

High Performance Film Resistors

Caddock pages from EEM date 1981

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Micronox® Resistance Films

For harsh environmental conditions, Caddock Micronox® resistors are truly unsurpassed. Produced by firing complex-oxide Micronox® resistance films onto ceramic core materials at temperatures above +1400°F, these precision resistors can withstand extremes of temperature, thermal shock, overvoltage and input power.



The result is a family of high voltage, high power precision resistors with an exceptional combination of performance advantages:

- **High Power Ratings** — to 30 watts.
- **High Voltage Ratings** — to 30,000 volts.
- **High Stability** — as close as 0.01% per 1000 hours in 50,000 hour extended life.
- **High Operating Temperatures** — up to +275°C.
- **A Wide Range of Resistance Values in Many Sizes** — from 30 ohms to 2000 Megohms.

These performance advantages make Caddock Micronox® film resistors ideal for use in many types of electronic circuitry, including —

- **Voltage Reference Circuits**
 - High Power Density Packaging
- **Precision Feedback Circuits**
 - Matched TC Resistor Pairs

Type MG Precision High-Voltage Resistors

Highest stability at continuous operation to 30,000 volts in single-resistor values as high as 2000 Megohms.



Pages 3684 and 3685

Type MS and MR Power Film Resistors

Power ratings to 15 watts at 6000 volts in a single axial-lead resistor — plus, Non-Inductive Performance is available.



Pages 3686 and 3687

Type ML and MM Precision Film Resistors

Molded case encapsulation to meet high temperature industrial and aerospace requirements.



Page 3688

Type MP Chassis Mounted Power Film Resistors

High power density in both 15 and 30 watt ratings with center-screw chassis mounting.



Page 3689

Type MK Low Cost Precision Film Resistors

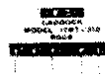
.75 watt rating at +125°C. Resistance range from 30 ohms to 100 Megohms.



Pages 3690 and 3691

Type 1787 Current Shunt Resistor Networks

2-, 3- and 4-decade input networks for accurate current sensing in multi-range instrumentation.



Pages 3692 and 3693

Tetrinox™ Resistance Films

In high-accuracy instrumentation where outstanding circuit performance is required through variations of temperature and through long-term operation, Caddock Tetrinox™ resistance films are the answer.



Constructed with advanced technology complex-oxide resistance films that are fired onto ceramic substrates, Caddock Tetrinox™ film resistors provide a unique combination of performance characteristics:

- **Ultra-Low Absolute and Ratio TC** — standard to less than 5 PPM/°C.
- **Ultra-Precision** — tolerances as tight as 0.01%.
- **High Resistance Range** — values to 10 Megohms in a miniature package.
- **Ultra-Stable in Loadlife** — ratio stability to within ±0.01% per 2000 hours.

This special combination of advantages make Caddock Tetrinox™ film resistors the optimum choice in many high stability applications, including —

- **Input Voltage Dividers in Precision Laboratory Instrumentation**
 - Precision Bridge Circuits
- **Precision Voltage Reference Circuits.**
 - Ultra-Stable Voltage Dividers.
- **Ultra-Low Power Precision Circuitry.**
 - Decade Resistance Networks.

Type 1776 Precision Decade Resistor Voltage Dividers

33 models of decade voltage dividers for accurate voltage-division in multi-range digital instrumentation.



Pages 3694 and 3695

Type TF Low TC Ultra-Precision Film Resistors

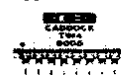
The cost-effective replacement for precision high-value wire-wound resistors.



Page 3696

Type T912 and T914 Precision Resistor Networks

Resistor pairs and quads with ultra-precision ratio characteristics for analog circuits.



Page 3697

Type TK Temp-Stable Precision Film Resistors.

Temperature coefficients to less than 5 PPM/°C in single resistor values as high as 10 Megohms.



Pages 3698 and 3699

If you should need additional information on any type of Caddock resistor, please call or write to our engineering and manufacturing offices in Riverside, California.

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Type MG Precision High-Voltage Resistors

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Type MG Precision High Voltage Resistors have been proven through many years of use in critical applications in airborne computers, manned space vehicles, geophysical instruments, TWT amplifiers and medical electronics where long-term reliability and stability are of utmost importance.

Caddock's Micronox® resistance films are the basic source of these outstanding performance features:

- Single-resistor values as high as 2000 Megohms.
- Maximum continuous operating voltages as high as 30,000 volts.
- Overvoltage capabilities of 150% of the standard working voltages for all models and values.
- Resistance Tolerances from ±1.0% to ±0.1%.

— plus

- Typical extended-life stability of 0.02% per 1000 hours as demonstrated by reliability testing.

The very high voltage ratings of these compact resistors often permits a single Type MG Precision High Voltage Resistor to replace multiple-resistor 'strings' with significant reductions in both component cost and equipment size.

Special High-Voltage and High-Voltage Pulse Performance

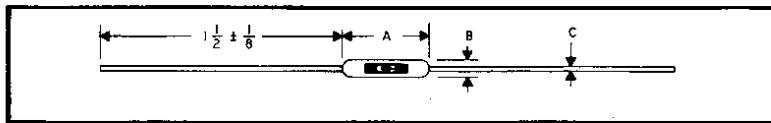
All power ratings and maximum working voltage ratings are for continuous duty. These ratings are based on pre-stress voltage levels applied during the manufacturing process to provide for stable resistor performance even under momentary overload conditions.

Maximum working voltages up to 60% higher than the values listed in the table can be achieved through special factory conditioning, provided the power ratings are not exceeded. To specify maximum working voltages above the values listed in the table, add a "-15" to the model number (Example: MG750-15) and identify the overvoltage value with the initial order. (Note that the standard overload and overvoltage ratings do not apply to the "-15" resistors.)

Non-Inductive Performance

Caddock's patented Exclusive Non-Inductive Design uses a serpentine resistive pattern that provides for neighboring lines to carry currents in opposite directions, thereby achieving maximum cancellation of flux fields over the entire length of the resistor. This efficient non-inductive construction is accomplished without derating of any performance advantages.

Most models are available with Caddock's Patented Non-Inductive Design. To specify this performance, add an "N" to the standard model number.



Model No.	Wattage	Max. Continuous Oper. Volt.	Oper. Temp. (Max.)	Dielect. Str'gth	TC ppm/°C†	Resistance		Dimensions		
						Min.	Max.	A	B	C
MG650	.5	600	225°C	750	80	200Ω	5 Meg	.313 ±.020	.094 ±.015	.025 ±.002
MG655	.5	600	225°C	750	80	200Ω	8 Meg	.313 ±.030	.109 ±.015	.025 ±.002
MG660	.6	1,000	225°C	750	80	400Ω	10 Meg	.500 ±.030	.094 ±.015	.025 ±.002
MG680	.8	2,000	225°C	750	80	600Ω	20 Meg	.750 ±.030	.094 ±.015	.025 ±.002
MG710	1.0	4,000	225°C	750	80	800Ω	50 Meg	1.000 ±.040	.094 ±.015	.025 ±.002
MG712	.6	1000	225°C	750	80	800Ω	20 Meg	.400 ±.060	.140 ±.030	.025 ±.002
MG714	1.0	1,000	225°C	750	80	200Ω	20 Meg	.562 ±.060	.150 ±.030	.032 ±.002
MG715	1.0	2,000	225°C	750	80	400Ω	50 Meg	.750 ±.060	.140 ±.030	.025 ±.002
MG716	1.5	4,000	225°C	750	80	600Ω	75 Meg	1.000 ±.060	.140 ±.030	.025 ±.002
MG717	1.5	2000	225°C	750	80	600Ω	75 Meg	.710 ±.050	.240 ±.015	.040 ±.002
MG721	2.0	4,000	225°C	750	80	200Ω	100 Meg	1.000 ±.050	.240 ±.030	.040 ±.002
MG730	3.0	6,000	225°C	1000	80	500Ω	250 Meg	1.500 ±.080	.240 ±.030	.040 ±.002
MG735	3.6	10,000	225°C	1000	80	750Ω	300 Meg	2.000 ±.080	.240 ±.030	.040 ±.002
MG745	5.0	15,000	225°C	1000	80	1K	500 Meg	3.000 ±.100	.240 ±.030	.040 ±.002
MG750	5.0	10,000	225°C	1000	80	400Ω	500 Meg	2.125 ±.060	.315 ±.030	.040 ±.002
MG780	7.5	15,000	225°C	1000	80	600Ω	750 Meg	3.125 ±.060	.315 ±.030	.040 ±.002
MG785	8.0	20,000	225°C	1000	80	800Ω	1000 Meg	4.000 ±.120	.315 ±.030	.040 ±.002
MG810	10.0	25,000	225°C	1000	80	1K	1250 Meg	5.000 ±.120	.315 ±.030	.040 ±.002
MG815	15.0	30,000	225°C	1000	80	1K	2000 Meg	6.000 ±.120	.350 ±.040	.040 ±.002

SPECIFICATIONS

Resistance Tolerance: ±1% (tolerances to .1% on special order).

Insulation Resistance: 100 megohms, minimum.

Overload/Overvoltage: 5 times rated power with applied voltage not to exceed 1.5 times maximum continuous operating voltage for 5 seconds, R shift 0.8% max.

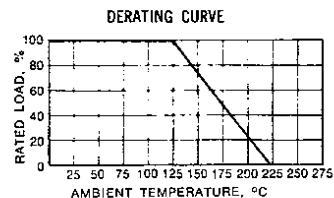
Thermal Shock: MIL-STD-202, method 107, cond. C, R shift .5% max.

Moisture Resistance: MIL-STD-202, method 106, R shift .8% max.

Loadlife: 1000 hours at rated power, R shift .8% max.

Lead Material: Gold Plated

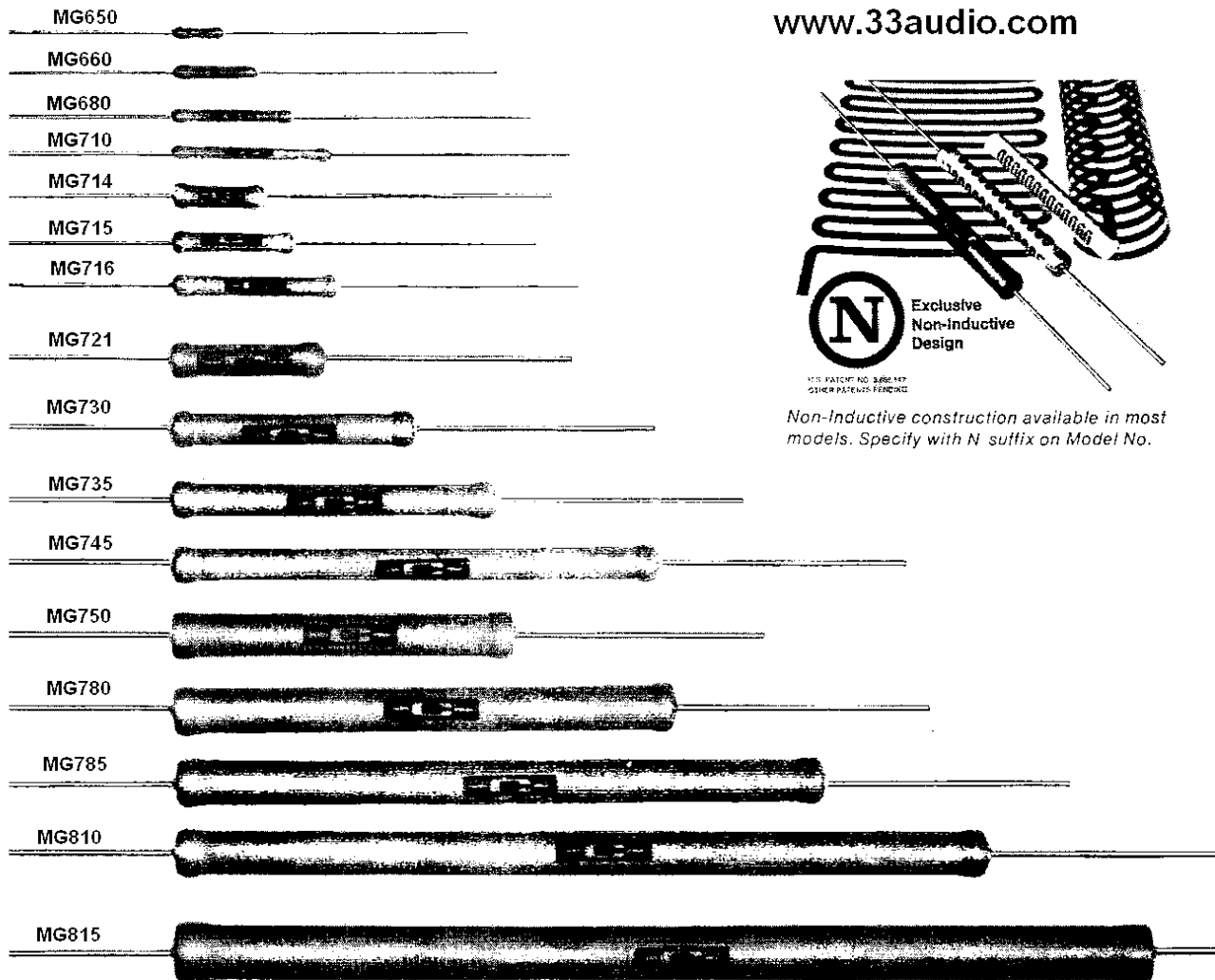
Encapsulation: Silicone Conformal



Type MG Precision High-Voltage Resistors

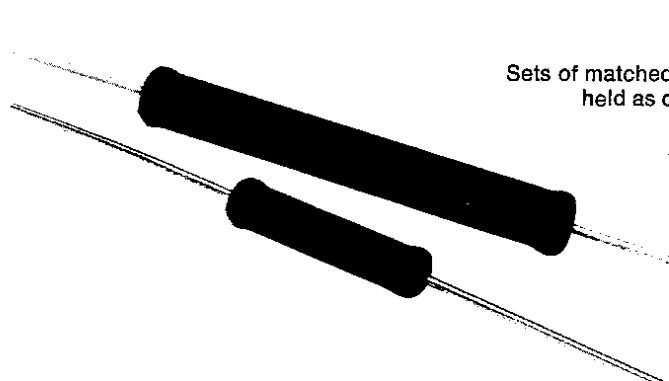
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Non-Inductive construction available in most models. Specify with N suffix on Model No.

Matched Type MG Resistor Sets with Tight Ratio Tolerances and Ratio TC Tracking.



Sets of matched Type MG resistors are available with ratios held as close as 0.05% over the range of ratios from 1:1 to 1:100,000 for use in voltage dividers, reference networks and feedback networks.

The ratio TC of these matched resistor sets can be held as close as 10 PPM/°C over the temperature range from -15°C to +105°C.

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RESISTORS

4700

Type MR & MS Power Film Resistors

Here are the power film resistors that overcome the design limitations of wire-wound resistors! Caddock Power Film Resistors provide power ratings to 15 watts at 6000 volts in a single axial lead resistor. By extending both the resistance range and maximum voltage ratings, Type MS Power Film Resistors simplify circuit design and reduce equipment complexity and cost.

All These Features in One Resistor

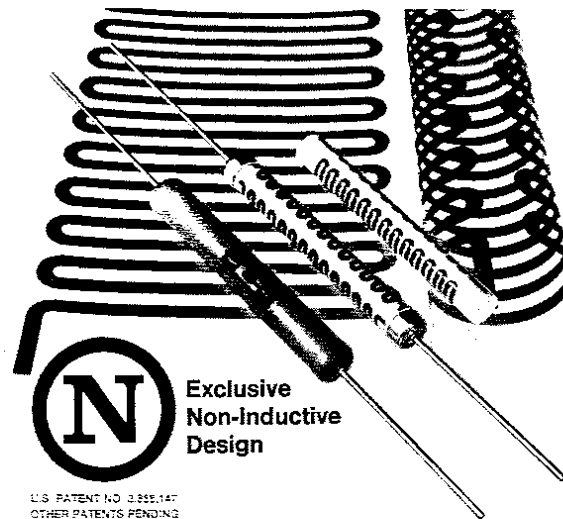
- Full power and voltage ratings, without derating —
— for non-inductive performance
— for high resistance values that extend the critical resistance value up to 10 times.
- Higher voltage ratings without the limitations of minimum wire size and spacing.
- Excellent long-term stability.
Tests demonstrate typical stability of 0.05% per 1000 hours over extended life.

MICRONOX® Resistance Films

Type MS performance begins with Micronox® resistance films, the basic element in every Caddock resistor. Produced exclusively by Caddock Electronics, these proven complex oxide films have been used reliably for 19 years in Caddock's precision power resistor products.

Micronox® resistance films are fired directly onto a ceramic core, in air, at 1400°F. These resistance films have demonstrated outstanding stability when exposed to a high ambient temperature, thermal shock and high power densities.

This totally new approach to precision power resistors opens new design possibilities because of the wider resistance range, precise temperature characteristics, and higher temperature and power handling capability.



There's no derating of performance when you specify Caddock's Exclusive Non-Inductive Design.

When non-inductive performance is specified, we produce these power film resistors with a serpentine resistive pattern that provides for neighboring lines to carry currents in opposite directions, thereby achieving maximum cancellation of flux fields over the entire length of the resistor.

The result is a truly non-inductive resistor that is about as inductive as a straight piece of wire the length of the resistor body. This efficient design means faster settling times and minimum distortion in all types of high frequency circuits.

Type MS Power Film Resistors are produced under carefully controlled manufacturing and test procedures.

Manufacturing Control

Type MS Resistors are produced under strict manufacturing controls with processes which include power conditioning, overvoltage conditioning and maximum temperature conditioning.

Quality Control

Type MS Resistors receive quality surveillance which reaches from incoming raw materials to your packaged resistors in the shipping area. And our QC system has been approved for conformance to the requirements of NASA NHB5300.4(1C) and MIL-I-45208 in many recent surveys.

Reliability Verification

Type MS Resistors are included in the Caddock Reliability Testing Program. Conformance to specification parameters including Extended Life, Shock, Vibration and Humidity are verified on a periodic basis. Data from MS resistors can be compared by similarity to other Caddock resistor types, since Type ML, MM, MS, MP, MG and MK represent an identical combination of materials — aluminum oxide substrate, Micronox® resistance film and silicone insulating coating.

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Type MR & MS Power Film Resistors

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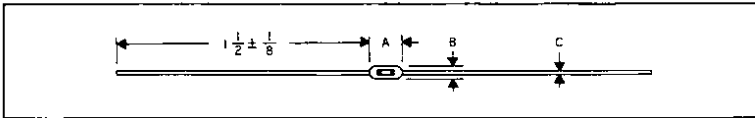
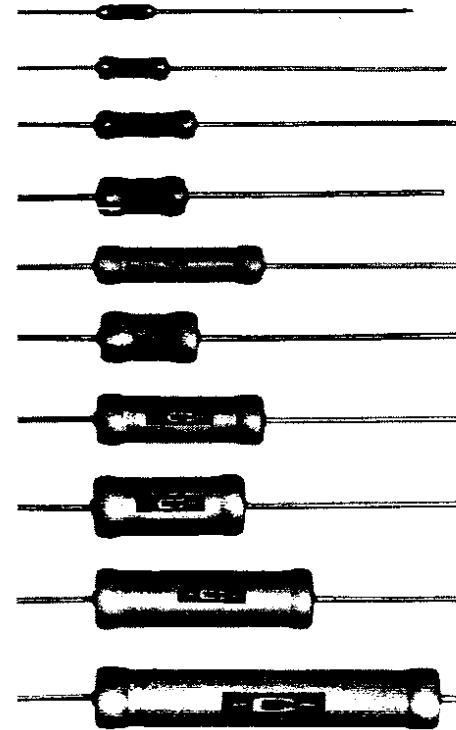
Type MS High Performance Power Film Resistors have a proven performance history in industrial, computer, military and space applications. This unique line now includes higher power ratings — up to 15 watts — and resistance values to 30 Megohms.

These exceptional resistors also provide outstanding extended life stability. In annual reliability tests where 2000 hour load-life stability data has been established, Type MS Power Film Resistors have demonstrated typical stability well within 0.1% per 1000 hours and extended life stability of 0.05% per 1000 hours.

Temperature coefficients are also low, with the standard TC of 50 PPM/°C available in all models of the Type MS Power Film Resistor. They can also be supplied on special order in matched resistor sets that provide ratio tracking with varying temperature to within 10 PPM/°C.

All of the Type MS Power Film Resistors are constructed with Micronox® resistance films bonded to a high strength solid ceramic core. Nickel alloy end caps and gold plated axial leads complete the assembly. Encapsulation is provided by a silicone conformal coating.

Non-inductive construction is available in most models. Specify by adding "N" suffix to Model Number.



Model No.	Wattage	Max. Voltage	Oper. Temp. (Max.)	Dielect. Strength	TC ppm/°C	Resistance		Dimensions			Encapsulation	Leadwire
						Min.	Max.	A	B	C		
MR 129	.25	200	275°C	500	150	50Ω	500 K	.188 ± .020	.070 ± .015	.020 ± .002	Silicone Conformal	Nickel
MR 154	.40	300	275°C	750	150	50Ω	1 Meg	.250 ± .020	.094 ± .015	.025 ± .002	Silicone Conformal	Nickel
MR 178	.60	500	275°C	750	150	50Ω	3 Meg	.313 ± .020	.094 ± .015	.025 ± .002	Silicone Conformal	Nickel
MS 126	.25	200	275°C	500	50	30Ω	1 Meg	.188 ± .020	.070 ± .015	.020 ± .002	Silicone Conformal	Gold Plated
MS 150	.5	—	275°C	500	50	30Ω	2 K	.188 ± .020	.070 ± .015	.020 ± .002	Silicone Conformal	Gold Plated
MS 151	.5	300	275°C	750	50	30Ω	2 Meg	.250 ± .020	.094 ± .015	.025 ± .002	Silicone Conformal	Gold Plated
MS 175	.75	—	275°C	750	50	30Ω	2 K	.250 ± .020	.094 ± .015	.025 ± .002	Silicone Conformal	Gold Plated
MS 176	.75	500	275°C	750	50	45Ω	5 Meg	.313 ± .020	.094 ± .015	.025 ± .002	Silicone Conformal	Gold Plated
MS 210	1.0	—	275°C	750	50	45Ω	3 K	.313 ± .020	.094 ± .015	.025 ± .002	Silicone Conformal	Gold Plated
MS 214	1.0	500	275°C	750	50	45Ω	5 Meg	.313 ± .030	.109 ± .015	.025 ± .002	Silicone Conformal	Gold Plated
MS 220	2.0	1000	275°C	800	50	45Ω	10 Meg	.400 ± .060	.140 ± .030	.025 ± .002	Silicone Conformal	Gold Plated
MS 221	3.0	1000	275°C	800	50	45Ω	10 Meg	.575 ± .050	.165 ± .030	.032 ± .002	Silicone Conformal	Gold Plated
MS 223	3.0	800	275°C	1000	50	30Ω	4 Meg	.480 ± .060	.230 ± .030	.040 ± .002	Silicone Conformal	Gold Plated
MS 244	4.0	2000	275°C	1000	50	45Ω	15 Meg	.950 ± .060	.230 ± .030	.040 ± .002	Silicone Conformal	Gold Plated
MS 245	4.0	800	275°C	1000	50	30Ω	6 Meg	.570 ± .060	.300 ± .030	.040 ± .002	Silicone Conformal	Gold Plated
MS 260	6.0	2000	275°C	1000	50	45Ω	15 Meg	.970 ± .060	.300 ± .030	.040 ± .002	Silicone Conformal	Gold Plated
MS 281	8.0	2000	275°C	1000	50	45Ω	8 Meg	.910 ± .060	.350 ± .040	.040 ± .002	Silicone Conformal	Gold Plated
MS 310	10.0	4500	275°C	1000	50	45Ω	20 Meg	1.25 ± .070	.350 ± .040	.040 ± .002	Silicone Conformal	Gold Plated
MS 313	12.5	6000	275°C	1000	50	50Ω	30 Meg	2.00 ± .080	.350 ± .040	.040 ± .002	Silicone Conformal	Gold Plated
MS 315	15.0	—	275°C	1000	50	50Ω	1 Meg	2.00 ± .080	.350 ± .040	.040 ± .002	Silicone Conformal	Gold Plated

†Temperature Coefficient: Referenced to 25°C, ΔR taken at -15°C and +105°C

SPECIFICATIONS

Resistance Tolerance: ±1% (tolerances to .1% on special order).

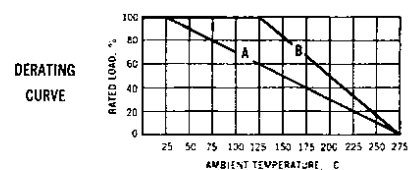
Insulation Resistance: 100 megohms, minimum.

Overload/Overvoltage: 5 times rated power with applied voltage not to exceed 1.5 times maximum continuous operating voltage for 5 seconds, R shift 0.5% max., or 0.5 ohms max., whichever is greater.

Thermal Shock: MIL-STD-202, method 107, cond. C, R shift .5% max., or .5 ohms max., whichever is greater.

Moisture Resistance: MIL-STD-202, method 106, R shift .5% max., or .5 ohms max., whichever is greater.

Loadlife: 1000 hours at rated power, R shift .5% max., or .5 ohms max., whichever is greater.



A—all MS models except MS126, MS151, MS176
B—all MR models, and MS126, MS151, MS176

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RESISTORS

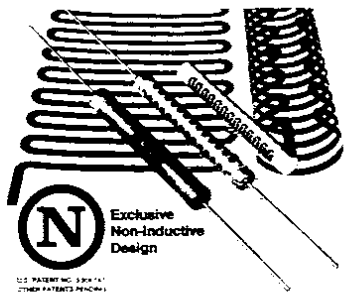
4700

Type ML & MM Precision Film Resistors

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Type ML and MM resistors have a proven performance history in industrial, computer, military and space applications. With power ratings up to 3 watts and resistance values to 15 megohms, these outstanding resistors are ideal for applications requiring tolerances as close as 0.1% and extended life stability of 0.1% per 1000 hours.

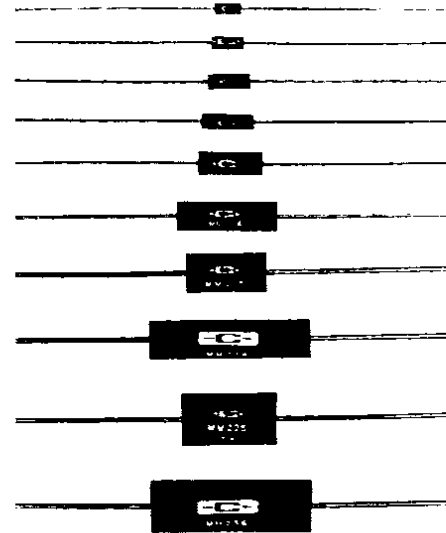
The Type MM Precision Film Resistors provide a maximum operating temperature range of +275°C and both the Type ML and the Type MM have temperature coefficients of only 50 PPM/°C over the range from -15°C to +105°C.



N Exclusive Non-Inductive Design
U.S. PATENT NO. 3,894,741
 OTHER PATENTS PENDING

Construction includes Micronox* resistance films fired onto a high strength solid ceramic core. End cap construction and a molded case completes the resistor assembly and provides increased resistance to abrasion and solvents.

Caddock's Exclusive Non-Inductive Performance can also be specified for any of these resistors by adding the "N" suffix to the model number.



Model No.	Wattage	Max. Voltage	Oper. Temp. (Max.)	Dielect. Str'ngth	TC PPM/°C	Resistance		Dimensions				Encapsulation	Leadwire
						Min.	Max.	A	B	C	D		
ML 104	.08	200	175°C	400	50	50Ω	300 K	150 -.010	.065 -.010	.016 -.002	1.50 -.12	Transfer Molded Type	Gold Plated
ML 114	.15	200	175°C	500	50	50Ω	500 K	188 -.020	.070 -.015	.020 -.002	1.50 -.12	Transfer Molded Type	Gold Plated
ML 124	.25	300	175°C	750	50	50Ω	600 K	250 -.020	.094 -.006	.025 -.002	1.50 -.12	Transfer Molded Type	Gold Plated
ML 131	.4	500	175°C	750	50	50Ω	1 Meg	313 -.020	.094 -.006	.025 -.002	1.50 -.12	Transfer Molded Type	Gold Plated
ML 181	.6	600	175°C	750	50	50Ω	5 Meg	400 -.020	.150 -.010	.025 -.002	1.50 -.12	Transfer Molded Type	Gold Plated
ML 212	1.0	1000	175°C	1000	50	45Ω	10 Meg	625 -.030	.190 -.020	.030 -.002	1.50 -.12	Transfer Molded Type	Gold Plated
ML 213	1.0	800	175°C	1500	50	30Ω	4 Meg	500 -.030	.250 -.020	.040 -.002	1.50 -.12	Transfer Molded Type	Gold Plated
ML 218	1.25	2000	175°C	1500	50	45Ω	15 Meg	1.00 -.030	.250 -.020	.040 -.002	1.50 -.12	Transfer Molded Type	Gold Plated
ML 219	1.25	800	175°C	2000	50	30Ω	6 Meg	600 -.030	.330 -.020	.040 -.002	1.50 -.12	Transfer Molded Type	Gold Plated
ML 226	2.0	2000	175°C	2000	50	45Ω	15 Meg	1.00 -.030	.330 -.020	.040 -.002	1.50 -.12	Transfer Molded Type	Gold Plated
MM 112	.12	200	275°C	400	50	45Ω	500 K	160 -.010	.065 -.010	.016 -.002	1.50 -.12	Black Molded Type	Gold Plated
MM 125	.25	200	275°C	500	50	30Ω	1 Meg	188 -.020	.070 -.015	.020 -.002	1.50 -.12	Black Molded Type	Gold Plated
MM 152	.4	300	275°C	750	50	30Ω	2 Meg	250 -.020	.094 -.006	.025 -.002	1.50 -.12	Black Molded Type	Gold Plated
MM 177	.6	500	275°C	750	50	45Ω	5 Meg	313 -.020	.094 -.006	.025 -.002	1.50 -.12	Black Molded Type	Gold Plated
MM 215	1.0	800	275°C	1000	50	45Ω	10 Meg	400 -.020	.150 -.010	.025 -.002	1.50 -.12	Black Molded Type	Gold Plated
MM 216	1.5	1000	275°C	1000	50	45Ω	10 Meg	625 -.030	.190 -.020	.030 -.002	1.50 -.12	Black Molded Type	Gold Plated
MM 217	1.5	800	275°C	1500	50	30Ω	4 Meg	500 -.030	.250 -.020	.040 -.002	1.50 -.12	Black Molded Type	Gold Plated
MM 224	2.0	2000	275°C	1500	50	45Ω	15 Meg	1.00 -.030	.250 -.020	.040 -.002	1.50 -.12	Black Molded Type	Gold Plated
MM 225	2.0	800	275°C	2000	50	30Ω	6 Meg	600 -.030	.330 -.020	.040 -.002	1.50 -.12	Black Molded Type	Gold Plated
MM 236	3.0	2000	275°C	2000	50	45Ω	15 Meg	1.00 -.030	.330 -.020	.040 -.002	1.50 -.12	Black Molded Type	Gold Plated

*Temperature Coefficient: Referenced to 25°C, ΔR taken at -15°C and +105°C

*Micronox is a registered trademark of Caddock Electronics, Inc.

SPECIFICATIONS

Resistance Tolerance: ±1% (tolerances to .1% on special order).

Insulation Resistance: 100 megohms, minimum.

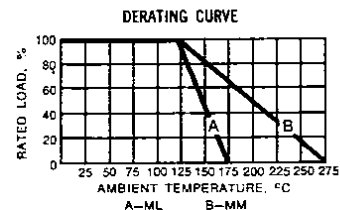
Overload: 5 times rated power for 5 seconds, R shift .5% max., or .5 ohms max., whichever is greater.

Overvoltage: 1.5 times max. voltage for .5 seconds, R shift .5% max., or .5 ohms max., whichever is greater.

Thermal Shock: MIL-STD-202, method 107, cond. B, R shift .2% max., or .5 ohms max., whichever is greater.

Moisture Resistance: MIL-STD-202, method 106, R shift .5% max., or .5 ohms max., whichever is greater.

Loadlife: 1000 hours at rated power, R shift .5% max., or .5 ohms, whichever is greater.



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1717 CHICAGO AVENUE, RIVERSIDE, CALIF. 92507 • PHONE: (714) 788-1700 • TWX: 910-332-6108

Type MP Chassis Mounted Power Film Resistors

Caddock pages from EEM date 1981

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Type MP Chassis Mounted Power Film Resistors are made with Micronox® resistance films fired onto a ceramic substrate which is thermally bonded to an anodized aluminum base. By mounting this assembly directly to a metal surface for improved heat transfer, the high power capabilities of these unique resistors can provide increased packaging densities in many types of electronic equipment.

The special performance features of the Type MP Power Film Resistors include:

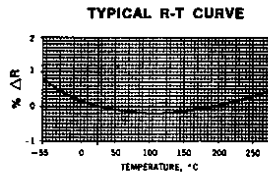
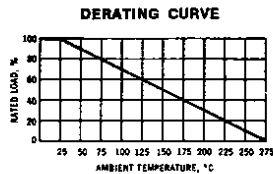
- Two case sizes that provide 15 watt and 30 watt ratings.
- Single-screw mounting to simplify attachment to the chassis or other heat conducting surface.
- A molded silicone case that encapsulates the resistor assembly to meet stringent environmental specifications.
- Extended-life stability better than 0.01% per 1000 hours has been demonstrated through a 5½ year, 50,000 hour program of continuous load-life testing.

Detailed information on power ratings versus ambient temperature and chassis area has been provided on this page. A detailed report on the results of extended-life stability tests is available from the applications engineering group at Caddock Electronics, Inc.

Model No.	Power Rating†	Max. Voltage	Diel. Str.	High Temp. TC‡	Resistance Range		Dimensions				Terminals
					Min.	Max.	A	B	C	D	
MP312	15 Watts	300	600	50	10Ω	200 K	.800	.188	.185	.092	Gold Plated Solder Lugs
MP330	30 Watts	450	1000	50	10Ω	200 K	.850	.250	.250	.142	Gold Plated Solder Lugs

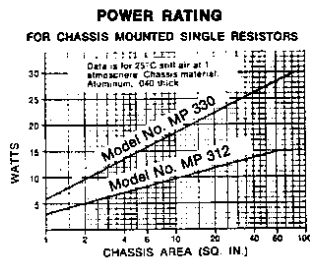
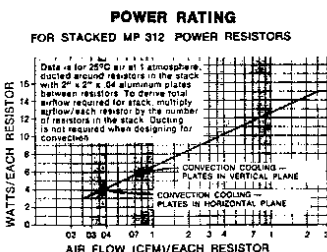
† Power rating based on chassis mounting with MP 312 on a 5" x 4" x 2" x .040" aluminum chassis and MP 330 on a 5" x 7" x 2" x .040" aluminum chassis.

‡ TC: 50 ppm referenced to 25°C, ΔR taken at +150°C and +275°C. (Low temp. TC will be nominally -85 ppm/°C at -55°C. See typical R-T curve.)

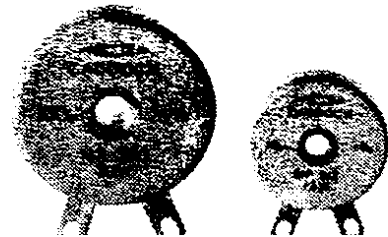


Stacked Type MP assemblies — constructed by bolting resistors between aluminum heat dissipating plates — provide a simple means of further improving packaging densities.

These charts of power ratings versus ambient temperature and chassis area show the high power levels that can be achieved with forced air cooling and with convection cooling in either vertical or horizontal orientation.



U.S. Patent No's 3,636,493 and 3,649,944 Other patents pending.



SPECIFICATIONS

Resistance Tolerance: ±1% standard (Other tolerances on special order.)

Insulation Resistance: 10,000 Megohms, dry. Method — Mil-R-18546D, para. 4.6.8.

Solderability: Per Mil-R-18546D, para. 3.7, para. 4.6.4.

Terminal Strength: Per Mil-Std-202, Method 211, Cond. A (Pull Test), 5 lbs., and Cond. B (Bend Test), Max. ΔR, .2% or .2Ω, whichever is greater.

Thermal Shock: Per Mil-R-18546D, para. 4.6.9, max. ΔR, .5% or .2Ω, whichever is greater.

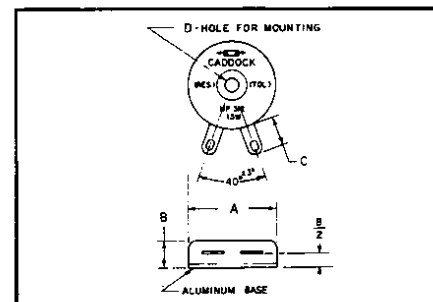
Momentary Overload: 2 times rated power or 1.5 times max. allowable working voltage, whichever gives the lower power, for 5 seconds. Max. ΔR, .5% or .2Ω, whichever is greater.

Moisture Resistance: Mil-Std-202, Method 106B, less steps 7a and 7b, max. ΔR, .5% or .2Ω, whichever is greater.

Life: Per Mil-R-18546D, para. 4.6.12, 1,000 hrs., Max. ΔR, 1% or .2Ω, whichever is greater.

Shock, Medium Impact: 50G, per Mil-Std-202, Method 205, Cond. C.

Vibration, High Frequency: Per Mil-Std-202, Method 204, Cond. B, Max. ΔR .2% or .2Ω, whichever is greater, through shock and vibration sequence.



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Caddock pages from EEM date 1981

EEM is Electronic Engineer's Master

Type MK Low Cost Precision Film Resistors

With Resistance Range Extended to 100 Megohms.

Here are the low cost precision resistors that provide high density packaging in large volume printed circuit applications. Available in two miniature rectangular package configurations with standard lead spacings, Type MK Precision Film Resistors now cover the entire resistance range from 10 ohms to 100 Megohms.

Constructed with Caddock Micronox® resistance films fired onto a solid ceramic substrate, Type MK Precision Film Resistors combine all of these outstanding advantages:

- ±1% resistance tolerance is standard and tolerances to ±0.1% are available on special order.
- Operating temperatures are from -55°C to +175°C.
- Full power rating at +125°C.
- Temperature Coefficient is only 50 PPM/°C up to 10 Megohms and 80 PPM/°C up to 100 Megohms, referenced to 25°C with the ΔR taken at -15°C and +105°C.
- Extended life stability is typically better than 0.1% per 1000 hours.
- Caddock's non-inductive performance provides greater pulse fidelity and wider bandwidths in high frequency circuits.

This combination of performance advantages in a small, standardized case can simplify many engineering and production problems:

One size of Type MK resistors can replace many sizes of radial lead resistors.

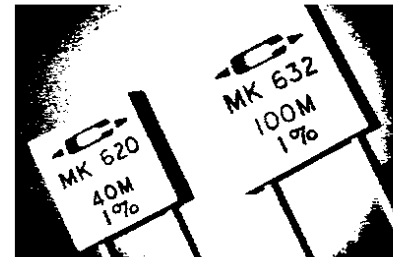
This table of "RN" style axial lead resistors shows the many sizes and power ratings that can be replaced with either of the two models of Type MK Precision Film Resistors within the maximum allowable voltage ratings.

Comparison of Type MK and "RN" Ratings and Dimensions			
Resistor Type	Power Rating	Maximum Resistance	Mounting Hole Spacing
MK 120 or MK 620	.50 WT.	40 Megohms	.150
MK 132 or MK 632	.75 WT.	100 Megohms	.200
RN50	.05 WT.	1 Megohm	.400
RN 55	.10 WT.	5 Megohms	.500
RN60	.125 WT.	10 Megohms	.625
RN65	.25 WT.	20 Megohms	.875
RN70	.50 WT.	40 Megohms	1.000

All outline drawings full size — dimensions in inches.

The largest Type MK — rated at .75 watt — requires less board space than even the 1/20th watt RN 50.

The smallest Type MK — rated at .5 watt — provides power dissipation equal to the RN 70 resistor. The RN 70 resistor requires a mounting hole spacing of 1" and a side-to-side spacing of .250 inches, resulting in a total mounting area of .25 square inches — 10 times the area required for a .75 watt Type MK resistor!



One standard resistor configuration can simplify board layouts.

With the exceptionally wide range of resistances that are available in each model of Type MK Precision Film Resistors, circuits can now be designed for maximum packaging densities without the need for leaving 'extra' space where resistor value changes can require larger resistors or non-uniform lead spacings.



Standardization of resistor size can speed assembly procedures and reduce procurement costs.

The standardization of resistor size can pay additional dividends by simplifying assembly procedures. The radial leads do not require additional bending prior to insertion, and the standard lead spacing can reduce the time required for assembly.

The combination of higher power rating and smaller size can also lower procurement costs. By reducing the wide variety of sizes and types of axial lead resistors to a single, 'standardized' resistor type, unit prices can be lowered and inventory problems simplified.

Low Quantity Prices — Fast Delivery

Quantity prices for Type MK Precision Film Resistors are low, with many values priced under 40 cents each in medium-to-large production orders.

Type MK Precision Film Resistors can be delivered in large quantities with normal delivery schedules of 4 to 6 weeks ARO, and prototype quantities can usually be delivered from stock.

A pricing schedule for all values and models of Type MK Precision Film Resistors is available upon request. For specific price and delivery information call or write to the main offices of Caddock Electronics in Riverside, California.

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Type MK Low Cost Precision Film Resistors

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Type MK Precision Film Resistors — Standard Resistance Range

Model No.	Wattage	Max. Voltage	Oper. Temp. (Max.)	Dielect. Str'gth	TC ppm/°C†	Resistance		Dimensions	Encapsulation	Leadwire
						Min.	Max.			
MK 120	.5	200	175°C	300	50	30 Ω	2 Meg.	Ref. Case "A" Dwg.	Transfer Molded Type	Tinned Copper
MK 132	.75	400	175°C	400	50	30 Ω	5 Meg.	Ref. Case "B" Dwg.	Transfer Molded Type	Tinned Copper

Resistance Tolerance: ±1% (tolerance to ±.1% on special order).

Operating Temperature: -55°C to 175°C.

Overload: 5 times rated power for 5 seconds, R shift .15% max., or .2 ohms max., whichever is greater.

Overvoltage: 1.5 times max. voltage for 5 seconds, R shift .15% max., or .2 ohms max., whichever is greater.

Thermal Shock: Mil-Std-202, Method 107, Cond. B, shift .2% max., or .2 ohms max., whichever is greater.

Moisture Resistance: Mil-Std-202, Method 106, R shift .5% max., or .2 ohms max., whichever is greater.

Loadlife: 1000 hours at rated power, R shift .4% max., or .2 ohms max., whichever is greater.

Insulation Resistance: 10,000 Megohms, minimum.

Type MK Precision Film Resistors — Extended Resistance Range

Model No.	Wattage	Max. Voltage	Oper. Temp. (Max.)	Dielect. Str'gth	TC ppm/°C†	Resistance		Dimensions	Encapsulation	Leadwire
						Min.	Max.			
MK 620	.5	200	175°C	300	80	2 Meg.	40 Meg.	Ref. Case "A" Dwg.	Transfer Molded Type	Tinned Copper
MK 632	.75	400	175°C	400	80	5.1 Meg.	100 Meg.	Ref. Case "B" Dwg.	Transfer Molded Type	Tinned Copper

Resistance Tolerance: ±1% (consult factory for tighter tolerances).

Operating Temperature: 55°C to 175°C.

Overvoltage: 1.5 times max. voltage for 5 seconds, R shift .5% max.

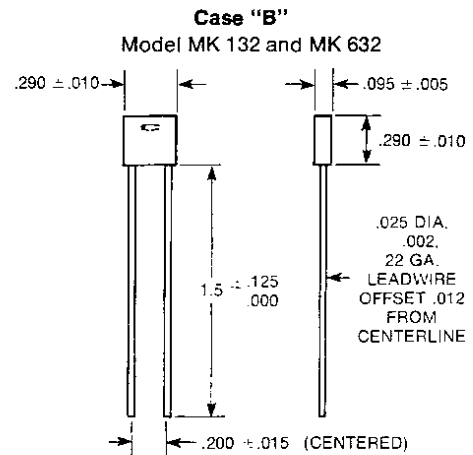
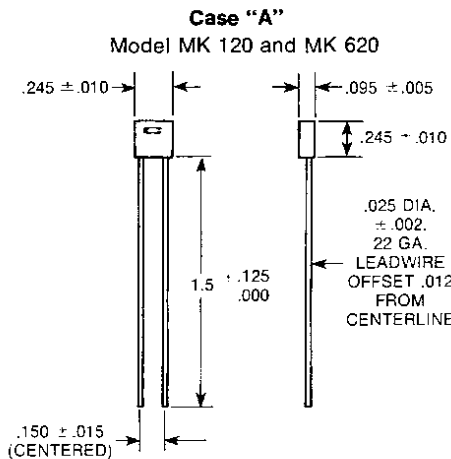
Thermal Shock: Mil-Std-202, Method 107, Cond. B, R shift .5% max.

Moisture Resistance: Mil-Std-202, Method 106, R shift .5% max.

Loadlife: 1000 hours at rated power, R shift .5% max.

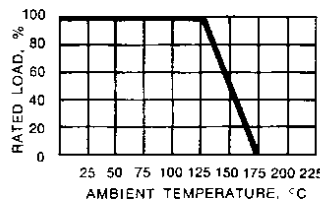
Insulation Resistance: 10,000 Megohms, minimum.

†Temperature Coefficient: Referenced to 25°C, ΔR taken at -15°C and +105°C



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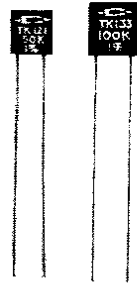
Type TK Temp-Stable Precision Film Resistors

With Temperature Coefficients to Less Than 5 PPM/°C.

Caddock introduces a new design element for precision electronic circuitry — an advanced technology breakthrough that solves many critical circuit stability problems — the **Type TK Temp-Stable Precision Film Resistors with the Tetrinox™ resistance system.**

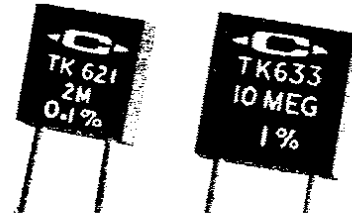
Type TK Temp-Stable Precision Film Resistors provide a combination of performance advantages never before available in a resistive component:

- **Temperature Stability** — to better than 5 PPM/°C over the entire temperature range from -55°C to +125°C!
- **Long-Term Absolute Stability** — better than ±0.05% per 2000 hours of operation.
- **Extended Resistance Range** — from 1000 ohms to 10 Megohms.
- **Precision Tolerances** — ±1% is standard, and tolerances as close as ±0.05% are available.
- **Wide Operating Temperature Range** — from -55°C to +175°C.
- **Small Size** — with two miniature rectangular cases for maximum packaging density and minimum mounting area.
- **High Power Density** — with power ratings of .2 watt and .3 watt in molded cases, the largest of which is a standard CK 06 package.
- **Highest Performance-to-Cost Ratio** — with many values priced below \$1.50 each in 1000 lot quantities.



(Photos show resistors full size)

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The exceptional performance of Type TK resistors can achieve improvements in many circuit applications:

Low TC "Matched-Pair" Voltage Dividers Can be Assembled Without Pre-Selection of Resistors.

An important application for Type TK resistors is in "matched-pair" voltage dividers where the low 5 PPM/°C temperature coefficient provides ratio tracking of less than 10 PPM/°C without resistor pre-selection or special testing.

With factory selection, Type TK resistor pairs can be matched to within 1 PPM/°C.

Extended Resistance Range Reduces Power Requirements

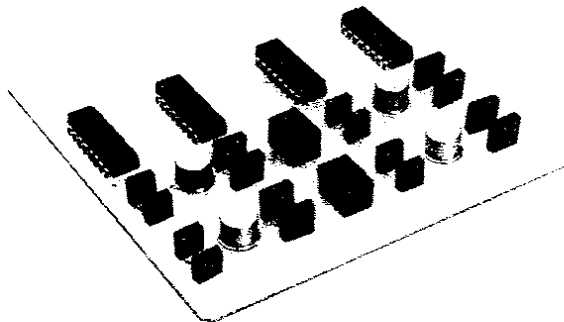
Because the Type TK resistors provide resistance values as high as 10 Megohms — values that are up to 100 times higher than other types of ultra-low TC resistors — engineers can now design precision circuits with lower current drain and lower power requirements.

High Density Packaging

The radial lead mounting and small rectangular case of Type TK resistors permits high packaging densities in low profile electronic circuitry. And because both models of Type TK resistors are available in an exceptionally wide range of resistances, lead spacing and mounting space can be standardized.

For additional information on the Type TK resistors for your high stability circuits, contact the engineering staff of Caddock Electronics in Riverside, California. They can assist you in determining the exact temperature coefficient and tolerances your application requires, and will provide both evaluation and production quantities of these new resistors on fast-delivery schedules.

Building on 19 years of experience with our unique complex-oxide technology, Caddock has perfected the Tetrinox™ resistance system — the first high resistance system to provide a TC that is well within 5 PPM/°C and that is also essentially linear over the entire temperature range from -55°C to +125°C.



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Type TK Temp-Stable Precision Film Resistors

Type TK Temp-Stable Precision Film Resistors — Standard Resistance Range

Model No.	Temperature Coefficient ppm/°C †	Resistance		Wattage @ +125°C	Max. Working Voltage	Dielect. Str'gth	Dimensions	Encapsulation	Leadwire
		Min.	Max.						
TK121	5, 10 or 20	1K	500K	.2	200	300	Ref. Case "A" Dwg.	Transfer Molded Type	Tinned Copper
TK133	5, 10 or 20	1K	1.5 Meg.	.3	300	400	Ref. Case "B" Dwg.	Transfer Molded Type	Tinned Copper
TK139	5, 10 or 20	1K	1.5 Meg.	.3	300	400	Ref. Case "C" Dwg.	Transfer Molded Type	Tinned Copper

† Specify TC when ordering. 10 PPM/°C is standard.

Resistance Tolerance: ±1% Standard. (Tolerances to ±0.05% on special order.)

Operating Temperature: -55°C to +175°C.

TC Temperature Range: -55°C to +125°C.

Overload:* 6.25 times rated power for 5 seconds at voltages not to exceed 1.5 times maximum rated working voltage, R shift less than 0.05%.

Thermal Shock: Mil-Std-202, Method 107, Condition B, R shift less than 0.05%.

Low Temperature Operation:* R shift less than 0.02%.

Dielectric Withstanding Voltage:* R shift less than 0.02%.

Moisture Resistance:* Mil-Std-202, Method 106, R shift less than 0.02%.

Load Life:* 2000 hours at +125°C, R shift less than 0.05%.

Shelf Life (Typical): 25 ppm/year.

Insulation Resistance: 10,000 Megohms.

Vibration:* R shift less than 0.01%.

Shock:* R shift less than 0.02%.

* Test methods per specifications and procedures of Mil-R-55182/9.

Type TK Temp-Stable Precision Film Resistors — Extended Resistance Range

Model No.	Temperature Coefficient ppm/°C †	Resistance		Wattage @ +125°C	Max. Working Voltage	Dielect. Str'gth	Dimensions	Encapsulation	Leadwire
		Min.	Max.						
TK621	5, 10 or 20	501K	2 Meg.	Limited by Maximum Working Voltage	200	300	Ref. Case "A" Dwg.	Transfer Molded Type	Tinned Copper
TK633	5, 10 or 20	1.51 Meg.	10 Meg.	Limited by Maximum Working Voltage	300	400	Ref. Case "B" Dwg.	Transfer Molded Type	Tinned Copper
TK639	5, 10 or 20	1.51 Meg.	10 Meg.		300	400	Ref. Case "C" Dwg.	Transfer Molded Type	Tinned Copper

† Specify TC when ordering. 10 PPM/°C is standard.

Resistance Tolerance: ±1% Standard. (Tolerances to ±0.05% on special order.)

Operating Temperature: -55°C to +175°C.

TC Temperature Range: -55°C to +105°C.

Overload:* 1.5 times maximum rated working voltage for 5 seconds, R shift less than 0.2%.

Thermal Shock: Mil-Std-202, Method 107, Condition B, R shift less than 0.1%.

Low Temperature Operation:* R shift less than 0.05%.

Dielectric Withstanding Voltage:* R shift less than 0.05%.

Moisture Resistance:* Mil-Std-202, Method 106, R shift less than 0.05%.

Load Life:* 2000 hours at +125°C, R shift less than 0.2%.

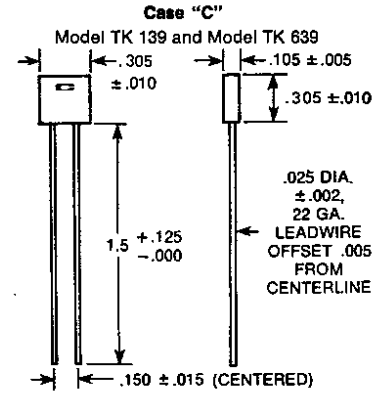
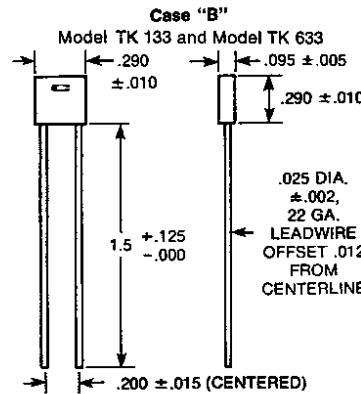
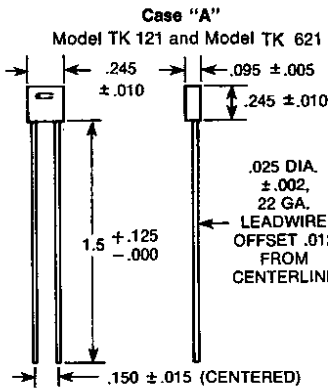
Shelf Life (Typical): 200 ppm/year.

Insulation Resistance: 10,000 Megohms.

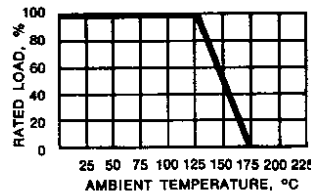
Vibration:* R shift less than 0.05%.

Shock:* R shift less than 0.05%.

* Test methods per specifications and procedures of Mil-R-55182/9.



OPERATING CURVE



APPLIES TO ALL MODELS OF TYPE TK RESISTORS

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