

**TYPES CD $\frac{1}{8}$ R, CD $\frac{1}{4}$ R, CD $\frac{1}{2}$ PR, CD $\frac{1}{2}$ MR, CD $\frac{1}{2}$ SR, CD1R, CD2R**

Texas Instruments  
 date 1966

**MIL-LINE PRECISION CARBON FILM RESISTORS**

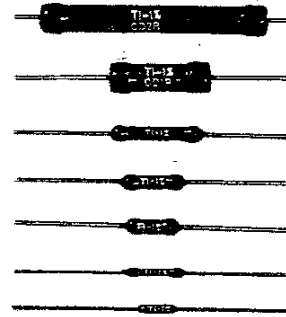


Meet or exceed all requirements of Specification MIL-R-10509B for Characteristic X

**NEW IMPROVED DESIGN**

- Full rated load at 70°C ambient (formerly 40°C)
- High degree of stability and reliability
- Precision resistance —  $\pm 1\%$  tolerance
- Exclusive tough multi-coat synthetic seal

- Insulation resistance greater than 50,000 megohms
- Withstand moisture, shock and abrasion



$\frac{1}{2}$  ACTUAL SIZE

TYPES CD1/8R, CD1/4R, CD1/2PR, CD1/2MR, CD1/2SR, CD1R, CD2R  
 BULLETIN NO. DL-C 611522, APRIL 1961  
 REPLACES BULLETIN NO. DL-C 1073, MAY 1959

**specifications**

TI type number	watt- age rating — watts	MIL desig- nation	standard resistance ranges	max. recom- mended voltage— volts	* body length — inches	body diameter— inches	lead length— inches	lead diameter		avg. weight per 100 unpacked units— lbs.
								inches	awg #	
CD $\frac{1}{8}$ R	$\frac{1}{8}$	—	10 Ohm-1 Meg	350	0.325 ( $\pm 0.050$ )	0.095 ( $\pm 0.015$ )	1.550 ( $\pm 0.062$ )	0.025	22	0.073
CD1/4R	$\frac{1}{4}$	RN10X	10 Ohm-1 Meg	500	0.480 ( $\pm 0.050$ )	0.095 ( $\pm 0.020$ )	1.562 ( $\pm 0.062$ )	0.025	22	0.079
CD1/2PR	$\frac{1}{2}$	RN15X	10 Ohm-3 Meg	650	0.455 ( $\pm 0.050$ )	0.160 ( $\pm 0.025$ )	1.562 ( $\pm 0.062$ )	0.032	20	0.158
CD $\frac{1}{2}$ MR	$\frac{1}{2}$	RN20X	10 Ohm-5 Meg	750	0.530 ( $\pm 0.050$ )	0.160 ( $\pm 0.025$ )	1.562 ( $\pm 0.062$ )	0.032	20	0.166
CD $\frac{1}{2}$ SR	$\frac{1}{2}$	—	50 Ohm-10 Meg	850	0.800 ( $\pm 0.050$ )	0.160 ( $\pm 0.025$ )	1.562 ( $\pm 0.062$ )	0.032	20	0.201
CD1R	1	RN25X	10 Ohm-10 Meg	1000	0.915 ( $\pm 0.050$ )	0.300 ( $\pm 0.025$ )	1.562 ( $\pm 0.062$ )	0.032	20	0.647
CD2R	2	RN30X	50 Ohm-50 Meg	2000	2.050 ( $\pm 0.050$ )	0.300 ( $\pm 0.025$ )	1.562 ( $\pm 0.062$ )	0.032	20	1.243

**symbolization**

- CD1/8R: TI - 1%, Value
- CD1/4R: either TI - 1%, Value or TI-RN10X, Value
- CD1/2SR: TI - 1%, CD1/2SR, Value
- CD1/2PR }  
CD1/2MR }  
CD1R }  
CD2R }
- TI - 1%  
Type  
RN Number  
MIL Value  
Commercial Value

All resistors are calibrated at 25°C. Resistance values are available expressed to a maximum of three significant figures.

**modifications available on request**

- Kel-F or VINYL Sleeving
- $\pm \frac{1}{2}$ , 2 or 5% Resistance Tolerances
- Resistance Values Outside Published Ranges

[www.33audio.com](http://www.33audio.com)

\*Body dimensions do not include coating material, which may extend along lead beyond resistor body. For minimum dimensions, consult your local TI Sales Office.

†Carbon film resistors are manufactured under license agreement with the Western Electric Company.

Texas Instruments date 1966

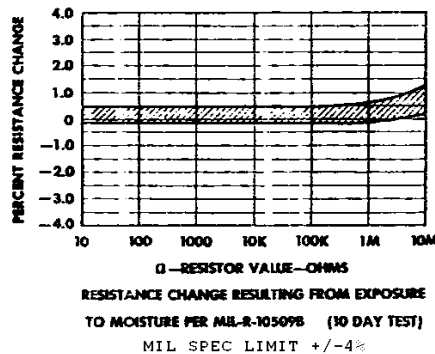
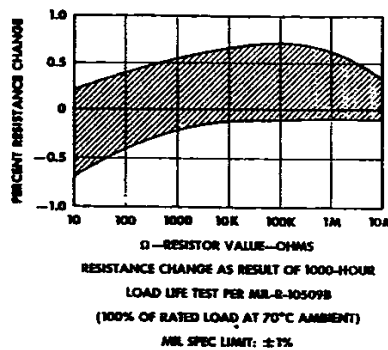
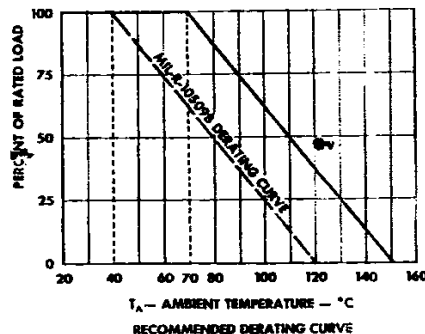
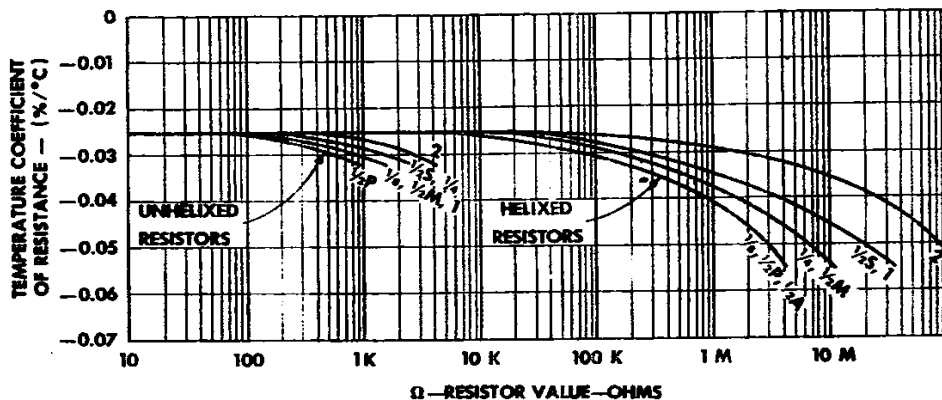
# TYPES CD $\frac{1}{4}$ R, CD $\frac{1}{4}$ R, CD $\frac{1}{2}$ PR, CD $\frac{1}{2}$ MR, CD $\frac{1}{2}$ SR, CD1R, CD2R MIL-LINE PRECISION CARBON FILM RESISTORS

www.33audio.com

## TYPICAL CHARACTERISTICS

test	average performance of TI resistors*	limits MIL-R-10509B
Temperature Cycling per Mil-R-10509B (4.6.3)	0 to -0.15%	±0.50%
Low Temperature Exposure per Mil-R-10509B (4.6.4)	Less than ±0.10%	±0.50%
Short Time Overload per Mil-R-10509B (4.6.5)	Less than ±0.10%	±0.75%
Effect of Soldering per Mil-R-10509B (4.6.8)	Less than ±0.10%	±0.50%
Vibration	Less than ±0.10%	No requirement
Shock	Less than ±0.10%	"
Acceleration	Less than ±0.20%	"
Shelf Life, change per year	Less than ±0.10%	"
Insulation Resistance per Mil-R-10509B (4.6.7)	Greater than 100,000 Megohms	"
Voltage Coefficient	Less than 0.002%/Volt	"

\* Unless otherwise noted, data is % change in total resistance.



PRINTED IN U.S.A.

TEXAS INSTRUMENTS RESERVES THE RIGHT TO MAKE CHANGES AT ANY TIME  
 IN ORDER TO IMPROVE DESIGN AND TO SUPPLY THE BEST PRODUCT POSSIBLE.

www.33audio.com

Texas Instruments  
 date 1966

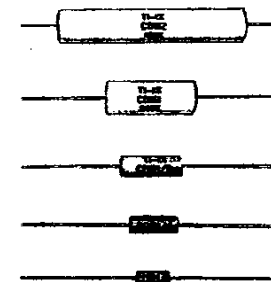
# TYPES CDM $\frac{1}{8}$ , CDM $\frac{1}{4}$ , CDM $\frac{1}{2}$ , CDM1, CDM2 MOLDED PRECISION CARBON FILM RESISTORS



Meet or exceed all requirements

of Specification MIL-R-10509C for Characteristic B

Full rated load at 70°C ambient  
 High degree of stability and reliability  
 Precision resistances— $\pm 1\%$  tolerance  
 Tough molded coating • Fully insulated



$\frac{1}{2}$  ACTUAL SIZE

TYPES CDM $\frac{1}{8}$ , CDM $\frac{1}{4}$ , CDM $\frac{1}{2}$ , CDM1, CDM2  
 BULLETIN NO. DL-C 1105 JUNE, 1959  
 REPLACES BULLETIN NO. DL-C 849

### specifications

TI type number	wattage rating — watts	MIL desig- nation	standard resistance ranges	max. recom- mended voltage — volts	body length — inches	body diameter — inches	lead length — inches	lead diameter		avg. weight per 100 unpacked units — lbs.
								inches	awg #	
CDM $\frac{1}{8}$	$\frac{1}{8}$	RN60B	10 Ohm-1 Meg	350	0.406 ( $\pm 0.015$ )	0.140 ( $\pm 0.015$ )	1.500 ( $\pm 0.062$ )	0.025	22	0.101
CDM $\frac{1}{4}$	$\frac{1}{4}$	RN65B	10 Ohm-1 Meg	500	0.585 ( $\pm 0.015$ )	0.200 ( $\pm 0.020$ )	1.500 ( $\pm 0.062$ )	0.025	22	0.198
CDM $\frac{1}{2}$	$\frac{1}{2}$	RN70B	10 Ohm-5 Meg	750	0.750 ( $\pm 0.015$ )	0.250 ( $\pm 0.020$ )	1.450 ( $\pm 0.062$ )	0.032	20	0.373
CDM1	1	RN75B	10 Ohm-10 Meg	1000	1.062 ( $\pm 0.020$ )	0.375 ( $\pm 0.025$ )	1.500 ( $\pm 0.062$ )	0.032	20	1.035
CDM 2	2	RN80B	50 Ohm-45 Meg	2000	2.187 ( $\pm 0.020$ )	0.375 ( $\pm 0.025$ )	1.500 ( $\pm 0.062$ )	0.032	20	2.055

### commercial symbolization

Standard symbolization includes TI Type Number, Resistance Value, and Tolerance.

Space limitations on the 1/8 watt resistor require that the type designation be abbreviated to C1/8.

### military symbolization

Per MIL-R-10509 — Resistors, Fixed Film (High Stability)

All resistors are calibrated at 25°C. Resistance values are available expressed to a maximum of three significant figures.

### modifications available upon request

$\pm \frac{1}{2}$ , 2 or 5% Resistance Tolerance  
 Resistance Values Outside Published Ranges

TI carbon film resistors are manufactured under license agreement with the Western Electric Company.



**TEXAS INSTRUMENTS**  
 INCORPORATED  
 SEMICONDUCTOR-COMPONENTS DIVISION  
 POST OFFICE BOX 5012 • DALLAS 22, TEXAS

Texas Instruments date 1966

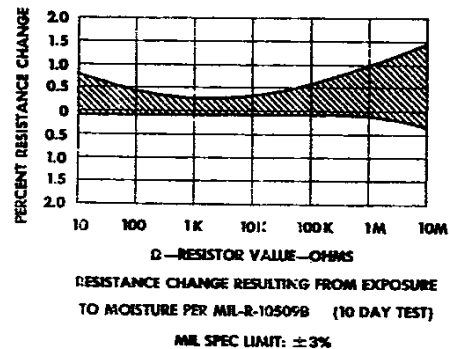
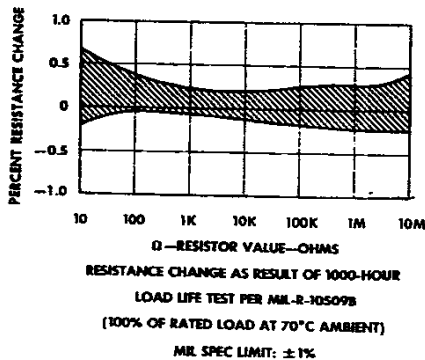
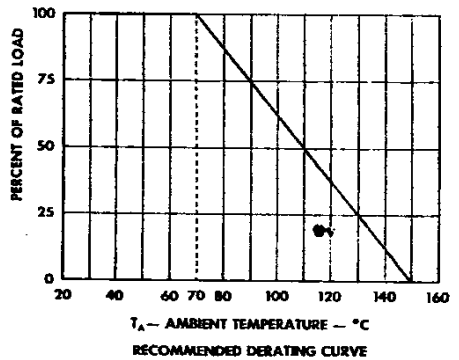
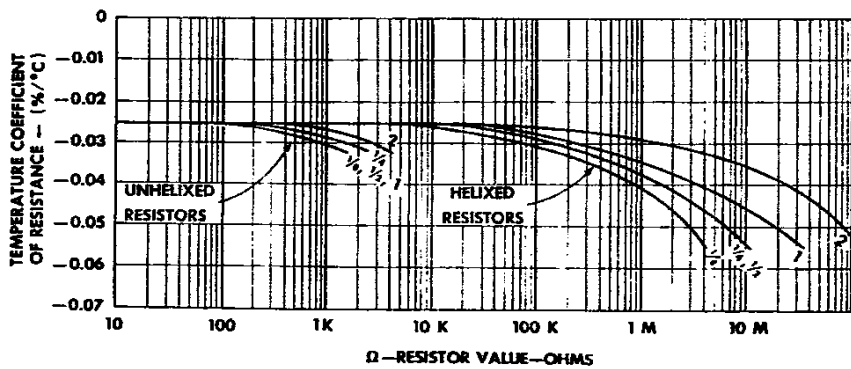
# TYPES CDM<sup>1/8</sup>, CDM<sup>1/4</sup>, CDM<sup>1/2</sup>, CDM1, CDM2 MOLDED PRECISION CARBON FILM RESISTORS

www.33audio.com

## TYPICAL CHARACTERISTICS

test	average performance of TI resistors*	limits MIL-R-10509C
Temperature Cycling per MIL-R-10509C (4.6.4)	+0.05 to -0.15%	±0.50%
Low Temperature Operation per MIL-R-10509C (4.6.5)	less than ±0.10%	±0.50%
Short Time Overload per MIL-R-10509C (4.6.6)	less than ±0.10%	±0.75%
Effect of Soldering per MIL-R-10509C (4.6.10)	less than ±0.05%	±0.50%
Insulation Resistance per MIL-R-10509C (4.6.9)	greater than 100,000 megohms	greater than 10,000 megohms
Acceleration per MIL-R-10509C (4.6.14)	less than ±0.10%	±0.50%
Shock per MIL-R-10509C (4.6.15)	less than ±0.10%	±0.50%
Vibration, High Frequency per MIL-R-10509C (4.6.16)	less than ±0.10%	±1.00%
Shelf Life, Change per Year	less than ±0.10%	no requirement
Voltage Coefficient	less than 0.002%/volt	no requirement

\*Unless otherwise noted, data is % change in total resistance. The two sigma limits were used as the range indications in all tests shown.



Texas Instruments date 1966

TYPES CG<sup>1</sup>/<sub>8</sub>, CG<sup>1</sup>/<sub>4</sub> AND CG<sup>1</sup>/<sub>2</sub>

**PRECISION, CARBON-FILM, GLASS-ENCAPSULATED HERMETIC RESISTORS**



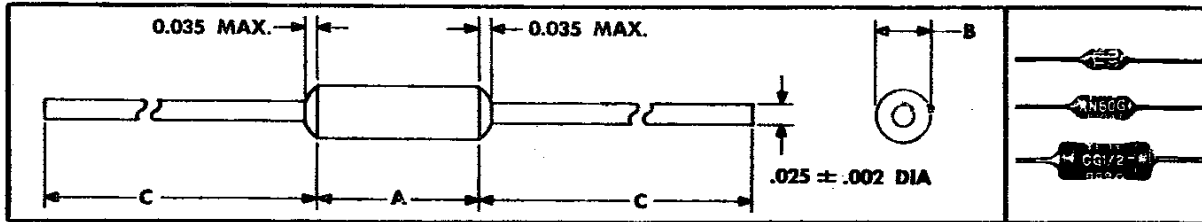
**Proven high reliability —**  
 > 40,000,000 test data hours  
 -65°C to 175°C storage temperature  
 Hermetically sealed in hard glass

**Meet or exceed all requirements of**  
**Specification MIL-R-10509D**  
**for Characteristics B, D & G**  
 Leads welded to end caps  
 ±1% ohmic tolerance

**environmental tests**

To achieve maximum reliability, all TI glass resistors are 100% inspected for hermetic seal as a continuous process control. Tests are conducted to all electrical, environmental, and mechanical specifications to insure full and continuous compliance with Mil-R-10509D, Characteristics B,D, and G.

**specifications**



TI type number	wattage rating (T <sub>A</sub> ≤ 70°C)*				MIL designation	standard resistance ranges	maximum working voltage**	body length*** (A)	body diameter (B)	lead length (C)	lead size	avg. weight per 100 unpacked units
	MIL											
	TI	B	D	G								
CG <sup>1</sup> / <sub>8</sub>	1/8	—	1/8	1/10	RN55	10Ω to 100KΩ	250	0.240(+.010, -.020)	0.125(±0.015)	1.500(±0.125)	22	0.076
CG <sup>1</sup> / <sub>4</sub>	1/4	1/4	1/4	1/4	RN60	10Ω to 1 MegΩ	350	0.360(+.025, -.015)	0.140(±0.020)	1.500(±0.125)	22	0.09
CG <sup>1</sup> / <sub>2</sub>	1/2	1/4	1/2	1/4	RN65	10Ω to 2 MegΩ	500	0.560(±.025)	0.225(±0.020)	1.500(±0.125)	22	0.228

\*For operation at higher temperature, see Dissipation Derating Curves, Page 2.  
 \*\*Critical ohmic value and above. For lower values use E = √PR. See Paragraph 3.6 of MIL-R-10509D  
 \*\*\*Length of glass package. Fillets on leads extend 0.035" max. beyond glass.

**symbolization**

CG<sup>1</sup>/<sub>8</sub> — Standard stock symbolization includes manufacturer's identification, tolerance and ohmic value (e.g. — TI, 1%, 100 K).  
 CG<sup>1</sup>/<sub>4</sub> — Standard stock symbolization includes manufacturer's identification, tolerance, mil-type designation and ohmic value (e.g. — TI, 1%, RN60G, 1003F, 100 K).  
 CG<sup>1</sup>/<sub>2</sub> — Standard stock symbolization includes manufacturer's identification, tolerance, mil-type designation and ohmic value (e.g. — TI, 1%, RN65G, 1003F, 100 K).

**modifications available on request**

- ± 1/2%, 2% or 5% Resistance Tolerance
- Resistance Values Outside Published Ranges
- Special symbolization

**performance characteristics †**

- Temperature Cycling per MIL-R-10509D (4.6.4)
- Low Temperature Operation per MIL-R-10509D (4.6.5)
- Short Time Overload per MIL-R-10509D (4.6.6)
- Effect of Soldering per MIL-R-10509D (4.6.10)
- Insulation Resistance per MIL-R-10509D (4.6.9)
- Moisture Resistance per MIL-R-10509D (4.6.11)
- Shock per MIL-R-10509D (4.6.15)
- Vibration, High Frequency per MIL-R-10509D (4.6.16)
- Shelf Life, Change per Year
- Voltage Coefficient

**average performance of TI CG<sup>1</sup>/<sub>4</sub> resistors**

- less than ± 0.05%
- less than ± 0.05%
- less than ± 0.05%
- less than ± 0.03%
- greater than 1,000,000 megohms
- less than ± 0.08%
- less than ± 0.05%
- less than ± 0.05%
- less than ± 0.04%
- less than 0.002%/volt

**limits**

MIL Char D	TI and MIL Char G
± 0.50%	± 0.25%
± 0.50%	± 0.25%
± 0.50%	± 0.25%
± 0.50%	± 0.10%
greater than 10,000 megohms	greater than 10,000 megohms
± 1.50%	± 0.50%
± 0.50%	± 0.25%
± 0.50%	± 0.25%
no requirement	no requirement
no requirement	no requirement

†Unless otherwise noted, data is % change in initial resistance. The two-sigma limits were used as the range indications for average performance.



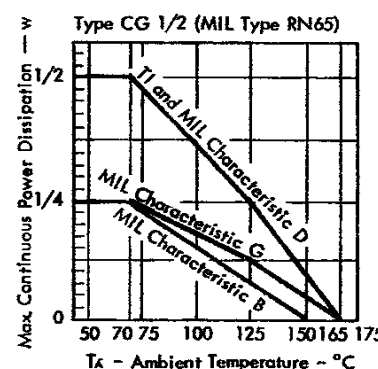
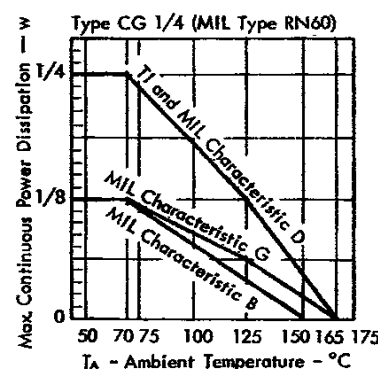
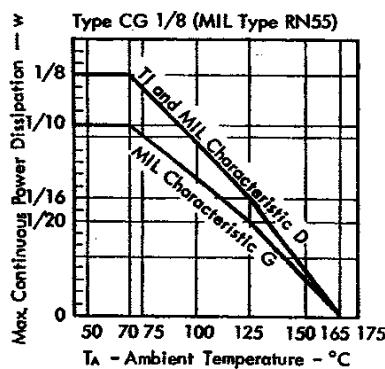
TYPES CG<sup>1</sup>/<sub>8</sub>-CG<sup>1</sup>/<sub>4</sub>-CG<sup>1</sup>/<sub>2</sub>  
 BULLETIN NO. DL-S 63484, SEPTEMBER 1963  
 REPLACES BULLETIN NO. DL-S 63484, MARCH 1963

## TYPES CG $\frac{1}{8}$ , CG $\frac{1}{4}$ AND CG $\frac{1}{2}$

### PRECISION, CARBON-FILM, GLASS-ENCAPSULATED HERMETIC RESISTORS

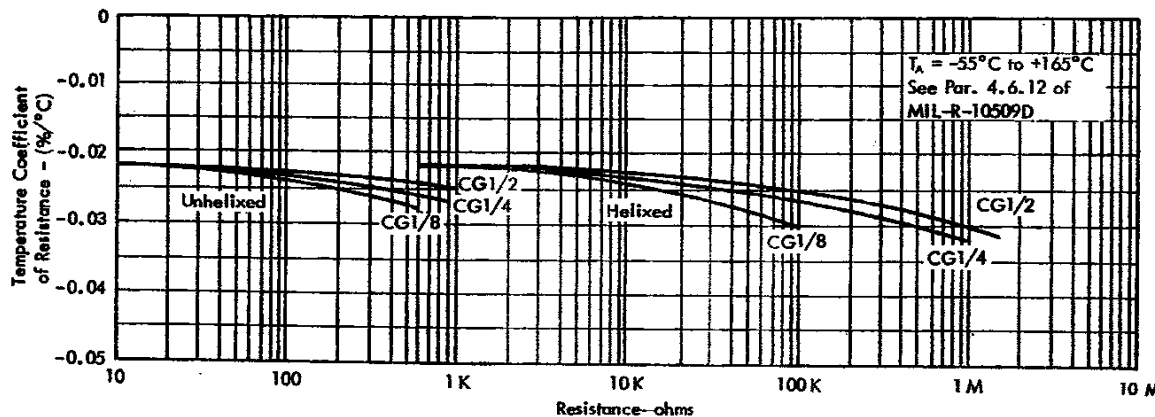
Texas Instruments date 1966

#### DISSIPATION DERATING CURVES

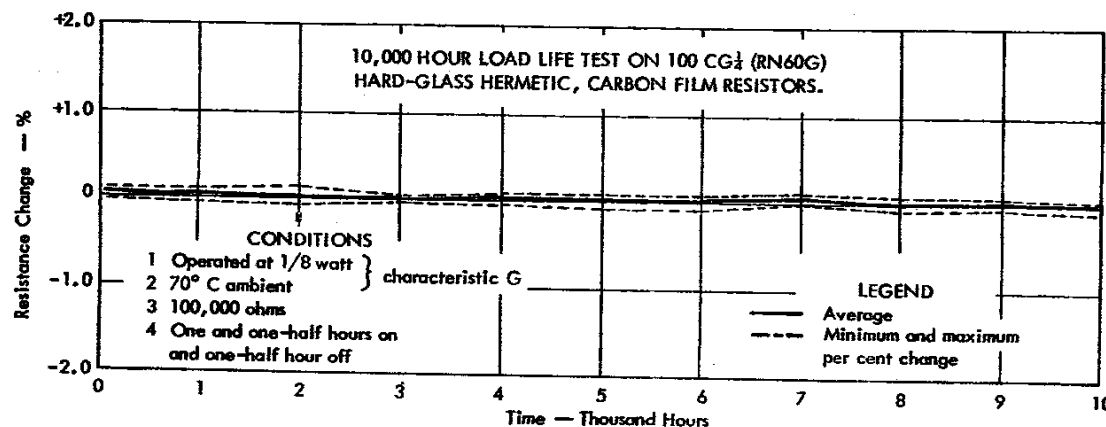


#### TYPICAL CHARACTERISTICS

##### TEMPERATURE COEFFICIENT vs RESISTANCE



##### LOAD LIFE PERCENT CHANGE vs TIME



Texas  
Instruments

Types CR1/8 CR1/4 CR1/2

**EPOXY-ENCAPSULATED PRECISION CARBON FILM RESISTORS**



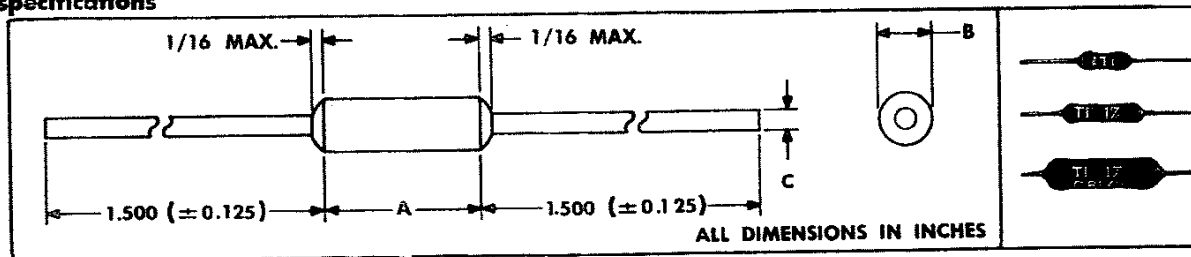
date 1966

Meet or exceed all requirements  
 of Specification MIL-R-10509D for Characteristics D & B

- Double wattage capability furnished by Char. D
- Full rated load at 70°C ambient temperature
- High degree of stability and reliability
- Precision resistance — ± 1% tolerance
- Double-tough Epoxy coating • Fully insulated
- Excellent for high moisture environments over complete temperature range of -55°C to +165°C

TYPE CR $\frac{1}{8}$ , CR $\frac{1}{4}$ , CR $\frac{1}{2}$   
 BULLETIN NO. DL-5-634030-1 JULY-1963  
 REPLACES BULLETIN NO. DL-5-633646

**specifications**



TYPE DESIGNATION		ELECTRICAL RATINGS AND CHARACTERISTICS						MECHANICAL DATA					
TI	MIL	wattage rating (T <sub>A</sub> ≤ 70°C) <sup>1</sup>			storage temperature range	maximum working voltage (v)	resistance value range (T <sub>A</sub> = 25°C)	standard resistance tolerance	body size		lead size		average weight for 100 unpacked units (lbs.)
		TI	MIL						length — A (inch)	diameter — B (inch)	diameter — C (inch)	avg #	
			B	D									
(w)	(w)	(w)											
CR $\frac{1}{8}$	RN55D	$\frac{1}{8}$	—	$\frac{1}{8}$	-65°C to +165°C	300	10 Ω to 301 kΩ	± 1%	0.250 (± 0.031)	0.095 (± 0.015)	0.025 (± 0.002)	22	0.075
CR $\frac{1}{4}$	RN60D, B	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	-65°C to +165°C	400	10 Ω to 1 Megohm	± 1%	0.375 (+ 0.062 / - 0.031)	0.105 (+ 0.015 / - 0.010)	0.025 (± 0.002)	22	0.101
CR $\frac{1}{2}$	RN65D, B	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{2}$	-65°C to +165°C	750	10 Ω to 2 Megohm	± 1%	0.600 (± 0.031)	0.175 (± 0.015)	0.025 (± 0.002)	22	0.198

<sup>1</sup>For operation above 70°C ambient temperature, refer to Power Dissipation Derating Curves, Page 2.

**symbolization**

Standard stock symbolization includes the following items:

CR $\frac{1}{8}$  — Manufacturer's identification and ohmic value (e.g. — TI, 301K)

CR $\frac{1}{4}$  — Manufacturer's identification, tolerance, mil-type designation, and ohmic value (e.g. — TI, 1%, RN60D, 1003F).

CR $\frac{1}{2}$  — Manufacturer's identification, tolerance, mil-type designation, and ohmic value (e.g. — TI, 1%, CR1/2, RN65D, 3013F, 301K).

Special markings can be supplied upon request. Resistance values symbolized to a maximum of three significant figures per MIL Standard 90169.

**modifications available upon request**

± ½, 2, or 5% Resistance Tolerance • Resistance Values Outside Published Ranges • Special Testing

\*Trademark of Texas Instruments Incorporated



Texas Instruments date 1966

# TYPES CR $\frac{1}{8}$ , CR $\frac{1}{4}$ , CR $\frac{1}{2}$ EPOXY-ENCAPSULATED PRECISION CARBON FILM RESISTORS

www.33audio.com

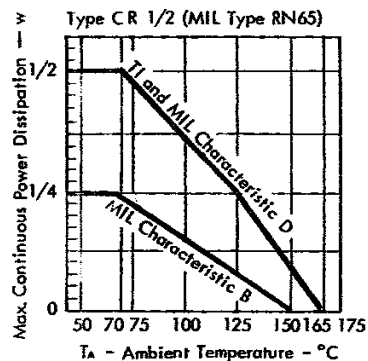
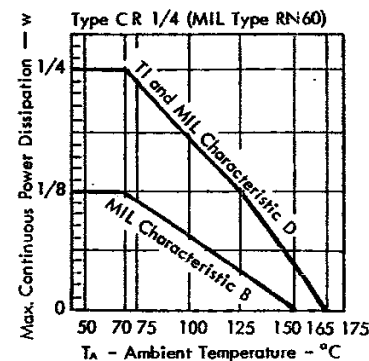
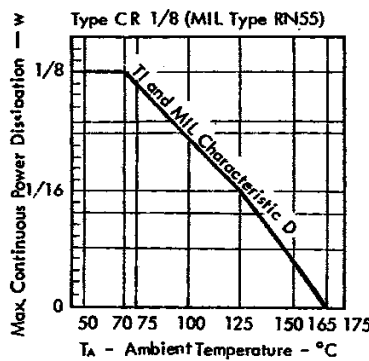
## † performance characteristics

test	typical performance of CR $\frac{1}{2}$ resistors	TI guaranteed and MIL-R-10509D limits (Char. D and B)
Temperature Cycling per MIL-R-10509D (4.6.4)	-0.06%	± 0.50% max
Low-Temperature Operation per MIL-R-10509D (4.6.5)	-0.07%	± 0.50% max
Short Time Overload per MIL-R-10509D (4.6.6)	-0.01%	± 0.50% max
Effect of Soldering per MIL-R-10509D (4.6.10)	+0.02%	± 0.50% max
Insulation Resistance per MIL-R-10509D (4.6.9)	greater than 1000K megohms	greater than 10,000 megohms
Moisture Resistance per MIL-R-10509D (4.6.11)	+0.34%	± 1.50% max
Shock per MIL-R-10509D (4.6.15)	+0.02%	± 0.50% max
Vibration, High Frequency per MIL-R-10509D (4.6.16)	+0.01%	± 0.50% max
Shelf Life, Change per Year	± 0.08%	no requirement
Voltage Coefficient	less than 0.002%/volt	no requirement

† Unless otherwise noted, data is % change in initial resistance.

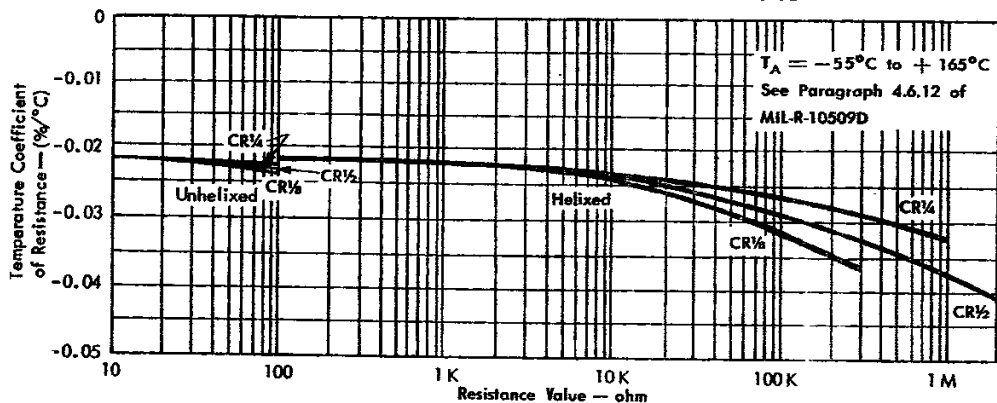
## THERMAL CHARACTERISTICS

### POWER DISSIPATION DERATING CURVES



## TYPICAL CHARACTERISTICS

### TEMPERATURE COEFFICIENT vs RESISTANCE VALUE



PRINTED IN U.S.A.



Texas Instruments  
 date 1966

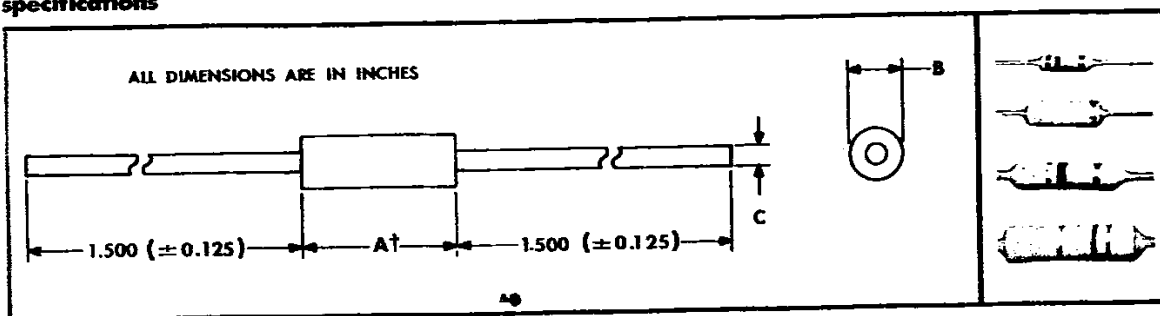
## TYPES GP1/4, GP1/2, GP1, GP2 GENERAL PURPOSE CARBON FILM RESISTORS

BULLETIN NO. DL-5-644928, FEBRUARY 1964

Meet or exceed all electrical requirements of specification MIL-R-11D

- Carbon film resistors designed for 5% tolerance applications
- Low temperature-coefficient-of-resistance of  $-0.02\%/^{\circ}\text{C}$  to  $-0.05\%/^{\circ}\text{C}$
- Full rated load at  $70^{\circ}\text{C}$  ambient temperature
- Exclusive, tough, multi-coat epoxy encapsulant
- Excellent resistance to moisture, shock, abrasion, and flux removers

### specifications



TYPE DESIGNATION	SIMILAR MIL TYPE	ELECTRICAL RATINGS AND CHARACTERISTICS					MECHANICAL DATA			
		wattage rating ( $T_A \leq 70^{\circ}\text{C}$ ) †	storage temperature range	maximum working voltage	resistance value range ( $T_A = 25^{\circ}\text{C}$ )	standard resistance tolerance	body size		lead size	
							length — A † (inch)	diameter — B (inch)	diameter — C (inch)	AWG #
GP1/4	RC07	1/4	$-65^{\circ}\text{C}$ to $+165^{\circ}\text{C}$	250	10 $\Omega$ to 300 k $\Omega$	5%	0.250(±0.031)	0.090(±0.008)	0.025(±0.002)	22
GP1/2	RC20	1/2	$-65^{\circ}\text{C}$ to $+165^{\circ}\text{C}$	350	10 $\Omega$ to 1 M $\Omega$	5%	0.375(±0.031)	0.140(±0.008)	0.032(±0.002)	20
GP1	RC32	1	$-65^{\circ}\text{C}$ to $+165^{\circ}\text{C}$	500	10 $\Omega$ to 1 M $\Omega$	5%	0.530 (+0.040) (-0.030)	0.150(±0.015)	0.040(±0.002)	18
GP2	RC42	2	$-65^{\circ}\text{C}$ to $+165^{\circ}\text{C}$	500	10 $\Omega$ to 2 M $\Omega$	5%	0.688(±0.031)	0.312(±0.008)	0.046(±0.002)	16

†Body length is measured between the end points where body diameter equals the smallest drill size larger than 150% of the nominal lead diameter.

‡For operation above  $70^{\circ}\text{C}$  ambient temperature, refer to Power Dissipation Derating Curves, Page 2.

### symbolization

Standard stock symbolization includes color coding according to EIA Marking Standard.

Other symbolization available upon request.

[www.33audio.com](http://www.33audio.com)



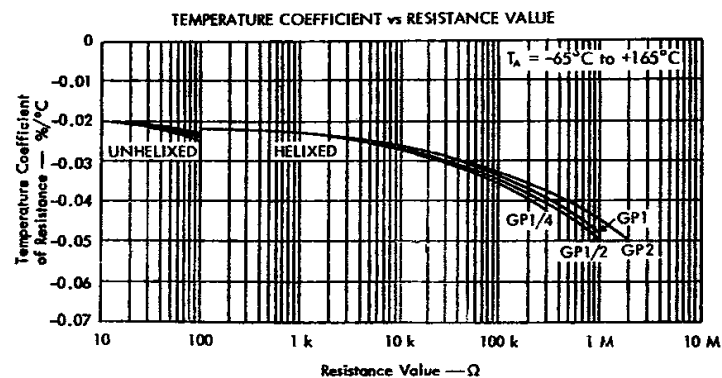
## TYPES GP1/4, GP1/2, GP1, GP2 GENERAL PURPOSE CARBON FILM RESISTORS

### Performance characteristics

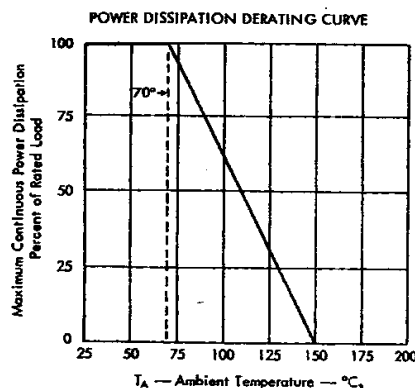
TEST	MIL-R-11D LIMITS	TYPICAL PERFORMANCE OF GP RESISTORS
Temperature Coefficient ( $T_A = 25^\circ\text{C}$ to $105^\circ\text{C}$ )	$\pm 625$ to $\pm 1250$ ppm max	-200 to -500 ppm
Temperature Coefficient ( $T_A = -55^\circ\text{C}$ to $+25^\circ\text{C}$ )	$\pm 815$ to $\pm 1875$ ppm max	-200 to -500 ppm
Voltage Coefficient	0.02 %/volt max	0.01 %/volt
Insulation Resistance	$10^4$ M $\Omega$ min	$10^6$ M $\Omega$
Low Temperature Operation	$\pm 3.0$ % max	-0.5 %
Temperature Cycling	$\pm 4.0$ % max	-0.5 %
Moisture Resistance	$\pm 10.0$ % max	+4.0 %
Short Time Overload	$\pm 2.5$ % max	-0.5 %
Load Life	$\pm 8.0$ % max	$\pm 2.0$ %

unless otherwise noted, data is percent change in initial resistance.

### TYPICAL CHARACTERISTICS



### THERMAL CHARACTERISTICS



### STANDARD RESISTANCE VALUES

#### EIA DECADE - 5% TOLERANCE

10	15	22	33	47	68
11	16	24	36	51	75
12	18	27	39	56	82
13	20	30	43	62	91

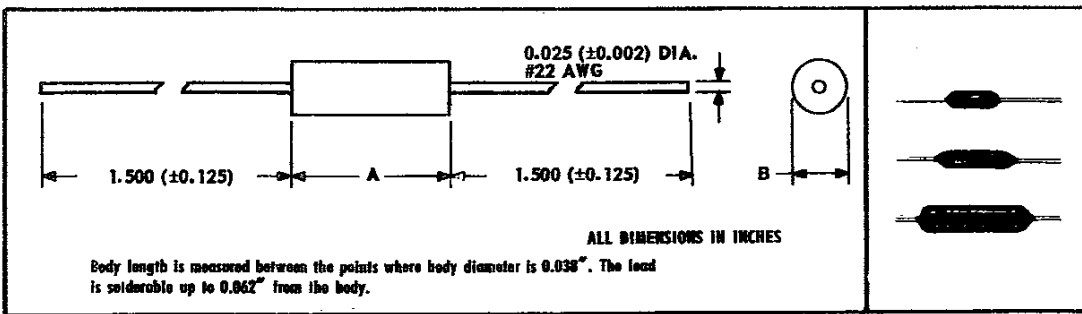
EPOXY-ENCAPSULATED PRECISION METAL-FILM RESISTORS  
 TYPES MC55 MC60 MC65 MC55D MC60D MC65D

Designed to meet or exceed all requirements of  
 Specification MIL-R-10509E for Characteristic C, D, E, & F.

- Load-rated for 125°C or 70°C applications
- High degree of stability and reliability
- Precision resistance tolerances
- Rugged cap-and-lead construction
- Temperature Coefficients ±10, ±25, ±50 and ±100 ppm/°C
- Tough Epoxy coating • Fully insulated

TYPES MC55, MC60, MC65, MC55D, MC60D, MC65D  
 BULLETIN NO. DLS 646350, JULY 1964  
 REPLACES BULLETIN NO. DLS 644764, MARCH 1964

specifications



MIL-R-10509E DESIGNATION			ELECTRICAL RATINGS AND CHARACTERISTICS			MECHANICAL DATA			
type	applicable characteristic	power rating†	power rating‡	maximum working voltage	resistance value range§ (T <sub>A</sub> = 25°C)	body size		average weight for 100 unpacked units¶	
						length -- A	diameter -- B		
--	--	(w)	(w)	(v)	--	(inch)	(inch)	(lb)	
RN55	C & E	1/10	MC55	1/8	250	24.9 Ω to 100 k Ω	0.250 (±0.031)	0.095 (±0.015)	0.075
	D	1/8	MC55D	1/4					
RN60	C & E	1/8	MC60	1/4	380	49.9 Ω to 499 k Ω	0.405 (±0.031)	0.109 (±0.015)	0.101
	B	1/4	MC60D	3/8					
RN65	C & E	1/4	MC65	1/2	350	49.9 Ω to 1 M Ω	0.625 (±0.031)	0.175 (±0.015)	0.198
	F	1/2	MC65D	1					
	D	1/2							

symbolization

Standard stock symbolization includes TI Type Number, Resistance Value, Tolerance, and Temperature Coefficient, depending upon wattage size and space available. Military type symbolization is used when applicable. Resistance values are symbolized to a maximum of three significant figures per Table 1.

military devices

The resistors are available in accordance with the requirements of MIL-R-10509E. For current availability of resistance values, tolerances, and characteristics consult a TI Sales Office.

modifications available upon request

- Special testing
- "A" nickel weldable leads
- Resistance values outside published ranges
- Special paint coverage

†These ratings apply at (or below) 125°C ambient temperature for characteristics C, E, and F and at (or below) 70°C ambient temperature for characteristic D. For higher temperatures refer to MIL-R-10509E.  
 ‡These ratings apply at (or below) 125°C ambient temperature for MC55, MC60, and MC65 and at (or below) 70°C ambient temperature for "D" suffix devices. For higher temperatures refer to Power Dissipation Derating Curves Page 2.  
 §The value ranges shown are for a temperature coefficient of 25 ppm. See "high- and low-value availability" on Page 2.

DATE 1966



Texas Instruments date 1966

# TYPES MC55, MC60, MC65, MC55D, MC60D, MC65D PAGE 2

## EPOXY-ENCAPSULATED PRECISION METAL-FILM RESISTORS

### RESISTANCE VALUE

#### standard values and tolerance

The following resistance values are standard and in most cases are available from stock. Nonstandard values will be manufactured to specific requirements.

TABLE 1 — 1% TOLERANCE

1.00	1.10	1.21	1.33	1.47	1.62	1.78	1.96	2.15	2.37	2.61	2.87	3.16	3.48	3.83	4.22	4.64	5.11	5.62	6.19	6.81	7.50	8.25	9.09
1.02	1.13	1.24	1.37	1.50	1.65	1.82	2.00	2.21	2.43	2.67	2.94	3.24	3.57	3.92	4.32	4.75	5.23	5.76	6.34	6.98	7.68	8.45	9.31
1.05	1.15	1.27	1.40	1.54	1.69	1.87	2.05	2.26	2.49	2.74	3.01	3.32	3.65	4.02	4.42	4.87	5.36	5.90	6.49	7.15	7.87	8.66	9.53
1.07	1.18	1.30	1.43	1.58	1.74	1.91	2.10	2.32	2.55	2.80	3.09	3.40	3.74	4.12	4.53	4.99	5.49	6.04	6.65	7.32	8.06	8.87	9.76

Standard stock tolerance is  $\pm 1\%$  (F). Tolerances of  $\pm 0.5\%$  (D),  $\pm 0.25\%$  (C), and  $\pm 0.1\%$  (B) are also available upon request. The MC — D series is also available with  $\pm 2\%$  tolerance. The parenthetical letters are equivalent MIL-R-10509E tolerance designations.

#### temperature coefficient

T-C Code Designation	Comparable MIL-R-10509E Characteristic	T-C Range	Temperature Range
T-1	D	$\pm 100$ ppm/ $^{\circ}$ C	$-55^{\circ}$ to $+175^{\circ}$ C
T-2	C & F	$\pm 50$ ppm/ $^{\circ}$ C	$-55^{\circ}$ to $+175^{\circ}$ C
T-9	E	$\pm 25$ ppm/ $^{\circ}$ C	$-55^{\circ}$ to $+175^{\circ}$ C
T-10	-	$\pm 10$ ppm/ $^{\circ}$ C	$+25^{\circ}$ to $+150^{\circ}$ C

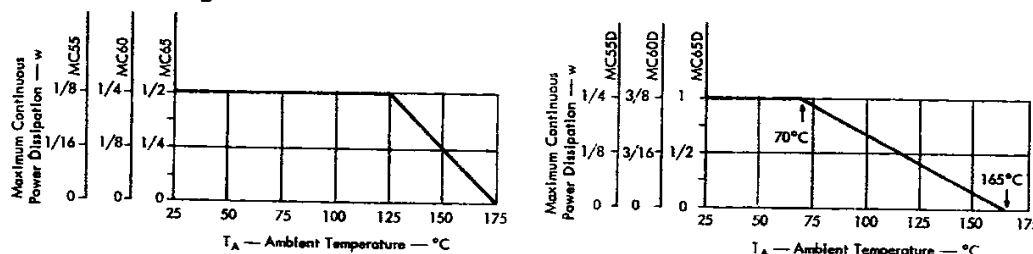
Special tracking requirements, temperature ranges, etc., are available.

#### hi- and low-value availability

The range of available resistance values is dependent upon temperature coefficient, e.g., the available range is extended for temperature coefficient of 100 ppm compared to 25 ppm. Contact a TI sales office for extended value ranges currently available in each T-C range.

### POWER RATING AND PERFORMANCE CHARACTERISTICS

#### power dissipation derating curves



#### performance characteristics

Resistance-value stability is affected by power dissipation in operational-environment tests. Following are two typical examples. In one, the more stable MC series is tested to a low-power MIL-R-10509 application demonstrating maximum stability. In the other example, the lower-cost MC — D series is tested at its maximum TI-rated power to demonstrate its excellent stability under these extreme power conditions.

TEST PER APPLICABLE MIL-R-10509E PROCEDURE	MC55, MC60, MC65		MC55D, MC60D, MC65D	
	MIL-R-10509E Char E LIMITS	TI TYPICAL PERFORMANCE	MIL-R-10509E Char D LIMITS	TI TYPICAL PERFORMANCE
1000-Hour Load Life	$\pm 0.50\%$ max	$\pm 0.14\%$ avg	$\pm 1.0\%$	$\pm 0.30\%$ avg <sup>■</sup>
Moisture Resistance	$\pm 0.50\%$ max	$\pm 0.15\%$ avg	$\pm 1.5\%$	$\pm 0.40\%$ avg <sup>■</sup>
Low-Temperature Operation	$\pm 0.25\%$ max	$\lt \pm 0.05\%$	$\pm 0.50\%$	$\pm 0.10\%$ avg
Temperature Cycling	$\pm 0.25\%$ max	$\lt \pm 0.05\%$	$\pm 0.50\%$	$\lt \pm 0.05\%$
Short-Time Overload	$\pm 0.25\%$ max	$\lt \pm 0.05\%$	$\pm 0.50\%$	$\pm 0.10\%$ avg <sup>■</sup>
Effect of Soldering	$\pm 0.10\%$ max	$\lt \pm 0.05\%$	$\pm 0.50\%$	$\lt \pm 0.05\%$
Insulation Resistance	$\gt 10^{10} \Omega$	$\gt 10^{12} \Omega$	$\gt 10^{10} \Omega$	$\gt 10^{12} \Omega$ □
Shock	$\pm 0.25\%$ max	$\lt \pm 0.05\%$	$\pm 0.50\%$	$\lt \pm 0.05\%$
Vibration	$\pm 0.25\%$ max	$\lt \pm 0.05\%$	$\pm 0.50\%$	$\lt \pm 0.05\%$

Unless otherwise noted, data is percent change from initial resistance. <sup>■</sup> Operated at maximum TI-rated power.

Texas  
 Instruments  
 date 1966

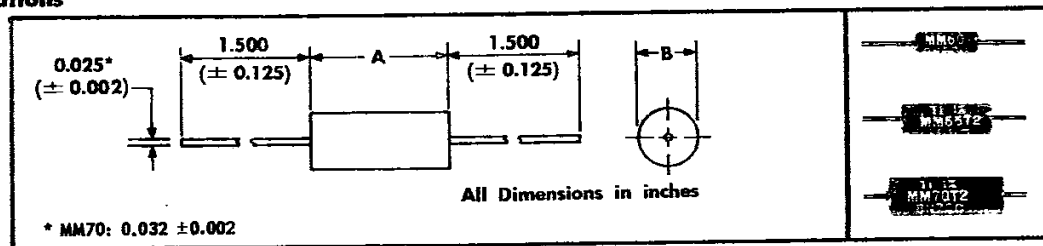
Types MM60, MM65, MM70  
**MOLDED PRECISION METAL-FILM RESISTORS**

Designed to meet or exceed all requirements of Specification  
 MIL-R-10509E for Characteristics C, E, & F.

- Full-rated load at 125°C ambient
- High degree of stability and reliability
- Precision resistance tolerances
- Rugged cap-and-lead construction
- Tough molded coating • Fully insulated
- Temperature Coefficients  $\pm 10$ ,  $\pm 25$ , and  $\pm 50$  ppm/°C

TI RES MM60, MM65, MM70  
 BULLETIN NO. DL-S-643776, JULY 1964  
 REPLACES NO. DL-S-623636, MARCH 1963

specifications



MIL-R-10509E DESIGNATION				ELECTRICAL RATINGS & CHARACTERISTICS			MECHANICAL DATA		
type	applicable characteristic	power rating† ( $T_A \leq 125^\circ\text{C}$ )	TI TYPE	power rating† ( $T_A \leq 125^\circ\text{C}$ )	maximum working voltage	resistance value range‡ ( $T_A = 25^\circ\text{C}$ )	body size		average weight for 100 unpacked units
							length A	diameter B	
—	—	(w)	-----	(w)	(v)	—	(inch)	(inch)	(lb)
RN60	C & E	1/8	MM60	1/8	250	24.9 $\Omega$ to 499 k $\Omega$	0.400 ( $\pm 0.010$ )	0.135 ( $\pm 0.010$ )	0.075
RN65	C & E	1/4	MM65	1/2	350	49.9 $\Omega$ to 1 M $\Omega$	0.575 ( $\pm 0.010$ )	0.200 ( $\pm 0.010$ )	0.101
	F	1/2							
RN70	C & E	1/2	MM70	3/4	500	24.9 $\Omega$ to 1 M $\Omega$	0.750 ( $\pm 0.010$ )	0.250 ( $\pm 0.010$ )	0.198
	F	3/4							

symbolization

Standard stock symbolization includes TI Type Number, Resistance Value, Tolerance, and Temperature Coefficient, depending upon wattage size and space available. Military type symbolization is used when applicable. Resistance values are symbolized to a maximum of three significant figures per Table 1.

military devices

The resistors are available in accordance with the requirements of MIL-R-10509E. For current availability of resistance values, tolerances, and characteristics consult a TI Sales Office.

modifications available upon request

Special testing  
 "A" nickel weldable leads

Resistance values outside published ranges  
 Special paint coverage

†For higher temperatures refer to Power Dissipation Derating Curves.

‡The value ranges shown are for a temperature coefficient of 25 ppm. See "high and low-value availability".

Texas Instruments date 1966

# TYPES MM60, MM65, MM70 page 2

## MOLDED PRECISION METAL-FILM RESISTORS

### RESISTANCE VALUE

#### standard values and tolerances

The following resistance values are standard and in most cases are available from stock. Nonstandard values will be manufactured to specific requirements.

**TABLE 1 — 1% TOLERANCE**

1.00	1.10	1.21	1.33	1.47	1.62	1.78	1.96	2.15	2.37	2.61	2.87	3.16	3.48	3.83	4.22	4.64	5.11	5.62	6.19	6.81	7.50	8.25	9.09
1.02	1.13	1.24	1.37	1.50	1.65	1.82	2.00	2.21	2.43	2.67	2.94	3.24	3.57	3.92	4.32	4.75	5.23	5.76	6.34	6.98	7.68	8.45	9.31
1.05	1.15	1.27	1.40	1.54	1.69	1.87	2.05	2.26	2.49	2.74	3.01	3.32	3.65	4.02	4.42	4.87	5.36	5.90	6.49	7.15	7.87	8.66	9.53
1.07	1.18	1.30	1.43	1.58	1.74	1.91	2.10	2.32	2.55	2.80	3.09	3.40	3.74	4.12	4.53	4.99	5.49	6.04	6.65	7.32	8.06	8.87	9.76

Standard stock tolerance is  $\pm 1\%$  (F). Tolerances of  $\pm 0.5\%$  (D),  $\pm 0.25\%$  (C), and  $\pm 0.1\%$  (B) are also available upon request. The parenthetical letters are equivalent MIL-R-10509E tolerance designations.

#### temperature coefficient

T-C Code Designation	Comparable MIL-R-10509E Characteristic	T-C Range	Temperature Range
T-1	D	$\pm 100$ ppm/ $^{\circ}$ C	$-55^{\circ}$ to $+175^{\circ}$ C
T-2	C & F	$\pm 50$ ppm/ $^{\circ}$ C	$-55^{\circ}$ to $+175^{\circ}$ C
T-9	E	$\pm 25$ ppm/ $^{\circ}$ C	$-55^{\circ}$ to $+175^{\circ}$ C
T-10	-	$\pm 10$ ppm/ $^{\circ}$ C	$+25^{\circ}$ to $+150^{\circ}$ C

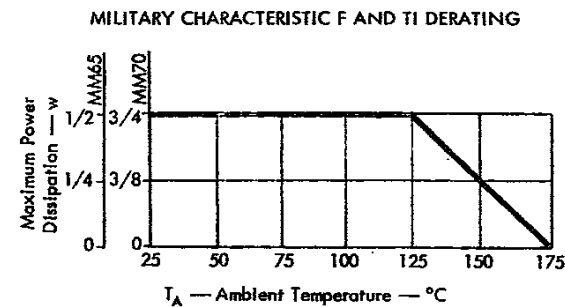
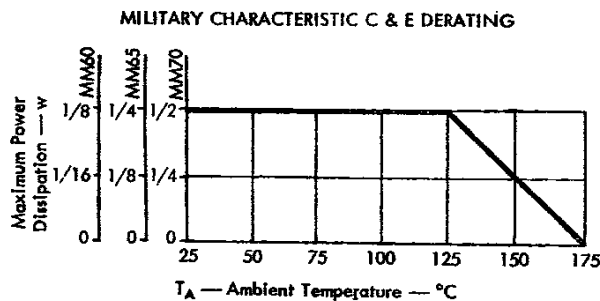
Special tracking requirements, temperature ranges, etc., are available.

#### hi- and low-value availability

The range of available resistance values is dependent upon temperature coefficient, e.g., the available range is extended for temperature coefficient of 100 ppm compared to 25 ppm. Contact a TI sales office for extended value ranges currently available in each T-C range.

### POWER RATING AND PERFORMANCE CHARACTERISTICS

#### power dissipation derating curves



#### performance characteristics

Resistance value stability is affected by power dissipation in operational-environment tests. The following table gives the differences in resistor stability that may be expected with the different power levels.

TEST PER APPLICABLE MIL-R-10509E PROCEDURE	MIL-R-10509E LIMITS	TYPICAL PERFORMANCE	
		MM60, MM65, MM70 Characteristic C & E	MM65 & MM70 Characteristic F
1000-Hour Load Life	$\pm 0.50\%$ max.	$+ 0.15\%$ avg.	$+ 0.22\%$ avg.
Moisture Resistance	$\pm 0.50\%$ max.	$+ 0.17\%$ avg.	$+ 0.19\%$ avg.
Low-Temperature Operation	$\pm 0.25\%$ max.	$< \pm 0.05\%$	$< \pm 0.05\%$
Temperature Cycling	$\pm 0.25\%$ max.	$< \pm 0.05\%$	$< \pm 0.05\%$
Short-Time Overload	$\pm 0.25\%$ max.	$< \pm 0.05\%$	$< \pm 0.05\%$
Effect of Soldering	$\pm 0.10\%$ max.	$< \pm 0.05\%$	$< \pm 0.05\%$
Insulation Resistance	$> 10^{10} \Omega$	$> 10^{12} \Omega$	$> 10^{12} \Omega$
Shock	$\pm 0.25\%$ max.	$< \pm 0.05\%$	$< \pm 0.05\%$
Vibration	$\pm 0.25\%$ max.	$< \pm 0.05\%$	$< \pm 0.05\%$

Unless otherwise noted, data is percent change from initial resistance.