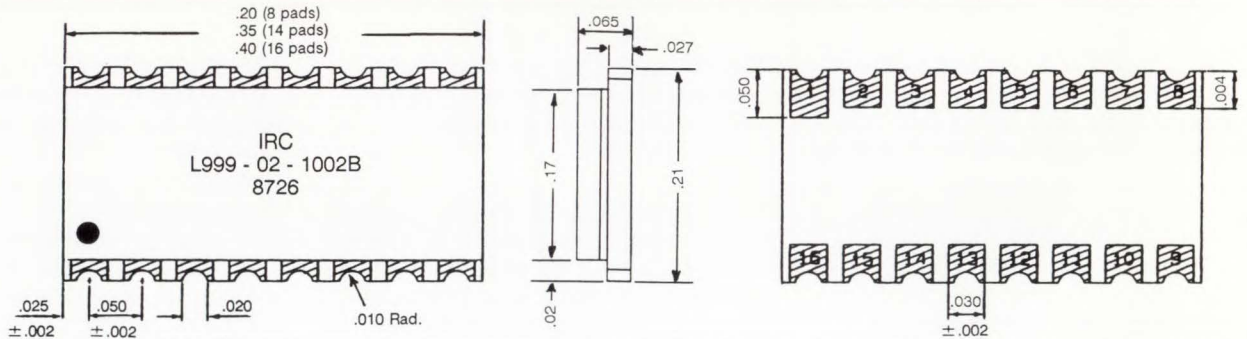


### SON PERFORMANCE TEST DATA

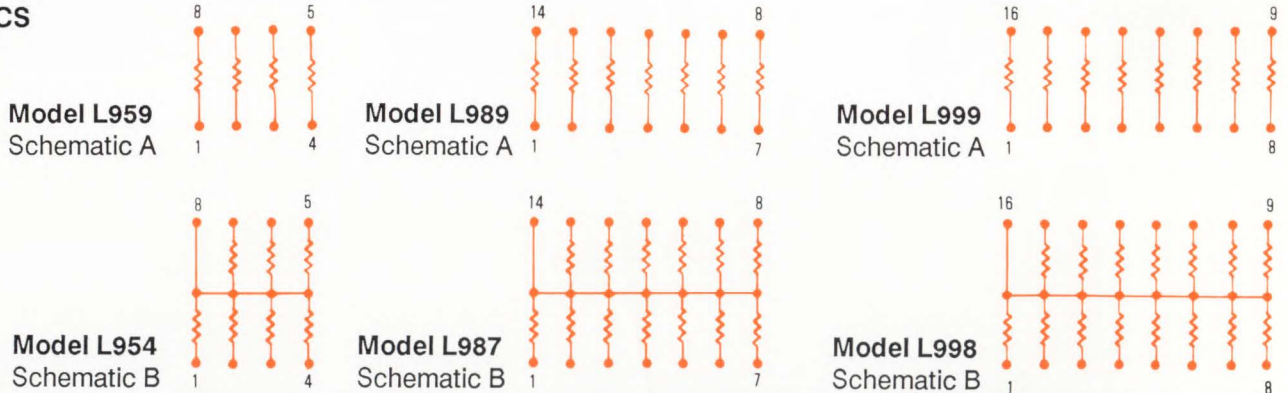
Test Per MIL-R-83401	MIL-R-83401 Limits ( $\Delta R\%$ )			TaNFilm Test Data ( $\Delta R\%$ )	
	M	K	H	Maximum	Minimum
Thermal Shock and Power Conditioning	0.70	0.70	0.50	0.10	0.02
Low Temperature Operations	0.50	0.25	0.10	0.10	0.01
Short Time Overload	0.50	0.25	0.10	0.05	0.01
Resistance to Soldering Heat	0.25	0.25	0.10	0.10	0.02
Moisture Resistance	0.50	0.50	0.40	0.10	0.03
Shock	0.25	0.25	0.25	0.10	0.03
Vibration	0.25	0.25	0.25	0.10	0.03
Life	2.00	0.50	0.50	0.10	0.05
High Temperature Exposure	1.00	0.50	0.20	0.10	0.05
Low Temperature	0.50	0.25	0.10	0.10	0.02
25°C Double Load	2.00	0.50	0.50	0.05	0.03

### DIMENSIONS

Tolerances unless otherwise noted -  
 .XXX is +.005  
 .XX is .010



### SCHEMATICS



### HOW TO ORDER

Sample Part Number:

**Model** L989    **Characteristic** 03    **Resistance Code** 1001    **Tolerance Code** B

### Model Number

### Description

### Characteristic Code TCR (ppm/°C)

### Resistance Code

### Tolerance Code %

L959	4 resistor, isolated, 8 pad SON	00	-100 $\pm$ 50	Standard	B $\pm$ .1%
L954	7 resistor, terminal #8 common, 8 pad SON	01	$\pm$ 100	Military	D $\pm$ .5%
L989	7 resistor, isolated, 14 pad SON	02	$\pm$ 50	Resistance	F $\pm$ 1%
L987	13 resistor, terminal #14 common, 14 pad SON	03	$\pm$ 25	Code	G $\pm$ 2%
L999	15 resistor, terminal #16 common, 16 pad SON			E.G.	
					1001 = 1000 $\Omega$

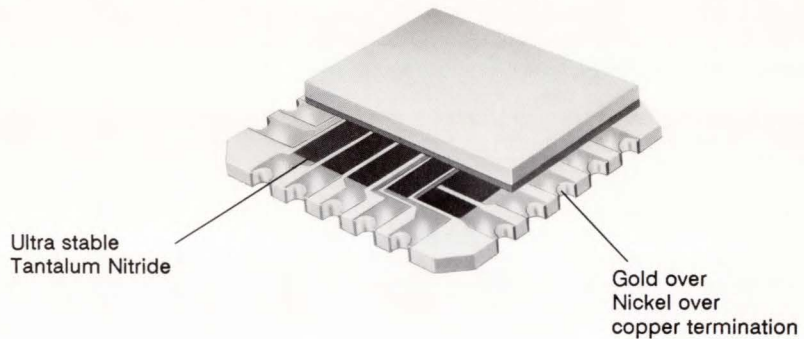




# TANFILM CHIP CARRIER RESISTOR NETWORKS

## CCN SERIES

- Increased component density
- Ideal for all reflow soldering techniques
- Best tolerances:  $\pm 0.02\%$  absolute  
-0.01% ratio
- Superior temperature performance:  
absolute T.C. to  $\pm 25$  ppm/ $^{\circ}\text{C}$  -  
Tracking 5 ppm/ $^{\circ}\text{C}$  standard,  
1 ppm/ $^{\circ}\text{C}$  available.
- Custom schematics readily available
- Meet JEDEC standard for Type 'C'  
package



The IRC TaNFilm Chip Carrier Network offers higher lead density, increased component count, lower installed resistor cost, better reliability, and is ideal for use with all surface mount solder techniques. In addition, the TaNFilm leadless Chip Carrier Network provides all the unique qualities of our other TaNFilm package configurations. Testing has demonstrated performance exceeding MIL-R-83401 Characteristic H.

The proven TaNFilm manufacturing process enhances reliability through elimination of wire bonds. Precise state-of-the-art laser trimming provides close tolerances and tight ratios. The TaNFilm process enables us to manufacture custom circuit configurations and multiple resistance values without sacrificing the tightest tolerance and tracking characteristics of precision networks. The Tantalum Nitride resistor

material is passivated for environmental protection surpassing military requirements and guaranteeing exceptional ratio stability.

For applications requiring a high degree of reliability, stability, accuracy and low noise, plus advantages of new resistor configuration, specify the IRC Leadless Chip Carrier Configuration Resistor Network.

### SPECIFICATIONS

Resistance Values: 50 $\Omega$  to 50K $\Omega$  standard; up to 250K $\Omega$  on special order

Resistance Tolerances:  
 $\pm .1\%$ ,  $\pm .25\%$ ,  $\pm .5\%$ ,  
 $\pm 1\%$ ,  $\pm 2\%$

Temperature Coefficient  
of Resistance:  
 $\pm 25$  ppm/ $^{\circ}\text{C}$ ,  $\pm 50$  ppm/ $^{\circ}\text{C}$ ,  
 $\pm 100$  ppm/ $^{\circ}\text{C}$ , -100  $\pm 50$  ppm/ $^{\circ}\text{C}$

TCR Tracking: 5 ppm/ $^{\circ}\text{C}$

Temperature Range:  
-55 $^{\circ}\text{C}$  to +150 $^{\circ}\text{C}$

Noise: Less than -25 dB

Power Rating @ 70 $^{\circ}\text{C}$ :  
.1 watt/resistor  
1.0 watt network

Meets JEDEC standard for  
type 'C' package

Terminations: Gold over nickel  
over copper

Substrate Material: 99.5% pure  
alumina ceramic

Construction: Ceramic  
chip/epoxy/ceramic

Custom Circuits and special testing  
available

Contact factory for any special  
features required.

### HOW TO ORDER

Sample Part Number:

Model      Characteristic      Resistance      Code  
7900                      01                      1001                      B

Model  
7900 - 19-resistor, pin #20  
common, min. 50 $\Omega$ ,  
max. 50K $\Omega$   
7909 - 10-resistor, isolated  
resistors, min. 50 $\Omega$ ,  
max. 100K $\Omega$

#### Characteristic

TCR Code	(ppm/ $^{\circ}\text{C}$ )
00	-100 $\pm$ 50
01	$\pm 100$
02	$\pm 50$
03	$\pm 25$

#### Resistance

Standard MIL  
resistance code

Example:  
1001 = 1000 $\Omega$

#### Tolerance

Standard MIL  
tolerance code

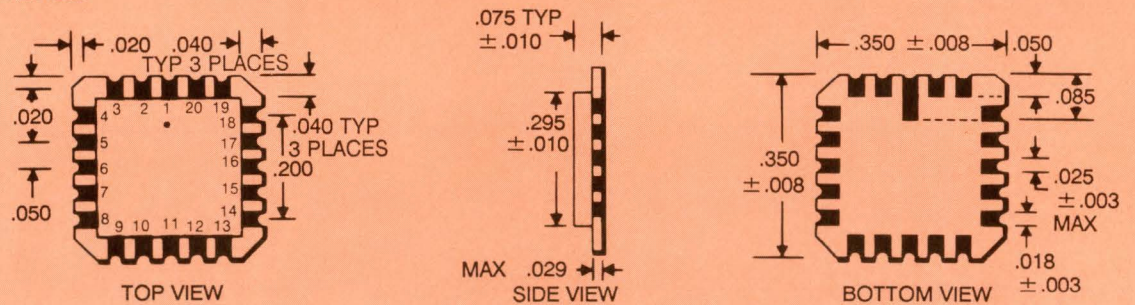
B =  $\pm .1\%$   
C =  $\pm .25\%$   
D =  $\pm .5\%$   
F =  $\pm 1\%$   
G =  $\pm 2\%$



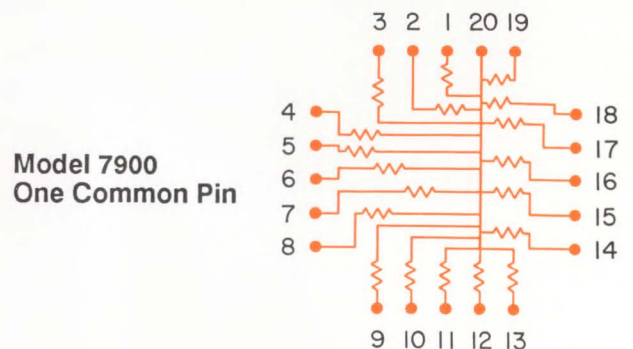
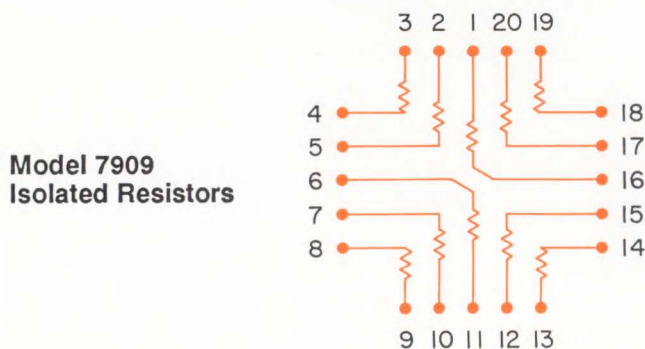
### CCN PERFORMANCE DATA

Test Per MIL-R-83401	MIL-R-83401 Limits ( $\Delta R\%$ )				TaNFilm Test Data ( $\Delta R$ )	
	M	K	H	V	Maximum	Typical
Thermal Shock And Power Conditioning	0.7	0.7	0.5	0.25	0.1	0.05
Low Temperature Operation	0.5	0.25	0.1	0.1	0.1	0.02
Short Time Overload	0.5	0.25	0.1	0.1	0.05	0.02
Resistance to Soldering Heat	0.25	0.25	0.1	0.1	0.1	0.02
Moisture Resistance	0.5	0.5	0.4	0.2	0.1	0.03
Shock	0.25	0.25	0.25	0.25	0.1	0.03
Vibration	0.25	0.25	0.25	0.25	0.1	0.03
Life	2.0	0.5	0.5	0.1	0.1	0.05
High Temperature Exposure	1.0	0.5	0.2	0.1	0.1	0.05
Low Temperature Storage	0.5	0.25	0.1	0.1	0.1	0.05
25°C Double Load	2.0	0.5	0.5	0.1	0.05	0.03

### DIMENSIONS - INCHES



### STANDARD CIRCUIT



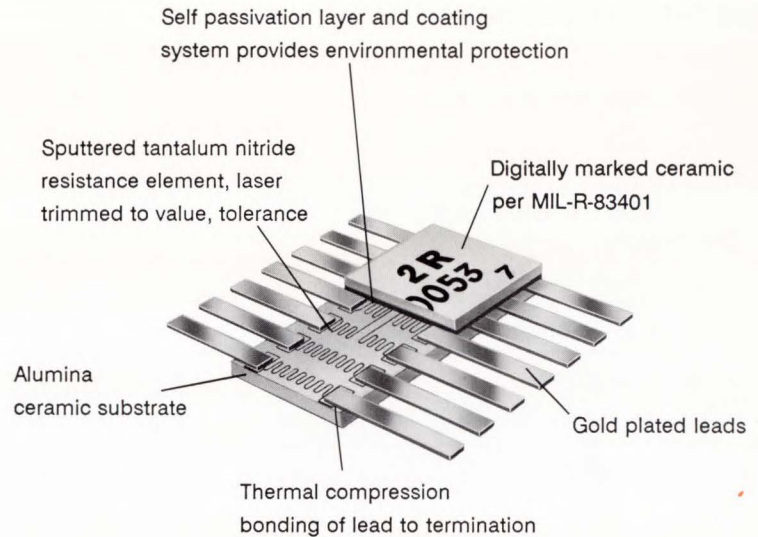




**TANFILM 8900  
RESISTOR NETWORKS**

**FLAT PACK SERIES**

- Qualified to MIL-R-83401/03, Characteristic H
- Available with custom testing
- Ultra precision - Absolute tolerance to  $\pm 0.02\%$  - Ratios to 0.01%
- Superior temperature performance. Absolute T.C. to  $\pm 25$  ppm/ $^{\circ}\text{C}$ . T.C. tracking  $\pm 25$  ppm/ $^{\circ}\text{C}$  standard 1 ppm/ $^{\circ}\text{C}$  available
- Custom schematics readily available
- Special mechanical configurations



Tanfilm resistor networks are designed for use in applications requiring a high degree of reliability, stability, tight tolerance, close TCR tracking, and low noise. The sputtering process for resistor formation has been perfected to allow a continuous feed production line under high vacuum conditions, thus, insuring uniformity of properties between networks. Laser trimming makes tight ratios easily achievable. The

gold plated copper leads are solid phase welded to a large area of gold conductor pads on the ceramic substrate assuring the most reliable termination and long term stability. The Tantalum Nitride resistor material is passivated for environmental protection insuring excellent performance far superior to military requirements.

Our TaNFilm process enables us to manufacture networks containing dif-

ferent resistance values and still maintain tight tolerances and tracking characteristics. The nature of our photo-etch process makes it readily adaptable to meet each individual customer's needs. Custom circuit designs and special mechanical configurations can be easily achieved with a modest set up charge while maintaining our high standards of precision and reliability.

**SPECIFICATIONS**

Mil qualified resistance ranges:  
Schematic A: 49.9 $\Omega$  to 121K  
Schematic B: 49.9 $\Omega$  to 121K  
Higher resistance values available

TCR Tracking: Referenced to R1 is  $\pm 5$  ppm/ $^{\circ}\text{C}$  except Model 8987 below 500 ohm, which is  $\pm 20$  ppm/ $^{\circ}\text{C}$   
2 ppm/ $^{\circ}\text{C}$  available

Ratio Tolerance: to  $\pm .01\%$

Standard Resistance Tolerances:  
 $\pm .1\%$ ,  $\pm .25\%$ ,  $\pm .5\%$ ,  
 $\pm 1\%$ ,  $\pm 2\%$   
.02% available

Temperature Range: -55 $^{\circ}\text{C}$  to +150 $^{\circ}\text{C}$

Construction: Ceramic sandwich package

Noise: Less than -25 dB

Custom Screening Procedures

Temperature Coefficient of Resistance:  
 $\pm 25$  ppm/ $^{\circ}\text{C}$ ,  $\pm 50$  ppm/ $^{\circ}\text{C}$ ,  
 $\pm 100$  ppm/ $^{\circ}\text{C}$ ,  $\pm 300$  ppm/ $^{\circ}\text{C}$ ,  
-100  $\pm 25$  ppm/ $^{\circ}\text{C}$

Power Ratings:  
.1 watt per resistor,  
.5 watt per network at 70 $^{\circ}\text{C}$ ,  
1.0 watt per network at 25 $^{\circ}\text{C}$

Packages: up to 20 leads

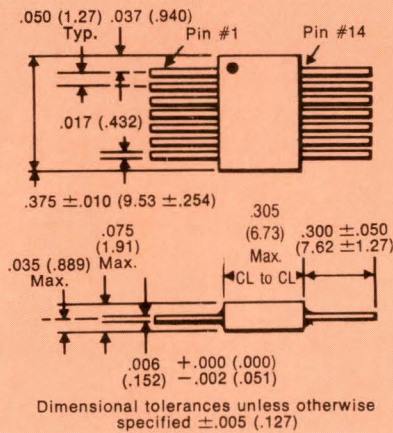
Contact factory for all custom packages and circuits



### FLAT PACK PERFORMANCE DATA

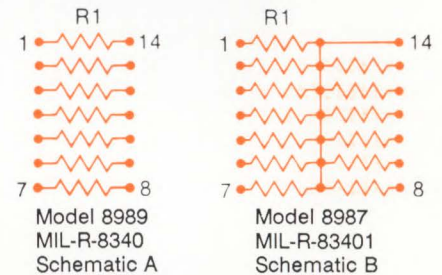
Test Per MIL-R-83401	MIL-R-83401 Limits ( $\Delta R\%$ )				TaNFilm Test Data ( $\Delta R\%$ )	
	M	K	H	V	Maximum	Typical
Thermal Shock and Power Conditioning	0.7	0.7	0.5	0.25	0.1	0.02
Low Temperature Operation	0.5	0.25	0.1	0.1	0.1	0.01
Short Time Overload	0.5	0.25	0.1	0.1	0.05	0.01
Terminal Strength	0.25	0.25	0.25	0.1	0.1	0.01
Resistance to Solder Heat	0.25	0.25	0.1	0.2	0.1	0.02
Moisture Resistance	0.5	0.5	0.4	0.25	0.1	0.03
Shock	0.25	0.25	0.25	0.25	0.1	0.03
Vibration	0.25	0.25	0.25	0.1	0.1	0.03
Life	2.0	0.5	0.5	0.1	0.1	0.05
High Temperature Exposure	1.0	0.5	0.2	0.1	0.1	0.05
Low Temperature Storage	0.5	0.25	0.1	0.1	0.1	0.02
25°C Double Load	2.0	0.5	0.5	0.1	0.05	0.03

### DIMENSIONS - IN AND (mm)



### STANDARD CIRCUITS

Both "A" and "B" schematics of MIL-R-83401 - RZ 030 are available as standard. Contact factory for custom packages and circuits.



### HOW TO ORDER

Sample Part No.

8987 - 05 - 1001 - B

#### Model

8989 7-resistors  
(MIL-R-83401-03  
Schematic A)

8987 13-resistors  
(MIL-R-83401-03,  
Schematic B)

#### Characteristic

Code	Classification	TCR (ppm/° C)
00	Commercial Grade	-100 $\pm$ 25
01	Commercial Grade	$\pm$ 100
02	Commercial Grade	$\pm$ 50
03	Commercial Grade	$\pm$ 25
04	MIL-R-83401M	$\pm$ 300
05	MIL-R-83401K	$\pm$ 100
06	MIL-R-83401H	$\pm$ 50
07	MIL-R-83401H	$\pm$ 25

#### Resistance

Standard MIL  
resistance code

Example:

1001 = 1000W

#### Tolerance

Standard MIL tolerance  
code:

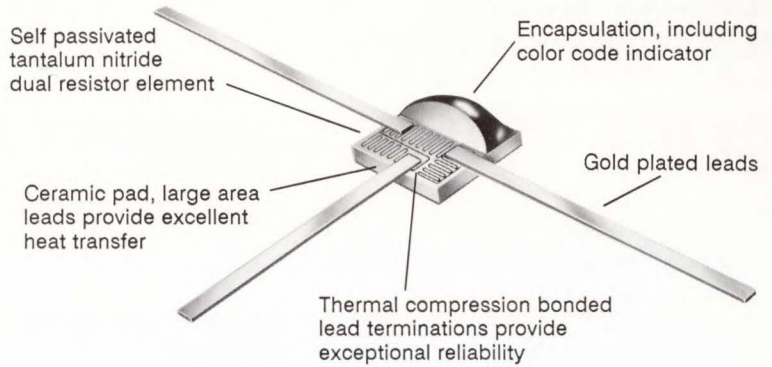
B =  $\pm$  .1%,  
C =  $\pm$  .25%,  
D =  $\pm$  .5%,  
F =  $\pm$  1%,  
G =  $\pm$  2%



# TANFILM SUBMINIATURE DUAL NETWORK

## TANTEE SERIES

- Subminiature (0.075" x 0.075")
- Dual resistor, center lead common
- Available with custom testing
- Ultra precision - Absolute tolerance to  $\pm 1\%$ , - Ratios to 0.1%
- Superior temperature performance  
Absolute T.C. to  $\pm 25$  ppm/ $^{\circ}\text{C}$   
T. C. tracking: 5 ppm/ $^{\circ}\text{C}$  standard
- .25 watt power dissipation



The TaNTee Series of TaNFilm resistor networks provide a miniature, two-resistor network adptable to many circuit requirements. The tantalum nitride film resistors are deposited on a 25 mil thick ceramic chip .075" x .075", and are protected by a rugged epoxy coating. Gold plated copper

leads are bonded to termination pads on the ceramic chip, resulting in a strong, reliable lead connection. Tantalum nitride is an extremely stable metal film resistor material capable of high operating power levels and also exceptional environmental performance. The TaNTee

dual resistor's physical size and construction make it ideally suited for high frequency applications. The excellent TC tracking of the two resistors on the chip provides a very stable voltage ratio over temperature.

### SPECIFICATIONS

Resistance Range, each R:

10 $\Omega$  to 10K $\Omega$

(See chart and schematic below)

Power Rating: 1/4 watt @ 85 $^{\circ}\text{C}$

Resistor Tolerance:

Absolute Tolerance -

$\pm 5\%$  standard,

$\pm 1\%$  available

Moisture Resistance,  $\Delta R$ :

$\pm 0.4\%$  max.

Thermal Shock,  $\Delta R$ :  $\pm 0.25\%$  max.

(5 cycles, -65 $^{\circ}\text{C}$  to +125 $^{\circ}\text{C}$ )

Temperature Coefficient:

Absolute - to  $\pm 25$  ppm/ $^{\circ}\text{C}$

Tracking - to 5 ppm

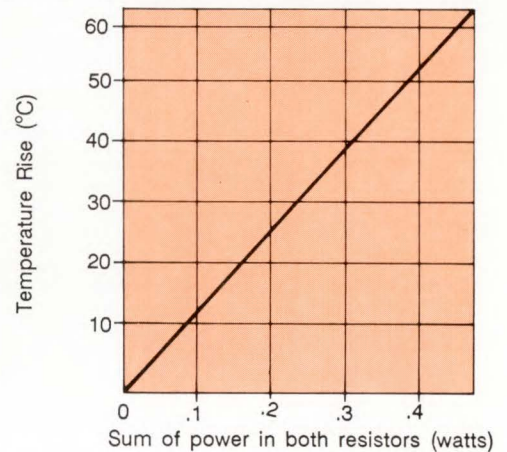
Load Life,  $\Delta R$ :  $\pm 5\%$  max.

(1000 hrs. @ 70 $^{\circ}\text{C}$  @ rated load)

Noise: -20 db max.

Short Time Overload,  $\Delta R$ :

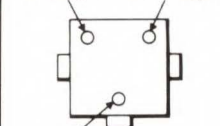
### TEMPERATURE RISE



Standard Resistance					1st and 2nd Digit		Multiplier
10	16	27	43	68	Black = 0	Green = 5	Black = X1
11	18	30	47	75	Brown = 1	Blue = 6	Brown = X10
12	20	33	51	82	Red = 2	Violet = 7	Red = X100
13	22	36	56	91	Orange = 3	Grey = 8	Orange = X1000
15	24	39	62		Yellow = 4	White = 9	
5% EIA Values							

### COLOR CODING

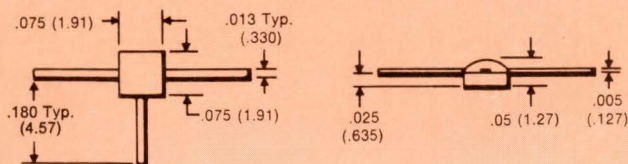
1st Digit 2nd Digit



### STANDARD CIRCUIT



### DIMENSIONS



### HOW TO ORDER

Sample Part Number:

TaNTee 2-X X X

Product Family

Resistance Value when  $R_1 = R_2^*$

(\*When  $R_1$  does not equal  $R_2$ , consult factory.)

First Digit

Second Digit

Multiplier

(Number of Zeros)

Example: 2100 = 10 $\Omega$  2101 = 100 $\Omega$  2103 = 10,000 $\Omega$

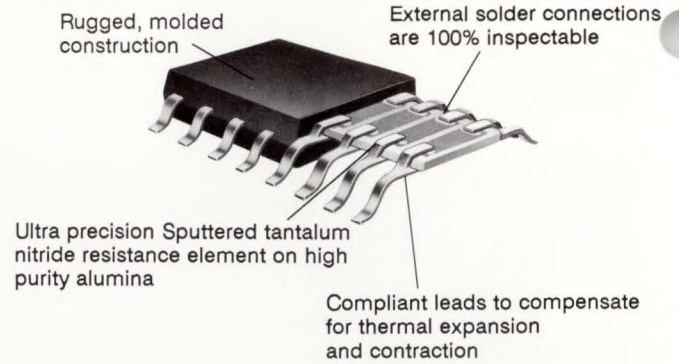




# TANFILM SMALL OUTLINE SURFACE MOUNT RESISTOR NETWORK

## GULL WING SERIES

- Thin Film precision
- Designed for reflow soldering techniques
- Uses less board space
- Standard JEDEC package for automatic placement equipment
- Reliable, no internal cavity, no internal wireboards
- Full military screening available



IRC's TaNFilm, Small Outline Integrated Circuit, resistor networks are ideally suited for surface mounting. The .05 inch lead spacing provides higher lead density, increased component count, lower installed resistor cost, and better reliability. They are ideally suited for the latest surface mount assembly techniques, and each lead can be 100% visually inspected. The compliant leads relieve thermal expansion and contraction stresses.

The Tantalum Nitride film system provides precision tolerance, exceptional TCR tracking, and low noise. TaNFilm provides stability, high reliability, and long life characteristics. Testing has demonstrated performance exceeding MIL-R-83401 characteristic H.

The proven TaNFilm manufacturing process begins with our in-house CAD system for both standard and custom designs. Vacuum sputtering, exacting photoetching and laser trimming formulate the resistor network on high purity alumina

ceramic. Resistor self-passivation provides excellent environmental protection. The resistor network is high temperature soldered into a lead frame and then molded. This yields a small, rugged package with stable dimensions. It is ideal for automatic assembly using pick and place equipment.

For applications requiring precision, small size, low cost, low noise, high frequency, and high power density, specify IRC Small Outline resistor networks.

### SPECIFICATIONS

Resistance Values: 50Ω to 50KΩ

Resistance Absolute Tolerance:  
.1%, .25%, .5%, 1.0%, 2.0%

Resistance Ratio: none standard,  
to .05% available

Temperature Coefficient  
of Resistance:  
± 25, ± 50, ± 100,  
-100 + 25 ppm/°C

TCR Tracking: 5 ppm/°C standard,  
referenced to R1, 3 ppm/°C available

Power Rating:  
(see standard circuits)

Operating Temperature Range:  
-55°C to +125°C

Noise: Less than -25dB

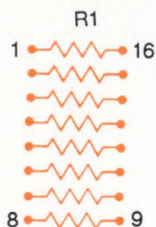
Substrate:  
99.5% pure alumina ceramic

Lead material: Copper alloy

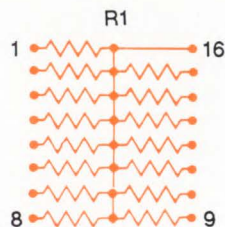
Lead plating: 60/40 solder plated

*Custom circuits and special testing  
available*

### STANDARD CIRCUITS



Schematic A  
Model GM8A

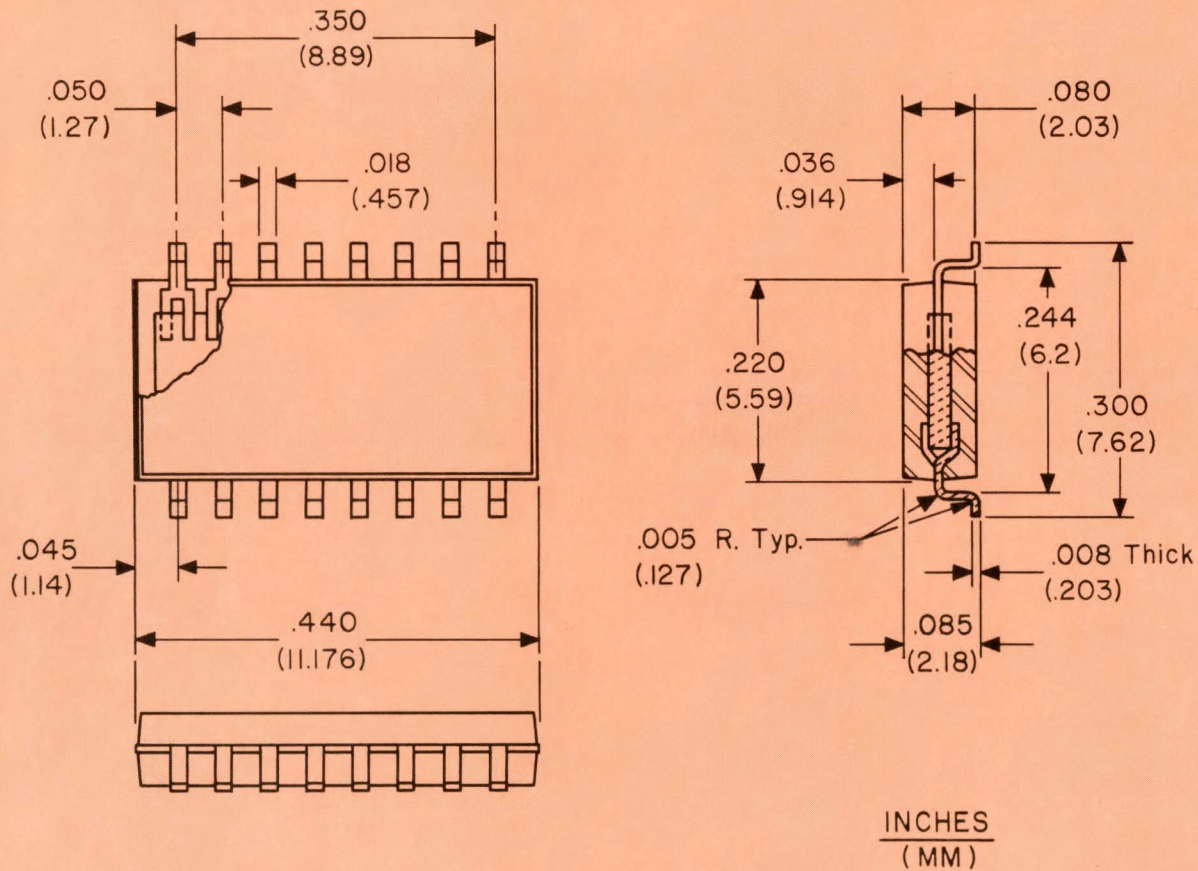


Schematic B  
Model GM8B

### POWER DISSIPATION (watts)

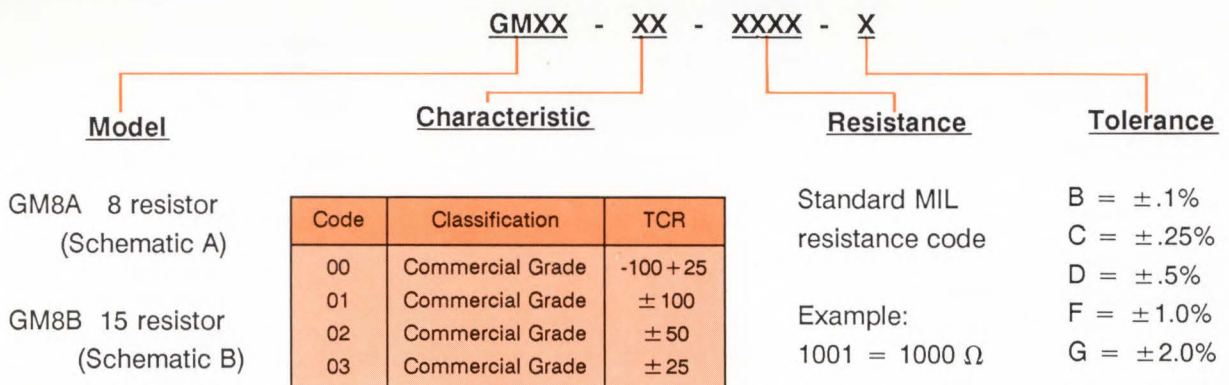
	Schematic A		Schematic B	
	Per Resistor	Per Package	Per Resistor	Per Package
25°C	.25	.75	.125	.75
70°C	.16	.48	.08	.48





**HOW TO ORDER**

Sample Part Number:

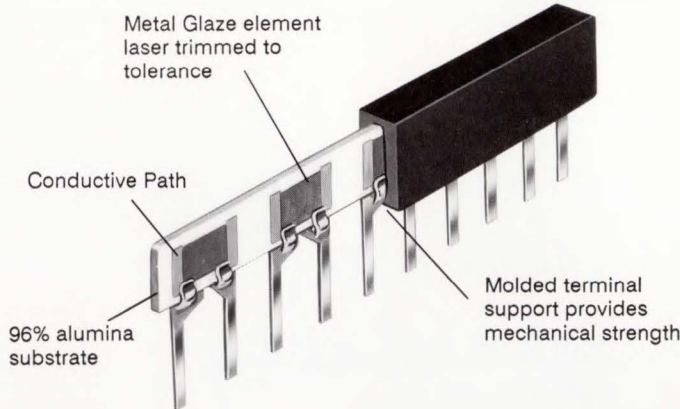






**THICK FILM MOLDED  
8- AND 10-PIN, .195-IN.**

**SIP NETWORKS**



**SPECIFICATIONS**

**Electrical**

Resistance Range: 22Ω to 150K

Resistance Tolerance:  
±2%, ±5%

Temperature Coefficient:  
±150 ppm/°C

TC Tracking: 50 ppm/°C typical

Max. Continuous Working Voltage:  
100V

Operating Temperature:  
-55°C to 150°C

**Physical**

Element:  
Fused thick-film composition

Substrate: 96% alumina

Body: Molded Epoxy

Terminals: Tinned Copper

Lead Pull: 4.5 pounds

Lead Solderability:  
MIL-STD-202, Method 208,  
and MIL-STD-883, Method 2003

Resistance to Soldering Heat:  
MIL-STD-202,  
Method 210, Cond. C

Marking Resistance to Solvents:  
MIL-STD-202, Method 215

**ENVIRONMENTAL  
PER MIL-R-83401**

TCR: ±150 ppm/°C

Thermal Shock: ±.50%

Power Conditioning: ±.50%

Low Temperature Operation:  
±.25%

Short Time Overload: ±.25%

Terminal Strength: ±.25%

Resistance to Solder Heat: ±.25%

Moisture Resistance: ±.50%

Shock: ±.25%

Vibration, High Frequency:  
±.25%

Life: ±1.0%

25°C Power Rating: ±1.0%

High Temperature Exposure:  
±.50%

Low Temperature Storage: ±.25%

Insulation Resistance:  
10,000 Megohms

\* ±1% tolerance & ±100 ppm/°C TCR  
available. Consult factory for details

**STANDARD RESISTANCE  
VALUES (OHMS)**

22	470	10K
27	560	12K
33	680	15K
39	820	18K
47	1.0K	22K
56	1.2K	27K
68	1.5K	33K
82	1.8K	39K
100	2.2K	47K
120	2.7K	56K
150	3.3K	68K
180	3.9K	82K
220	4.7K	100K
270	5.6K	120K
330	6.8K	150K
390	8.2K	

**HOW TO ORDER**

**6 08 1 - 09 - 102 - G**

**Product Family**  
(6 = .195" SIP)

**No. of Pins**

**Circuit Type**  
Type 1 = Pin 1 common  
Type 3 = Isolated

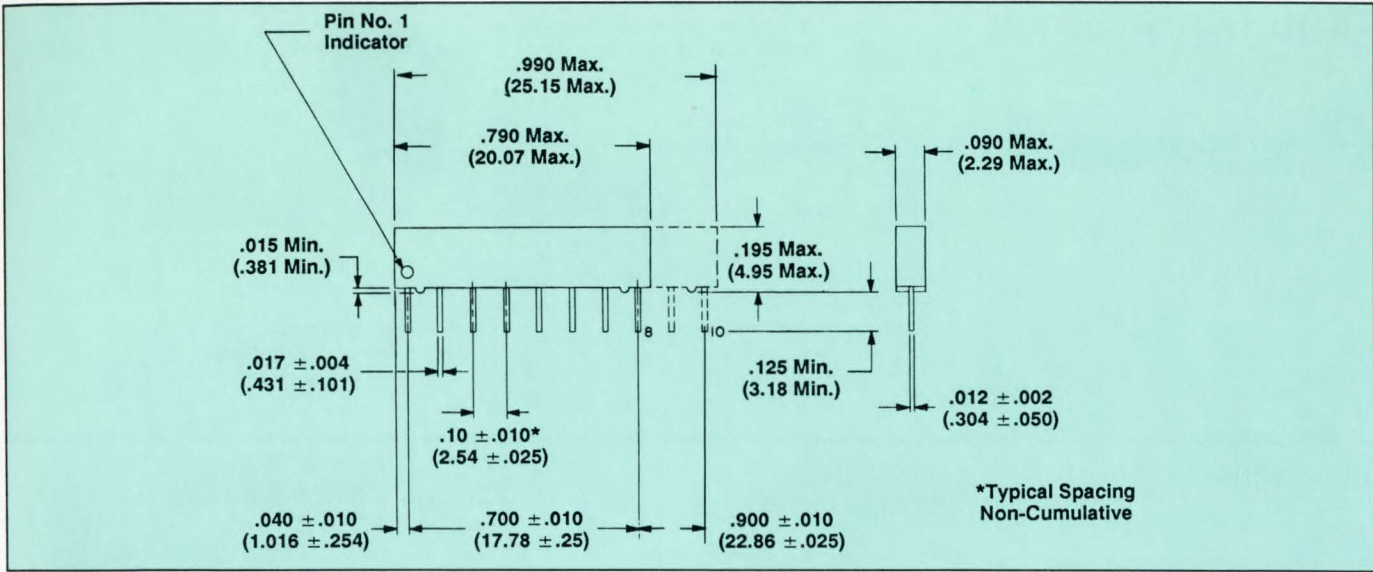
**Temp. Coefficient Code**  
09 = ±150 ppm/°C

**2 or 3 Digit Resistance  
Military Resistance**  
Code i.e.  
102 = 1K, 1002 = 10K

**Tolerance**  
G = ±2%  
J = ±5%



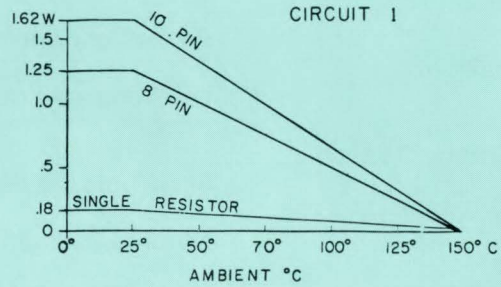
SIP DIMENSIONS - IN. AND (MM)



POWER RATING

Circuit 1

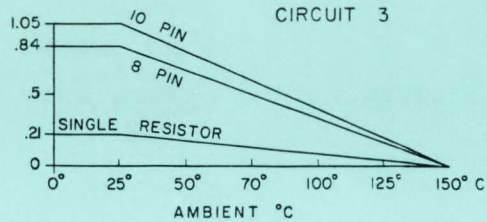
	8 Pin	10 Pin
- Total Package	1.25W	1.62W
- Single Resistor	.18W	.18W



Circuit 3

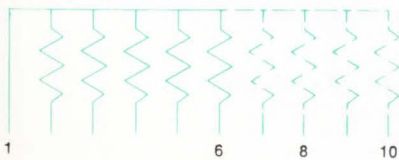
	8 Pin	10 Pin
- Total Package	.84W	1.05W
- Single Resistor	.21W	.21W

(Rating @ 70°C is 67% of 25° rating)

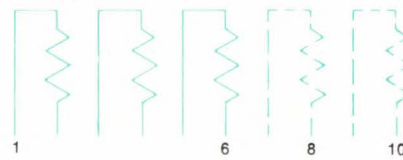


STANDARD CIRCUITS

Circuit 1



Circuit 3

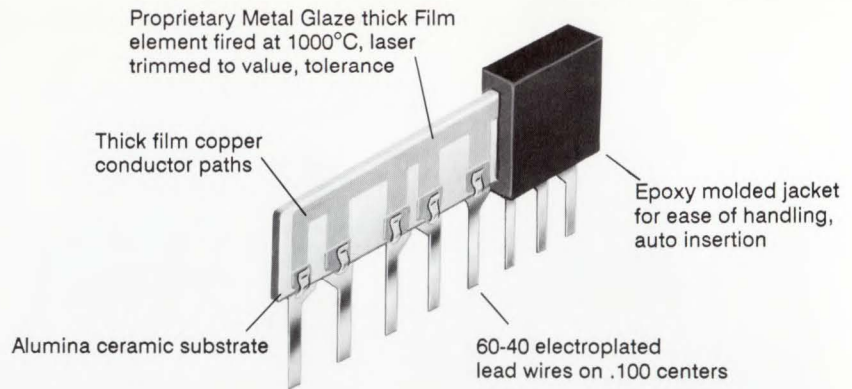






**THICK FILM MOLDED  
6-, 8- AND 10-PIN, .350-IN.**

**SIP NETWORKS**



**SPECIFICATIONS**

**Electrical**

Resistance Range: 22Ω to 1 meg

Resistance Tolerance:  
± 2%, ± 5%

Temperature Coefficient:  
± 150 ppm/°C

TC Tracking: 50 ppm/°C typical

Max. Continuous Working Voltage:  
100V

Operating Temperature:  
-55°C to 150°C

**Physical**

Element:  
Fused thick-film composition

Substrate: 96% alumina

Body: Molded Epoxy

Terminals: Tinned Copper

Lead Pull: 4.5 pounds

Lead Solderability:  
MIL-STD-202, Method 208,  
and MIL-STD-883, Method 2003

Resistance to Soldering Heat:  
MIL-STD-202,  
Method 210, Cond. C

Marking Resistance to Solvents:  
MIL-STD-202, Method 215

**ENVIRONMENTAL  
PER MIL-R-83401**

TCR: ± 150 ppm/°C

Thermal Shock: ± .50%

Power Conditioning: ± .50%

Low Temperature Operation:  
± .25%

Short Time Overload: ± .25%

Terminal Strength: ± .25%

Resistance to Solder Heat: ± .25%

Moisture Resistance: ± .50%

Shock: ± .25%

Vibration, High Frequency:  
± .25%

Life: ± 1.0%

25°C Power Rating: ± 1.0%

High Temperature Exposure:  
± .50%

Low Temperature Storage: ± .25%

Insulation Resistance:  
10,000 Megohms

**STANDARD RESISTANCE  
VALUES (OHMS)**

22	330	4.7K	68K
27	390	5.6K	82K
33	470	6.8K	100K
39	560	8.2K	120K
47	680	10K	150K
56	820	12K	180K
68	1.0K	15K	220K
82	1.2K	18K	270K
100	1.5K	22K	330K
120	1.8K	27K	390K
150	2.2K	33K	470K
180	2.7K	39K	560K
220	3.3K	47K	680K
270	3.9K	56K	820K

\*R<sub>2</sub>/R<sub>1</sub> Ratio = 1.2 (min) to 2.2 (max). R<sub>1</sub> min = 50 ohm; R<sub>2</sub> max = 1000 ohm.

**HOW TO ORDER**

**8 10 1 - 09 - 102 - G**

**Product Family**  
(8 = .350" SIP)

**No. of Pins**

**Circuit Type**  
1 = Pin 1 common  
3 = Isolated  
5 = Dual Terminator

**Temp. Coefficient Code**  
09 = ± 150 ppm/°C

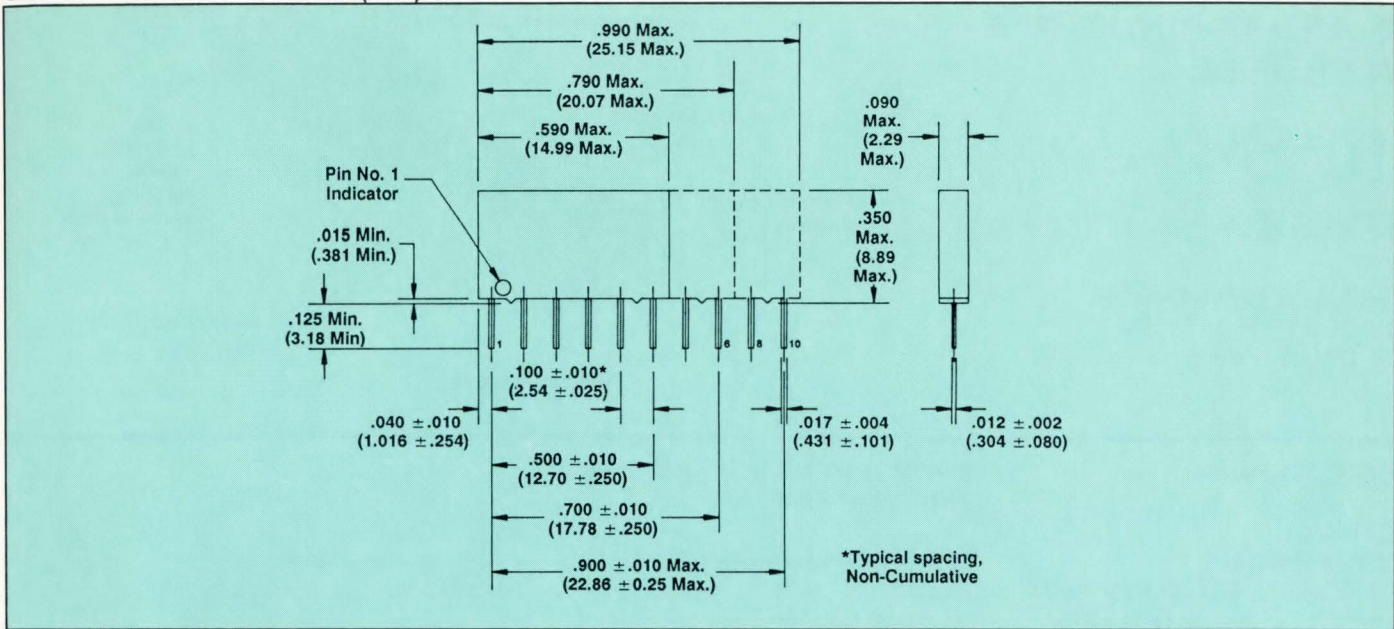
**2 or 3 Digit Resistance  
Military Resistance  
Code i.e.**  
102 = 1K, 1002 = 10K

**Tolerance**  
G = ± 2%  
J = ± 5%





SIP DIMENSIONS - IN. AND (MM)

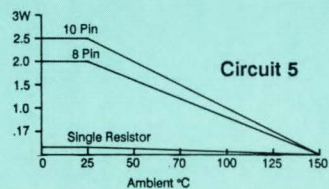
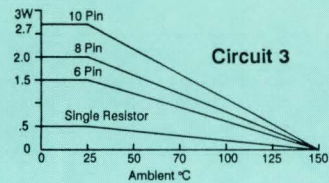
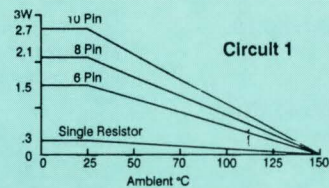


\* ± 1% tol. ± 100 ppm/°C TCR available Contact factory for details

POWER RATING

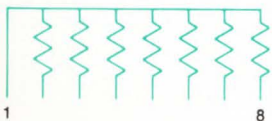
Circuit	6 Pin	8 Pin	10 Pin
<b>Circuit 1</b>			
- Total Package	1.5W	2.1W	2.7W
- Single Resistor	.3W	.3W	.3W
<b>Circuit 3</b>			
- Total Package	1.5W	2.0W	2.5W
- Single Resistor	.5W	.5W	.5W
<b>Circuit 5</b>			
- Total Package	--	2.0W	2.7W
- Single Resistor	--	.17W	.17W

(Rating @ 70°C is 67% of 25° rating)

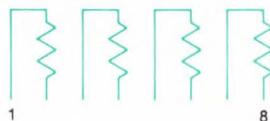


STANDARD CIRCUITS

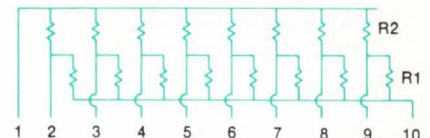
Circuit 1



Circuit 3



Circuit 5



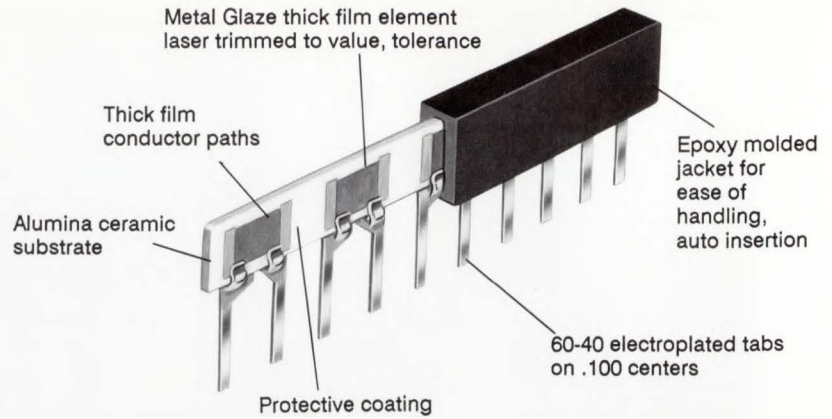




# THICK FILM MOLDED 6-, 8- AND 10-PIN, HIGH & LOW PROFILE

## MIL SIP NETWORKS

MIL-R-83401 approved styles  
RZ04, 05 & 06 High Profile  
RZ08, 09 Low Profile



### SPECIFICATIONS

#### ELECTRICAL

Resistance Range:  
Style RZ04, 05, & 06: 33Ω to 100K  
Style RZ08, & 09: 22 Ω to 100K

Resistance Tolerance:  
G - 2%, and J - 3%

Temperature Coefficient:  
MIL R83401 Characteristic M-  
± 300 ppm/°C

Maximum Ambient Temperature:  
at rated wattage = 70°C  
at 0 power = 125°C

### ENVIRONMENTAL - ΔR% MAX PER MIL-R-83401

Low Temperature Operation:  
±.50%

Short Time Overload:  
±.50%

Terminal Strength:  
±.25%

Resistance to Soldering Heat:  
±.25%

Moisture Resistance:  
±.50%

Mechanical Shock:  
±.25%

Vibration:  
±.25%

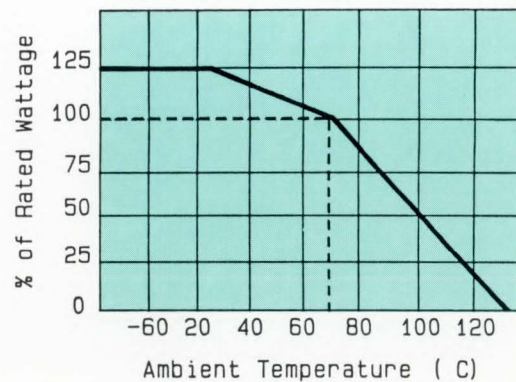
Life (1000 hours at 70°C):  
±2.00%

High Temperature Storage:  
±1.00%

Low Temperature Storage:  
±.50%

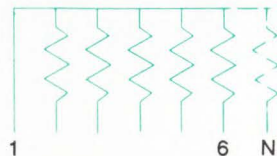
### POWER RATING @ 70°C

Mil Spec		Power, Watts	
Style	Schematic	Each Resistor	Each Network
RZ040 (6 PIN) High Profile	C	.20	1.00
	G	.20	0.60
RZ050 (8 PIN) High Profile	C	.20	1.40
	G	.20	0.80
R060 (10 PIN) High Profile	C	.20	1.80
	G	.20	1.00
RZ080 (8 PIN) Low Profile	C	.12	0.60
	G	.12	0.36
RZ090 (10 PIN) Low Profile	C	.12	0.84
	G	.12	0.48



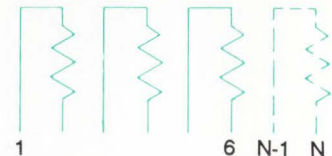
### SCHEMATICS

MIL Spec. Schematic C  
IRC Schematic 1  
(PIN 1 Common)



N = Number of Pins

MIL Spec. Schematic G  
IRC Schematic 3  
(Isolated)



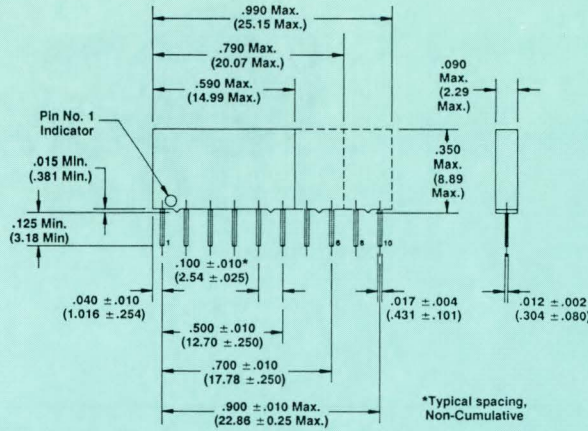
N = Number of Pins



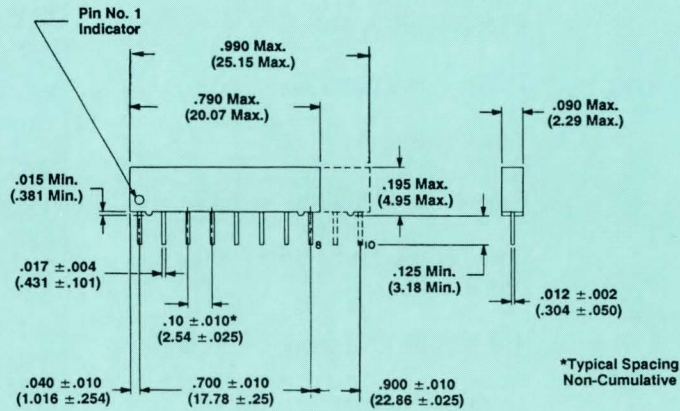


# MIL SIP DIMENSIONS - IN. AND (MM)

## Styles RZ04, 05, 06



## Styles RZ08 and 09



### HOW TO ORDER:

#### IRC

Sample Part Number: **8 08 3 - 04 - 1002 G**

#### Product Family

8 = .350" High SIP  
6 = .195" High SIP

#### Number of Pins

6, 8, 10 available in High Profile.  
8 & 10 available in Low Profile

#### Schematic

1 = 1 pin common  
3 = Isolated

#### Characteristic

± 300 ppm/°C

#### Resistance Code

Standard MIL Code

#### Tolerance G = ±2%

J = ±5%

#### MIL Spec.

Sample Part Number: **M83401 05 M 1002 G G**

#### MIL Spec

Resistor Network

#### Style

04 = 6 Pin High Profile  
05 = 8 Pin High Profile  
06 = 10 Pin High Profile  
08 = 8 Pin Low Profile  
10 = 10 Pin Low Profile

#### Characteristic

M = ±300 ppm/°C

#### Resistance Code

Standard MIL Code

#### Tolerance

G = ±2%  
J = ±5%

#### Schematic

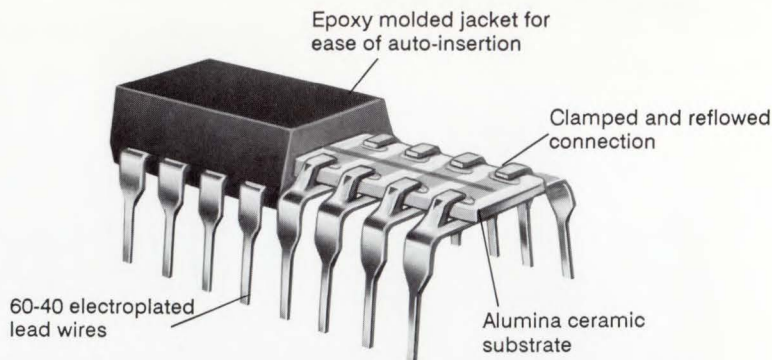
C = 1 Pin Common  
G = Isolated





# THICK FILM MOLDED 14- AND 16-PIN

## DIP NETWORKS



### SPECIFICATIONS

#### Electrical

Resistance Range: 22Ω to 1 meg

Resistance Tolerance:\*  
±2%, ±5%

Temperature Coefficient:\*  
±150 ppm/°C

TC Tracking: 50 ppm/°C typical

Max. Continuous Working Voltage:  
100V

Operating Temperature:  
-55°C to 150°C

#### Physical

Element:  
Fused thick-film composition

Substrate: 96% alumina

Body: Molded Epoxy

Terminals: Tinned Copper

Lead Pull: 4.5 pounds

Lead Solderability:  
MIL-STD-202, Method 208,  
and MIL-STD-883, Method 2003

Resistance to Soldering Heat:  
MIL-STD-202,  
Method 210, Cond. C

Marking Resistance to Solvents:  
MIL-STD-202, Method 215

### ENVIRONMENTAL PER MIL-R-83401

TCR: ±150 ppm/°C

Thermal Shock: ±.50%

Power Conditioning: ±.50%

Low Temperature Operation:  
±.25%

Short Time Overload: ±.25%

Terminal Strength: ±.25%

Resistance to Solder Heat: ±.25%

Moisture Resistance: ±.50%

Shock: ±.25%

Vibration, High Frequency:  
±.25%

Life: ±1.0%

25°C Power Rating: ±1.0%

High Temperature Exposure:  
±.50%

Low Temperature Storage: ±.25%

Insulation Resistance:  
10,000 Megohms

\* ±1% tolerance & ±100 ppm/°C TCR  
available. Consult factory for details

### STANDARD RESISTANCE VALUES (OHMS)

22	390	6.8K	120K
27	470	8.2K	150K
33	560	10K	180K
39	680	12K	220K
47	820	15K	270K
56	1.0K	18K	330K
68	1.2K	22K	390K
82	1.5K	27K	470K
100	1.8K	33K	560K
120	2.2K	39K	680K
150	2.7K	47K	820K
180	3.3K	56K	1Meg
220	3.9K	68K	
270	4.7K	82K	
330	5.6K	100K	

### HOW TO ORDER

5 14 1 - 09 - 102 - G

Product Family  
(5 = DIP)

No. of Pins

Circuit Type  
Type 1 = Pin 1 common  
Type 3 = Isolated

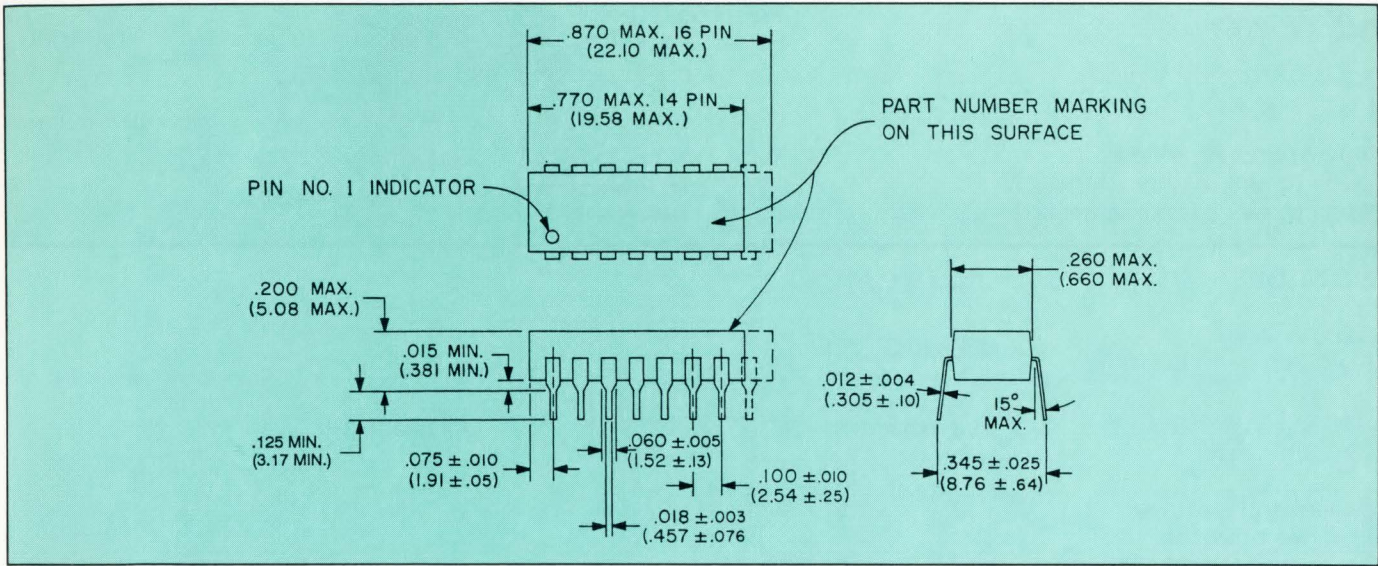
Temp. Coefficient Code  
09 = ±150 ppm/°C

Military Resistance Code  
Code i.e.  
102 = 1K, 1002 = 10K

Tolerance  
G = ±2%  
J = ±5%



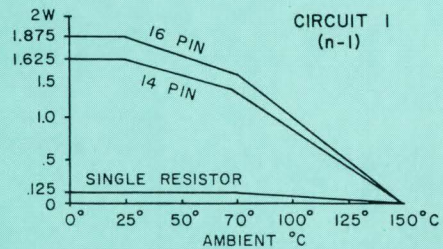
# DIP DIMENSIONS - IN. AND (MM)



## POWER RATING

### Circuit 1

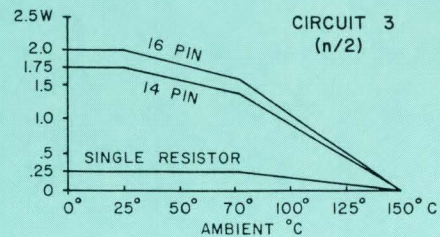
- Total Package	14 Pin 1.625W	16 Pin 1.875W
- Single Resistor	.125W	.125W



### Circuit 3

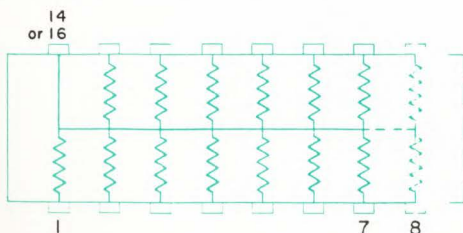
- Total Package	14 Pin 1.75W	16 Pin 2.00W
- Single Resistor	.25W	.25W

(Rating @ 70°C is 80% of 25° rating)

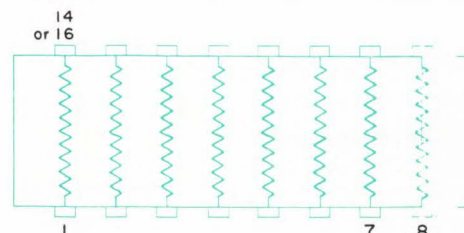


## STANDARD CIRCUITS

### Circuit 1



### Circuit 3



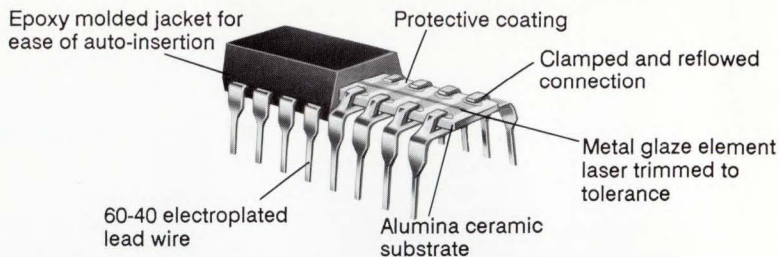




# THICK FILM MOLDED 14 and 16 pin

## MIL DIP NETWORKS

MIL 83401 Approved Styles:  
RZ010 (14 pin) to characteristic M  
RZ020 (16 pin) to characteristic M



### SPECIFICATIONS:

- Resistance Range:  
22 R0 (22Ω) to 1003 (100K)
- Resistance Tolerance:  
G (2%) and J 5%
- All physical and electrical specifications meet the requirements of MIL 83401 for styles RZ010 and RZ020
- All environmental performance to MIL 83401 characteristic M as follows:

Temperature coefficient  
± 300 ppm/°C

Max Ambient Temperature at  
Rated Wattage = 70°C

Max Ambient Temperature at zero  
power = 125°C

Low Temperature Operation = .5%

Short Time Overload = .5%

Terminal Strength = .25%

Resistance to soldering  
heat = .25%

Moisture Resistance = .5%

Shock = .25%

Vibration = .25%

Life (1000hrs at 70°C) = 2%

High Temperature Storage = 1%

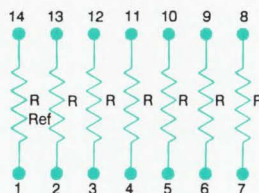
Low Temperature Storage = .5%

Each network supplied is subjected to thermal shock and power conditioning at 1.5 times normal power rating for 100 hrs. Total allowable % change for the combination of both conditions is .7%.

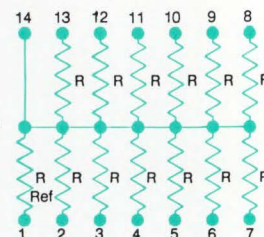
### SCHEMATICS

#### RZ010 STYLE

##### Schematic "A"

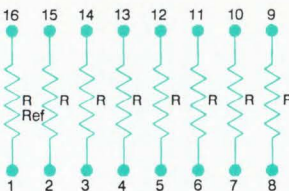


##### Schematic "B"

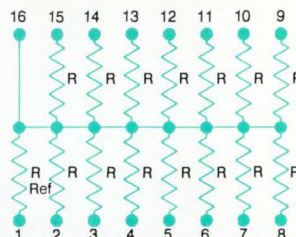


#### RZ020 STYLE

##### Schematic "A"

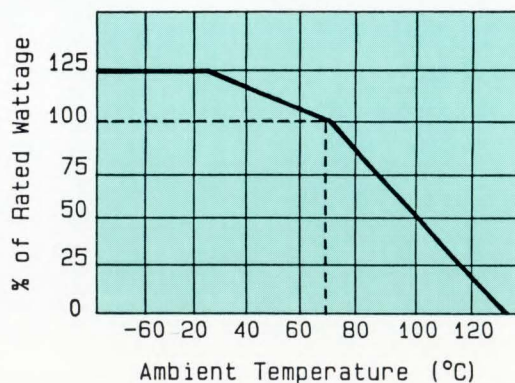


##### Schematic "B"



### POWER RATING @ 70°C

	Element Power Rating (W)	Network Power Rating (W)
Schematic A	0.2	1.6
Schematic B	0.1	1.5



### HOW TO ORDER

14 Pin RZ010  
to characteristic M

M83401 01 M XXXX G or A  
 Mil Spec | Style | Resistance Value per Mil Code | Tol 2% or 5% | Schematic  
 J or B

16 Pin RZ020  
to characteristic M

M83401 02 M XXXX G or A  
 J or B



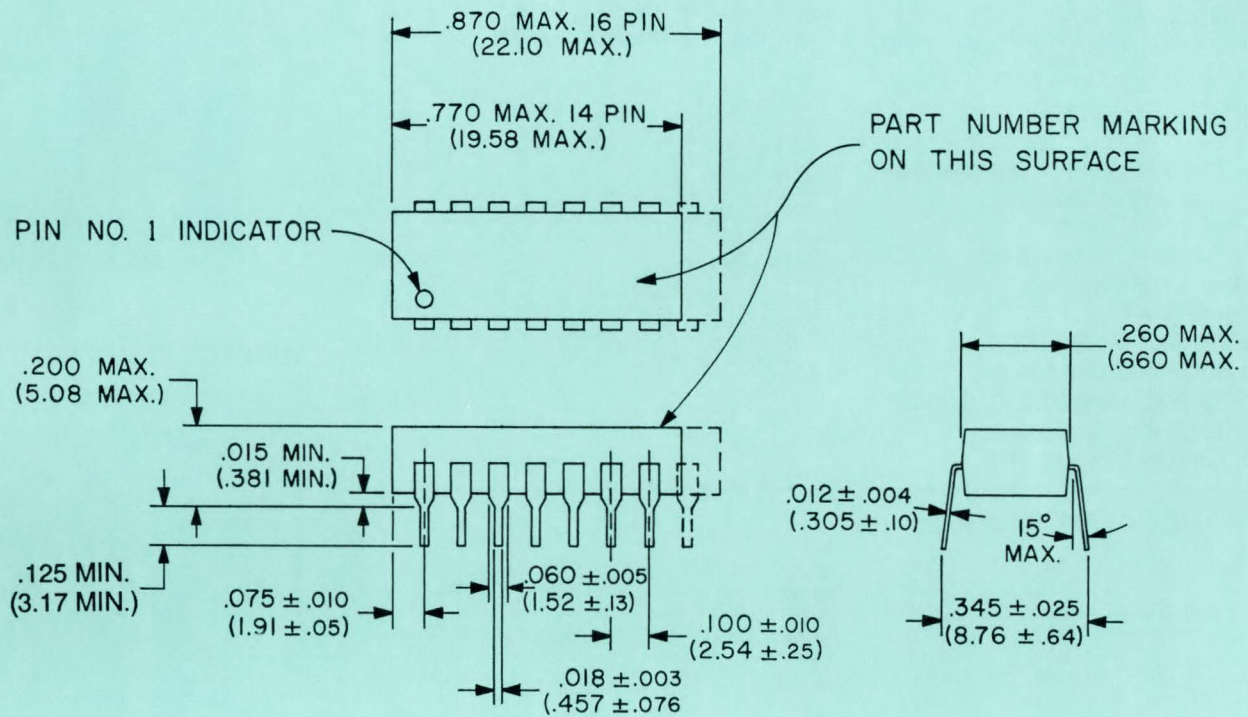


# THICK FILM MOLDED DIP PART NUMBER CONFIGURATION

## EXAMPLE:

M8340102 M 1002 G is a Mil 83401 RZ020 (16 pin) style Dip, characteristic M  $10K\Omega \pm 2\%$  schematic or circuit A (isolated resistors)

### DIMENSIONS - INCHES and (mm)



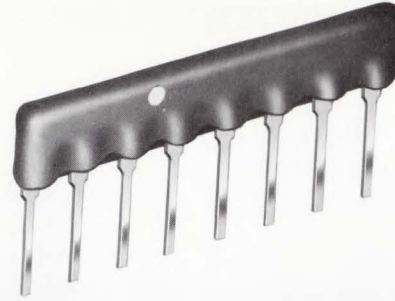




# THICK FILM CONFORMAL COATED

## SIP NETWORKS\*

- 4 through 14-pin packages
- Project .256 in. from circuit board
- Circuits -1, -3 and -5 are standard



### SPECIFICATIONS

#### Electrical

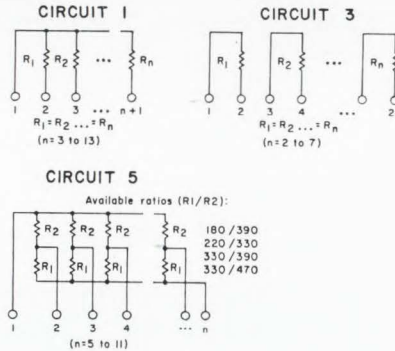
Resistance Range: 22Ω to 1.0MegΩ  
 Resistance Tolerance: ±2% and ±5%  
 Temperature Coefficient: ±200 ppm/°C  
 Max. Continuous Working Voltage: 50V  
 Operating Temp.: -40°C to +150°C

#### Physical

Element: Fused thick-film composition  
 Substrate: 96% Alumina  
 Body: Conformal Coated  
 Terminals: Solder Plated Steel  
 Lead Pull: 2.2 pounds  
 Lead Solderability:  
 MIL-STD-202, Method 208  
 Resistance to Soldering Heat:  
 MIL-STD-202, Method 210, Cond.  
 Marking Resistance to Solvents:  
 MIL-STD-202, Method 215

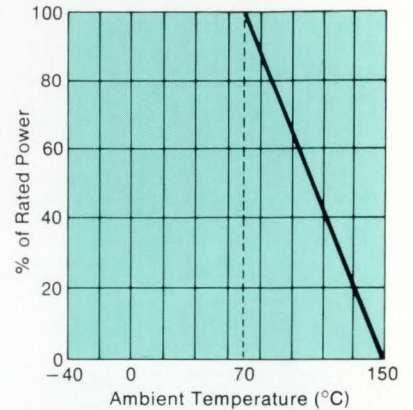
### ENVIRONMENTAL PER MIL-R-83401

Short Time Overload: ±.5%  
 Terminal Strength: ±.5%  
 Resistance to Solder Heat: ±.5%  
 Moisture Resistance: ±2%  
 Load Life: ±2%  
 Temperature Cycling: ±.5%

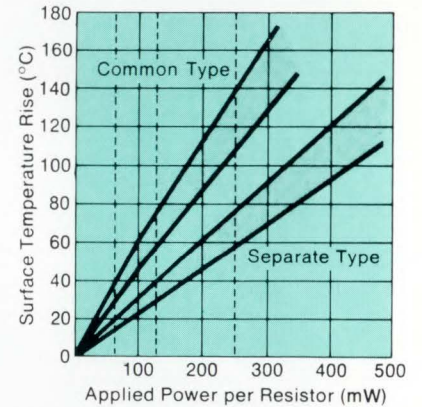


### STANDARD CIRCUITS

#### POWER DERATING



#### SURFACE TEMPERATURE RISE



### STANDARD RESISTANCE (OHMS)

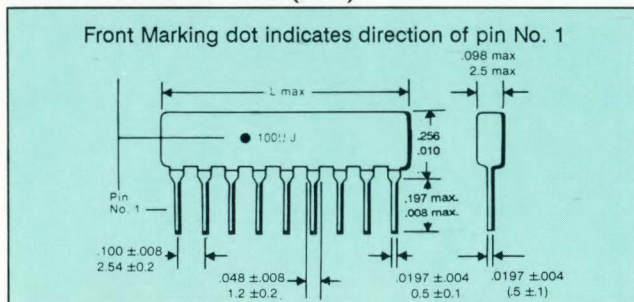
22	(100)	390	1.5K	5.6K	(22K)	82K	330K
27	120	(470)	1.8K	(6.8K)	27K	(100K)	390K
(33)	(150)	560	(2.2K)	8.2K	33K	120K	470K
39	180	(680)	2.7K	(10.0K)	39K	150K	560K
(47)	(220)	820	(3.3K)	12.0K	(47K)	180K	680K
(56)	(270)	(1K)	3.9K	(15.0K)	56K	220K	820K
68	(330)	1.2K	(4.7K)	18K	68K	270K	1M
82							

(\*) Preferred standard resistance values available immediately from stock.

### POWER RATING AT 70°C

Cir. Type	One Elem.	Max. Power In One Network (Watts)										
		4 Pin	5 Pin	6 Pin	7 Pin	8 Pin	9 Pin	10 Pin	11 Pin	12 Pin	13 Pin	14 Pin
-1	.125	.375	.5	.625	.75	.875	1	1.05	1.15	1.25	1.35	1.45
-3	.250	.500	--	.750	--	1	--	1.05	--	1.25	--	1.45
-5	.125	--	.5	.625	.75	.875	1	1.05	1.15			

### DIMENSIONS IN AND (mm)



No. Of Pins	L Max. Inches (mm)
4	0.43 (10.66)
5	0.53 (13.20)
6	0.63 (15.80)
7	0.73 (18.30)
8	0.83 (20.90)
9	0.93 (23.40)
10	1.03 (25.90)
11	1.13 (28.50)
12	1.23 (31.00)
13	1.33 (33.60)
14	1.43 (36.10)

### HOW TO ORDER

Sample Part No.:

C 10 - 3 - 223 - G

Product Family  
(C = .256 SIP)

Number of Pins  
(4 through 14)

Circuit Type  
(1, 3 or 5)

For Circuits 1 or 3, 2 digit  
Range and Digit Multiplier

For Circuit 5, ratio of R1/R2

Tolerance (G = 2%, J = 5%)

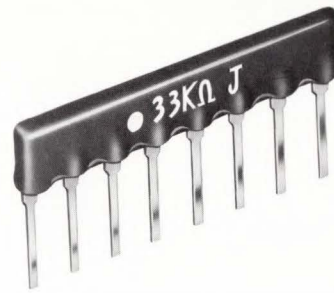
\* Manufactured in Japan





# THICK FILM CONFORMAL COATED LOW PROFILE

## SIP NETWORKS\*



- 5 through 11-pin packages
- Project .20 in. from circuit board
- Circuits -1, -3 are standard

### SPECIFICATIONS

#### Electrical

Resistance Range:  $22\Omega$  to 1.0 Meg  $\Omega$   
 Resistance Tolerance:  $\pm .2\%$  and  $\pm .5\%$   
 Temperature Coefficient:  $\pm 200$  ppm/ $^{\circ}\text{C}$   
 Max. Continuous Working voltage: 100V  
 Operating Temp:  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$

#### Physical

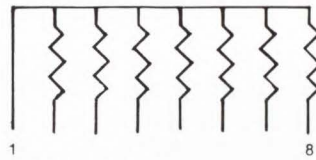
Element: Fused thick-film composition  
 Substrate: 96% Alumina  
 Body: Conformal Coated  
 Terminals: Solder Plated Steel  
 Lead Pull: 2.2 pounds  
 Lead Solderability:  
 MIL-STD-202, Method 210, Cond. A  
 Resistance to Soldering Heat:  
 MIL-STD-202, Method 210, Cond. A  
 Marking Resistance to Solvents:  
 MIL-STD-202, Method 215

#### Environmental Per MIL-R-83401

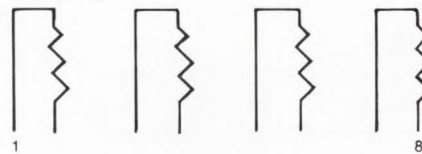
Short Time Overload:  $\pm .5\%$   
 Terminal Strength:  $\pm .5\%$   
 Resistance to Solder Heat:  $\pm .5\%$   
 Moisture Resistance:  $\pm .2\%$   
 Load Life:  $\pm .2\%$   
 Temperature Cycling:  $\pm .5\%$

### STANDARD CIRCUITS

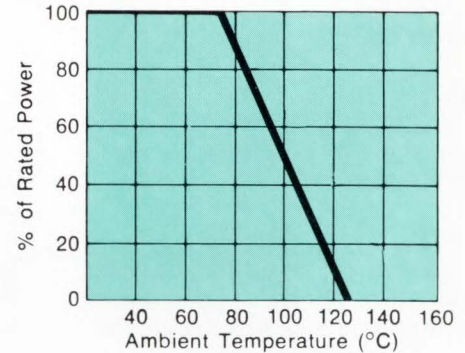
#### CIRCUIT 1



#### CIRCUIT 3



### POWER DERATING



### POWER RATING @ $70^{\circ}\text{C}$

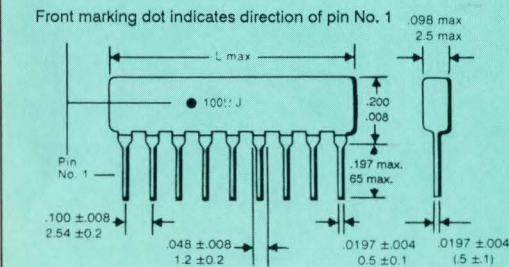
Circuit Type	One Element	Max. Power in One Network (watts)						
		5-Pin	6-Pin	7-Pin	8-Pin	9-Pin	10-Pin	11-Pin
-1	.125	.44	.51	.57	.61	.66	.70	.74
-3	.20							

### STANDARD RESISTANCE (OHMS)

22	(100)	(470)	1.8K	(6.8K)	27K	(100K)	390K
27	120	560	(2.2K)	8.2K	33K	120K	470K
(33)	(150)	(680)	2.7K	(10K)	39K	150K	560K
39	180	820	(3.3k)	12K	(47K)	180K	680K
(47)	(220)	(1K)	3.9K	(15K)	56K	220K	820K
(56)	(270)	1.2K	(4.7K)	18K	68K	270K	1M
68	(330)	1.5K	5.6K	(22K)	82K	330K	
82	390						

(\* Preferred standard resistance values available immediately from stock.

### DIMENSIONS - IN and (mm)



No. of Pins	L max inches (mm)
5	0.5 (12.7)
6	0.6 (15.24)
7	0.7 (17.78)
8	0.8 (20.32)
9	0.9 (22.86)
10	1.0 (25.40)
11	1.1 (27.94)

(The 3 circuits will be marked with a letter 'S' preceding the resistance value)

### HOW TO ORDER

CL - 10 - 3 - 223 - G

IRC Type  
 Number of Pins (5 through 11)  
 Circuit Type (1, 3)  
 Resistance Range  
 For Circuits 1 or 3, 2 Digit Range and Digit Multiplier  
 Tolerance (G = 2%, J = 5%)

Front marking dot indicates direction of pin No. 1

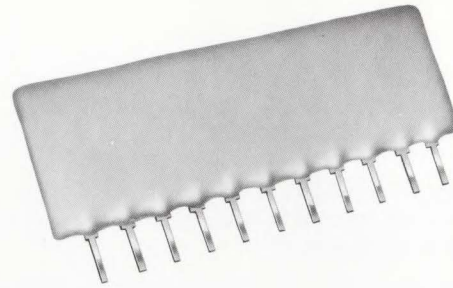
\*Manufactured in Japan





# LOW RESISTANCE-POWER SIP NETWORKS

## HD SERIES



- To 2W per resistor
- .1 ohm to 25 ohm
- TCR of resistive elements is less than 200 ppm/°C
- Minimum tolerance 0.1 to 1 ohm = ±5%, above 1 ohm = ±2%
- 4 terminal Kelvin pinouts available

### ADVANTAGES

#### COST:

Eliminates handling and assembly of discretes with comparable per resistor cost.

#### SPACE:

All resistors on single flat substrate requiring less board space. Leads mounted in .1 inch increments for PC board compatibility.

#### RELIABILITY:

Uses same non-noble materials technology as IRC RG resistor line with proven reliability for over 15 years.

#### TRACKING:

Resistor to resistor tracking excellent by design, i.e. all resistors in a network have same geometry and receive identical process and materials.

#### LOW INDUCTANCE:

Flat thick film resistor geometry offers inductance comparable to a straight piece of wire of the same physical length. Inductance is typically less than .03 μh (@1MHZ).

### SPECIFICATIONS

#### Resistance Range:

0.1 ohm to 25 ohm

#### Min. Tolerance:

0.1 to 1 ohm = ±5%  
Above 1 ohm = ±2%

#### TCR

Note: TCR for very low resistance values is affected by the conductor contribution. Therefore TCR is a function of resistance value and geometry used. Given here is a typical max. TCR vs. resistance value for reference. Accurate TCR can be determined only for specific designs. TCR of the resistive elements is less than 200 ppm/°C.

### APPLICATIONS

Any circuit requiring multiple low value (< 5Ω) resistors for current limiting and current or voltage sensing, e.g. hammer drivers in dot matrix or line printer or DC motor control circuits.

### ENVIRONMENTAL PERFORMANCE (Typical Max. ΔR)

#### Load Life:

2% (1000 hrs. @ rated wattage)

#### Moisture: 1%

#### Thermal Shock: 0.5%

#### STOL: 0.25%: 0.25%

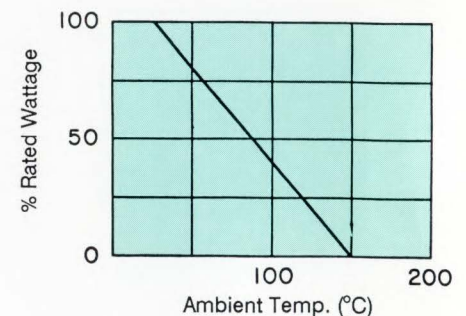
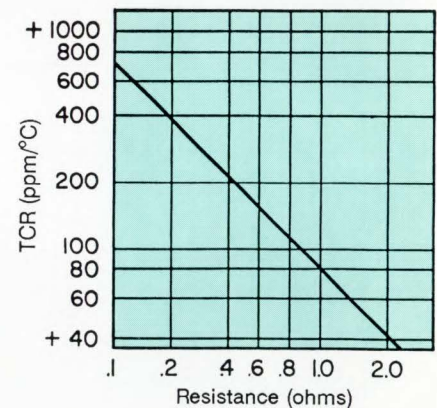
#### Operating Temp: -55 to +150°C

#### TCR: See Specifications

#### Power Rating:

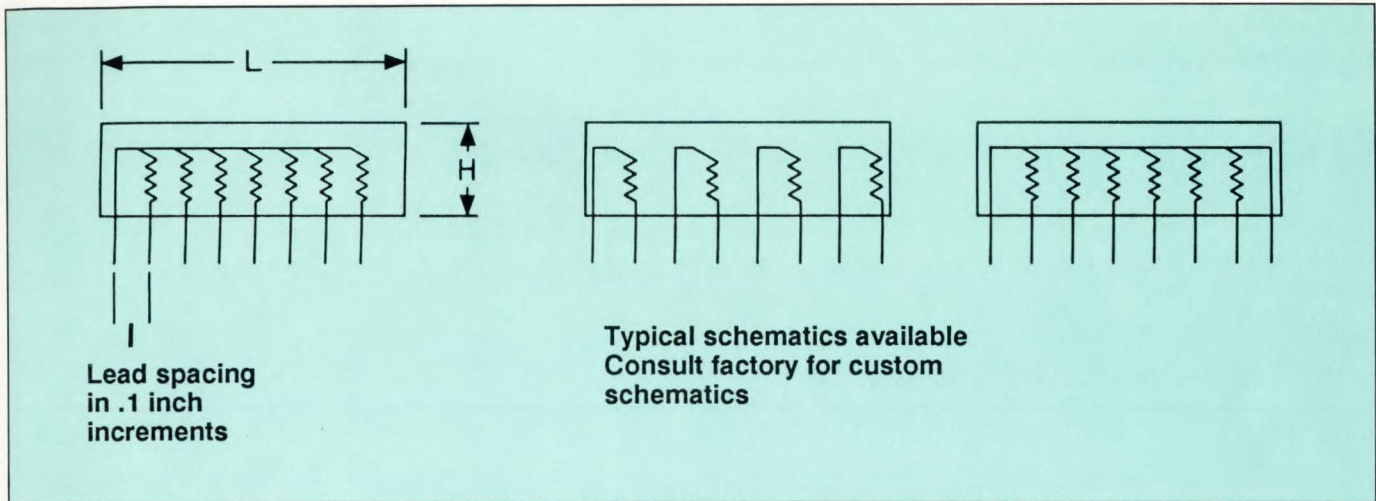
Up to 2 watts/resistor with max. total package rating of 4 watts/sq. inch of substrate area at 25°C ambient. Derate linearly from 100% rating @ 25°C to 0 wattage @ 150°C.

#### TYPICAL MAX. TCR VS. RESISTANCE

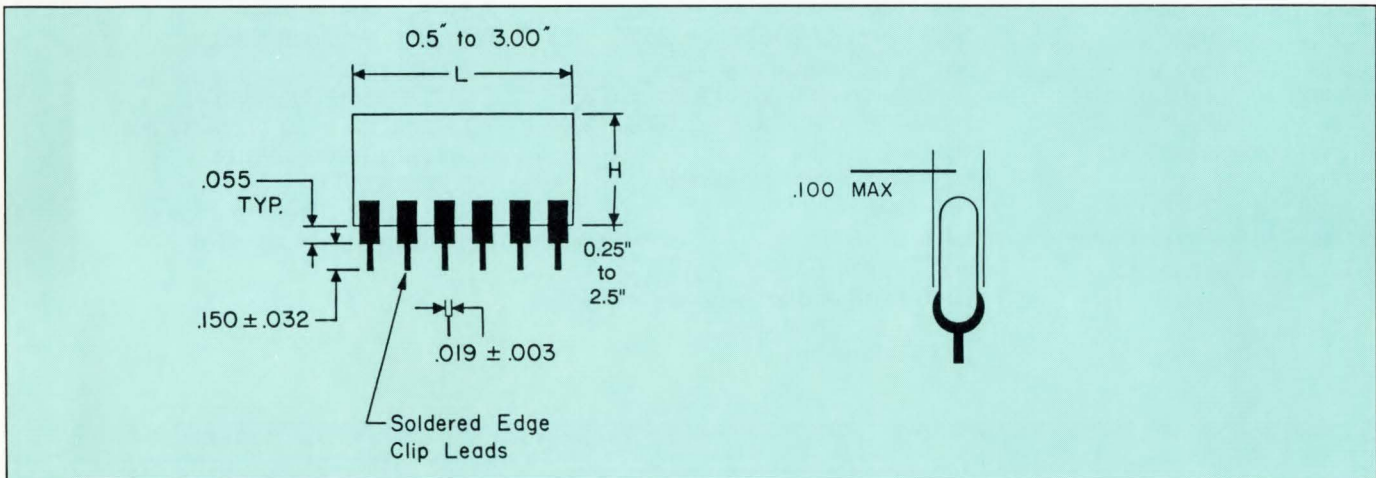




## HD TYPICAL NETWORK LAYOUT



## PHYSICAL DIMENSIONS



### SEND IRC YOUR REQUIREMENT SPECIFICATIONS:

#### Information Needed

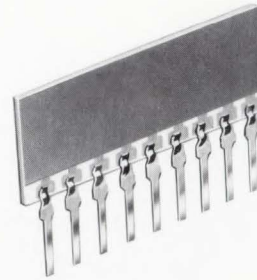
1. Resistors per package.
2. Resistor values and tolerance; pin out schematic
3. Power Requirements per resistor and total package. Include any surge or STOL requirements.





**THICK FILM  
INSULATED  
CUSTOM NETWORK**

**SIP NETWORKS**



- IRC non Noble Metal Glaze
- UV cured Epoxy Coating
- Meets US 94-V-0
- High reliability
- Major size reduction compared to discrete components

**SPECIFICATIONS**

**Physical**

Element:  
Fused thick-filmed composition  
Substrate: 96% alumina  
Terminals: Tinned Copper  
Lead Pull: 4.5 pounds  
Lead Solderability:  
MIL-ST-202, Method 208, and  
MIL-STD-883, Method 2003  
Resistance to Soldering Heat:  
MIL-STD-202,  
Method 202, Cond. C  
Marking Resistance to Solvents:  
MIL-STD-202, Method 215

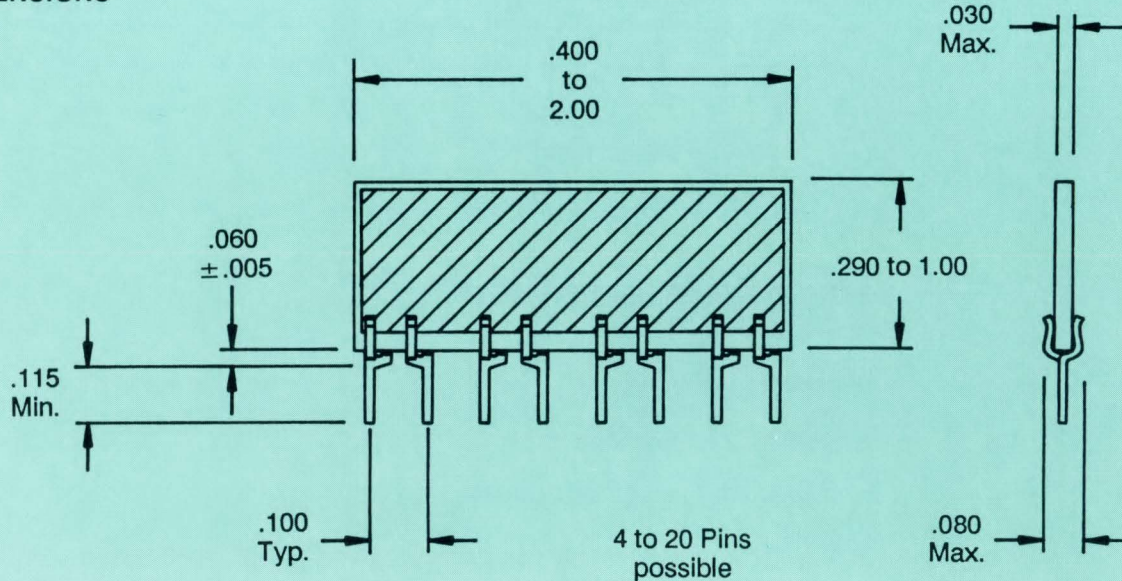
**Environmental Per MIL-R-83410**

Thermal Shock:  $\pm .50\%$   
Power Condition:  $\pm .50\%$   
Low Temperature Operation:  
 $\pm .25\%$   
Short Time Overload:  $\pm .25\%$   
Terminal Strength:  $\pm .25\%$   
Resistance to Solder Heat:  $\pm .25\%$   
Moisture Resistance:  $\pm .50\%$   
Shock:  $\pm .25\%$   
Vibration, High Frequency:  
 $\pm .25\%$   
Life:  $\pm 1.0\%$   
25°C Power Rating:  $\pm 1.0\%$   
High Temperature Storage:  $\pm .50\%$   
Insulation Resistance:  
20 Gigaohms

**Electrical**

Resistance Range:  
20 ohm to 2 meg  
Resistance Tolerance:  
 $\pm 1\%$ ,  $\pm 2\%$ ,  $\pm 5\%$   
Temperature Coefficient:  
 $\pm 150$  ppm/°C  
( $\pm 100$  ppm/°C available)  
TC Tracking:  $\pm 50$  pm/°C typical  
Operating Temperature:  
-55°C to 150°C  
Power Rating: Determined by  
circuit and package size

**DIMENSIONS**

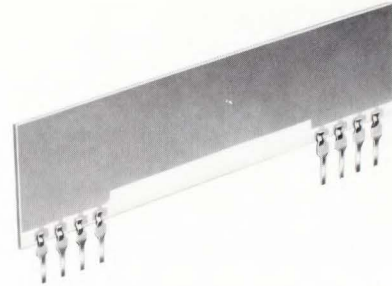






**THICK FILM  
INSULATED  
SIP RESISTOR**

**BATTERY FEED SERIES**



- IRC non Noble Metal Glaze
- Matched resistors in one package
- Meets UL 94-V-0
- Custom configurations available

**SPECIFICATIONS**

**Physical**

Element:  
Fused thick-filmed composition  
Substrate: 96% alumina  
Terminals: Tinned Copper  
Lead Pull: 4.5 pounds  
Lead Solderability:  
MIL-ST-202, Method 208, and  
MIL-STD-883, Method 2003  
Resistance to Soldering Heat:  
MIL-STD-202,  
Method 202, Cond. C  
Marking Resistance to Solvents:  
MIL-STD-202, Method 215

**Environmental**

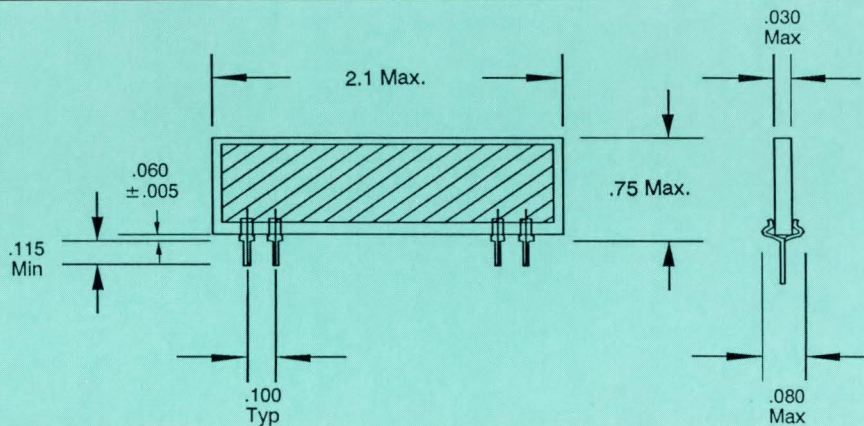
Thermal Shock:  $\pm .50\%$   
Power Condition:  $\pm .50\%$   
Low Temperature Operation:  
 $\pm .25\%$   
Short Time Overload:  $\pm .25\%$   
Terminal Strength:  $\pm .25\%$   
Resistance to Solder Heat:  $\pm .25\%$   
Moisture Resistance:  $\pm .50\%$   
Shock:  $\pm .25\%$   
Vibration, High Frequency:  $\pm .25\%$   
Life:  $\pm 1.0\%$   
25°C Power Rating:  $\pm 1.0\%$   
High Temperature Exposure:  
 $\pm .50\%$

Low Temperature Storage:  $\pm .25\%$   
Insulation Resistance:  
20 Gigaohms

**Electrical**

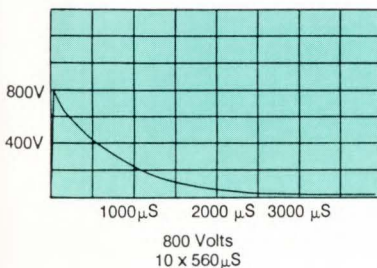
Resistance Range: 50 ohm to 10K  
Resistance Tolerance:  
 $\pm 1\%$ .  $\pm 2\%$ .  $\pm 5\%$   
Ratio Tolerance:  $\pm .5\%$   
Temperature Coefficient:  
 $\pm 100$  ppm/°C  
TC Tracking:  $\pm 50$  ppm/°C typical  
Operating Temperature:  
-55°C to 150°C  
Power Rating: Determined by  
circuit and package size

**DIMENSIONS**

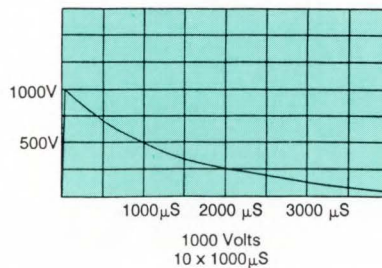


**PULSE HANDLING CAPABILITY**

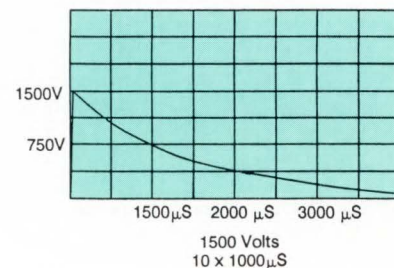
**50Ω to 90Ω**



**91Ω to 449Ω**



**450Ω to 10K**



\* 10 Microseconds - maximum rise time to peak voltage  
560 Microseconds - minimum decay time to one-half peak

\* 10 Microseconds - maximum rise time to peak voltage  
1000 Microseconds - minimum decay time to one-half peak

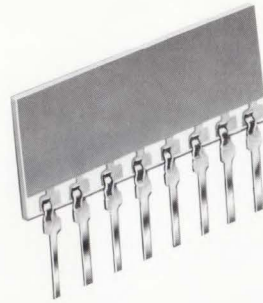
\* 10 Microseconds - maximum rise time to peak voltage  
1000 Microseconds - minimum decay time to one-half peak





# THICK FILM CUSTOM NETWORK

## R-2R CIRCUIT



- Range up to 100K
- $\pm 1/2$  least significant bit accuracy
- Up to 8 bits

### SPECIFICATIONS

#### Electrical

Resistance Tolerance:  
 $\pm 1\%$ ,  $\pm 2\%$ ,  $\pm 5\%$   
 Temperature Coefficient  
 $\pm 150$  ppm/ $^{\circ}$ C  
 ( $\pm 100$  ppm/ $^{\circ}$ C available)  
 TC Tracking:  $\pm 50$  ppm/ $^{\circ}$ C typical  
 Operating Temperature:  
 $-55^{\circ}$ C to  $150^{\circ}$ C  
 Power Rating: Determined by  
 circuit and package size

Substrate: 96% alumina  
 Terminals: Tinned copper  
 Lead Pull: 4.5 pounds  
 Lead Solderability:  
 MIL-ST-202, Method 208, and  
 MIL-STD-883, Method 2003  
 Resistance to Soldering Heat:  
 MIL-STD-202  
 Method 202, Cond. C  
 Marking Resistance to Solvents:  
 MIL-STD-202, Method 215

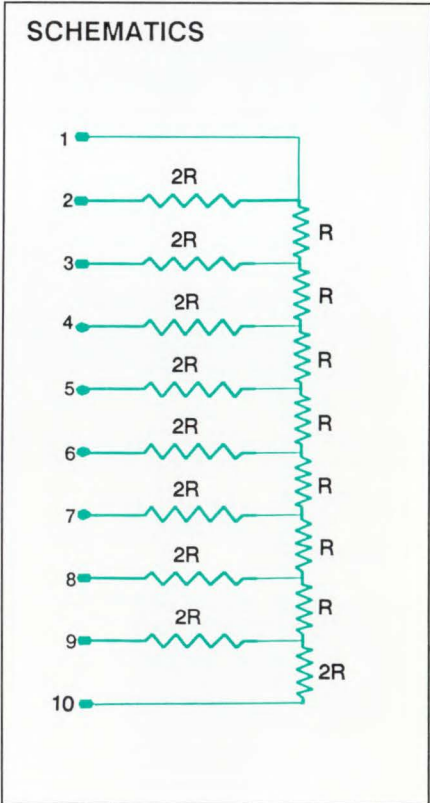
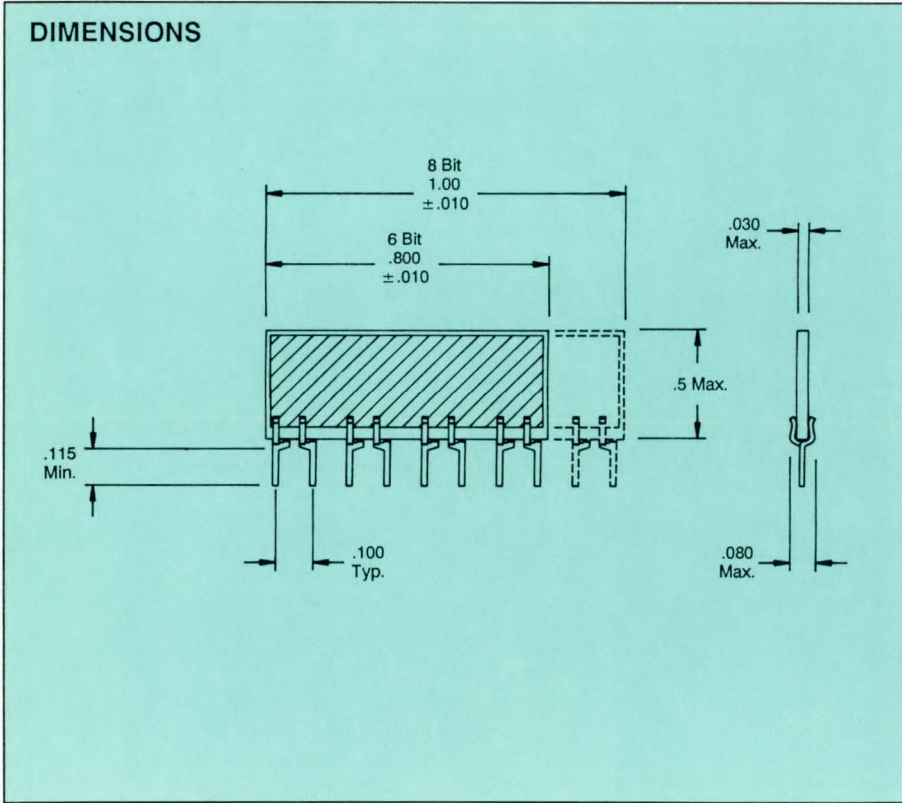
Low Temperature Operation:  
 $\pm .25\%$   
 Short Time Overload:  $\pm .25\%$   
 Terminal Strength:  $\pm .25\%$   
 Resistance to Solder Heat:  $\pm .25\%$   
 Moisture Resistance:  $\pm .50\%$   
 Shock:  $\pm .25\%$   
 Vibration, High Frequency:  $\pm .25\%$   
 Life:  $\pm 1.0\%$   
 25 $^{\circ}$ C Power Rating:  $\pm 1.0\%$   
 High Temperature Exposure:  
 $\pm .50\%$   
 Low Temperature Storage:  $\pm .25\%$

#### Environmental Per MIL-R-83401

#### Physical

Element:  
 Fused thick-filmed composition

Thermal Shock:  $\pm .50\%$   
 Power Condition:  $\pm .50\%$

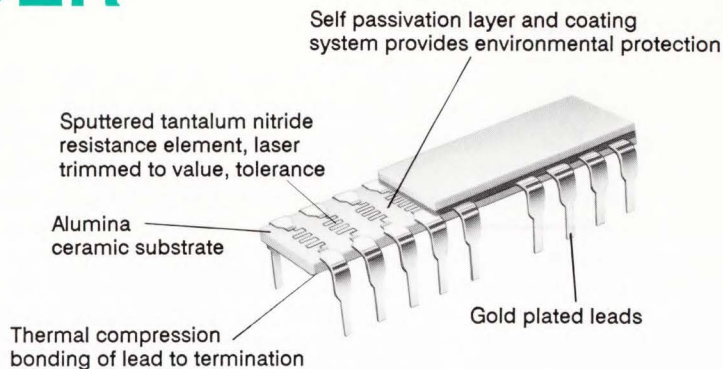




# TANFILM R-2R LADDER

## 12-BIT, 20-PIN DIP

- Proven reliability
- 12 bit,  $\pm 1/2$  LSB accuracy over 10,000 hour life
- Passivated TaNFilm for superior environmental performance
- $\pm 122$  ppm ladder accuracy over  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
- Standard DIP package
- 5 standard R values



The 5430 series R-2R ladder utilizes the unique characteristics of the TaNFilm process to provide the 1/2 LSB, 12 bit accuracy required for precision data conversion. Our continuous sputtering process deposits Tantalum Nitride resistance film over an entire substrate of 99.5% pure alumina, ensuring virtually identical resistance temperature characteristics of all resistors in the ladder. This guarantees no degradation in ladder accuracy over the full military

temperature range of  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ .

Passivation of the resistance film results in outstanding environmental performance. More importantly, since the aging process of this film results in a slight continuation of this passivation, all resistors change at the same rate. Consequently, voltage ratios required for ladder accuracy are very stable over long term, 10,000 hour load and temperature conditions.

Large area thermocompression bonding of gold plated leads eliminates the need for fine wire bonds and provides the ultimate in strength and reliability. In addition the combination of high alumina substrate for thermal conductivity and 1.5 mil minimum resistor line width enhances reliability for the most severe applications. Reliability and stability of TaNFilm networks are proven with years of MIL-R-83401 testing and qualification.

### STABILITY

TaNFilm 12 bit ladders exhibit  $\pm 122$  ppm maximum voltage ratio error after the following tests (per MIL-R-83401 except as noted):

**Operating Life:**

1000 Hrs. Full Load  $100^{\circ}\text{C}$

**Short Time Overload:**

10 Sec. 2.5 x Rated Voltage

**Thermal Shock:**

10 cycles -  $65^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$

**High Temperature Exposure:**

100 Hrs. @  $125^{\circ}\text{C}$

**Moisture Cycle, Load:** 10 Days

**Soldering Heat:** 10 Sec. @  $260^{\circ}\text{C}$

**Shock:** 100 g's for 6 Milliseconds

**Vibration:** 20 g's

**Terminal Strength:** 4.5 Lbs.

Note 1 - Consult factory for other switch compensation.

Note 2 - Ratio matching of each application resistor to ladder output resistance. Consult factory for other accuracy requirements.

### SPECIFICATIONS

Ladder Resistance Values (R):  
5K, 10K, 20K, 25K, 50K

Ladder Resistance Tolerance:  
 $\pm 5\%$

Maximum Input Voltage: 20V

Settling Time  
(to 0.1% of final value):  
100n sec.

Temperature Range:  
 $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$

External Switch Compensation  
(Note 1):

Models 5431-5434 - 5 $\Omega$

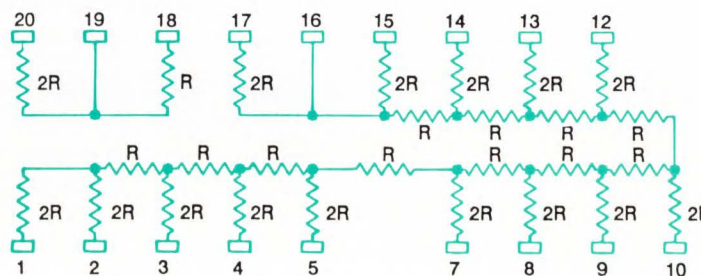
Model 5435 - 500 $\Omega$

Ladder Voltage Accuracy:  
122 ppm

Application Resistor Tolerance  
Ratio  
(Note 2): 0.04%

Lead Material:  
Gold plated copper alloy

### STANDARD CIRCUIT





### Testing R-2R Ladder Networks Conversion Accuracy Testing

IRC tests its R-2R ladders functionally by comparing the output of the DUT (device under test) with the output of a standard ladder having an accuracy of 1 ppm. The ladder networks are activated one bit at a time, starting with bit one and continuing to the LSB (least significant bit). See Figure 1. A computer controlled scanner having low thermal mercury relays is used for the switching. The reference voltage being applied to the corresponding bit of each ladder (standard and DUT) is 10 volts. The output voltage error is measured using a computer control DVM and is stored in the computer memory. After all bits have been read, the plus and minus sums are found by adding the appropriate errors of all bits. Normally each of these sums must be less than one half the output of a perfect ladder with only its least significant bit energized. This is 122 ppm for 12 bit ladders. This procedure guarantees monotonicity and a worst case accuracy of less than 1/2 LSB.

### Output Resistance Testing

The output resistance is determined by making a single measurement. All bits are connected to common and the resistance between the "OUT" terminal and common is measured. The value will be the R value of the ladder. When switch compensation is accounted for, the output resistance is  $\pm 5\%$  of the nominal value of R.

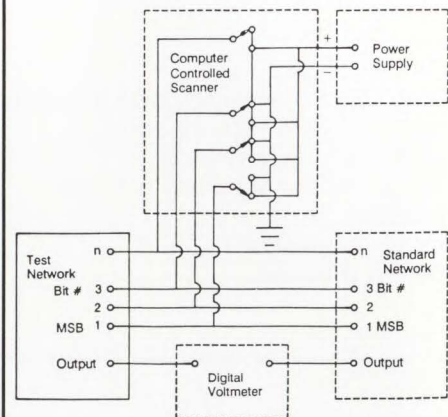
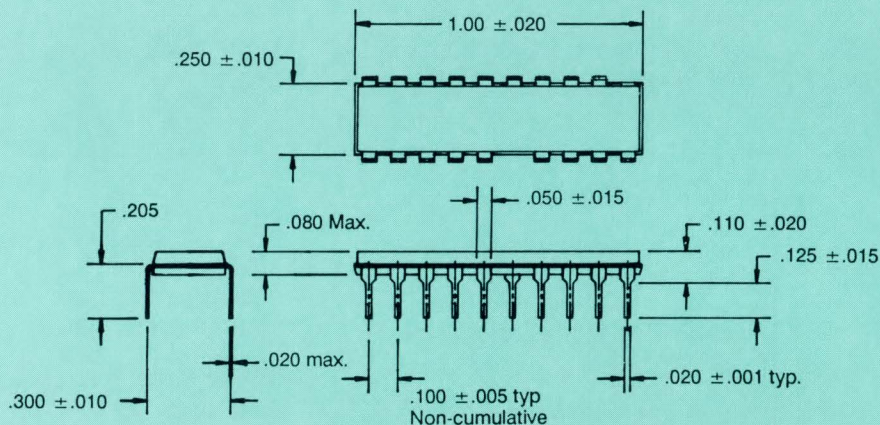


Figure 1. Conversion Accuracy Tester

### DIMENSIONS



### HOW TO ORDER

Model	Description
5431	5/10K, 12 bit, 20 pin DIP, R-2R ladder
5432	10/20K, 12 bit, 20 pin DIP, R-2R ladder
5433	20/40K, 12 bit, 20 pin DIP, R-2R ladder
5434	25/50K, 12 bit, 20 pin DIP, R-2R ladder
5435	50/100K, 12 bit, 20 pin DIP, R-2R ladder

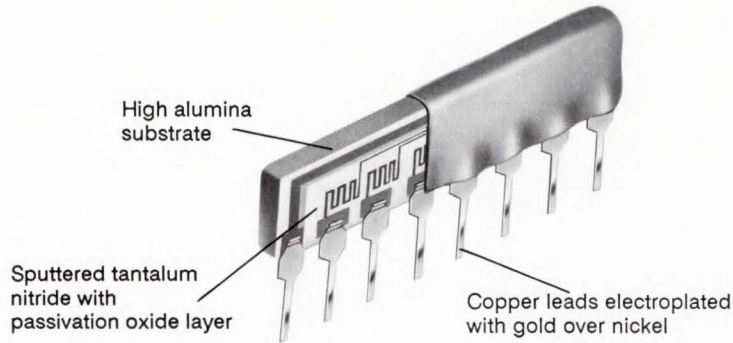




# TANFILM CONFORMALLY COATED

## SIP NETWORKS

- High precision
- Low profile
- High component density
- Superior TCR tracking
- 3 standard sizes
- Proven reliability
- Custom pin counts available



Where precision as well as long term reliability and stability are required in a small amount of space, the conformally coated SIP is the answer. This low profile SIP resistor network exhibits all the outstanding performance characteristics inherent in TaNFilm products. Our TaNFilm manufacturing process of sputtering Tantalum

Nitride on to ceramic substrates ensures uniform temperature characteristics of all the resistors in the networks. The resistance film is then passivated to improve its stability and to make it virtually impervious to environmental elements.

When you need high precision and ultimate reliability in a limited space, the TaNFilm SIP is the solution. The conformally coated SIP network can be tailored to meet special circuit configurations with multiple resistance values.

### SPECIFICATIONS

**Resistance Range:**  
 Schematic C: 49.9 Ω to 100KΩ  
 Schematic F: 20Ω to 100KΩ  
 Schematic G: 20Ω to 200KΩ  
 Higher & lower resistance values available

**Standard Resistance Tolerance:**  
 ±.1%, ±.25%, ±.5%, ±1%, ±2%  
 (.02% available)

**Temperature Coefficient:**  
 ±25 ppm/°C, ±50 ppm/°C  
 ±100 ppm/°C, -100 ±25 ppm/°C

**TCR Tracking:** 5 ppm/°C, (except Schematic C below 500Ω 20 ppm/°C) 2 ppm/°C available

**Temperature Range:**  
 -55°C to +150°C

**Noise:** Less than -30 dB

### Power Rating @ 70°C

Schematic	Resistor	Wattage		
		Network		
		6 Pin	8 Pin	10 Pin
C, F	.12	.60	.84	1.08
G	.12	.36	.48	0.60

**Lead Material:**  
 Gold plated copper

**Substrate Material:**  
 99.5% pure alumina ceramic

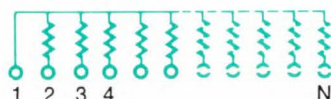
**Construction:**  
 Epoxy conformal coating

Custom circuits and special testing available

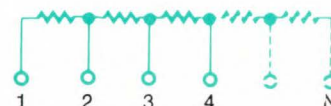
Contact factory for any special features required

### STANDARD CIRCUITS

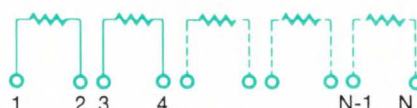
Schematic "C"



Schematic "F"



Schematic "G"



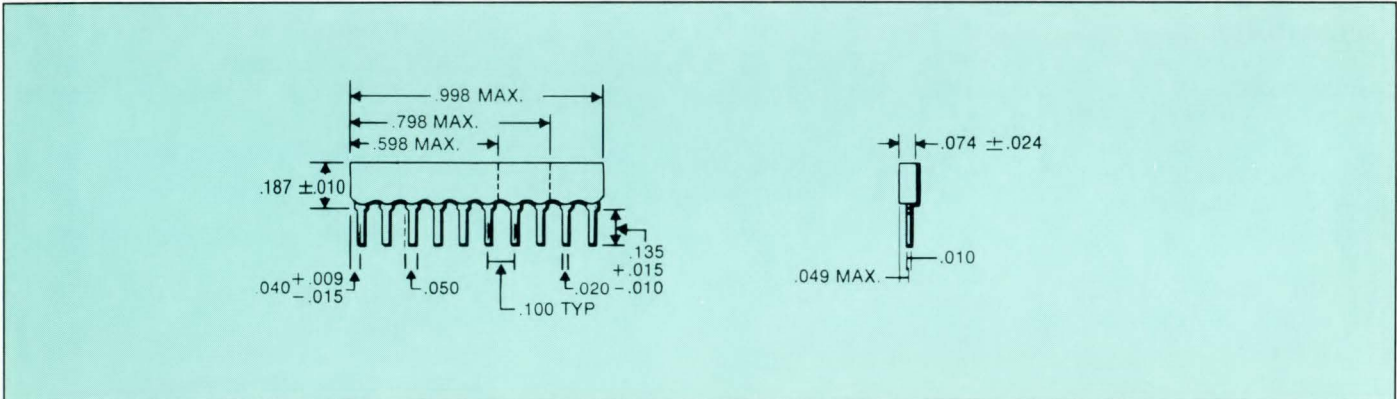




**CONFORMAL COATED SIP PERFORMANCE DATA**

Test Per MIL-R-83401	MIL-R-83401 Limits ( $\Delta R\%$ )			TaNFilm Test Data ( $\Delta R\%$ )	
	M	K	H	Maximum	Typical
Thermal Shock and Power Conditioning	.70	.70	.50	.10	.02
Low Temperature Operation	.50	.25	.10	.10	.02
Short Time Overload	.50	.25	.10	.05	.02
Terminal Strength	.25	.25	.25	.10	.02
Resistance to Soldering Heat	.25	.25	.10	.10	.02
Moisture Resistance	.50	.50	.40	.10	.02
Shock	.25	.25	.25	.10	.02
Vibration	.25	.25	.25	.10	.02
Life	2.0	.50	.50	.10	.02
High Temperature Exposure	1.0	.50	.20	.10	.02
Low Temperature Storage	.50	.25	.10	.10	.02
25°C Double Load	2.0	.50	.50	.05	.02

**DIMENSIONS**



**HOW TO ORDER**

Sample Part Number:

**4981 - 03 - 1001 - B**

**Tolerance**

Standard MIL tolerance code:

B = ±.1%, C = ±.25%

D = ±.5%, F = ±1%, G = ±2%

**Model**

- 4901 9-resistor, 10 pin SIP, one common lead (Schematic C)
- 4981 7-resistor, 8 pin SIP, one common lead (Schematic C)
- 4961 5-resistor, 6 pin SIP, one common lead (Schematic C)
- 4908 9-resistor, 10 pin SIP, series resistors (Schematic F)
- 4988 7-resistor, 8 pin SIP, series resistors (Schematic F)
- 4968 5-resistor, 6 pin SIP, series resistors (Schematic F)
- 4909 5-resistor, 10 pin SIP, isolated (Schematic G)
- 4989 4-resistor, 8 pin SIP, isolated (Schematic G)
- 4969 3-resistor, 6 pin SIP, isolated, (Schematic G)

**Resistance:**

Standard MIL resistance code

Example: 1001 = 1000Ω

**Characteristic**

Code	Classification	TCR (ppm/°C)
00	Commercial Grade	-100 ± 25
01	Commercial Grade	± 100
02	Commercial Grade	± 50
03	Commercial Grade	± 25

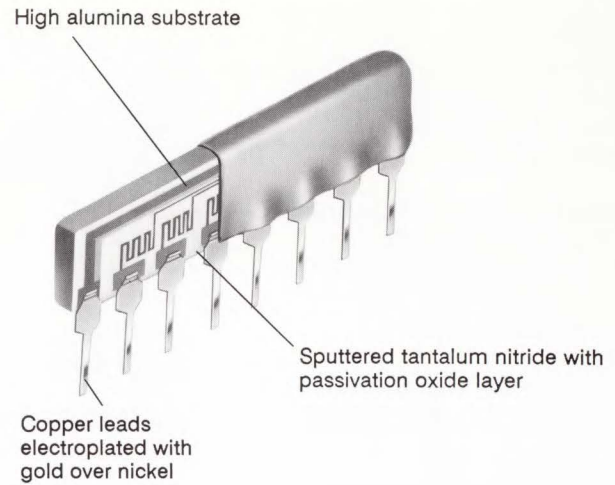




**TANFILM RESISTOR NETWORK  
ULTRA PRECISION**

**4900 SIP SERIES**  
**MIL-R-83401**

- Qualified to M83401, RZ07, RZ08 and RZ09, Characteristic H
- .1% tolerance
- High component density
- TC tracking 5 ppm standard, 2 ppm available
- Two standard circuit schematics
- Custom circuits available



TaNFilm model 4900 qualification to MIL-R-83401 brings all the TaNFilm precision network benefits to the latest low profile Mil spec SIP configuration. This SIP is qualified to 50 ppm temperature coefficient characteristic and .1% tolerance. More importantly, TaNFilm networks are capable of .05% absolute tolerance

and 25 ppm absolute temperature coefficient.

For more precision applications ratios of .01% are available. TC tracking is 5 ppm standard with 2 ppm capability. Custom circuit configuration is readily available when required.

The precision SIP model exhibits all the documented performance and reliability of other TaNFilm networks manufactured by IRC. These include superior environmental performance and long term stability.

**4900 SIP PERFORMANCE DATA**

Test Per MIL-R-83401	MIL-R-83401 Limits ( $\Delta R\%$ )			TaNFilm Test Data ( $\Delta R\%$ )	
	M	K	H	Maximum	Typical
Thermal Shock and Power Conditioning	.70	.70	.50	.10	.02
Low Temperature Operation	.50	.25	.10	.10	.02
Short Time Overload	.50	.25	.10	.05	.02
Terminal Strength	.25	.25	.25	.10	.02
Resistance to Soldering Heat	.25	.25	.10	.10	.02
Moisture Resistance	.50	.50	.40	.10	.02
Shock	.25	.25	.25	.10	.02
Vibration	.25	.25	.25	.10	.02
Life	2.0	.50	.50	.10	.02
High Temperature Exposure	1.0	.50	.20	.10	.02
Low Temperature Storage	.50	.25	.10	.10	.02
25°C Double Load	2.0	.50	.50	.05	.02





## SPECIFICATIONS

### Resistance Range

Schematic C: 100Ω to 100KΩ  
 Schematic G: 100Ω to 100KΩ  
 Lower & Higher resistance values available

### Standard Resistance Tolerances:

±.1%, ±.25%, ±.5%,  
 ±1%, ±2% (.02% available)

### Temperature Coefficient of Resistance:

±25 ppm/°C, ±50 ppm/°C,  
 ±100 ppm/°C, ±300 ppm/°C,

### TCR Tracking:

5 ppm/°C (except Schematic C below 500Ω 20 ppm/°C)

### Power Rating @ 70°C

Schematic	Each Resistor	Wattage		
		Each Network		
		6 Pin	8 Pin	10 Pin
C	.12	.60	.84	1.08
G	.12	.36	.48	.60

Lead Material:  
 Gold plated copper

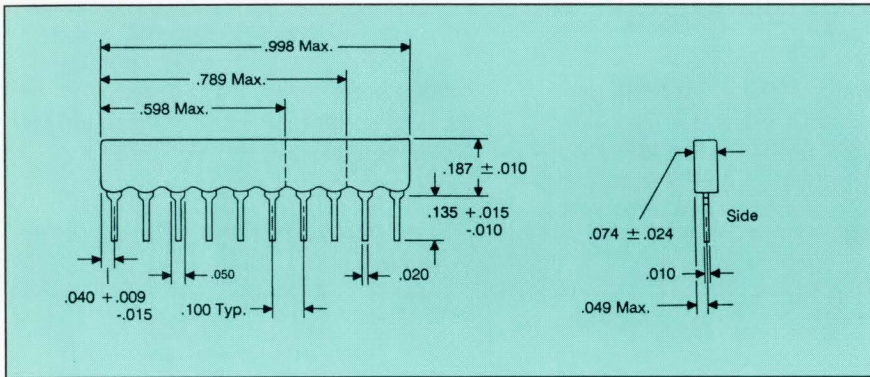
Substrate Material:  
 99.5% pure alumina ceramic

Construction:  
 Epoxy conformal coating

Custom circuits and special testing available

Contact factory for any special features required.

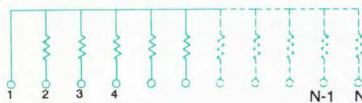
## DIMENSIONS



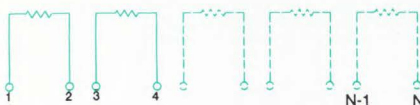
No. Pins	IRC Model No.	Mil Spec Style
10 Pin	490X	RZ09
8 Pin	498X	RZ08
6 Pin	496X	RZ07

## SCHEMATICS

### Schematic "C"



### Schematic "G"



## HOW TO ORDER

Sample Part Number

**4981 - 06 - 1001 B**

### Model

MIL-R-83401/09

4901 9 resistor, 10 pin, Schematic C  
 4909 5 resistor, 10 pin, Schematic G

MIL-R-83401/08

4981 7 resistor, 8 pin, Schematic C  
 4989 4 resistor, 8 pin, Schematic G

MIL-R-83401/07

4961 5 resistor, 6 pin, Schematic C  
 4969 3 resistor, 6 pin, Schematic G

### Characteristic

Code	MIL Designator	TCR (ppm/°C)
04	M	±300
05	K	±100
06	H	±50
07	--	±25

### Tolerance Code

Standard Mil tolerance code:

B = ±.1%  
 D = ±.5%  
 F = ±1%  
 G = ±2%

### Resistance Code

Standard Mil resistance code.

Example:  
 1001 = 1000Ω

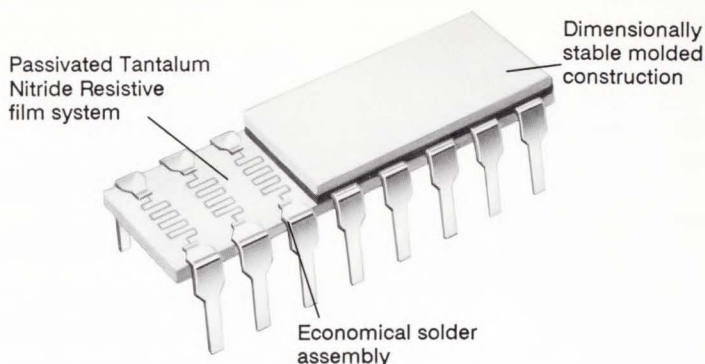




# TANFILM RESISTOR NETWORK PRECISION MOLDED DIP

## M900 SERIES

- Qualified to MIL-R-83401 .1% tolerance, Characteristic H
- Absolute tolerance to  $\pm 25$  ppm/ $^{\circ}$ C
- Superior TCR tracking to  $\pm 5$  ppm/ $^{\circ}$ C
- Ratios available to .05%
- Custom circuit schematics available



Molded TaN Film resistor networks are designed for use in applications requiring a high degree of reliability, stability, tight tolerance, close TCR tracking, and low noise. The molded construction provides excellent dimensional stability for automatic insertion. Our continuous feed, high vacuum sputter-

ing process ensures uniform properties from network to network.

Precise state of the art laser trimming enables us to easily zero in the tightest ratios. Passivated Tantalum Nitride resistor film ensures performance far superior to military specifications and provides excellent environmental protection.

The versatile nature of our photoetch process makes it possible to supply virtually any circuit configuration needed to meet special customer requirements. Custom circuit designs can be easily achieved with a modest set up charge. Military screening available on all units.

### PERFORMANCE DATA

Test Per MIL-R-83401	MIL-R-83401 Limits ( $\Delta R\%$ )			TaN Film Test Data ( $\Delta R\%$ )	
	M	K	H	Maximum	Typical
Thermal Shock and Power Conditioning	.70	.70	.50	.10	.02
Low Temperature Operation	.50	.25	.10	.10	.02
Short Time Overload	.50	.25	.10	.05	.02
Terminal Strength	.25	.25	.25	.10	.02
Resistance to Soldering Heat	.25	.25	.10	.10	.02
Moisture Resistance	.50	.50	.40	.10	.02
Shock	.25	.25	.25	.10	.02
Vibration	.25	.25	.25	.10	.02
Life	2.0	.50	.50	.10	.02
High Temperature Exposure	1.0	.50	.20	.10	.02
Low Temperature Storage	.50	.25	.10	.10	.02
25 $^{\circ}$ C Double Load	2.0	.50	.50	.05	.02





## M900 SPECIFICATIONS

### Resistance values:

M989 & M999: 50Ω to 100K  
 M987 & M998: 50Ω to 50K  
 Higher & lower resistance values available

### Temperature Coefficient of Resistance:

± 25 ppm/°C, ± 50 ppm/°C, ± 100 ppm/°C, and -75 to -125 ppm/°C

### Temperature Range:

-55°C to +150°C

### Resistance Tolerances:

±.1%, ±.5%, and ±1%

TCR Tracking: ± 5 ppm/°C except Schematic B below 500Ω (20 ppm/°C)

Noise: Less than -30 db

Construction: Molded epoxy

Substrate Material: 99.5% pure alumina ceramic

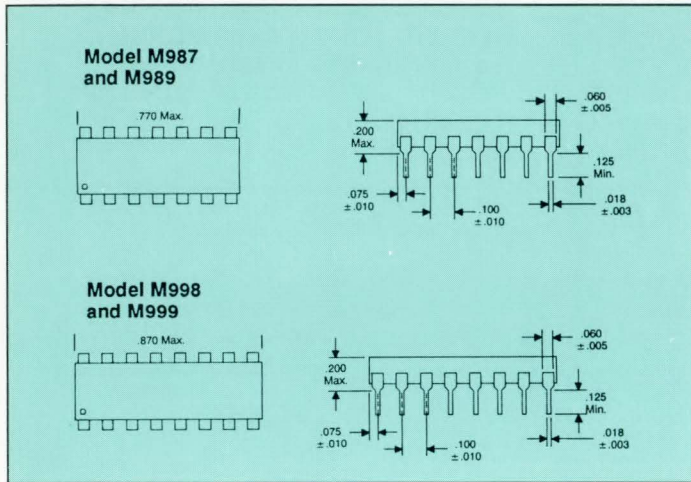
Custom circuits and special testing available

Contact factory for any special features

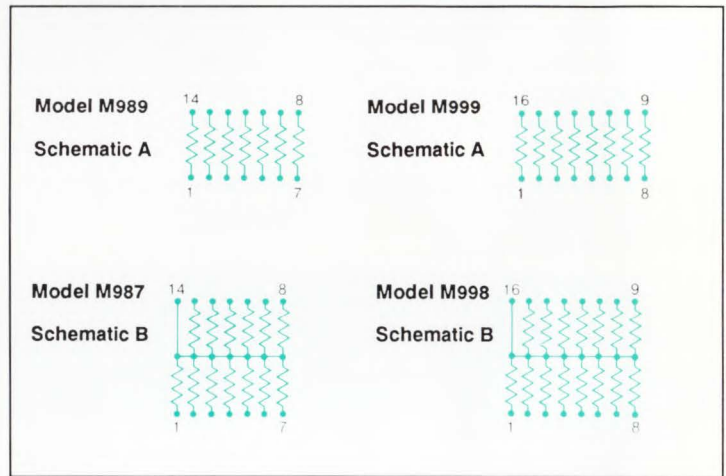
### Power Rating @ 70°C

Model	Wattage	
	Resistor	Network
M987	.1	1.3
M998	.1	1.5
M989	.2	1.4
M999	.2	1.6

## DIMENSIONS



## SCHEMATICS



## HOW TO ORDER

Sample Part Number:

**M989 - 02 - 1001 - B**

### Tolerance

Standard MIL tolerance code:

B = ±.1%, C = ±.25%

D = ±.5%, F = ±1%, G = ±2%

Model

- M989 7 resistor, 14 pin DIP, straight thru, MIL-R-83401-01 Schematic A
- M999 8 resistor, 16 pin DIP, straight thru, MIL-R-83401-02 Schematic A
- M987 13 resistor, 14 pin DIP, one common lead, MIL-R-83401-01 Schematic B
- M998 15 resistor, 16 pin DIP, one common lead, MIL-R-83401-02 Schematic B

### Resistance:

Standard MIL resistance code

Example: 1001 = 1000Ω

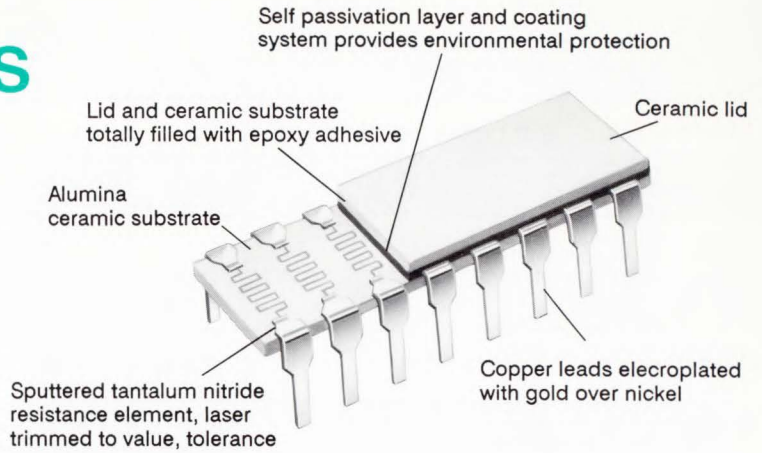
### Characteristic

Code	Classification	TCR (ppm/°C)
00	Commercial Grade	-100 ± 25
01	Commercial Grade	± 100
02	Commercial Grade	± 50
03	Commercial Grade	± 25
04	MIL-R-83401-M	± 300
05	MIL-R-83401-K	± 100
06	MIL-R-83401-H	± 50
07	MIL-R-83401-H	± 25



# TANFILM DIP RESISTOR NETWORKS

- MIL qualified to both MIL-R-83401/01 and MIL-R-83401/02
- MIL spec qualified to .1% Tol, .02% available
- MIL spec qualified to 50 ppm/°C, 25 ppm/°C available
- Superior TCR tracking to 2 ppm/°C
- Ratios available to 0.01%
- Special mechanical and electrical configurations available with military screening



TaNFilm resistor networks are designed for use in applications requiring a high degree of reliability, stability, tight tolerance, close TCR tracking, and low noise. Our continuous feed, high vacuum sputtering process insures uniform properties from network to network. Precise state-of-the-art laser trimming enables us to easily zero in

the tightest ratios. Gold-plated copper leads are thermal pulse bonded to large-area gold conductor pads on the ceramic substrate assuring the most reliable termination and long-term stability. Passivated Tantalum Nitride resistor material offers performance far superior to military specifications and excellent environmental protection.

The versatile nature of our photo-etch process makes it readily adaptable to meet special customer requirements. Custom circuit designs and special mechanical configurations can be easily achieved with a modest set up charge. Full military screening is also available with all units.

## SPECIFICATIONS

### MIL Qualified Resistance Values:

Schematic A: 100Ω to 100KΩ  
Schematic B: 100Ω to 70KΩ  
Higher and lower resistance values available

### Std Resistance Tolerances:

.1%, .25%, .5%, 1%, 2%,  
.02% available

### Temperature Coefficient of Resistance:

± 25 ppm/°C, ± 50 ppm/°C,  
± 100 ppm/°C, ± 300 ppm/°C,  
-100 ± 25 ppm

TCR Tracking: 5 ppm/°C, except  
Models 1987 & 1998 below 500Ω  
(20 ppm/°C); 2 ppm/°C

Temperature Range:  
-55°C to +150°C

Power Rating @ 70°C:

Model	Wattage	
	Resistor	Network
1987	.1	1.3
1998	.1	1.5
1989	.2	1.4
1999	.2	1.6

Noise: Less than -30 dB

Lead Material: Gold plated copper

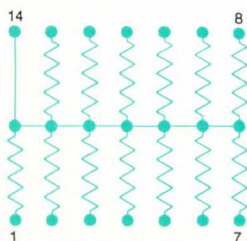
Substrate Material: 99.5% pure alumina ceramic

Construction: Ceramic sandwich epoxy encapsulant

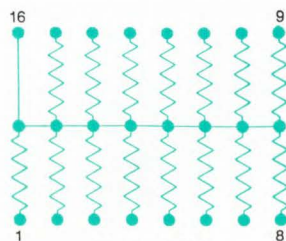
Custom Circuit and Special Testing Available

Contact factory for any special features required

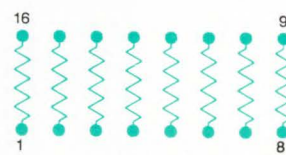
## STANDARD CIRCUITS



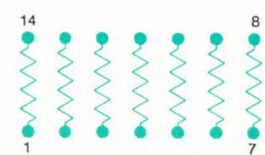
Model 1987  
Schematic B



Model 1998  
Schematic B



Model 1999  
Schematic A



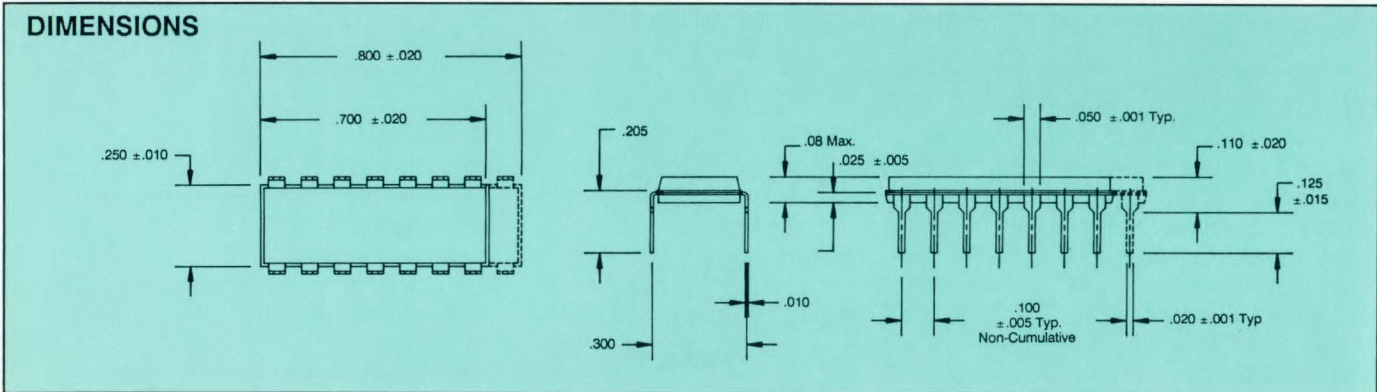
Model 1989  
Schematic A





TANFILM DIP PERFORMANCE DATA

Test Per MIL-R-83401	MIL-R-83401 Limits (ΔR%)			TanFilm Test Data (ΔR%)	
	M	K	H	Maximum	Typical
Thermal Shock and Power Conditioning	0.70	.70	.50	.10	.02
Low Temperature Operation	0.50	.25	.10	.10	.02
Short Time Overload	0.50	.25	.10	.05	.02
Terminal Strength	0.25	.25	.25	.10	.02
Resistance to Soldering Heat	0.25	.25	.10	.10	.02
Moisture Resistance	0.50	.50	.40	.10	.02
Shock	0.25	.25	.25	.10	.02
Vibration	0.25	.25	.25	.10	.02
Life	2.00	.50	.50	.10	.02
High Temperature Exposure	1.00	.50	.20	.10	.02
Low Temperature Storage	0.50	.25	.10	.10	.02
25°C Double Load	2.00	.50	.50	.05	.02



HOW TO ORDER

Sample Part No:

1999 - 06 - 1001 - B

Model

- 1989 7-resistor 14 Pin DIP, straight thru (MIL-R-83401-01, schematic A)
- 1999 8-resistor 16 Pin DIP, straight thru (MIL-R-83401-02, schematic A)
- 1987 13-resistor, 14 Pin DIP, one common lead (MIL-R-83401-01, schematic B)
- 1998 15-resistor, 16 Pin DIP, one common lead (MIL-R-83401-02, schematic B)

Resistance

Standard MIL resistance code  
Example: 1001-1000Ω

Tolerance

Standard MIL tolerance code:  
B = .1%, C = .25%,  
D = .5%, F = 1%, G = 2%

Characteristic

Code	Classification	TCR (ppm/°C)
00	Commercial grade	-100 ± 25
01	Commercial grade	± 100
02	Commercial grade	± 50
03	Commercial grade	± 25
04	MIL-R-83401M	± 300
05	MIL-R-83401K	± 100
06	MIL-R-83401H	± 50
07	MIL-R-83401H	± 25

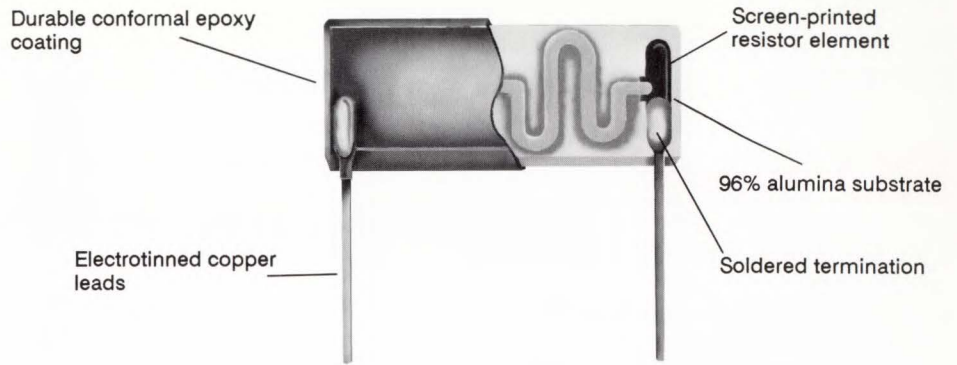




# HIGH VOLTAGE THICK FILM RESISTORS

## RB SERIES

- 1 watt to 5 watts
- 1 ohm to 1000 megohms
- 10KV to 25KV
- 5% to 20% tolerance
- TCR of  $\pm 200$  ppm/ $^{\circ}$ C



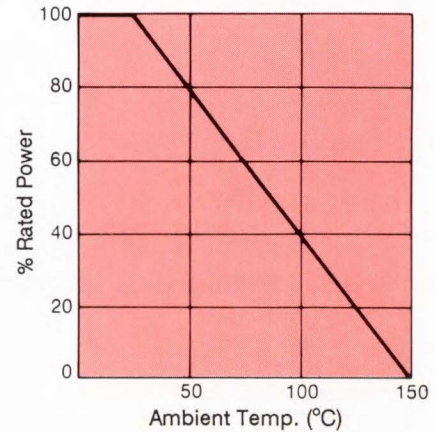
### FEATURES

- IRC proprietary non-noble thick film technology
- Space saving thin body design
- PC board compatible
- High voltage stability
- Low inductance design
- Backed by IRC high volume production capability

### APPLICATIONS

- High voltage power resistors for use in:
  - Power supplies
  - Voltage multipliers
  - Electrostatic equipment
  - Copiers
- Low resistance - low inductance power resistors

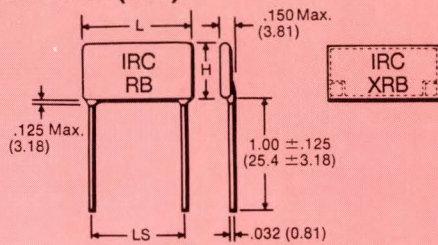
### POWER DERATING



### TYPICAL PERFORMANCE CHARACTERISTICS

Temperature Coefficient	$\pm 200$ ppm/ $^{\circ}$ C
Voltage Coefficient	$\pm 5$ ppm/V
1000 hr 25 $^{\circ}$ C Load Life	2%
Moisture Resistance	1%
Thermal Shock	0.5%
Operating Temperature	-55 to +150 $^{\circ}$ C

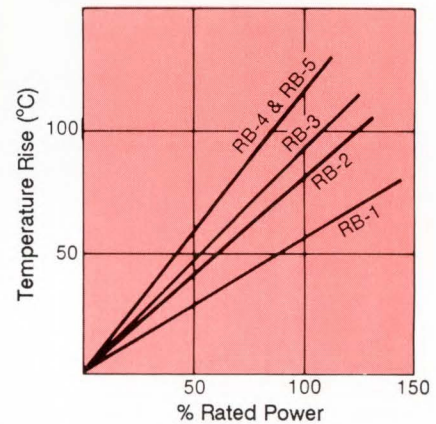
### DIMENSIONS - IN. AND (MM)



IRC Type†	25 $^{\circ}$ C Power Rating	Max. DC Voltage	Physical Dimensions		
			L $\pm .031$ ( $\pm .791$ )	H $\pm .031$ ( $\pm .791$ )	LS $\pm .031$ ( $\pm .791$ )
RB-1	1 watt	10KV	1.03 (26.16)	.28 (7.11)	.90 (22.86)
RB-2	2 watts	10KV	1.03 (26.16)	.53 (13.46)	.90 (22.86)
LRB-2	2 watts	20KV	2.03 (51.56)	.28 (7.11)	1.9 (48.26)
RB-3	3 watts	15KV	1.53 (38.86)	.53 (13.46)	1.40 (35.56)
RB-4	4 watts	20KV	2.03 (51.56)	.53 (13.46)	2.4 (60.96)
RB-5	5 watts	25KV	2.53 (64.26)	.53 (13.46)	1.90 (48.26)
RB-10	10 watts	25KV	2.53 (64.26)	1.28 (32.51)	2.4 (60.96)

† All RB sizes are available in XRB style. The XRB is an RB unit without leads. It is provided with screen printed epoxy overcoat and exposed soldered termination pads. Designed for use in potted assembly applications.

### HOT SPOT TEMPERATURE



### HOW TO ORDER

Sample Part No:

**RB - 3 - 100 Meg $\Omega$  - 5%**

IRC Type

Resistance Value

Tolerance

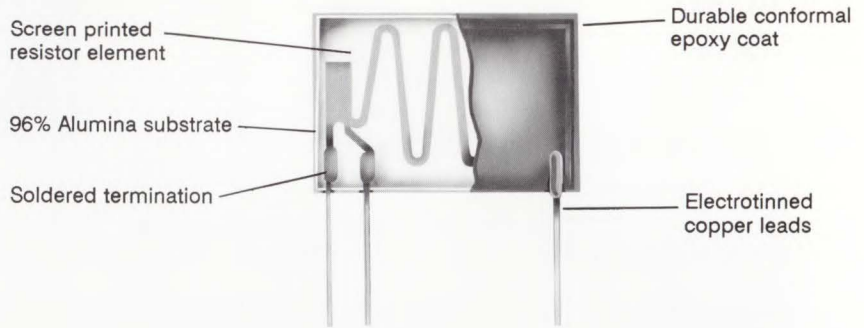




# THICK FILM HIGH VOLTAGE DIVIDERS

## RD SERIES

- IRC proprietary thick film materials and technology
- Space-saving thin body design
- PC board compatible
- High voltage stability
- Wide resistance and ratio selection



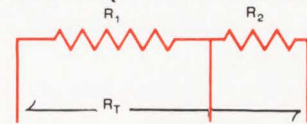
### SPECIFICATIONS

Power Rating: 3 to 7 watts  
 Resistance Range:  
 100KΩ to 500MΩ  
 Max. DC Voltage: 10 kV to 20 kV  
 Resistance Tolerance: 10%, 20%  
 Ratios: 1:1 to 2000:1  
 Ratio Tolerance: 3% to 5%  
 Ratio tracking: 50 ppm/°C

### APPLICATIONS

- High Voltage Dividers for use in:
  - CRT Circuits
  - Voltage Multipliers
  - Power Supplies
  - Voltage Readout Sensing

### SCHEMATIC (STAMPED SIDE)

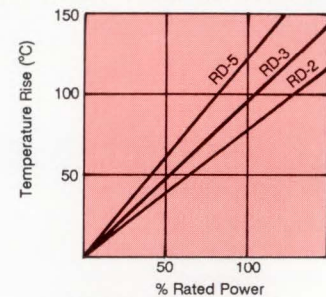


### TYPICAL PERFORMANCE CHARACTERISTICS (Max Δ)

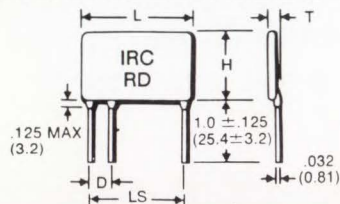
Temperature Coefficient  
 Voltage Coefficient  
 1000 Hour 24°C Load Life Δ R  
 Moisture Resistance  
 Thermal Shock  
 Operating Temperature

OVERALL	RATIO
200 ppm/°C	50 ppm/°C
5 ppm/V	5 ppm/V
2%	1%
1%	0.5%
0.5%	0.5%
-55 to + 150°C	

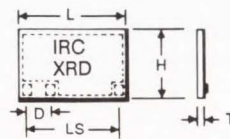
### HOT SPOT TEMPERATURE RISE



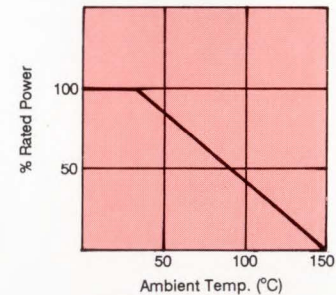
### STANDARD CONFIGURATION



### ALTERNATE CONFIGURATION



### POWER DERATING



IRC Type	25°C Power Rating	Max.* DC Voltage	Physical Dimensions† - In. and (mm)			
			L ±.031 (±.791)	H ±.031 (±.791)	LS ±.031 (±.791)	T Max.
RD-2	3 watts	10KV	1.03 (26.16)	1.03 (26.16)	0.90 (22.86)	.150 (3.81)
RD-3	4 watts	15KV	1.53 (38.86)	1.03 (26.16)	1.40 (35.56)	.150 (3.81)
RD-5	7 watts	20KV	2.03 (51.56)	1.03 (26.16)	1.80 (45.72)	.150 (3.81)
XRD-2	3 watts	10KV	1.00 (25.40)	1.00 (25.40)	0.90 (22.86)	.05 (1.27)
XRD-3	4 watts	15KV	1.50 (38.10)	1.00 (25.40)	1.40 (35.56)	.05 (1.27)
XRD-5	7 watts	20KV	2.00 (50.80)	1.00 (25.40)	1.80 (45.75)	.065 (1.65)

\* Power and voltage rating can be higher for potted applications. Consult factory for over rating information  
 † Tolerance for XRD dimensions L, H, LS, and D is .01" (.254mm)

Note: The XRD is an RD unit without leads. It is provided with screen printed epoxy overcoat and exposed soldered termination pads, and is designed for use in potted assembly applications.

### D -Typical Nominal Dimension

IRC Type	R1/R2 Ratio Range				
	Up to 1:1	2:1 to 5:1	6:1 to 25:1	25:1 to 99:1	10 0:1 & Up
RD-2	.40 (10.2)	.30 (7.6)	.30 (7.6)	.30 (7.6)	.20 (5.1)
XRD-2					
RD-3	.70 (17.8)	.40 (10.2)	.30 (7.6)	.20 (5.1)	.20 (5.1)
XRD-3					
RD-5	.70 (17.8)	.40 (10.2)	.40 (10.2)	.20 (5.1)	.20 (5.1)
XRD-5					

### HOW TO ORDER

Sample Part No:

**RD - 3 10M ± 10% - 25:1 - ± 5%**

IRC Type

Resistance Value (megohms)  
 See specification table for values available

Resistance Tolerance (10%, 20%)

Divider Ratio (R1/R2)

Ratio Tolerance

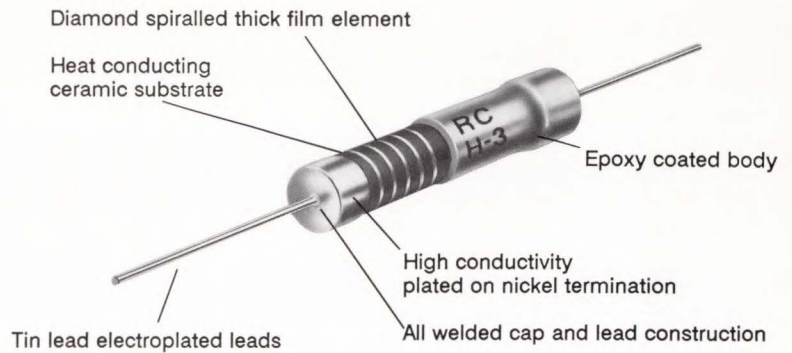




**PRECISION,  
HIGH-VOLTAGE  
THICK FILM RESISTORS**

**CGH SERIES**

- 1/4 watt to 5 watts
- 100K to 5000 megohm range
- ±0.5%, ±1%, ±2% or ±5% tolerance
- TC of 50 ppm/°C or 100 ppm/°C



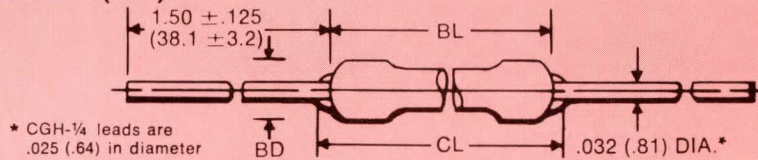
**SPECIFICATIONS**

IRC Type	Power Rating at 70°C (watts) <sup>1</sup>	Voltage Rating (volts) <sup>2</sup>	Resistance Range (ohms) <sup>4</sup>	Tolerance (%) <sup>5</sup>	Maximum TCR (ppm/°C)	VCR (ppm/V) <sup>3</sup>
CGH-1/4	1/4	750	100K-100M	.5, 1, 2, 5	50, 100	0 to -5
CGH-1/2	1/2	1,500	100K-400M	.5, 1, 2, 5	50, 100	0 to -5
CGH-1	1	3,000	50K-750M	.5, 1, 2, 5	50, 100	0 to -5
CGH-2	2	5,000	100K-1200M	.5, 1, 2, 5	50, 100	0 to -5
CGH-3	3	10,000	200K-4000M	.5, 1, 2, 5	50, 100	0 to -5
CGH-5	5	20,000	300K-5000M	.5, 1, 2, 5	50, 100	0 to -5

**NOTES:**

- 1 For power rating above 70°C, see derating curve.
- 2 Voltage rating shown is the rated DC continuous working voltage or the sine-wave RMS absolute maximum voltage at commercial line frequency. For DC applications the absolute maximum permissible voltage is 1.5 times the value shown for low repetition short-time-overload or pulse conditions of 10 seconds or less duration.
- 3 Typical voltage coefficient of resistance is -1 to -2 ppm/V measured at full rated voltage and 10% rated voltage.
- 4 Contact factory for higher resistance values. Above 15 gigohm available 2Q88.
- 5 For CGH1 and 2 above 500 meg and CGH3 and 5 above 1000M only 2 and 5% tolerance available.

**DIMENSIONS - IN. AND (mm)**



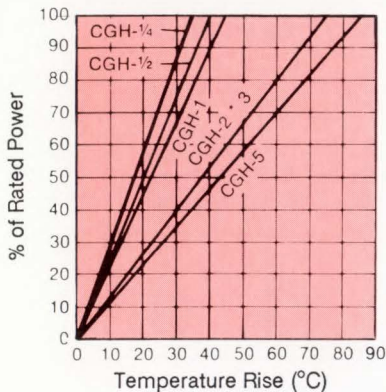
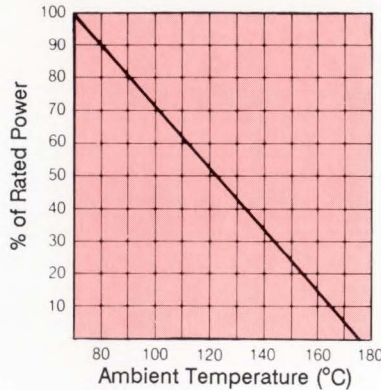
IRC Type	Body Length BL	Body Diameter BD	Clean Lead to Clean Lead CL
CGH-1/4	0.275 ±0.031 (6.98 ±0.79)	0.088 ±0.010 (2.22 ±0.25)	0.400 (10.16)
CGH-1/2	0.400 ±0.031 (10.16 ±0.79)	0.138 ±0.016 (3.51 ±0.41)	0.525 (13.34)
CGH-1	0.690 ±0.062 (17.53 ±1.57)	0.297 ±0.031 (7.54 ±0.79)	0.900 (22.86)
CGH-2	1.062 ±0.062 (26.97 ±1.57)	0.297 ±0.031 (7.54 ±0.79)	1.250 (31.75)
CGH-3	2.062 ±0.062 (52.37 ±1.57)	0.297 ±0.031 (7.54 ±0.79)	2.250 (57.15)
CGH-5	3.062 ±0.062 (77.77 ±1.57)	0.297 ±0.031 (7.54 ±0.79)	3.250 (82.55)



TEST CONDITION <sup>1</sup>	Maximum $\Delta R$ ( $\pm 3\sigma$ )	Typical <sup>2</sup> $\Delta R$
Temperature Shock	$\pm 0.25\%$	$\pm 0.10\%$
Short-Time Overload (1.5 times rated V for 10 sec)	$\pm 0.20\%$	$\pm 0.10\%$
Solder Effect	$\pm 0.15\%$	$\pm 0.05\%$
Terminal Strength	$\pm 0.20\%$	$\pm 0.05\%$
Moisture Resistance (no load or polar)	$\pm 0.50\%$	$\pm 0.20\%$
Load Life (1000 Hours at 70°C)	$\pm 1.00\%$	$\pm 0.25\%$
Shelf Life (1 year at 25°C)	$\pm 0.10\%$	$\pm 0.03\%$
High-Temperature Exposure (150°C for 2000 Hours)	$\pm 0.75\%$	$\pm 0.30\%$
(175°C for 2000 Hours)	$\pm 1.0\%$	$\pm 0.40\%$
Dielectric Breakdown <sup>3</sup> (1/4 and 1/2 watt size)	2000 VDC, 1500 VAC	
(1-watt through 5-watt size)	3500 VDC, 2500 VAC	
Dielectric Strength <sup>4</sup>	$\pm 0.15\%$	$\pm 0.05\%$
Insulation Resistance at 500 VDC	$10^9$ ohms min.	$10^{11}$ ohms typ.

**NOTES:**

- 1 Test method per MIL-STD-202 unless otherwise indicated.
- 2 Typical defined as that percent change which will include a minimum of 50% of the measured changes in resistance from a variety of lots representing various unit sizes and ranges.
- 3 Values shown are the maximum safe dielectric voltage applied from a V block or foil wrapping which extends the complete body length of the resistor under test.
- 4 Percent change after the maximum safe dielectric voltage is applied for 1 minute.

**TEMPERATURE RISE**

**POWER DERATING**

**HOW TO ORDER**

Sample Part No:

**CGH - 3 - 50 PPM/°C - 22M - 1%**
**IRC Type**

 CGH-1/4, CGH-1/2  
 CGH-1, CGH-2,  
 CGH-3, CGH-5

**Temperature Coefficient**
 $\pm 100$  ppm/°C,  $\pm 50$  ppm/°C

**Resistance**

 Standard EIA/MIL values  
 for metal film resistors.  
 See specification chart for range

**Tolerance**
 $\pm 0.5\%$ ,  $\pm 1\%$ ,  $\pm 2\%$ ,  $\pm 5\%$



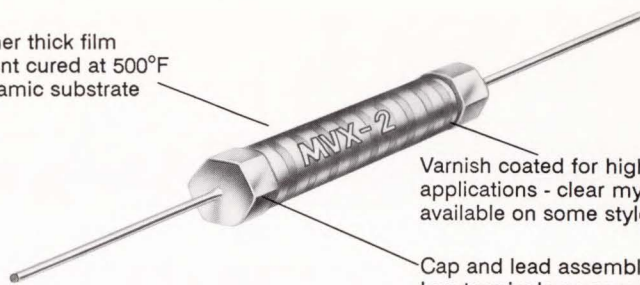


# GENERAL-PURPOSE HIGH-VOLTAGE FILM RESISTORS

## MV SERIES\*

- 1 watt to 90 watts
- 10k to 1000 megohm range
- ±5%, ±10%, or ±20% tolerance

Polymer thick film element cured at 500°F to ceramic substrate



Varnish coated for high voltage applications - clear mylar insulation available on some styles

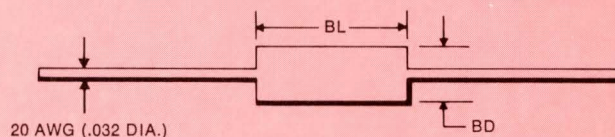
Cap and lead assembly. Lug terminals on some styles

### SPECIFICATIONS - LUG TERMINALS OR COLLOIDAL SILVER TERMINALS

IRC Type	Standard Terminal Type	Special Terminals Available	Power Rating (watts)	Peak Volt. Rating (KV)*	Minimum Available Resistance		Dimensions in Inches				
					±10% or ±20% Tol.	±5% Tol.	Maximum Available Resist. (Megs)	Resistor Body Length BL	Resistor Body Diameter BD	Ceramic Inside Diameter	Width of Silver Bands #15 Term.
MVC-1	‡	Axial Leads	1	3.5	10K	100K	500	1.00 ±.03	.31 ±.03	THD #6-32	--
MVC-2	‡	Axial Leads	2	7.5	25K	100K	1,000	1.75 ±.03	.31 ±.03	THD #6-32	--
MVC-3	‡	Axial Leads	3	15.0	100K	100K	1,000	3.00 ±.03	.31 ±.03	THD #6-32	--
MVC-5	‡	Axial Leads	5	30.0	100K	200K	1,000	5.50 ±.06	.31 ±.03	THD #6-32	--
MXV-1	Axial Leads	--	1	3.5	100K	100K	500	1.00 ±.03	.25 ±.03	--	--
MXV-2	Axial Leads	--	2	10.0	100K	100K	1,000	2.00 ±.03	.25 ±.03	--	--
MXV-3	Axial Leads	--	3	15.0	100K	100K	1,000	3.00 ±.06	.25 ±.03	--	--
MVH-2	‡	--	4	15.0	100K	150K	1,000	2.50 ±.05	.56 ±.03	THD #6-32	--
MVH-4	‡	--	6	25.0	100K	400K	1,000	4.00 ±.06	.56 ±.03	THD #6-32	--
MVL	‡	--	5	30.0	100K	100K	1,000	4.50 ±.06	.50 ±.03	THD #6-32	--
MVF	#15	--	2	5.0	100K	25K	1,000	1.75 ±.03	.31 ±.03	.19 ±.03	.38 ±.03
MVG	#15	#17	4	7.5	100K	100K	1,000	2.00 ±.03	.56 ±.03	.38 ±.03	.56 ±.06
MVK	#15	#17	10	20.0	100K	200K	1,000	5.00 ±.06	.56 ±.03	.38 ±.03	.56 ±.06
MVJ	#15	#17	5	10.0	100K	200K	1,000	3.00 ±.03	.56 ±.03	.38 ±.03	.56 ±.06
MVP	#15	#17	10	15.0	100K	400K	1,000	4.50 ±.06	.75 ±.03	.50 ±.03	.56 ±.06
MVA	#15	#17	20	25.0	200K	1.0 Meg	1,000	6.50 ±.06	1.12 ±.03	.75 ±.03	.56 ±.06
MVO	#15	#17	30	50.0	400K	2.0 Meg	1,000	10.5 ±.06	1.12 ±.03	.75 ±.03	.56 ±.06
MVQ	#15	#16, 17	50	50.0	500K	3.5 Meg	1,000	10.5 ±.12	2.00 ±.05	1.56 ±.05	.88 ±.06
MVR	#15	#17	90	100.0	1 Meg	7.0 Meg	1,000	18.5 ±.12	2.00 ±.05	1.56 ±.05	.88 ±.06

‡Solder lug or screw mounted  
\*Rated continuous working voltage determined by  $E = \sqrt{PR}$   
E should not exceed value listed in column above

### DIMENSIONS - INCHES and (mm)



\*Manufactured in Mexico

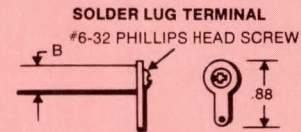
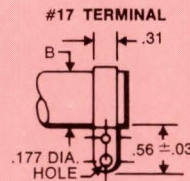
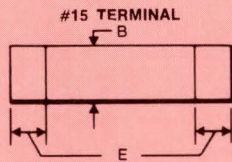
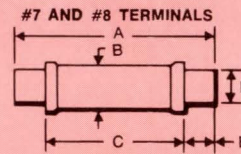
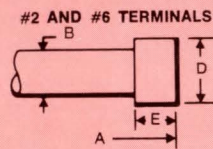


## MV FERRULE TERMINALS

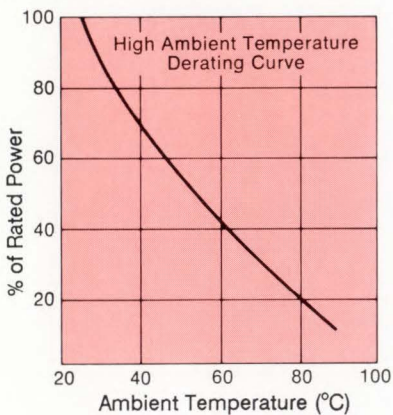
IRC Type	Power Rating at 25°C Ambient (watts)	(KV) Rating* Voltage Peak	Type Terminal	"A" (Max.) Length Overall	Dimensions in Inches			
					Nominal Diameter "B"	Ferrule Spacing "C"	Ferrule Diameter "D"	Ferrule Length "E"
MVP-2	10	15.0	#2	4.56	.75 ±.03	-	.91 ±.03	.50 ±.06
MVO-7	30	50.0	#7	12.00	1.12 ±.03	10.81 ±.06	.81 ±.03	.50 ±.06
MVQ-8	50	50.0	#8	11.72	2.00 ±.05	10.56 ±.16	1.12 ±.03	.56 ±.03
MVR-8	90	100.0	#8	19.94	2.00 ±.05	18.56 ±.16	1.12 ±.03	.56 ±.03

\* Rated continuous working voltage determined by  $E = \sqrt{PR}$  E should not exceed value listed in column above.

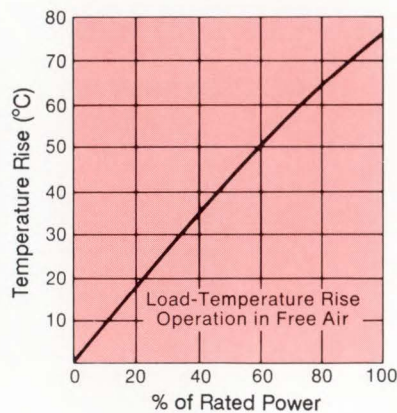
## STANDARD TERMINALS



## POWER DERATING



## TEMPERATURE RISE



## HOW TO ORDER

Sample Part No:

MVX1 - 510M - 10%

### IRC Type

See specification table for types and power ratings available.

### Resistance

10K ohms to 1000M ohms in standard EIA/MIL values. See specification table for exact range.

### Tolerance

±20%, ±10% or ±5%  
See specification table for availability





# HIGH VOLTAGE RESISTORS

## T40/F40 SERIES\*

- Resistance range: 100KΩ to 150GΩ
- Low TCR: Down to ±50 ppm/°C
- Low VCR: less than 1 ppm/volt
- Withstands up to 50KV dc continuously in air and up to 100KV in oil
- Low inductance version available
- Matched sets available



### SPECIFICATIONS

#### Construction

The T40 series is based on an Invarox<sup>®</sup> ruthenium oxide, the F40 series is based on a Cermetox<sup>®</sup> cintered oxide. Both films are deposited onto high purity ceramic which are forced-fitted with brass endcaps. The resistors are adjusted to value with a helical cut through the film, and finally a protective sleeve is fitted to provide mechanical protection and electrical insulation.

#### Oil Emersion

Resistors for use in oil can be supplied with a lacquer protection and without sleeve.

#### Low Inductance Version

Resistors can be supplied using a special adjustment technique to reduce inductance to a minimum.

#### Terminations

Three styles of termination are available to permit resistors to be screwed together in a series chain, with the end members having axial wires for soldering.

#### Material

Solder coated copper wire.

#### Pull Strength

1kg

#### Solderability

The terminations meet the requirements of IEC 68-2-20, Part 2, Test T,3.2, Solder bath method (270°C)

#### Screw Terminations

Styles KU and TU

All Caps are tapped UNF-10x .165(4.2) deep (full depth thread).

UNF-10 is 32 TPI, 60° thread angle, .186 (4.2) ± .003 (0.07) outside diameter, .151 (3.83) core diameter.

All style KU and TU resistors are supplied with a single .312 (8) long screwed brass coupling stud.

#### Marking

Legend marked with type resistance value, tolerance and date code.

#### Solvent Resistance

The protective sleeve provides excellent resistance to all normal industrial cleaning solvents.

#### Flammability

The protective sleeve is flame retardant within the terms of DEF5011, Test No. 7, Fire Risk.

### DIMENSIONS - INCHES and (mm)

Type	Length (L)	Diameter (D)
T43D	1.00 (25.4)	.331 (8.4)
T44D	2.00 (50.8)	.331 (8.4)
T48D	5.90 (150.0)	.331 (8.4)
T43KU	1.20 (30.2)	.334 (8.5)
T44KU	2.10 (53.2)	.334 (8.5)
T48KU	6.00 (152.4)	.334 (8.5)
T43TU	1.28 (32.6)	.334 (8.5)
T44TU	2.20 (55.6)	.334 (8.5)
T48TU	6.09 (154.8)	.334 (8.5)
F43D	1.00 (25.4)	.331 (8.4)
F44D	2.00 (50.8)	.331 (8.4)
F43KU	1.20 (30.2)	.334 (8.5)
F44KU	2.10 (53.2)	.334 (8.5)
F43TU	1.28 (32.6)	.334 (8.4)
F44TU	2.20 (55.6)	.334 (8.4)

\*Manufactured in the U.K.





## T40/F40 ELECTRICAL DATA

Type	Rated Dissipation in air at 20°C (watts)	Resistance Range	Limiting Element Voltage DC or AC RMS (DV)	Peak Voltage DC or AC (KV)
T43	1.5	1KΩ to 4GΩ	4	6
T44	3.5	1KΩ to 15GΩ	14	10
T48	10.0	1KΩ to 45GΩ	50	10
F43	0.7	2MΩ to 100GΩ at ± 5%, ± 10% 2MΩ to 5GΩ at ± 2%	4	6
F44	1.3	2MΩ to 150GΩ at ± 5%, ± 10% 2MΩ to 5GΩ at ± 2%	14	14

### Manufactured Values

Available in any value within the specified range.

### Standard Selection Tolerances

T40: ± 1, 2, and 5% over the full resistance range: measured at 100V dc max. Closer tolerances available. F40: ± 2%, 5%, 10%. Measured at 100V dc.

### Derating

T40: Derate linearly from rated dissipation at 20°C to zero at 150°C.  
F40: Derate linearly from rated dissipation at 20°C to zero at 100°C.

### Temperature Coefficient of Resistance

T40: (-55°C to +150°C) The TCR will not exceed 100 ppm/°C over the full resistance and temperature range. Lower TCR can be supplied.  
F40: The temperature coefficient is typically within the range -1500 ppm to -2000 ppm/°C.

### Insulation Resistance

Greater than 10<sup>13</sup>Ω

### Thermal Impedance

Type	T43	T44	T48	F43	F44
(°C/Watt)	31	27	13	44	33

### Voltage Coefficient

T40: The effect on the measured resistance value is less than 1 ppm per volt applied.  
F40: The combined effect of voltage and self-heating is negative and accurately retraceable. The effect is dependent upon resistance value and will be within the range -5% to -9% when the limiting element voltage is applied.

### Noise

The noise voltage has been measured in accordance with IEC 195, using applied voltages up to 250V. Noise is typically less than 2.5μ V/V per decade of frequency.

### Low Inductance Version

For those applications requiring minimum inductance, a specially adjusted version is available.

### ENVIRONMENTAL DATA

#### Load Life

T40: 1000 hours at rated dissipation in 20°C ambient: ΔR typically better than 0.3%.  
F40: 1000 hours at rated dissipation in 20°C ambient: ΔR typically better than 1%..

#### Shelf Life

T40: 12 months ΔR typically 0.3%.  
F40: 12 months ΔR typically 0.5%.

#### Temperature Range

T40: -55°C to 150°C. Due to the possibility of surface condensation it is recommended that high voltages are not applied to resistors in conditions of high humidity.  
F40: -55°C to 100°C. Due to the possibility of surface condensation it is recommended that high voltages are not applied to resistors in conditions of high humidity.

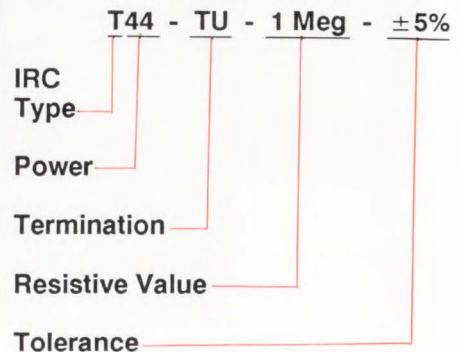
### MATCHED SETS

Matched sets can be supplied for use as precision voltage dividers. These may be screwed together to form sticks and, by selecting the type of termination, a wire connection can be provided at each end of the stick. Voltage or resistance ratios up to 1000:1 with an accuracy of ± 1% or ± 2% are available.

TCR can be matched to 10 ppm/°C, depending on ratio and temperature range.

### HOW TO ORDER:

Sample Part No.:



### APPLICATION NOTES

The wire terminations should not be bent closer than .059 (1.5) from the body, and the recommended minimum bend radius is .039 (1).

Care should be taken to prevent the resistor marking from being abraded while cleaning solvents or their vapors are present.

Due to the high voltage which can appear between the endcap and any adjacent metal part, resistors should be mounted at an adequate distance from other conducting parts.

An appropriate number of resistors may be screwed together as a stick to provide an assembly which will be capable of

withstanding any desired voltage, providing that no individual resistor is subjected to a greater stress or power dissipation than is recommended in this data sheet, and that appropriate anti-corona devices are fitted.

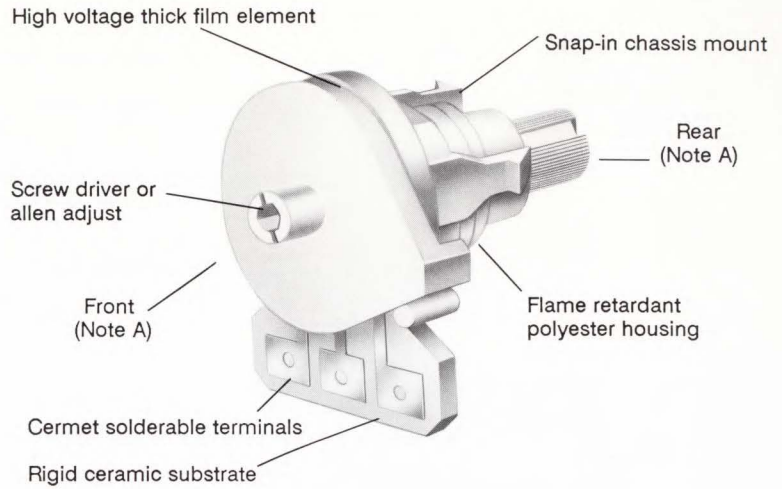
For some high voltage applications it is required to immerse the components in oil or gas to reduce the effects of corona and surface tracking. A special lacquer protected version to the resistor is available suitable for immersion in transformer oil or SF6.

When resistors are required to be potted, the preferred medium is a silicone compound.



# HIGH-VOLTAGE FOCUS RESISTOR

- 3kV voltage rating
- Resistance ranges from 1 megohm to 100 megohms
- Rated 1 W at 65°C, derated to 0 at 105°C
- Potential applications include electrostatic copiers, CRT displays, computer terminals, video games and instrumentation
- Thick Film element



## SPECIFICATIONS

### Resistance Tolerance:

Standard:  $\pm 20\%$ ; Special:  $\pm 10\%$

### Voltage Rating:

Across end terminals:  
3000 VDC; Mounting plate to terminals: 7500 VDC

### Tapers Available: Linear only

$\pm 20\%$  Terminal Minimum Resistance (Both Ends of Rotation):  
10% of total resistance maximum

### Temperature Coefficient

(-55 to +105°C) 200 ppm/°C

### Voltage Coefficient:

Less than 10 ppm/V

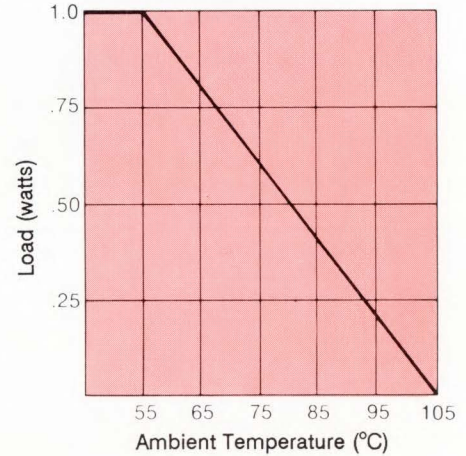
### Rotational torque: 1 - 8 in. oz.

### Molded Materials: SE-O Rated

### Environmental Performance:

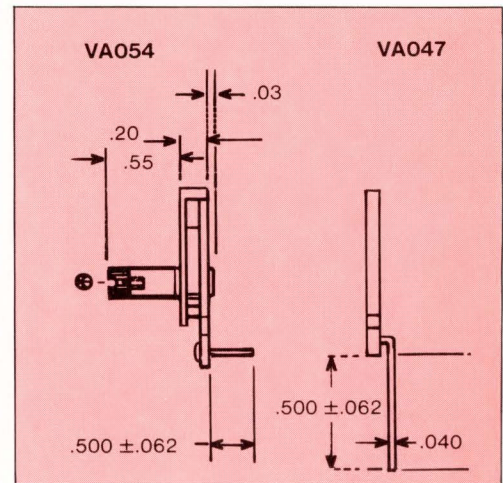
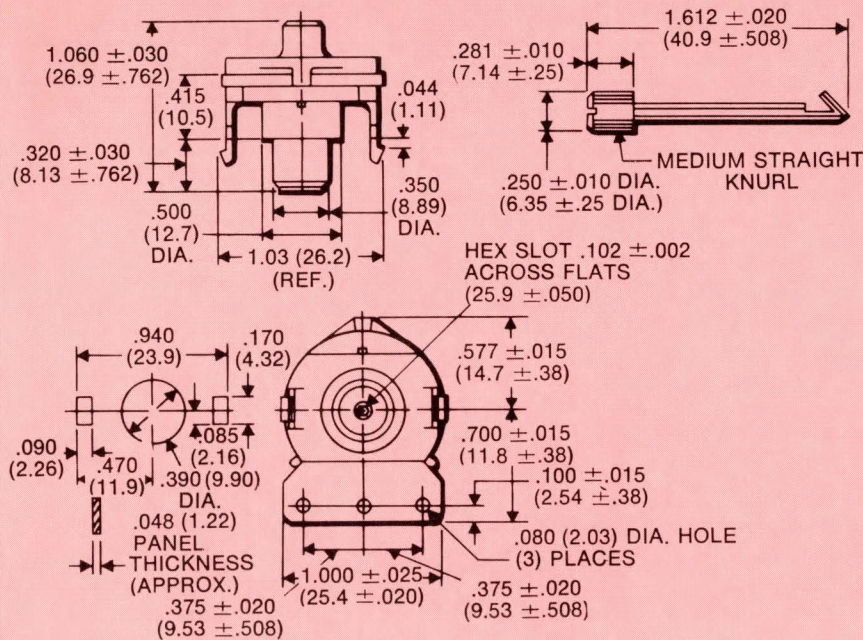
Load Life: Maximum  $\Delta R$  after 1000 hours at 65°C  $\pm 5\%$   
Rotational Life (No Load):  
Maximum  $\Delta R$  (after 240 hours at 40°C and 90-95% R.H.)  $\pm 5\%$

## POWER DERATING



Note: Available with leads for PC board mounting.

## DIMENSIONS - IN. and (mm)



Note A: When ordering optional shaft, specify insertion from front or rear





# PRECISION MIL-QUALIFIED METAL GLAZE RESISTORS

## RG SERIES

- 1/8 watt to 3 watts
- 1 ohm to 5.1 megohms
- 0.5% to 5% tolerance; 0.1% in selected ranges
- $\pm 25$  ppm/ $^{\circ}$ C to  $\pm 200$  ppm/ $^{\circ}$ C

Digital or color code marking per MIL-R-22684 (RL), 39017 (RLR), 55182 (RNC), 10509 (RN)

Spiralled or laser helixed to resistance value, tolerance

High temperature soldered termination-lead assembly

30-70 electroplated copper leads



Tough molded jacket. RG 1/8 types have glass-filled conformal jacket.

Metal Glaze thick film element fired at 1000°C to solid ceramic core.

### SPECIFICATIONS

IRC Type	MIL Type	Marking	Tol ( $\pm$ %)	T.C. (ppm/ $^{\circ}$ C)	IRC Power Rating (watts)	MIL Power Rating (watts)	Max Volt. Rtg.	IRC Resistance Range	MIL Approved Resistance Range	Nominal Size	Dimension Code
RG1/8 <sup>1</sup>	-	Band	2, 5	200	1/4 @ 70 $^{\circ}$ C	-	200	4.3 $\Omega$ to 1.5M $\Omega$	-	1/8W	1
RG1/4	-	Band	5	200	1/2 @ 70 $^{\circ}$ C	-	250	4.3 $\Omega$ to 5.1M $\Omega$	-	1/4W	4
RG1/2	-	Band	5	200	1 @ 70 $^{\circ}$ C	-	350	4.3 $\Omega$ to 5.1M $\Omega$	-	1/2W	5
RG1	-	Band	5	200	1 @ 70 $^{\circ}$ C	-	500	4.3 $\Omega$ to 5.1M $\Omega$	-	1W	7
TO-50 <sup>1</sup>	-	Stamp	.5, 1	100	1/4 @ 70 $^{\circ}$ C	-	200	10 $\Omega$ to 1M $\Omega$	-	1/8W	1
T2-50 <sup>1</sup>	RN50C	Stamp	.5, 1	50	1/8 @ 70 $^{\circ}$ C	-	200	10 $\Omega$ to 1M $\Omega$	10 $\Omega$ to 100K $\Omega$	1/8W	1
T9-50 <sup>1</sup>	-	Stamp	.5, 1	25	1/8 @ 70 $^{\circ}$ C	-	200	10 $\Omega$ to 1M $\Omega$	-	1/8W	1
TF-05 <sup>1</sup>	-	Band/Stamp	1, 2, 5	100	1/4 @ 70 $^{\circ}$ C	-	200	1 $\Omega$ to 9.9 $\Omega$	-	1/8W	1
TF-07	-	Band/Stamp	1, 2, 5	100	1/2 @ 70 $^{\circ}$ C	-	250	1 $\Omega$ to 9.9 $\Omega$	-	1/4W	4
TF-20	-	Band/Stamp	1, 2, 5	100	1 @ 70 $^{\circ}$ C	-	250	1 $\Omega$ to 9.9 $\Omega$	-	1/2W	5
GF-55	Flame Resist <sup>3</sup>	Stamp	1	50, 100	1/2 @ 70 $^{\circ}$ C	-	250	.4 $\Omega$ to 2M $\Omega$	-	1/4W	4
GF-07	Flame Resist <sup>3</sup>	Stamp	2, 5	100	1/2 @ 70 $^{\circ}$ C	-	250	.4 $\Omega$ to 2M $\Omega$	-	1/4W	4
GF-60	Flame Resist <sup>3</sup>	Stamp	1	50, 100	3/4 @ 70 $^{\circ}$ C	-	350	.4 $\Omega$ to 2M $\Omega$	-	1/2W	6
GF-20	Flame Resist <sup>3</sup>	Stamp	2, 5	100	3/4 @ 70 $^{\circ}$ C	-	350	.4 $\Omega$ to 2M $\Omega$	-	1/2W	6
GF-3	Flame Resist <sup>3</sup>	Stamp	1, 2, 5	200	2 @ 70 $^{\circ}$ C 3 @ 25 $^{\circ}$ C	-	750	1 $\Omega$ to 2M $\Omega$	-	3W	9
GS-3	-	Stamp	1, 2, 5	50, 100	2 @ 70 $^{\circ}$ C 3 @ 25 $^{\circ}$ C	-	1000	1 $\Omega$ to 3M $\Omega$	-	3W	9
RG07	RL07	Band	2, 5 <sup>7</sup>	200	1/2 @ 70 $^{\circ}$ C	1/4 @ 70 $^{\circ}$ C	250	4.3 $\Omega$ to 5.1M $\Omega$	51 $\Omega$ to 150K $\Omega$	1/4W	4
RG20	RL20	Band	2, 5 <sup>7</sup>	200	1 @ 70 $^{\circ}$ C	1/2 @ 70 $^{\circ}$ C	350	4.3 $\Omega$ to 5.1M $\Omega$	4.3 $\Omega$ to 470K $\Omega$	1/2W	5
RG32	RL32	Band	2, 5 <sup>7</sup>	200	1 @ 70 $^{\circ}$ C	1 @ 70 $^{\circ}$ C	500	4.3 $\Omega$ to 5.1M $\Omega$	10 $\Omega$ to 1M $\Omega$	1W	7
RGR05 <sup>1</sup>	RLR05/S <sup>2</sup>	Stamp	1, 2	100	1/8 @ 70 $^{\circ}$ C	1/8 @ 70 $^{\circ}$ C	200	10 $\Omega$ to 300K $\Omega$	10 $\Omega$ to 300K $\Omega$	1/8W	2
RGR07	RLR07/S <sup>2</sup>	Stamp	1, 2	100	1/4 @ 70 $^{\circ}$ C	1/4 @ 70 $^{\circ}$ C	250	10 $\Omega$ to 3.01M $\Omega$	10 $\Omega$ to 3.01M $\Omega$	1/4W	4
RGR20	RLR20/S <sup>2</sup>	Stamp	1, 2	100	1/2 @ 70 $^{\circ}$ C	1/2 @ 70 $^{\circ}$ C	350	4.3 $\Omega$ to 3.01M $\Omega$	4.3 $\Omega$ to 3.01M $\Omega$	1/2W	5
RGR32	RLR32/S <sup>2</sup>	Stamp	1, 2	100	1 @ 70 $^{\circ}$ C	1 @ 70 $^{\circ}$ C	500	10 $\Omega$ to 2.7M $\Omega$	10 $\Omega$ to 2.7M $\Omega$	1W	7
TO-55	RN55D	Band/Stamp	.1, .5, 1 <sup>5</sup>	100	1/2 @ 70 $^{\circ}$ C	1/8 @ 70 $^{\circ}$ C	200	10 $\Omega$ to 3.01M $\Omega$	10 $\Omega$ to 301K $\Omega$	1/4W	4
T2-55	RN55C	Stamp	.1, .5, 1 <sup>5</sup>	50	1/4 @ 70 $^{\circ}$ C	1/10 @ 125 $^{\circ}$ C	200	10 $\Omega$ to 3.01M $\Omega$	49.9 $\Omega$ to 100K $\Omega$	1/4W	4
T9-55	RN55E	Stamp	.1, .5, 1 <sup>5</sup>	25	1/4 @ 70 $^{\circ}$ C	1/10 @ 125 $^{\circ}$ C	200	10 $\Omega$ to 3.01M $\Omega$	49.9 $\Omega$ to 100K $\Omega$	1/4W	4
TO-60	RN60D	Band/Stamp	.1, .5, 1 <sup>5</sup>	100	3/4 @ 70 $^{\circ}$ C	1/4 @ 70 $^{\circ}$ C	300	10 $\Omega$ to 3.01M $\Omega$	10 $\Omega$ to 1M $\Omega$	1/2W	6
T2-60	RN60C	Stamp	.1, .5, 1 <sup>5</sup>	50	1/2 @ 70 $^{\circ}$ C	1/8 @ 125 $^{\circ}$ C	250	10 $\Omega$ to 3.01M $\Omega$	49.9 $\Omega$ to 499K $\Omega$	1/2W	6
T9-60	RN60E	Stamp	.1, .5, 1 <sup>5</sup>	25	1/2 @ 70 $^{\circ}$ C	1/8 @ 125 $^{\circ}$ C	250	10 $\Omega$ to 3.01M $\Omega$	49.9 $\Omega$ to 499K $\Omega$	1/2W	6
TO-65	RN65D	Band/Stamp	.1, .5, 1 <sup>5</sup>	100	1 @ 70 $^{\circ}$ C	1/2 @ 70 $^{\circ}$ C	350	10 $\Omega$ to 3.01M $\Omega$	10 $\Omega$ to 1M $\Omega$	1W	8
T2-65	RN65C	Stamp	.1, .5, 1 <sup>5</sup>	50	1/2 @ 70 $^{\circ}$ C	1/4 @ 125 $^{\circ}$ C	300	10 $\Omega$ to 3.01M $\Omega$	49.9 $\Omega$ to 1M $\Omega$	1W	8
T9-65	RN65E	Stamp	.1, .5, 1 <sup>5</sup>	25	1/2 @ 70 $^{\circ}$ C	1/4 @ 125 $^{\circ}$ C	300	10 $\Omega$ to 3.01M $\Omega$	49.9 $\Omega$ to 1M $\Omega$	1W	8
TH50 <sup>1</sup>	RNC50H/S <sup>2</sup>	Stamp	1	50	1/20 @ 125 $^{\circ}$ C	1/20 @ 125 $^{\circ}$ C	200	10 $\Omega$ to 301K $\Omega$	10 $\Omega$ to 301K $\Omega$	1/8W	3
TK50 <sup>1</sup>	RNC50K/S <sup>2</sup>	Stamp	1	100	1/20 @ 125 $^{\circ}$ C	1/20 @ 125 $^{\circ}$ C	200	10 $\Omega$ to 301K $\Omega$	10 $\Omega$ to 301K $\Omega$	1/8W	3
TJ50 <sup>1</sup>	RNC50J/S <sup>2</sup>	Stamp	1	25	1/20 @ 125 $^{\circ}$ C	1/20 @ 125 $^{\circ}$ C	200	10 $\Omega$ to 301K $\Omega$	10 $\Omega$ to 301K $\Omega$	1/8W	3
TH55	RNC55H/S <sup>2</sup>	Stamp	.1, .5, 1 <sup>4</sup>	50	1/10 @ 125 $^{\circ}$ C	1/10 @ 125 $^{\circ}$ C	200	10 $\Omega$ to 2M $\Omega$	10 $\Omega$ to 2M $\Omega$	1/4W	4
TK55	RNC55K/S <sup>2</sup>	Stamp	.1, .5, 1 <sup>4</sup>	100	1/10 @ 125 $^{\circ}$ C	1/10 @ 125 $^{\circ}$ C	200	10 $\Omega$ to 2M $\Omega$	10 $\Omega$ to 2M $\Omega$	1/4W	4
TJ55	RNC55J/S <sup>2</sup>	Stamp	.1, .5, 1 <sup>4</sup>	25	1/10 @ 125 $^{\circ}$ C	1/10 @ 125 $^{\circ}$ C	200	10 $\Omega$ to 2M $\Omega$	10 $\Omega$ to 2M $\Omega$	1/4W	4
TH60	RNC60H/S <sup>2</sup>	Stamp	.1, .5, 1 <sup>5</sup>	50	1/8 @ 125 $^{\circ}$ C	1/8 @ 125 $^{\circ}$ C	250	10 $\Omega$ to 3.01M $\Omega$	10 $\Omega$ to 3M $\Omega$	1/2W	6
TK60	RNC60K/S <sup>2</sup>	Stamp	.1, .5, 1 <sup>5</sup>	100	1/8 @ 125 $^{\circ}$ C	1/8 @ 125 $^{\circ}$ C	250	10 $\Omega$ to 3.01M $\Omega$	10 $\Omega$ to 3.01M $\Omega$	1/2W	6
TJ60	RNC60J/S <sup>2</sup>	Stamp	.1, .5, 1 <sup>5</sup>	25	1/8 @ 125 $^{\circ}$ C	1/8 @ 125 $^{\circ}$ C	250	10 $\Omega$ to 3.01M $\Omega$	10 $\Omega$ to 3.01M $\Omega$	1/2W	6
TH65	RNC65H/S <sup>2</sup>	Stamp	.1, .5, 1 <sup>6</sup>	50	1/4 @ 125 $^{\circ}$ C	1/4 @ 125 $^{\circ}$ C	300	10 $\Omega$ to 3.01M $\Omega$	10 $\Omega$ to 3.01M $\Omega$	1W	8
TK65	RNC65K/S <sup>2</sup>	Stamp	.1, .5, 1 <sup>6</sup>	100	1/4 @ 125 $^{\circ}$ C	1/4 @ 125 $^{\circ}$ C	300	10 $\Omega$ to 3.01M $\Omega$	10 $\Omega$ to 3.01M $\Omega$	1W	8
TJ65	RNC65J/S <sup>2</sup>	Stamp	.1, .5, 1 <sup>6</sup>	25	1/4 @ 125 $^{\circ}$ C	1/4 @ 125 $^{\circ}$ C	300	10 $\Omega$ to 3.01M $\Omega$	10 $\Omega$ to 3.01M $\Omega$	1W	8

<sup>1</sup>Conformally coated construction on all 1/8W nominal size resistors.

<sup>2</sup>Failure rate symbol; S = .001%/1000 Hours at 60 $^{\circ}$  Conf.

<sup>3</sup>Contact factory for details of flame-resistant specifications.

<sup>4</sup>Only available in F tolerance above 1M $\Omega$ .

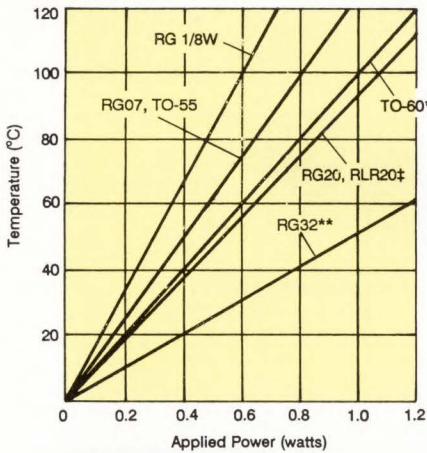
<sup>5</sup>Only available in F tolerance above 2M $\Omega$ .

<sup>6</sup>Only available in F tolerance below 49.9 $\Omega$  and above 2M $\Omega$ .

<sup>7</sup>Contact factory for values above 5.1M $\Omega$

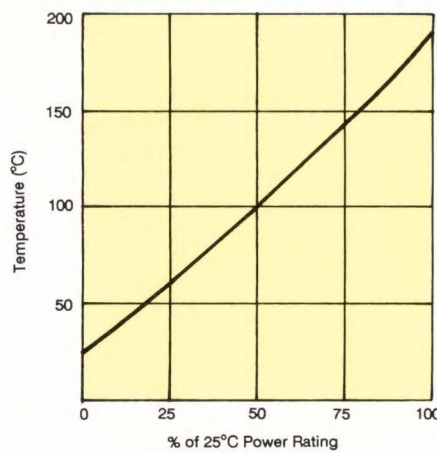


### RG "TO" FILM TEMPERATURE RISE

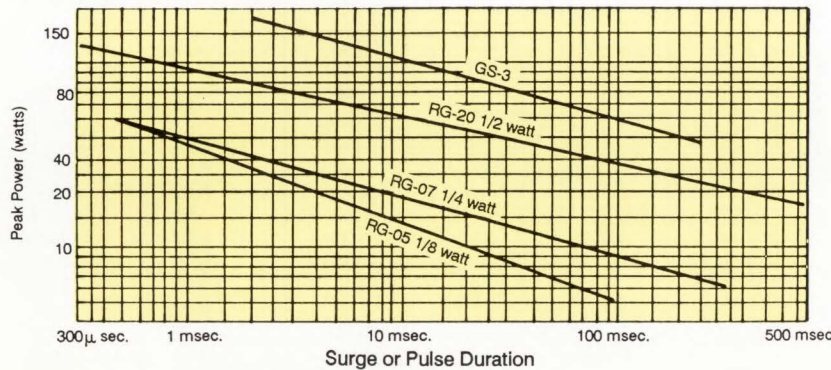


\*.025 in. leads  
 †.032 in. leads  
 \*\*.040 in. leads

### GS-3 SURFACE TEMPERATURE RISE

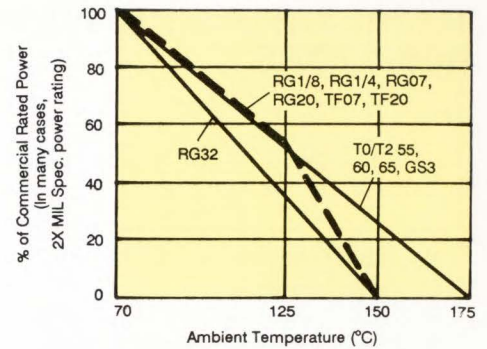


### SURGE CAPABILITY

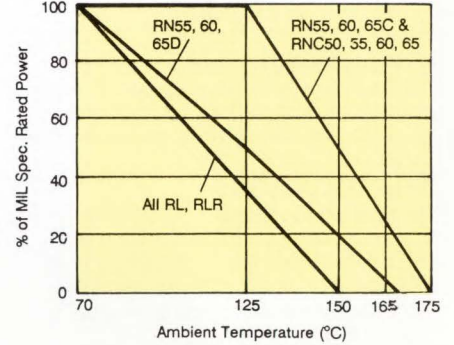


Note: Average power dissipation is not to exceed the component power rating at 70°C

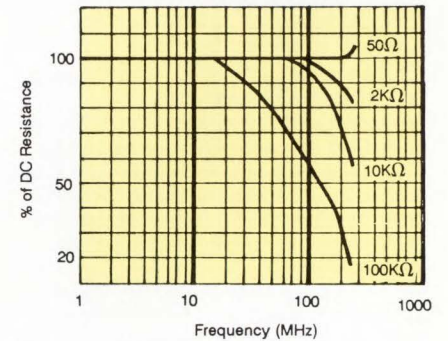
### COMMERCIAL POWER DERATING



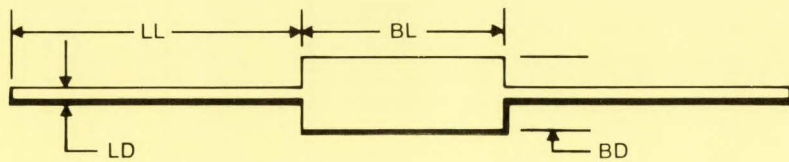
### MIL SPEC POWER DERATING



### RG1/4 HIGH-FREQUENCY CHARACTERISTICS



### DIMENSIONS - IN. and (mm)



Dim Code	Nominal Size	Body Length BL (mm)	Body Diameter BD (mm)	Lead Length LL (mm)	Lead Diameter LD (mm)	Clean Lead (mm)
1	1/8 watt	0.150 ± 0.020 (3.8 ± 0.3)	0.066 ± 0.008 (1.7 ± 0.2)	1.00 ± 0.125 (25.4 ± 3.2)	0.016 ± .002 (0.41 ± .05)	0.225 (5.7)
2	1/8 watt RLR05	0.150 ± 0.020 (3.8 ± 0.3)	0.066 ± 0.008 (1.7 ± 0.2)	1.00 ± 0.125 (25.4 ± 3.2)	0.016 ± .002 (0.41 ± .05)	0.187 (4.7)
3	1/8 watt RNC50	0.150 ± 0.020 (3.8 ± 0.3)	0.074 ± 0.006 (1.9 ± 0.13)	1.00 ± 0.125 (25.4 ± 3.2)	0.016 ± .002 (0.41 ± .05)	0.225 (5.7)
4	1/4 watt	0.250 ± 0.015 (6.4 ± 0.4)	0.090 ± 0.008 (2.3 ± 0.2)	1.50 ± 0.125 (38.1 ± 3.2)	0.025 ± .002 (0.64 ± .05)	0.310 (7.9)
5	1/2 watt	0.390 ± 0.010 (9.9 ± 0.3)	0.140 ± 0.008 (3.6 ± 0.2)	1.50 ± 0.125 (38.1 ± 3.2)	0.032 ± .002 (0.81 ± .05)	0.450 (11.4)
6	1/2 watt	0.390 ± 0.010 (9.9 ± 0.3)	0.140 ± 0.008 (3.6 ± 0.2)	1.50 ± 0.125 (38.1 ± 3.2)	0.025 ± .002 (0.64 ± .05)	0.450 (11.4)
7	1 watt	0.562 ± 0.031 (14.3 ± 0.8)	0.190 ± 0.008 (4.8 ± 0.2)	1.50 ± 0.125 (38.1 ± 3.2)	0.040 ± .002 (1.02 ± .05)	0.682 (17.3)
8	1 watt	0.562 ± 0.031 (14.3 ± 0.8)	0.190 ± 0.008 (4.8 ± 0.2)	1.50 ± 0.125 (38.1 ± 3.2)	0.025 ± .002 (0.64 ± .05)	0.682 (17.3)
9	3 watt	0.515 ± .010 (13.1 ± 0.3)	0.225 ± .008 (5.7 ± 0.2)	1.50 ± 0.125 (38.1 ± 3.2)	0.032 ± .002 (0.81 ± .05)	0.575 (14.6)

**ESTABLISHED RELIABILITY MIL SPECIFICATIONS**  
 RLR and RNC products listed above are qualified to the appropriate established reliability MIL Specification.

### HOW TO ORDER

Sample Part No.:

**RG1/4 - 220K - 5%**

**IRC Type**  
 See specification table for types available.

**Resistance**  
 Standard EIA/MIL resistance values for metal film resistors. See specification table for range.

**Tolerance**  
 ±0.1% to ±5%  
 See specification table for availability.





# THICK FILM TEMPERATURE COMPENSATION RESISTORS

## RGT SERIES

- Negative temperature Coefficient
- Superior Linearity
- Effective compensation for positive TC devices, semiconductors, & copper
- Ultra miniature
- Stable thick-film technology



### APPLICATIONS

Compensates transistors, diodes, sensors, transducers, hall devices, microprocessors, strain gauges. Proven in automotive under-hood use.

### SPECIFICATIONS

Temperature Coefficient:  $-0.30\%/^{\circ}\text{C}$   
(minus 3000 ppm/ $^{\circ}\text{C}$  @  $25^{\circ}\text{C}$ )

Resistance Ratio:  $R_{25^{\circ}\text{C}}/R_{125^{\circ}\text{C}} = 1.37$

Linearity: Less than 1.2% deviation per  $100^{\circ}\text{C}$  (typical over range from  $-55^{\circ}\text{C}$  to  $+175^{\circ}\text{C}$ )

Standard Resistance Values @  $25^{\circ}\text{C}$ :

740 $\Omega$ , 1K $\Omega$  and 10K $\Omega$ . Others available.

Standard Resistance Tolerance @  $25^{\circ}\text{C}$ :

$\pm 2\%$ ,  $\pm 5\%$ ,  $\pm 10\%$

Operating Temperature Range:

$-55^{\circ}\text{C}$  to  $+175^{\circ}\text{C}$

High Temperature Stability: 2000 Hours at  $175^{\circ}\text{C}$ , less than 0.5%  $\Delta R$

Time Constants: 7.4 sec for RGT-1, 2.9 sec for RGT-2 (Time to achieve 63.2% of an applied step-change in temperature in still air)

Dissipation Constants: 8.1 mW/ $^{\circ}\text{C}$  for RGT-1, 4.7 mW/ $^{\circ}\text{C}$  for RGT-2 (Power required to raise sensor temperature  $1^{\circ}\text{C}$  in a still air ambient of  $25^{\circ}\text{C}$ )

Element: Fused thick-film composition

Substrate: Solid-core alumina ceramic

Lead Pull: 5 pounds for 5 sec.

Resistance to Soldering Heat:  $350^{\circ}\text{C}$  for 3.5 sec. (MIL-STD-202E, Method 210A, Cond. A, 5%  $\Delta R$ )

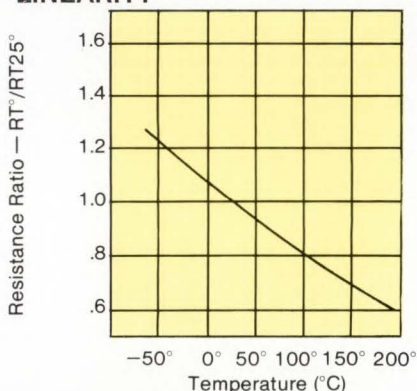
Lead Solderability:  $230^{\circ}\text{C}$  for 5 sec.

(MIL-STD-202, Method 208)

Marking Resistance to Solvents:

MIL-STD-202 Method 215

### LINEARITY



### CURVE TOLERANCES ( $\pm$ )

Temperature	G Tol.	J Tol.	K Tol.
$-55^{\circ}\text{C}$ $-67^{\circ}\text{F}$	7%	10%	15%
$-15^{\circ}\text{C}$ $+9^{\circ}\text{F}$	4.5%	7.5%	12.5%
$0^{\circ}\text{C}$ $+32^{\circ}\text{F}$	3.6%	6.6%	11.6%
$25^{\circ}\text{C}$ $77^{\circ}\text{F}$	$\pm 2\%$	$\pm 5\%$	$\pm 10\%$
$50^{\circ}\text{C}$ $122^{\circ}\text{F}$	2.5%	5.5%	10.5%
$75^{\circ}\text{C}$ $167^{\circ}\text{F}$	3.0%	6.0%	11.0%
$100^{\circ}\text{C}$ $212^{\circ}\text{F}$	3.5%	6.5%	11.5%
$125^{\circ}\text{C}$ $257^{\circ}\text{F}$	4.0%	7.0%	12.0%
$150^{\circ}\text{C}$ $302^{\circ}\text{F}$	4.5%	7.5%	12.5%
$175^{\circ}\text{C}$ $347^{\circ}\text{F}$	5%	8%	13%

### RESISTANCE VS TEMPERATURE

$^{\circ}\text{C}$	$^{\circ}\text{F}$	R in $\Omega$ 's*
-60	-76	1285.2
-40	-40	1208.5
-30	-22	1173.4
-20	-4	1139.3
-10	+14	1106.3
0	+32	1074.6
+10	+50	1044.1
+20	+68	1014.6
+25	+77	1000.0
+30	+86	985.5
+40	+104	956.7
+50	+122	928.2
+60	+140	900.2
+70	+158	872.3
+75	+167	858.7
+80	+176	845.2
+90	+194	818.8
+100	+212	793.2
+110	+230	768.5
+120	+248	745.1
+125	+257	734.0
+130	+266	723.2
+140	+284	703.7
+150	+302	685.8
+160	+320	669.3
+170	+338	653.8
+180	+356	639.7
+230	+446	582.9

\*Based on actual measurements of resistors that were 1000 ohms at  $25^{\circ}\text{C}$

### HOW TO ORDER

Sample Part No.:

RGT - 2 - 103 - G

IRC Type

Size

See 2 sizes available at left

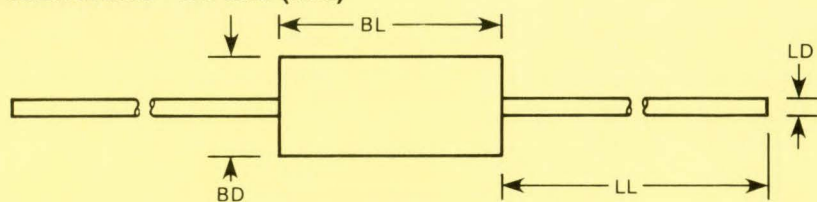
Resistance Value

2 Digit range and 1 Digit Multiplier

Tolerance

G = 2%, J = 5%, K = 10%

### DIMENSIONS - IN. and (mm)



IRC Type	Body Length BL	Body Diameter BD	Lead Diameter LD	Lead Length LL
RGT-2	.150 (3.81)	.066 (1.70)	.016 (0.41)	1.0 (25.4)
RGT-1	.250 (6.35)	.090 (2.29)	.025 (0.64)	1.5 (38.1)





**RADIAL LEAD  
MOLDED  
METAL GLAZE  
RESISTORS**

**RGU SERIES\***

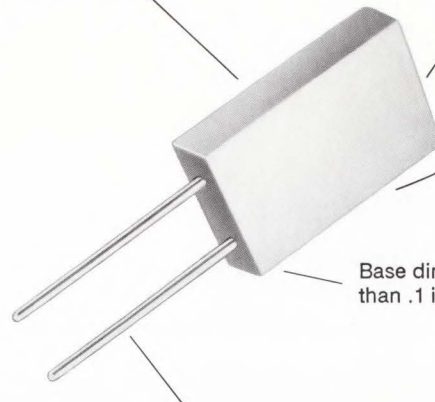
- Take up half the PC board area of comparably rated axial-lead resistors
- Project 0.39 in. from the board surface when installed
- Can be placed individually, or grouped in rows, in any direction on standard predrilled PC boards
- Available on carrier tape and are auto-insertable with existing equipment

\*Manufactured in West Germany

Contains Metal Glaze thick film element fired at high temperatures on an alumina slug

Four-band color code on top for easy identification

Rectangular, molded synthetic resin case



Base dimensions slightly less than .1 in. wide by .2 in. long

Leads spaced on .1 in. centers

**SPECIFICATIONS**

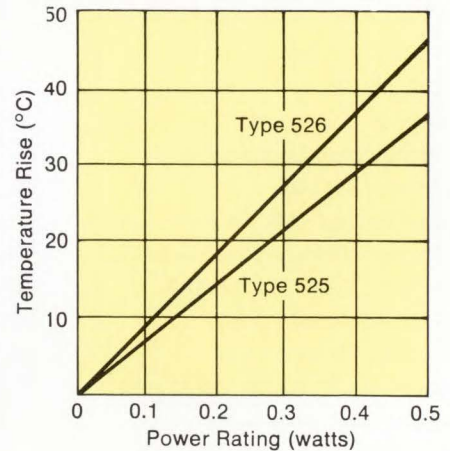
Resistance Range:  
10 ohms to 1 megohm  
Tolerance (E96, E24):  
± 1%, ± 2%, ± 5%  
Temperature Coefficient:  
± 50, ± 100 ppm/°C  
Voltage Coefficient:  
Less than 30 ppm/V  
Max. Continuous Working Voltage:  
350V RMS  
Dielectric Withstanding Voltage:  
1000V RMS min.  
Insulation Resistance:  
Greater than 10<sup>4</sup> Megohms, except top surface  
Power Rating: 1/2 watt at 70°C

Temperature Range:  
-55°C to +155°C for 56 days,  
-65°C to 75°C  
Stability 70°C, 5000 h: ± 0.5%  
Damp Heat steady State (40°C, 90 to 95% R.H., 56 days, 5 VDC):  
1.0%  
Failure Rate (V<sup>0</sup> = 155°C):  
x 10<sup>9</sup>/h

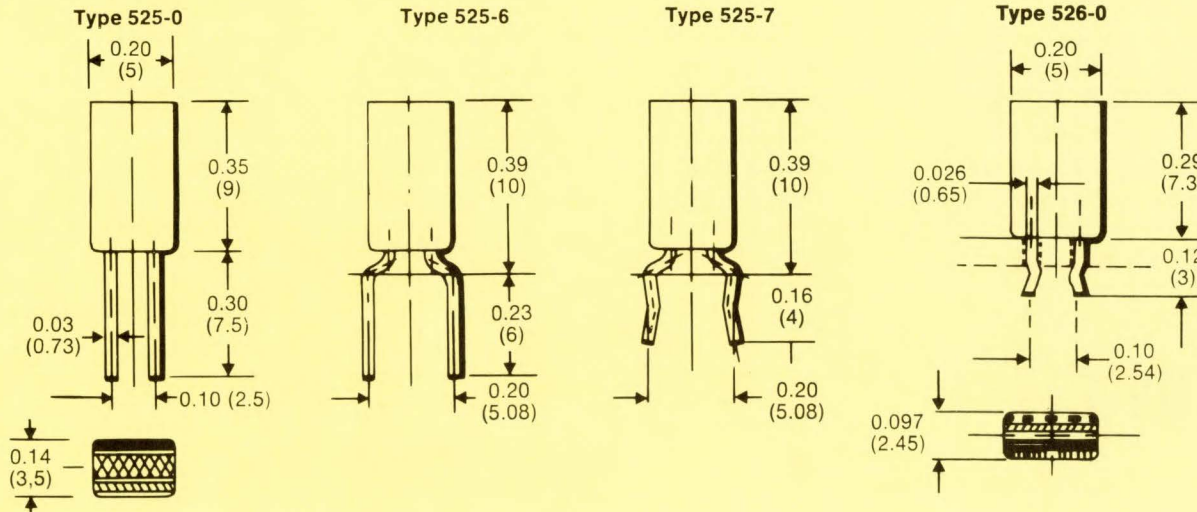
**STANDARDS**

Electrical properties according to MIL-R-22684

**TEMPERATURE RISE**



**DIMENSIONS - IN. and (mm)**



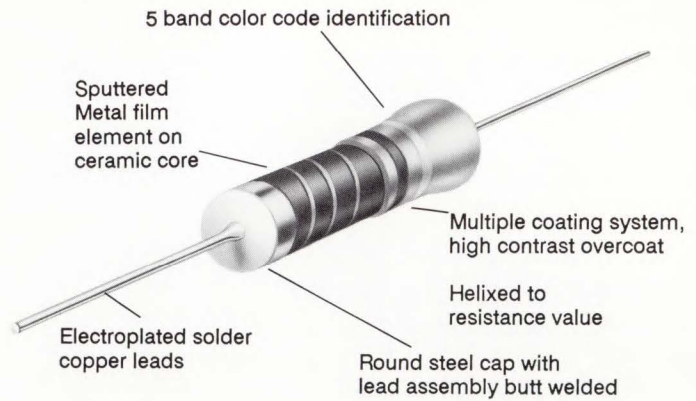




# RN GENERAL-PURPOSE EQUIVALENT METAL FILM

## GP SERIES \*

- Metal film stability
- ± 1% tolerance standard- 2%, 5% available
- ± 50 ppm/°C, ± 100 ppm/°C T.C.
- 10 ohm to 1 megohm
- Meets or exceeds MIL-R-10509 and R-22684
- E.I.A. Standard Color Code System



### SPECIFICATIONS

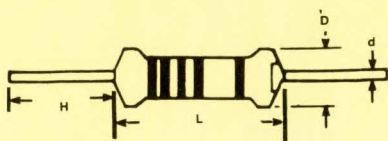
Type	GP50 1/8W	GP55 1/4W	GP60 1/2W	GP65 1W	GP70 2W
Resistance, Standard @ 100 ppm	51.1Ω - 511K	10Ω - 1M	10Ω - .2M	5.11Ω - 1M	5.11Ω - 5.11M
Tolerances, Standard	1%	1%	1%	1%	1%
Power Rating	1/8W	1/4W	1/2W	1W	2W
Maximum Continuous Working Voltage	200	250	350	500	500

Test		GP Series % Change in Resistance (ΔR)					Mil-R-22684 Style RL Requirement	Mil-R-10509 Chart C, B Requirement
		GP50	GP55	GP60	GP65	GP70		
1. Temperature Cycling, -65°C to +150°C	(%)	± 0.25	± 0.25	± 0.25	± 0.25	± 0.25	≤ 1.00	≤ 0.50
2. Low Temperature Operation, -65°C	(%)	± 0.25	± 0.25	± 0.25	± 0.25	± 0.25	≤ 0.50	≤ 0.50
3. Short Time Overload	(%)	± 0.25	± 0.25	± 0.25	± 0.25	± 0.25	≤ 0.50	≤ 0.50
4. Terminal Strength, 5lb. pull	(%)	± 0.20	± 0.20	± 0.20	± 0.15	± 0.15	≤ 0.50	≤ 0.20
5. Resistance to Soldering Heat, +350°C	(%)	± 0.25	± 0.25	± 0.25	± 0.25	± 0.25	≤ 0.50	≤ 0.50
6. Moisture Resistance, Mil Std 202	(%)	± 1.0	± 1.0	± 1.0	± 1.0	± 1.0	≤ 1.50	≤ 1.50
7. Life 1000 hrs (Rated Power)	(%)	± 1.0	± 1.0	± 1.0	± 1.0	± 1.0	≤ 2.00	≤ 1.00
8. Shock, 50G, 11ms	(%)	± 0.25	± 0.25	± 0.25	± 0.25	± 0.25	≤ 0.50	≤ 0.50
9. Vibration-High Frequency, 10-2000 Hz	(%)	± 0.25	± 0.25	± 0.25	± 0.25	± 0.25	≤ 0.50	≤ 0.50
10. Insulation Resistance		≥ 10 <sup>10</sup> Ω	≥ 10 <sup>10</sup> Ω	≥ 10 <sup>10</sup> Ω	≥ 10 <sup>10</sup> Ω	≥ 10 <sup>10</sup> Ω	≥ 10 <sup>9</sup> Ω	≥ 10 <sup>9</sup> Ω
11. Failure-Rate		< 10 <sup>8</sup> /h	< 10 <sup>8</sup> /h	< 10 <sup>8</sup> /h	< 10 <sup>8</sup> /h	< 10 <sup>8</sup> /h		

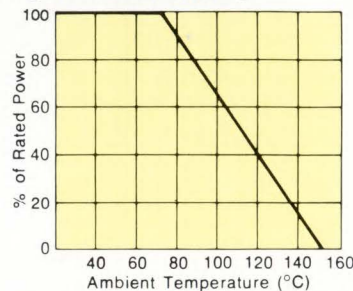
### DIMENSION IN & (mm)

Type	L	D	H	d
GP50	.150 ± .008 (3.8 ± 0.2)	.059 ± .008 (1.5 ± 0.2)	1.1 ± .12 (28 ± 3.0)	.018 (0.45)
GP55	.256 ± .020 (6.5 ± 0.5)	.091 ± .012 (2.3 ± 0.3)	1.1 ± .08 (28 ± 2.0)	.024 (0.60)
GP60	.374 ± .020 (9.5 ± 0.5)	.126 ± .020 (3.2 ± 0.5)	1.1 ± .08 (28 ± 2.0)	.024 (0.60)
GP65	.512 ± .039 (13 ± 1.0)	.177 ± .020 (4.5 ± 0.5)	1.5 ± .12 (38 ± 3.0)	.031 (0.80)
GP70	.669 ± .039 (17 ± 1.0)	.217 ± .028 (5.5 ± 0.5)	1.5 ± .12 (38 ± 3.0)	.031 (0.80)

### DIMENSIONS - IN and (mm)



### POWER DERATING



### HOW TO ORDER

Sample Part No.:

GP55 - TX - XXXX - 1%

IRC Type

TC T0 = 100 ppm

T2 = 50 ppm

Resistance Value

Standard MIL resistance code

Tolerance

\*Made in Far East

INTERNATIONAL RESISTIVE COMPANY, INC.

59 P.O. Box 1860, Greenway Road • Boone, NC 28607.1860 • 704-264-8861 or 1-800-255-4-IRC • TLX: 46.9902



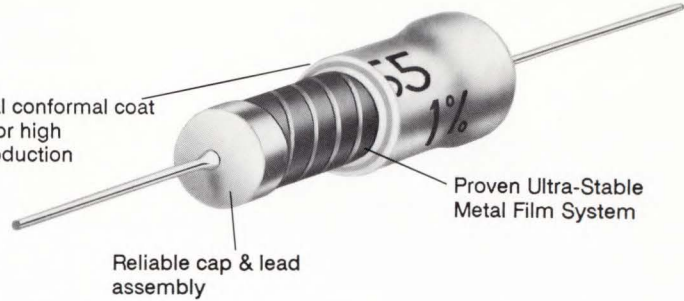


# LOW TC INDUSTRIAL PRECISION METAL FILM RESISTOR

## CM55 SERIES

- Cost effective
- Proven conformal coating system
- Proven IRC metal film stability
- High volume production capacity
- Reduced size for greater board density

Economical conformal coat designed for high volume production



Proven Ultra-Stable Metal Film System

Reliable cap & lead assembly

### SPECIFICATIONS

The cost effective CM Series of resistors is a result of proven IRC resistive film technology combined with state of the art high speed production equipment, and the latest resistance measurement systems. Performance is documented by extensive environmental test data.

The series utilizes an improved sputtered film system and mechanically superior cap and lead construction. CMs offer the most cost effective solution to ultra stable circuit needs. This product line covers virtually all

tolerances, and temperature coefficients, required for precision resistor applications.

Matched sets of CM Series resistors provide the ultimate in resistor matching and temperature coefficient tracking. Matched sets with  $\pm .01\%$  ratio tolerance and  $\pm 2$  ppm/ $^{\circ}\text{C}$  temperature coefficient tracking are available. Consult your IRC Sales Office for details.

RESISTANCE RANGE:

10 $\Omega$  to 5 Meg $\Omega$ (see chart below)

TEMPERATURE COEFFICIENT:

5 ppm/ $^{\circ}\text{C}$  to 100 ppm/ $^{\circ}\text{C}$   
(see chart below)

POWER RATING:

1/10 watt @ 85 $^{\circ}\text{C}$   
(see Power Derating chart)

MAXIMUM WORKING VOLTAGE: 250 VDC

TEMPERATURE RANGE:

- 55 $^{\circ}\text{C}$  to 150 $^{\circ}\text{C}$

### RESISTANCE RANGE VS. TEMPERATURE COEFFICIENT

TCR, ppm/ $^{\circ}\text{C}$	5	10	15	25	100
Resistance Range, $\Omega$	10 - 300K	10 - 350K	10 - 500K	10 - 1 Meg	10 - 5 Meg

### CM MATCHED SETS

Ratio to Master	TC Tracking to Master	Ratio Accuracy
1:1	2 ppm	.01%
10:1	2 ppm	.02%
100:1	2 ppm	.02%
1000:1	4 ppm	.04%

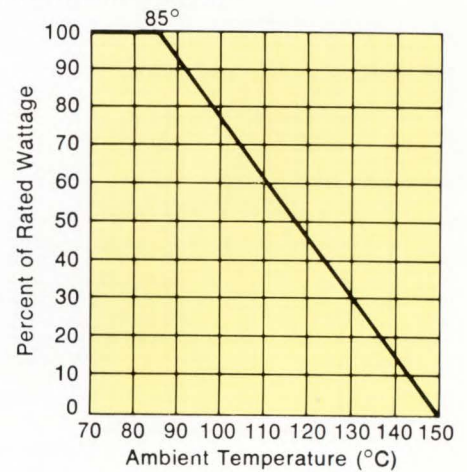
Absolute TC and tolerance per product used. Tracking over the temp. range 0 $^{\circ}$  to 70 $^{\circ}\text{C}$ .

Custom screening of sets available -

### PERFORMANCE DATA

Test Conditions Per MIL-R-55182, Except Where Noted	Typical $\Delta R$
1,000 Hour Loadlife (Rated Power @ 85 $^{\circ}\text{C}$ )	$\pm 0.02$
Humidity	$\pm 0.04$
Thermal Shock (Tested Per Method 107, MIL-STD 202, Condition F)	$\pm 0.01$
Effect of Solder (Tested Per Method 210, MIL-STD 202)	$\pm 0.01$
Dielectric Withstanding	$\pm 0.01$
Shock and Vibration	+ 0.01
Short Time Overload	+ 0.01
Insulation Resistance	10,000 Meg
Noise Index	- 30 dB
Voltage Coefficient	.05 ppm/Volt
1-Year Shelf Life	$\pm 50$ ppm

### POWER DERATING



### HOW TO ORDER

Sample Part No.:

**CM55 T13 100K 0.1%**

IRC Type  
CM55

TC

T16 (5 ppm)      T9 (25 ppm)  
T13 (10 ppm)    T2 (50 ppm)  
T10 (15 ppm)    T0 (100 ppm)

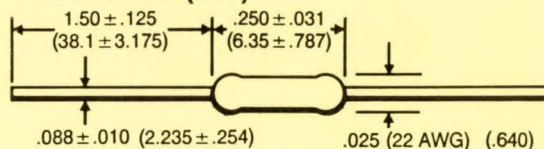
Resistance

Standard EIA/MIL values for metal film resistors, see specification table

Tolerances

.01%, .05%, .1%, .25%, .5% and 1%

### DIMENSIONS - INCHES and (mm)



### PACKAGING:

Bulk Package: 250/Pack Lead Tape & Reel: Per EIA Spec RS-296D. Special lead tape & reel and anti static packaging available; consult factory.

INTERNATIONAL RESISTIVE COMPANY, INC.

P.O. Box 1860, Greenway Road • Boone, NC 28607.1860 • 704-264-8861 or 1-800-255-4-IRC • TLX: 46.9902

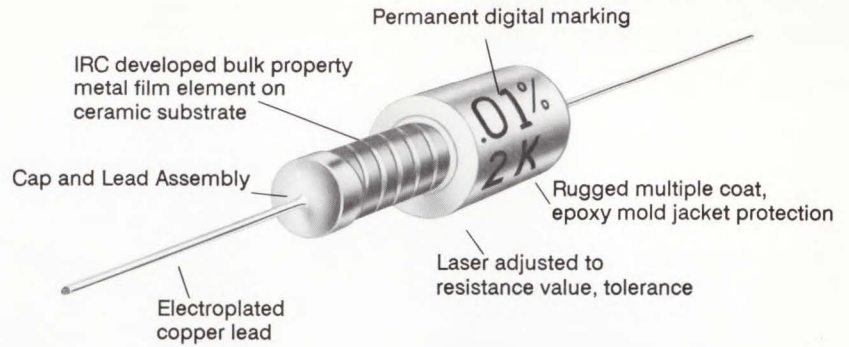




# ULTRA-PRECISION METAL FILM RESISTOR

## MAR SERIES

- High reliability
- Ultra low temperature coefficient
- Non-measurable noise
- Superior moisture performance
- Tailored or standard values
- Highest stability metal film available
- Matched sets and networks



The MAR resistors meet the need for an ultra precision metal film resistor with characteristics that are superior to other precision resistor techniques. Among these are higher reliability, lower inductance, smaller size for a given power rating, and cost effectiveness.

Proprietary organic undercoats and void free mold jacket provides superior protection for the harshest manufacturing environment. This rugged enclosure system assures long term installed stability and reliability. Matched sets of MAR resistors are available, which provides the ultimate in

resistor tolerance matching and temperature tracking. Resistance matching to  $\pm .005\%$  and temperature coefficient tracking as low as  $\pm 1$  ppm/ $^{\circ}\text{C}$  in modular assemblies of resistors.

### SPECIFICATIONS

IRC Model	Resistance Range ( $\Omega$ ) by Tolerance Class		Resistance Range ( $\Omega$ ) by TCR Class					Power Rating @ 85°C	Voltage Rating
	1 - .1%	.05 - .01%	T2	T9	T10	T13	T16		
MAR3	10-1M	10-150K	10-1M	10-750K	10-250K	10-150K	10-125K	1/20W	200 V
MAR5	10-3M	10-250K	10-3M	10-1.5M	10-500K	10-350K	10-300K	1/10W	250 V
MAR6	10-5M	10-500K	10-5M	10-3M	10-1M	10-700K	10-500K	1/8 W	300 V
MAR7	10-10M	10-1M	10-10M	10-5M	10-3.5M	10-1.5M	10-1M	1/4 W	500 V

### DIMENSIONS - IN. and (mm)

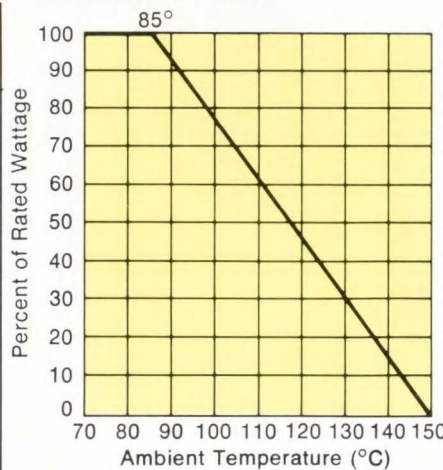
IRC Model	Body Length BL	Body Dia. BD	Lead Length LL	Lead Diameter LD
MAR3	.191 (4.85)	.082 (2.08)	1.00 $\pm$ .062 (25.4 $\pm$ 1.57)	.016 (.406)
MAR5	.281 (7.14)	.102 (2.59)	1.50 $\pm$ .125 (38.1 $\pm$ 3.18)	.025 (.635)
MAR6	.425 (10.8)	.155 (3.94)	1.50 $\pm$ .125 (38.1 $\pm$ 3.18)	.025 (.635)
MAR7	.650 (16.5)	.195 (4.95)	1.50 $\pm$ .125 (38.1 $\pm$ 3.18)	.025 (.635)

\*The MAR5 resistor is qualified to Characteristics H, J and K and to Tolerances B, D and F of MIL-R-55182 (E). Approved resistance range is 49.9 $\Omega$  to 150K $\Omega$ . Higher resistance ranges are available; consult factory.

### PERFORMANCE DATA

Test Conditions Per MIL-R-055182, Except Where Noted	Typical $\Delta R\%$
1,000 Hour Loadlife (rated power @ 85°C)	$\pm 0.02$
Humidity	$\pm 0.04$
Thermal Shock (tested per method 107, MIL-STD 202, Condition F)	$\pm 0.01$
Effect of Solder (tested per method 210, MIL-STD 202)	$\pm 0.01$
Dielectric Withstanding	$\pm 0.01$
Shock and Vibration	+0.01
Short Time Overload	+0.01
Insulation Resistance	10,000 Meg
Noise Index	< -30 dB
Voltage Coefficient	< .05 ppm/Volt
1-Year Shelf Life	$\pm 30$ ppm

### POWER DERATING



### HOW TO ORDER

Sample Part No.:

**MAR6 - T16 - 15K - 0.02%**

#### IRC

MAR3 (1/20 watt at 85°C),  
MAR5 (1/10 watt at 85°C),  
MAR6 (1/8 watt at 85°C) or  
MAR7 (1/4 watt at 85°C).

#### TC

T16 ( $\pm 5$  ppm/ $^{\circ}\text{C}$ )  
T13 ( $\pm 10$  ppm/ $^{\circ}\text{C}$ )  
T10 ( $\pm 15$  ppm/ $^{\circ}\text{C}$ )  
T9 ( $\pm 25$  ppm/ $^{\circ}\text{C}$ )  
T2 ( $\pm 50$  ppm/ $^{\circ}\text{C}$ )

#### Resistance

Standard EIA/MIL values for metal film resistors. See specification table for range.

#### Tolerance

$\pm 0.01\%$ ,  $\pm 0.02\%$ ,  $\pm 0.05\%$ ,  $\pm 0.1\%$ ,  
 $\pm 0.2\%$ ,  $\pm 0.25\%$ ,  $\pm 0.5\%$ , 1%  
See specification table for availability.





# ULTRA-PRECISION METAL FILM RESISTORS

## MAR40 SERIES

- High power ultra-precision resistor
- Tight temperature coefficient
- High reliability construction
- Tolerance to  $\pm 0.005\%$
- Rugged solid epoxy encapsulation
- Custom reliability screening available



NOTE: See MAR Series for construction features.

The MAR40 Series of ultra-precision resistors combines the benefits of proven IRC metal film reliability, non-measurable noise, and superior frequency response with very low temperature characteristics, convenient radial lead design, and efficient use of printed circuit board "real estate".

The shelf life and load life stability characteristics are derived from our expertise with

the MAR Series of axial leaded resistors. The physical size coincides nicely with the military standard RNC90. The internal construction utilizes the high reliability, "end cap" technology of the MAR. In short, the design engineers can take an effective step towards product reliability and long, service-free life, by specifying the MAR40. The MAR40 may be specified to any custom value needed and/or purchased in matched

sets with tolerances placed on the nominal ratios and close tracking of temperature coefficients.

The MAR40 ultra-precision resistor can be made to exact specifications without the usual delays in delivery of prototypes. The flexibility of the MAR40 manufacturing process allows quick response to customer delivery.

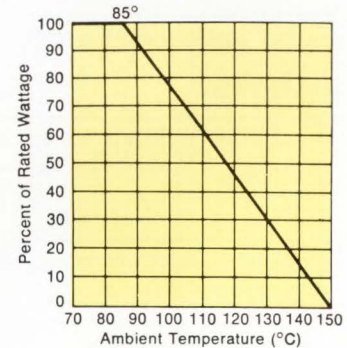
### SPECIFICATIONS

IRC Type	TC Code	Standard Temperature Coefficient		Standard Resistance Range (ohms)	Resistance Tolerance	Power Rating @ 85°C (watts)	Voltage Rating (volts)
		0 $\pm$ 5 ppm/°C 0 $\pm$ 10 ppm/°C	0 to 60°C -55° to 125°C				
MAR40	T16	0 $\pm$ 5 ppm/°C 0 $\pm$ 10 ppm/°C	0 to 60°C -55° to 125°C	20-250K	0.005, 0.01, 0.02, 0.05, 0.1, 0.25, 0.5, 1.0	0.3	250
MAR40	T18	0 $\pm$ 2 ppm/°C 0 $\pm$ 5 ppm/°C	0 to 60°C -55° to 125°C	20-250K			

### PERFORMANCE DATA

Test Conditions per MIL-R-55182, Except where noted	Typical $\Delta R\%$
1000 Hour loadlife (Rated power at 85°C)	$\pm 0.02$
Humidity	$\pm 0.04$
Thermal Shock	$\pm 0.01$
(Tested Per Method 107, MIL-STD 202, Condition F)	
Effect of Solder (Tested Per Method 210, MIL-STD 202)	$\pm 0.01$
Dielectric Withstanding Voltage	$\pm 0.01$
Shock and Vibration	$\pm 0.01$
Short Time Overload	$\pm 0.01$
Insulation Resistance	10,000 Meg
Noise Index	-30 dB
Voltage Coefficient	0.05 ppm/Volt
1-Year Shelf Life	$\pm 30$ ppm

### POWER DERATING



### HOW TO ORDER

Sample Part No.:

**MAR40 - T16 - 91K - 0.02%**

IRC Type

Temperature Coefficient

T16 ( $\pm 5$  ppm),  
T18 ( $\pm 2$  ppm)

Resistance Ranges

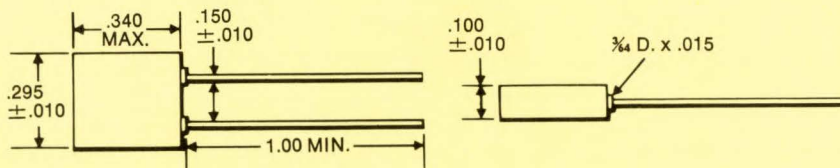
See table above

Tolerance

$\pm 1\%$ ,  $\pm 5\%$ ,  $\pm .25\%$ ,  $\pm .1\%$   
 $\pm .05\%$ ,  $\pm .02\%$ ,  $\pm .01\%$ ,  $\pm .005\%*$

$\pm .005\%$  tolerance available; consult factory.

### DIMENSIONS - INCHES





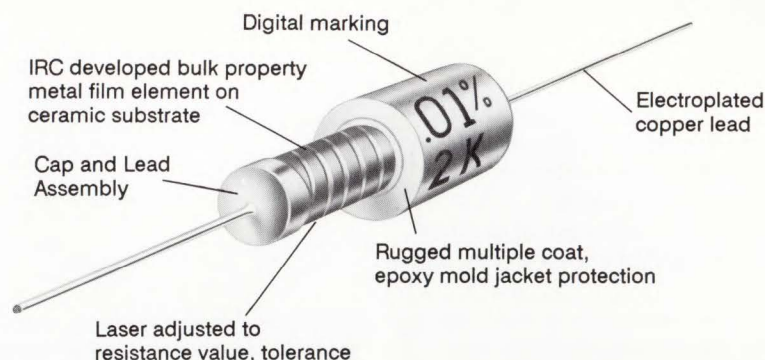


# ULTRA-PRECISION THIN FILM DISCRETE RESISTOR

## MAR

### MATCHED SETS

- 1/20 watt to 1/4 watt
- 10 ohms to 3 megohms
- Tolerances from  $\pm 0.01\%$  to  $\pm 1.0\%$ ;  
Ratios to 0.005%
- TCs of  $\pm 5$ ,  $\pm 10$  and  $\pm 15$  ppm/ $^{\circ}\text{C}$ ;  
Tracking to 1 ppm/ $^{\circ}\text{C}$



The performance of most precision resistor circuits requires that the relationship of all the resistors used be held to exacting tolerances in relation to each other. This tight tolerance relationship can be accomplished in two ways. One is to specify absolute tolerances so that no resistor can deviate from any other resistor by more than twice this tolerance. The other is to specify matched sets of resistors where the relationship between resistors, rather than absolute tolerances, is tightly controlled. In many designs, the absolute values are not so critical as the maintenance of a precise relationship among the set during changing ambients.

Matched resistor sets using the MAR series of resistors provide a decade or greater improvement in performance at significantly less cost than individually specified resistors. While others of our resistor products can be specified as matched sets, the MAR

Series is recommended for most critical applications.

Specifying matched resistor sets requires that the resistance ratio tolerance be specified along with allowable absolute tolerance; and the temperature coefficient tracking tolerance be specified with the basic TC.

Two examples of specifying matched sets are shown below. Other design considerations permitting, it is more economical to specify ratios to a reference resistor than to each other. However, if required, the MAR series offers the inherent precision and stability for either method.

A knowledge of the availability of these two ways to achieve extreme stability offers options to the designer which may prevent overspecifying, with attendant economic considerations.

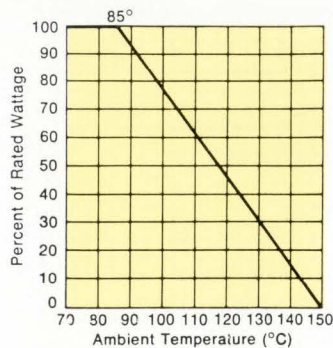
### ENVIRONMENTAL PERFORMANCE

Test Conditions per MIL-R-55182, except where noted	Typical $\Delta R$
1,000 Hour Load Life (Rated Power at 85 $^{\circ}\text{C}$ )	$\pm 0.02$
Humidity	$\pm 0.04$
Thermal Shock (Tested per Method 107 MIL-STD 202, Condition F)	$\pm 0.01$
Effect of Solder (Tested per Method 210, MIL-STD-202)	$\pm 0.01$
Dielectric Withstanding Shock and Vibration	$\pm 0.01$
Short-Time Overload	$\pm 0.01$
Insulation Resistance	$\pm 0.01$
Noise Index	10,000 Meg
Voltage Coefficient	-30 dB
1-Year Shelf Life	$\pm 0.05$ ppm/volt

### SPECIFICATIONS

IRC Model	Resistance Range( $\Omega$ ) By Tolerance Class		Resistance Range ( $\Omega$ ) by TCR Class					Power Rating @ 85 $^{\circ}\text{C}$	Voltage Rating
	1 - .1%	.05 - .01%	T2	T9	T10	T13	T16		
MAR3	10-1M	10-150K	10-1M	10-750K	10-250K	10-150K	10-125K	1/20W	200 V
MAR5	10-3M	10-250K	10-3M	10-1.5M	10-500K	10-350K	10-300K	1/10W	250 V
MAR6	10-5M	10-500K	10-5M	10-3M	10-1M	10-700K	10-500K	1/8 W	300 V
MAR7	10-10M	10-1M	10-10M	10-5M	10-3.5M	10-1.5M	10-1M	1/4 W	500 V

### DERATING CURVE



### RATIO ACCURACY AND TC TRACKING SPECIFICATIONS

Ratio to Master	TC Tracking 0 $^{\circ}$ to 70 $^{\circ}\text{C}$	Resistance Ratio Accuracy
1:1	1 ppm/ $^{\circ}\text{C}$	.005%
10:1	2 ppm/ $^{\circ}\text{C}$	.01%
100:1	2 ppm/ $^{\circ}\text{C}$	.01%
1000:1	4 ppm/ $^{\circ}\text{C}$	.02%

### SPECIFICATION EXAMPLE

Resistor	Ohms	Watts	Abs. Tol. %	Abs. TC (ppm/ $^{\circ}\text{C}$ )	Ratio Tol. Ref. to R <sub>1</sub> (%)	TC Tracking Ref. to R <sub>1</sub> (ppm/ $^{\circ}\text{C}$ )
R <sub>1</sub>	1K	1/8	$\pm 1\%$	$\pm 25\%$	--	--
R <sub>2</sub>	2K	1/8	$\pm 1\%$	$\pm 25\%$	0.02	5
R <sub>3</sub>	4K	1/8	$\pm 1\%$	$\pm 25\%$	0.04	10
R <sub>4</sub>	8K	1/8	$\pm 1\%$	$\pm 25\%$	0.08	20



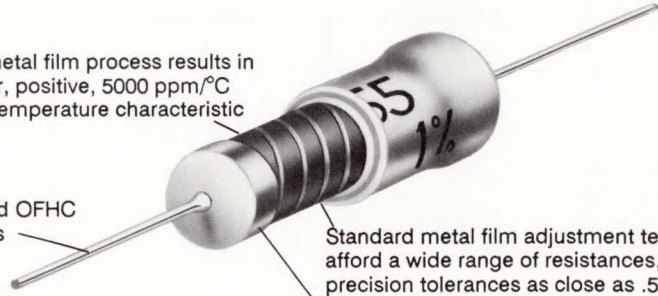
# THIN FILM RESISTANCE TEMPERATURE SENSING ELEMENT

## TD SERIES

- Proven metal film reliability
- Fast thermal response
- Positive temperature coefficient
- Close tolerance
- Superior linearity
- Ultra miniature

Exclusive metal film process results in a very linear, positive, 5000 ppm/°C resistance temperature characteristic

Solder Plated OFHC copper leads



Standard metal film adjustment techniques afford a wide range of resistances, and precision tolerances as close as .5%

Reliable welded cap & lead assembly

### SPECIFICATIONS

Resistance Range at 25°C  
TDM50 - 10 to 1K  
TD55 - 10 to 3K

Temperature Coefficient:  
+5000 ±100 ppm/°C @ 25°C

Tolerance @ 25°C:  
±.5%, ±1%, ±2%, or ±5%

Oper. Temp. Range:  
-55°C to +175°C

Interchangeability Accuracy:  
±1°C @ 25°C for .5% tolerance  
±2°C @ 25°C for 1% tolerance  
±4°C @ 25°C for 2% tolerance

Accuracy Limits: ±1.5°C for .5% tolerance (-50°C to +100°C) ±3°C for 1% tolerance (-50°C to +100°C) ±6°C for 2% tolerance (-50°C to +100°C)

Retracking Error:  
<.05% of nominal (-55°C to +175°C)

Resistance Ratio:  
R @ 125°C/R @ 25°C = 1.56

Linearity: .2% maximum deviation from best straight line fit over any 100°C interval between -55°C and +175°C

Thermal Time Constant  
(Time to achieve 63.2% of an applied step change):

	Oil	Still Air
TDM50	0.9 sec	3.7 sec
TD55	1.3 sec	5.5 sec

Dissipation Constants:  
TDM50 4.2 mw/°C  
TD55 6.8 mw/°C

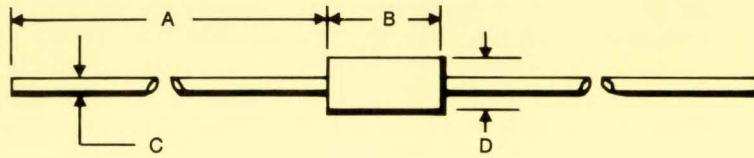
### ENVIRONMENTAL PERFORMANCE

Type of Test	Maximum ΔR	Typical ΔR
Thermal Shock (5 Cycles, -55°C to +175°C)	.10%	.05%
Effect of Solder	.15%	.02%
Moisture Resistance	.25%	.10%
Load Life (2,000 hours @ +125°C)	.25%	.15%
High Temperature Exposure (2,000 hours @ +175°C)	.50%	.25%
Low Temperature Exposure (-65°C)	.10%	.05%
Dielectric Strength	.30%	.20%
Insulation Resistance	100MΩ	---
Terminal Strength	.05%	.020%
Shock	.05%	.020%
High Frequency Vibration	.05%	.020%
Short Time Overload (1 watt, 1 minute)	.15%	.050%
Noise	---	-35 dB



**TD DIMENSIONS - IN. and (mm)**

IRC Type	Body Length B	Body Diameter D	Lead Length A	Lead Diameter C
TDM50 Molded Const.	.191 max (4.85 max)	.082 max (2.08 max)	1.00 ± .062 (25.4 ± 1.57)	#26 .016 (0.41)
TDM55 Molded Const.	.281 max (7.14)	.102 max (2.60)	1.25 ± .125 (31.75 ± 3.18)	#22 .0253 (0.64)
TD55	.281 max (7.14)	.098 (2.49)	1.25 ± .125 (31.75 ± 3.18)	#22 .0253 (0.64)



Note: TD55 is conformally coated. The drawing represents the envelope of this item. Slight deviations in outline will occur.

**TEMPERATURE VS RESISTANCE (Typical for 1000Ω Sensor)**

Degrees C	R in Ohms	Degrees C	R in Ohms	Degrees C	R in Ohms
-55	638.4	+25	1000.0	+105	1438.4
-50	658.8	+30	1025.2	+110	1468.4
-45	679.4	+35	1050.6	+115	1498.6
-40	700.4	+40	1076.4	+120	1529.2
-35	721.6	+45	1102.4	+125	1560.0
-30	743.2	+50	1128.8	+130	1591.2
-25	765.0	+55	1155.4	+135	1622.6
-20	787.2	+60	1182.4	+140	1654.4
-15	809.6	+65	1209.6	+145	1686.4
-10	832.4	+70	1237.2	+150	1718.8
-5	855.4	+75	1265.0	+155	1751.4
0	878.8	+80	1293.2	+160	1784.4
+5	902.4	+85	1321.6	+165	1817.6
+10	926.4	+90	1350.4	+170	1851.2
+15	950.6	+95	1379.4	+175	1885.0
+20	975.2	+100	1408.8		

**HOW TO ORDER**

Sample Part No.:

TD55 - 1% - 5000 ppm/°C - 2K

**IRC Type**

TDM50 = 1/20W @ 70°C  
TD55 = 1/10W @ 70°C

**Tolerance\***

±.5%, ±1%, ±2%  
or ±5%

**Temperature Coefficient\***

+5000 °100 ppm/°C @ 25°C

**Resistance\***

Standard Resistances at 25°C  
10 to 3K

\* Contact factory for specific T.C. tolerance and resistance requirements not shown above.

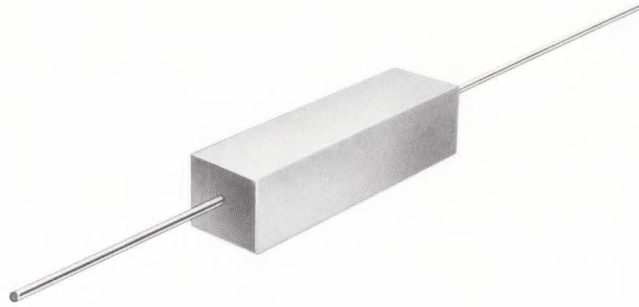




# ULTRA-PRECISION, HIGH POWER, HIGH RESISTANCE THIN FILM RESISTORS

## AR90 SERIES

- 1 watt rating
- 50 ohms to 15 megohms
- Tolerance to  $\pm 0.02\%$
- Standard TCs from  $\pm 5 \text{ ppm}/^\circ\text{C}$  to  $\pm 50 \text{ ppm}/^\circ\text{C}$



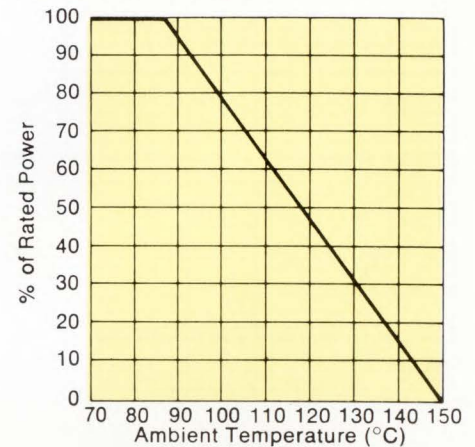
### SPECIFICATIONS

IRC Type	Resistance Range By Tolerance Class		Resistance Range ( $\Omega$ ) By TCR Class				Power Rating at 85°C (watts)	Voltage Rating (volts)
	1-.5%	.1-.02%	T2	T10	T13	T16		
AR90	50 $\Omega$ -15M	50 $\Omega$ -5M	50 $\Omega$ -15M	50 $\Omega$ -10M	50 $\Omega$ -5M	50 $\Omega$ -3M	1W	1500V

### ENVIRONMENTAL PERFORMANCE

Test Conditions per MIL-R-55182, except where noted	Typical $\Delta R\%$
1000 -Hour Load Life (Rated Power at 86°C)	$\pm 0.02$
Humidity	$\pm 0.04$
Temperature Cycle (Tested per Method 102, MIL-STD 202, Condition C)	$\pm 0.01$
Effect of Solder (Tested per Method 210, MIL-STD 202)	$\pm 0.01$
Dielectric Withstanding Voltage	$\pm 0.01$
Shock and Vibration	$\pm 0.01$
Short-Time Overload	$\pm 0.01$
Insulation Resistance	10,000 Meg $\Omega$
Noise Index	< -30dB
Voltage Coefficient	< 0.05 ppm/volt
1-Year Shelf Life	$\pm 50 \text{ ppm}$

### POWER DERATING



### TEMPERATURE COEFFICIENTS

TC Code	Temperature Coefficient
T16	$\pm 5 \text{ ppm}/^\circ\text{C}$ from $-20^\circ\text{C}$ to $+85^\circ\text{C}$
T13	$\pm 10 \text{ ppm}/^\circ\text{C}$ from $-20^\circ\text{C}$ to $+85^\circ\text{C}$
T10	$\pm 15 \text{ ppm}/^\circ\text{C}$ from $-20^\circ\text{C}$ to $+85^\circ\text{C}$
T2	$\pm 50 \text{ ppm}/^\circ\text{C}$ from $-20^\circ\text{C}$ to $+85^\circ\text{C}$

### HOW TO ORDER

Sample Part No.:

**AR90 - T16 - 91K - 0.02%**

#### IRC Type

AR90  
(1.0 watt at 85°C).

#### Temperature Coefficient

T16, T13, T10, or T2  
See specification table for availability

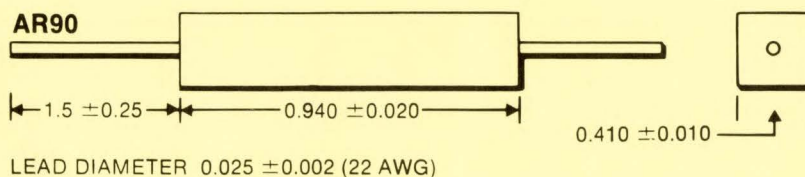
#### Resistance

Standard EIA/MIL values for metal film resistors. See specification table for range.

#### Tolerance

$\pm 1.0\%$  to  $\pm .02\%$ . See specification table for exact tolerances available.

### DIMENSIONS - INCHES







# GENERAL-PURPOSE CARBON FILM RESISTORS

## CF SERIES\*

- 1/8 watt to 2 watt
- 1 ohm to 10.0 megohm
- $\pm 5\%$  tolerance



### SPECIFICATIONS

Type	CF-1/8	CF-1/4	CF-1/2	CF-1	CF-2
Resistance, Standard	1 $\Omega$ to 1M $\Omega$	1 $\Omega$ to 1M $\Omega$	1 $\Omega$ to 1M $\Omega$	1 $\Omega$ to 1M $\Omega$	1 $\Omega$ to 10M $\Omega$
Tolerances, Standard	$\pm 5\%$	$\pm 5\%$	$\pm 5\%$	$\pm 5\%$	$\pm 5\%$
Power Rating	1/8W @ 70°C	1/4W @ 70°C	1/2W @ 70°C	1W @ 70°C	2W @ 70°C
Maximum Continuous Working Voltage	150 volts	250 volts	350 volts	500 volts	500 volts
Minimum Insulating Resistance - Dry	100M $\Omega$	1000M $\Omega$	1000M $\Omega$	1000M $\Omega$	1000M $\Omega$
Minimum Dielectric Withstanding Vol.- Atmospheric	300 volts	500 volts	500 volts	500 volts	500 volts
Load Life - Typical $\Delta R$ less than	$\pm 3\%$	$\pm 3\%$	$\pm 3\%$	$\pm 3\%$	$\pm 3\%$

### RESISTANCE - TEMPERATURE CHARACTERISTICS

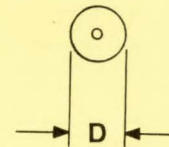
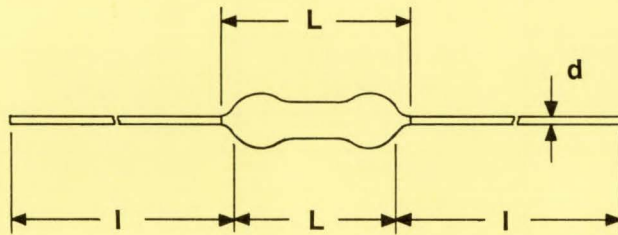
Nominal Resistance ( $\Omega$ )	Typical Temperature Coefficient (ppm/°C)				
	CF-1/8	CF-1/4	CF-1/2	CF-1	CF-2
1.0 $\Omega$ to 91.0 $\Omega$	+ 50 to -250	+ 50 to -250	+ 50 to -250	+ 50 to -250	+ 50 to -250
100 $\Omega$ to 10K $\Omega$	-100 to -400	-100 to -400	-150 to -400	-150 to -350	-150 to -350
11K $\Omega$ to 100K $\Omega$	-150 to -600	-150 to -600	-200 to -500	-200 to -500	-200 to -500
110K $\Omega$ to 1.0M $\Omega$	-200 to -1200	-250 to -1000	-250 to -800	-250 to -800	-250 to -800
1.1M $\Omega$ to 10.0M $\Omega$	---	-300 to -1800	-300 to -1800	-300 to -1800	-300 to -1800

\*Made in Far East



**DIMENSIONS - IN and (mm)**

Type	Clean Lead to Clean Lead L	Body Length L	Body Diameter D	Lead Length l	Lead d
CF-1/8	.18 Max (4.6 Max)	.150 ± .008 (3.8 ± .2)	.06 ± .008 (1.5 ± .2)	1.1 ± .04 (26 ± 1)	.02 (.5)
CF-1/4	.33 Max (8.5 Max)	.26 ± .02 (6.5 ± .5)	.1 ± .008 (2.5 ± .2)	1.1 ± .04 (28 ± 1)	.024 (.6)
CF-1/2	.43 Max (11 Max)	.37 ± .02 (9.5 ± .5)	.14 ± .02 (3.5 ± .5)	1.1 ± .04 (28 ± 1)	.024 (.6)
CF-1	.56 Max (14.2 Max)	.51 ± .04 (13 ± 1)	.19 ± .04 (4.8 ± 1)	1.5 ± .08 (38 ± 1)	.024 (.6)
CF-2	.79 Max (20 Max)	.71 ± .04 (18 ± 1)	.26 ± .04 (6.5 ± 1)	1.5 ± .08 (38 ± 2)	.024 (.6)



The carbon film resistors' contact caps are pressed on the rods and a helical groove cut through the film to give the re-

quired resistance value, connecting wire of lead-tin coated electrolytic copper is welded to the end caps. Finally the resis-

tors are coated with multiple layers of insulating lacquer. This process gives improved physical and electrical performance.

**HOW TO ORDER**

Sample Part No.:

CF - 1/4 - 47Ω - 5%

IRC Type

Power Rating @ 70°C  
1/4, 1/2, 1, or 2 watt

Resistance  
Standard Resistance Value  
Multipliers:

Tolerance  
± 5%

± 5% Tol.	± 5% Tol.	± 5% Tol.	± 5% Tol.
1.0	1.8	3.3	5.6
1.1	2.0	3.6	6.2
1.2	2.2	3.9	6.8
1.3	2.4	4.3	7.5
1.5	2.7	4.7	8.2
1.6	3.0	5.1	9.1

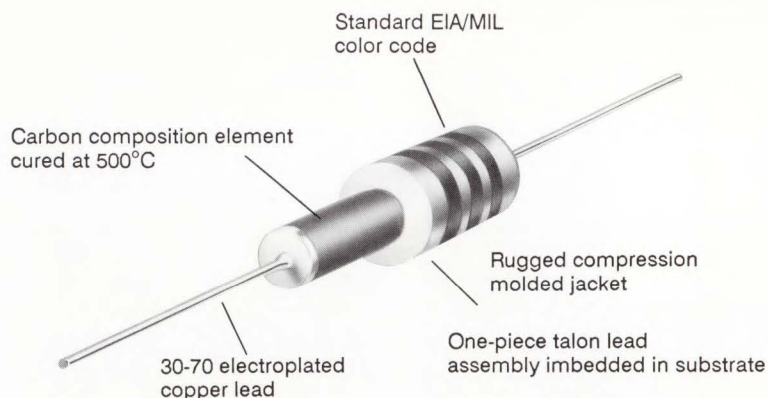




# GENERAL-PURPOSE CARBON COMPOSITION RESISTORS

## IBT SERIES\*

- 1/4 watt to 1 watt
- 10 ohms to 22 megohms
- ± 5% tolerance
- Excellent high-frequency response
- Exceptional long-term load life performance



### SPECIFICATIONS

Electrical Characteristics	IBT-1/4	IBT-1/2	IBT-1
MIL-R-11 Style	RC07	RC20	RC32
Resistance Range	10 to 1M	10 to 22M	10 to 10M
Tolerance	± 5% (Series E24)	± 5% (Series E24)	± 5% (Series E24)
Rated Power	0.25W @ 70°C	0.50W @ 70°C	1W @ 70°C
Max. Continuous Working voltage	250V	350V	500V
Surface Temperature Rise	32°C @ 0.25W	50°C @ 0.5W	70°C @ 1W
Average Shunt Capacitance	0.15 pF	0.175 pF	0.30 pF
Dielectric withstanding Voltage - Atmospheric Pressure - At 87mm of Mercury	500V RMS, min. 325V RMS, min.	700V RMS, min. 450V RMS, min.	1000V RMS, min. 625V RMS, min.
Insulation Resistance - Dry Wet	10 <sup>5</sup> MΩ min. 10 <sup>3</sup> MΩ min.	10 <sup>5</sup> MΩ min. 10 <sup>3</sup> MΩ min.	10 <sup>4</sup> MΩ min. 10 <sup>2</sup> MΩ min.

### Performance Characteristics (Typical % ΔR for the entire ohmic range)

Operating Temperature Range	-55 °C to +150 °C	-55C to +150°C	-55 C to +150 °C
Voltage Coefficient	-0.025%/V max.	-0.025%/V max.	-0.020%/V max.
Life (Method 108, MIL-STD-202, Cond. D)	± 2.50%	± 5%	± 5%
Short Time Overload (6.25 x Rated Power, 5 sec.)	± 1%	± 1.50%	± 1.50%
Moisture Resistance (Method 106, MIL-STD-202)	± 8%	± 3%	± 3%
Temperature Cycling (Method 102, MIL-STD-202, Cond. D)	± 1%	± 0.75%	± 1%
Low Temperature Operation (MIL-R-11, Para 4.6.7; -65°C)	± 0.75%	± 0.50%	± 1%
Terminal Strength (Method 211, MIL-STD-202, Cond. A, D)	± 0.30%	± 0.50%	± 0.50%
Resistance to Soldering (Method 210, MIL-STD-202, Cond.A)	± 2%	± 0.50%	± 2%
Shock, Medium Impact (Method 205, MIL-STD-202, Cond. C)	± 1%	± 0.50%	± 0.50%
Vibration, High Frequency (Method 204, MIL-STD-202, Cond. D)	± 1%	± 0.50%	± 0.50%

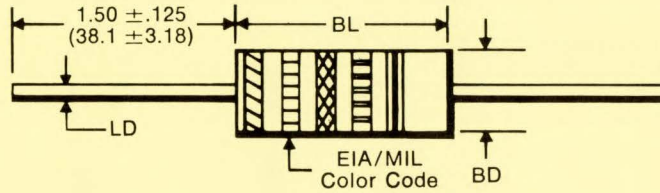
\*Manufactured in Italy



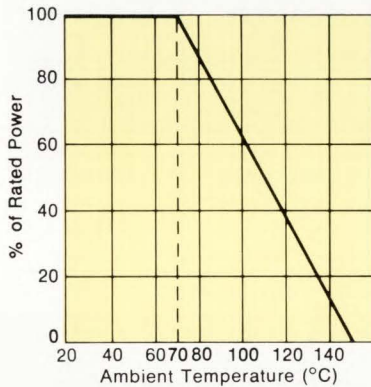


**IBT DIMENSIONS - IN. and (mm)**

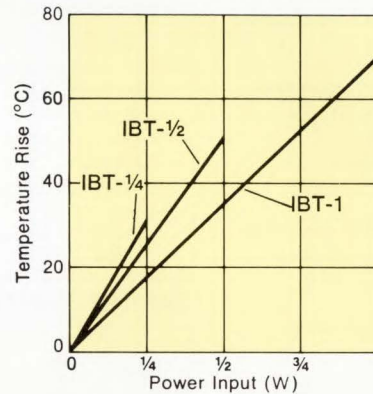
IRC Type	Body Length BL	Body Diameter BD	Lead Diameter LD
IBT-1/4	.250 ±.015 (6.35 ±.30)	.090 ±.007 (2.29 ±.20)	.025 ±.001 (.635 ±.03)
IBT-1/2	.390 ±.010 (9.91 ±.30)	.140 ±.008 (3.56 ±.20)	.031 ±.001 (.787 ±.03)
IBT-1	.562 ±.010 (14.3 ±.30)	.225 ±.008 (5.72 ±.20)	.040 ±.001 (1.02 ±.03)



**POWER DERATING**



**SURFACE TEMPERATURE RISE**



**HOW TO ORDER**

Sample Part No.:

**IBT - 1/2 - 680K - 5%**

IRC Type

Power Rating @ 70°C  
1/4, 1/2, or 1 watt

Resistance  
Standard EIA/MIL values for carbon composition resistors.  
See specification table for range.

Tolerance  
±5%

±5% Tol.	±5% Tol.	±5% Tol.	±5% Tol.
1.0	1.8	3.3	5.6
1.1	2.0	3.6	6.2
1.2	2.2	3.9	6.8
1.3	2.4	4.3	7.5
1.5	2.7	4.7	8.2
1.6	3.0	5.1	9.1





# MOLDED‡ AND CONFORMAL COATED\*

## ZEROHM JUMPER WIRES



- Available in 1/8, & 1/4, watt size
- Supplied on lead tape and reel for automatic insertion
- Less than 0.01 Ohm

### SPECIFICATIONS

Maximum Resistance: 0.01 ohm

Lead Material: Leads are copper with solder alloy coating. Molded 1/4W has solder coated copper clad steel.

Body Material: Electrical grade, high performance, coating and molding compounds

Minimum Insulation Resistance: Dry, 10,000 megohm; Wet, 100 megohm

Minimum Dielectric Withstanding; for 1/4W, Voltage: Atmospheric, 500V RMS; Reduced, 325V RMS

Current Rating: 2.5 amps at 70°C for 1/8W, 15 amps at 70°C for 1/4W

Voltage: Atmospheric, 300V RMS

### APPLICATIONS

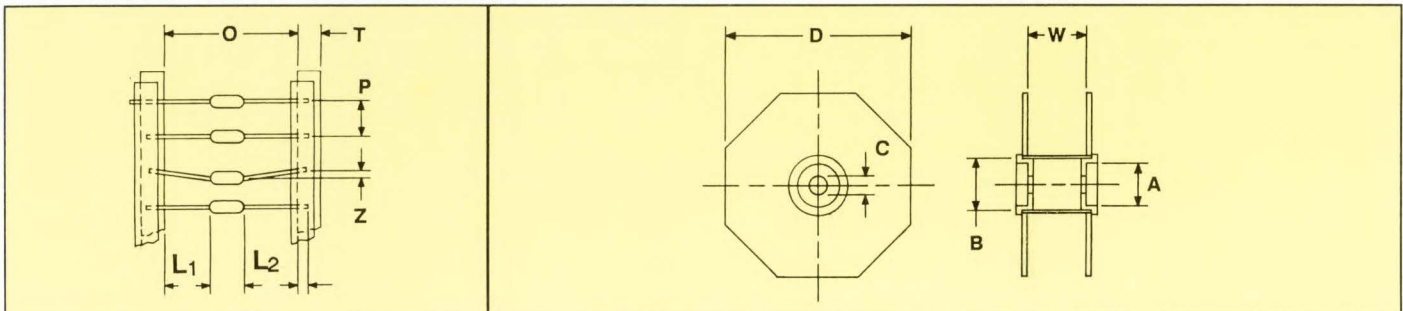
Jumper wire or crossovers, as they are sometimes called, are basically interconnection devices between points on a PC board.

Generally they are used for the following reasons:

- Inability to connect two points on a PC board due to other circuit paths which must be crossed over.
- An after-the-fact design change that requires new point connections.
- Circuit tuning by changing point connections.

IRC's jumper wires offer a quick simple solution to these problems. They are especially suited for automatic machine insertion on lead tape, and are available in all packaging styles including pre-cut and formed leads for manual insertion.

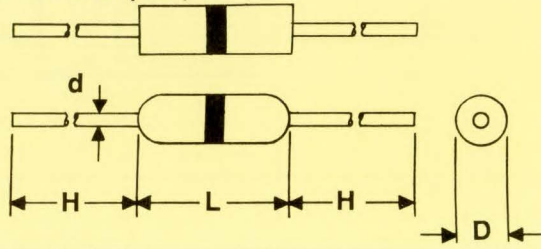
### TAPING AND PACKAGING DIMENSIONS



‡Molded types manufactured in U.S.

\*Coated types manufactured in Far East

### DIMENSIONS - IN. and (mm)



### DIMENSIONS - IN. and (mm)

Unit	Body Length L	Body Diameter D	Lead Length H	Lead Diameter d
Molded 1/4W	.250 ±.015 (6.35 ±.381)	.090 ±.008 (2.3 ±0.2)	1.50 ±.125 (38.1 ±3.2)	.025 nom. (.63 nom.)
Coated 1/4W	.256 ±.012 (6.5 ±0.30)	.090 ±.008 (2.3 ±0.2)	1.10 ±.08 (28.0 ±2.0)	.022 nom. (.56 nom.)
Coated 1/8W	.152 ±.008 (3.8 ±0.2)	.059 ±.008 (1.5 ±0.2)	1.12 ±.008 (28 ±2.0)	.018 nom. (.45 nom.)

### TAPING DIMENSIONS

Unit	O	P	L <sub>1</sub> - L <sub>2</sub>	T	Z
mm	52.5 ±1.5	5 ±0.1	1.2 max	6 ±0.5	1 max
inches	2.067 ±.06	.20 ±.01	.04 max	.236 ±.02	.04 max

### PACKAGING DIMENSIONS

	Unit	Quantity	A	B	C	D
1/8 - 1/4 Coated	mm	5,000 pcs/reel	51	72	15	305
	inches		2	2.835	0.785	12
1/4W Molded	mm					356
	inches					14

Leader tape of 910 ± 50 mm (36 inches) shall be provided after the last component in the reel.





# FLAME-PROOF TYPE

# METAL OXIDE\* FILM RESISTORS



- Low cost, prompt delivery
- High power-to-size ratio for significant space savings
- Excellent long-term stability
- Complete flameproof construction
- High surge/overload capability
- Controlled temperature coefficient
- Non-inductive design
- Wide resistance range: 0.5Ω to 1 Meg
- Standard tolerance: ±2%, ±5% (Consult factory for 1%)

\*Manufactured in the Far East

## ELECTRICAL SPECIFICATIONS

All measurements are taken at +25°C at 1 KHz and 65% relative humidity, unless otherwise stated.

## DESCRIPTION

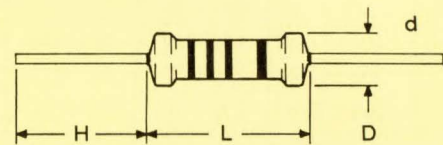
These Metal Oxide Resistors offer excellent performance in applications where stability

and uniformity of characteristics are desired. They provide lower cost alternatives to Carbon Composition Resistors and General Purpose Metal Films. Metal Oxides also can replace many low power General Purpose wirewound applications, saving both money and time, with shorter delivery cycles. These Metal Oxides meet overload tests in accordance with UL specification

#1412 without producing a fire hazard. (UL 1412 is the standard for fusing resistors and temperature-limited resistors). These Metal Oxides withstand solvents test in accordance with article Mil-Std-202E without producing mechanical or electrical damage.

## DIMENSIONS

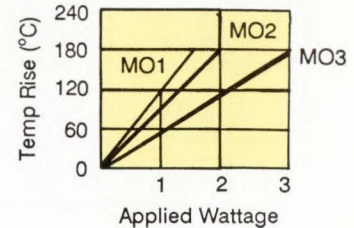
TYPE	L	D	H	d
MO1	.512 ± .039 (13 ± 1)	.177 ± .02 (4.5 ± 0.5)	1.50 ± .118 (38 ± 3)	.032 (0.8)
MO2	.670 ± .039 (17 ± 1)	.217 ± .02 (5.5 ± 0.5)	1.50 ± .118 (38 ± 3)	.032 (0.8)
MO3	1.062 ± .039 (27 ± 1)	.335 ± .02 (8.5 ± 0.5)	1.50 ± .118 (38 ± 3)	.032 (0.8)



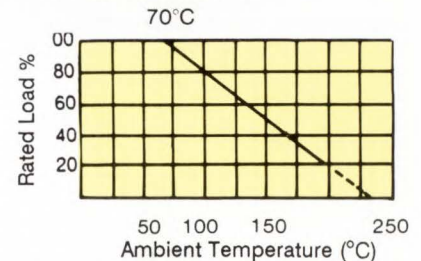
## GENERAL SPECIFICATION

Type	Power Rating	Maximum Working Voltage	Maximum Overload Voltage	Resistance Range 2%, 5%, 10%
MO1	1W	350V	600	0.5Ω - 1MΩ
MO2	2W	350V	600	0.5Ω - 1MΩ
MO3	3W	500V	800	0.5Ω - 1MΩ

## DERATING CURVE



## TEMPERATURE RISE



## SPECIFICATIONS

Temperature Coefficient	±200 ppm Typ. ±350 Max.
Insulation Resistance	10,000 MW Min
Load Life (1,000 hours)	< % Typ. ±3% Max.
Short-time Overload	±0.5% Max
Temperature Cycling	±1.0% Max
Moisture Resistance	±1.0% Max
Shock and Vibration	±0.2% Max
Effect of Soldering	±0.5% Max
Voltage Coefficient	.001%/V
Current Noise	.1μV/V

## HOW TO ORDER

Sample Part No.:

MO - 1 - 1K - 2%

IRC Type

Power (See specification chart for other power ratings)

Resistance Value Expressed in ohms (Standard EIA/MIL Values)

Tolerance ±10%, ±5%, ±2% standard





# FLAME PROOF RESISTORS

## FA SERIES\*

- Resistance range: 1Ω to 1MΩ
- Flameproof
- Standard EIA values
- TC ±250 ppm/°C



### SPECIFICATIONS Construction

The film is deposited on a high purity ceramic rod. End caps are force fitted and termination wires welded to the caps. The resistive film is adjusted to the required resistance value by a helical cut; finally the cement protection is applied to the resistor body as a conformal coat.

### Terminations

**Material:** Tin-lead coated copper wire.

**Strength:** The terminations withstand all appropriate tests defined by BS CECC 40 101-019

**Solderability:** The leads adequately meet the requirements of BS 2011, Part 2T, Method 1 (Solder bath), (IEC 68-20)

**Marking:** Color Band

**Flammability:** The resistor coating will not burn under any condition of applied temperature or component overload.

### DIMENSIONS - INCHES and (mm)

Type	L Max	D Max	d Nom	A Nom	Mounting Centers	
					Length	Width
FA025	.276 (7.0)	.091 (2.3)	.024 (0.6)	0.91 (23.0)	0.45	0.10
FA05	.400 (10.0)	.126 (3.2)	.031 (0.8)	0.85 (21.5)	0.55	0.15
FA1	.570 (14.5)	.200 (5.1)	.031 (0.8)	1.04 (26.3)	0.75	0.20
FA2	.681 (17.3)	.295 (7.5)	.031 (0.8)	0.98 (24.9)	0.85	0.30

\*For maximum packing density, with adequate clearance, use this table of dimensions (based on the 0.05" gird) to establish printed circuit board drill centers.

### ELECTRICAL DATA

Type	Resistance Range (ohms)	Rated Dissipation at 70°C	Limiting Element Voltage (voltage dc or ac rms)	Peak Voltage dc or ac
FA025	1Ω to 1M	.25W	250	500
FA05	1Ω to 1M	.5W	350	750
FA1	1Ω to 1M	1W	500	1000
FA2	10Ω to 100K	2W	700	1400

#### Selection Tolerance:

- 1Ω to 2.2Ω: ±10%
- 2.7Ω to 9.1Ω: ±10%, ±5%
- 10Ω and above: ±5%, ±2%, ±1%

Non-standard values available

Closer tolerances available

Voltage Coefficient: Negligible

Insulation Resistance: > 10<sup>10</sup>Ω at 500V dc

Thermal Impedance

FA025: 140

FA05: 90

FA1: 70

FA2: 50

### ENVIRONMENTAL DATA

Load Life: 1000 hours at 70°C at rated dissipation: ΔR better than 2%

Soldering Resistance to heat: ΔR better than .5%

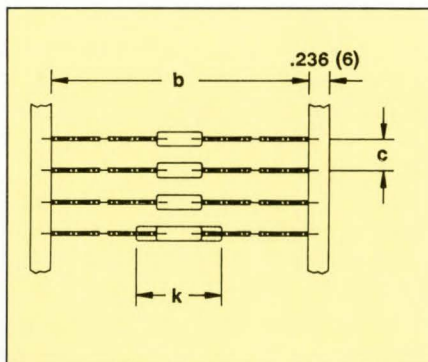
Short Time Overload: After 6.25 times stated dissipation for 5 seconds: ΔR < .5%

Shelf Life: 12 months: ΔR better than .5%

Moisture Resistance: ΔR < 1%

Thermal Shock: ΔR better than .5%

\*Manufactured in the U.K.



Resistor Type	b	c
FA025	2.08 ± .079	.197 ± 0.20
FA05	(53 ± 2)	(5 ± 0.5)
FA1	2.64 ± .079	.394 ± 0.20
FA2	(76 ± 2)	(10 ± 0.5)

### PACKAGING

All FA resistors are supplied tape packed ready for loading on to automatic sequencing and insertion machines.

Resistors will be located within the window of dimension k. Dimension k is always .055 (1.4) greater than the maximum body length and lies centrally between the tapes.

Leads will not protrude beyond the outside edge of the tapes.

Taped resistors will be supplied either on spools or in boxes depending upon ordered quantities.

A detailed tape packaging specification is available upon request.

### HOW TO ORDER

Sample Part No.:

FA - 1 - 1001 - ±1%







# POWER METOX RESISTORS

## FA80 SERIES \*



- Resistance range; 0.1Ω to 80KΩ
- 0.5 to 7 watts at 70°C
- Flameproof

### SPECIFICATIONS

The film is deposited on a high purity ceramic rod. End caps are force fitted and termination wires welded to the caps. The cement protection is applied to the resistor body as a conformal coat.

The low value end of the resistance range has been extended down to 0.1Ω by introducing a wirewound element for very low values. The wire element is welded to the end caps but in all other respects the construction and protection is identical to the film resistors.

### Terminations

**Material:**  
Solder coated copper wire.  
**Strength:**  
Pull strength 1Kg

### Solderability:

The terminations adequately meet the requirements of BS2011, Part 2T, Method 1 (Solder Bath), (IEC 68-20)

### Flammability:

The resistor coating will not burn under any condition of applied temperature or overload.

### Marking

FA82, FA83 and FA84: Standard 4-band color code - two significant figures, multiplier and tolerance bands.

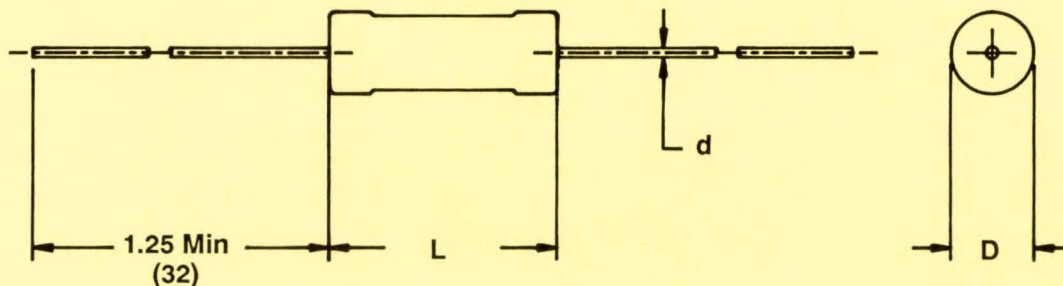
Other sizes legend marked with type reference, value, tolerance. Manufacturer's code and date code are included where space permits.

### Solvent Proof

The protection will withstand all the commonly used industrial cleaning fluids.

### DIMENSIONS - INCHES and (mm)

Type	D		L	d
	Film	Wirewound		
FA82	.098 (2.5)	NA	.275 (7)	.024 (0.6)
FA83	.126 (3.2)	NA	.394 (10)	.031 (0.8)
FA84	.201 (5.1)	.212 (5.4)	.590 (15)	.031 (0.8)
FA85	.362 (9.2)	.394 (10)	.866 (22)	.031 (0.8)
FA86	.362 (9.2)	.394 (10)	1.260 (32)	.031 (0.8)
FA87	.362 (9.2)	.394 (10)	1.650 (42)	.031 (0.8)
FA88	.362 (9.2)	.394 (10)	2.050 (52)	.031 (0.8)
FA89	.362 (9.2)	.394 (10)	.984 (25)	.031 (0.8)



\*Manufactured in the U.K.





# ELECTRICAL DATA

Type	Resistance Range (ohms)			Film	Rated Dissipation (watts) at		Thermal Impedance (°C/watt)	Limiting Element Voltage	Peak Voltage (dc or ac)
	Wirewound				40°C	70°C			
	Min. at +10%	Min. at 10%	Max.						
FA82	--	--	--	1 to 10K	0.75	0.5	120	250	--
FA83	--	--	--	10 to 82K	1.5	1.0	90	350	--
FA84	0.1	0.5	15	16 to 40K	2.5	2.0	65	350	--
FA85	0.1	0.5	20	22 to 60K	3.7	3.0	44	450	400
FA86	0.1	0.5	20	22 to 65K	5.9	5.0	40	500	400
FA87	0.1	0.75	39	43 to 70K	7.0	6.0	30	650	400
FA88	0.2	1.0	47	51 to 80K	8.2	7.0	26	650	400
FA89	0.1	0.5	20	22 to 60K	3.7	3.0	42	450	400

**Manufactured Values:**  
Standard EIA Values

**Fusing Characteristics:**  
For full information on the range of fusible resistors please contact factory.

**Derating:**  
Derate linearly from rated dissipation at 40°C or 70°C to zero at 235°C

**Temperature Coefficient Film:**  
FA82 and 83: better than ±250 ppm/°C. All other sizes: Better than ±500 ppm/°C.

**Wirewound:**  
Better than +100 ppm/°C

**Standard Selection Tolerance:**  
+5%.

Very low values available at +10%.  
See table above.

## ENVIRONMENTAL DATA

**Endurance**  
1000 hours at full load in 40°C ambient: ΔR better than 3%.

**Moisture Resistance:**  
ΔR typically 1%

**Shelf Life:**  
12 months ΔR better than 2%

**Thermal Shock:**  
ΔR better than .5%

**Soldering Resistance to Heat:**  
ΔR better than .5%

## APPLICATION NOTES

The axial terminations should not be bent closer than .059 (1.5) from the body, and the recommended minimum bend radius is .039 (1). If the resistors are to dissipate full rated power, it is recommended that the terminations should not be soldered closer than .157 (4) from the body.

The protection will withstand all the commonly used industrial cleaning fluids.

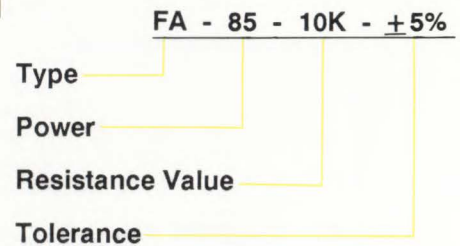
Due to limitations imposed by some pcb materials, derating may be necessary. In general, the lower the cost of the base material the lower will be its maximum operating temperature. To ensure that this temperature is not exceeded, derating must be applied.

FA style resistors, mounted directly on a p.c. board, will impart a similar temperature rise to the board as is experienced by the resistor. See table above, "Thermal Impedance".

## PACKAGING

FA82, FA83 And FA84  
Tape and Reel  
FA85, FA86, FA87, FA88, and FA89  
Bulk Std.  
Available in Tape and Reel 1000 pc. minimum quantity

**HOW TO ORDER**  
Sample Part No.:



Also available with .157" and .197" stand-off's for PCB mounting





# METAL FILM RESISTORS

## MFR SERIES\*

- Maximum dissipation at 70°C 0.75 watt
- Temperature coefficient down to  $\pm 50$  ppm/°C
- Resistance range 1 ohm to 1M



### SPECIFICATIONS

#### Construction

The resistance element is a precisely controlled thin film of metal alloy evaporated on to a high purity ceramic core, protected by a moisture-resistant, high dielectric

strength coating applied so that the terminations remain completely clear.

(solder bath), components for normal applications.

#### Terminations

Material: Solder coated copper wire  
Solderability: The leads adequately meet the requirements of IEC 68, Method 1

Marking: Color band

Solvent resistance: The body protection and marking are resistant to all normal industrial cleaning solvents suitable for printed circuits.

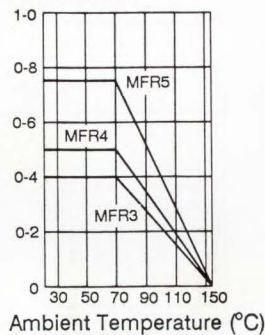
### DIMENSIONS - INCHES and (mm)

Type	L Max.	D Max.	d Nom.	A Nom.
MFR3	.161 (4.1)	.071 (1.8)	.020 (0.5)	.945 (24)
MFR4	.276 (7.0)	.091 (2.3)	.024 (0.6)	.906 (23)
MFR5	.394 (10.0)	.134 (3.4)	.031 (0.8)	.846 (21.5)

After Cutting From Tapes

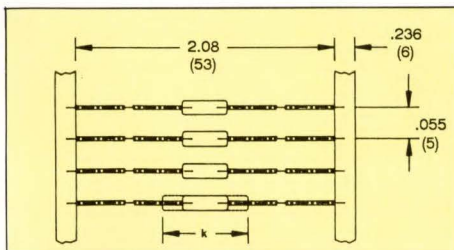
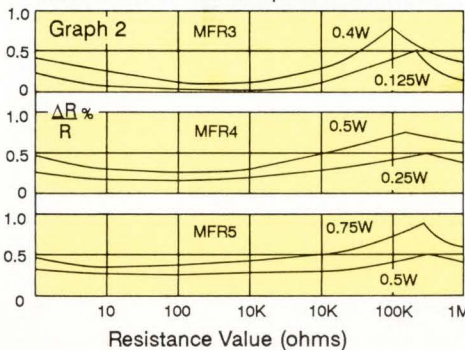
### POWER DERATING

Graph 1



#### Load Life:

1000 hours at rated dissipation and 70°C



### ELECTRICAL DATA

Type	Resistance Range (ohms)	Rated Dissipation at 70°C Ambient	RMS Voltage (dc or ac)	Peak Voltage (dc or ac)
MFR3	1-1M	0.4W	200V	400V
MFR4	1-1M	0.5W	250V	500V
MFR5	1-1M	0.75W	350V	700V

Manufactured Values: Standard EIA Values

Selection Tolerance:

- MFR3  $\pm 1, 2, 5\%$
- MFR4  $\pm 0.5, 1, 2\%$
- MFR5  $\pm 0.5, 1, 2, 5\%$

Temperature Coefficient:

- MFR3, MFR4  $\pm 50$  ppm/°C
- MFR5  $\pm 100$  ppm/°C

Thermal Impedance (°C/watt):

- MFR3 160, MFR4 140, MFR5 90

Operating Temperature Range:

- 55°C to 155°C

Noise: Less than 0.1mV/volt

### ENVIRONMENTAL DATA

Soldering, Resistance to Heat:  $\Delta R < 0.25\%$

Short Time Overload: After 6.25 times stated dissipation for 5 seconds  $\Delta R < 0.25\%$  times stated dissipation for 5 seconds  $\Delta R < 0.25\%$  (MFR3 0.125Ω; MFR4 0.25Ω; MFR5 0.5Ω)

Shelf Life: 12 months:  $\Delta R < 0.1\%$

Moisture Resistance:  $\Delta R < 0.5\%$

Thermal Shock:  $\Delta R < 0.25\%$

### PACKAGING

All MFR resistors are supplied tape packed ready for loading on to automatic sequencing and insertion machines.

Resistors will be located within the window of dimension K. Dimension K is always .055 (1.4) greater than the maximum body length and lies centrally between the tapes.

Axial leads will not protrude beyond the outside edge of the tapes.

\*Manufactured in the U.K.

### HOW TO ORDER

Sample Part No.:

**MFR-4 - 1003 -  $\pm 1\%$**

Type

Value

Tolerance



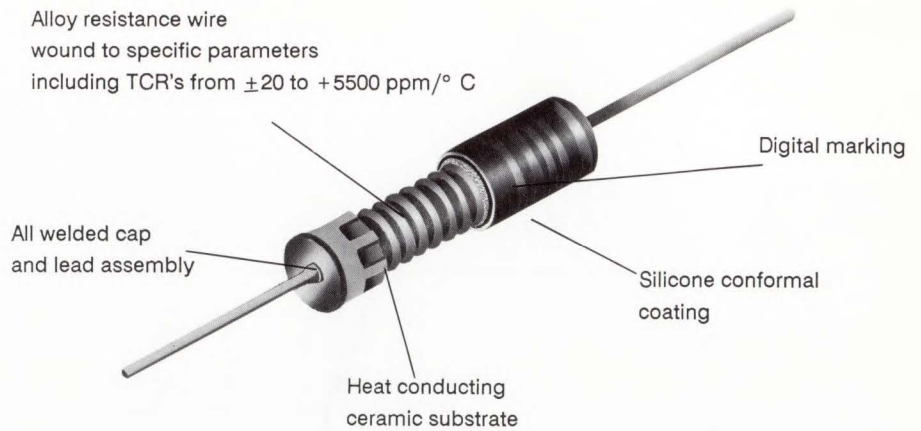


# SEMI-PRECISION POWER WIREWOUNDS

## AS SERIES

- 1/2 watt to 10 watts
  - $\pm 5\%$ ,  $\pm 3\%$ ,  $\pm 1\%$ ,  $\pm .5\%$ ,  
 $\pm .25\%$ ,  $\pm .1\%$  tolerance
  - 0.1 ohm to 175K ohms
  - Resistance wire TCR  $\pm 20$  ppm/ $^{\circ}$ C
  - AS-SM for Surface Mount Capabilities
- See page 3 for details

Alloy resistance wire  
wound to specific parameters  
including TCR's from  $\pm 20$  to  $+5500$  ppm/ $^{\circ}$  C



### SPECIFICATIONS

IRC Type	Equivalent MIL-R-26 Style	IRC Power Rating 275 $^{\circ}$ C Max. Hot Spot (Watts)		Commercial Range (ohms)		Voltage Rating (volts)	Non-Inductive Range (ohms)		Available Resistance (ohms)			
		125 $^{\circ}$ C	25 $^{\circ}$ C	Min.	Max.		Min.	Max.	0.1%	0.25%	0.5%, 1%	3%, 5%
AS-1/2		0.5	1	0.1	6.0K	100	*	*	5-2K	2.5-2K	1-6K	0.1-6K
AS-1	RW70U	1	2	0.1	7.5K	130	0.1	3.8K	5-3K	2.5-3K	1-7.5K	0.1-7.5K
AS-1C		1	2	.05	2K	110	*	*	5-2K	2.5-2K	1-2K	.05-2K
AS-2	RW69V/ RW79U	2	3	0.1	20K	140	0.5	10K	5-4.2K	2.5-4.2K	1-20K	0.1-20K
AS-2B		3	4	0.1	24K	185	0.5	12K	5-4.5K	2.5-4.5K	1-24K	0.1-24K
AS-2C		2	3	0.1	18K	160	0.2	7.5K	5-4.2K	2.5-4.2K	1-18K	0.1-18K
AS-3		3	5	0.1	30K	200	0.5	15K	5-6.5K	2.5-6.5K	1-30K	0.1-30K
AS-5	RW74U RW67V	5	7	0.1	60K	400	0.8	30K	5-15.5K	2.5-15.5K	1-60K	0.1-60K
AS-7		7	9	0.1	90K	600	1.0	45K	5-22K	2.5-22K	1-90K	0.1-90K
AS-10	RW68V/ RW78U	10	14	0.1	175K	1000	3.0	50K	5-55K	2.5-55K	1-175K	0.1-175K

Inductance of AS-1/2 is less than 1  $\mu$ H at 1MHz.

\*Typical inductance of AS-1C < 5 ohms is < 1  $\mu$ H.

To order non-inductive types, add the prefix 'N'. Example: NAS-1, NAS-2C, etc.

Lower values available upon request.

### ENVIRONMENTAL TESTING

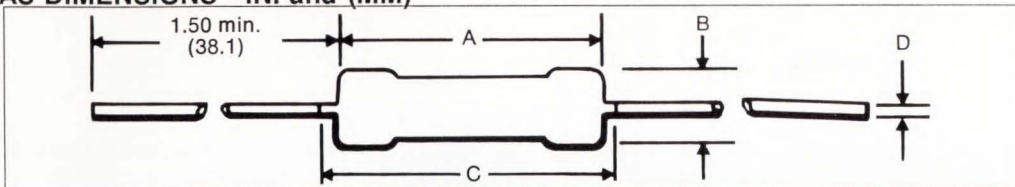
Test Condition	Max. $\Delta$ R
Load Life 1000 Hours	1.0%
Moisture Resistance	1.0%
Temperature Cycle	0.5%
Short Time Overload	0.5%

Test Condition	Max. $\Delta$ R
Low Temperature Operation	0.5%
Solder Heat	0.25%
Shock	0.5%
Vibration	0.5%





### AS DIMENSIONS - IN. and (MM)



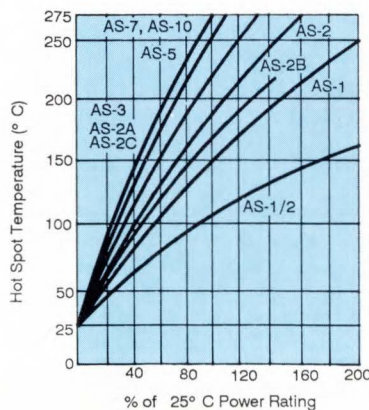
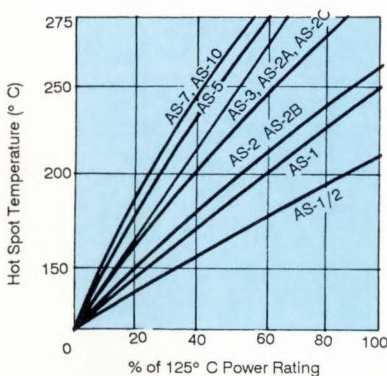
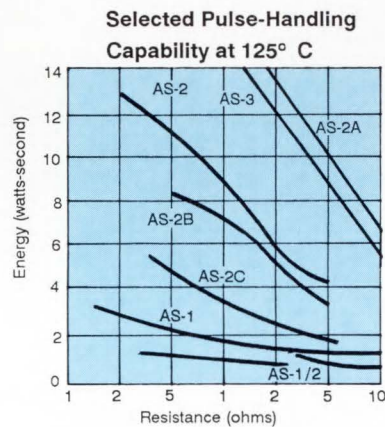
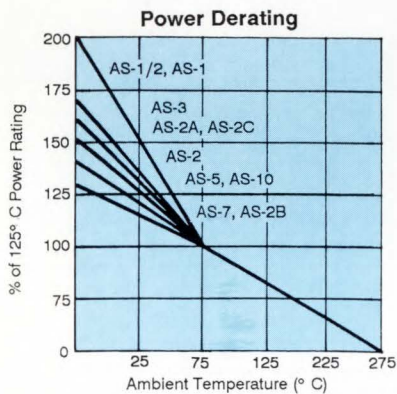
Note: Coating and marking is resistant to normal freon de-greasing. Consult factory for special requirements.

IRC TYPE	Dim. A ±0.032	Dim. B (Max)	Dim. C (Max)	Dim. D (Lead Dia.)
AS-1/2	.312 (7.9)	.094 (2.4)	.375 (9.5)	.020 (.5)
AS-1	.367 (9.3)	.125 (3.2)	.429 (10.9)	.020 (.5) .025 (.64)
AS-1C	.256 (6.5)	.115 (2.9)	.303 (7.7)	.025 (.64) .032 (.8)
AS-2	.480 (12.2)	.250 (6.3)	.600 (15.2)	.032 (.8)
AS-2B	.540 (13.7)	.219 (5.6)	.663 (16.6)	.032 (.8)
AS-2C	.489 (11.0)	.157 (4.0)	.594 (15.1)	.032 (.8)
AS-3	.687 (17.5)	.282 (7.2)	.812 (20.6)	.040 (1.0)
AS-5	.875 (22.2)	.344 (8.8)	.980 (24.9)	.040 (1.0)
AS-7	1.250 (31.8)	.344 (8.8)	1.375 (35.0)	.040 (1.0)
AS-10	1.812 (46.0)	.385 (9.8)	1.937 (49.2)	.040 (1.0)

\*Leads 60/40 are solder plated. AS-1C leads are copper. All others are 40% conductivity copper sheathed steel.

Made in Barbados

### POWER DERATING & PULSE HANDLING



### HOW TO ORDER

Sample Part No.:

AS - 3 - 27 OHM - .25%

IRC Type

Power

3 = 3 watts (See specification chart for other power ratings)

Resistance Value

Expressed in ohms (Standard EIA/MIL Values)

Tolerance

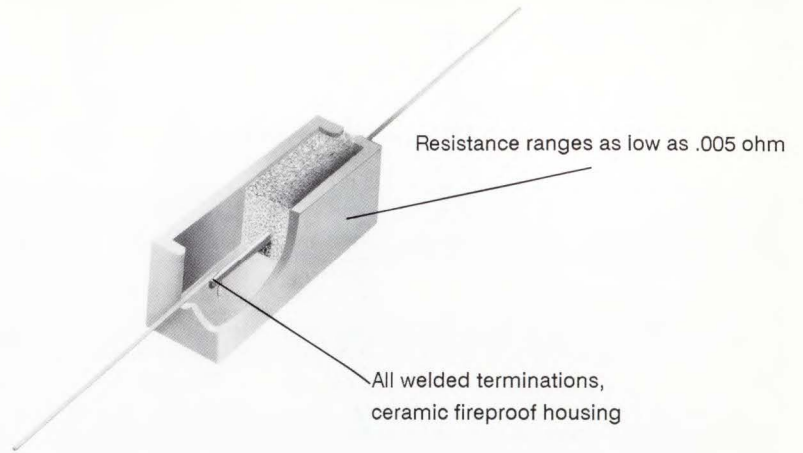
±5%, ±3%, ±1%, ±.5%, ±.25%, ±.1%





# EXTREMELY LOW RESISTANCE POWER WIREWOUNDS LPW SERIES

- 3 watts to 15 watts
- $\pm 1\%$ ,  $\pm 2\%$ ,  $\pm 3\%$ ,  $\pm 5\%$ ,  $\pm 10\%$  tolerance
- .005 ohm to 1.0 ohm
- LPW-SM for Surface Mount Capabilities  
See page 5 for details



## SPECIFICATIONS

IRC Type	Power at 25° C (watts)	Max. Current (amps)	Resistance Range (ohms)
LPW-3	3	10	.005 to 1.0
LPW-5	5	10	.005 to 1.0
LPW-7	7	20	.01 to 1.0
LPW-10	10	20	.01 to 1.0
LPW-15	15	20	.01 to 1.0

Note: Test points for LPW-3 and LPW-5 are 1.750 in. (44.45mm); test points for LPW-7, LPW-10 and LPW-15 are 2.500 in. (63.50mm).

**Standard Configuration**

Type LPW

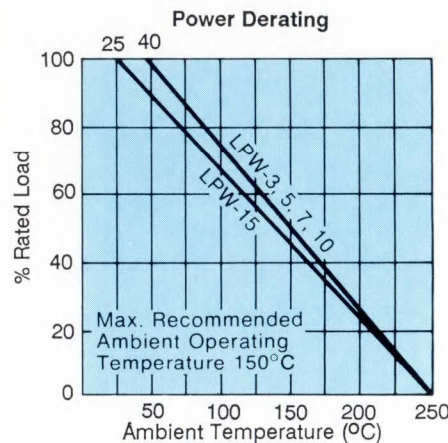
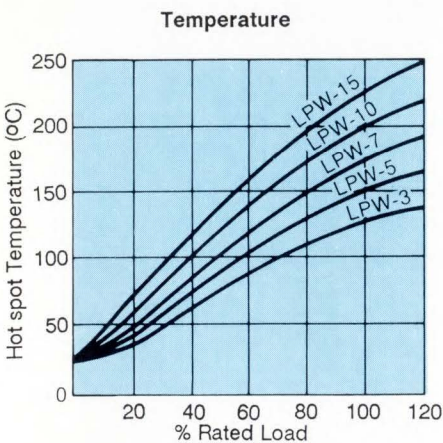
**Alternate Configuration**

Type LPW-A

DIMENSIONS - IN. and (MM)	IRC Type	L $\pm .063$ (1.6)	W $\pm .03$ (.8)	H $\pm .03$ (.8)	D Diameter	E $\pm .03$ (.8)
		LPW-3	0.88 (22.4)	.31 (7.87)	.31 (7.87)	.036* (.9)
	LPW-5	0.88 (22.4)	.38 (9.65)	.35 (8.89)	.036* (.9)	.41 (10.4)
	LPW-7	1.39 (35.3)	.38 (9.65)	.35 (8.89)	.036* (.9)	.47 (11.9)
	LPW-10	1.88 (47.8)	.38 (9.65)	.35 (8.89)	.036* (.9)	.47 (11.9)
	LPW-15	1.88 (47.8)	.50 (12.7)	.50 (12.7)	.036* (.9)	.63 (16.0)

\*For resistance above .05 ohms, diameter D is .032 in. (.8mm)

## TEMPERATURE RISE AND POWER DERATING



## HOW TO ORDER

Sample Part Number

LPW - 5 - .02 ohm - 3%

IRC Type

Power

5 = 5 watts (see specification chart for other power ratings)

Resistance Value

Expressed in ohms (Standard EIA/MIL Values)

Tolerance

$\pm 1\%$ ,  $\pm 2\%$ ,  $\pm 3\%$ ,  $\pm 5\%$ ,  $\pm 10\%$  standard





# FOUR-TERMINAL CURRENT-SENSING WIREWOUNDS

## 4LPW SERIES

- 3 watts to 15 watts
- $\pm 1\%$ ,  $\pm 2\%$ ,  $\pm 3\%$ ,  $\pm 5\%$ ,  $\pm 10\%$  tolerance
- .005 ohm to 1.0 ohm
- TC =  $\pm 40$  ppm

Resistance values to .005 ohm

"Current" leads

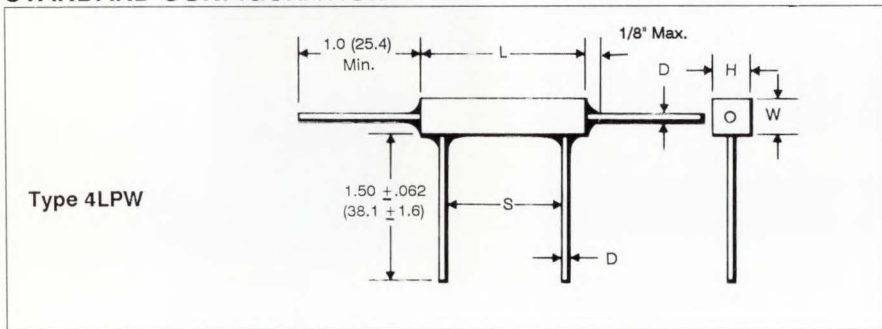
"Sense" leads

All welded terminations, ceramic fireproof housing

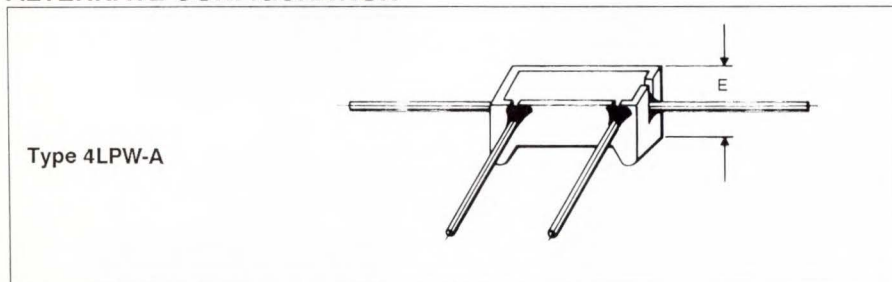
### SPECIFICATIONS

IRC Type	Power at 25° C (watts)	Max. Current (amps)	Resistance Range (ohms)
4LPW-3	3	10	.005 to 1.0
4LPW-5	5	10	.005 to 1.0
4LPW-7	7	20	.01 to 1.0
4LPW-10	10	20	.01 to 1.0
4LPW-15	15	20	.01 to 1.0

### STANDARD CONFIGURATION



### ALTERNATE CONFIGURATION



### DIMENSIONS - IN. & (MM)

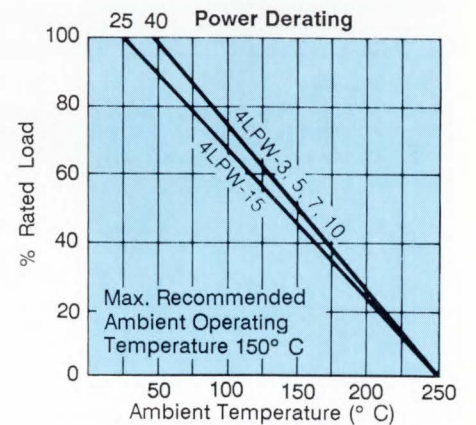
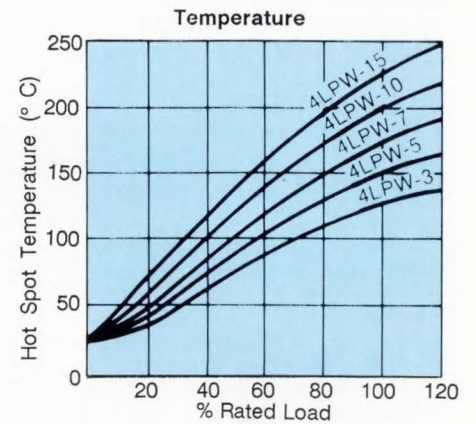
IRC Type	L $\pm .063$ (1.6)	W $\pm .03$ (.8)	H $\pm .03$ (.8)	S $\pm .062$ (1.6)	D Diameter	E $\pm .03$ (.8)
4LPW-3	.88 (22.4)	.31 (7.87)	.31 (7.87)	.563 (14.3)	.036* (.9)	.38 (9.65)
4LPW-5	.88 (22.4)	.38 (9.65)	.35 (8.89)	.563 (14.3)	.036* (.9)	.41 (10.4)
4LPW-7	1.39 (35.3)	.38 (9.65)	.35 (8.89)	1.013 (25.7)	.036* (.9)	.47 (11.9)
4LPW-10	1.88 (47.8)	.38 (9.65)	.35 (8.89)	1.388 (35.3)	.036* (.9)	.47 (11.9)
4LPW-15	1.88 (47.8)	.50 (12.7)	.50 (12.7)	1.388 (35.3)	.036* (.9)	.63 (16.0)

\* For resistances above .05 ohms, diameter D is .032 in. (.8mm)

INTERNATIONAL RESISTIVE COMPANY, INC.

P.O. Box 1860, Greenway Road • Boone, NC 28607.1860 • 704-264-8861 or 1-800-255-4-IRC • TLX: 46.9902

### TEMPERATURE RISE & POWER DERATING



### HOW TO ORDER:

Sample Part No.:

**4LPW - 15 - .01 ohm - 1%**

IRC Type

Power

15 = 15 watts (see specification chart for other power ratings)

Resistance Value

Expressed in ohms (Standard EIA/MIL Values)

Tolerance

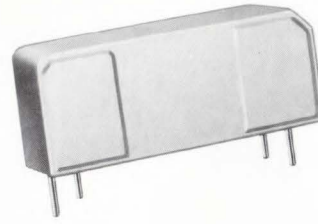
$\pm 1\%$ ,  $\pm 2\%$ ,  $\pm 3\%$ ,

$\pm 5\%$ ,  $\pm 10\%$ , standard





# TELECOMMUNICATIONS LINE FEED RESISTOR



## LFR-2 SERIES

- Withstands lightning surges
- Opens safely under power cross
- Flameproof inorganic construction
- Auto-insertable
- Small size
- Water soluble flux safe available
- Meets FCC, EIA and UL requirements

### DESIGN & CONSTRUCTION

The Line Feed Resistor is a tight tolerance, stable resistor which has the additional capability to withstand both inrush currents and

certain lightning pulse surges but would still fuse safely when exposed to overload conditions such as 600 volt power line crosses. This protective device appears to

have application in the telecommunications industry as well as other areas requiring this type of component. (Contact factory for surface mount applications).

### SPECIFICATIONS

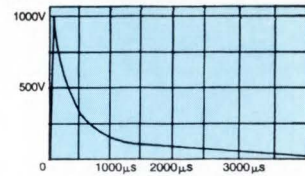
Characteristics	Limits	
	LFR-2, LFR-2A	LFR-2B, LFR-2C
Wattage	2 Watts	2 Watts
Temperature Coefficient	50 ppm/°C	300 ppm/°C
Tolerances	1, 2, or 3%	5 or 10%
Load Life (1000 Hrs.)	1%ΔR maximum	7%ΔR maximum
Temperature Cycling	1%ΔR maximum	7%ΔR maximum
Short Time Overload (5x RW for 10 Sec.)	1%ΔR maximum	5%ΔR maximum
Moisture Load	1%ΔR maximum	5%ΔR maximum
Resistance Range	1 to 1600 ohm	1 to 1600 ohm
Lightning Surge (See Table 1) 5 Negative & 5 Positive Surges (2 minute intervals)	2%ΔR maximum	5%ΔR maximum

### LIGHTNING SURGE CAPABILITIES

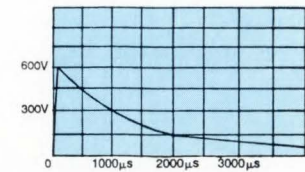
Table 1

Resistive Range	10 x 1000*	10 x 360*
1 to 9.9Ω	250 volts	650 volts
10 to 29.9Ω	500 volts	850 volts
30 to 1600 Ω	600 volts	1000 volts

\*10 Microseconds - Maximum rise time to peak voltage. 360 or 1000 Microseconds - Minimum decay time to one-half peak.

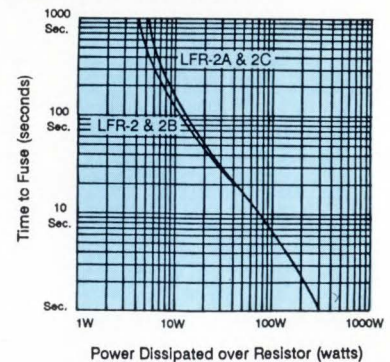


1000 Volts  
10 x 360 μsec



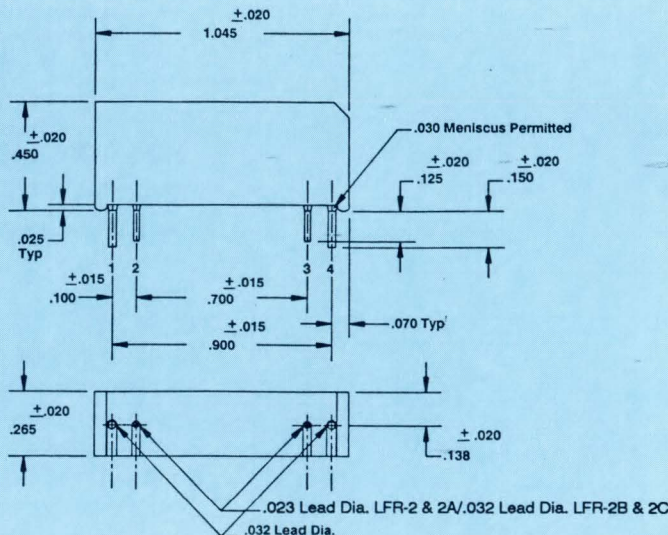
600 Volts  
10 x 1000 μsec

### TYPICAL FUSING CURVE Fusing Time vs. Power



### DIMENSIONS:

The four (4) terminal leads shall be in line to a tolerance of +/- .015 inch. The lead spacing dimensions as specified, shall be measured from the tip of the lead to the tip of the lead. The leads may have a 15 degree draft relative to the protector body.



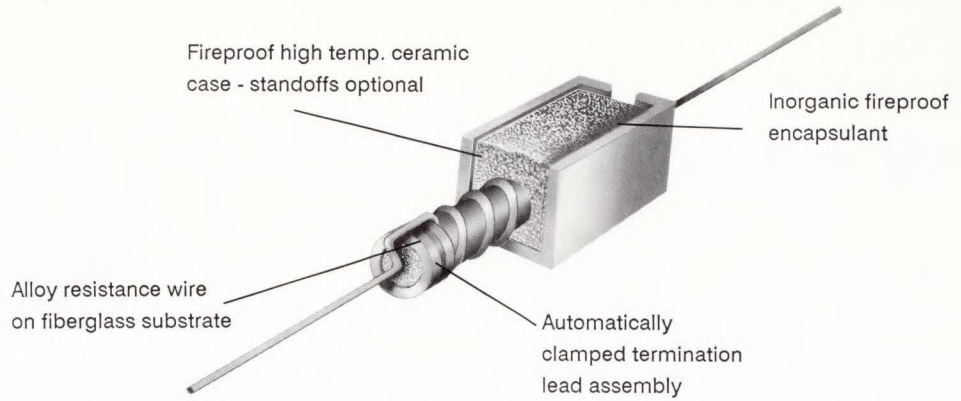




# GENERAL-PURPOSE POWER WIREWOUNDS

## PW SERIES

- 2 watts to 25 watts
- $\pm 10\%$ ,  $\pm 5\%$  tolerance
- 0.10 ohms to 30K ohms
- TC's from 300 ppm/ $^{\circ}$  C to +5500 ppm/ $^{\circ}$  C

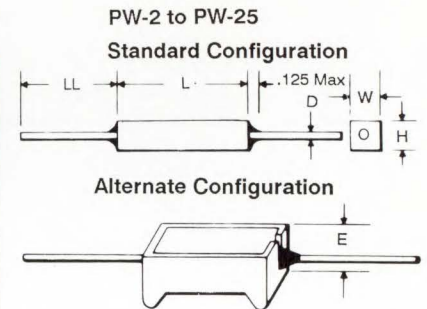


### SPECIFICATIONS

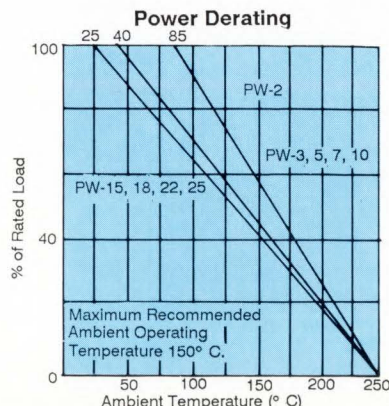
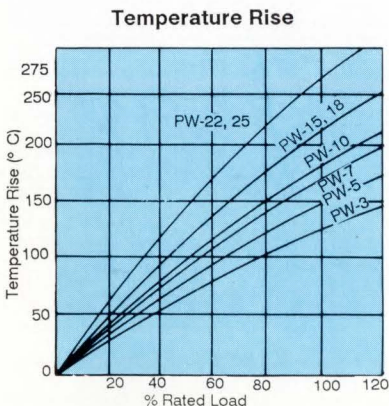
IRC Type	Power Rating at 25 $^{\circ}$ C (watts)	Standard Resistance Range (ohms)	Standard Temperature Coefficients		Special Temperature Coefficients		
			0.06/ $^{\circ}$ C over R range of	0.03/ $^{\circ}$ C over R range of	+0.55/ $^{\circ}$ C over R range of	+0.45/ $^{\circ}$ C over R range of	+0.26/ $^{\circ}$ C over R range of
PW-2	2	0.18 to 2.4K	0.18 to 0.99	1.0 to 2.4K	0.1 to 30	0.24 to 130	1.0 to 10
PW-3	3	0.1 to 7.5K	0.1 to 0.99	1.0 to 7.5K	0.1 to 86	0.1 to 270	0.24 to 20
PW-5	5	0.1 to 8.5K	0.1 to 0.99	1.0 to 8.5K	0.1 to 68	0.1 to 300	0.27 to 22
PW-7	7	0.1 to 18K	0.1 to 0.99	1.0 to 18K	0.1 to 150	0.15 to 680	0.62 to 51
PW-10	10	0.18 to 30K	0.18 to 0.99	1.0 to 30K	0.1 to 240	0.24 to 1100	1.0 to 82
PW-15	15	0.18 to 30K	0.18 to 0.99	1.0 to 30K	0.1 to 240	0.24 to 1100	1.0 to 82
PW-18	18	0.18 to 22K	0.18 to 0.99	1.0 to 22K	0.1 to 200	0.24 to 1000	1.0 to 70
PW-22	22	0.27 to 18K	0.27 to 1.3	1.5 to 18K	0.15 to 360	0.36 to 1800	1.0 to 120
PW-25	25	0.27 to 18K	0.27 to 1.3	1.5 to 18K	0.15 to 300	0.36 to 1200	1.5 to 100

### DIMENSIONS - IN. AND (MM)

IRC Type	L $\pm$ .03 (.8)	W $\pm$ .03 (.8)	H $\pm$ .03 (.8)	D-Dia. $\pm$ .002	E $\pm$ .03 (.8)	LL min.
PW-2	.69 (17.5)	.25 (6.35)	.25 (6.35)	.032 (.8)	.31 (7.87)	1.44 (36.6)
PW-3	.88 (22.4)	.31 (7.87)	.31 (7.87)	.036 (.9)	.38 (9.65)	1.44 (36.6)
PW-5	.88 (22.4)	.38 (9.65)	.35 (8.89)	.036 (.9)	.41 (10.4)	1.50 (38.1)
PW-7	1.39 (35.3)	.38 (9.65)	.35 (8.89)	.036 (.9)	.47 (11.9)	1.50 (38.1)
PW-10	1.88 (47.8)	.38 (9.65)	.35 (8.89)	.036 (.9)	.47 (11.9)	1.50 (38.1)
PW-15	1.88 (47.8)	.50 (12.7)	.50 (12.7)	.036 (.9)	.63 (16.0)	1.50 (38.1)
PW-18	1.88 (47.8)	.50 (12.7)	.50 (12.7)	.036 (.9)	.63 (16.0)	1.50 (38.1)
PW-22	2.50 (63.5)	.50 (12.7)	.50 (12.7)	.040 (1.0)	.63 (16.0)	1.50 (38.1)
PW-25	2.50 (63.5)	.50 (12.7)	.50 (12.7)	.040 (1.0)	.63 (16.0)	1.50 (38.1)



### POWER DERATING & TEMPERATURE RISE



### HOW TO ORDER

Sample Part No:

**PW - 18 - 12K - 10%**

- IRC Type** — PW
- Power** — 18 = 18 watts (see specification chart for other power ratings)
- Resistance Value** — Expressed in ohms (Standard EIA/MIL Values)
- Tolerance** —  $\pm 10\%$ ,  $\pm 5\%$  Standard



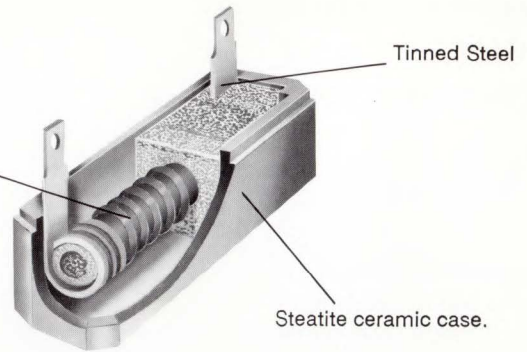


# GENERAL PURPOSE POWER WIREWOUNDS

## PW SERIES

- 20 watts to 50 watts
- $\pm 10\%$ ,  $\pm 5\%$  tolerance
- 0.1 ohms to 5.1K ohms
- Customs

Alloy resistance wire on fiberglass substrate.



### SPECIFICATIONS:

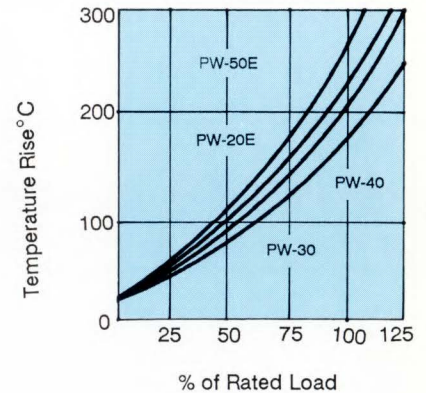
- Flameproof Inorganic Construction.
- EIA RS-344, Insulated Fixed Wirewound Resistors.
- 1000 hour load life at 25°C: 5% maximum.
- Moisture no load 240 hours: 2% maximum.
- Temperature cycling (5 cycles: 5% maximum).
- Thermal shock 2% max.

IRC Type	Power at 25°C (watts)	Resistance Range (ohms)
PW-20E	20	.1 - 5.1K
PW-30	30	.5 - 1.2K
PW-40	40	.65 - 1.5K
PW-50E	50	.8 - 1.8K

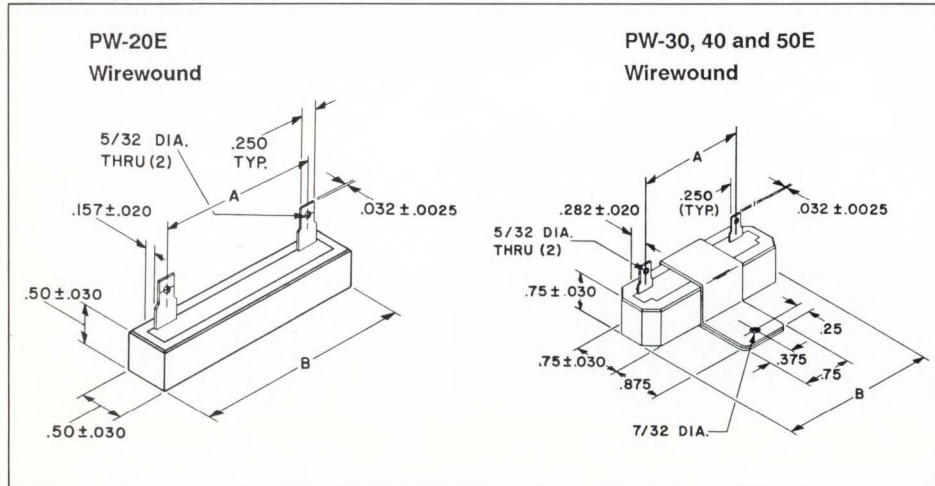
### TEMPERATURE RISE

#### & POWER DERATING:

Temperature Rise at 25 °C (without bracket)



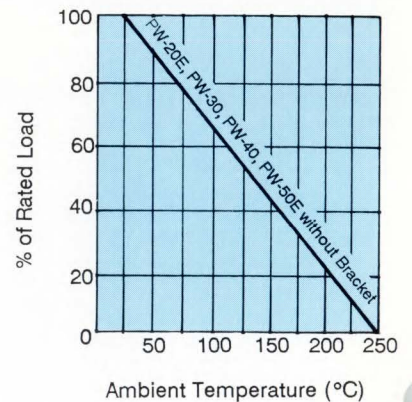
### DIMENSIONS:



DIMENSIONS - IN.			PW-20E Alternate Terminal Configurations .020" Tin Coated Steel	
IRC Type	A $\pm .030$	B $\pm .060$		
PW-20E	1.875	2.50 $\pm .060$		
PW-30	2.00	2.55		
PW-40	2.45	3.00		
PW-50E	3.075	3.625		


### Power Derating



With Bracket  
 PW-30 Increased to 40 watts  
 PW-40 Increased to 50 watts  
 PW-50E Increased to 60 watts

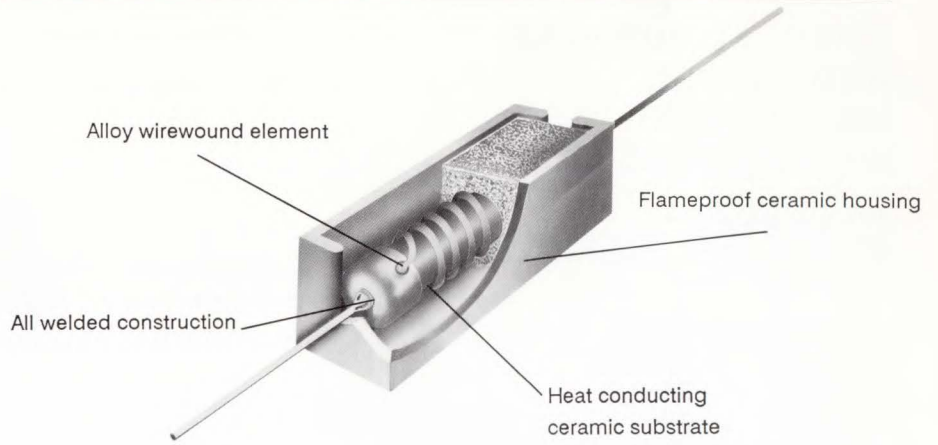




# SEMI-PRECISION POWER WIREWOUNDS FOR PULSE AND SURGE APPLICATIONS

## PPW SERIES

- 2 watts to 15 watts
- $\pm 3\%$ ,  $\pm 2\%$ ,  $\pm 1\%$  tolerance
- 1 ohm to 5000 ohms
- $\pm 20$  ppm/ $^{\circ}$  C TCR

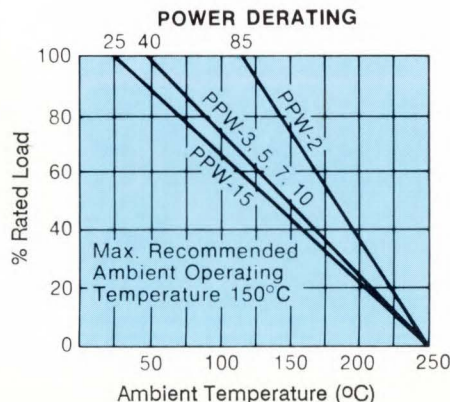
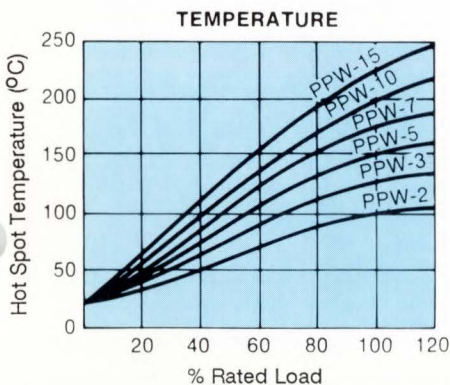


### SPECIFICATIONS:

IRC Type	Power at 25 $^{\circ}$ C (watts)	Resistance Range (ohms)
PPW-2	2	1 to 1600
PPW-3	3	1 to 1600
PPW-5	5	1 to 1600
PPW-7	7	1 to 2500
PPW-10	10	1 to 5000
PPW-15	15	1 to 5000

DIMENSIONS - IN. and (MM)	IRC Type	L	W	H	D	E
		$\pm .03$ (.8)	$\pm .03$ (.8)	$\pm .03$ (.8)	Diameter	$\pm .03$ (.8)
	PPW-2	.69 (17.5)	.275 (6.99)	.275 (6.99)	.032 (.8)	.32 (8.13)
	PPW-3	.88 (22.3)	.310 (7.87)	.310 (7.87)	.032 (.8)	.38 (9.65)
	PPW-5	.88 (22.3)	.380 (9.65)	.350 (8.89)	.032 (.8)	.41 (10.4)
	PPW-7	1.39 (35.3)	.380 (9.65)	.350 (8.89)	.032 (.8)	.47 (11.9)
	PPW-10	1.88 (47.7)	.380 (9.65)	.350 (8.89)	.032 (.8)	.47 (11.9)
	PPW-15	1.88 (47.7)	.500 (12.7)	.500 (12.7)	.032 (.8)	.50 (12.7)

### TEMPERATURE & POWER DERATING:



### HOW TO ORDER:

Sample Part No.:

PPW - 10 - 15 ohm - 2%

IRC Type  
Power  
Resistance Value  
Tolerance

10 = 10 watts (See specification chart for other power ratings)  
Expressed in ohms (Standard EIA/MIL Values)  
 $\pm 3\%$ ,  $\pm 2\%$ ,  $\pm 1\%$  standard

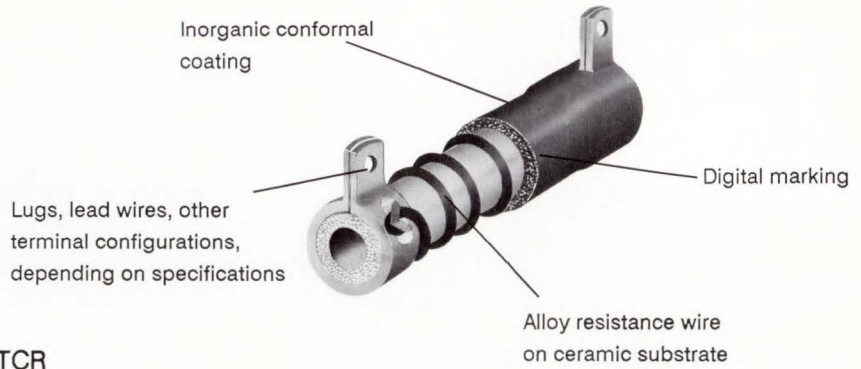




# FIXED, ADJUSTABLE AND TAPPED HIGH POWER WIREWOUNDS

## PWW SERIES

- 5 watts to 225 watts
- $\pm 10\%$   $\pm 5\%$  tolerance
- 0.1 ohms to 1.5 meg.
- TC's from  $\pm 50$  ppm/°C to  $\pm 400$  ppm/°C TCR (specials available to  $\pm 5500$  ppm/°C)

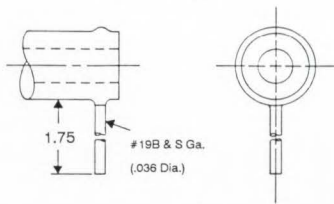


### TUBULAR STYLE - FIXED

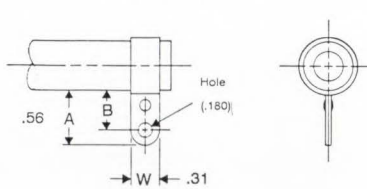
IRC Type	Power Rating at 25° C (watts)	MIL Equivalent		Core Dimensions			Terminals		Min Resistance (ohms) **	Maximum Resistance (ohms)			O.D. Over Coating $\pm .06$
		MIL Style	MIL Power Rating (watts)	Length inches (mm)	O.D. Inches (mm)	I.D. Inches (mm)	Std.	Special		.0025 Wire	.00175 Wire	.0008 Wire	
1A	5	---	---	1.00 (25.4)	.31 (7.9)	.19 (4.8)	13A	1, 12A †	0.10	530	1,550	15K	.41 (10.4)
1 3/4A	12	RW29	11	1.75 (44.5)	.31 (7.9)	.19 (4.8)	13A ‡	1, 12A	0.10	2,400	5,600	50K	.41 (10.4)
1C	12	RW30	11	1.00 (25.4)	.44 (11.2)	.27 (6.9)	12A	1, 13A	0.10	900	2,500	20K	.53 (13.5)
1 1/2C	15	RW31	14	1.50 (38.1)	.44 (11.2)	.27 (6.9)	12A	1, 13A	0.10	2,000	6,300	50K	.53 (13.5)
2C	20	RW32	17	2.00 (50.8)	.44 (11.2)	.27 (6.9)	13A ‡	1, 12A	0.10	4,000	10K	80K	.53 (13.5)
2D	25	---	---	2.00 (50.8)	.56 (14.2)	.38 (9.7)	12A	1, 4A, 13A	0.10	4,500	12K	100K	.66 (16.8)
3C	26	RW33	26	3.00 (76.2)	.44 (11.2)	.27 (6.9)	12A	1, 13A	0.10	8,000	18K	150K	.53 (13.5)
3D	35	---	---	3.00 (76.2)	.56 (14.2)	.38 (9.7)	12A	1A, 13A	0.10	8,250	23.8K	200K	.66 (16.8)
4D	50	---	---	4.00 (101.6)	.56 (14.2)	.38 (9.7)	12A	1, 4A, 13A	0.20	12K	35K	300K	.66 (16.8)
4H	80	RW36	78	4.00 (101.6)	1.12 (28.4)	.75 (19.1)	4A	---	0.30	23K	68.5K	525K	1.31 (33.3)
6H	120	RW37	113	6.00 (152.4)	1.12 (28.4)	.75 (19.1)	4A	---	0.47	38K	112.5K	850K	1.31 (33.3)
6 1/2H	130	---	---	6.50 (165.1)	1.12 (28.4)	.75 (19.1)	4A	---	0.56	41.5K	120K	900K	1.31 (33.3)
8H	160	RW38	159	8.00 (203.2)	1.12 (28.4)	.75 (19.1)	4A	---	0.68	54K	156K	1,15M	1.31 (33.3)
8 1/2H	175	---	---	8.50 (215.9)	1.12 (28.4)	.75 (19.1)	4A	---	0.75	57K	167K	1.25M	1.31 (33.3)
10 1/2H	225	RW47	210	10.50 (266.7)	1.12 (28.4)	.75 (19.1)	4A	---	0.91	72K	210K	1.5M	1.31 (33.3)

† 8 watts      ‡ 12A standard on adjustable type      \*\* Except #1 terminal

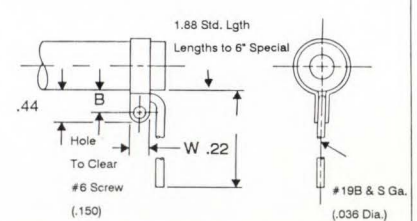
Terminal Style 1



Terminal Style 4A



Terminal Style 12A (no lead) and 13A (with lead)



### TUBULAR STYLE - ADJUSTABLE

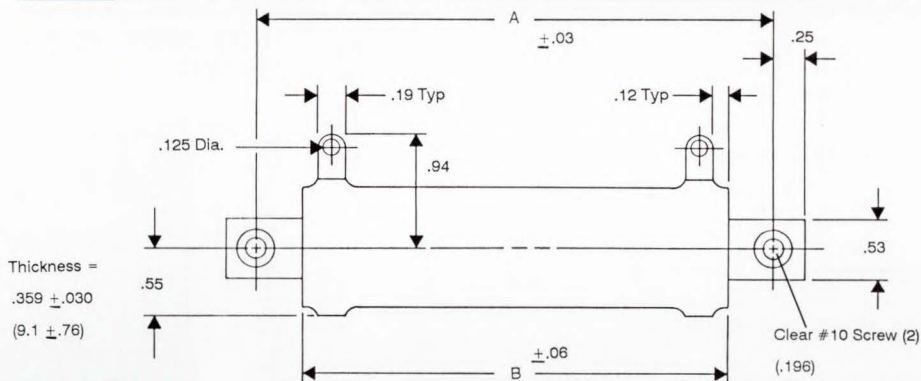
IRC Type	Power Rating at 25° C (watts)	Maximum Resistance (ohms)		
		.0025 Wire	.00175 Wire	.0014 Wire
1 3/4AA	12	2.5K	5.6K	10K
2CA	20	3K	9.5K	10K
2DA	25	4.5K	12K	20K
3CA	26	6K	18K	31K
3DA	35	8.25K	23.8K	40K
4DA	50	12K	35K	60K

IRC Type	Power Rating at 25° C (watts)	Maximum Resistance (ohms)		
		.0025 Wire	.00175 Wire	.0014 Wire
4EA	60	16K	45K	75K
4HA	80	23K	68.5K	110K
6HA	120	38K	112.5K	180K
6 1/2HA	130	41.5K	120K	220K
8HA	160	54K	156K	280K
8 1/2HA	175	57K	167K	300K
10 1/2HA	225	72K	210K	350K



## PWW FLAT STYLE - FIXED

IRC Type	Power Rating at 25° C (watts)	MIL Equivalent		Dimensions in Inches (mm)		Min. Resistance (ohms)	Maximum Resistance (ohms)		
		MIL Style	MIL Power Rating (watts)	Mounting Center A	Core Length B		.0025 Wire	.00175 Wire	.0014 Wire
FRW-20	30	RW20	21	2.00 (50.8)	1.25 (31.8)	0.10	2.75K	8K	15K
FRW-21	40	RW21	31	2.75 (69.9)	2.00 (50.8)	0.10	6K	18K	35K
FRW-22	55	RW22	53	4.25 (108)	3.50 (88.9)	0.20	13K	38K	75K
FRW-23	70	RW23	68	5.50 (121)	4.75 (121)	0.25	19K	56K	110K
FRW-24	95	RW24	91	6.75 (172)	6.00 (152)	0.35	25K	75K	140K



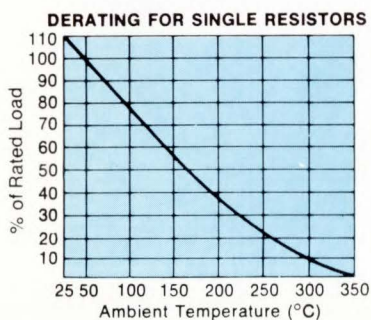
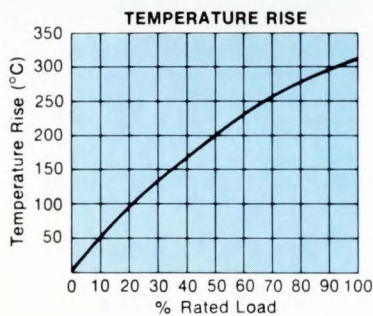
## FLAT STYLE - ADJUSTABLE

IRC Type	Power Rating at 25° C (watts)	Dimensions in Inches (mm)		Minimum Resistance (ohms)	Maximum Resistance (ohms)		
		Mounting Center A	Core Length B		.0025 Wire	.00175 Wire	.0014 Wire
FRWA-21	40	2.75 (69.9)	2.00 (50.8)	0.10	6K	18K	35K
FRWA-22	55	4.25 (108)	3.50 (88.9)	0.20	13K	38K	75K
FRWA-23	70	5.50 (140)	4.75 (121)	0.25	19K	56K	110K
FRWA-24	95	6.75 (172)	6.00 (152)	0.35	25K	75K	140K

\* Adjustable resistors are identified by adding the letter "A" to the designation of standard resistors.

Made in Barbados.

## TEMPERATURE RISE & POWER DERATING



## HOW TO ORDER

Sample Part No:

**FRWA - 23 - 470K - 10%**

IRC Type \_\_\_\_\_  
A = Adjustable

Power \_\_\_\_\_  
23 = 70 watts (See specification chart for other power ratings)

Resistance Value \_\_\_\_\_  
Expressed in ohms (Standard EIA/MIL values)

Tolerance \_\_\_\_\_  
±5% standard for fixed resistors,  
±10% standard for adjustable and tapped



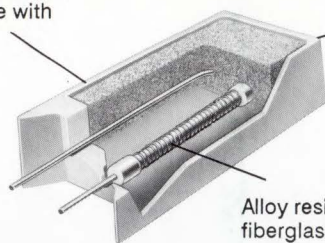


# GENERAL-PURPOSE POWER WIREDOUNDS

## PWR SERIES

- 10 watts
- Radial leads for PC Mount
- 0.1 ohms to 18K ohms
- TC's from 300 ppm/°C to +5500 ppm/°C

Fireproof high temp. ceramic case with stand off



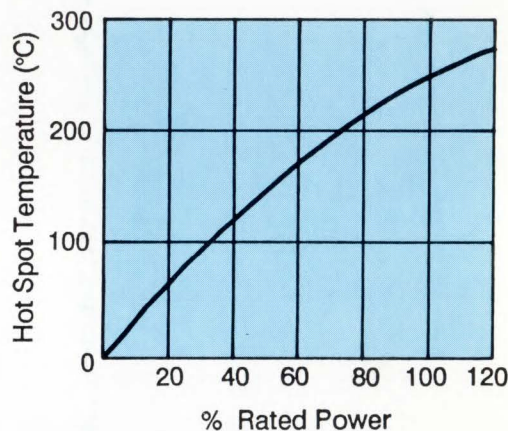
Inorganic fireproof encapsulant

Alloy resistance wire on fiberglass substrate

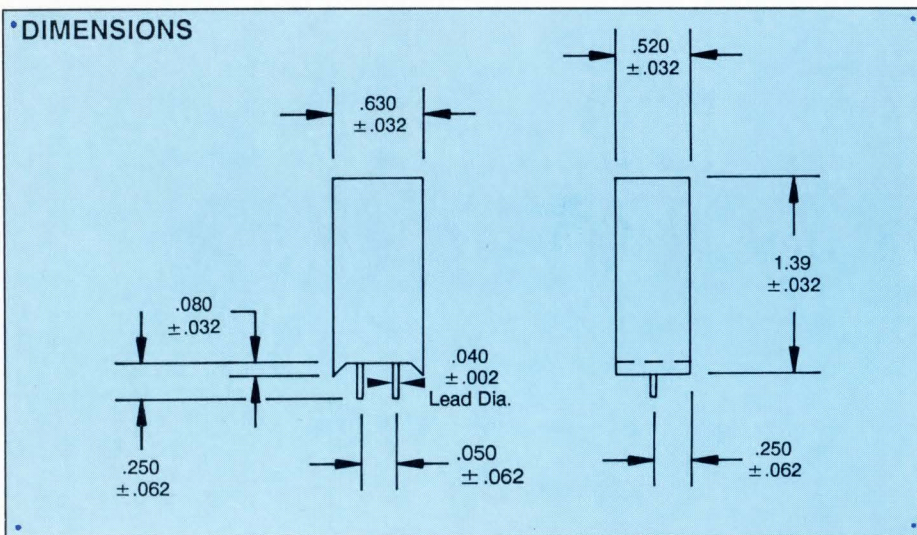
### SPECIFICATIONS:

- Power Rating: 10 watts
- Resistance Range: 0.1 ohms to 18K ohms
- Tolerance:  $\pm 10\%$ ,  $\pm 5\%$
- Flameproof Inorganic Construction
- EIA RS-344, Insulated Fixed Wirewound Resistors

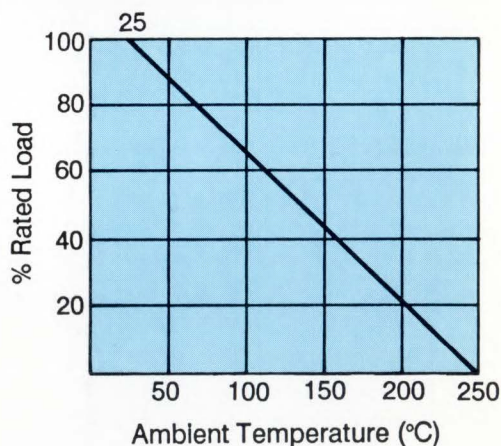
### HOT SPOT TEMPERATURE RISE @ 25°C



### DIMENSIONS



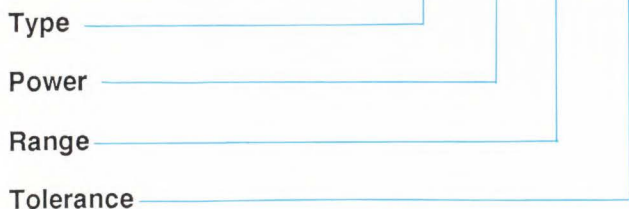
### POWER DERATING



### HOW TO ORDER:

Sample Part No.:

PWR - 10 - 12K - 10%







# GENERAL-PURPOSE POWER WIREWOUNDS FOR PC BOARD APPLICATIONS

## PCH SERIES

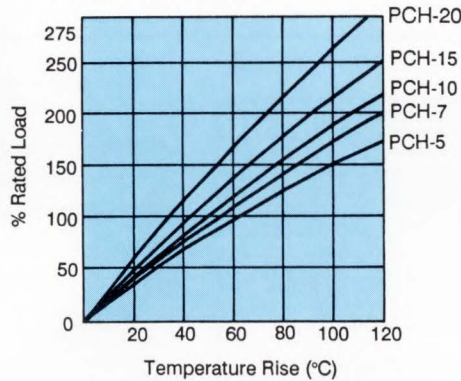
- 5 watts to 20 watts
- $\pm 10\%$ ,  $\pm 5\%$  tolerance
- 1 ohm to 3500 ohms
- $\pm 400$  ppm/ $^{\circ}\text{C}$  TC



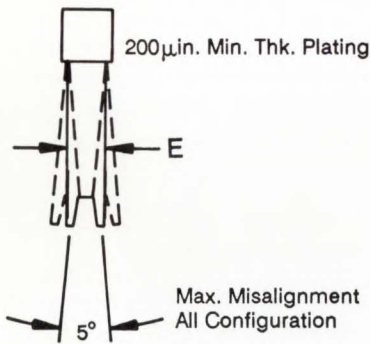
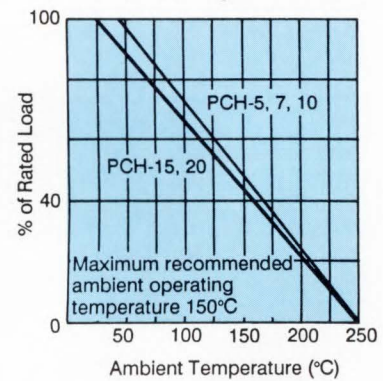
### SPECIFICATIONS

IRC Type	Power @ 25°C (watts)	Resistance Range (ohms)
PCH-5	5	1 to 1100
PCH-7	7	1 to 1600
PCH-10	10	1 to 2600
PCH-15	15	1 to 2400
PCH-20	20	1 to 3500

### POWER DERATING & TEMPERATURE RISE

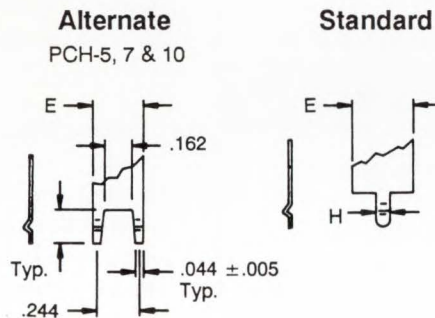


### Power Derating

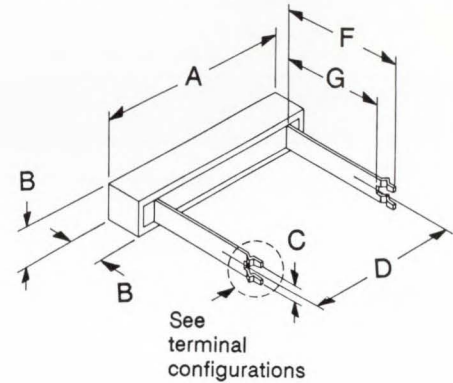


Note: Terminals are 200µ inch min. solder plated steel (.020"  $\pm$  .002" thick).

### TERMINAL CONFIGURATIONS



### PCH CONFIGURATION



### DIMENSIONS - INCHES and (mm)

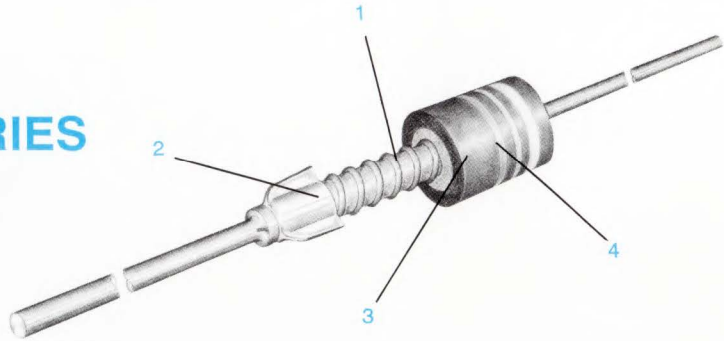
Product & Wattage	A $\pm .030$ ( $\pm .762$ )	B $\pm .030$ ( $\pm .254$ )	C $\pm .030$ ( $\pm .254$ )	D $\pm .244$ (6.20)	G $+.08 -.04$ ( $\pm 2.0$ )	E $\pm .012$ ( $\pm 0.3$ )	H $\pm .008$ ( $\pm 1.4$ )
PCH-5	1.062 (27.000)	.375 (9.525)	.244 (6.20)	.590 (14.99)	.394 (10.0)	.287 (7.3)	.055 (1.4)
PCH-7	1.420 (36.068)	.375 (9.525)	.244 (6.20)	.886 (22.50)	.984 (25.0)	.287 (7.3)	.055 (1.4)
PCH-10	1.875 (47.635)	.375 (9.525)	.244 (6.20)	1.38 (35.05)	.984 (25.0)	.287 (7.3)	.055 (1.4)
PCH-15	1.89 (48.006)	.492 (12.497)		1.28 (32.51)	1.18 (30.0)	.394 (10.0)	.106 (2.69)
PCH-20	2.500 (63.500)	.492 (12.497)		1.87 (47.50)	1.18 (30.0)	.394 (10.0)	.106 (2.69)





**GENERAL-PURPOSE/  
FAILSAFE  
MOLDED  
WIREWOUNDS**

# SP20/SP20F SERIES



- Drop in replacement for BW20/BW20F
- 1 Watt
- $\pm 2\%$ ,  $\pm 5\%$ ,  $\pm 10\%$  tolerance
- 0.1 ohm to 1200 ohms
- TC's as low as  $\pm 150$  ppm/ $^{\circ}$  C std.  
(Custom TC's available)
- .032" copperweld lead

## SPECIFICATIONS

IRC Type	SP-20	SP-20F
EIA RS-344 Style	CRU1	CRU1
MIL-R-11 Style Equivalent	RC20/RC32	RC20/RC32
Resistance - Standard	0.1R to 1200R	0.1R to 1000R
Tolerance - Standard	$\pm 2\%$ , $\pm 5\%$ , $\pm 10\%$	$\pm 2\%$ , $\pm 5\%$ , $\pm 10\%$
Power Rating	1 watt at 50 $^{\circ}$ C 3/4 Watt at 70 $^{\circ}$ C 1/2 watt at 100 $^{\circ}$ C Derating to 0 at 160 $^{\circ}$ C	1 watt at 50 $^{\circ}$ C 3/4 watt at 70 $^{\circ}$ C — Derating to 0 at 160 $^{\circ}$ C
Max. Continuous Working Voltage	$\sqrt{PR}$	$\sqrt{PR}$
Min. Insulation Resistance	Dry 10,000 Megohms Wet 100 Megohms	10,000 Megohms 100 Megohms
Min. Dielectric Withstanding Volts (RMS)	ATM 700V Reduced Pressure 450V	700V 450V
Hotspot Temperature Rise	120 $^{\circ}$ C at 1 watt	120 $^{\circ}$ C at 1 watt
Typical Load Life	0.49%	0.80%
Current Noise	Negligible	Negligible

### 1. Resistive Element

All resistor types have resistance alloy winding on a braided fiberglass substrate. Intermediate silicone coatings are used to enhance processibility and to provide protection to the resistive element.

### 2. Termination

The SP-20 and SP-20F resistors are terminated using an alloy coated copper flashed steel lead welded to a cap of the same material. This termination assembly is mechanically crimped, utilizing an improved crimp design, to the resistive element.

### 3. Encapsulation

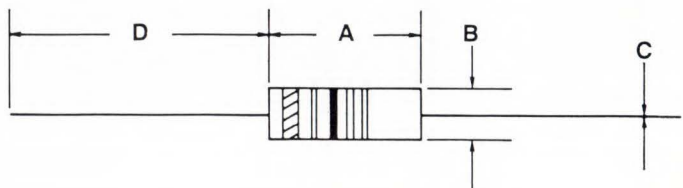
The SP-20 and SP-20F are encapsulated utilizing a compression molded phenolic plastic material. The SP-20F has a flame-resistant coating applied over the resistive element to provide flammability protection when destructive overloads may occur.

### 4. Marking

All products are marked utilizing heat and solvent resistant color code bands consistent with EIA/MIL requirements. The first band is double width to designate wirewound construction. A fifth band, blue in color, is used for flameproof identification.

## DIMENSIONS

IRC Type	SP-20	SP-20F
A $\pm .010$ (.25)	.390 (9.91)	.390 (9.91)
B $\pm .008$ (.20)	.140 (3.56)	.140 (3.56)
C $\pm .002$ (.05)	.032 (.813)	.032 (.813)
D $\pm .126$ (3.2)	1.50 (38.1)	1.50 (38.1)



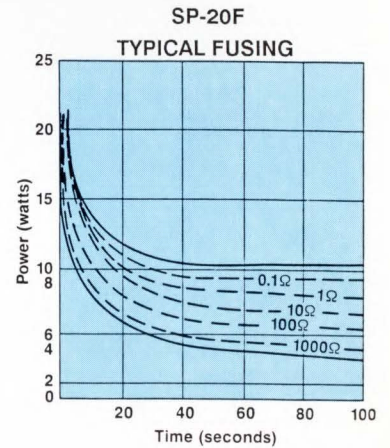
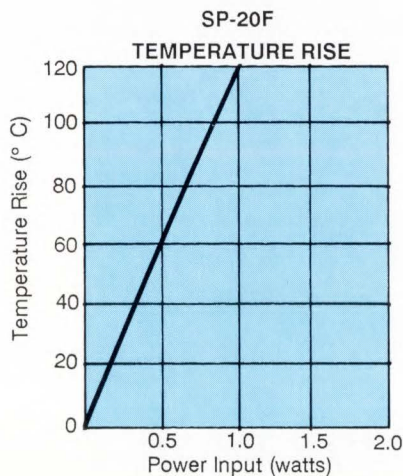
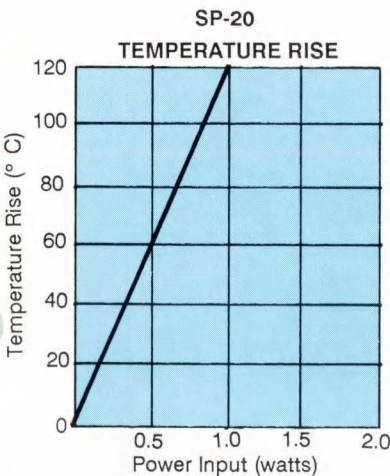
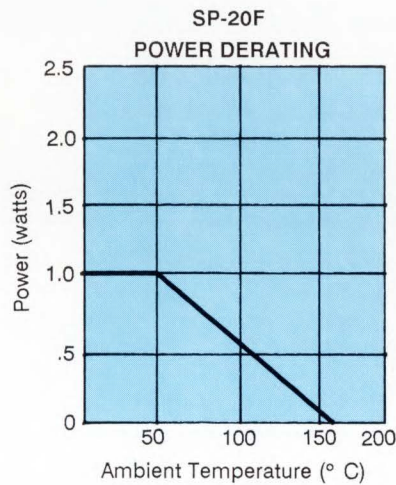
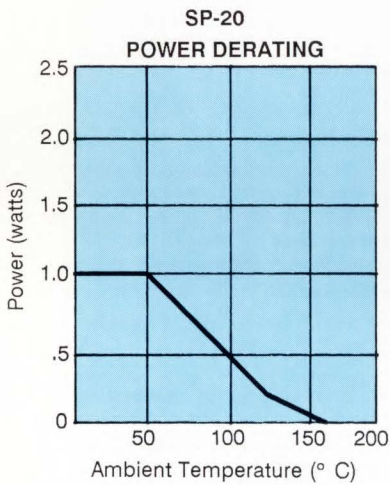


## SP20, SP20F CHARACTERISTICS

Test	EIA RS-344	SP-20 Typical Average	SP-20F Typical Average
Temperature Coefficient (PPM)	< 1R $\pm 800$ ppm	< $\pm 800$	* < $\pm 800$
	$\geq 1R \pm 400$ ppm	< $\pm 150$	< $\pm 150$
Dielectric Withstanding Voltage (RMS)	700V	700V	700V
Momentary Overload	$\pm 4\%$ Max. $\Delta R$	0.31%	0.55%
Low Temperature Operation	$\pm 3\%$ Max. $\Delta R$	0.28%	0.17%
Temperature Cycle	$\pm 5\%$ Max. $\Delta R$	0.30%	0.36%
Humidity	$\pm 5\%$ Max. $\Delta R$	0.70%	0.70%
Load Life	$\pm 10\%$ Max $\Delta R$	0.49%	0.80%
Terminal Strength	$\pm 2\%$ Max. $\Delta R$	0.10%	0.08%
Resistance to Solder Heat	$\pm 4\%$ Max. $\Delta R$	0.36%	0.48%
Solderability	Test Condition 1 RS-178	No Failures	No Failures

\*0.1 ohm SP20F < 1000 ppm.

## TEMPERATURE & POWER DERATING







**GENERAL-PURPOSE/  
FAILSAFE  
MOLDED  
WIREWOUNDS**

**SPH/SPF SERIES**

- Drop-in replacement for BWH/BWF
- 2 Watt
- ±2%, ±5%, ±10% Tolerance
- .05 ohm to 2400 ohms
- TCR's as low as ±400 ppm/° C std  
(Custom TC's available)
- .032" copper lead



**SPECIFICATIONS**

IRC Type	SPH	SPF
EIA RS-344 Style	CRU 2	CRU 2
MIL-R-11 Style Equivalent	RC32/RC42	RC32/RC42
Resistance - Std.	.05 Ω to 2400 Ω	.1Ω to 1000Ω
Tolerance - Std.	±2%, ±5%, ±10%	±2%, ±5%, ±10%
Power Rating	2 watt @ 70°C 1 watt @ 115°C Derating to 0 @ 160°C	2 watt @ 70°C 1 watt @ 115°C Derating to 0 @ 160°C
Max. Continuous Working Voltage	$\sqrt{PR}$	$\sqrt{PR}$
Min. Insulation Resistance	Dry: 10,000 Meg Wet: 100 Meg	10,000 Meg 100 Meg
Min. Dielectric withstanding volts (RMS)	ATM: 1000V Reduced Pressure: 625V	1000V 625V
Hotspot Temperature Rise	145°C @ 2 watts	145°C @ 2 watts
Typical Load Life	0.43%	0.45%
Current Noise	Negligible	Negligible

**1. Resistive Element**

All resistor types have resistance alloy winding on a braided fiberglass substrate. Intermediate silicone coatings are used to enhance processibility and to provide protection to the resistive element.

**2. Termination**

The SPH and SPF resistors are terminated using an alloy coated copper flashed steel lead welded to a cap of the same material. This termination assembly is mechanically crimped, utilizing a 6 point crimp design, to the resistive element.

**3. Encapsulation**

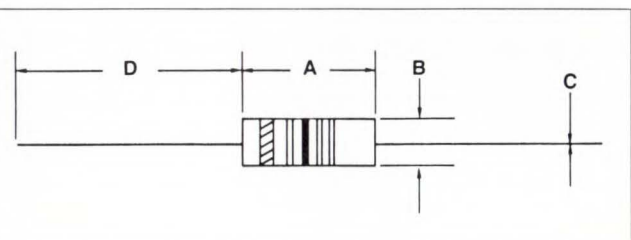
The SPH and SPF are encapsulated utilizing a compression molded phenolic plastic material. The SPF has a flame-resistant coating applied over the resistive element to provide flammability protection when destructive overloads may occur.

**4. Marking**

All products are marked utilizing heat and solvent resistant color code bands consistent with EIA/MIL requirements. The first band is double width to designate wirewound construction. A fifth band, blue in color, is used for flameproof identification.

**DIMENSIONS**

IRC Type	SPH	SPF
A ± .010 (.25)	.562 (14.3)	.562 (14.3)
B ± .008 (.20)	.225 (5.72)	.225 (5.72)
C ± .002 (.05)	.032 (.813)	.032 (.813)
D ± .126 (3.2)	1.50 (38.1)	1.50 (38.1)





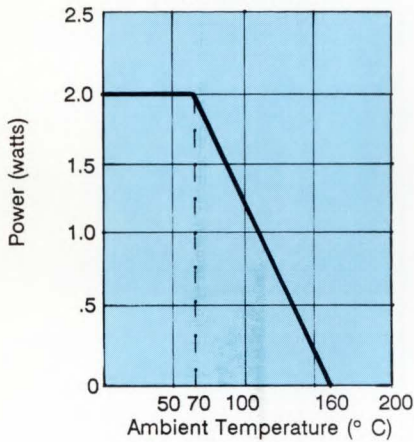
### SPH/SPF CHARACTERISTICS

Test	EIA RS-344	SPH Typical Average	SPF Typical Average
Temp. Coefficient (PPM)*	< 1R ± 800 ppm ≥ 1R ± 400 ppm	0.05 Ω - 0.16 Ω ±1000 0.18 Ω - 0.68 Ω ±800 0.75 Ω - 2400 Ω ±400	0.10 Ω ±1700 0.11 Ω - 0.16 Ω ±1000 0.18 Ω - 0.68 Ω ± 800 0.75 Ω - 1000 Ω ± 400
Dielectric withstanding Volt.(RMS)	1000V	1000V	1000V
Momentary Overload	±4% Max Δ R	0.2%	0.3%
Low Temp. Operation	±3% Max. Δ R	0.3%	0.4%
Temperature Cycle	±5% Max. Δ R	0.3%	0.4%
Humidity	±5% Max.ΔR	0.5%	0.6%
Load Life	±10% Max.Δ R	0.5%	0.5%
Terminal Strength	±2% Max. Δ R	0.05%	0.04%
Resistance to Solder Heat	±4% Max. Δ R	0.3%	0.1%
Solderability	Test Condition 1 RS-178	No Failures	No Failures

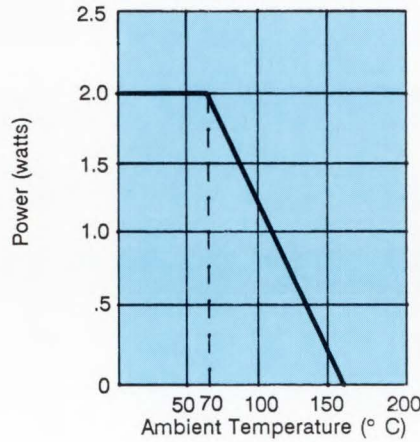
\*All ppm levels listed are maximum.

### POWER DERATING & TEMPERATURE RISE

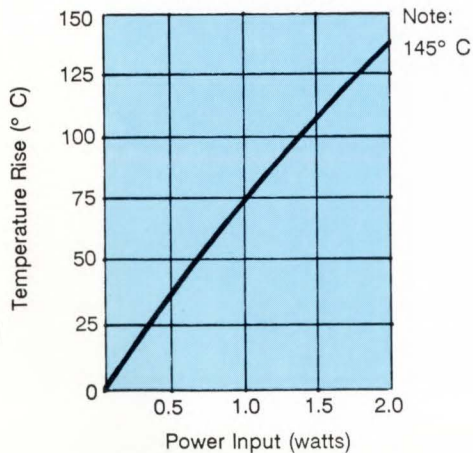
**SPH  
POWER DERATING**



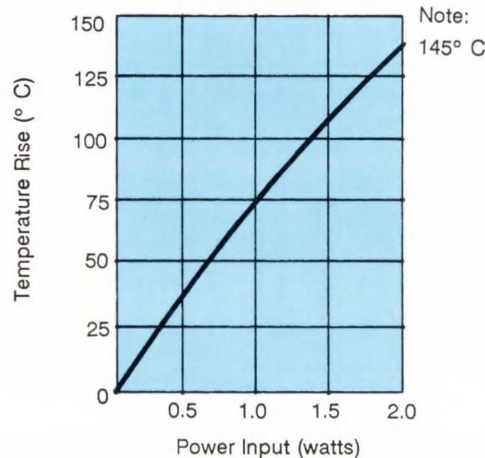
**SPF  
POWER DERATING**



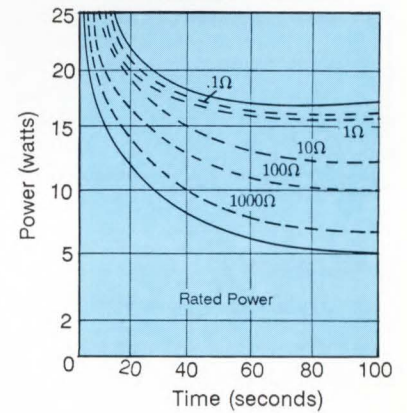
**SPH  
TEMPERATURE RISE**



**SPF  
TEMPERATURE RISE**



**TYPICAL SPF FUSING**







# LOW-COST GENERAL-PURPOSE CONFORMAL COATED WIREWOUND

## SPP SERIES

- Color band standard identification; (stamped marking also available)
- Coated or uncoated units
- Positive high T.C.'s upon request
- Weldable and solderable magnetic leads

EIA/MIL color code  
First wide band indicates  
wirewound construction,  
blue indicator indicates  
flameproof.



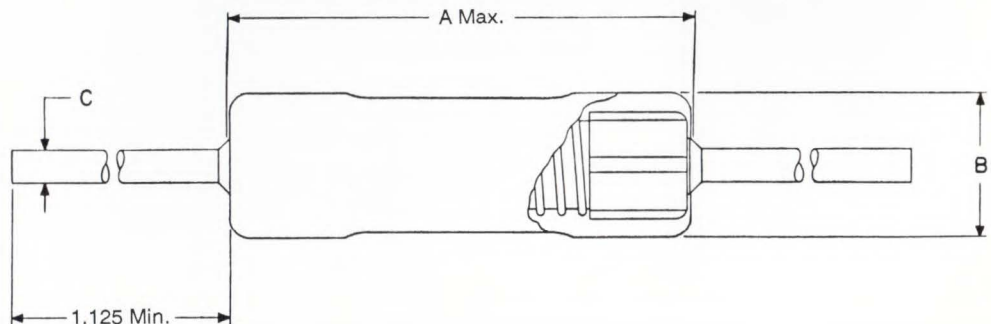
### SPECIFICATIONS

IRC Type	SPP-1	SPP-2		
Resistance - Standard	.1 ohm thru 1200 ohm*	.1 ohm thru 2400 ohm		
Tolerance - Standard	+5%, +10%	+5%, +10%		
Power Rating	1W @ 85° C 3/4W @ 105° C 1/2W @ 125° C Derating to 0 @ 160° C	2W @ 85° C 1W @ 140° C ---- ----		
Load Life Stability	1W@ 85° C ±10%	2W @ 85° C ±10%		
Max. Continuous Working Voltage	$\sqrt{PR}$	$\sqrt{PR}$		
Min. Insulation Resistance - Dry	10,000 Megohm	10,000 Megohm		
Min. Insulation Resistance - Wet	100 Megohm	100 Megohm		
Min. Dielectric Withstanding Voltage	600 Volts RMS	600 Volts RMS		
Current Voltage	Negligible	Negligible		
Standard Resistance	*0.10 ohm to 1000 ohm	*0.10 ohm to 2400 ohm		
Temp. Rise at Rated Load, 25° C Ambient	Approx. 200° C	Approx. 200° C		
Temp. Coef.	±600/° C 0.10 ohm to 0.91 ohm	±300/° C 1.0 ohm to 1200 ohm	±600/° C 0.10 ohm to 0.91 ohm	±300/° C 1.0 ohm to 2400 ohm

\*For lower ranges consult factory.

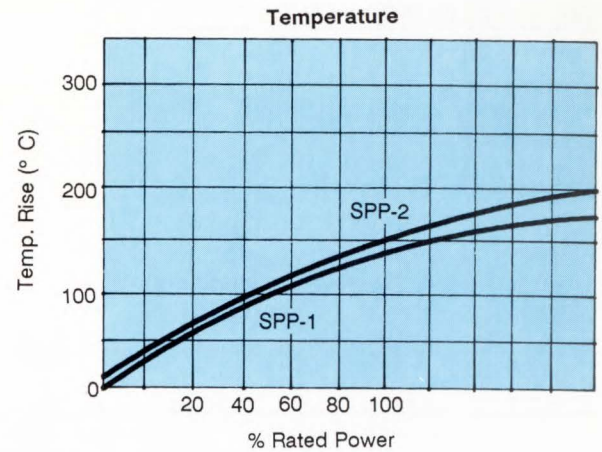
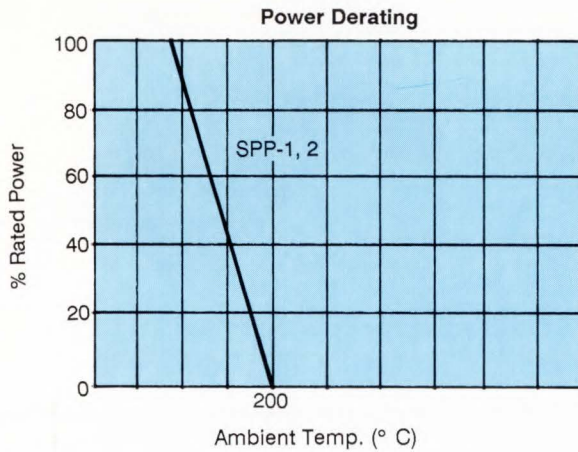
### DIMENSIONS

IRC Type	A	B	C ±.002
SPP-1	.400 max.	.148 max.	.032
SPP-2	.570 max.	.170 max.	.032





## SPP POWER DERATING & TEMPERATURE



## FUSE/PULSE APPLICATIONS

SPP resistors normally fuse in less than one minute with five to ten times rated wattage depending on the range. By modifying the windings, using a different wire size or type, they can be made to fuse much faster.

On the other hand, by using larger wire diameters and higher melt temperature alloys they can handle high overloads (pulses). A standard SPP can handle from five to fifty times the overloads of film resistors depending on the range.

## CHARACTERISTICS

Characteristics	Maximum Limits
Temperature Coefficient	SPP-1: $\pm 600/^{\circ}\text{C}$ 0.10 ohms to 0.91 ohms $\pm 300/^{\circ}\text{C}$ 1.0 ohms to 1200 ohms
	SPP-2: $\pm 600/^{\circ}\text{C}$ 0.10 ohms to 0.91 ohms $\pm 300/^{\circ}\text{C}$ 1.0 ohms to 2400 ohms
Thermal Shock	$\pm 5\%$
Low Temperature	$\pm 5\%$
Short Time Overload	$\pm 5\%$
Commercial Short Time Overload	$\pm 5\%$
Resistance to Solder Immersion	$\pm 3\%$
Solderability	95% minimum coverage
Moisture Resistance	$\pm 5\%$
Life Test	$\pm 5\%$
Test Method	EIA Specification RS344

## HOW TO ORDER

Sample Part No.: **SPP** **1** **1K** **5%**

**IRC Type** \_\_\_\_\_

**Power** \_\_\_\_\_

(See specification chart for other power ratings)

**Resistance Value** \_\_\_\_\_

Expressed in ohms (Standard EIA/MIL Values)

**Tolerance** \_\_\_\_\_

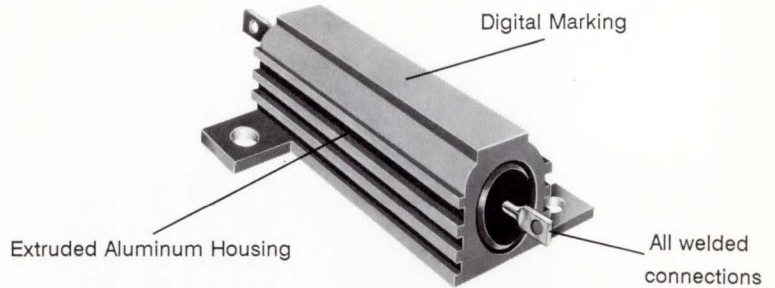
$\pm 10\%$ ,  $\pm 5\%$  standard



# CHASSIS MOUNTING WIREWOUND RESISTORS

## WH SERIES\*

- High power for size
- Standard or low inductance winding
- Approved to CECC 40 203-001 and CCTU; conforms to MIL-R 18546 and 39009
- Suitable for high dissipation, heat sink mounting applications in severe environments
- Flameproof

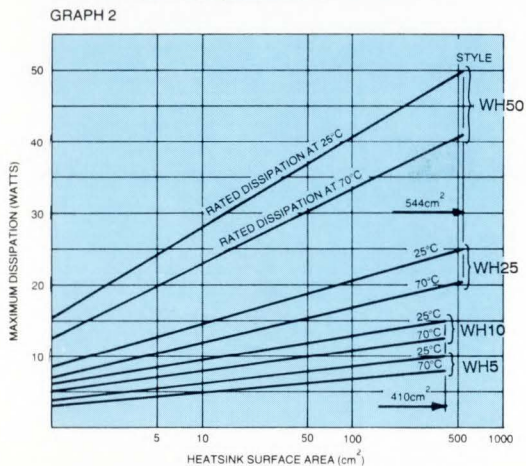
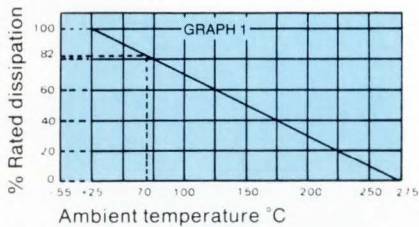


### SPECIFICATIONS

Type	Max. Dissipation (watts)			CECC 40 203 001 Rated Dissipation (watts) @ 25° ambient	Approved Resistance Range (ohms)	Limiting Element Voltage (dc or ac rms)	Isolation Voltage (ac pk)	Low Inductance Winding	
	Without Heatsink	With Heatsink at ambient						Type	Resistance Range (ohms)
		25° C	70° C						
WH5/WH5N*	5.0	10	8.2	10	0.05 - 3.4K	150V	1000V	WH5N	0.05 - 2.61K
WH10/WH10N	6.0	15	12.3	15	0.05 - 15K	250V	1000V	WH10N	0.05 - 2.61K
WH25/WH25N	12.5	25	20.5	25	0.05 - 33K	500V	2000V	WH25N	0.05 - 11K
WH50/WH50N	25.0	50	32.8	*40	0.05 - 82K	1250V	2000V	WH50N	0.05 - 30.1K

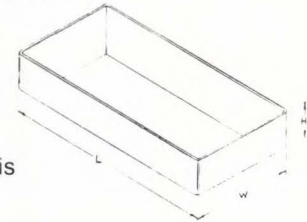
\* N Designates non-inductive winding  
Type WH50 has a 50W capability at 25°C ambient temperature.

### POWER DERATING



### Reference Aluminum Heatsink Dimensions

Aluminium thickness 1mm.



Reference chassis

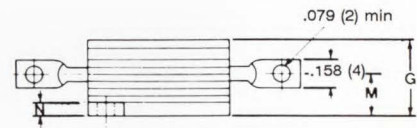
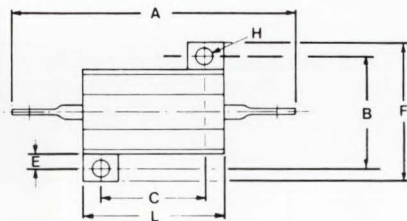
Type	L (in)	W (in)	H (in)	Reference Area (sq. in)
WH 5, WH10	6.2	4.0	2	164
WH25, WH50	7.2	5.2	2	218

\*Manufactured in the U.K.



### CHASSIS MOUNT DIMENSIONS - IN. and (MM)

Type	A Max.	B ±.012 (±0.3)	C ±.012 (±0.3)	E Min.	F Max.	G Max.	H ±.008 (±0.2)	L Max.	M ±.019 (±0.5)	N Max.
WH5/WH5N	1.181 (30.0)	.490 (12.40)	.450 (11.30)	.075 (1.90)	.669 (17.0)	.355 (9.0)	.095 (2.40)	.669 (17.0)	.169 (4.3)	.098 (2.50)
WH10/WH10N	1.437 (36.5)	.620 (15.90)	.562 (14.3)	.075 (1.90)	.827 (21.0)	.433 (11.0)	.095 (2.40)	.827 (21.0)	.205 (5.20)	.126 (3.20)
WH25/WH25N	2.008 (51.0)	.780 (19.8)	.720 (18.3)	.110 (2.80)	1.102 (28.0)	.591 (15.0)	.130 (3.30)	1.141 (29.0)	.283 (7.20)	.126 (3.20)
WH50/WH50N	2.854 (72.5)	.840 (21.40)	1.563 (39.70)	.110 (2.80)	1.181 (30.0)	.669 (17.0)	.130 (3.30)	2.008 (51.0)	.311 (7.90)	.126 (3.20)



#### ENVIRONMENTAL DATA:

Load Life:  $\pm(1\% + .05 \text{ ohm}) \Delta R$   
 Moisture Resistance:  $\pm(1\% + .05 \text{ ohm}) \Delta R$   
 Thermal Shock:  $\pm(.25\% + .05 \text{ ohm}) \Delta R$   
 Overload:  $\pm(1\% .05 \text{ ohm}) \Delta R$   
 Temperature Coefficient:  
 $\pm 50 \text{ ppm}/^\circ \text{C}$  less than 1 ohm  
 $\pm 30 \text{ ppm}/^\circ \text{C}$  1 ohm and above

#### MECHANICAL DATA:

Construction. The wire element is wound on a high purity ceramic rod, and all electrical connections are welded. The assembled and wound rod is encapsulated in a specially selected molding material and then cased in an extruded aluminum housing, ensuring electrical stability and reliability.

#### HOW TO ORDER:

Sample Part No.:

WH - 5 - 100 ohm -  $\pm 5\%$

Type

Power

Resistance  
Value

Tolerance

$\pm 1\%$ ,  $\pm 5\%$ ,  $\pm 10\%$

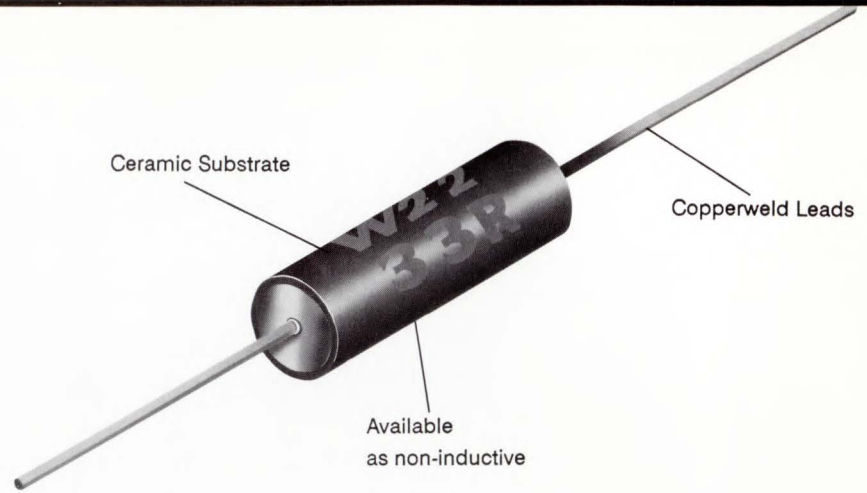




# VITREOUS ENAMELLED WIREWOUND RESISTORS

## W20 SERIES\*

- High dissipation: 2.5 to 12 watts at 70°C
- All electrical connections welded
- Suitable for harsh environments
- Inorganic materials
- Digital marking



\*Manufactured in the U.K.

### SPECIFICATIONS:

Type	BS CECC40 201-002 Style	Resistance Range (ohms)					Rated Dissipation at 70°C (watts)	Limiting Element Voltage (DC or AC RMS)
		Min. at ±10%	Min. at ±5%	Min. at ±2%	Min. at ±1%	Max. at all Tols.		
W21	JB	0.1	0.3	0.5	1	10K	2.5	100
W215	HB	0.15	0.3	0.5	1	15K	4.3	160
W22	KB	0.1	0.3	0.5	1	20K	6	200
W23	LB	0.15	0.5	1	1	60K	9	500
W24	MB	0.2	0.5	1	1	100K	12	750

**Selection Tolerances.** Standard ±5%, ±10%. ±1%, ±2% available upon request.

**Inductance.** Inductance is dependent on resistance value and the following information is intended as a guide. More detailed information for specific applications is available upon request. W21 up to 20 ohm, W215 up to 180 ohm, W22 up to 150 ohm, W23 up to 75 ohm, W24 up to 50 ohm: inductance is typically less than 2µH.

**Voltage Coefficient.** Negligible.

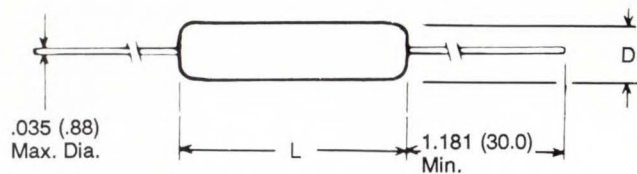
**Noise.** Current noise is zero.

**Construction.** A high purity ceramic substrate is assembled with force fit end caps to which are welded the termination wires. The resistive element is wound on the substrate and the ends welded to the caps; the vitreous enamel protective coating is then applied to the body.

#### Environmental Data:

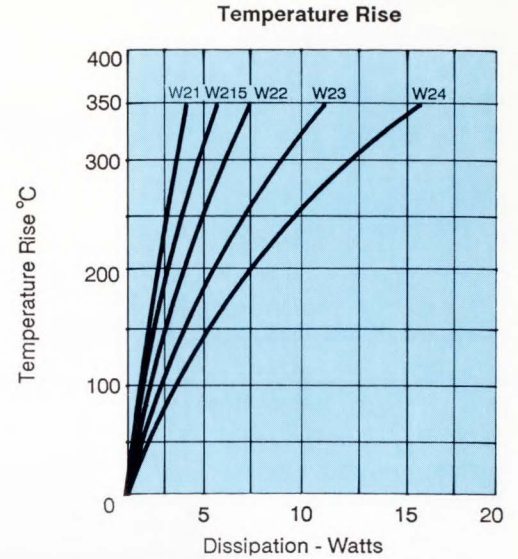
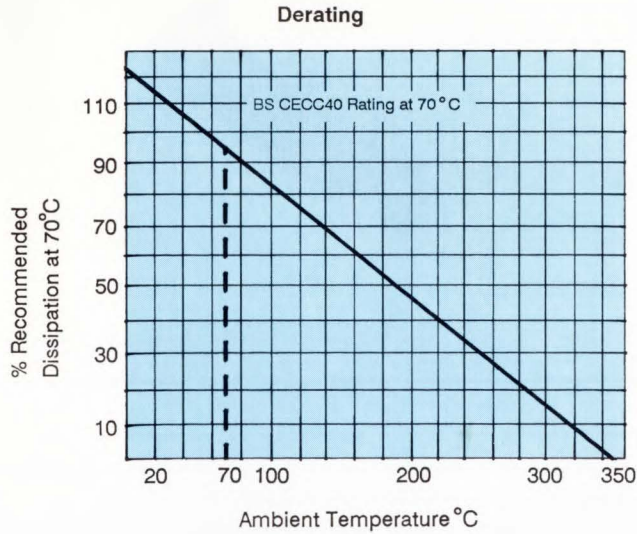
Load Life: ±(2% + .05 ohm) ΔR  
 Moisture Resistance: ±(1% + .05%) ΔR  
 Thermal Shock: ±(0.2% + .05 ohm) ΔR  
 Shelf Life: ±(0.1% + .05 ohm) ΔR  
 Soldering Resistance To Heat:  
 ±(0.1% + .05 ohm) ΔR  
 Temperature Coefficient:  
 Typically less than ±75 ppm/°C  
 Maximum 120 ppm/°C.

DIMENSIONS - IN. and (MM)		
Type	L	D
W21	.500 (12.70)	.220 (5.60)
W215	.905 (23.0)	.275 (7.0)
W22	.875 (22.20)	.315 (8.0)
W23	1.500 (38.10)	.315 (8.0)
W24	2.106 (53.50)	.315 (8.0)





## W20 POWER DERATING & TEMPERATURE:



### APPLICATION NOTES:

The terminations should not be bent closer than .059 (1.5) from the body, and the recommended minimum bend radius is .039 (1).

If resistors are to dissipate full rated power, the terminations should not be soldered closer than .157 (4) from the body.

If operated in an ambient of 20° C, permissible dissipation is approximately 20% greater than the 70° C figure for

the same performance. (See Derating Chart). If some reduction of stability is acceptable the resistor may be permitted to dissipate a higher power, providing always that surface temperature does not exceed 400° C. (See Temp. Chart).

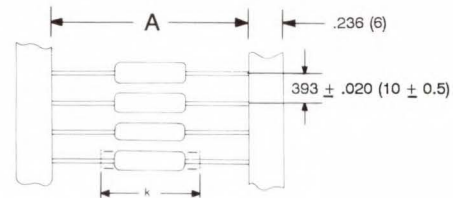
When cold, vitreous enamel has excellent insulation resistance. In common with all insulants with specific resistance of the enamel decreases with increase in temperature. Therefore, resistors operated at near maximum temperature

cannot be classed as insulated and should not be used in contact with any conducting material.

Care must be taken when determining clearance distance between the resistor body and the printed circuit board or other components to ensure these are not over heated. Reference to Temp. Chart will indicated the derating necessary to avoid damage. Resistance is measured .236 (6) from the body.

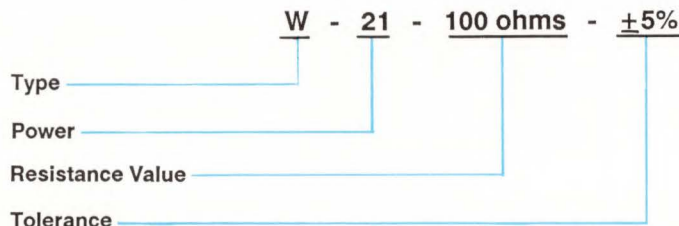
### TAPING DIMENSIONS:

Type	Dimension A ±.079 (2)	Maximum Quantity Per Reel
W21	2.52 (64)	1000
W215	2.89 (73)	800
W22	2.89 (73)	700



### HOW TO ORDER:

Sample Part No.:



### PACKAGING:

Tape & reel or bulk. Bulk only W23, W24.



# VITREOUS ENAMEL WIREWOUNDS

## 1600/1900 SERIES\*

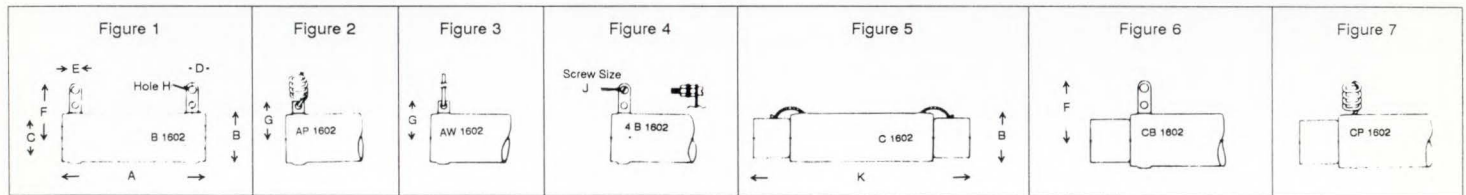
- 5W to 208W
- TC  $\pm 75$  ppm typically
- Thirteen tube sizes, seven termination styles
- Available with Fixed, Adjustable, Tapped or Low Inductance windings



### FIXED TUBULAR RESISTORS

#### DIMENSIONS - INCHES and (MM)

Tube Size	A Max.	B Max.	C Nom.	D Nom.	E Max.	F Max.	G Nom.	H $\pm .059$ ( $\pm .150$ )	K Max.
1601	1.30 (33.0)	.698 (17.50)	.323 (8.20)	.177 (4.50)	.197 (5.00)	.768 (19.50)	.591 (15.00)	.126 (3.20)	2.323(59.00)
1905	2.210 (56.10)	.571 (14.50)	.256 (6.50)	.177 (4.50)	.197 (5.00)	.689 (17.50)	.394 (10.00)	.126 (3.20)	----
1600	2.421 (61.50)	.571 (14.50)	.256 (6.50)	.177 (4.50)	.197 (5.00)	.689 (17.50)	.394 (10.00)	.126 (3.20)	----
1602	2.008 (51.00)	.689 (17.50)	.323 (8.20)	.177 (4.50)	.197 (5.00)	.768 (19.50)	.394 (15.00)	.126 (3.20)	3.031 (77.00)
1906	2.520 (64.30)	.689 (17.50)	.323 (8.20)	.177 (4.50)	.197 (5.00)	.768 (19.50)	.591 (15.00)	.126 (3.20)	3.543 (90.00)
1603	2.933 (74.50)	.689 (17.50)	.323 (8.20)	.177 (4.50)	.197 (5.00)	.768 (19.50)	.591 (15.00)	.126 (3.20)	3.976 (101.00)
1604	4.015 (102.00)	.689 (17.50)	.323 (8.20)	.177 (4.50)	.197 (5.00)	.768 (19.50)	.591 (15.00)	.126 (3.20)	5.039 (128.00)
1605	3.534 (89.50)	.945 (24.00)	.521 (13.20)	.224 (5.70)	.268 (6.80)	1.043 (26.50)	.591 (15.00)	.165 (4.20)	4.803 (122.00)
1908	4.015 (102.00)	.945 (24.00)	.521 (13.20)	.224 (5.70)	.268 (6.80)	1.043 (26.50)	.669 (17.00)	.165 (4.20)	5.275 (134.00)
1607	4.015 (102.00)	1.26 (32.00)	.750 (19.20)	.276 (7.00)	.385 (9.80)	1.260 (32.00)	.866 (22.00)	.256 (6.50)	5.275 (134.00)
1606	6.535 (166.00)	.945 (24.00)	.521 (13.20)	.224 (5.70)	.268 (6.80)	1.043 (26.50)	.669 (17.00)	.165 (4.20)	7.795 (198.00)
1608	5.984 (152.00)	1.26 (32.00)	.750 (19.20)	.276 (7.00)	.385 (9.80)	1.260 (32.00)	.866 (22.00)	.256 (6.50)	7.244 (184.00)
1609	8.504 (216.00)	1.26 (32.00)	.750 (19.20)	.276 (7.00)	.385 (9.80)	1.260 (32.00)	.866 (22.00)	.256 (6.50)	9.763 (248.00)



### TERMINATIONS

Styles B, 4B, AP and AW are available in all 13 tube sizes.

Styles C, CB and CP are available in sizes 1601 to 1609 inclusive, 1906 and 1908.

**Lugs (Figure 1):** 60/40 solder coated nickel iron. Denoted by prefix 'B' to size reference, thus: B1602.

**Pigtails (Figure 2):** 14/.193mm copper, 5.90 (150) minimum length. Denoted by prefix 'AP': thus AP1602.

**Rigid wires (Figure 3):** .047 (1.2) diameter tinned copper, 1.260 (32) minimum length. Denoted by prefix 'AW': thus AW1602.

**Lugs with screws, nuts and washers (Figure 4):** Nickel plated brass screws and nuts. Denoted by prefix '4B': thus 4B1602.

**Ferrule, electrically live (Figure 5):** Nickel plated brass. Denoted by prefix 'C': thus C1602.

**Ferrule, electrically isolated (Figure 6):** Connection to resistor via 60/40 solder coated nickel iron lugs. Denoted by prefix 'CB': thus CB 1602.

**Ferrule, electrically isolated (Figure 7):** Connection to resistor via pigtails of 14/.193mm copper, 5.90 (150) minimum length. Denoted by prefix 'CP': thus CP1602.

### MARKING

The resistors are legend marked with type reference resistance value, tolerance and manufacturing date code.

\*Manufactured in the U.K.



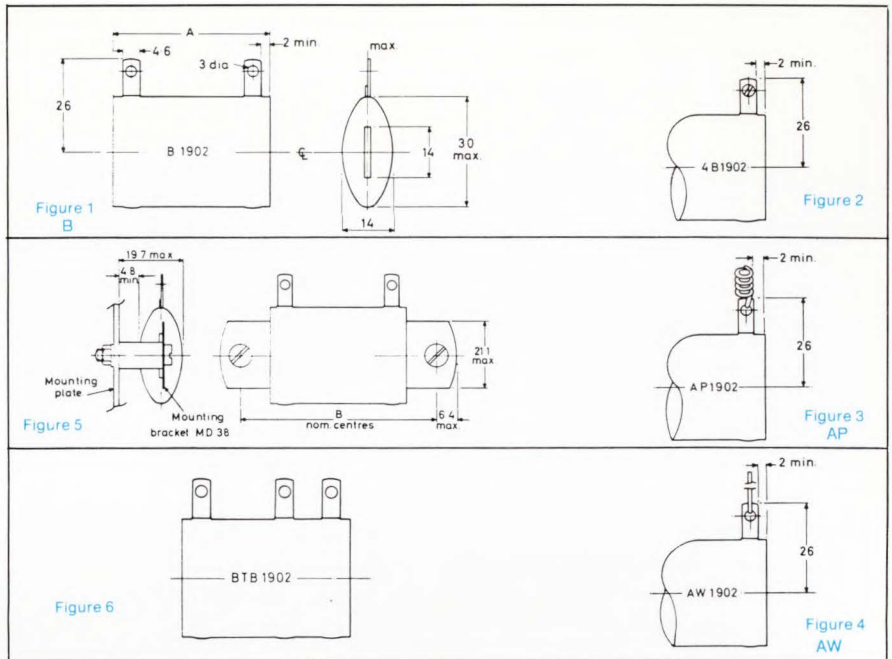
# ELLIPTICAL VITREOUS ENAMELLED WIREWOUNDS

## DIMENSIONS - INCHES and (MM)

See Figures 1 and 2

Size Ref.	Resistor Length A Max.	Fixing Centers B Nom.
1900	1.043 (26.5)	1.772 (45.0)
1901	1.280 (32.5)	2.008 (51.0)
1902	1.692 (43.0)	2.402 (61.0)
1903	2.047 (52.0)	2.756 (70.0)
1904	3.524 (89.5)	4.252 (108.0)

Any termination style, B, 4B, AP, or AW is available in each of the five sizes.



## ELECTRICAL DATA

Size Ref.	*Dissipation (watts) to produce operating hotspot temperature of				Resistance Range (ohms)					Limiting Element Voltage
	Ambient = 20° C			Ambient = 70° C	Min. Resistance at				Max. Value	
	200° C	300° C	375° C	375° C	+10%	+5%	+2%	+1%		
1900	8.5	16	23	18.5	1	4	20	40	2.8K	140
1901	9.5	18	26	21.0	1	6	40	70	4.8K	250
1902	11.0	21	30	24.0	2	10	60	70	8.3K	400
1903	12.0	24	35	27.0	2	14	60	100	11.5K	530
1904	20.0	40	56	43.0	4	30	60	100	24.4K	1100

\*The stated dissipation applies to single resistors mounted as shown in Figure 5.

## TAPPED RESISTORS

Size Ref.	*Maximum Total Dissipation (watts) with Single Tap	Maximum Total Resistance with Single Tap (ohms)	Maximum Number of Taps
1902	21	5.8K	1
1903	27	90K	1
1904	50	22.0K	2

\* Maximum total dissipation assumes that this will be evenly spread over the total element length, and will produce a hot spot temperature of 375° C in 20° C ambient.

Enquiries for tapped resistors should stated the following details:

- Resistance per section. Maximum dissipation per sections.
- Maximum operating ambient temperature. Maximum permissible dimensions, if important.
- Type of terminations required.
- Proposed method of mounting: vertical or horizontal axis; flat or on edge.
- Details of stacking, where applicable.

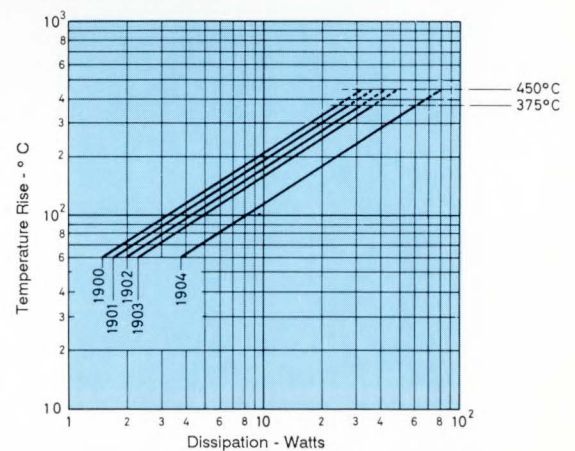
## ENVIRONMENTAL DATA

Load Life: ±5% after 1000 hours operation at recommended dissipation.

Moisture Resistance: +(2% +.05 ohm)ΔR.

Shelf Life: +(1% +.05 ohm)ΔR.

## TEMPERATURE RISE



## ORDERING PROCEDURE

Specify full type reference, resistance value and tolerance, using IEC resistance code. E.g. B1902/10R +5% is a resistor of size 1902 with B style lugs, 10 ohm +5%.



## TUBULAR ELECTRICAL DATA

Tube Size	*Dissipation (watts) to Produce Operating Hotspot Temperature (%C) of:				Resistance Range (ohms)				Limiting Element Voltage		Low Inductance Winding Resistance Range (ohms)		
	200	300	375	375	Minimum Resistance at			Max. at Any Tol.	Termination Style		Min. Res. at		Max. At Either Tol.
	Ambient of 20° C				±5%	±2%	±%		C	All Others	±10%	±5%	
Ambient 70° C													
1601	5	10	14	11	1	15	25	15K	250	150	10	50	1.3K
1905	7	14.5	20	16	1	15	30	30K	----	450	10	50	3.5K
1600	7.5	15	21	16.5	1	15	30	56K	----	600	10	50	5.0K
1602	8	15.5	22	17	1	20	25	43K	500	350	10	50	4.0K
1906	9.5	19	28	22	1	20	30	50K	700	550	10	50	5.5K
1603	11	22	32	25	1	20	30	83K	850	750	10	50	7.5K
1604	15.5	31	45	35	1	20	60	100K	1300	1000	15	50	11.5K
1605	21	41	59	47	1	30	40	100K	1100	900	15	50	14K
1908	24	47	68	54	1	30	40	100K	1200	1000	10	50	16K
1607	34	66	95	76	1	30	50	100K	1300	900	15	50	22K
1606	41	80	115	91	1	30	40	160K	2100	1900	15	50	32K
1608	52	101	145	115	1	30	50	180K	2100	1800	20	50	38K
1609	74	145	208	165	1	35	50	250K	3000	2500	30	100	58K

\*The stated dissipation applies to resistors mounted horizontally with unobstructed bore.

**HOW TO ORDER:** For Fixed Tubular Resistors specify full type reference, resistance value and tolerance, using IEC resistance code. For example, C1602/10R 5% is a resistor of size 16-2 with electrically live ferrules, 10 ohm +5%. For Low Inductance Windings specify the full type reference, resistance value and tolerance, using IEC code references. The addition of "L" to the prefix describing terminal configuration indicates Ayrton-Perry winding. E.G. BL 1602/50R +5%.

## ADJUSTABLE RESISTORS - TUBULAR

### ADJUSTABLE - HOT SPOT TEMP/MIN. MAX. RANGE

Tube Size	Max. Dissipation in 20° C Ambient (watts)		Resistance Range (ohms)		
	200° C Hotspot	300° C Hotspot	Min. for Styles	Min. for All	Max. for All
			VC, VCP	Other Styles	All Styles
1602	8	15.5	4	3	1.6K
1906	9.5	19	4	3	2.5K
1603	11	22	6	6	3.0K
1604	16	31	8	8	5.3K
1605	21	41	6	6	4.5K
1908	24	47	11	10	7.5K
1607	34	66	11	9	8.1K
1606	41	80	14	13	13.2K
1608	52	101	17	16	15.4K
1609	74	145	25	24	24.5K

## TAPPED RESISTORS

Tube Size	*Maximum Total Dissipation in 20° C Ambient (watts) With Single Tap	Max. Total Resistance With Single Tap (ohms)	Max. Number of Taps	Figure 9
1905	14.5	9K	1	* Maximum total dissipation assumes that this will be evenly spread over the total element length.
1600	15.0	12K	1	
1602	15.5	9K	1	
1906	19.0	13K	1	
1603	22.0	18K	1	
1604	31.0	29K	2	
1605	41.0	34K	2	
1908	47.0	38K	2	
1607	66.0	53K	2	
1606	80.0	78K	4	
1608	101.0	93K	4	
1609	145.0	140K	4	

### Standard Selection Tolerances:

Standard Winding: ±5%, ±2%, ±1%  
 Low inductance winding: ±10%, ±5%

### Temperature Coefficients of Resistance:

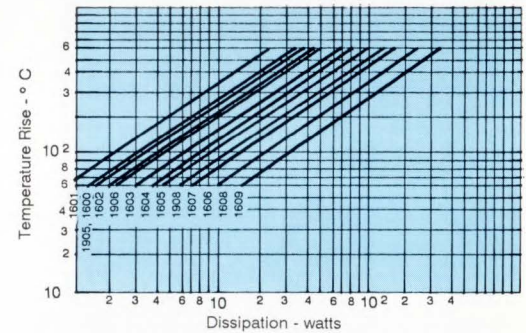
TCR is typically ±75ppm/° C and will not exceed ±120ppm/° C.

**Noise:** Current noise is zero.

### Low Inductance Windings:

Ayrton-Perry wound elements are supplied for low inductance applications. This winding style has a maximum permissible hot spot temperature of 300° C. The maximum dissipation is defined in the Electrical Data Table under the heading Operating Hotspot Temperature of 300° C and resistance ranges are defined in the three right hand columns of this table.

## TEMPERATURE RISE



## ADJUSTABLE - DIMENSIONS - INCHES and (MM)

Tube Size	Figure 8			
	A mm Max.	B mm Max.	Hole C Dia. mm	Max. No of Adjusting Bands
1602, 1603, 1906	20	25	3	1
1604	20	25	3	3
1605, 1908	25	30	4	2
1606	25	30	4	4
1607	30	35	4	2
1608	30	35	4	3
1609	30	35	4	5

All other dimensions are as for fixed resistors.

### ENQUIRES for Tapped Resistors must state:

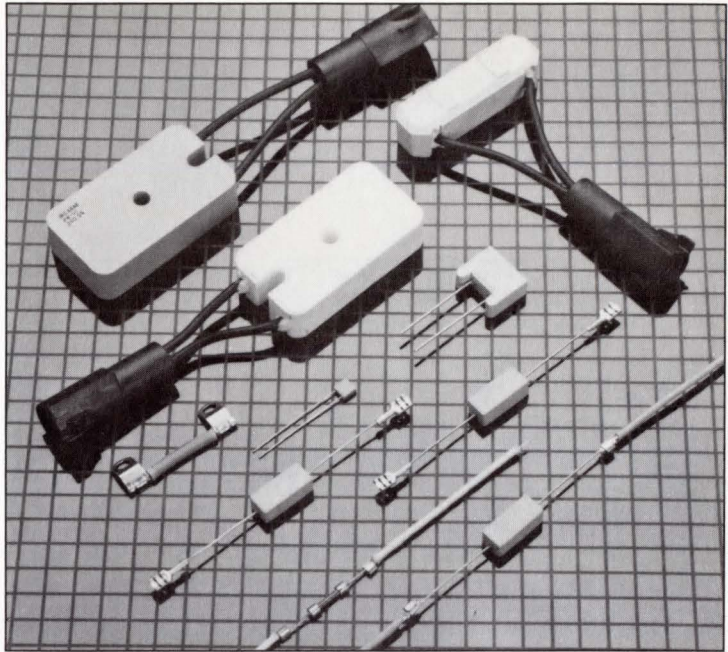
- Resistance per section
- Maximum dissipation per section
- Maximum operating ambient temperature
- Maximum permissible dimensions
- Type of terminations required
- Resistor style or proposed method of mounting

**HOW TO ORDER:** Specify full type reference, resistance value and tolerance. The addition of "V" to the prefix describing terminal configuration indicates an adjustable resistor. E.G. VCP 1602/60R ±10% is a 60 ohm adjustable resistor with ferrules and pigtail terminations.



## CUSTOM WIREWOUNDS AND ASSEMBLIES

Let IRC's Engineering staff design and build a resistor for your specific requirement.



### ALTERNATIVES

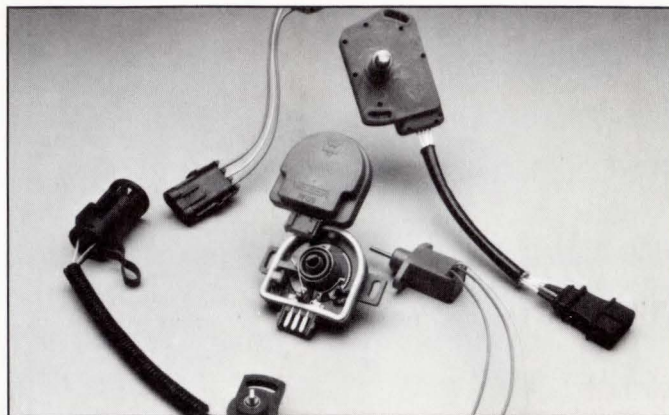
- **Power** - Available from 1/2W through 100 watts and beyond.
- **TCR** - High positive TCR's available with ratings of 1250 ppm, 4500 ppm and 5500 ppm. (other TCR's available)
- **Fuses** - By combining your fusing parameters with IRC's expertise a wirewound can be designed to fuse under very specific conditions.
- **Pulse/Surge Protection** - Specifically designed for applications requiring 5% tolerance or tighter and/or a low temperature coefficient in a flameproof package.
- **Package** - Special ceramic packages available or we will custom design the product to specifically fill your requirement.
- **Low Resistance** - Resistance values available down to .005 ohm for current sensing applications.
- **Value Added** - We will provide any wirewound element with appropriate quick disconnect terminal, sealed connector, stranded insulated lead wires, sleeving and other combinations.

### How To Order:

Consult factory.



- Conductive plastic
- High reliability prime signal source
- General purpose and precision
- Single/dual track with switch available
- Linear and non-linear
- Servo and Bush mount
- Sintered bearings and precious metal wipers available
- Wirewound and cermet potentiometers available



## SPECIFICATIONS

### CONDUCTIVE PLASTIC PRECISION POTENTIOMETERS

Series Reference	Available Resistance Range	Available Selection Tolerance	Power Rating @ 70°C	Linearity (Independent)	Body Dia. In/(mm)	Spindle Dia. In (mm)	Angle of Eff. Rotation	Output Smoothness	No. of Gangs Max
11CP	1KΩ-20KΩ	10% closer available	1 Watt	0.5% (std) 0.15% . available	1.06 (26.9)	1/8-1/4	345" max.	0.1% max. on 345"	5
15CP	1KΩ-20KΩ	10% closer available	1.5 Watt	0.5% (std) closer. available	1.32 (33.33)	1/8-1/4	345" max.	0.1% max. on 345"	5
18CP	1KΩ-20KΩ	10% closer available	1.5 Watt	0.5% (std) closer. available	1.56 (39.68)	1/8-1/4	345" max.	0.1% max. on 345"	5
20CP	1KΩ-20KΩ	10% closer available	2 Watt	0.2% over 350" 0.1% overcenter 315"	2.00 (50.80)	1/4	350" max.	0.1% max. on 350"	12

### CONDUCTIVE PLASTIC GENERAL PURPOSE POTENTIOMETERS

Series Reference	Available Resistance Range	Available Selection Tolerance	Power Rating @ 70°C	Linearity (Independent)	Body Dia. In/(mm)	Spindle Dia. In (mm)	Angle of Eff. Rotation	Output Smoothness	Mechanical Endurance
CP 1600	1KΩ-100KΩ	20% 10%	1 Watt	2%-0.5%	.95 (24.9)	.2 (-1/4 Or 6mm)	330" max.	0.1% max.	3x10 <sup>5</sup> std 2x10 <sup>6</sup> ss spindle
CP 1700	1KΩ-100KΩ	20% 10%	1.5 Watt	0.5% (std) closer. available	.95 (24.0)	.158 (4)	330" max.	0.1% max. on 345"	5x10 <sup>6</sup>

### CONDUCTIVE PLASTIC AUTOMOTIVE POTENTIOMETERS

CP 17/210	1K-10K	20% 10%	1 Watt	± 2% closer available	1.56 (39.6)	.Lever or 24 (6mm)	90" std (120 max).	0.5% max.	5x10 <sup>6</sup>
LM1 Linear motion	500R-10KW	20%	1 Watt	± 2% std.	.75x.79x1.38 (19x20x23)	.12 (3)	Eff .24-.39 (6-10)  Mechanical .50 max (12.5 max.)	0.5% max.	5x10 <sup>6</sup>

Note: All conductive plastic potentiometers should be used as potential dividers and be subject to a wiper load resistance to 100 times the track resistance.

\*Manufactured in the U.K.

INTERNATIONAL RESISTIVE COMPANY, INC.

103 P.O. Box 1860, Greenway Road • Boone, NC 28607.1860 • 704-264-8861 or 1-800-255-4-IRC • TLX: 46.9902





IRC introduces a total family of rugged, compact, low cost, thick film polymer potentiometers specially engineered as position sensors. The cost-effective potentiometers, designated IRC Autosensors, offer high performance characteristics and excellent reliability in such applications as fuel injection, automatic transmission control,

load leveling, and drive-by-wire systems based on computer control.

The Autosensors feature an improved track and wiper combination for higher current-handling capacity and longer mechanical life. Continuously contoured track tailoring provides superior linearity. Stainless steel spindle, rugged metal or plastic housing, and

mechanically locked end terminations assure the longest performance life. Printed-and-fired conductive polymer track construction permits design and production flexibility to exactly match a customer's electrical specification. Can be produced with multiple tracks for integral control of several functions.

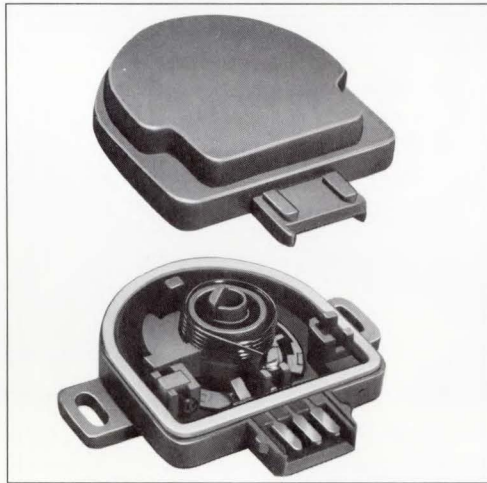
Screen printed conductor on molded substrates offers low tooling and production costs. Both resistive and switching track patterns can be printed.

Cost effective multi-fingered slider contacts are designed to withstand vibration levels up to 50g. These comprise precious metal contacts welded to base metal carriers.

Potentiometer tracks can be printed to a linear law conformity of 1% to 3% depending on diameter and electrical angle but law conformity can be improved by computer controlled law trimming techniques. The accuracy of non-linear laws depends on the max/min. slope ratios but trimming techniques can be utilized to achieve the best accuracy to suit particular applications.

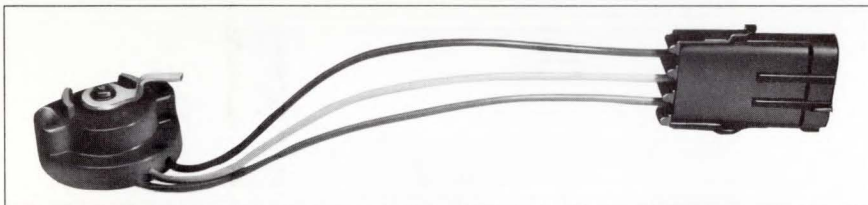


Potentiometer end resistors, printed in the same material as the track, can be trimmed to accurately control the output slope, to relate the switch are potentiometer outputs or to provide accurate output levels at the ends of the track to monitor the transducer in service



## APPLICATIONS

- Aerospace Servo Systems
- Liquid Level Controls
- Servo-Feedback Systems
- Missiles (Fin Control)
- Air-Conditioning Systems
- Robotics
- Micro-Processor Sewing Machines
- Electric Vehicle Controls
- Pen and Chart Recorders
- Power Station Control Equipment
- Joysticks



Wide variety of custom connectors, flying leads, and molded cases available for specific designs.



Standard Components will operate continuously from  $-40^{\circ}\text{C}$  to  $+135^{\circ}\text{C}$  and mechanical endurance tests are carried out over this temperature range. Capability above  $135^{\circ}\text{C}$  is available using high temperature plastics or other suitable materials.

## HOW TO ORDER:

Consult factory for ordering information and further assistance.

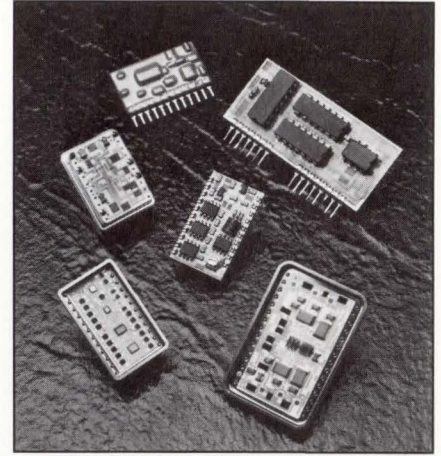




CUSTOM THICK & THIN FILM

# HYBRID CIRCUITS

- Commercial
- High Rel
- Military

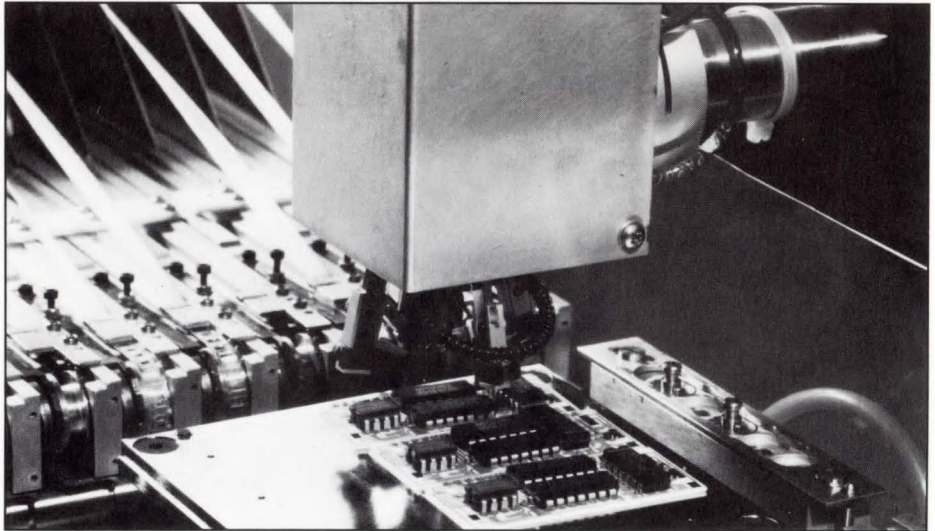


IRC has combined its proven resistive products and materials expertise with surface mount or chip and wire technology to provide a up to date hybrid manufacturing facility for your functional circuits needs.

Modern  
Manufacturing  
Facility

## FEATURES

- Thin or Thick Film Technology
- Noble & Non-noble terminations and glaze systems
- Surface Mount or Chip & Wire
- Plated through holes - multilayer and dual sided capabilities
- Automated placement
- Hermetically sealed Thick & Thin Film Circuits
- Proven design rules
- SIP and DIP packaging



## PERFORMANCE

- Tight tolerance and ratio matching
- High conductivity copper
- Functional trim and test

Class 10,000 Facility

## RELIABILITY

- MIL STD 883
- MIL STD 1772 (pursuing)

## DESIGN

- Modern C.A.D. systems
- Special packaging

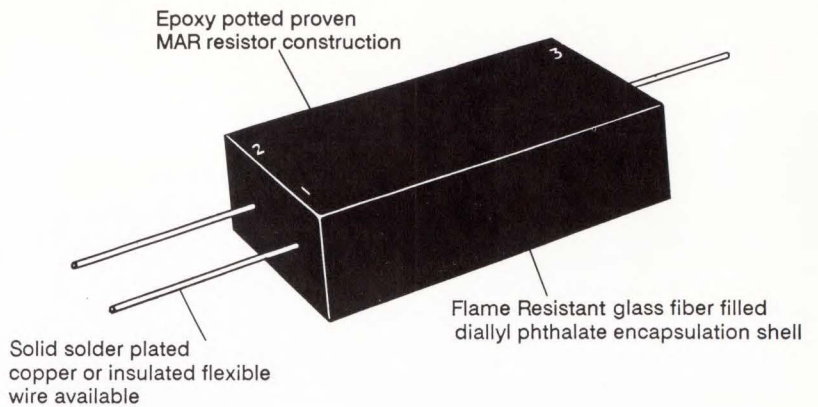






# CUSTOM THIN FILM RESISTOR MODULES

- High reliability
- Superior environmental performance
- Ultra-precision - absolute and tracking tolerance to  $\pm .01\%$
- Precision temperature performances:  
Absolute TC to  $\pm 5 \text{ ppm}/^\circ\text{C}$   
TC tracking to  $\pm 2 \text{ ppm}/^\circ\text{C}$
- High voltage applications -  
Up to 40kv
- Broad resistance ranges -  
Up to 300 meg ohm
- R-C modules available



- Custom tailored circuit design
- Ultra precision tolerances and TCs available to  $.01\%$  and  $5 \text{ ppm}/^\circ\text{C}$
- Ultra precision ration matching - to  $2 \text{ ppm}/^\circ\text{C}$  and  $.01\%$  tolerance
- High voltage applications - up to 40kv
- Very high resistance applications to 300 megohms
- Custom packaging to meet specific needs
- Rugged epoxy construction
- Very large pin out configurations possible (30 pins or more)
- Matched resistor - capacitor capabilities
- Internal crossovers economically accomplished
- Low noise
- High reliability - military proven
- Special screening available

IRC's expertise in thin film resistor technology is available to assist you in meeting your custom network needs. Years of experience in ultra precision resistor manufacturing techniques, coupled with computer matching technology, allows the production of custom passive networks to meet a wide range of circuit needs:

- R2R Precision Ladders
- Very High Voltage Dividers
- Ultra Precision R-C Modules
- Special Temperature Compensation Resistor Networks
- High Reliability Circuits
- Precision Attenuator Networks

In addition, an almost unlimited number of packaging styles, sizes and pin out configurations are available to meet special mounting requirements. Why not let IRC's network engineers assist you in special network or circuit needs?

Note: Consult factory for additional information relating to your specific application.

## SPECIFICATIONS

**Example specifications of current CUSTOM networks:**

<p><b>High Voltage Divider</b></p> <p>Voltage Rating: 12,000 v d.c. Ratio Tolerance Accuracy: <math>\pm 0.1\%</math> Absolute Tolerance: <math>\pm 0.1\%</math> TCR Tracking: <math>\pm 15 \text{ ppm}/^\circ\text{C}</math></p>	<p><b>R/C Modules</b></p> <p>Voltage Rating: 250V Time Constant Accuracy: to <math>\pm .5\%</math> Stability: Life, 1000 Hours, <math>70^\circ\text{C}</math>, <math>\pm 0.5\%</math> Temperature Coefficient: <math>\pm 10 \text{ ppm}/^\circ\text{C}</math> of Time Constant</p>
--	--

IRC offers custom thin film resistor networks to meet individual circuit needs. Many years of expertise in ultra precision metal film manufacturing, coupled with computer matching technology, allow production of resistors and resistor/capacitor networks of unsurpassed precision and reliability. Consult your IRC Sales Office for your individual needs.



# RESISTANCE STRIPS & DISCS



## SPECIFICATIONS ELEMENTS

IRC resistance strips consist of a high grade paper-base phenolic laminate with the resistance material permanently bonded to the surface. Disc resistors are simply die stamped from a resistance strip.

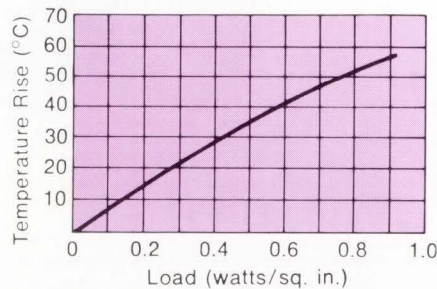
Strips can be supplied with a low-resistance colloidal silver contact coating over any portion of the surface where a low-resistance positive contact is desired. On discs, inner and outer rings of colloidal silver are applied to provide contact with coaxial line fixtures.

For both strips and discs, mechanical pressure type contacts must be used rather than soldered connections.

## RESISTANCE VALUES

Strips are available with resistances from 19 ohms/square to 1.0 megohm/square. Standard disc values range from 5 ohms to 100,000 ohms.

## TEMPERATURE RISE



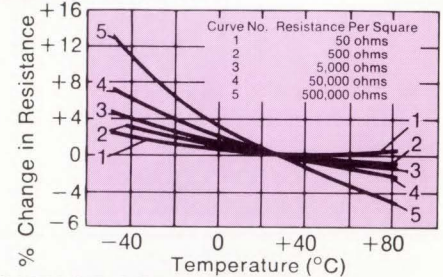
## TOLERANCE

Standard tolerance is  $\pm 20\%$ . Special tolerances of  $\pm 15\%$  and  $\pm 10\%$  are available on special order.

## VOLTAGE RATING

Maximum rated voltage is 500 volts per inch of current path.

## TEMPERATURE-RESISTANCE CHARACTERISTICS



## VOLTAGE COEFFICIENT

The voltage coefficient of resistance is negative and varies from approximately -0.001%/volt/inch of active strip length (for coatings of 19 ohms/square) to -0.03%/volt/inch of active strip length (for coatings of 1.0 megohm/square).

## TEMPERATURE COEFFICIENT

The temperature coefficient of resistance between 25 and 80°C varies from +0.05%/°C (for coatings of 1.0 megohm/square). Approximate temperature resistance characteristics for temperatures ranging from -55 to +80C may be determined from the curve above.

## AGING

At room temperature, the resistance will remain within  $\pm 5\%$  of the original value over extended periods of time.

## HUMIDITY

Change of resistance during exposure to 90% relative humidity for 100 hours at 40°C is approximately +5% for low-resistance coatings. This increases somewhat with resistance value. At completion of the humidity test, the resistance returns very closely to its original values within a few days.

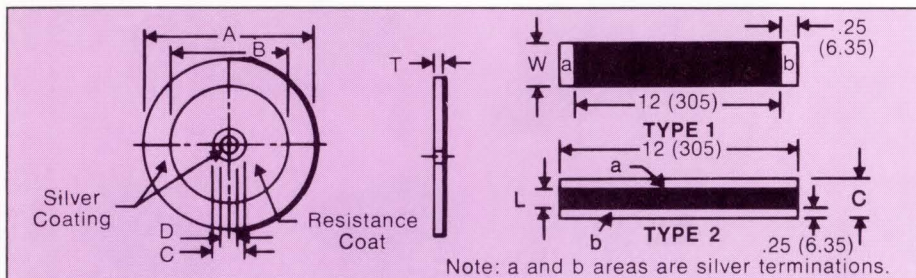
## POWER RATINGS

Maximum power load should be such that the maximum surface operating temperature does not exceed 80°C. The allowable load per square inch for an ambient temperature of 25°C on a resistance strip suspended in free air is 0.95 watts.

## HOW TO ORDER

To order standard resistance strips, specify the type of strip desired, total width of strip, resistance value in ohms/square, and quantity desired. For special resistance strips, provide these specifications and as much information as possible about the proposed application.

Standard concentric disc resistors should be ordered by the disc type, total resistance between silver terminals, and resistance tolerance. For special concentric discs, give all dimensions shown on the drawing at left, plus total resistance between silver terminals and resistance tolerance.



Note: a and b areas are silver terminations.

## DISC DIMENSIONS\* - IN. AND (mm)

IRC Style	A	B	C	D	T $\pm .005$
DRT	.25 (6.35)	.22 (5.59)	.12 (3.04)	.076 (1.93)	.127 (.686)
DRU	.28 (7.11)	.22 (5.59)	.12 (3.04)	.076 (1.93)	.027 (.686)
DRX	.38 (9.65)	.28 (7.11)	.12 (3.04)	.076 (1.93)	.027 (.686)
DRB	.50 (12.7)	.38 (9.65)	.12 (3.04)	.076 (1.93)	.027 (.686)
DRD	.63 (16.0)	.44 (11.2)	.19 (4.83)	.076 (1.93)	.027 (.686)
DRF	.75 (19.1)	.50 (12.7)	.25 (6.35)	.076 (1.93)	.027 (.686)
DRJ	1.00 (25.4)	.75 (19.1)	.25 (6.35)	.076 (1.93)	.027 (.686)
DRN	1.50 (38.1)	1.25 (31.8)	.25 (6.35)	.076 (1.93)	.027 (.686)

\*Special sizes available on request. Sizes include standard dimensions for colloidal silver contact rings.  
†Other thicknesses available on special order.

## STRIP DIMENSIONS - IN. AND (mm)

### TYPE 1

Length Between Terminals $\pm .06$	Total Strip Width (W) $\pm .03$	Thickness Thickness $\pm .005$
12 (305)	0.88 (22.4)	.027 (.686)
12 (305)	1.19 (30.2)	.027 (.686)
12 (305)	1.38 (35.1)	.027 (.686)
12 (305)	1.50 (38.1)	.027 (.686)
12 (305)	1.75 (44.5)	.027 (.686)

### TYPE 2

Width (W) $\pm .06$	L $\pm .03$	C $\pm .03$	Thickness $\pm .005$
12 (305)	.38	0.88 (22.4)	.027 (.686)
12 (305)	.69	1.19 (30.2)	.027 (.686)
12 (305)	.88	1.38 (35.1)	.027 (.686)
12 (305)	1.00	1.50 (38.1)	.027 (.686)
12 (305)	1.25	1.75 (44.5)	.027 (.686)



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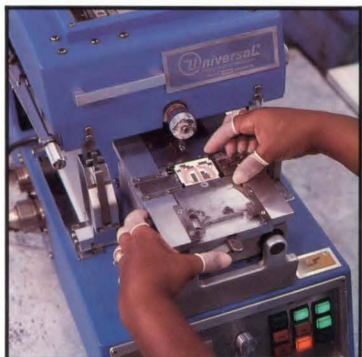
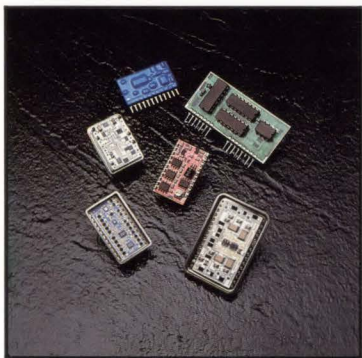
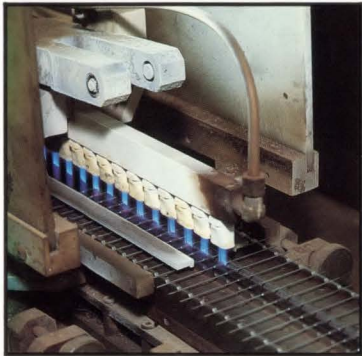
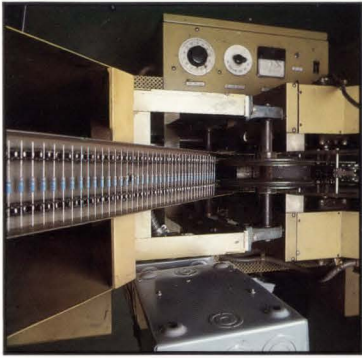
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# IRC TECHNOLOGY

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With several varieties of High Voltage resistors available IRC can provide virtually any product size and voltage-resistance-tolerance rating.

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From one source you can get virtually every type of discrete resistor and resistor network than can be produced in a surface-mount package.

## CUSTOMS

Heavily involved in ever changing customer requirements, IRC is committed to offering Custom Products when necessary. From Custom Hybrids, to Networks, to Wirewound, to Assemblies, to Value Added, IRC has the experience and expertise to provide the exact product you need.





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