

FULL LINE CATALOG



DALE
ELECTRONICS
INC.

FULL LINE CATALOG

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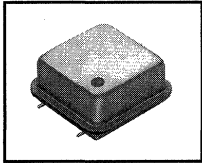
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EB7D, edgeboard connectors	284	PBG-C, linear bar graph displays	368	X, M, C, F, T, B, NTC thermistors	214
EB7S, edgeboard connectors	286	PD-04A200, alphanumeric displays	372	XO-43B, crystal clock oscillators	5
EB8, edgeboard connectors	288	PD-16A040, alphanumeric displays	374	XO-52B, BD, BE, crystal clock oscillators	6
EBT156, edgeboard connectors	290	PD-32A025, alphanumeric displays	376	XO-53B, crystal clock oscillators	7
ERC, MF resistors, E-Rel, MIL-R-55182, RNC	116	PDS-30/1/2, controller card, (displays)	358	XO-54B, BD, BE, crystal clock oscillators	8
ERH/NH, WW res., E-Rel, MIL-R-39009, RER	50	PH, wirewound resistors	54	XOSM-52B, BE, surface mount oscillators	4

MODELS XOSM-52B and XOSM-52BE Clock Oscillators

Hybrid Crystal, Surface Mount

240 Hz to 72 MHz (-52B), 500 KHz to 40 MHz (-52BE)



FEATURES

- HCMOS, CMOS, NMOS, TTL, LS-TTL, S-TTL compatible
- Enabled tri-state output optional
- Hermetically sealed package

ELECTRICAL SPECIFICATIONS

Operating Temperature Range: 0°C to 70°C.

Frequency Stability: (Inclusive of calibration tolerance at 25°C temperature change, input voltage change, load change, aging, shock and vibration): $\pm .01\%$ ($\pm 100\text{PPM}$).

Input Voltage (Vdd): $+ 5.0 \pm 0.5$ VDC.

Input Current: 5 to 50 mA typical (see table).

Rise Time: 4nS typical (CMOS levels), 2nS typical (TTL levels).

Fall Time: 4nS typical (CMOS levels), 2nS typical (TTL levels).

Logic '0' Level: 0.1 Vdd maximum CMOS, 0.4 V maximum TTL.

Logic '1' Level: 0.9 Vdd minimum CMOS, 2.4 V minimum TTL.

Logic '0' Sink Current: 16 mA minimum.

Logic '1' Source Current: 0.4 mA minimum.

Output Waveform: Squarewave, HCMOS, CMOS, NMOS, TTL, LS-TTL, S-TTL compatible, waveform symmetry. (0.5 Vdd CMOS or 1.4 V TTL levels): $50 \pm 10\%$.

Output Load: 50 pF HCMOS or 1-10 TTL loads.

Enable Input Voltage: 3.5 V minimum.

Disable Input Voltage: 0.8 V maximum.

Enable Input Current: 10 μA maximum.

Disable Input Current: 300 μA maximum.

MECHANICAL SPECIFICATIONS

Hermetically Sealed Package: Leak rate less than 2×10^{-8} atmosphere cc/sec. of helium.

Marking Ink: Epoxy, solvent resistant.

Solvent Resistance: Isopropyl alcohol, trichloroethane, Freon TMC.

Terminal Solderability: Per MIL-STD-202, Method 208C.

ENVIRONMENTAL SPECIFICATIONS

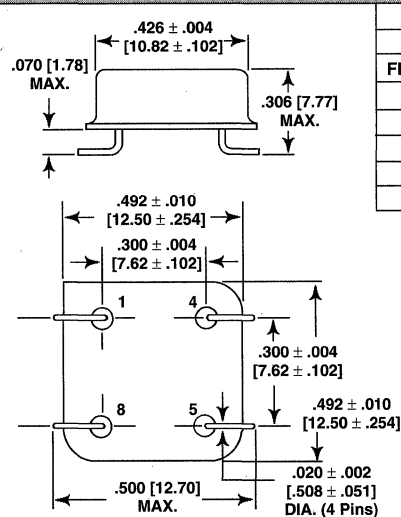
Temperature Cycle: - 55°C to + 85°C, 3 cycles.

Shock: 1000 G's 0.35 millisecond, 1/2 sine wave, 3 shocks each plane.

Vibration: .06 D.A., 10-55 Hz, 35 G, 55-2000 Hz.

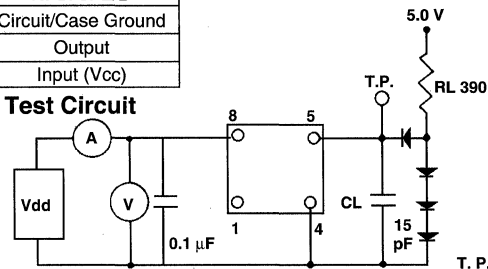
Humidity: 85% relative humidity at 85°C, 240 hours.

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

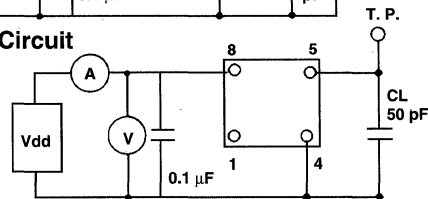


IDD CHARACTERISTICS AT 5 VDC			PIN	CONNECTION
IDD (TYP) IN mA, 15 pf, LOAD			1	N. C. or E/D
FREQ. MHz	XOSM-52B	XOSM-52BE	4	Circuit/Case Ground
1	10	10	5	Output
4	6	10	8	Input (Vcc)
16	13	14		
40	23	20		
60	40	—		

TTL Test Circuit



CMOS Test Circuit



CL - To include probe and fixture capacitance.

PART MARKING

- Model
- Frequency
- Pin identifier
- Dale

HOW TO ORDER

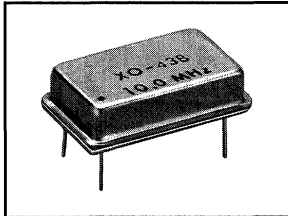
XOSM-52	B	E	10
MODEL	FREQ. ACCURACY	ENABLE/DISABLE	FREQ./MHZ
	A = .005%	E = With function	
	B = (.01% Std. tol.)	BLANK = #1 Pin open	

Contact factory for other models, logic families, stabilities and temperature ranges.



MODEL XO-43B Clock Oscillators

Hybrid Crystal, Resistance Welded Metal Package Low Profile, 250 KHz to 60 MHz



FEATURES

- Able to withstand flow soldering
- Wide range of standard frequencies available from stock (listed below)
- Hermetically sealed package
- Low profile .225" [5.72] maximum seating height
- Metal Case - corrosion resistant and grounded for EMI shielding
- Glass standoffs for spacing from mounting surface

STANDARD ELECTRICAL SPECIFICATIONS					
FREQUENCY RANGE	INPUT CURRENT (mA)	WAVEFORM SYMMETRY AT 1.4 VDC	TTL OUTPUT RISE & FALL TIME (From Zero to One Level)	"ZERO" LEVEL SINKING 16 mA	"ONE" LEVEL SOURCING 0.4 mA
250 KHz to 3.999 MHz	65 max.	55/45	15 nS max.	0.4 volts max.	2.4 volts min.
4.0 MHz to 24.999 MHz	40 max.	60/40*	10 nS max.	0.4 volts max.	2.4 volts min.
25.0 MHz to 60.0 MHz	50 max.	60/40*	6 nS max.	0.4 volts max.	2.4 volts min.

* 55/45 Available

ELECTRICAL SPECIFICATIONS

Input Voltage: + 5 VDC \pm 0.5 V.
Frequency Range: 250 KHz to 60 MHz.
Operating Temperature Range: 0°C to 70°C.
TTL Compatible: Will drive 1-10 TTL Gates.

MECHANICAL SPECIFICATIONS

Hermetically Sealed Package: Leak rate less than 2×10^{-8} atmosphere cc/sec. of helium.
Marking Ink: Epoxy, solvent resistant.
Solvent Resistance: Isopropyl alcohol, Trichloroethane, Freon TMC.
Terminal Solderability: Per MIL-STD-202, Method 208C.
Package: Cold Rolled Steel (CRS), Nickel-Plated Base with Resistance Welded Stainless Steel Cover.

ENVIRONMENTAL SPECIFICATIONS

Temperature Cycle: - 55°C to + 85°C, 3 cycles.
Shock: 1000 G's 0.35 millisecond, 1/2 sine wave, 3 shocks each plane.
Vibration: .06 D.A., 10-55 Hz, 35 G, 55-2000 Hz.
Humidity: 85% relative humidity at 85°C, 240 hours.

STOCKING FREQUENCIES (MHz) "B" accuracy only

1.0	4.9152	10.0	19.6608	32.0
1.2288	5.0	12.0	20.0	40.0
2.0	5.0688	16.0	24.0	50.0
2.4576	6.0	16.384	25.0	
4.0	8.0	18.432	30.0	

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]		Schematic									
<p>Pin #1 is identified by square corner. Design subject to change without notice.</p>	<table border="1"> <thead> <tr> <th colspan="2">PIN CONNECTION</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>N. C.</td> </tr> <tr> <td>7</td> <td>Ground</td> </tr> <tr> <td>8</td> <td>Output</td> </tr> <tr> <td>14</td> <td>+ 5 VDC</td> </tr> </tbody> </table>	PIN CONNECTION		1	N. C.	7	Ground	8	Output	14	+ 5 VDC
PIN CONNECTION											
1	N. C.										
7	Ground										
8	Output										
14	+ 5 VDC										

PART MARKING	
—	Model
—	Frequency
—	Pin identifier
—	Dale

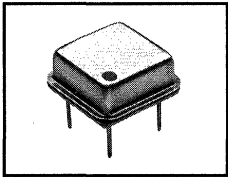
HOW TO ORDER			
XO-43	B	- 59	10
MODEL	FREQ. ACCURACY (All conditions)	SYMMETRY	FREQ./MHz
	A = \pm .005% (\pm 50PPM) B = \pm .01% (\pm 100PPM)	BLANK = Std. Symmetry - 59 = 55/45 Symmetry	
Contact factory for other models, logic families, stabilities and temperature ranges.			

MODELS XO-52B, XO-52BD, XO-52BE Clock Oscillators



Hybrid Crystal, 240 Hz to 110 MHz (-52B)

1.0 MHz to 70 MHz (-52BD), 1.0 MHz to 110 MHz (-52BE)



FEATURES

- HCMOS, CMOS, NMOS, TTL, LS-TTL, S-TTL compatible
- Enabled output optional
- Hermetically sealed package

ELECTRICAL SPECIFICATIONS

Operating Temperature Range: 0°C to 70°C.

Frequency Stability: (Inclusive of calibration tolerance at 25°C temperature change, input voltage change, load change, aging, shock and vibration): ± .01% (± 100PPM).

Input Voltage (Vdd): + 5.0 ± 0.5 VDC.

Input Current: 5 to 50 mA typical (see graph).

Rise Time: 4nS typical (CMOS levels), 2nS typical (TTL levels).

Fall Time: 4nS typical (CMOS levels), 2nS typical (TTL levels).

Logic '0' Level: 0.5 V maximum CMOS, 0.4 V maximum TTL (Vdd = 5 V).

Logic '1' Level: 4.5 V minimum CMOS, 2.4 V minimum TTL (Vdd = 5 V).

Logic '0' Sink Current: 16 mA minimum.

Logic '1' Source Current: 0.4 mA minimum.

Output Waveform Symmetry: 60/40 standard. 55/45 available.

Output Load: 50 pF HCMOS or 1-10 TTL loads.

Enable Input Voltage: 3.5 V minimum.

Disable Input Voltage: 0.5 V maximum.

Enable Input Current: 10 µA maximum.

Disable Input Current: 300 µA maximum.

MECHANICAL SPECIFICATIONS

Hermetically Sealed Package: Leak rate less than 2×10^{-8} atmosphere cc/sec. of helium.

Marking Ink: Epoxy, solvent resistant.

Solvent Resistance: Isopropyl alcohol, trichloroethane, Freon TMC.

Terminal Solderability: Per MIL-STD-202, Method 208C.

ENVIRONMENTAL SPECIFICATIONS

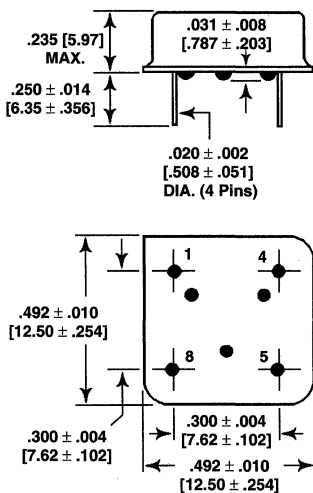
Temperature Cycle: - 55°C to + 85°C, 3 cycles.

Shock: 1000 G's 0.35 millisecond, 1/2 sine wave, 3 shocks each plane.

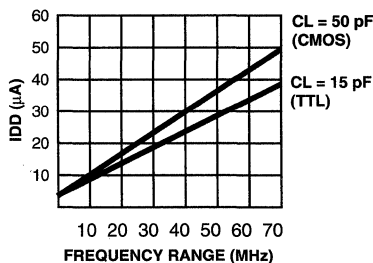
Vibration: .06 D.A., 10-55 Hz, 35 G, 55-2000 Hz.

Humidity: 85% relative humidity at 85°C, 240 hours.

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



FREQ. - IDD CHARACTERISTICS
(TYPICAL AT VDD = 5.0 VDC)

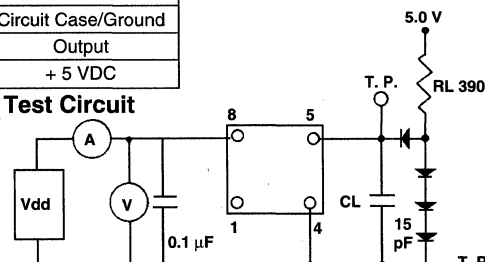


Pin 1 identified by square corner/dot.
 CAUTION: Unit can be damaged if plugged in backwards.

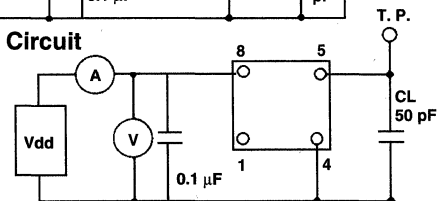
PIN CONNECTION

PIN	CONNECTION
1	N. C. or E/D
4	Circuit Case/Ground
5	Output
8	+ 5 VDC

TTL Test Circuit



CMOS Test Circuit



CL - To include probe and fixture capacitance.

PART MARKING

- Model
- Frequency
- Pin identifier
- Dale

HOW TO ORDER

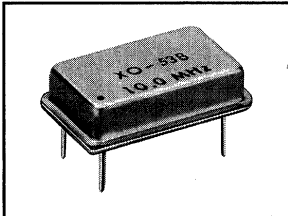
XO-52	B	E	-59	10
MODEL	FREQ. ACCURACY	ENABLE/DISABLE	SYMMETRY	FREQ./MHZ
	AA = .0025% A = .005% B = (.01% Std. tol.)	D = Disable to Logic 1 Level E = Disable to Tri-State BLANK = #1 Pin open	Blank = Std. 60/40 -59 = 45/55 TTL Level -60 = 45/55 CMOS Level	

Contact factory for other models, logic families, stabilities and temperature ranges.



MODEL XO-53B Clock Oscillators

Hybrid Crystal, Resistance Welded Metal Package Low Profile, 250 KHz to 60 MHz



FEATURES

- Able to withstand flow soldering
- Wide range of standard frequencies available from stock (listed below)
- Hermetically sealed package
- Low profile .225" [5.72] maximum seating height
- Metal Case - corrosion resistant and grounded for EMI shielding
- Glass standoffs for spacing from mounting surface

STANDARD ELECTRICAL SPECIFICATIONS					
FREQUENCY RANGE	INPUT CURRENT (mA)	WAVEFORM SYMMETRY AT 1.4 VDC	TTL OUTPUT RISE & FALL TIME (From Zero to One Level)	"ZERO" LEVEL SINKING 16 mA	"ONE" LEVEL SOURCING 0.4 mA
250 KHz to 3.999 MHz	90 max.	60/40	15 nS max.	0.4 volts max.	2.4 volts min.
4.0 MHz to 8.999 MHz	40 max.	60/40	15 nS max.	0.4 volts max.	2.4 volts min.
9.0 MHz to 24.999 MHz	40 max.	60/40	10 nS max.	0.4 volts max.	2.4 volts min.
25.0 MHz to 31.999 MHz	70 max.	60/40	10 nS max.	0.5 volts max.	2.4 volts min.
32.0 MHz to 60.0 MHz	70 max.	60/40	6 nS max.	0.5 volts max.	2.4 volts min.

ELECTRICAL SPECIFICATIONS

Input Voltage: + 5 VDC \pm 0.5 V.
Frequency Range: 250 KHz to 60 MHz.
Frequency Stability: \pm .01% (\pm 100PPM).
Operating Temperature Range: 0°C to 70°C.
TTL Compatible: Will drive 1-10 TTL Gates.

MECHANICAL SPECIFICATIONS

Hermetically Sealed Package: Leak rate less than 2×10^{-8} atmosphere cc/sec. of helium.
Marking Ink: Epoxy, solvent resistant.
Solvent Resistance: Isopropyl alcohol, Trichloroethane, Freon TMC.
Terminal Solderability: Per MIL-STD-202, Method 208C.

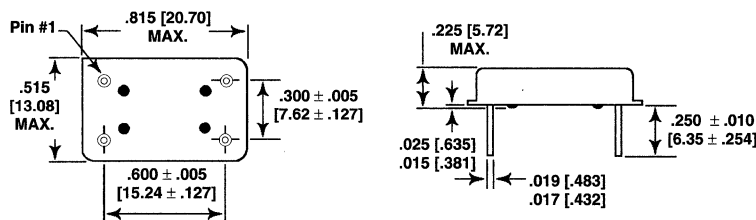
ENVIRONMENTAL SPECIFICATIONS

Temperature Cycle: - 55°C to + 85°C, 3 cycles.
Shock: 1000 G's 0.35 millisecond, 1/2 sine wave, 3 shocks each plane.
Vibration: .06 D.A., 10-55 Hz, 35 G, 55-2000 Hz.
Humidity: 85% relative humidity at 85°C, 240 hours.

STOCKING FREQUENCIES (MHz)

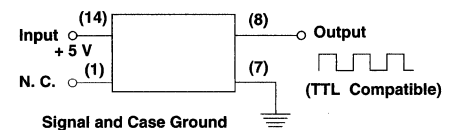
1.0	4.9152	10.0	19.6608	32.0
1.2288	5.0	12.0	20.0	40.0
2.0	5.0688	16.0	24.0	50.0
2.4576	6.0	16.384	25.0	
4.0	8.0	18.432	30.0	

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



Pin #1 is identified by square corner. Design subject to change without notice.

Schematic



PIN CONNECTION	
1	N. C.
7	Ground
8	Output
14	+ 5 VDC

PART MARKING

- Model
- Frequency
- Pin identifier
- Dale

HOW TO ORDER

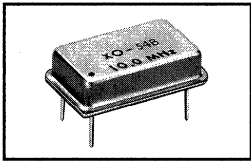
<u>XO-53</u> MODEL	<u>B</u> FREQ. ACCURACY (All conditions) B = \pm 0.01% (\pm 100PPM)	<u>10</u> FREQ./MHz
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Contact factory for other models, logic families, stabilities and temperature ranges.

MODELS XO-54B, XO-54BD, XO-54BE Clock Oscillators

Hybrid Crystal, 240 Hz to 110 MHz (-54B)

1.0 MHz to 70 MHz (-54BD), 1.0 MHz to 110 MHz (-54BE)



FEATURES

- HCMOS, CMOS, NMOS, TTL, LS-TTL, S-TTL compatible
- Enabled output optional
- Hermetically sealed package

ELECTRICAL SPECIFICATIONS

Operating Temperature Range: 0°C to 70°C.

Frequency Stability: (Inclusive of calibration tolerance at 25°C temperature change, input voltage change, load change, aging, shock and vibration): $\pm .01\%$ (± 100 PPM).

Input Voltage (Vdd): $+ 5.0 \pm 0.5$ VDC.

Input Current: 5 to 50 mA typical (see graph).

Rise Time: 4nS typical (CMOS levels), 2nS typical (TTL levels).

Fall Time: 4nS typical (CMOS levels), 2nS typical (TTL levels).

Logic '0' Level: 0.5 V maximum CMOS, 0.4 V maximum TTL (Vdd = 5 V).

Logic '1' Level: 4.5 V minimum CMOS, 2.4 V minimum TTL (Vdd = 5 V).

Logic '0' Sink Current: 16 mA minimum.

Logic '1' Source Current: 0.4 mA minimum.

Output Waveform Symmetry: 60/40 standard. 55/45 available.

Output Load: 50 pF HCMOS or 1-10 TTL loads.

Enable Input Voltage: 3.5 V minimum.

Disable Input Voltage: 0.5 V maximum.

Enable Input Current: 10 μ A maximum.

Disable Input Current: 300 μ A maximum.

MECHANICAL SPECIFICATIONS

Hermetically Sealed Package: Leak rate less than 2×10^{-8} atmosphere cc/sec. of helium.

Marking Ink: Epoxy, solvent resistant.

Solvent Resistance: Isopropyl alcohol, trichloroethane, Freon TMC.

Terminal Solderability: Per MIL-STD-202, Method 208C.

ENVIRONMENTAL SPECIFICATIONS

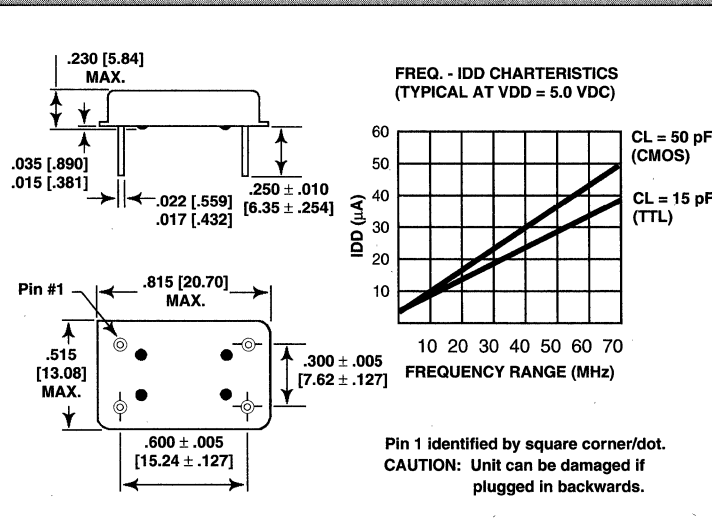
Temperature Cycle: -55°C to +85°C, 3 cycles.

Shock: 1000 G's 0.35 millisecond, 1/2 sine wave, 3 shocks each plane.

Vibration: .06 D.A., 10-55 Hz, 35 G, 55-2000 Hz.

Humidity: 85% relative humidity at 85°C, 240 hours.

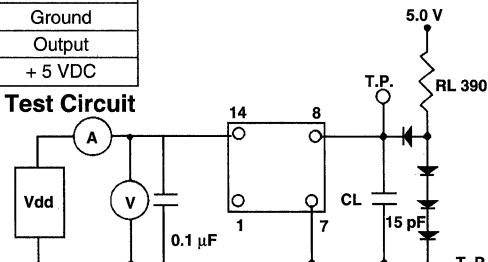
DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



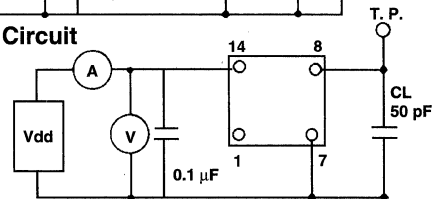
PIN CONNECTION

1	N. C. or E/D
7	Ground
8	Output
14	+ 5 VDC

TTL Test Circuit



CMOS Test Circuit



CL - To include probe and fixture capacitance.

PART MARKING

- Model
- Frequency
- Pin identifier
- Dale

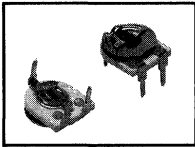
HOW TO ORDER

XO-54	B	E	-59	10
MODEL	FREQ. ACCURACY	ENABLE/DISABLE	SYMMETRY	FREQ./MHZ
	AA = .0025% A = .005% B = (.01% Std. tol.)	D = Disable to Logic 1 Level E = Disable to Tri-State BLANK = #1 Pin open	Blank = Std. 60/40 -59 = 45/55 TTL Level -60 = 45/55 CMOS Level	

Contact factory for other models, logic families, stabilities and temperature ranges.

MODELS E08C, E10C, E15C Cermet Trimmers

Miniature, Industrial Grade, Singleturn
Open Frame, Ceramic Construction



FEATURES

- Adjustable - top + bottom or front + back
- Durable ceramic and metal construction
- Low profile

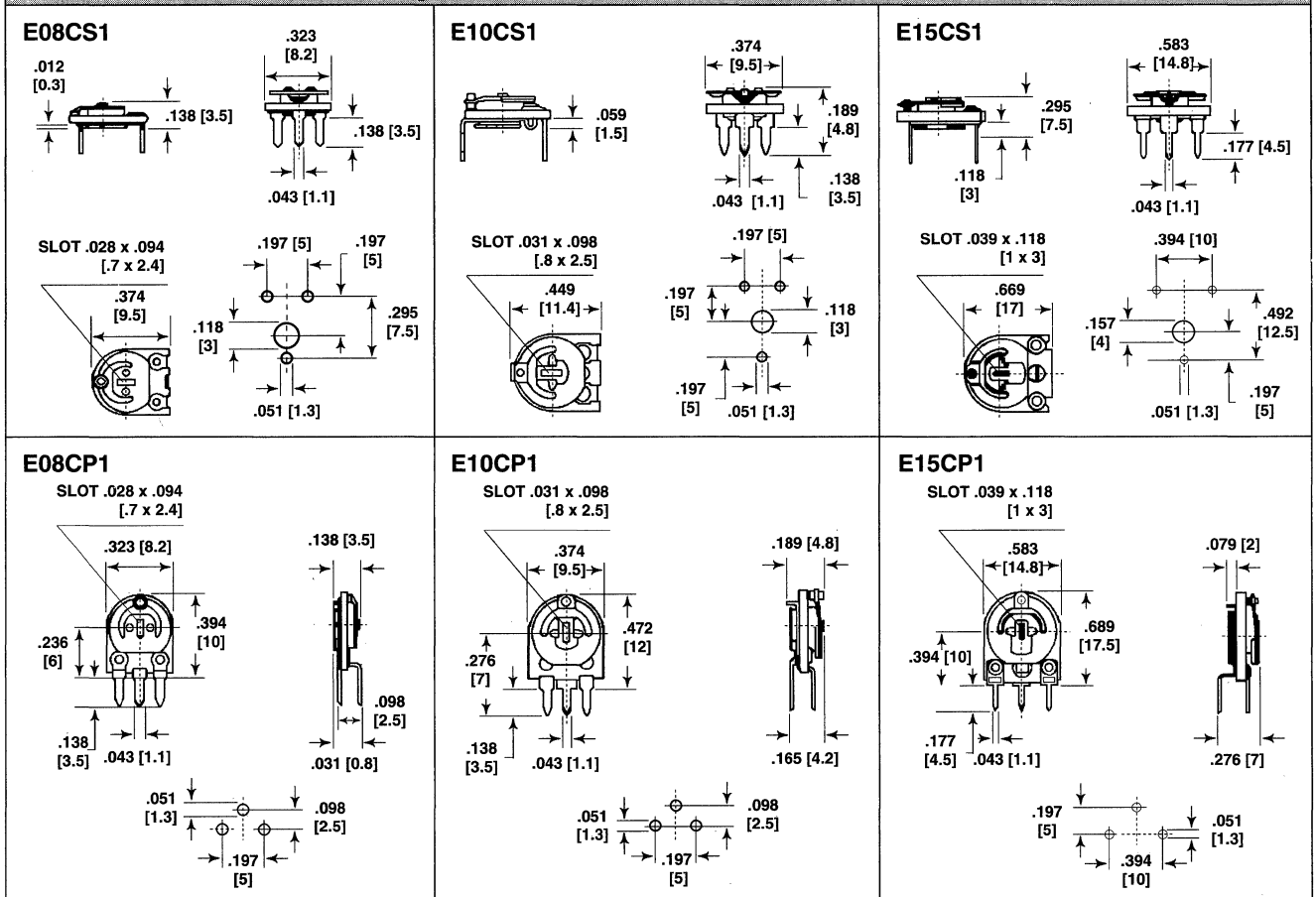
MECHANICAL SPECIFICATIONS

MODEL	E08C	E10C	E15C
Mechanical Travel	240	240	260
Operating Torque	.3-1.5 cmN	.4-2 cmN	.5-2.5 cmN
Weight (Grams)	.4	.8	2.3

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	RESISTANCE RANGE (Ohms)	TOLERANCE				POWER RATING @70°C	TEMPERATURE COEFFICIENT				TEMPERATURE LIMITS
		10Ω-47Ω	22Ω-47Ω	47Ω-1M	47Ω-2.2M		10Ω-47Ω	47Ω-100Ω	100Ω-1M	100Ω-2.2M	
E08C	10-1M	± 30%	—	± 20%	—	.33W	± 250PPM	± 150PPM	± 100PPM	—	-55°C - + 110°C
E10C	10-2.2M	± 30%	—	—	± 20%	.5W	± 250PPM	± 150PPM	—	± 100PPM	-55°C - + 110°C
E15C	22-2.2M	—	± 30%	—	± 20%	1W	± 250PPM	± 150PPM	—	± 100PPM	-55°C - + 110°C

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



PART MARKING

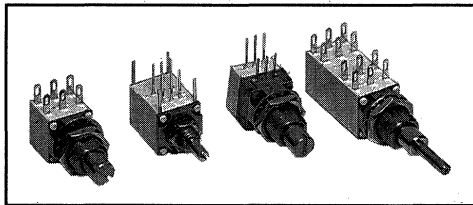
- Manufacturer's name (Draloric)
- Resistance value

HOW TO ORDER

MODEL	VALUE	TOLERANCE
E10CS1	10k	20%

MODELS P11 and PA11 Modular Potentiometers

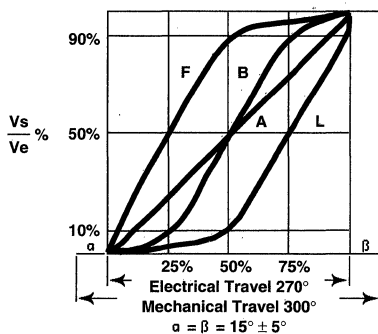
Cermet/Conductive Plastic Element



FEATURES

- Miniature module size - .5" [12.7] x .5" [12.7] x .2" [5.08]
- Shaft diameters - 1/4", 1/8", 3mm, 4mm, 6mm
- Up to seven modules as standard
- P.C. pins or solder lugs
- P.C. mounting brackets
- Up to twenty-one detents
- Rotary switch modules
- Concentric shafts
- Motorized designs
- Custom designs

TAPERS



STANDARD ELECTRICAL SPECIFICATIONS

	P11 (Cermet)	PA11 (Conductive Plastic)
Electrical Travel	270° ± 10°	270° ± 10°
Resistance Range	20Ω to 2MΩ - Linear 1kΩ to 1MΩ - Non-linear	500Ω to 200kΩ - Linear 1kΩ to 1MΩ - Non-linear
Resistance Tolerance		
Standard	± 10%	± 20%
On Request	± 5%	± 10%
Power Rating		
Linear Taper	1 W at 70°C	0.5 W at 70°C
Non-linear Tapers	0.5 W at 70°C	0.5 W at 70°C
Multiple Assemblies	0.5 W per element	0.5 W per element
Temperature Coefficient	± 100PPM if R > = 100Ω	± 500PPM typical/C°
Limiting Element Voltage	350 V	350 V
Contact Resistance Variation	2% or 3Ω linear taper	1% linear taper
End Resistance	2Ω	2Ω
Independent Linearity	± 5% linear taper	± 5% maximum linear taper
Insulation Resistance	100,000MΩ minimum	100,000MΩ minimum
Dielectric Strength	1500 V RMS minimum	1500 V RMS minimum
Attenuation		90 dB maximum 0.05 dB minimum
Rotational Life	50,000 cycles	100,000 cycles

MECHANICAL SPECIFICATIONS

Mechanical Travel: 300° ± 5°.

Operating Torque - Single and dual assemblies:

1/8", 3mm, 4mm D shafts = 0.7 - 1.4 ounce inch maximum.

1/4", 6mm D shafts = 1 - 1.9 ounce inch maximum.

3 to 7 modules = 0.3 - 0.45 ounce inch maximum per module.

End Stop Torque:

1/8", 3mm, 4mm D shafts = 3 pound inch minimum.

1/4", 6mm D shafts = 6.8 pound inch minimum.

Tightening Torque:

1/4", 6mm, 7mm D bushings = 13 pound inch minimum.

3/8", 10mm D bushings = 21 pound inch minimum.

MULTIPLE ASSEMBLIES

Standard assemblies can comprise up to 7 modules in addition to the shaft and bushing module.

- Detents module (CV).
- Switch modules (RS or RSI).
- Potentiometer modules.
- Spacer modules, to increase the distance between rows of pins from .2" [5.08] to .4" [10.16].
- Screening module, with ground terminal.

Preferred assembly sequence, not mandatory:

[Shaft and bushing module] [Detents module]
[Switch module(s)] [Potentiometer module(s)].

CONCENTRIC SHAFTS

Characteristics and performances remain identical to those of single shaft assemblies. Solder lugs Y or PC pins X styles only.

The outer shaft, 1/4" or 6mm D, drives the module situated immediately behind the panel, before the spacer module.

The spacer module has standard P11 module dimensions: .5" [12.7] x .5" [12.7] x .2" [5.08].

The inner shaft, 1/8" or 3mm D, drives the modules situated after the spacer module.

Standard combinations comprise up to 6 modules - either potentiometer, switch or valley detents module - plus 1 spacer module.

Preferred assembly sequence, starting with a concentric shafts and bushing module:

1. [Detents Module] [Switch module(s)]
[Potentiometer module(s)] driven by the outer shaft.
2. [Spacer module].
3. [Detents module] [Switch module(s)]
[Potentiometer module(s)] driven by the inner shaft.

CUSTOM SHAFTS

Shaft length is measured from the mounting surface (FMS).

Shaft slots are aligned to ± 10° of the wiper position.

When special machining is required - flats, threaded ends, special shaft lengths, etc., a drawing is needed.

MODELS P11 and PA11 SWITCH MODULES

RS and RSI rotary switches are housed in a standard P11 module, size .5" [12.7] x .5" [12.7] x .2" [5.08].

Caution: Because of the switch actuation travel, the potentiometer total electrical travel is reduced to 240 ± 10 degrees.

Switch actuation is described as seen from the shaft end.

D: Means actuation in maximum CCW position.

F: Means actuation in maximum CW position.

RSD SINGLE POLE SWITCH NORMALLY OPEN

In full CCW position, the contact between 1 and 3 is open.

It is made at the beginning of the travel in CW direction.

RSF SINGLE POLE SWITCH NORMALLY OPEN

In full CW position, the contact between 1 and 3 is open.

It is made at the beginning of the travel in CCW direction.

RSID SINGLE POLE CHANGEOVER

In full CCW position, the contact is made between 3 and 2.

Switch actuation (CW direction) makes contact between 1 and 2.

RSIF SINGLE POLE CHANGEOVER

In full CW position, the contact is made between 1 and 2.

Switch actuation (CCW direction) makes contact between 2 and 3.

SWITCH SPECIFICATIONS

Switch Actuation Travel: 25°.

Potentiometer Electrical Travel: 240° ± 10°.

Total Mechanical Travel: 300° ± 5°.

Power Rating: 250 V 1 Amp/30 V 1 Amp with resistive load.

Minimum Current/Voltage: 10 mAmp/50 mV.

Initial Contact Resistance: 30 Megohm.

Dielectric Withstand Voltage: 1000 V RMS, terminal to terminal.

Rotational Life: 10,000 actuations.

Temperature Range: - 40°C + 85°C.

VALLEY DETENTS

Up to 21 detents positions available. The valley detents mechanism is housed in a standard P11 module, size .5" [12.7] x .5" [12.7] x .2" [5.08].

Count detents as follows: 1 for full CCW position, 1 for full CW position, plus the other positions forming equal resistance increments (linear taper) - not equal angles.

IMPORTANT: Always consult Dale to obtain a sketch indicating the angular distribution of front panel indexes.

LOCATING PEGS (Anti-Rotation Lugs)

These come on a bushing ring. See chart for dimensional specifications.

Four set positions are available, clockface orientation: 00.00 03.00 06.00 09.00. Although the orientation is set to your order requirements, it can be reset as required.

NOTE: All P11 bushings have a double flat. When panel mounting holes have been punched accordingly, an anti-rotation lug is not necessary.

CENTER TAPS

The extra terminal is a solder lug, situated in the potentiometer module opposite the terminals. Center taps short circuit 11° of travel.

LINEARITY

Measured over 90% minimum of actual electrical travel. On request, linearity can be guaranteed to ± 3% (option J123) or to ± 2% (option J145), linear taper only.

INTERLINEARITY (Tracking)

It is the maximum deviation between the actual voltage outputs of 2 or more potentiometer modules in the same assembly. It is expressed as a percentage of the total applied voltage, or preferably in dB attenuation.

Interlinearity is measured between 2 potentiometer modules, over 10 to 90% of the total electrical travel.

Linear taper: ± 0.8 dB typical, ± 0.42 dB on request.

Non linear tapers: ± 2 dB typical, ± 0.83 dB on request.

OTHER OPTIONS

Contact Dale Electronics for further details. Many options are available. The following is a selection:

Motorized Potentiometer: The reduced size of P11 multiple assemblies makes them an ideal fit for motorized potentiometer assemblies.

Heavy Duty Trimmer: Bushingless, oversize screwdriver slot.

Potentiometer Module Only: For servo applications.

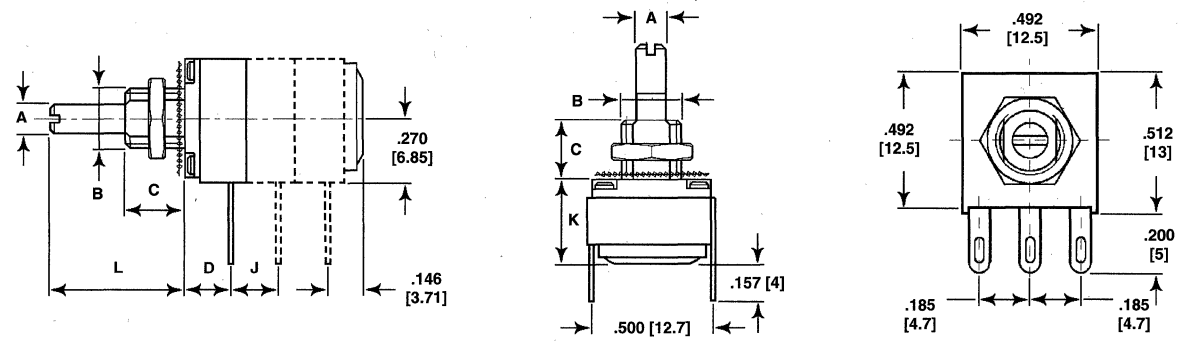
Extra Long Rotational Life: To 1 million cycles.

ENVIRONMENTAL PERFORMANCE (All Plastic Materials are UL-94-VO)		
	P11 (Cermet)*	PA11 (Conductive Plastic)
Shock	50G 11 msecs, 3 shocks, 3 directions	50G 11 msecs, 3 shocks, 3 directions
Total Resistance Shift	0.2%	0.2%
Resistance Setting Change	0.5% typical	0.5% typical
Vibration	10 - 55Hz/0.75mm or 10G/6 hours	10 - 55Hz/0.75mm or 10G/6 hours
Total Resistance Shift	0.2%	0.2%
Voltage Setting Change	0.5% typical	0.5% typical
Temperature Cycle	5 cycles, - 55°C to 125°C	5 cycles, - 55°C to 125°C
Total Resistance Shift	0.2%	0.5% typical
Rotational Life	50,000 cycles	100,000 cycles
Total Resistance Shift	3%	6%
Contact Resistance Variation	5%	2%
Load Life	1,000 hours at 70°C (90' on, 30' off)	1,000 hours at 70°C (90' on, 30' off)
Total Resistance Shift	2%	5%
Contact Resistance Variation	4%	5%
Moisture (40°C - 98% RH)	56 days	21 days
Total Resistance Shift	2%	5%
Insulation Resistance	> 1,000MΩ	> 10MΩ
Operating Temperature Range	- 55°C to + 125°C	- 55°C to + 125°C
Climatic Sequence - 5 Cycles	Dry heat + 125°C/ Damp heat/ Cold - 55°C/ Damp heat/ 5 cycles	
Total Resistance Shift	1%	

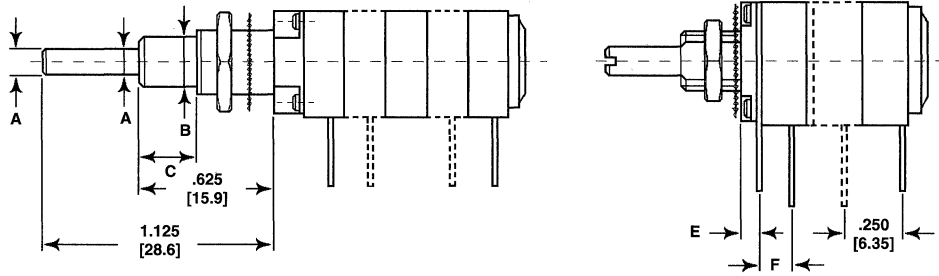
* Above specifications do not apply to values equal to or below 100Ω.

MODELS P11 and PA11

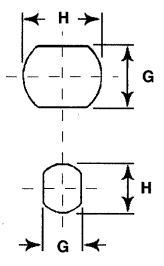
DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



Concentric Shafts



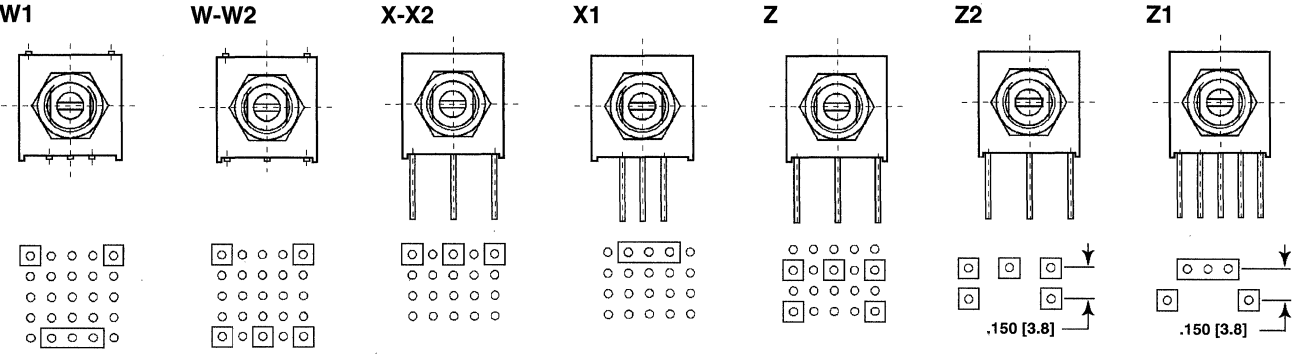
Panel Cutout



Solder lugs Y and PCB pins X only.

The outer shaft (D or VD) drives the module(s) situated immediately behind the panel, before the spacer module. The inner shaft (U or VU) drives the module(s) situated after the spacer.

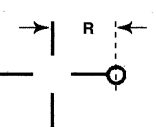
Terminals (Pin spacings on .1" [25.4] grid unless specified otherwise)



	SHAFT DIA. DIM. A	BUSHING DIA. DIM. B	BUSHING LENGTH DIM. C	TERMINALS Y, X, X1, X2 DIM. D	DIM. K	TERMINAL Z ONLY DIM. E	TERMINALS Z1, Z2, A, A1, A2 DIM. E	PANEL CUTOUT DIM. G	PANEL CUTOUT DIM. H	NUT WRENCH SIZE
T	[3]	[6]	[8]	[5]	[9.1]	[1.8]	[1.6]	[5.2]	[6.5]	[8]
Q	[4]	[7]	[8]	[5]	[9.1]	[1.8]	[1.6]	[6.2]	[7.5]	[10]
V	[6]	[10]	[9.5]	[7.6]	[11.1]	[3.8]	[3.6]	[8.2]	[10.5]	[12]
CC	[3]/[6]	[10]	[9.5]	[7.6]	—	[3.8]	[3.6]	[8.2]	[10.5]	[12]
7	.125	.250	.250	.200	.357	.071	.063	.244	.295	.314
2	.250	.375	.375	.300	.436	.150	.140	.323	.413	.500
0	.125/.250	.375	.375	.300	—	.150	.140	.323	.413	.500

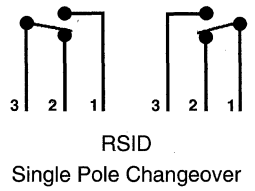
L, J and pin dimensions determined by part number on the preceding page.

Locating Pegs

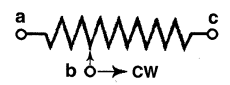


OPTION	BUSHING	THICKNESS	R
B	7-T-9	.012	.244
D	2-V	.031	.531
C	All	.016	.305

Switch Schematic



Circuit Diagram



MODELS P11 and PA11

HOW TO ORDER

Shaft and Bushing Module

BASIC MODULE

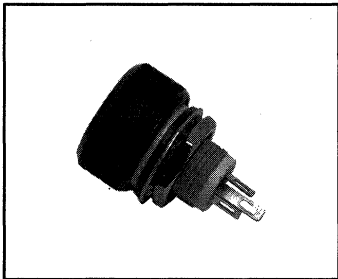
P11 MODEL	2 SHAFT AND BUSHING	X24 TERMINAL STYLE	B3 OPTION LOCATING PEG	P OPTION PANEL + SHAFT SEALING	CK STD SHAFT LENGTH																																																																																																																						
ELEMENTS P11 - Cermet PA11 - Conductive Plastic	<table border="1"> <thead> <tr> <th>BUSH. DIA.</th> <th>BUSH. LENGTH</th> <th>SHAFT DIA.</th> </tr> </thead> <tbody> <tr> <td>2 3/8"</td> <td>3/8"</td> <td>1/4"</td> </tr> <tr> <td>7 1/4"</td> <td>1/4"</td> <td>1/8"</td> </tr> </tbody> </table> <p>Metric (mm)</p> <table border="1"> <tbody> <tr> <td>T 6</td> <td>8</td> <td>3</td> </tr> <tr> <td>Q 7</td> <td>8</td> <td>4</td> </tr> <tr> <td>V 10</td> <td>9.5</td> <td>6</td> </tr> </tbody> </table> <p>CONCENTRIC SHAFTS</p> <table border="1"> <tbody> <tr> <td>O 3/8"</td> <td>3/8"</td> <td>1/8" - 1/4"</td> </tr> </tbody> </table> <p>Metric (mm)</p> <table border="1"> <tbody> <tr> <td>CC 10</td> <td>9.5</td> <td>3 - 6</td> </tr> </tbody> </table> <p>Panel and Shaft Sealing versions have 8mm D and 8mm L Bushing</p>	BUSH. DIA.	BUSH. LENGTH	SHAFT DIA.	2 3/8"	3/8"	1/4"	7 1/4"	1/4"	1/8"	T 6	8	3	Q 7	8	4	V 10	9.5	6	O 3/8"	3/8"	1/8" - 1/4"	CC 10	9.5	3 - 6	<table border="1"> <tbody> <tr> <td>Y</td> <td>Solder Lugs, Radial</td> </tr> <tr> <td>X</td> <td>PCB Pins, Radial</td> </tr> <tr> <td>Z</td> <td>PCB Pins, Radial with Front Support Plate</td> </tr> <tr> <td>A</td> <td>PCB Pins, Radial with Front and Back Support Plates</td> </tr> <tr> <td>W</td> <td>PCB Pins, Axial with 2 Extra Pin 1 Module Only</td> </tr> <tr> <td>-</td> <td>.200" Centers for X, Z, W Pins are .035" x .012"</td> </tr> <tr> <td>1</td> <td>.100" Centers for X, Z, W Pins are .024" x .012"</td> </tr> <tr> <td>2</td> <td>.200" Centers for X, Z, W Pins are .024" x .012"</td> </tr> <tr> <td>-</td> <td>.200" Spacing Between Modules</td> </tr> <tr> <td>3</td> <td>.300" Spacing Between Modules</td> </tr> <tr> <td>4</td> <td>.400" Spacing Between Modules</td> </tr> </tbody> </table>	Y	Solder Lugs, Radial	X	PCB Pins, Radial	Z	PCB Pins, Radial with Front Support Plate	A	PCB Pins, Radial with Front and Back Support Plates	W	PCB Pins, Axial with 2 Extra Pin 1 Module Only	-	.200" Centers for X, Z, W Pins are .035" x .012"	1	.100" Centers for X, Z, W Pins are .024" x .012"	2	.200" Centers for X, Z, W Pins are .024" x .012"	-	.200" Spacing Between Modules	3	.300" Spacing Between Modules	4	.400" Spacing Between Modules	<p>Clock Face Orientation</p> <p>B3 Set at 03:00 B6 Set at 06:00 B9 Set at 09:00 B0 Set at 00:00</p> <p>C3 Set at 03:00 C6 Set at 06:00 C9 Set at 09:00 C0 Set at 00:00</p> <p>D3 Set at 03:00 D6 Set at 06:00 D9 Set at 09:00 D0 Set at 00:00</p> <p>Default - No Locating Peg</p> <p>Not available with Panel + Shaft Sealing Option</p>	<p>P</p> <p>0 No Option</p> <p>Panel + Shaft Sealing Versions have 8mm D 8mm L Bushing</p> <p>Not Standard with Shafts K, M, E, D</p> <p>Other bushing sizes available, consult factory.</p>	<table border="1"> <thead> <tr> <th>DIA.</th> <th>LENGTH</th> <th>END</th> </tr> </thead> <tbody> <tr> <td>CK 1/8"</td> <td>3/8"</td> <td>Slotted</td> </tr> <tr> <td>CM 1/8"</td> <td>1/2"</td> <td>Slotted</td> </tr> <tr> <td>CD 1/8"</td> <td>5/8"</td> <td>Slotted</td> </tr> <tr> <td>CH 1/8"</td> <td>3/4"</td> <td>Slotted</td> </tr> <tr> <td>CR 1/8"</td> <td>7/8"</td> <td>Slotted</td> </tr> <tr> <td>VD 1/4"</td> <td>5/8"</td> <td>Slotted</td> </tr> <tr> <td>VR 1/4"</td> <td>7/8"</td> <td>Slotted</td> </tr> <tr> <td>VN 1/4"</td> <td>1"</td> <td>Slotted</td> </tr> <tr> <td>VL 1/4"</td> <td>1 1/2"</td> <td>Slotted</td> </tr> </tbody> </table> <p>Metric (mm)</p> <table border="1"> <tbody> <tr> <td>K 3</td> <td>9.5</td> <td>Slotted</td> </tr> <tr> <td>M 3</td> <td>12.5</td> <td>Slotted</td> </tr> <tr> <td>R 3</td> <td>22</td> <td>Slotted</td> </tr> <tr> <td>E 4</td> <td>9.5</td> <td>Slotted</td> </tr> <tr> <td>F 4</td> <td>12.5</td> <td>Slotted</td> </tr> <tr> <td>G 4</td> <td>22</td> <td>Slotted</td> </tr> <tr> <td>D 6</td> <td>16</td> <td>Slotted</td> </tr> <tr> <td>I 6</td> <td>19</td> <td>Knurled</td> </tr> <tr> <td>N 6</td> <td>25</td> <td>Slotted</td> </tr> <tr> <td>S 6</td> <td>50</td> <td>Slotted</td> </tr> </tbody> </table> <p>CONCENTRIC SHAFTS</p> <table border="1"> <tbody> <tr> <td>D 1/4"</td> <td>5/8"</td> <td>Plain</td> </tr> <tr> <td>U 1/8"</td> <td>36/32"</td> <td>Plain</td> </tr> </tbody> </table> <p>Metric (mm)</p> <table border="1"> <tbody> <tr> <td>D 6</td> <td>16</td> <td>Plain</td> </tr> <tr> <td>U 3</td> <td>28.5</td> <td>Plain</td> </tr> </tbody> </table> <p>C Custom - Specify or quote drawing</p> <p>Shaft lengths measured from mounting surface</p>	DIA.	LENGTH	END	CK 1/8"	3/8"	Slotted	CM 1/8"	1/2"	Slotted	CD 1/8"	5/8"	Slotted	CH 1/8"	3/4"	Slotted	CR 1/8"	7/8"	Slotted	VD 1/4"	5/8"	Slotted	VR 1/4"	7/8"	Slotted	VN 1/4"	1"	Slotted	VL 1/4"	1 1/2"	Slotted	K 3	9.5	Slotted	M 3	12.5	Slotted	R 3	22	Slotted	E 4	9.5	Slotted	F 4	12.5	Slotted	G 4	22	Slotted	D 6	16	Slotted	I 6	19	Knurled	N 6	25	Slotted	S 6	50	Slotted	D 1/4"	5/8"	Plain	U 1/8"	36/32"	Plain	D 6	16	Plain	U 3	28.5	Plain
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P112X24B3PCK BASIC MODULE	CV1M OPTION DETENTS MODULE	RSD OPTION SWITCH MODULE(S)	20Ω VALUE	10% TOLERANCE	A TAPER	J 000 OPTIONS
<p>CV1M 1 Detent at Half Travel</p> <p>CV1D 1 Detent in CCW Position</p> <p>CV1F 1 Detent in CW Position</p> <p>CV03 3 Detents inc. CW and CCW</p> <p>CV05 5 Detents</p> <p>CV07 7 Detents</p> <p>CV09 9 Detents</p> <p>CV11 11 Detents...(Standard)</p> <p>CV13 13 Detents</p> <p>CV15 15 Detents</p> <p>CV17 17 Detents</p> <p>CV19 19 Detents</p> <p>CV21 21 Detents...(Standard)</p> <p>0000 No Option</p> <p>The number of detents is always an odd number.</p> <p>Always consult Dale to obtain a sketch indicating the angular distribution of panel indexes - not equal angles.</p>	<p>RSD Single pole normally open switch in CCW position</p> <p>RSF Single pole normally open switch in CW position</p> <p>RSID Single pole changeover switch in CCW position</p> <p>RSIF Single pole changeover switch in CW position</p> <p>0000 No Option</p> <p>An assembly can comprise 1 or more switch modules.</p> <p>Distance between pins .100" or .200" as selected for potentiometer modules</p>	<p>Quote in clear using multipliers K, M or use 3 digit code.</p> <p>20Ω - 2MΩ A Linear Taper: Cermet 500Ω - 2MΩ L, F and S Non-linear Tapers: Cermet and Conductive Plastic</p> <p>500Ω - 1MΩ A Linear Taper Conductive Plastic</p>	<p>20% Standard Conductive Plastic</p> <p>10% Standard for Cermet-Optional for Conductive Plastic</p> <p>5% Optional for Cermet</p>	<p>A Linear</p> <p>L CW Log</p> <p>F CW Reverse Log</p> <p>S Audio S Shape Symmetrical CW Log</p>	<p>J 000 Center Tap</p> <p>J 084 Improved Accuracy of Center Point for CV1M</p> <p>J 123 Linearity ± 3% (Linear Law)</p> <p>J 145 Linearity ± 2% (Linear Law)</p> <p>J 116 Interlinearity ± 0.42 dB</p> <p>J 119 Interlinearity ± 0.83 dB for L, F and S Non-linear Laws</p> <p>EC Torque Compensation Module</p> <p>More options available</p>	
1ST POTENTIOMETER MODULE						<p> If more Potentiometer Modules are desired (there can be up to seven), then repeat Value, Tolerance, Taper and Options for each.</p>

Standard Assemblies can comprise up to 7 modules in addition to shaft and bushing module. See preferred assembly sequence under heading "Multiple Assemblies".

MODELS P16 and PA16 Panel Controls

Miniature, "Pot in the Knob"
Cermet/Conductive Plastic



FEATURES

- Compact, minimum clearance, low profile design
- Fully sealed and panel sealed
- Easy to specify part type for ordering
- Metal bushing
- Available through distribution
- Simple, compact, reliable, available
- Bushing mounted panel control built inside a knob rather than behind a panel

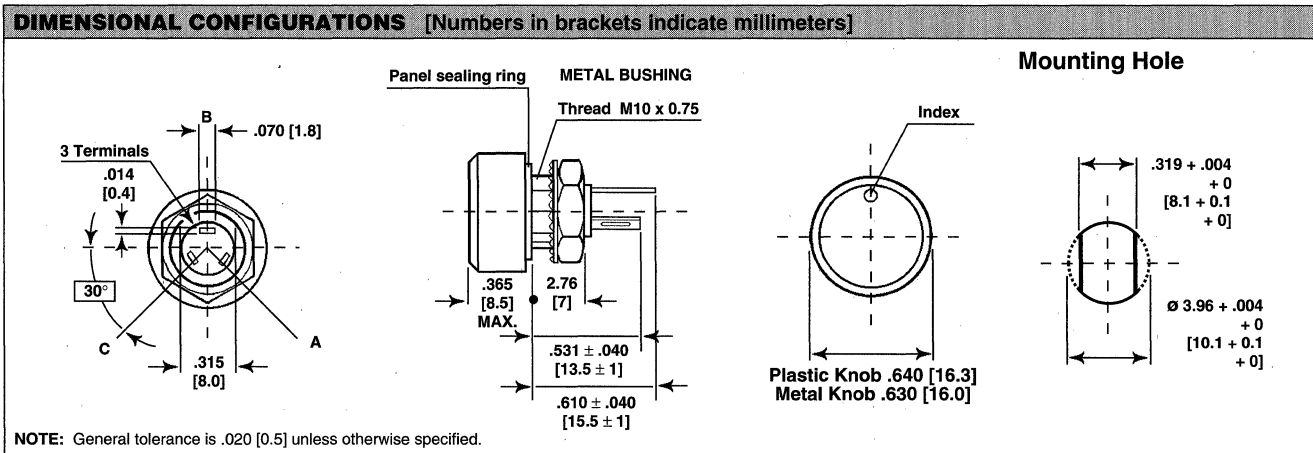
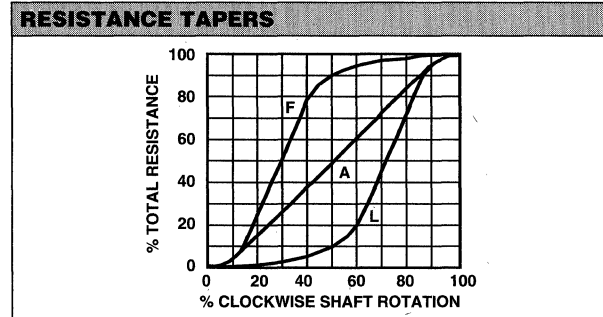
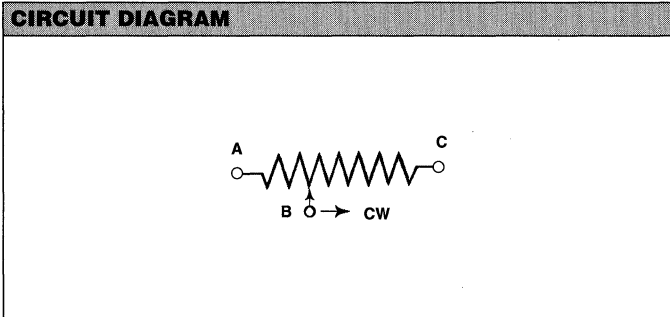
STANDARD ELECTRICAL SPECIFICATIONS		
	CERMET ELEMENT	CONDUCTIVE PLASTIC ELEMENT
Resistance Range		
Linear Taper	22Ω-10M	500Ω-100k
Non-Linear Taper	1k-1M	500Ω-100k
Tolerance		
Standard	± 10%	± 20%
Optional	± 5%	± 10%
Power Rating		
Linear Taper	1 W @ 40°C	.5 W @ 40°C
Non-Linear Taper	.5 W @ 40°C	.25 W @ 40°C
Temperature Coefficient	± 100PPM if R > 100	± 1000PPM/°C Max.
Contact Resistance Variation	3% or 3	1% Linear Taper 3% Non-Linear

ELECTRICAL SPECIFICATIONS

Electrical Travel: 270° ± 10°.
Dielectric Strength: 2500 V.
Limiting Element Voltage: 350 V linear taper.
Insulation Resistance: > 10 Megohm, 500 VDC.
End Resistance: 1 typical.

MECHANICAL SPECIFICATIONS

Mechanical Travel: 300° ± 5°.
Operating Torque: 2.8 ounce/inch typical.
End Stop Torque: 2 pound/inch typical.
Unit Weight: Plastic knob .17 ounces typical,
 metal knob .20 ounces typical.



MODELS P16 and PA16

ENVIRONMENTAL PERFORMANCE		
	CERMET ELEMENT	CONDUCTIVE PLASTIC ELEMENT
Operating Temperature Range Metal Knob Plastic Knob	- 55°C to + 125°C - 55°C to + 85°C	- 55°C to + 125°C - 55°C to + 85°C
Climatic Sequence Total Resistance Shift	5 cycles Dry heat + 125°C Damp heat Cold - 55°C Damp heat 0.5%	5 cycles Dry heat + 125°C Damp heat Cold - 55°C Damp heat 0.5%
Moisture Total Resistance Shift Insulation Resistance	56 days 0.5% > 10000M	56 days 2% > 10000M
Shock Total Resistance Shift Change in Setting	50g for 11 ms 3 shocks in 3 directions 0.1% 0.2%	50g for 11 ms 3 shocks in 3 directions 0.2% 0.5%
Vibration Total Resistance Shift Change in Voltage Setting	10-55 Hz/0.75mm or 10g/6 hours 0.1% 0.2%	10-55 Hz/0.75mm or 10g/6 hours 0.2% 0.5%
Temperature Cycles Plastic Knob, 5 cycles Metal Knob, 5 cycles Total Resistance Shift	- 55°C to + 85°C - 55°C to + 85°C 0.5%	- 55°C to + 85°C - 55°C to + 85°C 0.5%
Rotational Life Total Resistance Shift Contact Resistance Variation	25,000 cycles 3% < 2%	25,000 cycles 5% < 2%
Load Life	1000 hours @ 40°C. Cycles 90 min. on, 30 min. off	1000 hours @ 40°C. Cycles 90 min. on, 30 min. off

MOUNTING RECOMMENDATIONS

We recommend a mounting hole be punched in the panel matching the two flats on the bushing. This is to provide a means of anti-rotational support.

Should the mounting hole be round, the bushing (not the knob) should be held by any means while the hex nut is being tightened. Tightening force shall not exceed 21 pounds per square inch. Panel sealing will be achieved at a pressure of 13 pounds per square inch.

The P16 bushing generally fits mounting holes as specified for 3/8 [9.53] diameter bushings.

OPTIONS

A limited variety of colors are available for the plastic knobs. Colors available include black, blue, red and white. Consult the factory for minimums. Consult the factory for color options on the metal knob.

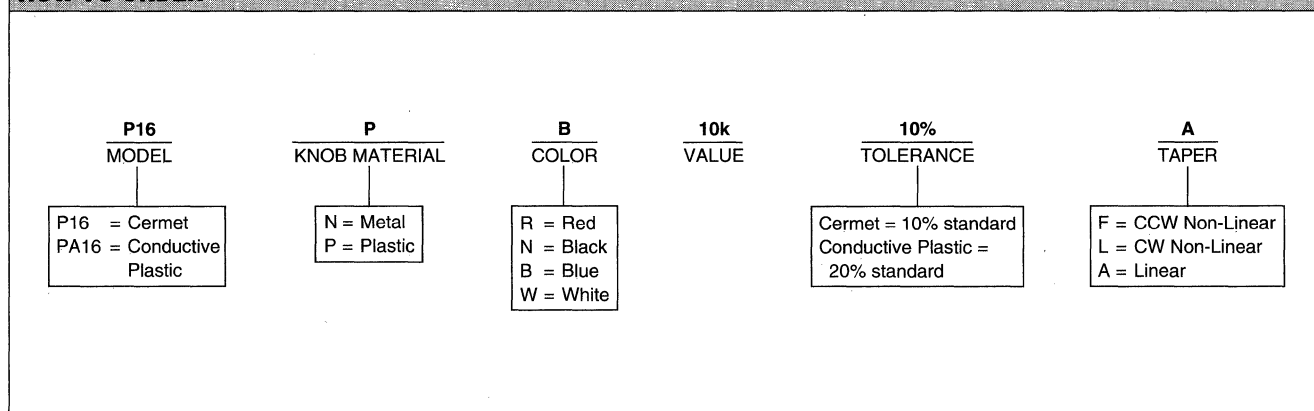
PACKAGING

The P16 is packed in tubes (20 per tube) with the leads protected.

PART MARKING

(on bushing flat)
— Ohmic Value
— Tolerance
— Taper Code

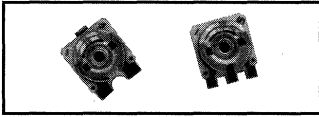
HOW TO ORDER



MODELS ST-22 and ST-23 Chip Potentiometers

Surface Mounted

Single Turn, Open Frame, 4mm Square



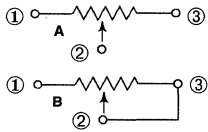
FEATURES

- Designed for efficient, accurate miniaturization
- Can be wave or dip soldered without rotor problems
- Coded marking for easy identification of resistance value
- Models for standard, automatic or reverse adjustment
- 12mm tape and reel packaging

ELECTRICAL SPECIFICATIONS

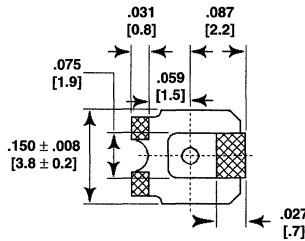
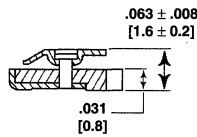
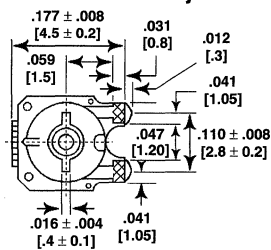
- Resistance Values:** 100 ohm to 1 Megohm.
- Resistance Tolerance:** $\pm 30\%$.
- Rated Power:** 0.2 watt at 70°C.
- Rated Voltage:** 100 VDC.
- Rotation Life:** 20 rotations.
- Torque:** 20 to 200 g cm.
- Rotation Angle:** $270^\circ \pm 20^\circ$ total.
- Operating Temperature Range:** - 40°C to + 100°C.
- TCR:** $\pm 250\text{PPM}/^\circ\text{C}$.
- CRV:** 5% maximum.

EQUIVALENT CIRCUIT

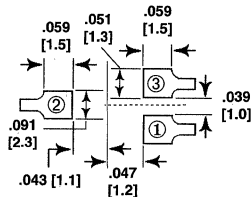


DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

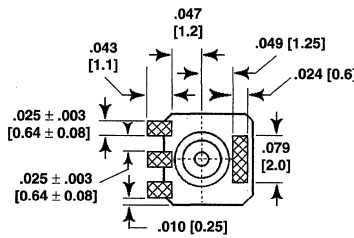
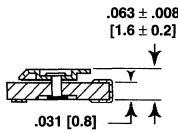
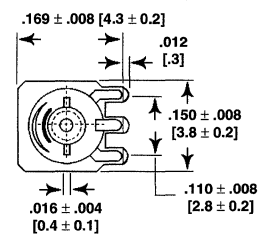
ST-22 Standard Adjustment



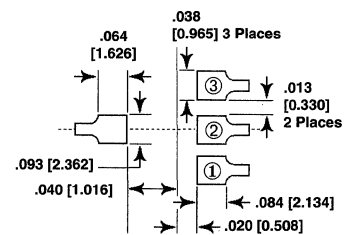
NOTE: Numbers without specified tolerance are for reference only.



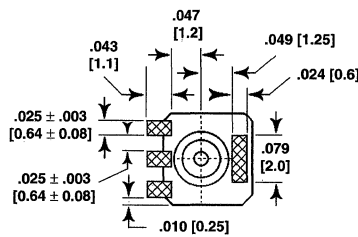
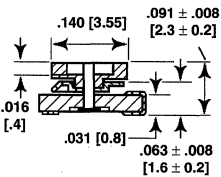
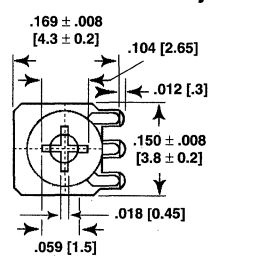
ST-23 Standard Adjustment



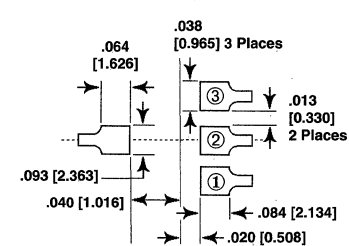
Standard PC Board Pattern



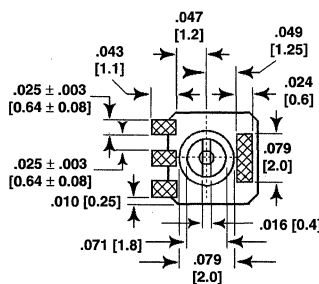
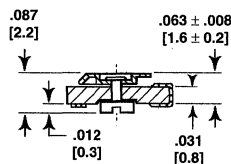
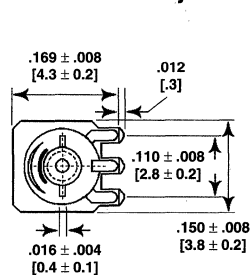
ST-23 Automatic Adjustment



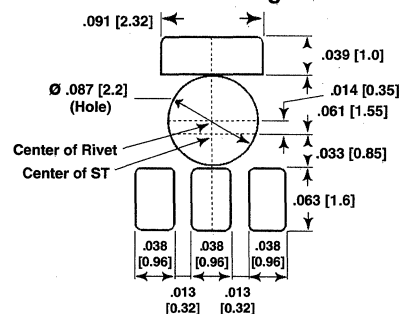
Standard PC Board Pattern



ST-23 Reverse Adjustment



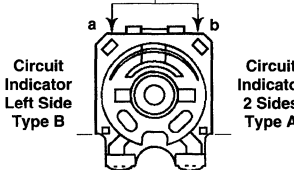
ST-23 Reverse Standard Mounting Pad-Pattern



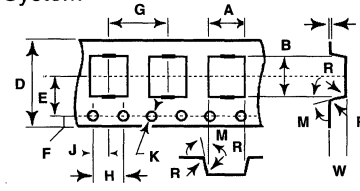
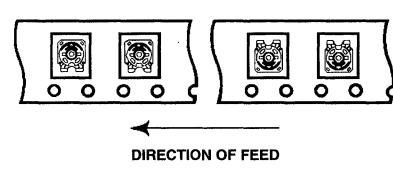
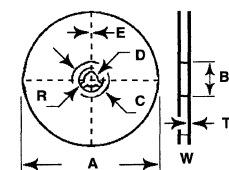
MODELS ST-22 and ST-23

ENVIRONMENTAL PERFORMANCE		
PARAMETER	TEST METHODS	SPECIFICATIONS
Resistance to Soldering Heat	Set rotor to full value, immerse in SN62 solder bath at 250°C for 5 ± 1 seconds. Stabilize at 25°C for 5 hours. Measure resistance value.	ΔR < ± 1% of initial value
Vibration	Set rotor to nominal value, frequency 10-55 Hz, amplitude 1.5mm, duration 2 hours in X, Y and Z axis.	ΔR < ± 1% of initial value
Temperature Cycle	Set rotor to full value 5 cycles from - 40°C to 25°C. Dwell for 30 minutes at - 40°C and + 100°C. Dwell 15 minutes at 25°C. Stabilization time is 1 hour each.	ΔR < ± 2% of initial value
Heat Resistance	Set rotor to full value, bake at + 100°C for 250 hours, stabilize at 25°C for 1 hour prior to taking final measurements.	ΔR < ± 3% of initial value
Rotation Life (Resistance)	Rotate 20 times through 90° of effective rotation angle at a rate of 10 rotations per minute.	ΔR < ± 15% of initial value
Rotation Life (Torque)	Rotate rotor 10 times through 270° arc. Measure torque after 5 and 10 rotations.	Torque to be 20 g cm-200 g cm
Load Life	Set rotor to full value, test temperature + 70°C ± 2°C, cycle voltage on for 90 minutes, off for 30 minutes for 1000 hours. Stabilize at 25°C for 1 hour. Measure resistance value.	ΔR < ± 3% of initial value
Load Life in Moisture	Set rotor to full value, test temperature + 40°C ± 2°C at 90-95% RH. Cycle voltage on for 90 minutes, off for 30 minutes for 500 hours. Stabilize at 25°C for 1 hour. Measure resistance value.	ΔR < ± 3% of initial value
Solvent Resistance	Set rotor to full value, immerse in Trichloroethylene or equivalent for 15 minutes. Air dry at 25°C for 5 hours. Measure resistance value.	ΔR < ± 1% of initial value

STANDARD RESISTANCE VALUES		
Ohms	Ohms	Ohms
100	5k	200k
200	10k	500k
500	20k	1M
1k	50k	
2k	100k	

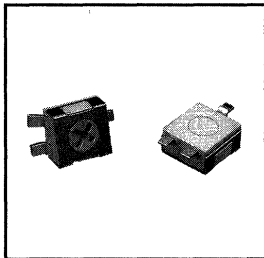
PART MARKING								
Resistance Code			Marking Codes					
			Resistance Value	a	b	Resistance Value	a	b
			100Ω	1	1	200k	2	4
1k	1	2	500Ω	5	1			
10k	1	3	5k	5	2			
100k	1	4	50k	5	3			
200Ω	2	1	500k	5	4			
2k	2	2	1M	1	5			
20k	2	3						

HOW TO ORDER					
ST MODEL	22 STYLE	A CIRCUIT TYPE	XXX VALUE	A ADJUSTMENT TYPE	W TAPE PACKAGING DIRECTION
	22 23	A = 3 terminal (Voltage Divider Circuit) B = 2 terminal (Rheostat Circuit)	The first two digits are significant. The third digit is the number of zeros following to express resistance in ohms.	A = Standard B = Automatic adjustment C = Reverse adjustment	W X

TAPE AND REEL PACKAGING [Numbers in brackets indicate millimeters]																																											
Tape: Styrene-System-Plastic Sheet						Tape Loading																																					
																																											
CODE	A	B	D	E	F	G	H	J	K	M	R	W	T																														
DIM.	.177 ± .008 [4.5 ± 0.2]	.189 ± .008 [4.8 ± 0.2]	.472 ± .012 [12.0 ± 0.3]	.217 ± .004 [5.5 ± 0.1]	.059 ± .008 [1.5 ± 0.2]	.315 ± .004 [8.0 ± 0.1]	.157 ± .004 [4.0 ± 0.1]	.079 ± .004 [2.0 ± 0.1]	.059 + .004 - .00 [1.5 + 0.1 - 0.0]	15° + 0 0.3° + 0	.106 ± .004 [2.7 ± 0.1]	.102 ± .004 [0.3 ± 0.1]																															
Reel Material: Cardboard						<table border="1"> <thead> <tr> <th>CODE</th> <th colspan="2">DIMENSIONS</th> </tr> <tr> <th></th> <th>1000 PER REEL</th> <th>5000 PER REEL</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>7.01 ± .080 [178.0 ± 2.0]</td> <td>16.5 ± .079 [420.0 ± 2.0]</td> </tr> <tr> <td>B</td> <td>1.97 [50.0]</td> <td>3.15 ± .079 [80.0 ± 2.0]</td> </tr> <tr> <td>C</td> <td>.709 ± .020 [18.0 ± 0.5]</td> <td>.709 ± .020 [18.0 ± 0.5]</td> </tr> <tr> <td>D</td> <td>.827 ± .031 [21.0 ± 0.8]</td> <td>.827 ± .031 [21.0 ± 0.8]</td> </tr> <tr> <td>E</td> <td>.079 ± .020 [2.0 ± 0.5]</td> <td>.079 ± .020 [2.0 ± 0.5]</td> </tr> <tr> <td>W</td> <td>.551 ± .059 [14.0 ± 1.5]</td> <td>.551 ± .059 [14.0 ± 1.5]</td> </tr> <tr> <td>T</td> <td>.039 ± .020 [1.0 ± 0.5]</td> <td>.079 ± .020 [2.0 ± 0.5]</td> </tr> <tr> <td>R</td> <td>.039 [1.0]</td> <td>.197 [5.0]</td> </tr> </tbody> </table>								CODE	DIMENSIONS			1000 PER REEL	5000 PER REEL	A	7.01 ± .080 [178.0 ± 2.0]	16.5 ± .079 [420.0 ± 2.0]	B	1.97 [50.0]	3.15 ± .079 [80.0 ± 2.0]	C	.709 ± .020 [18.0 ± 0.5]	.709 ± .020 [18.0 ± 0.5]	D	.827 ± .031 [21.0 ± 0.8]	.827 ± .031 [21.0 ± 0.8]	E	.079 ± .020 [2.0 ± 0.5]	.079 ± .020 [2.0 ± 0.5]	W	.551 ± .059 [14.0 ± 1.5]	.551 ± .059 [14.0 ± 1.5]	T	.039 ± .020 [1.0 ± 0.5]	.079 ± .020 [2.0 ± 0.5]	R	.039 [1.0]	.197 [5.0]
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MODELS ST53YJ and ST53YL Cermet Trimmers

Surface Mount, Miniature, Single Turn, Fully Sealed



FEATURES

- 0.2 watts at 85°C
- Excellent stability
- Wide ohmic range
- Fully sealed
- Low temperature coefficient
- Low contact resistance variation
- Manual or automatic operations
- Small size for optimum packing density

APPLICATIONS

The ST53 trimming potentiometers have been designed for surface mount applications. They offer volumetric efficiency and have dimensions of .197" x .197" x .106" [5.0 x 5.0 x 2.7] with high performance and stability.

The ST53 models are suitable for both manual or automatic operation and can withstand wave, vapor phase and reflow soldering techniques.

ELECTRICAL SPECIFICATIONS

Electrical Travel: 220° ± 15°.

Resistance Range: 10 ohm to 1 Megohm.

Standard Series: 1-2-5.

Resistance Tolerance: ± 20% standard.

Temperature Coefficient: ± 100PPM/°C (- 55°C to + 155°C) for Rn ≥ 100 ohm.

Power Rating: 0.2 watt at + 85°C.

Limiting Element Voltage: 200 V.

Contact Resistance Variation: 1% Rn or 3 ohm.

End Resistance Variation: 1 ohm typical.

Dielectric Strength: 1000 V RMS.

Insulation Resistance: 10⁶ Megohm.

Specification: In accordance with NFC 83251 or CECC 41100 and VRCI.

MECHANICAL SPECIFICATIONS

Mechanical Travel: 270° ± 10°.

Operating Torque: 2.2 ounce inch maximum.

End Stop Torque: 5.0 ounce inch minimum.

Weight: 0.15 grams maximum.

Resistive Element: Cermet.

ENVIRONMENTAL SPECIFICATIONS

Temperature Limits: - 55°C to + 155°C.

Climatic Category: 55/125/56.

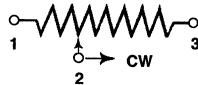
Sealing: Fully sealed container, solder immersion.

Soldering Cycle (Surface Mounting): 2 minutes at 215°C or 10 seconds at 260°C or 3 seconds at 350°C (according to VRCI). Soldering is possible by wave, reflow and vapor phase.

STANDARD RESISTANCE ELEMENT DATA

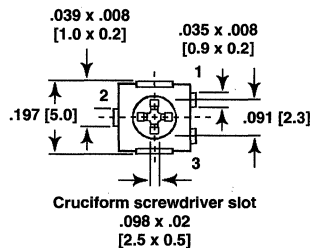
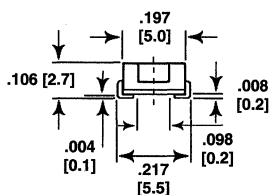
STANDARD RESISTANCE VALUES (Ohms)	LINEAR LAW			T. C. - 55°C + 125°C PPM/°C
	MAXIMUM POWER AT 85°C (Watts)	MAXIMUM WORKING VOLTAGE (Volts)	MAX. CURRENT THROUGH WIPER (mA)	
10	0.20	1.41	141.0	0 + 200
20	0.20	2.00	100.0	
50	0.20	3.16	63.0	
100	0.20	4.47	45.0	
200	0.20	6.32	32.0	
500	0.20	10.0	20.0	
1k	0.20	14.1	14.0	
2k	0.20	20.0	10.0	
5k	0.20	31.6	6.3	
10k	0.20	44.7	4.5	
20k	0.20	63.2	3.2	± 100
50k	0.20	100.0	2.0	
100k	0.10	100.0	1.0	
200k	0.05	100.0	0.5	
500k	0.02	100.0	0.2	
1M	0.01	100.0	0.1	

CIRCUIT DIAGRAM

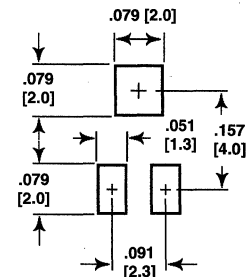


DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

ST53YJ



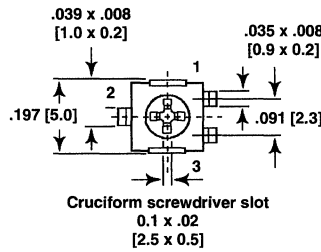
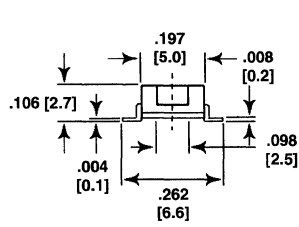
Recommended Soldering Areas



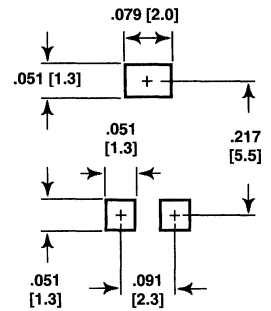
MODELS ST53YJ and ST53YL

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

ST53YL



Recommended Soldering Areas

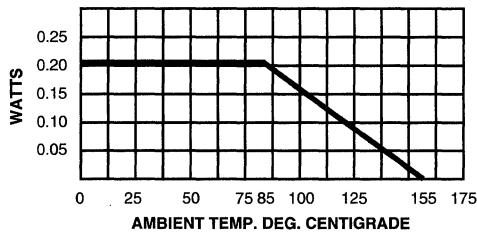


ENVIRONMENTAL PERFORMANCE

TEST*	CONDITIONS	TYPICAL VALUES AND DRIFTS	
		$\frac{\Delta RT}{RT}$ %	$\frac{\Delta R1-2}{R1-2}$ %
Thermal Shock	5 cycles, - 55°C to + 125°C	1%	$\Delta V1-2$ 2% V1-3
Moisture Resistance (106)	10 cycles of 24 hours constituted with damp heat-cold-vibrations	2% Dielectric strength Insulation resistance	3% 1000 V RMS 10 ⁴ M
Long Term Damp Heat	Temperature = 40°C, RH = 90 - 95%, 10% rated power/56 days	2% Dielectric strength Insulation resistance	3% 1000 V RMS 10 ⁴ M
Shock	3 successive shocks, in 3 directions, 100g, 6 ms	1%	$\Delta V1-2$ 1% V1-3
Vibration	20g, 12 hours, 10 - 55 Hz	1%	$\Delta V1-2$ 1% V1-3
Rotational Life (electrical and mechanical)	100 cycles at rated power	3%	
Load Life	1000 hours at rated power, 90°/30° ambient temperature + 85°C	2% Contact resistance variation	3% < 1% RN

* Numbers in parenthesis refer to test method of MIL-STD-202 as modified by the detail specification.

DERATING



PART MARKING

- Date code
- Ohmic Value (3 digit code)
- Trademark

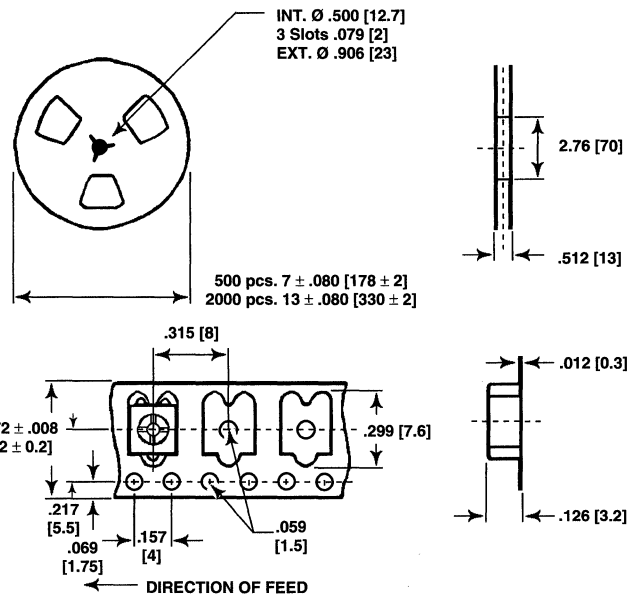
HOW TO ORDER

ST53	YJ, YL	500k	± 20%
MODEL	STYLE	VALUE	TOLERANCE

NOTE: On delivery, the wiper is positioned at mid-travel.

PACKAGING

Tape and reel - 500 pieces standard, 2000 pieces optional.
 The pull strength of the cover tape conforms to EIA 481A and 286 CE13.

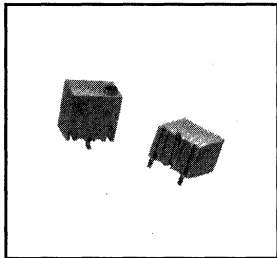


MODELS ST63Y and ST63Z

Cermet Trimmers

Surface Mount, Miniature

Industrial Grade, Multiturn, Fully Sealed



FEATURES

- 1/4" square
- 0.25 watts at 85°C
- Multiturn operation
- Fully sealed
- Very low temperature coefficient
- Low contact resistance variation
- Tight tolerance
- Low end contact resistance
- Tape and reel or tube packaging

APPLICATIONS

The ST63 trimmer has dimensions of 6.6 x 6.8 x 4.6mm and has been designed for use in PCB surface mounting applications where size is important. Two styles are available according to the positioning of the control screw and contact positions.

The cermet track gives a high stability performance with an extended ohmic capacity of 10 ohm to 2 Megohm.

ELECTRICAL SPECIFICATIONS

Electrical Travel: 13 turns \pm 2.

Resistance Range: 10 ohm to 2 Megohm.

Standard Series: 1-2-5.

Resistance Tolerance: \pm 10% standard.

Temperature Coefficient: \pm 100PPM/°C (- 55°C to + 155°C) for $R_n \geq 100$ ohm.

Power Rating: 0.25 watt at + 85°C.

Limiting Element Voltage: 250 V.

Contact Resistance Variation: 2% R_n or 2 ohm, whichever is greater.

End Resistance Variation: 1 ohm typical.

Dielectric Strength: 1000 V RMS.

Insulation Resistance: 10^6 Megohm, 500 VDC.

ENVIRONMENTAL SPECIFICATIONS

Temperature Limits: - 55°C to + 155°C.

Climatic Category: 55/125/56.

Sealing: Fully sealed container, solder immersion.

Soldering Cycle (Surface Mounting): 2 minutes at 215°C or 10 seconds at 260°C or 3 seconds at 350°C (according to VRCI). Soldering is possible by wave, reflow and vapor phase.

STANDARD RESISTANCE ELEMENT DATA				
STANDARD RESISTANCE VALUES (Ohms)	LINEAR LAW			T. C. - 55°C + 125°C PPM/°C
	MAXIMUM POWER AT 85°C (Watts)	MAXIMUM WORKING VOLTAGE (Volts)	MAX. CURRENT THROUGH WIPER (mA)	
10	0.25	1.58	158.0	0 + 200
20	0.25	2.23	112.0	
50	0.25	3.53	77.0	
100	0.25	5.00	50.0	
200	0.25	7.07	35.0	
500	0.25	11.2	22.0	
1k	0.25	15.8	15.8	
2k	0.25	22.3	11.2	
5k	0.25	35.3	7.1	
10k	0.25	50.0	5.0	
20k	0.25	70.7	3.5	\pm 100
50k	0.25	112.0	2.2	
100k	0.25	158.0	1.6	
200k	0.25	223.0	1.1	
500k	0.13	250.0	0.50	
1M	0.06	250.0	0.25	
2M	0.03	250.0	0.12	

MECHANICAL SPECIFICATIONS

Mechanical Travel: 15 turns \pm 5.

Operating Torque: 2.1 ounce inch maximum.

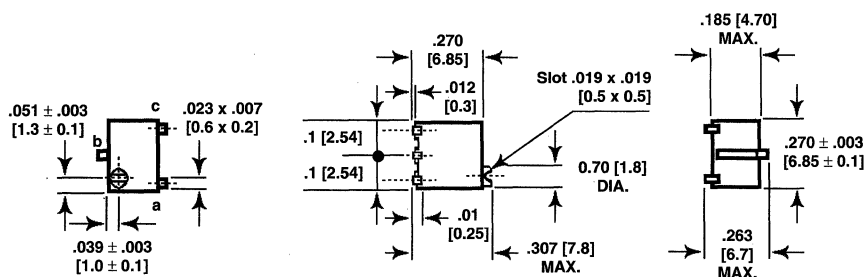
End Stop Torque: Clutch action.

Weight: 0.5 grams maximum.

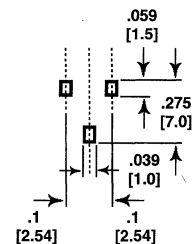
Resistive Element: Cermet.

DIMENSIONAL CONFIGURATIONS 1/4" [6.35] Square [Numbers in brackets indicate millimeters]

ST63Y



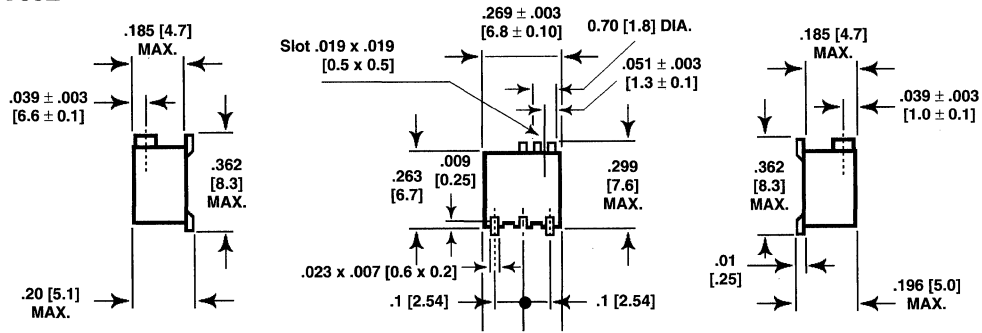
Recommended Soldering Areas



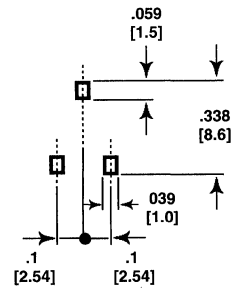
MODELS ST63Y and ST63Z

DIMENSIONAL CONFIGURATIONS 1/4 [6.35] Square [Numbers in brackets indicate millimeters]

ST63Z



Recommended Soldering Areas

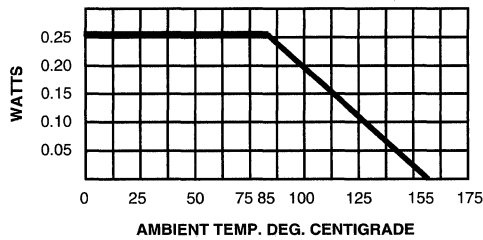


ENVIRONMENTAL PERFORMANCE

TEST*	CONDITIONS	TYPICAL VALUES AND DRIFTS	
		$\frac{\Delta RT}{RT}$ %	$\frac{\Delta R1-2}{R1-2}$ %
Thermal Shock	5 cycles, - 55°C to + 125°C	0.5%	$\Delta V1-2$ 1% V1-3
Moisture Resistance (106)	10 cycles of 24 hours constituted with damp heat-cold-vibrations	1% Dielectric strength Insulation resistance	2% 1000 V RMS 10 ⁴ M
Long Term Damp Heat	Temperature = 40°C, RH = 90 - 95%, 10% rated power/56 days	1% Dielectric strength Insulation resistance	2% 1000 V RMS 10 ⁴ M
Shock	3 successive shocks, in 3 directions, 100g, 6 ms	1%	$\Delta V1-2$ 1% V1-3
Vibration	20g, 12 hours, 10 - 55 Hz	1%	$\Delta V1-2$ 1% V1-3
Rotational Life (electrical and mechanical)	100 cycles at rated power	1% Operation torque Dielectric strength Insulation resistance	1.4 oz. inch 1000 V RMS > 10 ⁴ M
Load Life	1000 hours at rated power, 90°/30° ambient temperature + 85°C	1% Contact resistance variation	2% < 1% RN

* Numbers in parenthesis refer to test method of MIL-STD-202 as modified by the detail specification.

DERATING



PART MARKING

- Model
- Style
- Value
- Tolerance
- Date code
- Marking of terminal: 3
- Trademark

HOW TO ORDER

ST63
MODEL

Y, Z
STYLE

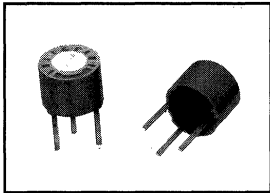
500k
VALUE

± 10%
TOLERANCE

NOTE: On delivery, the wiper is positioned at mid-travel.

MODELS T7YA and T7YB Cermet Trimmers

Miniature, Industrial Grade



FEATURES

- 0.5 watts at 85°C
- High stability
- Low temperature coefficient
- Wide resistance range
- Easy to read scale

APPLICATIONS

The T7 trimmer is only .275" [7.0] in diameter and fits almost anywhere. A sealed plastic case protecting a quality cermet track guarantees high performance and reliability. Adjustments are made easier by the clear scale readings. Competitively priced, the T7 is ideally suited to all industrial applications.

ELECTRICAL SPECIFICATIONS

- Electrical Travel:** 270° ± 15°.
- Resistance Range:** 10 ohm to 2 Megohm.
- Standard Series:** 1-2-5.
- Resistance Tolerance:** ± 10% standard.
- Temperature Coefficient:** (- 55°C to + 125°C) ± 100PPM/°C for Rn ≥ 100 ohm.
- Power Rating:** 0.5 watt at + 85°C.
- Limiting Element Voltage:** 250 V.
- Contact Resistance Variation:** 3% or 3 ohm, whichever is greater.
- End Resistance Variation:** 1 ohm typical.
- Dielectric Strength:** 1000 V RMS.
- Insulation Resistance:** 10⁶ Megohm (500 VDC).

MECHANICAL SPECIFICATIONS

- Mechanical Travel:** 300° ± 15°.
- Operating Torque:** 3 ounce inch maximum.
- End Stop Torque:** 5.6 ounce inch minimum.
- Weight:** 0.02 ounces.
- Resistive Element:** Cermet.

ENVIRONMENTAL SPECIFICATIONS

- Temperature Limits:** - 55°C to + 125°C.
- Climatic Category:** 55/100/56.
- Sealing:** Enables cleaning. T7 trimming potentiometers are sealed against dust and P.C. board cleaning with the following solvents: Trichlorotrifluoroethane, Alcohol, Trichlorethane.

STANDARD RESISTANCE ELEMENT DATA

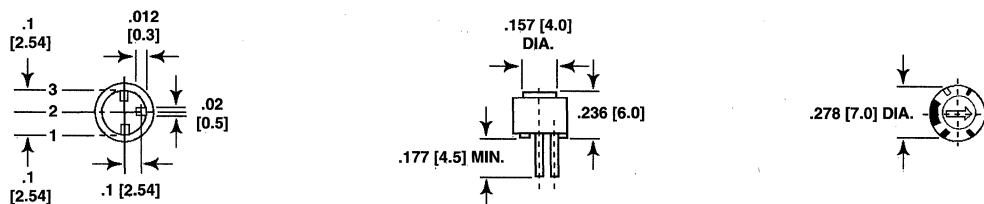
STANDARD RESISTANCE VALUES (Ohms)	LINEAR LAW			T. C. - 55°C + 125°C PPM/°C
	MAXIMUM POWER AT 85°C (Watts)	MAXIMUM WORKING VOLTAGE (Volts)	MAX. CURRENT THROUGH WIPER (mA)	
10	0.50	2.2	224.0	0 + 200
20	0.50	3.2	158.0	
50	0.50	5.0	100.0	
100	0.50	7.0	70.0	
200	0.50	10.0	50.0	
500	0.50	15.8	32.0	
1k	0.50	22.4	22.0	
2k	0.50	31.6	16.0	
5k	0.50	50.0	10.0	
10k	0.50	70.7	7.0	
20k	0.50	100.0	5.0	± 100
50k	0.50	158.0	3.2	
100k	0.50	224.0	2.2	
200k	0.31	250.0	1.25	
500k	0.12	250.0	0.50	
1M	0.06	250.0	0.25	

CIRCUIT DIAGRAM



DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

T7YA

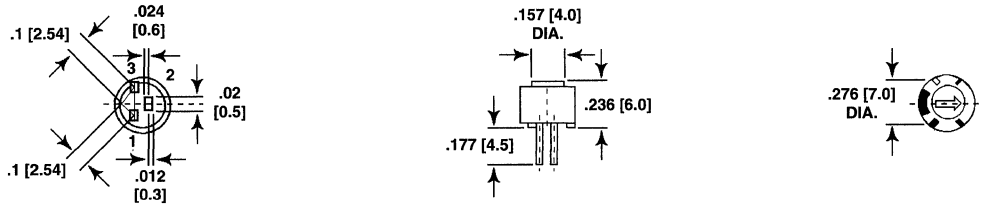


NOTE: Tolerance unless otherwise specified ± .020 [.508].

MODELS T7YA and T7YB

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

T7YB



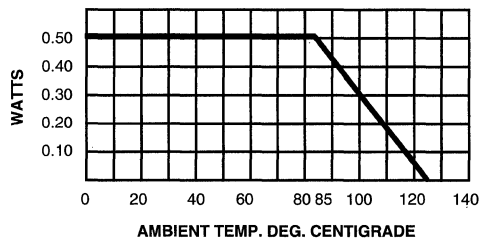
NOTE: Tolerance unless otherwise specified $\pm .020$ [.508].

ENVIRONMENTAL PERFORMANCE

TEST*	CONDITIONS	TYPICAL VALUES AND DRIFTS	
		$\frac{\Delta RT}{RT}$ %	$\frac{\Delta R1-2}{R1-2}$ %
Thermal Shock	5 cycles, - 55°C to + 125°C	1%	$\Delta \frac{V1-2}{V1-3}$ 2%
Moisture Resistance (106)	10 cycles of 24 hours constituted with damp heat-cold-vibrations	2% Dielectric strength Insulation resistance	3% 1000 V RMS 10 ⁴ M
Long Term Damp Heat	Temperature = 40°C, RH = 90 - 95%, 10% rated power/56 days	2% Dielectric strength Insulation resistance	3% 1000 V RMS 10 ⁴ M
Shock	3 successive shocks, in 3 directions, 100g, 6 ms	1%	$\Delta \frac{V1-2}{V1-3}$ 1%
Vibration	20g, 12 hours, 10 - 55 Hz	1%	$\Delta \frac{V1-2}{V1-3}$ 1%
Rotational Life (electrical and mechanical)	200 cycles at rated power	2% Operation torque Dielectric strength Insulation resistance	1.4 oz. inch 1000 V RMS > 10 ⁴ M
Load Life	1000 hours at rated power, 90°/30° ambient temperature + 85°C	3% Contact resistance variation	4% < 3% RN

* Numbers in parenthesis refer to test method of MIL-STD-202 as modified by the detail specification.

DERATING



PART MARKING

- Model
- Style
- Value
- Date code
- Marking of terminal: 3
- Trademark

HOW TO ORDER

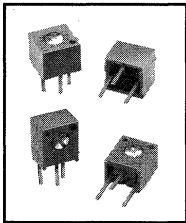
T7
MODEL

YA, YB
STYLE

500k
VALUE

± 10%
TOLERANCE

MODELS TX, TXD, TY (A, D, M, P) Cermet Trimmers Miniature, Industrial Grade



FEATURES

- 0.5 watt at 85°C
- Typical contact resistance variation of 1%
- Fully sealed
- Wide temperature range - 55°C to + 125°C
- Easy to read scale
- Excellent stability owing to multi-contact wiper in precious metal

APPLICATIONS

This newly designed trimming potentiometer can be mounted on PCBs as an alternative to most of the current 3/8" [9.53] square trimmers with the advantage of a significantly smaller size 9/32" [7.14].

STANDARD RESISTANCE ELEMENT DATA				
STANDARD RESISTANCE VALUES (Ohms)	LINEAR LAW			T. C. - 55°C + 125°C PPM/°C
	MAXIMUM POWER AT 85°C (Watts)	MAXIMUM WORKING VOLTAGE (Volts)	MAX. CURRENT THROUGH WIPER (mA)	
10	0.50	2.2	224.0	0 + 200
20	0.50	3.2	158.0	
50	0.50	5.0	100.0	
100	0.50	7.0	70.0	± 100
200	0.50	10.0	50.0	
500	0.50	15.8	32.0	
1k	0.50	22.4	22.0	
2k	0.50	31.6	16.0	
5k	0.50	50.0	10.0	
10k	0.50	70.7	7.0	
20k	0.50	100.0	5.0	
50k	0.50	158.0	3.2	
100k	0.50	224.0	2.2	
200k	0.31	250.0	1.25	
500k	0.12	250.0	0.5	
1M	0.06	250.0	0.25	
2M	0.031	250.0	0.12	

ELECTRICAL SPECIFICATIONS

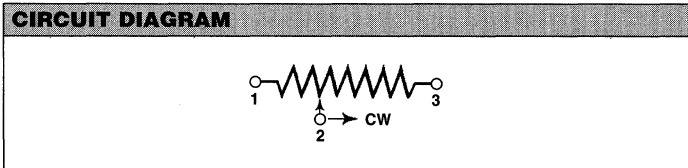
- Electrical Travel:** 260° ± 15°.
- Resistance Range:** 10 ohm to 2 Megohm.
- Standard Series:** 1-2-5.
- Resistance Tolerance:** ± 10% standard. ± 5% available.
- Temperature Coefficient:** ± 100PPM/°C (- 55°C to + 125°C) for Rn ≥ 100 ohm.
- Power Rating:** 0.5 watt at + 85°C.
- Limiting Element Voltage:** 250 V.
- Contact Resistance Variation:** 1% or 2 ohm (whichever is greater).
- End Resistance Variation:** 1 ohm typical.
- Dielectric Strength:** 1000 V RMS.
- Insulation Resistance:** 10⁶ Megohm (500 VDC).

MECHANICAL SPECIFICATIONS

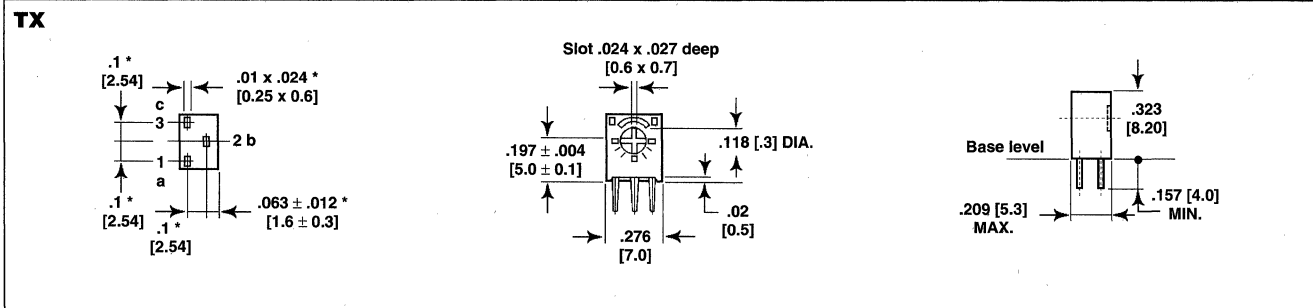
- Mechanical Travel:** 300° ± 15°.
- Operating Torque:** 3 ounce inch maximum.
- End Stop Torque:** 5.7 ounce inch maximum.
- Weight:** 0.02 ounces maximum.
- Resistive Element:** Cermet.

ENVIRONMENTAL SPECIFICATIONS

- Temperature Limits:** - 55°C to + 125°C.
- Climatic Category:** 55/100/56.
- Sealing:** Fully sealed container.



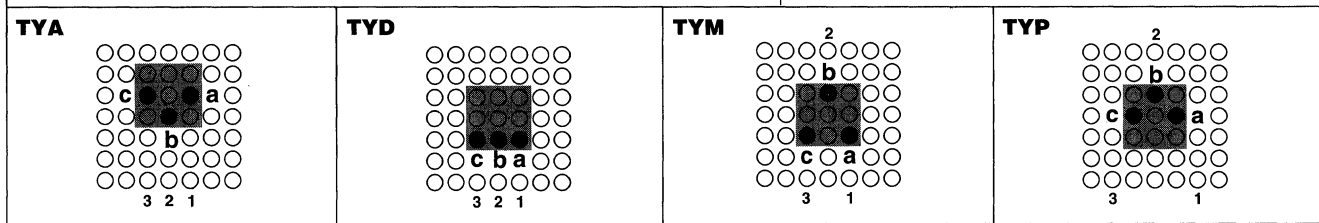
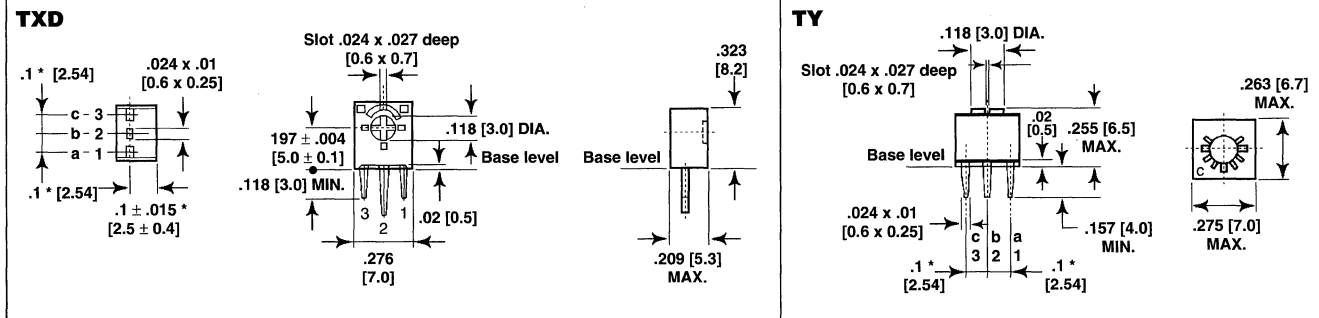
DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



* To be measured at base level.

MODELS TX, TXD, TY (A, D, M, P)

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



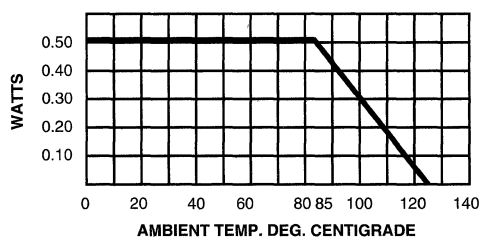
* To be measured at base level.

ENVIRONMENTAL PERFORMANCE

TEST	CONDITIONS	TYPICAL VALUES AND DRIFTS	
		$\frac{\Delta RT}{RT}$ %	$\frac{\Delta R1-2}{R1-2}$ %
Thermal Shock	5 cycles, - 55°C to + 125°C	1%	$\Delta V1-2$ 2% V1-3
Moisture Resistance (106)	10 cycles of 24 hours constituted with damp heat-cold-vibrations	1%	2% Dielectric strength 1000 V RMS Insulation resistance 10 ⁴ M
Long Term Damp Heat	Temperature = 40°C, RH = 90 - 95%, 10% rated power/56 days	1%	2% Dielectric strength 1000 V RMS Insulation resistance 10 ⁴ M
Shock	3 successive shocks, in 3 directions, 100g, 6 ms	1%	$\Delta V1-2$ 1% V1-3
Vibration	20g, 12 hours, 10 - 55 Hz	1%	$\Delta V1-2$ 1% V1-3
Rotational Life (electrical and mechanical)	100 cycles at rated power	2%	Operation torque 1.4 oz. inch Dielectric strength 1000 V RMS Insulation resistance > 10 ⁶ M
Load Life	1000 hours at rated power, 90°/30° ambient temperature + 85°C	1%	2% Contact resistance variation < 1% RN

* Numbers in parenthesis refer to test method of MIL-STD-202 as modified by the detail specification.

DERATING



PART MARKING

- Model
- Value
- Date code
- Marking of terminal:
3 with the letter C
- Trademark

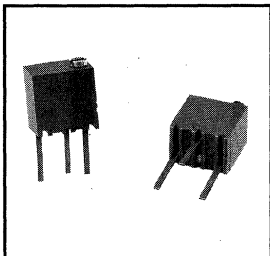
HOW TO ORDER

TX TY MODEL	Blank or D A, D, M or P STYLE	500k VALUE	± 10% TOLERANCE
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NOTE: On delivery, the wiper is positioned at mid-travel.

MODEL T63 Cermet Trimmers

Small Size, 1/4" [6.35], Industrial Grade
Multiturn, Fully Sealed Container



FEATURES

- 0.25 watts at 85°C
- Fully sealed
- Space saving
- Multi-contact wiper in precious metal
- Excellent stability
- Excellent setting accuracy
- Wide range of ohmic values

APPLICATIONS

Due to their square shape and small size (6.6 x 6.8 x 4.7mm), the T63 multiturn trimmers are ideally suited for PCB use, enabling high density board mounting with reduced space requirement between cards. Four styles are available differing by the top or side position of the adjustment screw and by the spacing of the terminals. The use of cermet for the resistive track ensures excellent stability of the nominal specifications throughout life.

STANDARD RESISTANCE ELEMENT DATA

STANDARD RESISTANCE VALUES (Ohms)	LINEAR LAW			T. C. - 55°C + 125°C PPM/°C
	MAXIMUM POWER AT 85°C (Watts)	MAXIMUM WORKING VOLTAGE (Volts)	MAX. CURRENT THROUGH WIPER (mA)	
10	0.25	1.58	158.0	0 + 200
20	0.25	2.23	112.0	
50	0.25	3.53	70.7	
100	0.25	5.0	50.0	
200	0.25	7.07	35.0	
500	0.25	11.2	22.0	
1k	0.25	15.8	15.8	
2k	0.25	22.3	11.2	
5k	0.25	35.3	7.1	
10k	0.25	50.0	5.0	
20k	0.25	70.7	3.5	
50k	0.25	112.0	2.2	
100k	0.25	158.0	1.6	
200k	0.25	224.0	1.1	
500k	0.13	250.0	0.50	
1M	0.06	250.0	0.25	
2M	0.031	250.0	0.13	

ELECTRICAL SPECIFICATIONS

- Electrical Travel:** 13 turns ± 2.
- Resistance Range:** 10 ohm to 2 Megohm.
- Standard Series:** 1-2-5.
- Resistance Tolerance:** ± 10% standard.
- Temperature Coefficient:** ± 100PPM/°C (- 55°C to + 155°C) for Rn ≥ 100 ohm.
- Power Rating:** 0.25 watt at + 85°C.
- Limiting Element Voltage:** 250 V.
- Contact Resistance Variation:** 2% Rn or 2 ohm (whichever is greater).
- End Resistance :** 1 ohm typical.
- Dielectric Strength:** 1000 V RMS.
- Insulation Resistance:** 10⁶ Megohm (500 VDC).

MECHANICAL SPECIFICATIONS

- Mechanical Travel:** 15 turns ± 5.
- Operating Torque:** 2.1 ounce inch maximum.
- End Stop Torque:** Clutch action.
- Weight:** 0.02 ounces.
- Resistive Element:** Cermet.

ENVIRONMENTAL SPECIFICATIONS

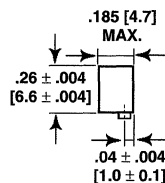
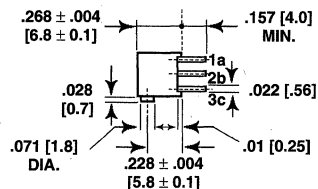
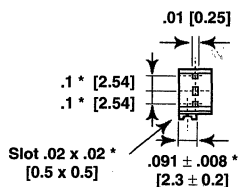
- Temperature Limits:** - 55°C to + 155°C.
- Climatic Category:** 55/125/56.
- Sealing:** Fully sealed container.

CIRCUIT DIAGRAM

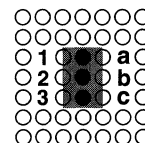


DIMENSIONAL CONFIGURATIONS 1/4 [6.35] Square [Numbers in brackets indicate millimeters]

T63XA



TERMINAL SPACING ON A .100 [2.54] PCB



* To be measured at base level.

MODEL T63

DIMENSIONAL CONFIGURATIONS 1/4 [6.35] Square [Numbers in brackets indicate millimeters]

T63XB

TERMINAL SPACING ON A .100 [2.54] PCB

T63YA

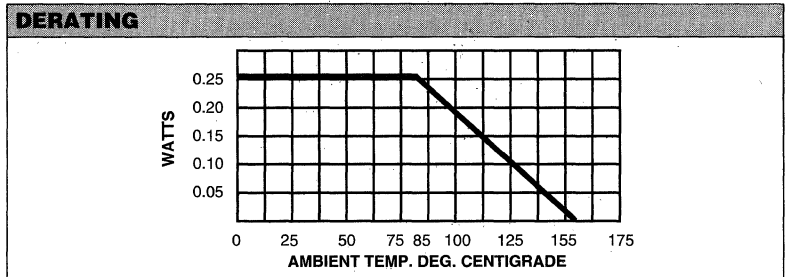
T63YB

* To be measured at base level.

ENVIRONMENTAL PERFORMANCE

TEST*	CONDITIONS	TYPICAL VALUES AND DRIFTS	
		$\frac{\Delta RT}{RT}$ %	$\frac{\Delta R1-2}{R1-2}$ %
Thermal Shock	5 cycles, - 55°C to + 125°C	0.5%	$\Delta V1-2$ 1% V1-3
Moisture Resistance (106)	10 cycles of 24 hours constituted with damp heat-cold-vibrations	1% Dielectric strength Insulation resistance	2% 1000 V RMS 10 ⁶ M
Long Term Damp Heat	Temperature = 40°C, RH = 90 - 95%, 10% rated power/56 days	1% Dielectric strength Insulation resistance	2% 1000 V RMS 10 ⁶ M
Shock	3 successive shocks, in 3 directions, 100g, 6 ms	1%	$\Delta V1-2$ 1% V1-3
Vibration	20g, 12 hours, 10 - 55 Hz	1%	$\Delta V1-2$ 1% V1-3
Rotational Life (electrical and mechanical)	100 cycles at rated power	1% Operation torque Dielectric strength Insulation resistance	1.4 oz. inch 1000 V RMS > 10 ⁶ M
Load Life	1000 hours at rated power, 90°/30° ambient temperature + 85°C	1% Contact resistance variation	2% < 1% RN

* Numbers in parenthesis refer to test method of MIL-STD-202 as modified by the detail specification.



PART MARKING

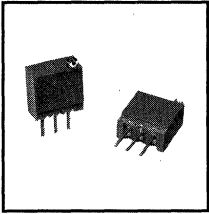
- Model
- Style
- Value
- Tolerance
- Date code
- Marking of terminal: 3
- Trademark

HOW TO ORDER

T63 MODEL	XA, XB, YA, YB STYLE	100k VALUE	± 10% TOLERANCE	NOTE: On delivery, the wiper is positioned at mid-travel.
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MODEL T93 Cermet Trimmers

Small Size, 3/8" [9.53] Square,
Industrial Grade, Multiturn



FEATURES

- 0.5 watts at 85°C
- Fully sealed container
- Contact resistance variation < 1% typical
- Multi-finger wiper contact in precious metal
- Tape and reel for pin style "A"

APPLICATIONS

The T93 is a small size trimmer - 3/8" x 3/8" x 3/16" [9.53 x 9.53 x 4.78] for PC board mounting requirements. Five styles are available which differ by the position of the control screw in relation to the PC board plane and by the spacing of the terminals. Excellent operational stability is provided by the use of a cermet element. The T93 model is ideally suited for all industrial applications.

STANDARD RESISTANCE ELEMENT DATA

STANDARD RESISTANCE VALUES (Ohms)	LINEAR LAW			T. C. -55°C + 125°C PPM/°C
	MAXIMUM POWER AT 85°C (Watts)	MAXIMUM WORKING VOLTAGE (Volts)	MAX. CURRENT THROUGH WIPER (mA)	
10	0.50	2.2	224.0	0 + 200
20	0.50	3.2	158.0	
50	0.50	5.0	100.0	
100	0.50	7.0	70.0	
200	0.50	10.0	50.0	
500	0.50	15.8	32.0	
1k	0.50	22.4	22.0	
2k	0.50	31.6	16.0	
5k	0.50	50.0	10.0	
10k	0.50	70.7	7.0	
20k	0.50	100.0	5.0	± 100
50k	0.50	158.0	3.2	
100k	0.50	224.0	2.2	
200k	0.31	250.0	1.25	
500k	0.12	250.0	0.50	
1M	0.06	250.0	0.25	
2M	0.031	250.0	0.12	

ELECTRICAL SPECIFICATIONS

- Electrical Travel:** 19 turns ± 2.
- Resistance Range:** 10 ohm to 2 Megohm.
- Standard Series:** 1-2-5.
- Resistance Tolerance:** ± 10% standard. ± 5% available.
- Temperature Coefficient:** ± 100PPM/°C (-55°C to +155°C) for Rn ≥ 100 ohm.
- Power Rating:** 0.5 watt at +85°C.
- Limiting Element Voltage:** 250 V.
- Contact Resistance Variation:** 2% Rn or 2 ohm (whichever is greater).
- End Resistance :** 1 ohm typical.
- Dielectric Strength:** 1000 V RMS.
- Insulation Resistance:** 10⁶ Megohm (500 VDC).

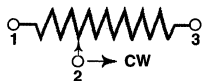
MECHANICAL SPECIFICATIONS

- Mechanical Travel:** 22 turns ± 5.
- Operating Torque:** 2.1 ounce inch maximum.
- End Stop Torque:** Clutch action.
- Weight:** 0.04 ounces.
- Resistive Element:** Cermet.

ENVIRONMENTAL SPECIFICATIONS

- Temperature Limits:** -55°C to +155°C.
- Climatic Category:** 55/125/56.
- Sealing:** Fully sealed container.

CIRCUIT DIAGRAM



DIMENSIONAL CONFIGURATIONS 3/8" [9.53] Square [Numbers in brackets indicate millimeters]

Model	Terminal Spacing Diagram	Terminal Spacing
T93XA		<p>TERMINAL SPACING ON A .100 [2.54] PCB</p>
T93XB		

* To be measured at base level.

MODEL T93

DIMENSIONAL CONFIGURATIONS 3/8" [9.53] Square [Numbers in brackets indicate millimeters]

T93YA

T93YB

T93Z

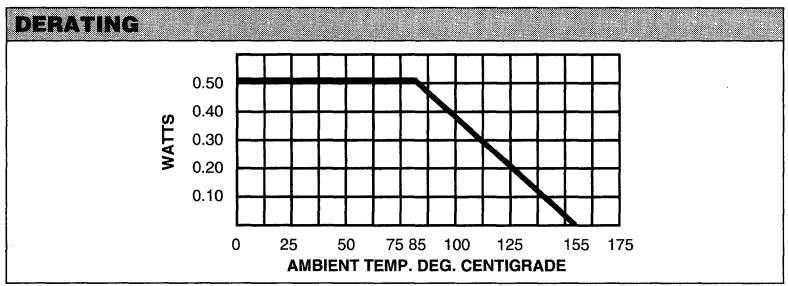
TERMINAL SPACING ON A .100 [2.54] PCB

* To be measured at base level.

ENVIRONMENTAL PERFORMANCE

TEST*	CONDITIONS	TYPICAL VALUES AND DRIFTS	
		$\frac{\Delta RT}{RT}$ %	$\frac{\Delta R1-2}{R1-2}$ %
Thermal Shock	5 cycles, - 55°C to + 125°C	0.5%	$\Delta V1-2$ 1% V1-3
Moisture Resistance (106)	10 cycles of 24 hours constituted with damp heat-cold-vibrations	1% Dielectric strength Insulation resistance	2% 1000 V RMS 10 ⁴ M
Long Term Damp Heat	Temperature = 40°C, RH = 90 - 95%, 10% rated power/56 days	1% Dielectric strength Insulation resistance	2% 1000 V RMS 10 ⁴ M
Shock	3 successive shocks, in 3 directions, 100g, 6 ms	1%	$\Delta V1-2$ 1% V1-3
Vibration	20g, 12 hours, 10 - 55 Hz	1%	$\Delta V1-2$ 1% V1-3
Rotational Life (electrical and mechanical)	100 cycles at rated power	1% Operation torque Dielectric strength Insulation resistance	1.4 oz. inch 1000 V RMS > 10 ⁴ M
Load Life	1000 hours at rated power, 90°/30° ambient temperature + 85°C	1% Contact resistance variation	2% < 1% RN

* Numbers in parenthesis refer to test method of MIL-STD-202 as modified by the detail specification.



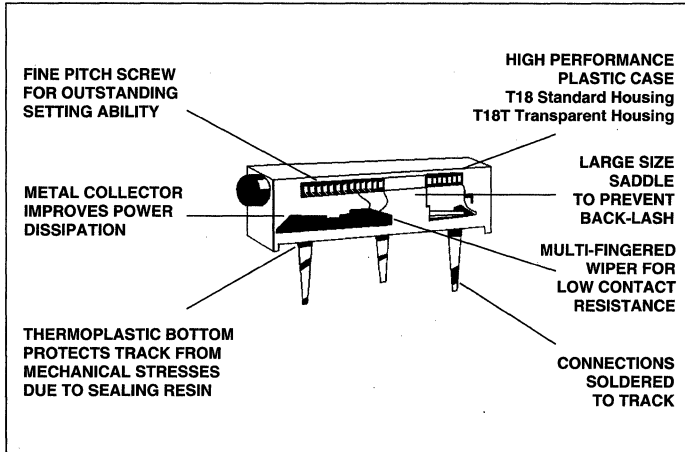
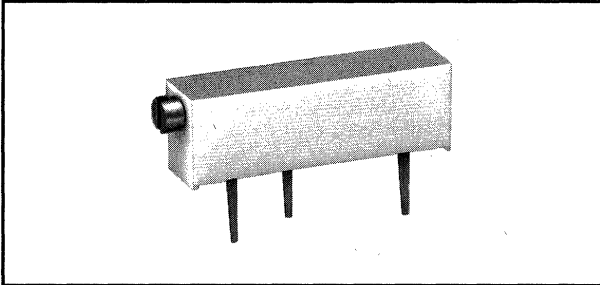
- PART MARKING**
- Model
 - Style
 - Value
 - Tolerance
 - Date code
 - Marking of terminal:
3 with the letter C
 - Trademark

HOW TO ORDER

T93 MODEL	XA, XB, YA, YB, Z STYLE	100k VALUE	± 10% TOLERANCE	NOTE: On delivery, the wiper is positioned at mid-travel.
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MODELS T18 and T18T Cermet Trimmers

3/4" [19.0] Rectangular, Industrial Grade, Multiturn



FEATURES

- 3/4" [19.05] rectangular
- 0.75 watts at 70°C
- T18 normal housing
- T18T transparent housing

ELECTRICAL SPECIFICATIONS

Electrical Travel: 15 turns \pm 1.

Resistance Range: 10 ohm to 2 Megohm.

Standard Series: 1-2-5.

Resistance Tolerance: \pm 10% standard.

Temperature Coefficient:

T18: (- 55°C to + 125°C) \pm 100PPM/°C
for $R_n \geq 100$ ohm.

T18T: (- 55°C to + 105°C) \pm 100PPM/°C
for $R_n \geq 100$ ohm.

Power Rating: 0.75 watt at + 70°C.

Limiting Element Voltage: 250 volts.

Contact Resistance Variation: 2% or 2 ohm,
whichever is greater.

End Resistance Variation: 1 ohm typical.

Dielectric Strength: 1000 V RMS.

Insulation Resistance: 10⁶ Megohm, 500 VDC.

MECHANICAL SPECIFICATIONS

Mechanical Travel: 18 turns \pm 3.

Operating Torque: 2.8 ounces inch maximum.

End Stop Torque: Clutch action.

Weight: .04 ounces maximum.

Resistive Element: Cermet.

STANDARD RESISTANCE ELEMENT DATA

STANDARD RESISTANCE VALUES (Ohms)	LINEAR LAW			T. C. - 55°C + 125°C PPM/°C
	MAXIMUM POWER AT 70°C (Watts)	MAXIMUM WORKING VOLTAGE (Volts)	MAX. CURRENT THROUGH WIPER (mA)	
10	0.75	2.7	270.0	0 + 200
20	0.75	3.9	195.0	
50	0.75	6.1	122.0	
100	0.75	8.7	87.0	± 100
200	0.75	12.2	61.0	
500	0.75	19.4	39.0	
1k	0.75	27.4	27.0	
2k	0.75	38.7	19.0	
5k	0.75	61.2	12.0	
10k	0.75	86.6	9.0	
20k	0.75	122.0	6.0	
50k	0.75	194.0	4.0	
100k	0.625	250.0	2.5	
200k	0.31	250.0	1.25	
500k	0.12	250.0	0.50	
1M	0.06	250.0	0.25	
2M	0.031	250.0	0.12	

ENVIRONMENTAL SPECIFICATIONS

Temperature Limits: T18: - 55°C to + 125°C.

T18T: - 55°C to + 105°C.

Climatic Category: 55/100/56.

Sealing: T18: Fully sealed container. T18T: Enables cleaning.

MODELS T18 and T18T

DIMENSIONAL CONFIGURATIONS 3/4" [19.0] Rectangular [Numbers in brackets indicate millimeters]

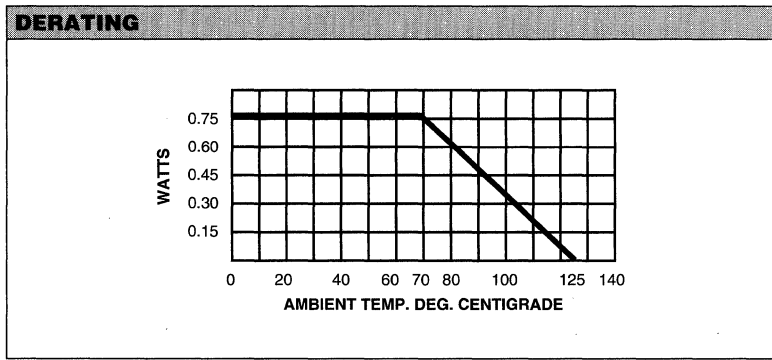
Circuit Diagram

Shaft

* To be measured at base level.

ENVIRONMENTAL PERFORMANCE		TYPICAL VALUES AND DRIFTS	
TEST *	CONDITIONS	$\frac{\Delta RT}{RT}$ %	$\frac{\Delta R1-2}{R1-2}$ %
Thermal Shock	5 cycles, - 55°C to + 125°C	0.5%	$\Delta V1-2$ 1% V1-3
Moisture Resistance (106)	10 cycles of 24 hours constituted with damp heat-cold-vibrations	1% Dielectric strength Insulation resistance	2% 1000 V RMS 10 ⁴ M
Long Term Damp Heat	Temperature = 40°C, RH = 90 - 95%, 10% rated power/56 days	1% Dielectric strength Insulation resistance	2% 1000 V RMS 10 ⁴ M
Shock	3 successive shocks, in 3 directions, 100g, 6 ms	1%	$\Delta V1-2$ 1% V1-3
Vibration	20g, 12 hours, 10 - 55 Hz	1%	$\Delta V1-2$ 1% V1-3
Rotational Life (electrical and mechanical)	100 cycles at rated power	1% Operation torque Dielectric strength Insulation resistance	1.4 oz. inch 1000 V RMS >10 ⁴ M
Load Life	1000 hours at rated power, 90"/30" ambient temperature + 85°C	1% Contact resistance variation	2% < 1% RN

* Numbers in parenthesis refer to test method of MIL-STD-202 as modified by the detail specification.



- PART MARKING**
- Model
 - Value
 - Tolerance
 - Date code
 - Marking of terminal: 3
 - Trademark

HOW TO ORDER

T18
MODEL

T18 = Standard
T18T = Transparent

100k
VALUE

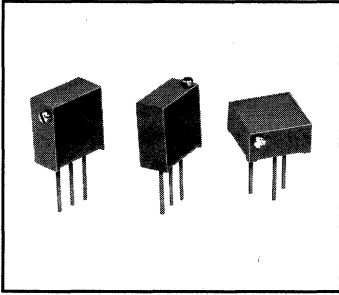
± 10%
TOLERANCE

NOTE: On delivery, the wiper is positioned at mid-travel.

MODELS RJ24 and RJR24 Cermet Trimmers

Military, MIL-R-22097 Qualified, Type RJ

Established Reliability, MIL-R-39035 Qualified, Type RJR



FEATURES

- 0.5 watt at 85°C
- Infinite resolution
- Over 20 turns
- Board washable
- Withstands thermal stress environments
- Easy adjustability
- Established reliability per MIL-R-39035
- Solderable leads, Hot Solder Dipped
- The RJ/RJR24 trimmers are continually tested to the most demanding requirements of MIL-R-22097 and MIL-R-39035. Units are qualified from 10 ohm to 1 Megohm to Characteristic H ($\pm 50\text{PPM}/^\circ\text{C}$) of MIL-R-39035. Additional testing can be performed by our in-house DESC-approved testing facilities.

STANDARD RESISTANCE VALUES

3/8" [9.52] MODELS RJ24 and RJR24

RESISTANCE (Ohms)	MAXIMUM WORKING VOLTAGE (Volts)
10	2.23
20	3.10
50	5.00
100	7.00
200	10.00
500	15.80
1k	22.30
2k	31.60
5k	50.00
10k	70.70
20k	100.00
25k	111.00
50k	158.00
100k	223.00
250k	300.00
500k	300.00
1M	300.00

ELECTRICAL SPECIFICATIONS

Electrical Travel: 25 ± 2 turns.

Resistance Range: 10 ohm to 1 Megohm.

Resistance Tolerance: $\pm 10\%$ standard.

Temperature Coefficient: $(-55^\circ\text{C to } +150^\circ\text{C}) \pm 100\text{PPM}/^\circ\text{C}$.
 $\pm 50\text{PPM}/^\circ\text{C}$ available.

Power Rating: 0.5 watt at 85°C derated to 0 watt at 150°C.

Maximum Contact Resistance Variation (CRV): 3% of R or 3 ohm, whichever is greater, typical 0.5%.

End Resistance: 2% of R or 2 ohm, whichever is greater, typical 0.2 ohm.

Dielectric Strength: 1000 VAC at ambient temperature.

Insulation Resistance: $> 100,000$ Megohm (500 VDC).

MECHANICAL SPECIFICATIONS

Operating Torque: 5 ounce inch maximum.

Rotation: Clutch stop, wiper idles.

Weight: 1.3 grams maximum.

Resistive Element: Thick film.

Rotational Life: 200 cycles minimum.

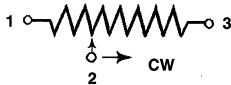
Terminal Strength: 2 pounds for 10 seconds.

ENVIRONMENTAL SPECIFICATIONS

Temperature Limits: $-65^\circ\text{C to } +150^\circ\text{C}$.

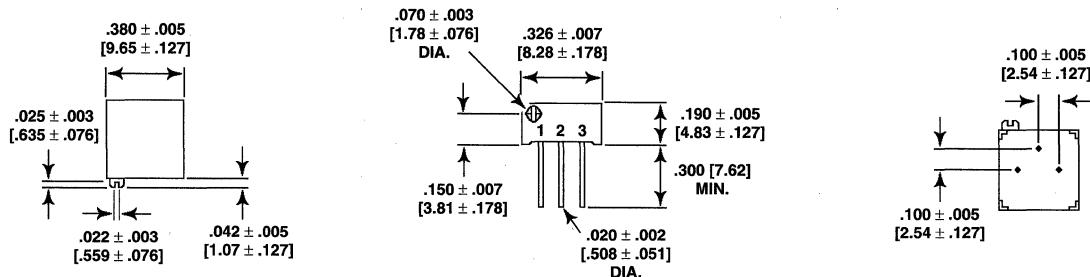
Sealing: Fully sealed case (non-hermetic).

CIRCUIT DIAGRAM



DIMENSIONAL CONFIGURATIONS 3/8" [9.52] Square [Numbers in brackets indicate millimeters]

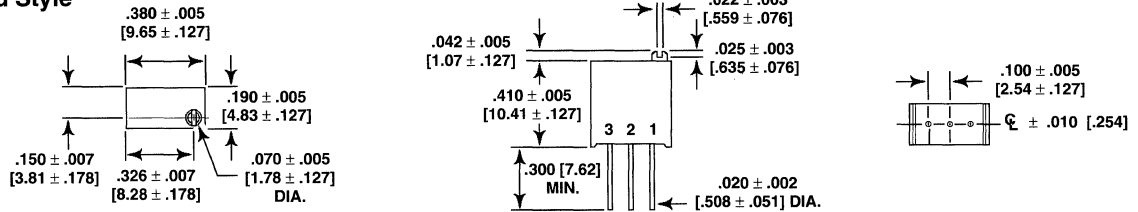
P Lead Style



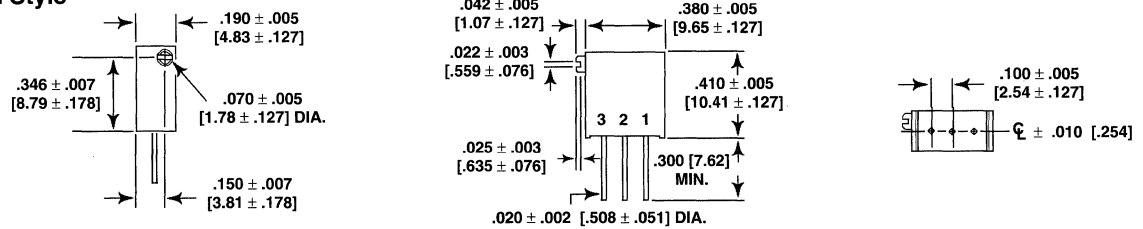
MODELS RJ24 and RJR24

DIMENSIONAL CONFIGURATIONS 3/8" [9.52] Square [Numbers in brackets indicate millimeters]

W Lead Style



X Lead Style

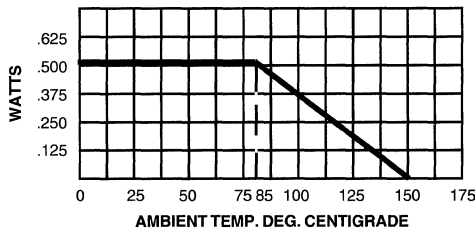


ENVIRONMENTAL PERFORMANCE

TEST ¹	CONDITIONS	MIL-R-39035 REQUIREMENT	TYPICAL CHANGE
Power Conditioning	(108) 50 hours at 0.75 watt at 25°C, 90°/30° cycle	$\Delta R \leq 1.0\%$	$\Delta R < 0.26\%$
Thermal Shock	(107) 5 cycles, - 65°C to + 150°C	$\Delta R \leq 1.0\%$	$\Delta R < 0.09\%$
Low Temperature Storage	24 hours, no load at - 65°C	$\Delta R \leq 1.0\%$	$\Delta R < 0.12\%$
Low Temperature Operation	1 hour storage, 45 minutes rated power at - 55°C	$\Delta R \leq 1.0\%$	$\Delta R < 0.03\%$
High Temperature Exposure	1000 hours, no load at 150°C	$\Delta R \leq 3.0\%$	$\Delta R < 0.85\%$
Moisture Resistance	(106) 480 hours at rated power with humidity ranging from 80% RH to 98% RH	$\Delta R \leq 1.0\%$	$\Delta R < 0.21\%$
Resistance to Soldering Heat	(210) 350°C for 3 seconds	$\Delta R \leq 1.0\%$	$\Delta R < 0.02\%$
Shock	(213) 18 shocks, 100g, 6 ms, sawtooth, 3 axes	$\Delta R \leq 1.0\%$	$\Delta R < 0.02\%$
Vibration	(204) 10 to 2000 Hz, 20g, 12 hours, 3 axes	$\Delta R \leq 1.0\%$	$\Delta R < 0.10\%$
Rotational Life	200 cycles	$\Delta R \leq 2.0\%$	$\Delta R < 0.27\%$
Load Life	(108) 10,000 hours at rated power at 85°C, 90°/30° cycle	$\Delta R \leq 3.0\%$	$\Delta R < 0.96\%$

1. Numbers in parenthesis refer to test method of MIL-STD-202 as modified by the detail specification.

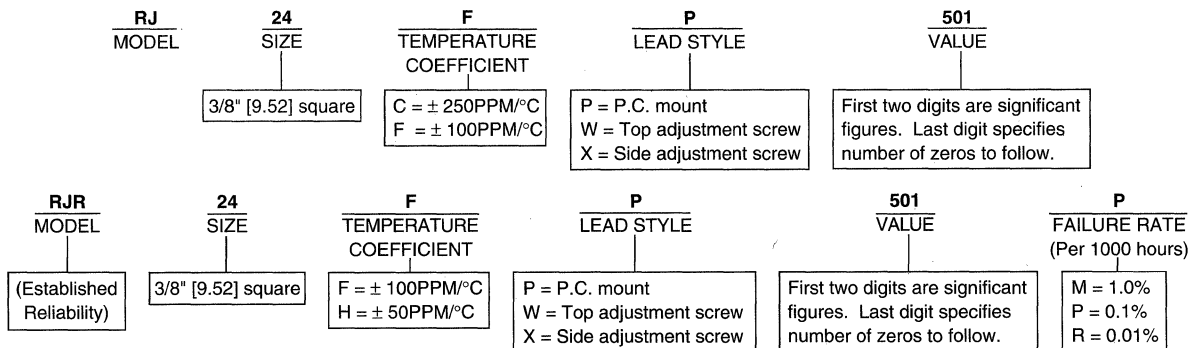
DERATING



PART MARKING

- Manufacturer's name or code
- Wiring diagram
- Date code
- Resistance
- MIL-Spec part number (when applicable)

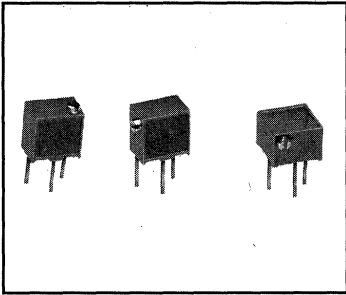
HOW TO ORDER



MODELS RJ26 and RJR26 Cermet Trimmers

Military, MIL-R-22097 Qualified, Type RJ

Established Reliability, MIL-R-39035 Qualified, Type RJR



FEATURES

- 0.25 watt at 85°C
- Infinite resolution
- Over 20 turns
- Board washable
- Withstands thermal stress environments
- Easy adjustability
- Established reliability per MIL-R-39035
- Solderable leads, Hot Solder Dipped
- The RJ/RJR26 trimmers are continually tested to the most demanding requirements of MIL-R-22097 and MIL-R-39035. Units are qualified from 10 ohm to 1 Megohm to Characteristic H ($\pm 50\text{PPM}/^\circ\text{C}$) of MIL-R-39035. Additional testing can be performed by our in-house DESC-approved testing facilities.

STANDARD RESISTANCE VALUES

1/4" [6.35] MODELS RJ26 and RJR26

RESISTANCE (Ohms)	MAXIMUM WORKING VOLTAGE (Volts)
10	1.58
20	2.23
50	3.54
100	5.00
200	7.07
500	11.10
1k	15.80
2k	22.30
5k	35.40
10k	50.00
20k	70.07
25k	79.00
50k	111.00
100k	158.00
250k	200.00
500k	200.00
1M	200.00

ELECTRICAL SPECIFICATIONS

Electrical Travel: 22 ± 2 turns.

Resistance Range: 10 ohm to 1 Megohm.

Resistance Tolerance: $\pm 10\%$ standard.

Temperature Coefficient: $(-55^\circ\text{C}$ to $+150^\circ\text{C}) \pm 100\text{PPM}/^\circ\text{C}$. $\pm 50\text{PPM}/^\circ\text{C}$ available.

Power Rating: 0.25 watt at 85°C derated to 0 watt at 150°C .

Maximum Contact Resistance Variation (CRV): 3% of R or 3 ohm, whichever is greater, typical 0.5%.

End Resistance: 2% of R or 2 ohm, whichever is greater, typical 0.2 ohm.

Dielectric Strength: 1000 VAC at ambient temperature.

Insulation Resistance: $> 100,000$ Megohm (500 VDC).

MECHANICAL SPECIFICATIONS

Operating Torque: 3 ounce inch maximum.

Rotation: Clutch stop, wiper idles.

Weight: 0.6 grams maximum.

Resistive Element: Thick film.

Rotational Life: 200 cycles minimum.

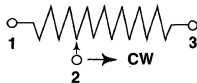
Terminal Strength: 2 pounds for 10 seconds.

ENVIRONMENTAL SPECIFICATIONS

Temperature Limits: -65°C to $+150^\circ\text{C}$.

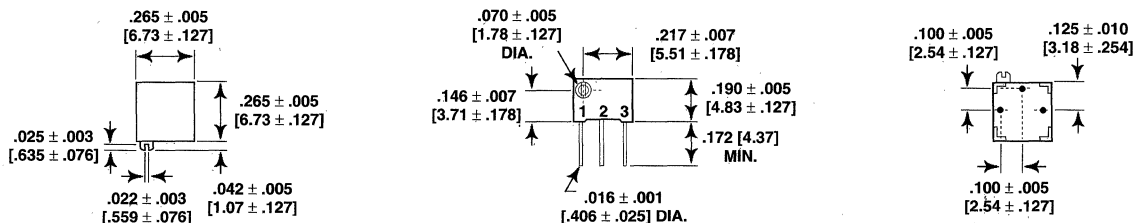
Sealing: Fully sealed case (non-hermetic).

CIRCUIT DIAGRAM



DIMENSIONAL CONFIGURATIONS 1/4" [6.35] Square [Numbers in brackets indicate millimeters]

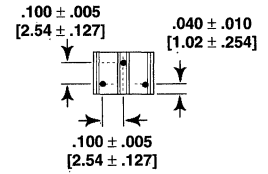
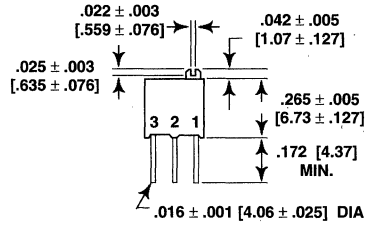
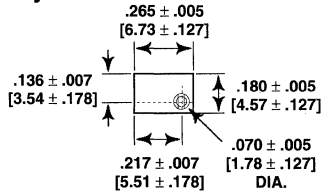
P Lead Style



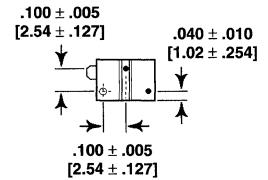
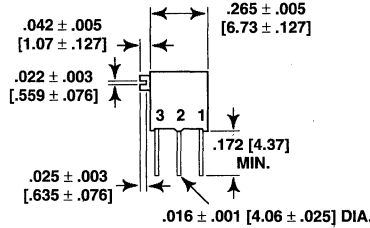
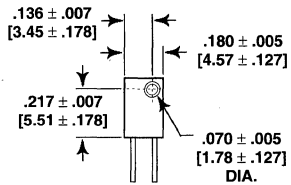
MODELS RJ26 and RJR26

DIMENSIONAL CONFIGURATIONS 1/4 [6.35] Square [Numbers in brackets indicate millimeters]

W Lead Style



X Lead Style

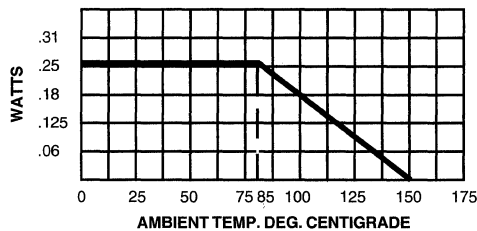


ENVIRONMENTAL PERFORMANCE

TEST ¹	CONDITIONS	MIL-R-39035 REQUIREMENT	TYPICAL CHANGE
Power Conditioning	(108) 50 hours at 0.375 watt at 25°C, 90°/30" cycle	ΔR ≤ 1.0%	ΔR < 0.15%
Thermal Shock	(107) 5 cycles, - 65°C to + 150°C	ΔR ≤ 1.0%	ΔR < 0.09%
Low Temperature Storage	24 hours, no load at - 65°C	ΔR ≤ 1.0%	ΔR < 0.10%
Low Temperature Operation	1 hour storage, 45 minutes rated power at - 55°C	ΔR ≤ 1.0%	ΔR < 0.02%
High Temperature Exposure	1000 hours, no load at 150°C	ΔR ≤ 3.0%	ΔR < 0.80%
Moisture Resistance	(106) 480 hours at rated power with humidity ranging from 80% RH to 98% RH	ΔR ≤ 1.0%	ΔR < 0.08%
Resistance to Soldering Heat	(210) 350°C for 3 seconds	ΔR ≤ 1.0%	ΔR < 0.02%
Shock	(213) 18 shocks, 100g, 6 ms, sawtooth, 3 axes	ΔR ≤ 1.0%	ΔR < 0.03%
Vibration	(204) 10 to 2000 Hz, 20g, 12 hours, 3 axes	ΔR ≤ 1.0%	ΔR < 0.06%
Rotational Life	200 cycles	ΔR ≤ 2.0%	ΔR < 0.20%
Load Life	(108) 10,000 hours at rated power at 85°C, 90°/30" cycle	ΔR ≤ 3.0%	ΔR < 0.50%

1. Numbers in parenthesis refer to test method of MIL-STD-202 as modified by the detail specification.

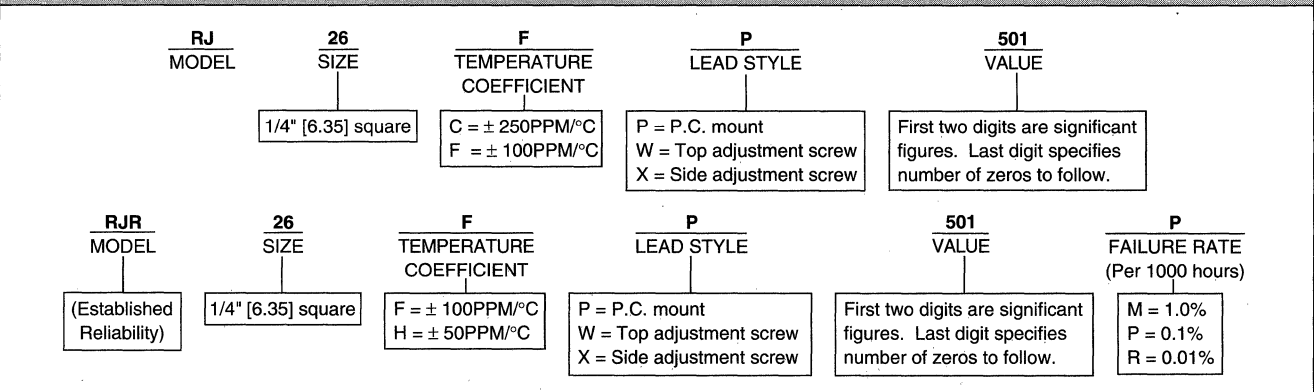
DERATING



PART MARKING

- Manufacturer's name or code
- Wiring diagram
- Date code
- Resistance
- MIL-Spec part number (when applicable)

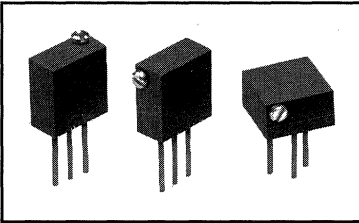
HOW TO ORDER



MODELS RT24 and RTR24 Wirewound Trimmers

Military, MIL-R-27208 Qualified, Type RT

Established Reliability, MIL-R-39015 Qualified, Type RTR



FEATURES

- Precious metal wiper
- 1.0 watt to 85°C
- TCR $\pm 50\text{PPM}/^\circ\text{C}$
- Solderable leads
- Military quality at affordable prices
- Established Reliability to 0.01%/1,000 hours R level per MIL-R-39015 (Type RTR)

APPLICATIONS

Wirewound trimmers are particularly useful in those applications where any combination of high power, low temperature coefficient of resistance and/or excellent long term life stability are important design considerations.

STANDARD RESISTANCE VALUES

3/8" [9.52] MODELS RT24 and RTR24	
RESISTANCE* (Ohms)	NOMINAL RESOLUTION (%)
10	1.10
20	.85
50	.65
100	.51
200	.40
500	.45
1k	.34
2k	.27
5k	.20
10k	.16
20k	.13
25k	.12
35k	.11
50k	.10

* Other resistances available upon request.
Bold type indicates MIL approved range.

ELECTRICAL SPECIFICATIONS

Electrical Travel: 22 ± 4 turns.

Resistance Range¹: 10 ohm to 10 kilohm.

Resistance Tolerance: $\pm 5\%$ standard. Closer tolerances available.

Temperature Coefficient: $(-65^\circ\text{C to } +150^\circ\text{C}) \pm 50\text{PPM}/^\circ\text{C}$.

Power Rating²: 1.0 watt at 85°C derated to 0 watt at 150°C.

End Resistance: 1 ohm or 2%, whichever is greater.

Equivalent Noise Resistance (ENR): 100 ohm maximum.

Dielectric (DWV)²: 1000 VAC at atmospheric pressure.

Insulation Resistance²: $> 100,000$ Megohm (500 VDC).

- NOTES: 1. Extended range available in non MIL Spec product.
2. These specifications exceed MIL Spec.

MECHANICAL SPECIFICATIONS

Operating Torque: 5 ounce inch maximum.

Rotation: Clutch stop, wiper idles.

Weight: 0.935 grams maximum.

Resistive Element: Nickel chromium.

Rotational Life: 200 cycles minimum.

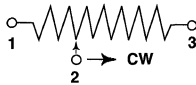
Terminal Strength: 2 pounds for 10 seconds.

ENVIRONMENTAL SPECIFICATIONS

Temperature Limits: $-65^\circ\text{C to } +150^\circ\text{C}$.

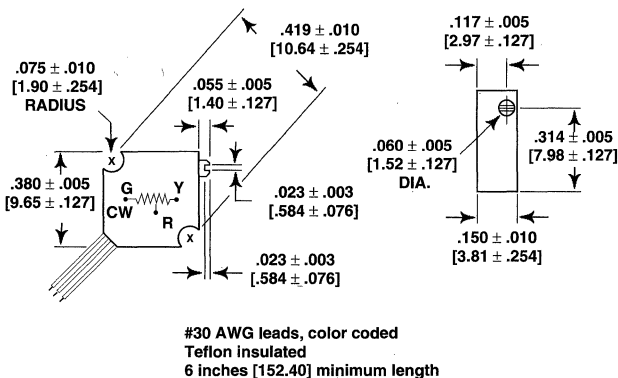
Sealing: Fully sealed case (non-hermetic).

CIRCUIT DIAGRAM

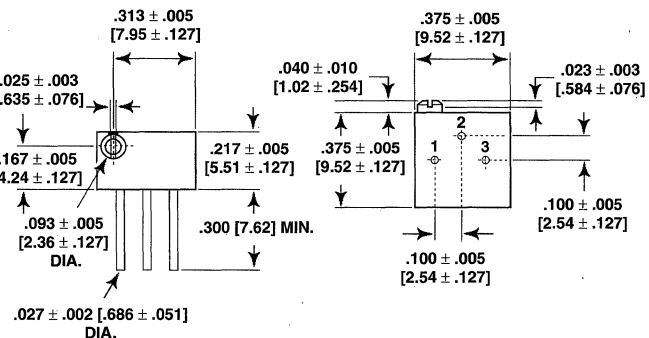


DIMENSIONAL CONFIGURATIONS 3/8" [9.52] Square [Numbers in brackets indicate millimeters]

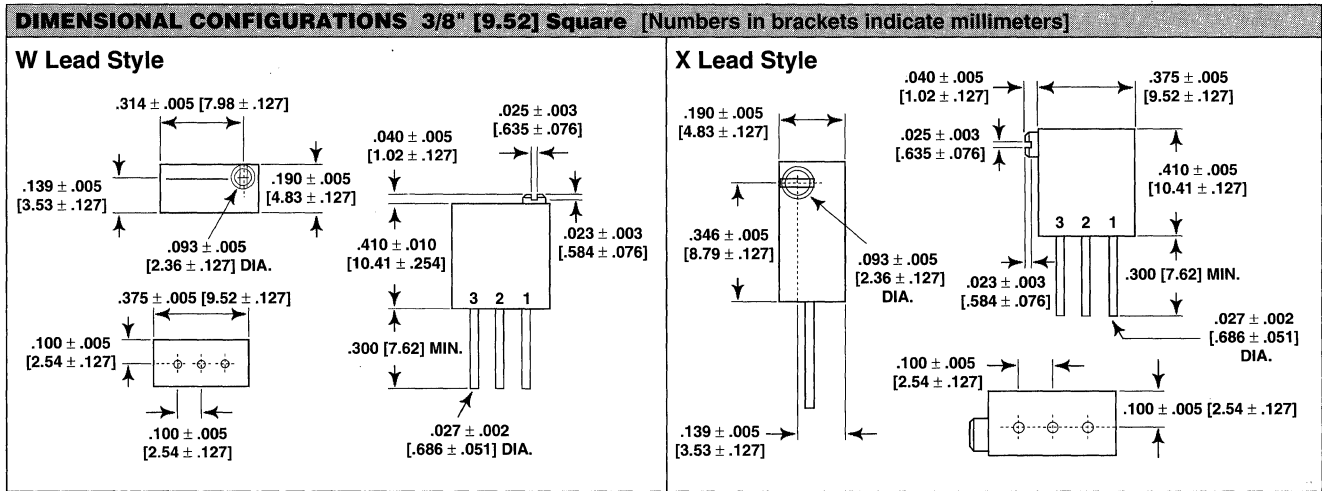
L Lead Style



P Lead Style



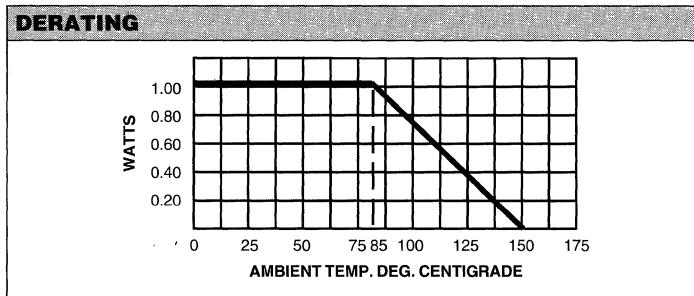
MODELS RT24 and RTR24



ENVIRONMENTAL PERFORMANCE

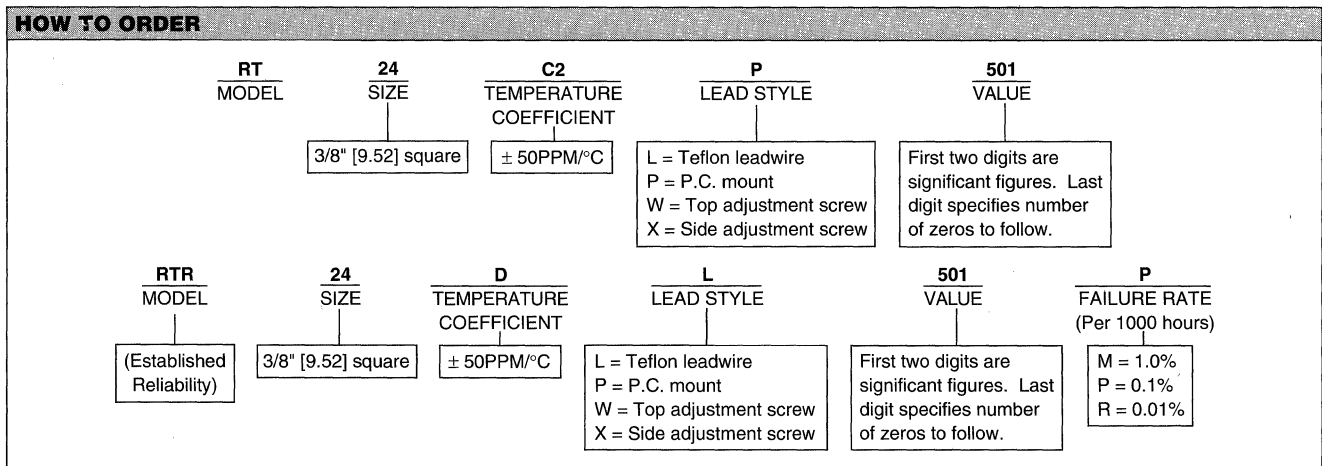
TEST ¹	CONDITIONS	MIL-R-39015 REQUIREMENT	TYPICAL CHANGE
Power Conditioning	(108) 50 hours at 1 watt at 25°C, 90°/30" cycle	$\Delta R \leq 0.5\%^2$	$\Delta R < 0.08\%$
Thermal Shock	(107) 5 cycles, - 55°C to + 125°C	$\Delta R \leq 1.0\%^2$	$\Delta R < 0.07\%$
Low Temperature Storage	72 hours, no load at - 65°C	$\Delta R \leq 1.0\%^2$	$\Delta R < 0.05\%$
Low Temperature Operation	1 hour storage, 45 minutes rated power at - 55°C	$\Delta R \leq 1.0\%^{2,3}$	$\Delta R < 0.08\%$
High Temperature Exposure	1000 hours, no load at 150°C	$\Delta R \leq 1.0\%^{2,3}$	$\Delta R < 0.03\%$
Moisture Resistance	(106) 480 hours at rated power with humidity ranging from 80% RH to 98% RH	$\Delta R \leq 1.0\%^2$	$\Delta R < 0.22\%$
Resistance to Soldering Heat	(210) 350°C for 3 seconds	$\Delta R \leq 1.0\%^2$	$\Delta R < 0.02\%$
Shock	(213) 18 shocks, 100g, 6 ms, sawtooth, 3 axes	$\Delta R \leq 1.0\%^{2,3}$	$\Delta R < 0.27\%$
Vibration	(204) 10 to 2000 Hz, 20g, 12 hours, 3 axes	$\Delta R \leq 1.0\%^{2,3}$	$\Delta R < 0.04\%$
Rotational Life	200 cycles	$\Delta R \leq 2.0\%$	$\Delta R < 0.06\%$
Load Life	(108) 10,000 hours at rated power at 85°C, 90°/30" cycle	$\Delta R \leq 3.0\%$	$\Delta R < 0.23\%$

1. Numbers in parenthesis refer to test method of MIL-STD-202 as modified by the detail specification.
 2. For values below 100 ohm, add 0.05 ohm to the allowable change.
 3. The referenced tests also require that setting stability change shall not exceed ± 0.05 percent plus the specified maximum resolution.



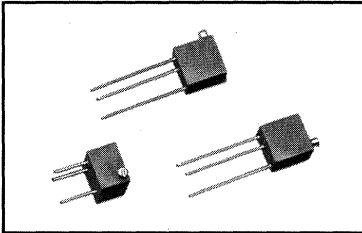
PART MARKING

- Manufacturer's name or code
- Wiring diagram
- Date code
- Resistance
- MIL-Spec part number (when applicable)



MODELS RT26 and RT27 Wirewound Trimmers

Military, MIL-R-27208 Qualified, Type RT



FEATURES

- Precious metal wiper
- 0.25 watt to 85°C
- TCR < 50PPM/°C
- Solderable leads
- Special configurations available
- Military quality at affordable prices

APPLICATIONS

Wirewound trimmers are particularly useful in those applications where any combination of high power, low temperature coefficient of resistance and/or excellent long term life stability are important design considerations.

STANDARD RESISTANCE VALUES	
1/4" [6.35] MODELS RT26 and RT27	
RESISTANCE* (Ohms)	NOMINAL RESOLUTION (%)
10	1.65
20	1.35
50	1.13
100	.82
200	.62
500	.62
1k	.49
2k	.34
5k	.27
10k	.21
20k	.17
25k	.16

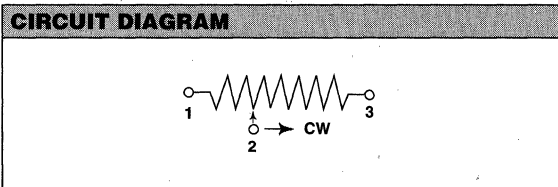
* Other resistances available upon request.
Bold type indicates MIL approved range.

ELECTRICAL SPECIFICATIONS

- Electrical Travel:** 22 ± 4 turns.
 - Resistance Range¹:** 10 ohm to 5 kilohm.
 - Resistance Tolerance:** ± 5% standard.
Closer tolerances available.
 - Temperature Coefficient:** (- 65°C to + 150°C) ± 50PPM/°C.
 - Power Rating²:** 0.5 watt at 85°C derated to 0 watt at 150°C.
 - End Resistance:** 1 ohm or 2%, whichever is greater.
 - Equivalent Noise Resistance (ENR):** 100 ohm maximum.
 - Dielectric (DWV)²:** 1000 VAC at atmospheric pressure.
 - Insulation Resistance²:** > 100,000 Megohm (500 VDC).
- NOTES:** 1. Extended range available in non MIL Spec product.
2. These specifications exceed MIL Spec.

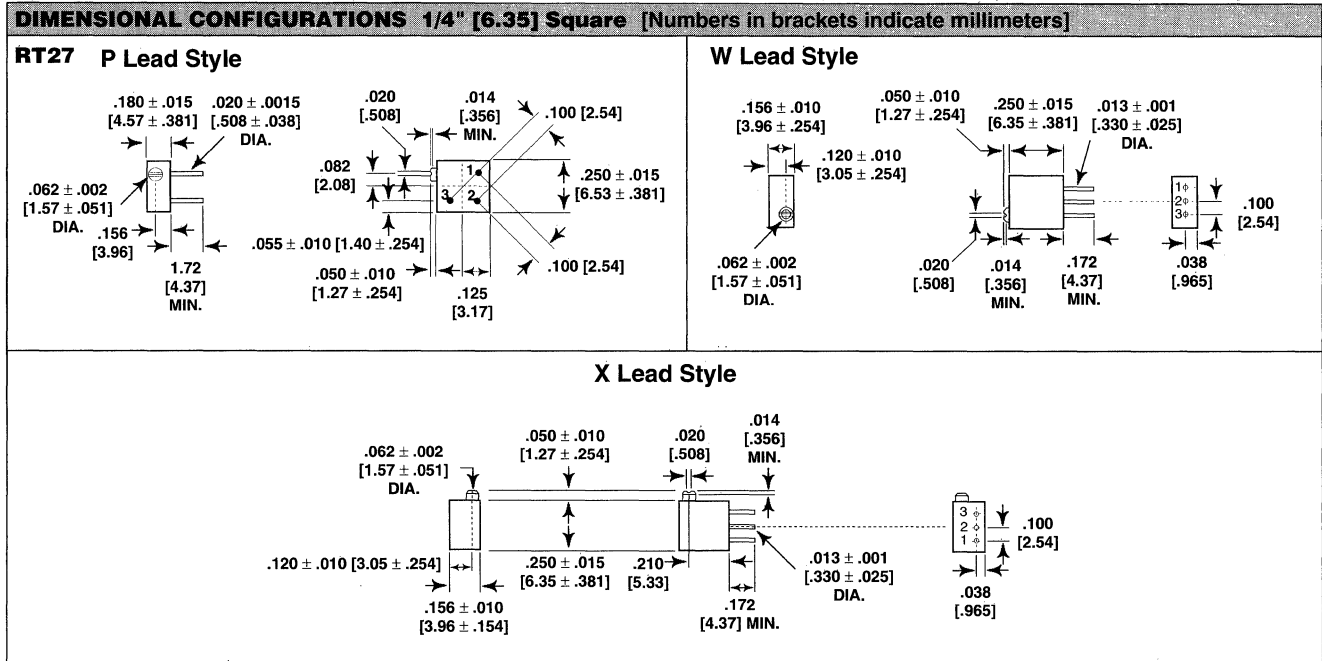
MECHANICAL SPECIFICATIONS

- Operating Torque:** 3 ounce inch maximum, RT26.
5 ounces inch maximum, RT27.
 - Rotation:** Clutch stop, wiper idles.
 - Weight:** 0.935 grams maximum.
 - Resistive Element:** Nickel chromium.
 - Rotational Life:** 200 cycles minimum.
 - Terminal Strength:** 2 pounds for 10 seconds.
- ENVIRONMENTAL SPECIFICATIONS**
- Temperature Limits:** - 65°C to + 175°C.
 - Sealing:** Fully sealed case (non-hermetic).



DIMENSIONAL CONFIGURATIONS 1/4" [6.35] Square [Numbers in brackets indicate millimeters]	
<h4>RT26 W Lead Style</h4>	<h4>X Lead Style</h4>

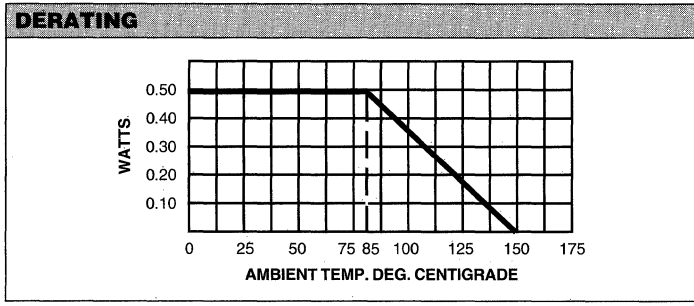
MODELS RT26 and RT27



ENVIRONMENTAL PERFORMANCE

TEST ¹	CONDITIONS	MIL-R-27208 REQUIREMENT	TYPICAL CHANGE
Thermal Shock	(107) 5 cycles, - 55°C to + 125°C	ΔR ≤ 1.0% ²	ΔR < 0.02%
Low Temperature Operation	1 hour storage, 45 minutes rated power at - 55°C	ΔR ≤ 1.0% ^{2,3}	ΔR < 0.01%
High Temperature Exposure	250 hours, no load at 150°C	ΔR ≤ 1.0% ^{2,3}	ΔR < 0.03%
Moisture Resistance	(106) 240 hours at rated power with humidity ranging from 80% RH to 98% RH	ΔR ≤ 1.0% ²	ΔR < 0.02%
Resistance to Soldering Heat (210)	350°C for 3 seconds	ΔR ≤ 1.0% ²	ΔR < 0.01%
Shock	(213) 18 shocks, 100g, 6 ms, sawtooth, 3 axes	ΔR ≤ 1.0% ^{2,3}	ΔR < 0.07%
Vibration	(204) 10 to 2000 Hz, 20g, 12 hours, 3 axes	ΔR ≤ 1.0% ^{2,3}	ΔR < 0.02%
Rotational Life	200 cycles	ΔR ≤ 2.0%	ΔR < 0.04%
Load Life	(108) 1,000 hours at rated power at 85°C, 90°/30° cycle	ΔR ≤ 2.0%	ΔR < 0.12%

1. Numbers in parenthesis refer to test method of MIL-STD-202 as modified by the detail specification.
 2. For values below 100 ohm, add 0.05 ohm to the allowable change.
 3. The referenced tests also require that setting stability change shall not exceed ± 1.0 percent plus the specified maximum resolution and operating torque shall not exceed 150% of the specified maximum.



PART MARKING

- Manufacturer's name or code
- Wiring diagram
- Date code
- Resistance
- MIL-Spec part number (when applicable)

HOW TO ORDER

RT MODEL	26 SIZE (1/4" [6.35] SQUARE)	C2 TEMPERATURE COEFFICIENT ± 50PPM/°C	P LEAD STYLE P = P.C. mount W = Top adjustment screw X = Side adjustment screw	501 VALUE First two digits are significant figures. Last digit specifies number of zeros to follow.
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Operating Torque
 26 = 3 ounce inch maximum
 27 = 5 ounce inch maximum

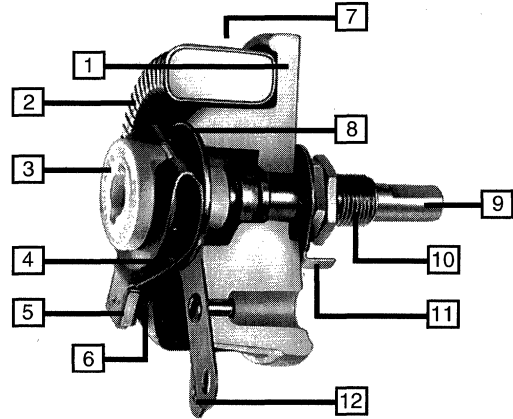
Power Rheostats

Standard and Special Features

Angstrohm's broad line of vitreous enameled power rheostats is designed to provide exceptional reliability through the application of modern manufacturing techniques and the use of sophisticated materials. These same techniques have resulted in a line of power rheostats that feature a very compact size for their dissipation rating. Furthermore, many standard value rheostats are available for "off-the-shelf" delivery, while special devices are available with short delivery cycles.

STANDARD DESIGN FEATURES

1. **Base and Ring:** Molded of high density ceramic, the base and ring provide the rheostat foundation.
2. **Winding:** Utilizing the most modern toroidal winding machines assures a uniform wind. Resolution and power dissipation are maintained at a maximum through proper selection of wire size.
3. **Insulator:** Molded of high density, porcelain/ceramic. Electrically "isolates" the contact assembly from the control shaft.
4. **Contact Arm:** Balanced and plated for protection, the contact arm assures positive contact between the winding and the contact shoe and between the contact ring and collector ring, through the employment of a "live" spring of simple, yet reliable design.
5. **Contact Shoe:** Fabricated of long-life, metallic material. Minimizes wire wear and assures excellent current conduction from the winding to the center terminal.
6. **Shunt Pigtail:** Carries the current from the contact shoe to the contact ring.
7. **Vitreous Enamel:** Provides the "bonding medium" necessary to securely attach the ring and base together and to lock the windings from shifting.
8. **Contact Ring:** Provides high current carrying capabilities through its large surface area to the center terminal. The ring is nickel plated to withstand corrosion.
9. **Control Shaft:** Manufactured to exacting tolerances and protected from adverse environments by plating, the shaft provides for rotation of the contact assembly.
10. **Bushing:** Precision machined, the polished brass bushing affords smooth, uniform rotation of the control shaft.



11. **Locating Tab:** Provides rheostat indexing and "non-turn" feature. The tab may be ordered at 3, 6, 9 or 12 o'clock positions. 6 o'clock is standard on all models - rheostat terminals located downward.
12. **Three Terminals:** Permit use as a potentiometer or rheostat. The center terminal or "collector ring," collects the current from the winding via the shoe-shunt assembly.

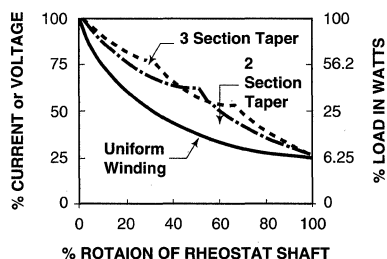
SPECIAL DESIGN FEATURES

Our application engineering department will be glad to advise you on special features (some of which are listed here). Send your requirements to the factory for analysis and we will design a unit to meet your needs. Please furnish your data in as complete a fashion as possible. This helps to avoid delays in completion of projects.

Tapered Windings: Available in all sizes, tapered windings offer more linear and closer load control than the standard rheostat winding. Consult factory for standard available tapers.

COMPARISON CURVES

UNIFORM VERSUS
TAPERED WINDING



Controlled Temperature Coefficient: Controlled Temperature Coefficient of Resistance can be supplied for applications requiring a minimum change in resistance due to changes in temperature.

Blank-Section: Rheostats can be made to your specifications with the resistance element eliminated at any point in the inherent 300° rotational limit of the unit.

Dead-Lug Off-Position: The rheostat resistive circuit is opened at the "high resistance" end position. This should be restricted to units of medium resistance values in low current applications.

Moved Terminal Off-Position: Terminal is "moved" so that the contact brush slides off the terminal onto a dead-section of the ceramic ring.

Cut-Off Lugs: The projecting portion of the terminal is omitted. This can be supplied with any style "off" position.

Switching Lugs: Provides for a tap switch effect at the end of the rheostat winding. These lugs are not to add an "off" position, but to accommodate the introduction of external circuitry into the rheostat circuit.

Extra Terminals: Unlike switching-lugs, these terminals furnish intermediate taps within the winding.

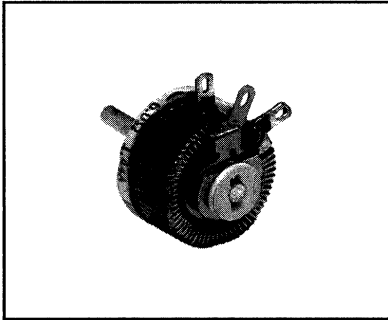
Quick-Connect Terminal: Male terminals will accept 1/4" [6.35] wide female connectors. Not available on Model MP06.

"U" Type Spade: Male and quick-connect terminals. Same as single-space above except on the rheostats and terminals, the configuration is in the shape of a "U" to allow two female connectors to be used. Provides a junction for more than one wire at the end terminal locations.

Less Than Standard Rotation: Rheostats can be supplied with a winding angle less than standard. These units can be equipped with stops limiting the rotation to that of the winding angle. The wattage rating of such rheostats is proportional to the decrease in winding angle.

ANGSTROHM Precision, Inc., is marketed through Dale Electronics, Inc., Film Division, Norfolk, Nebraska.

MODEL MP06 Power Rheostats 12.5 Watt



FEATURES

- Diameter 7/8" [22.22]
- Depth behind panel 11/16" [17.46]
- Shaft 1/8" [3.18] diameter
- Rotation 300° ± 5°
- Weight .037 pounds (17 grams)
- Mounts on panels up to 1/8" [3.18] by means of a 1/4" [6.35], 32 bushing and hex nut
- Non-turn lugs require 1/8" [3.18] hole, 1/4" [6.35] below center of shaft - Type "A" shaft

RESISTANCE VALUES*

TOTAL OHMS	MAXIMUM AMPS	APPROXIMATE STEPS
1.0	3.530	29
2.0	2.500	42
2.5	2.240	38
3.0	2.040	44
5.0	1.580	40
6.0	1.440	48
8.0	1.250	51
10.0	1.120	51
15.0	.910	51
25.0	.710	73
35.0	.600	75
50.0	.500	86
75.0	.410	103
100.0	.350	108
125.0	.320	128
150.0	.290	128
175.0	.270	148
200.0	.250	130
250.0	.220	166
350.0	.190	185
500.0	.160	215
750.0	.130	255
1000.0	.110	260
1500.0	.091	310
2500.0	.071	321
3500.0	.060	378
5000.0	.050	430

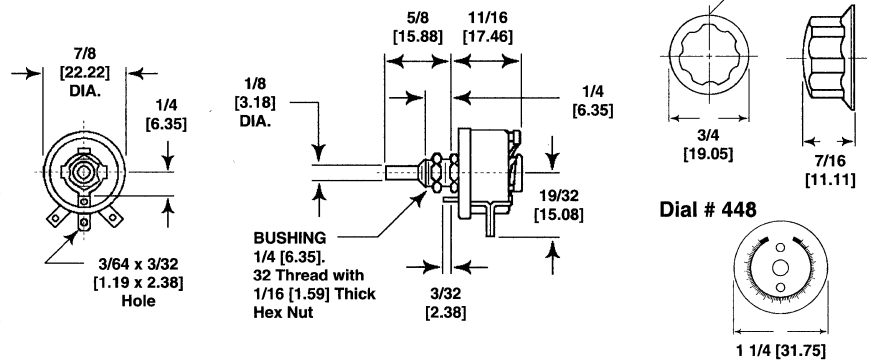
* All other intermediate resistance values are available and can be manufactured on a normal delivery cycle.

PART MARKING

- Resistance value
- Amps
- Date code

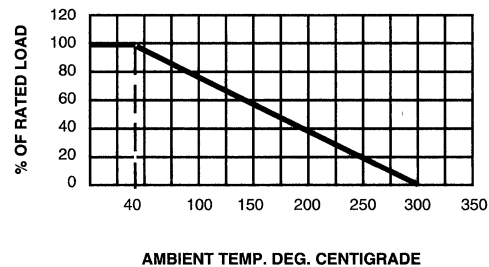
DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



DERATING

Angstrohm rheostat standard wattage ratings are based on a 300°C rise in "free-air" in ambient not exceeding 40°C (shown). For other applications, wattage ratings are available based on 340°C rise in "free-air" in ambient not exceeding 25°C, and in other cases 50°C.



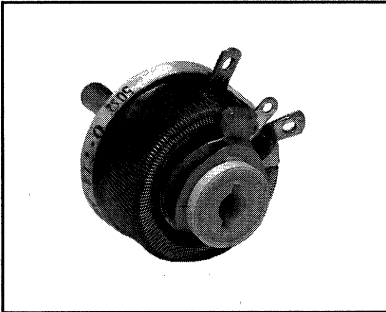
HOW TO ORDER

MP06 MODEL A BUSHING AND SHAFT CONFIGURATION 100 VALUE
 A = Standard Round Shaft

NOTE: For Additional Features: Submit detailed drawing information when ordering "non-standard" parts.

ANGSTROHM Precision, Inc., is marketed through Dale Electronics, Inc., Film Division, Norfolk, Nebraska.

MODEL MP10 Power Rheostats 25 Watt



FEATURES

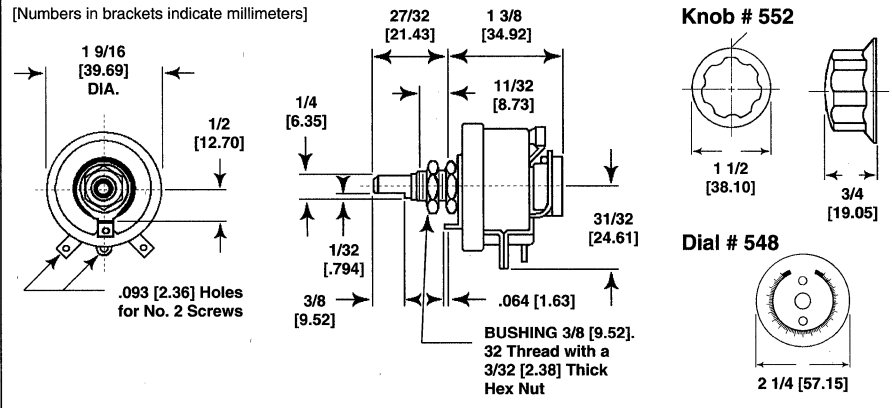
- Diameter 1 9/16" [39.69]
- Depth behind panel 1 3/8" [34.92]
- Shaft 1/4" [6.35] diameter
- Rotation 300° ± 5°
- Weight .180 pounds (82 grams)
- Mounts on panels up to 1/4" [6.35] by means of a 3/8" [9.52], 32 bushing and hex nut
- Non-turn lugs require 3/16" [4.76] hole, 1/2" [12.70] below center of shaft - Type "A" shaft
- U. L. Approved, File No. E51076 and C. S. A. File No. LR62770

RESISTANCE VALUES*

TOTAL OHMS	MAXIMUM AMPS	APPROXIMATE STEPS
1.0	5.00	28
2.0	3.54	31
3.0	2.89	48
6.0	2.04	51
8.0	1.77	54
10.0	1.58	54
15.0	1.29	64
25.0	1.00	86
35.0	.85	105
50.0	.71	115
75.0	.58	135
100.0	.50	152
125.0	.45	143
175.0	.38	160
250.0	.32	185
350.0	.27	205
500.0	.22	230
750.0	.18	270
1000.0	.16	292
1500.0	.13	353
2500.0	.10	358
3500.0	.08	392
5000.0	.07	440

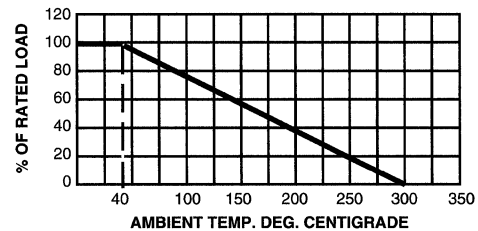
* All other intermediate resistance values are available and can be manufactured on a normal delivery cycle.

DIMENSIONAL CONFIGURATIONS

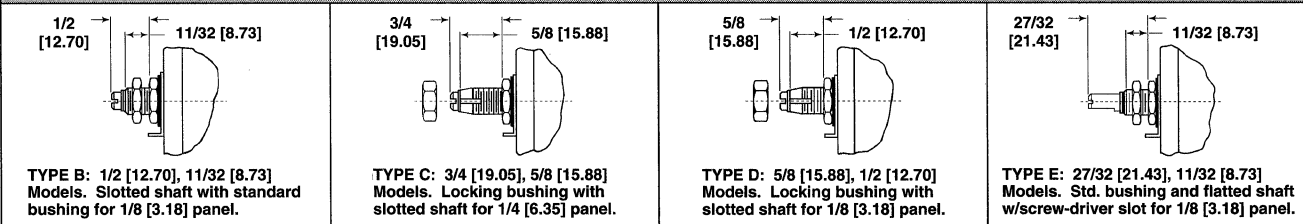


DERATING

Angstrohm rheostat standard wattage ratings are based on a 300°C rise in "free-air" in ambient not exceeding 40°C (shown). For other applications, wattage ratings are available based on 340°C rise in "free-air" in ambient not exceeding 25°C, and in other cases 50°C.



SPECIAL SHAFTS



PART MARKING

- Resistance value
- Amps
- Date code

HOW TO ORDER

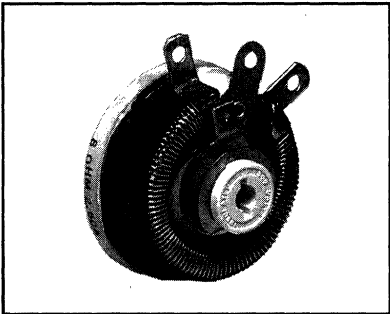
MP10 MODEL A BUSHING AND SHAFT CONFIGURATION 1500 VALUE

A = Standard Flatted Shaft

NOTE: For Additional Features: Submit detailed drawing information when ordering "non-standard" parts.

ANGSTROHM Precision, Inc., is marketed through Dale Electronics, Inc., Film Division, Norfolk, Nebraska.

MODEL MP15 Power Rheostats 50 Watt



FEATURES

- Diameter 2 9/32" [57.94]
- Depth behind panel 1 3/8" [34.92]
- Shaft 1/4" [6.35] diameter
- Rotation 300° ± 5°
- Weight .321 pounds (145 grams)
- Mounts on panels up to 1/4" [6.35] by means of a 3/8" [9.52], 32 bushing and hex nut
- Non-turn lugs require 3/16" [4.76] hole, 1/2" [12.70] below center of shaft - Type "A" shaft
- U. L. Approved, File No. E51076 and C. S. A. File No. LR62770

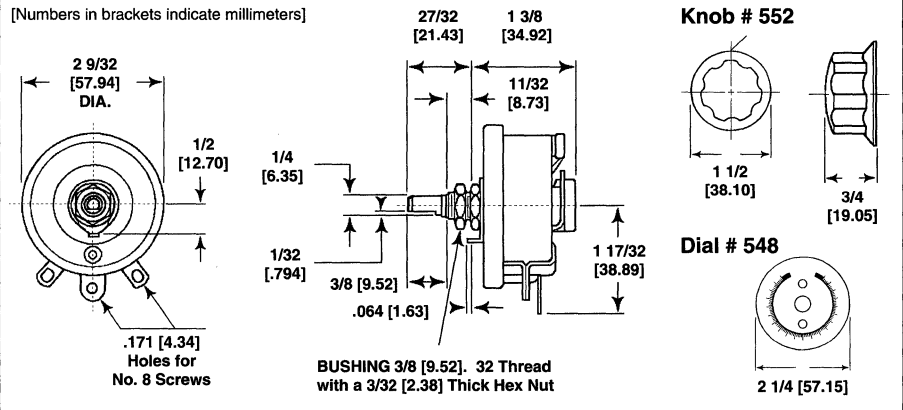
RESISTANCE VALUES*

TOTAL OHMS	MAXIMUM AMPS	APPROXIMATE STEPS
.5	10.00	24
1.0	7.07	46
2.0	5.00	50
4.0	3.54	44
6.0	2.89	74
8.0	2.50	85
12.0	2.04	108
16.0	1.76	108
22.0	1.50	123
35.0	1.19	148
50.0	1.00	113
80.0	.79	147
125.0	.63	178
150.0	.58	173
225.0	.47	203
300.0	.41	214
500.0	.32	290
800.0	.25	365
1000.0	.22	358
1600.0	.18	367
2500.0	.14	460
3500.0	.12	505
5000.0	.10	565
8000.0	.08	695
10000.0	.07	693

* All other intermediate resistance values are available and can be manufactured on a normal delivery cycle.

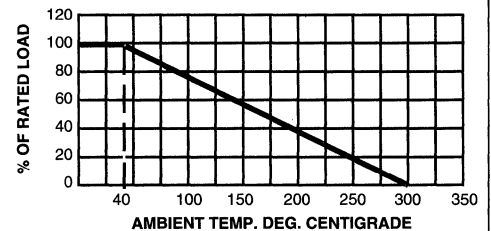
DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]

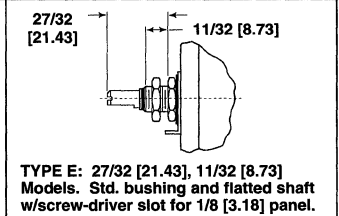
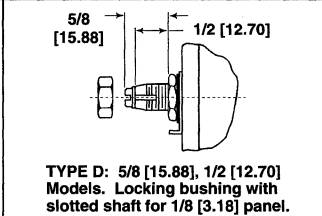
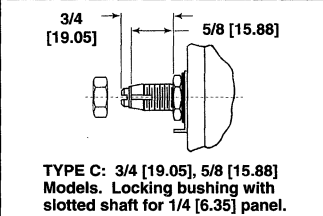
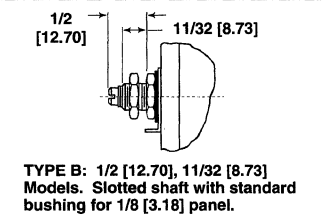


DERATING

Angstrom rheostat standard wattage ratings are based on a 300°C rise in "free-air" in ambient not exceeding 40°C (shown). For other applications, wattage ratings are available based on 340°C rise in "free-air" in ambient not exceeding 25°C, and in other cases 50°C.



SPECIAL SHAFTS



PART MARKING

- Resistance value
- Amps
- Date code

HOW TO ORDER

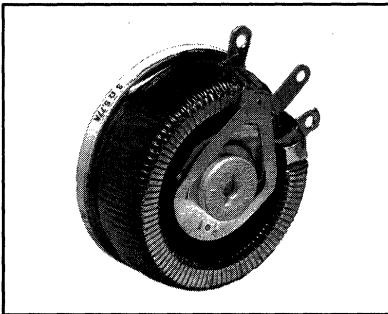
MP15 MODEL A BUSHING AND SHAFT CONFIGURATION 5 VALUE

A = Standard Flatted Shaft

NOTE: For Additional Features: Submit detailed drawing information when ordering "non-standard" parts.

ANGSTROHM Precision, Inc., is marketed through Dale Electronics, Inc., Film Division, Norfolk, Nebraska.

MODEL MP25 Power Rheostats 100 Watt



FEATURES

- Diameter 3 5/32" [80.17]
- Depth behind panel 1 1/2" [38.10]
- Shaft 1/4" [6.35] diameter
- Rotation 300° ± 5°
- Weight .594 pounds (268 grams)
- Mounts on panels up to 1/4" [6.35] by means of a 3/8" [9.52], 32 bushing and hex nut
- Non-turn lugs require 3/16" [4.76] hole, 1/2" [12.70] below center of shaft - Type "A" shaft
- U. L. Approved, File No. E51076 and C. S. A. File No. LR62770

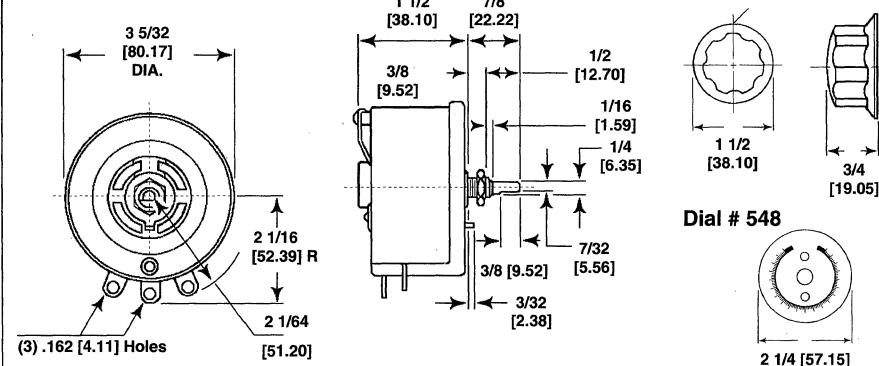
RESISTANCE VALUES*

TOTAL OHMS	MAXIMUM AMPS	APPROXIMATE STEPS
.5	14.140	30
1.0	10.000	30
2.0	7.071	56
3.0	5.774	66
5.0	4.472	56
7.5	3.652	66
10.0	3.162	104
15.0	2.582	113
25.0	2.000	144
50.0	1.414	180
75.0	1.155	180
100.0	1.000	216
200.0	.707	252
300.0	.557	252
400.0	.500	252
500.0	.447	324
750.0	.365	396
1000.0	.316	410
2000.0	.224	410
2500.0	.200	410
5000.0	.141	685
7500.0	.115	820
10000.0	.100	820

* All other intermediate resistance values are available and can be manufactured on a normal delivery cycle.

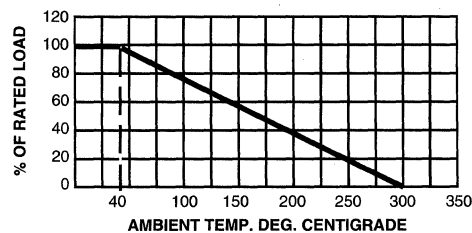
DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]

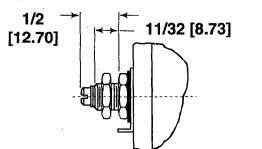
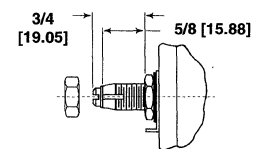
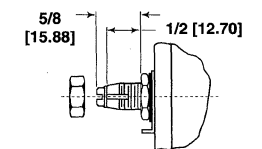
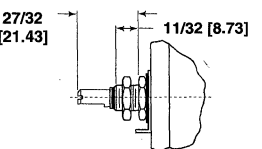


DERATING

Angstromh rheostat standard wattage ratings are based on a 300°C rise in "free-air" in ambient not exceeding 40°C (shown). For other applications, wattage ratings are available based on 340°C rise in "free-air" in ambient not exceeding 25°C, and in other cases 50°C.



SPECIAL SHAFTS

 <p>TYPE B: 1/2 [12.70], 11/32 [8.73] Models. Slotted shaft with standard bushing for 1/8 [3.18] panel.</p>	 <p>TYPE C: 3/4 [19.05], 5/8 [15.88] Models. Locking bushing with slotted shaft for 1/4 [6.35] panel.</p>	 <p>TYPE D: 5/8 [15.88], 1/2 [12.70] Models. Locking bushing with slotted shaft for 1/8 [3.18] panel.</p>	 <p>TYPE E: 27/32 [21.43], 11/32 [8.73] Models. Std. bushing and flattened shaft w/screw-driver slot for 1/8 [3.18] panel.</p>
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PART MARKING

- Resistance value
- Amps
- Date code

HOW TO ORDER

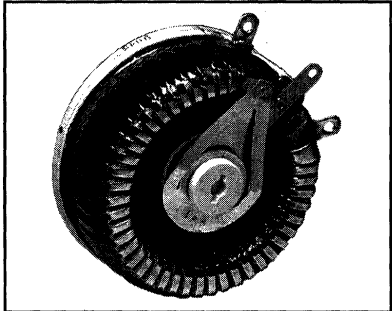
MP25 MODEL A BUSHING AND SHAFT CONFIGURATION 25 VALUE

A = Standard Flatted Shaft.

NOTE: For Additional Features: Submit detailed drawing information when ordering "non-standard" parts.

ANGSTROHM Precision, Inc., is marketed through Dale Electronics, Inc., Film Division, Norfolk, Nebraska.

MODEL MP30 Power Rheostats 150 Watt



FEATURES

- Diameter 4" [101.60]
- Depth behind panel 1 3/4" [44.45]
- Shaft 1/4" [6.35] diameter
- Rotation 300° ± 5° and weight 1.014 pounds (460 grams)
- Total ohms available in higher ranges up to 25,000 ohms
- Mounts on panels up to 1/4" [6.35] by means of a 3/8" [9.52], 32 bushing and hex nut
- Non-turn lugs require 3/16" [4.76] hole, 1/2" [12.70] below center of shaft - Type "A" shaft
- U. L. Approved, File No. E51076 and C. S. A. File No. LR62770

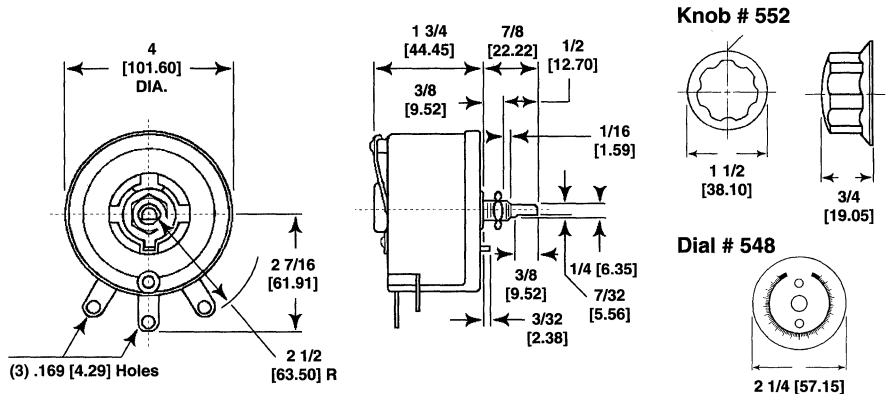
RESISTANCE VALUES*

TOTAL OHMS	MAXIMUM AMPS	APPROXIMATE STEPS
.5	17.350	35
1.0	12.247	39
2.0	8.660	39
3.0	7.071	70
5.0	5.477	73
7.5	4.472	70
10.0	3.873	70
15.0	3.162	120
25.0	2.449	152
50.0	1.732	190
75.0	1.414	228
100.0	1.225	228
200.0	.866	265
300.0	.707	303
400.0	.612	342
500.0	.548	342
750.0	.447	418
1000.0	.387	432
2000.0	.274	575
2500.0	.244	456
5000.0	.173	865
7500.0	.141	1000
10000.0	.122	1000

* All other intermediate resistance values are available and can be manufactured on a normal delivery cycle.

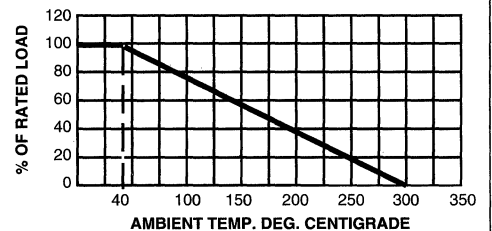
DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



DERATING

Angstrom rheostat standard wattage ratings are based on a 300°C rise in "free-air" in ambient not exceeding 40°C (shown). For other applications, wattage ratings are available based on 340°C rise in "free-air" in ambient not exceeding 25°C, and in other cases 50°C.



PART MARKING

- Resistance value
- Amps
- Date code

HOW TO ORDER

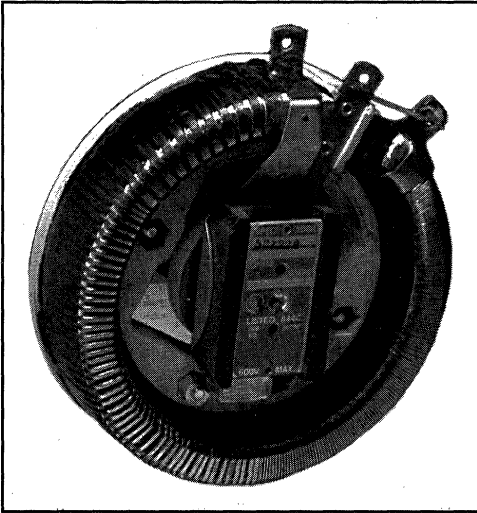
MP30 MODEL A BUSHING AND SHAFT CONFIGURATION 25 VALUE

A = Standard Flatted Shaft.

NOTE: For Additional Features: Submit detailed drawing information when ordering "non-standard" parts.

ANGSTROHM Precision, Inc., is marketed through Dale Electronics, Inc., Film Division, Norfolk, Nebraska.

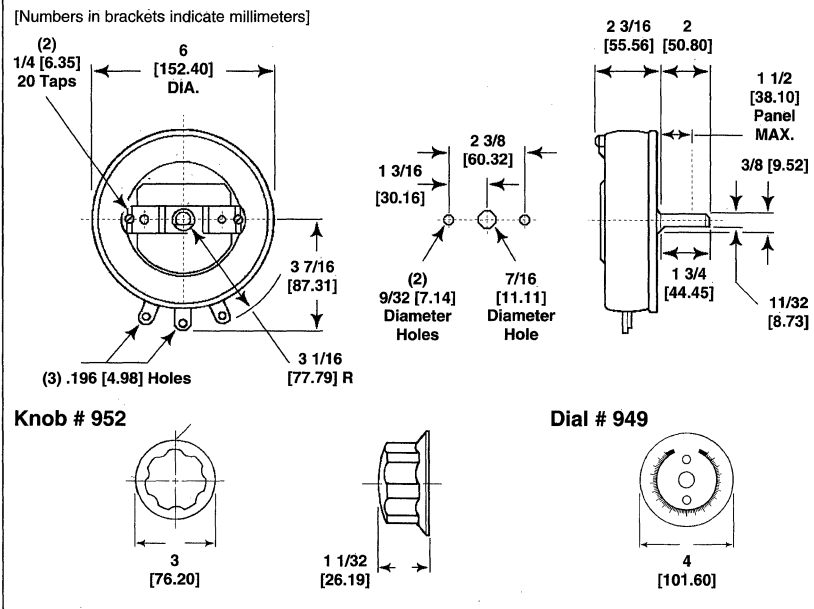
MODEL MP40 Power Rheostats 300 Watt



FEATURES

- Diameter 6" [152.40]
- Depth behind panel 2 3/16" [55.56]
- Shaft 3/8" [9.52] diameter
- Rotation 315° ± 5°
- Type "A" shaft
- Weight 2.625 pounds (1.191 kilograms)
- Total ohms available in higher ranges up to 25,000 ohms
- Mounts on panels up to 1 1/4" [31.75] by means of a mounting bracket with two 1/4" [6.35], 20 flat head screws
- U. L. Approved, File No. E51076 and C. S. A. File No. LR62770

DIMENSIONAL CONFIGURATIONS



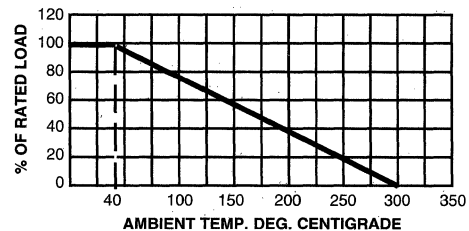
RESISTANCE VALUES*

TOTAL OHMS	MAXIMUM AMPS	APPROXIMATE STEPS
1.0	17.320	40
1.5	14.142	58
2.0	12.247	78
2.5	10.954	78
3.0	10.000	73
4.0	8.660	78
5.0	7.745	78
7.5	6.324	148
10.0	5.477	154
15.0	4.472	147
25.0	3.464	155
35.0	2.927	231
50.0	2.449	267
75.0	2.000	308
100.0	1.732	326
150.0	1.414	270
200.0	1.224	308
300.0	1.000	340
400.0	.886	370
500.0	.774	455
750.0	.632	514
1000.0	.547	578
1500.0	.447	675
2500.0	.346	720

* All other intermediate resistance values are available and can be manufactured on a normal delivery cycle.

DERATING

Angstrom rheostat standard wattage ratings are based on a 300°C rise in "free-air" in ambient not exceeding 40°C (shown). For other applications, wattage ratings are available based on 340°C rise in "free-air" in ambient not exceeding 25°C, and in other cases 50°C.



PART MARKING

- Resistance value
- Amps
- Date code

HOW TO ORDER

MP40 MODEL **A** STANDARD SHAFT CONFIGURATION **25** VALUE

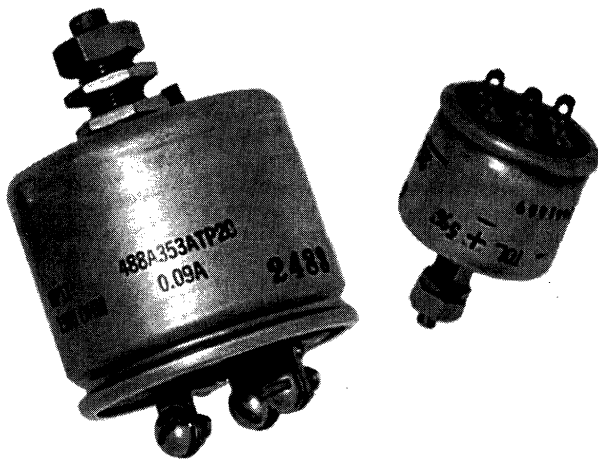
Other lengths available on special order.

NOTE: For Additional Features: Submit detailed drawing information when ordering "non-standard" parts.

ANGSTROHM Precision, Inc., is marketed through Dale Electronics, Inc., Film Division, Norfolk, Nebraska.

Special Power Rheostats

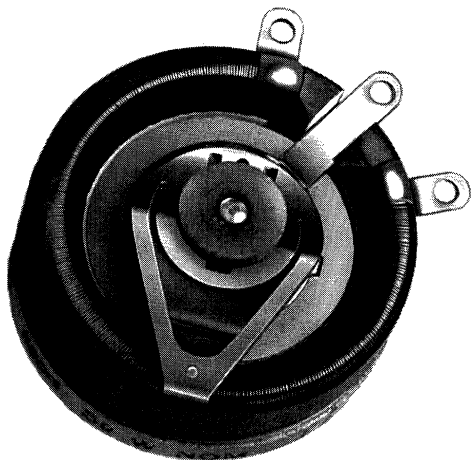
Enclosed - Models MP07 and MP11
Ring Type - Model N152, Tandem Assemblies



ENCLOSED RHEOSTATS

MODEL MP07, 12.5 Watt derated to 6.25 Watt
MODEL MP11, 25 Watt derated to 12.6 Watt

The MP07 and MP11 Rheostats can be furnished in a light-weight, dust-proof metal can, equipped with two or three screw terminals or solder lugs. They are not hermetically sealed but are closed by a rolled double seam. The MP07 is available in resistance values as listed for the MP06 (page 41), and the MP11 is available in resistance values as listed for the MP10 (page 42). How to Order information for the MP07 and the MP11 is the same as the MP06 and the MP10, respectively.



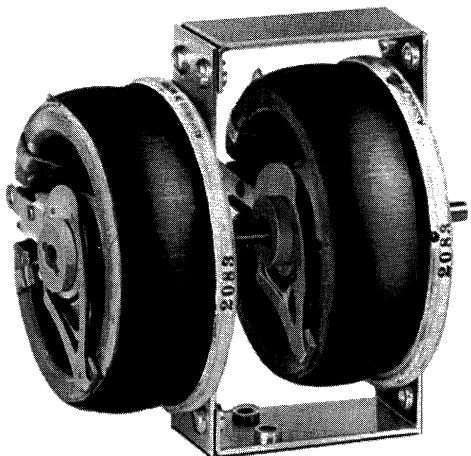
RING TYPE RHEOSTATS

MODEL N152

Angstrohm N152 ring rheostats are especially designed for portable and mobile apparatus likely to be subject to severe shock. Their rugged construction makes them well suited for this use.

FEATURES

- Operation - Manual
- Type - Rheostat, adjustable
- Duty - Continuous
- Enclosure - Open
- Form - EW, Exposed Wire or Ribbon
- Service - Navy A
- Ambient - 50°C
- Insulation - Class C
- Rating - 50 Watt



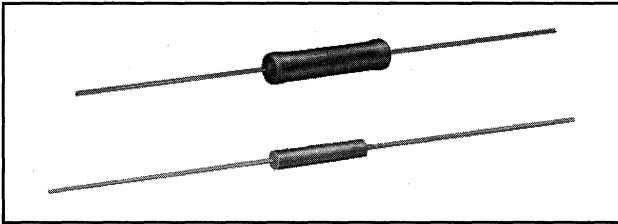
TANDEM ASSEMBLIES

Two or more rheostats may be specified in tandem to save space on the face of a panel. These assemblies are manufactured using a common shaft arrangement which virtually eliminates backlash while providing smooth positive action. Since there are countless tandem combinations possible, consult Angstrohm for information regarding your specific requirements.

ANGSTROHM Precision, Inc., is marketed through Dale Electronics, Inc., Film Division, Norfolk, Nebraska.

MODELS ESS/W/N, EGS/W/N Wirewound Resistors

Military/Established Reliability
MIL-R-39007 Qualified, Type RWR, R Level



FEATURES

- Meets solvent resistance of MIL-STD-202, Method 215
- 100% power stabilization and screening test
- Traceability of materials and processing
- Non-inductive styles - ESN and EGN
- Covered by U.S. Patent 3,295,090
- Silicone coated and molded
- "S" level failure rate available

STANDARD ELECTRICAL SPECIFICATIONS

DALE MODEL	MIL-R-39007 TYPE	POWER RATING (Watts)	MILITARY RANGE (Ohms)			DALE RANGE (Non-Mil.) (Ohms)			MAXIMUM WEIGHT (Grams)	
			.1%	.5 & 1%	.05%	.1%	.25%	.5%, 1%, 3%, 5%		
MOLDED MODELS	EGS-1-80	RWR81S	1	.499-1000	.1-1000	1-1000	.499-1000	.499-3400	.1-3400	.21
	EGW-1	RWR81W	1	.499-1000	.1-1000	1-1000	.499-1000	.499-3400	.1-3400	.21
	EGN-1-80	RWR81N	1	10-499	.1-499	1-500	.499-500	.499-1700	.1-1700	.21
	EGN-1-10	RWR81Z	1	10-499	.1-499	1-500	.499-500	.499-1700	.1-1700	.21
	EGS-2	RWR82S	1.5	.499-1300	.1-1300	1-1300	.499-1300	.499-4900	.1-4900	.23
	EGW-2	RWR82W	1.5	.499-1300	.1-1300	1-1300	.499-1300	.499-4900	.1-4900	.23
	EGN-2	RWR82N	1.5	.499-649	.1-649	1-650	.499-650	.499-2450	.1-2450	.23
	EGN-2-10	RWR82Z	1.5	.499-649	.1-649	1-650	.499-650	.499-2450	.1-2450	.23
	EGS-3-80	RWR80S	2	.499-3160	.1-3160	1-2700	.499-3160	.499-10,400	.1-10,400	.34
	EGW-3	RWR80W	2	.499-3160	.1-3160	1-2700	.499-3160	.499-10,400	.1-10,400	.34
COATED MODELS	EGN-3-80	RWR80N	2	10-1580	.1-1580	1-1350	.499-1580	.499-5200	.1-5200	.34
	EGN-3-10	RWR80Z	2	10-1580	.1-1580	1-1350	.499-1580	.499-5200	.1-5200	.34
	ESS-2A	RWR71S	2	.499-12.1k	.1-12.1k	.499-11.4k	.499-11.4k	.1-42.1k	.1-42.1k	.90
	ESW-2A	RWR71W	2	.499-12.1k	.1-12.1k	.499-11.4k	.499-11.4k	.1-42.1k	.1-42.1k	.90
	ESN-2A	RWR71N	2	10-6.04k	.1-6.04k	.499-5.7k	.499-5.7k	.1-21.05k	.1-21.05k	.90
	ESN-2A-10	RWR71Z	2	10-6.04k	.1-6.04k	.499-5.7k	.499-5.7k	.1-21.05k	.1-21.05k	.90
	ESS-2B	RWR89S	3	.499-4120	.1-4120	.499-6500	.499-6500	.1-24,500	.1-24,500	.70
	ESW-2B	RWR89W	3	.499-4120	.1-4120	.499-6500	.499-6500	.1-24,500	.1-24,500	.70
	ESN-2B	RWR89N	3	10-2050	.1-2050	.499-3250	.499-3250	.1-12,250	.1-12,250	.70
	ESN-2B-10	RWR89Z	3	10-2050	.1-2050	.499-3250	.499-3250	.1-12,250	.1-12,250	.70
COATED MODELS	ESS-5	RWR74S	5	.499-12,100	.1-12,100	.499-24,500	.499-24,500	.1-91,000	.1-91,000	4.2
	ESW-5	RWR74W	5	.499-12,100	.1-12,100	.499-24,500	.499-24,500	.1-91,000	.1-91,000	4.2
	ESN-5	RWR74N	5	10-6040	.1-6040	.499-12,200	.499-12,200	.1-45,500	.1-45,500	4.2
	ESN-5-10	RWR74Z	5	10-6040	.1-6040	.499-12,200	.499-12,200	.1-45,500	.1-45,500	4.2
	EGS-10-80	RWR84S	7	.499-12,400	.1-12,400	.499-24,500	.499-24,500	.1-91,000	.1-91,000	3.6
	EGW-10	RWR84W	7	.499-12,400	.1-12,400	.499-24,500	.499-24,500	.1-91,000	.1-91,000	3.6
	EGN-10-80	RWR84N	7	10-6190	.1-6190	.499-12,200	.499-12,200	.1-45,500	.1-45,500	3.6
	EGN-10-10	RWR84Z	7	10-6190	.1-6190	.499-12,200	.499-12,200	.1-45,500	.1-45,500	3.6
	ESS-10	RWR78S	10	.499-39,200	.1-39,200	.499-71,500	.499-71,500	.1-265,000	.1-265,000	9.0
	ESW-10	RWR78W	10	.499-39,200	.1-39,200	.499-71,500	.499-71,500	.1-265,000	.1-265,000	9.0
COATED MODELS	ESN-10	RWR78N	10	10-19,600	.1-19,600	.499-35,700	.499-35,700	.1-132,500	.1-132,500	9.0
	ESN-10-10	RWR78Z	10	10-19,600	.1-19,600	.499-35,700	.499-35,700	.1-132,500	.1-132,500	9.0

NOTE: All resistance ranges shown conform to military specifications unless otherwise indicated.

ELECTRICAL SPECIFICATIONS

Resistance Tolerance: .1%, .5%, 1%.

Temperature Coefficient: (-55°C to +275°C).

± 650PPM/°C, .1 ohm - .499 ohm.

± 400PPM/°C, .499 ohm - 1 ohm.

± 50PPM/°C, 1 ohm - 10 ohm.

± 20PPM/°C, 10 ohm and above.

Dielectric Strength: 500 VAC for 2 watt size and smaller.

1000 VAC for 3 watt size and larger.

Insulation Resistance: 1000 Megohm minimum.

Short Time Overload: 5 seconds at 5 times rated power for 3 watt size and smaller. 5 seconds at 10 times rated power for 5 watt size and larger.

MECHANICAL SPECIFICATIONS

Terminal Strength: 5 pound pull for 2 watt size and smaller. 10 pound pull for 3 watt size and larger.

Solderability: Meets requirements of MIL-STD-202, Method 208.

Solvent Resistance: Meets requirements of MIL-STD-202, Method 215.

MODELS ESS, ESW, ESN, EGS, EGW, EGN

MATERIAL SPECIFICATIONS

Core: Beryllium oxide, alumina and steatite are used, depending on power requirement.

Element: Copper-nickel alloy or nickel-chromium alloy, depending on resistance value.

Terminal and Winding: The terminal and the winding are identified by a letter symbol in the military type designation. Military Symbol:

- S = Solderable, inductively wound.
- W = Weldable, inductively wound.
- N = Solderable, non-inductively wound.
- Z = Weldable, non-inductively wound.

Leads: Solderable - Tinned Copperweld® per MIL-STD-1276, Type W-5.

Weldable - Bare Nickel per MIL-STD-1276, Type N-1.

End Caps: Stainless steel or alloy #46.

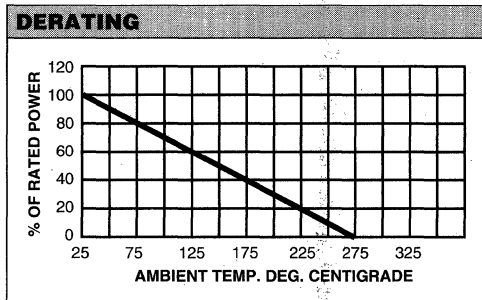
Coating: Special high temperature silicone.

APPLICABLE MIL-SPECIFICATION

MIL-R-39007: This is the military specification covering axial lead established reliability power wirewound resistors. Dale® ESS, ESW, EGS, EGW, ESN and EGN resistors meet or exceed the electrical, environmental and dimensional requirements of this specification.

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]				
	MIL-R-39007 TYPE			
	A	B	C	
MOLDED	RWR81	.250 ± .015 [6.35 ± .381]	.078 ± .015 [1.98 ± .381]	.020 ± .0015 [.508 ± .038]
	RWR82	.312 ± .015 [7.92 ± .381]	.078 ± .015 [1.98 ± .381]	.020 ± .0015 [.508 ± .038]
COATED	RWR80	.422 ± .015 [10.72 ± .381]	.110 ± .015 [2.79 ± .381]	.020 ± .0015 [.508 ± .038]
	RWR71	.812 ± .062 [20.62 ± 1.58]	.187 ± .031 [4.75 ± .787]	.032 ± .002 [.813 ± .051]
	RWR89	.560 ± .062 [14.22 ± 1.58]	.187 ± .031 [4.75 ± .787]	.032 ± .002 [.813 ± .051]
	RWR74	.875 ± .062 [22.23 ± 1.58]	.312 ± .031 [7.92 ± .787]	.040 ± .002 [1.02 ± .051]
	RWR84	.875 ± .062 [22.23 ± 1.58]	.312 ± .031 [7.92 ± .787]	.040 ± .002 [1.02 ± .051]
RWR78	1.780 ± .062 [45.21 ± 1.58]	.375 ± .031 [9.52 ± .787]	.040 ± .002 [1.02 ± .051]	

ENVIRONMENTAL PERFORMANCE		
TEST	TEST CONDITIONS	LIMITS
Power Conditioning	100 hours at rated power and + 25°C	.2% + .005Ω
D.C. Resistance	MIL-STD-202, Method 303	Within tolerance
Visual and Mechanical	Visual inspection	
Dielectric Strength	500 V or 1000 V	.1% + .005Ω
Solderability	Method 208, MIL-STD-202	95% coverage
Resistance to Solvents	Method 215, MIL-STD-202	
Thermal Shock	Method 107, MIL-STD 202, Condition B	.2% + .005Ω
Short Time Overload	5 seconds at 10 or 5 times rated power	.2% + .005Ω
Insulation Resistance	Method 302, MIL-STD-202, Condition A	1000 Megohm
Load Life	10,000 hours at rated power + 25°C	1% + .005Ω
Temperature Coefficient	- 55°C to + 275°C	0 ± 650PPM/°C .1Ω-.499Ω 0 ± 400PPM/°C .499Ω-1Ω 0 ± 50PPM/°C 1Ω-10Ω 0 ± 20PPM/°C 10Ω & up
Thermal Shock	Method 107, MIL-STD-202, Condition B	.2% + .005Ω
Dielectric Strength	500 V or 1000 V	.1% + .005Ω
Low Temperature Storage	- 65°C for 24 hours	.1% + .005Ω
Moisture Resistance	Method 106, MIL-STD-202	.2% + .005Ω
Terminal Strength	5 pound or 10 pound pull	.1% + .005Ω
Insulation Resistance	Method 302, MIL-STD-202, Condition A	1000 Megohm
Thermal Shock	Method 107, MIL-STD-202, Condition B	.2% + .005Ω
Shock	Method 205, MIL-STD-202, Condition C	.1% + .005Ω
Vibration	Method 204, MIL-STD-202, Condition D	.1% + .005Ω
Reactance	Non-inductive only	
High Temperature Exposure	+ 275°C for 2000 hours	.5% + .05Ω



POWER RATING
Power ratings are based on a maximum ΔR of .5% + .05 ohm when operated for 2000 hours at rated power and at an ambient of + 25°C.

PART MARKING

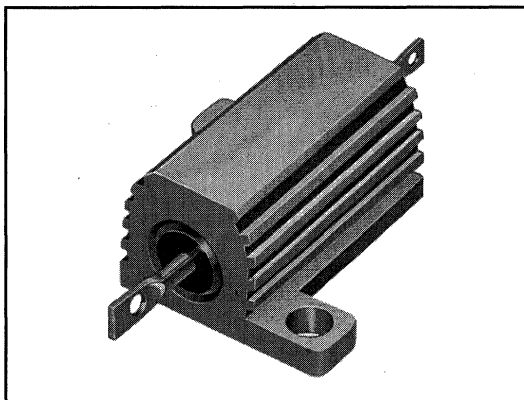
- Source code
- Date code, lot code and "JAN" marking
- Style
- Terminal - non-inductive designator and resistance value
- Tolerance and failure rate

HOW TO ORDER

RWR74	S	49R9	F	M
MILITARY TYPE	TERMINAL WIRE AND WINDING	RESISTANCE	RESISTANCE TOLERANCE	FAILURE RATE

MODELS ERH and ENH Wirewound Resistors

Military/Established Reliability,
MIL-R-39009 Qualified, Type RER, R Level



FEATURES

- Aluminum housed
- Standard (ERH) or non-inductive (ENH) winding
- Molded construction gives complete environmental protection
- Complete welded construction
- Mounts on chassis to utilize heat sink effect
- High stability at conventional power ratings
- Flat marking surface for easy identification
- Covered by U.S. Patents 201,884, 3,201,855 and 3,206,704
- 100% power stabilization and screening tests

STANDARD ELECTRICAL SPECIFICATIONS

DALE MODEL	MIL-R-39009 TYPE	POWER RATING (Watts)		MILITARY RESISTANCE RANGE (Ohms) 1%	MAX. WORKING VOLTAGE	MAX. WEIGHT (Grams)	MIL-R-39009 STANDARD TEMPERATURE COEFFICIENT VALUE RANGES (Ohms)		
		MOUNTED	FREE AIR				± 100PPM	± 50PPM	± 30PPM
ENH-5	RER40	5	3	1-1.65k	128.9	3.3	—	1-19.9	20-1.65k
ENH-10	RER45	10	6	1-2.8k	190.0	8.8	—	1-19.9	20-2.8k
ENH-25	RER50	20	8	1-6.04k	390.0	16.5	—	1-19.9	20-6.04k
ENH-50	RER55	30	10	1-19.6k	890.0	35.0	—	1-19.9	20-19.6k
ERH-5	RER60	5	3	0.10-3.32k	160.0	3.0	.1-.99	1-19.9	20-3.32k
ERH-10	RER65	10	6	0.10-5.62k	265.0	6.0	.1-.99	1-19.9	20-5.62k
ERH-25	RER70	20	8	0.10-12.1k	550.0	13.0	.1-.99	1-19.9	20-12.1k
ERH-50	RER75	30	10	0.10-39.2k	1250.0	28.0	.1-.99	1-19.9	20-39.2k

NOTE: All resistance ranges shown conform to military specifications unless otherwise indicated.

ELECTRICAL SPECIFICATIONS

Tolerance: Only military specification tolerance available is $\pm 1\%$.

Dielectric Strength: 1000 VAC on 5, 10 and 25 watt units. 2,000 VAC on 30 watt units.

Insulation Resistance: 10,000 Megohm minimum dry, 1,000 Megohm minimum after moisture test.

MECHANICAL SPECIFICATIONS

Terminal Strength: 5 lb. pull test on 5 and 10 watt units. 10 lb. pull test on 20 and 30 watt units.

Solderability: Satisfactory when tested in accordance with Method 208 of MIL-STD-202.

MATERIAL SPECIFICATIONS

Core: Ceramic: Steatite or alumina, depending on physical size.

Element: Copper-nickel alloy or nickel-chrome alloy, depending on resistance value.

End Caps: Stainless steel.

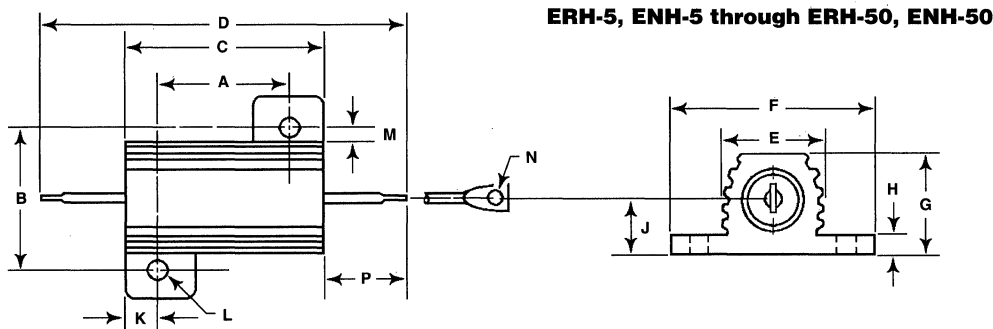
Encapsulant: Molded construction.

Housing: Aluminum with hard anodic coating.

Terminals: Tinned Copperweld®.

MODELS ERH and ENH

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



MODEL	A	B	C	D	E	F	G	H	J	K	L	M	N	P
ERH-5 ENH-5	.444 ± .005 [11.28 ± .127]	.490 ± .005 [12.45 ± .127]	.600 ± .031 [15.24 ± .787]	1.125 ± .062 [28.58 ± 1.57]	.334 ± .015 [8.48 ± .381]	.646 ± .015 [16.41 ± .381]	.320 ± .015 [8.13 ± .381]	.065 ± .010 [1.65 ± .254]	.133 ± .010 [3.38 ± .254]	.078 ± .010 [1.98 ± .254]	.093 ± .005 [2.36 ± .127]	.078 ± .015 [1.98 ± .381]	.050 ± .005 [1.27 ± .127]	.266 ± .062 [6.76 ± 1.57]
ERH-10 ENH-10	.562 ± .005 [14.27 ± .127]	.625 ± .005 [15.88 ± .127]	.750 ± .031 [19.05 ± .787]	1.375 ± .062 [34.93 ± 1.57]	.420 ± .015 [10.67 ± .381]	.800 ± .015 [20.32 ± .381]	.390 ± .015 [9.91 ± .381]	.075 ± .010 [1.90 ± .254]	.165 ± .010 [4.19 ± .254]	.093 ± .010 [2.36 ± .254]	.094 ± .005 [2.39 ± .127]	.102 ± .015 [2.59 ± .381]	.085 ± .005 [2.16 ± .127]	.312 ± .062 [7.92 ± 1.57]
ERH-25 ENH-25	.719 ± .005 [18.26 ± .127]	.781 ± .005 [19.84 ± .127]	1.062 ± .031 [26.97 ± .787]	1.938 ± .062 [49.23 ± 1.57]	.550 ± .015 [13.97 ± .381]	1.080 ± .015 [27.43 ± .381]	.546 ± .015 [13.87 ± .381]	.075 ± .010 [1.90 ± .254]	.231 ± .010 [5.87 ± .254]	.172 ± .010 [4.37 ± .254]	.125 ± .005 [3.18 ± .127]	.115 ± .015 [2.92 ± .381]	.085 ± .005 [2.16 ± .127]	.438 ± .062 [11.13 ± 1.57]
ERH-50 ENH-50	1.562 ± .005 [39.67 ± .127]	.844 ± .005 [21.44 ± .127]	1.968 ± .031 [49.99 ± .787]	2.781 ± .062 [70.64 ± 1.57]	.630 ± .015 [16.00 ± .381]	1.140 ± .015 [28.96 ± .381]	.610 ± .015 [15.49 ± .381]	.088 ± .010 [2.24 ± .254]	.260 ± .010 [6.60 ± .254]	.196 ± .010 [4.98 ± .254]	.125 ± .005 [3.18 ± .127]	.107 ± .015 [2.72 ± .381]	.085 ± .005 [2.16 ± .127]	.438 ± .062 [11.13 ± 1.57]

NOTE: All resistance ranges shown conform to military specifications unless otherwise indicated.

ENVIRONMENTAL PERFORMANCE

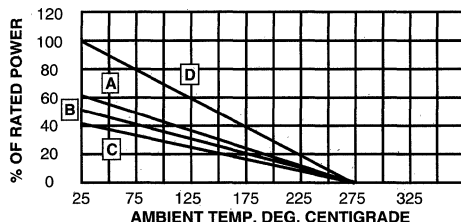
GENERAL: Testing of ERH and ENH resistors is done according to the procedures and test methods described in MIL-R-39009. The table below shows the military and the Dale® performance requirements.

TEST	MIL-R-39009	DALE TYPICAL
Temperature Coefficient	± 30PPM 20Ω and up ± 50PPM 1Ω to 19.60Ω ± 100PPM below 1Ω	See Table
Thermal Shock	± (.3% + 0.01Ω) ΔR	± (.2% + 0.01Ω) ΔR
Short Time Overload	± (.3% + 0.01Ω) ΔR	± (.15% + 0.01Ω) ΔR
Dielectric	± (.2% + 0.01Ω) ΔR	± (.2% + 0.01Ω) ΔR
High Temperature Storage (2 hours)	± (.5% + 0.01Ω) ΔR	± (.25% + 0.01Ω) ΔR
High Temperature Exposure (2,000 hours)	± (.1% + 0.01Ω) ΔR	± (.75% + 0.01Ω) ΔR
Moisture Resistance	± (.5% + 0.01Ω) ΔR	± (.25% + 0.01Ω) ΔR
Shock	± (.2% + 0.01Ω) ΔR	± (.1% + 0.01Ω) ΔR
Vibration	± (.2% + 0.01Ω) ΔR	± (.1% + 0.01Ω) ΔR
Load Life (2,000 hours)	± (.1% + 0.01Ω) ΔR	± (.5% + 0.01Ω) ΔR
Terminal Strength	± (.2% + 0.01Ω) ΔR	± (.1% + 0.01Ω) ΔR

DERATING

ERH and ENH resistors have an operating temperature range of -55°C to + 275°C. Derating is required for reduced chassis mounting area and for high ambient temperatures. The following curves apply to operation of unmounted resistors:

- A = ERH-5, ENH-5, ERH-10, ENH-10, unmounted.
- B = ERH-25, ENH-25, unmounted.
- C = ERH-50, ENH-50, unmounted.
- D = All types mounted to aluminum chassis.



POWER RATING

Dale® ERH and ENH resistor ratings are based on the following requirements:

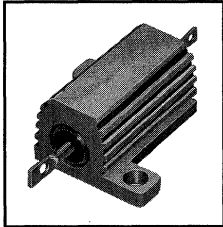
1. 275°C maximum internal hotspot temperature.
2. 1% maximum ΔR in 2000 hour load life.
3. Proper heat sink:
4 x 6 x 2 x .040 aluminum chassis for ERH-5, ENH-5, ERH-10 and ENH-10.
5 x 7 x 2 x .040 aluminum chassis for ERH-25, ENH-25, ERH-50 and ENH-50.

PART MARKING

- JAN
- 91637
- Value and tolerance
- Mil mark
- Date/lot code

MODELS RH and NH Wirewound Resistors

Military, MIL-R-18546 Qualified, Type RE Aluminum Housed, Chassis Mount



FEATURES

- Standard winding (Model RH)
- Non-inductive winding (Model NH)
- Molded construction for total environmental protection
- Complete welded construction
- Mounts on chassis to utilize heat-sink effect
- High stability at conventional power ratings
- Flat marking surface for easy identification

SPECIAL MODIFICATIONS

- Available upon request
- Special: Threaded mounting holes
 - Housing configurations
 - Resistance-temperature characteristic
 - Terminal configurations and materials
 - Resistances and tolerances
 - Pre-conditioning

STANDARD ELECTRICAL SPECIFICATIONS

DALE MODEL	MIL-R-18546 TYPE	POWER RATING (Watts)		RESISTANCE RANGE (Ohms)				MAX. WORKING VOLTAGE	MAX. WEIGHT (Grams)	STANDARD TEMP. COEFFICIENT VALUE RANGES (Ohms)*		
		DALE	MILITARY	MIL. RANGE SHOWN IN BOLD FACE						± 50PPM	± 30PPM	± 20PPM
RH-5	RE60G	7.5 (5)	5	.26-6.75k	.05-24.5k	.02-24.5k	.02-24.5k .10-3.32k	160	3	1-9.9	10-49	50-24.5k
NH-5	RE60N	7.5 (5)	5	.26-3.4k	.05-12.25k	.05-12.25k	.05-12.75k 1.0-1.65k	110	3.3	1-9.9	10-25	26-12.25k
RH-10	RE65G	12.5 (10)	10	.16-12.7k	.05-47.1k	.01-47.1k	.01-47.1k .10-5.62k	265	6	1-9.9	10-79	80-47.1k
NH-10	RE65N	12.5 (10)	10	.16-6.4k	.05-23.5k	.05-23.5k	.05-23.5k 1.0-2.8k	190	8.8	1-9.9	10-40	41-23.5k
RH-25	RE70G	25	20	.16-25.7k	.05-95.2k	.01-95.2k	.01-95.2k .10-12.1k	550	13	1-9.9	10-169	170-95.2k
NH-25	RE70N	25	20	.16-12.8k	.05-47.6k	.05-47.6k	.05-47.6k 1.0-6.04k	390	16.5	1-9.9	10-85	86-47.6k
RH-50	RE75G	50	30	.16-73.4k	.064-273k	.01-273k	.01-273k .10-39.2k	1250	28	1-9.9	10-469	470-273k
NH-50	RE75N	50	30	.16-36.7k	.064-136k	.064-136k	.05-136k 1.0-19.6k	890	35	1-9.9	10-235	236-136k
RH-100	RE77G	100	75	.5-90k	.1-90k	.05-90k	.05-90k .05-29.4k	1900	400	1-99	100-949	950-90k
NH-100	RE77N	100	75	.5-25k	.1-25k	.05-25k	.05-37.5k 1.0-14.7k	1350	440	1-49	50-475	476-375k
RH-250	RE80G	250	120	.5-116k	.1-116k	.1-116k	.05-116k .10-35.7k	2300	800	1-99	100-999	1k-116k
NH-250	RE80N	250	120	.5-37.5k	.1-37.5k	.1-37.5k	.05-48.5k 1.0-17.4k	1625	880	1-49	50-499	500-48.5k

* .1 ohm to .99 ohm = ± 100PPM.

NOTE: All resistance ranges shown conform to military specifications unless otherwise indicated. Figures in parentheses on RH-5 and RH-10 indicate wattage printed. New construction allows these resistors to be rated at 7.5 and 12.5 watts, but they will be printed with these higher ratings **only** upon customer request.

ELECTRICAL SPECIFICATIONS

Resistance Tolerance: 3%, 1%, .5%, .25%, .10%, .05%.

Operating Temperature Range: -55°C to +275°C. Derating is required for reduced chassis mounting area and for high ambient temperatures. (See Derating Curve.)

Power Rating: Ratings are based on these requirements:

1. 275°C maximum internal hotspot temperature.
2. 1% max. ΔR in 1000 hour load life for RH-5 thru RH-50.
3% max. ΔR in 1000 hour load life for RH-100 and RH-250.
3. Proper heat sink:
4 x 6 x 2 x .040 aluminum chassis = 5 and 10 watt units.
5 x 7 x 2 x .040 aluminum chassis = 25 watt units.
12 x 12 x .059 aluminum panel = 50 watt units.
12 x 12 x .125 aluminum panel = 100 and 250 watt units.

Dielectric Strength: 1000 VAC = 5, 10, 25 watt units.
2000 VAC = 50 watt units. 4500 VAC = 100, 250 watt units.

Insulation Resistance: 10,000 Megohm minimum dry,
1,000 Megohm minimum after moisture test.

MECHANICAL SPECIFICATIONS

Terminal Strength: 5 lb. pull test = RH-5, NH-5, RH-10, NH-10.
10 lb. pull test = RH-25 thru RH-250, NH-25 thru NH-250.

Solderability: Satisfactory when tested in accordance with Method 208 of MIL-STD-202.

MATERIAL SPECIFICATIONS

Core: Ceramic steatite or alumina, depending on physical size.

Element: Copper-nickel alloy, nickel-chrome alloy or manganese copper, depending on resistance value.

End Caps: Stainless steel.

Encapsulant: Silicone molded construction.

Housing: Aluminum with hard anodic coating.

Standard Terminals: Tinned Copperweld® on 5 thru 50 watt units. Threaded terminals on 100 and 250 watt units.

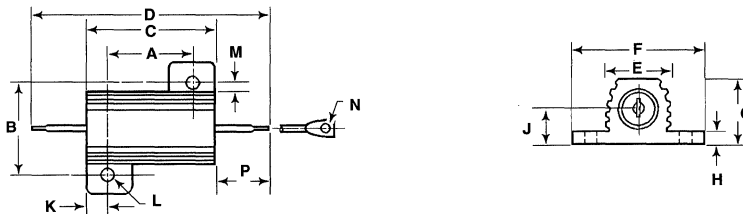
APPLICABLE MIL-SPECIFICATIONS

MIL-R-18546: The military specification covering housed chassis-mounted power resistors. Dale® RH and NH resistors meet or exceed the electrical, environmental and dimensional requirements of this specification.

MODELS RH and NH

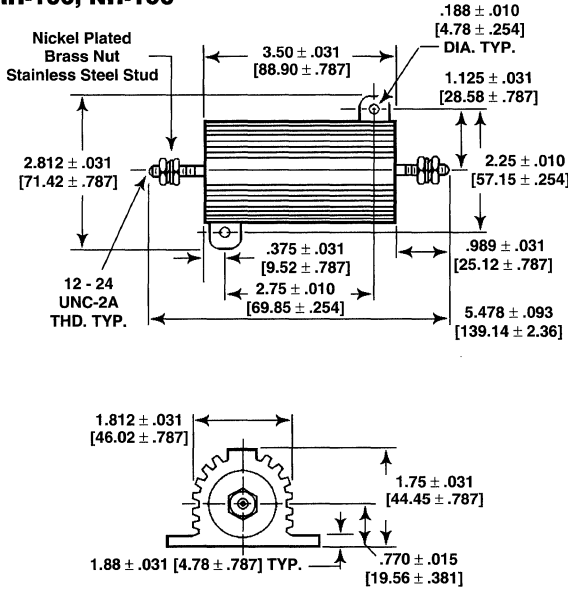
DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

RH-5, -10, -25, -50
NH-5, -10, -25, -50

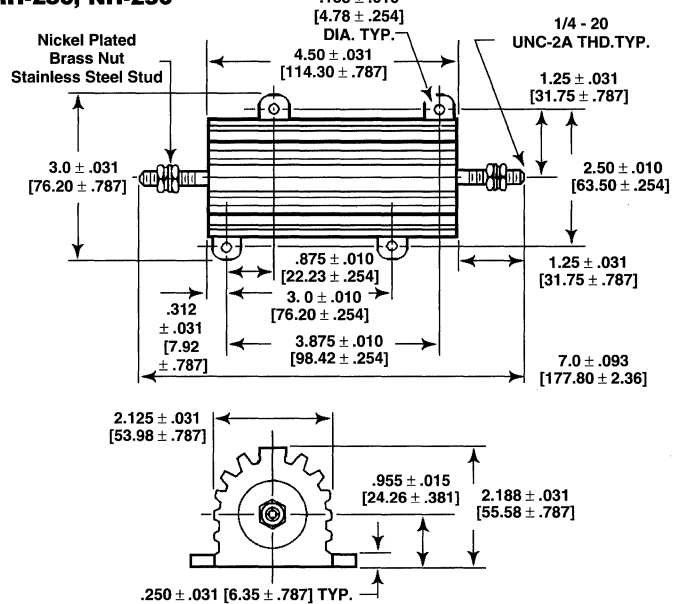


TYPE	A	B	C	D	E	F	G	H	J	K	L	M	N	P
RH-5	.444	.490	.600	1.125	.334	.646	.320	.065	.133	.078	.093	.078	.050	.266
NH-5	±.005 [11.28 ±.127]	±.005 [12.45 ±.127]	±.031 [15.24 ±.787]	±.062 [28.58 ±.157]	±.015 [8.48 ±.381]	±.015 [16.41 ±.381]	±.015 [8.13 ±.381]	±.010 [1.65 ±.254]	±.010 [3.38 ±.254]	±.010 [1.98 ±.254]	±.005 [2.36 ±.127]	±.015 [1.98 ±.381]	±.005 [1.27 ±.127]	±.062 [6.76 ±.157]
RH-10	.562	.625	.750	1.375	.420	.800	.390	.075	.165	.093	.094	.102	.085	.312
NH-10	±.005 [14.27 ±.127]	±.005 [15.88 ±.127]	±.031 [19.05 ±.787]	±.062 [34.93 ±.157]	±.015 [13.97 ±.381]	±.015 [20.32 ±.381]	±.015 [9.91 ±.381]	±.010 [1.90 ±.254]	±.010 [4.19 ±.254]	±.010 [2.36 ±.254]	±.005 [2.39 ±.127]	±.015 [2.59 ±.381]	±.005 [2.16 ±.127]	±.062 [7.92 ±.157]
RH-25	.719	.781	1.062	1.938	.550	1.080	.546	.075	.231	.172	.125	.115	.085	.438
NH-25	±.005 [18.27 ±.127]	±.005 [19.84 ±.127]	±.031 [26.97 ±.787]	±.062 [49.23 ±.157]	±.015 [13.97 ±.381]	±.015 [27.43 ±.381]	±.015 [13.87 ±.381]	±.010 [1.90 ±.254]	±.010 [5.87 ±.254]	±.010 [4.37 ±.254]	±.005 [3.18 ±.127]	±.015 [2.92 ±.381]	±.005 [2.16 ±.127]	±.062 [11.13 ±.157]
RH-50	1.562	.844	1.968	2.781	.630	1.140	.610	.088	.260	.196	.125	.107	.085	.438
NH-50	±.005 [39.67 ±.127]	±.005 [21.44 ±.127]	±.031 [49.99 ±.787]	±.062 [70.64 ±.157]	±.015 [16.00 ±.381]	±.015 [28.96 ±.381]	±.015 [15.49 ±.381]	±.010 [2.24 ±.254]	±.010 [6.60 ±.254]	±.010 [4.98 ±.254]	±.005 [3.18 ±.127]	±.015 [2.72 ±.381]	±.005 [2.16 ±.127]	±.062 [11.13 ±.157]

RH-100, NH-100



RH-250, NH-250



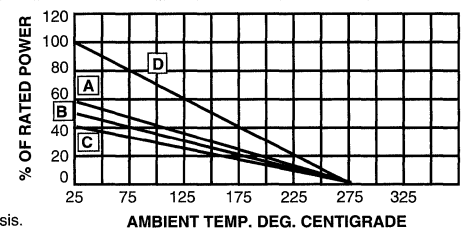
ENVIRONMENTAL PERFORMANCE

General: Testing is done according to the procedures and test methods described in MIL-R-18546. The table below shows the military and the Dale performance requirements. All specifications are based on testing of 1% tolerance units.

TEST	MIL-R-18546 REQUIREMENT	TYPICAL CHANGE
Temperature Coefficient	± 50PPM 2000Ω ± 30PPM over 2000Ω	See Table
Thermal Shock	± (.5% + 0.01Ω) ΔR	± (.25% + 0.01Ω) ΔR
Short Time Overload	± (.5% + 0.01Ω) ΔR	± (.25% + 0.01Ω) ΔR
Dielectric	± (.2% + 0.01Ω) ΔR	± (.1% + 0.01Ω) ΔR
High Temperature Storage	± (.5% + 0.01Ω) ΔR	± (.25% + 0.01Ω) ΔR
Moisture Resistance	± (.1% + 0.01Ω) ΔR	± (.5% + 0.01Ω) ΔR
Shock	± (.2% + 0.01Ω) ΔR	± (.1% + 0.01Ω) ΔR
Load Life	± (.1% + 0.01Ω) ΔR	± (.5% + 0.01Ω) ΔR
Vibration	± (.2% + 0.01Ω) ΔR	± (.1% + 0.01Ω) ΔR
Terminal Strength	± (.2% + 0.01Ω) ΔR	± (.1% + 0.01Ω) ΔR

DERATING

The following curves apply to operation of unmounted resistors:
A = 5 & 10 watt units, unmounted,
B = 25 watt units, unmounted,
C = 50, 100 & 250 watt units, unmounted,
D = All types mounted to aluminum chassis.



PART MARKING

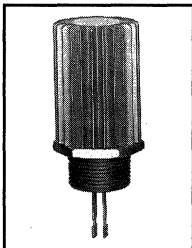
DALE: — Dale
 — Model
 — Value and tolerance
 — Wattage
 — Date code

MILITARY: — Dale
 — Model
 — Value and tolerance
 — Wattage
 — Mil mark
 — Date code

MODEL PH Wirewound Resistors

Precision Power

Aluminum Housed, Thru-Chassis Mount



FEATURES

- Complete welded construction
- Complete environmental protection
- Designed to utilize heat-sink effect of chassis
- Plug-in connections available for quick connect/disconnect from circuit

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	RATING (Watts)	RESISTANCE RANGES (Ohms) *		MAX. WORKING VOLTAGE	MAX. WEIGHT (Grams)	STANDARD TEMPERATURE COEFFICIENT VALUE RANGES (Ohms) †		
		.05%, .1%, .25%	.5%, 1%, 3%			± 50PPM	± 30PPM	± 20PPM
PH-10-1	10	1-12.7k	.1-47.1k	240	6	1-9.9	10-79	80-47.1k
PH-25	25	.5-25.7k	.1-95.2k	550	22	1-9.9	10-169	170-95.2k
PH-25A	25	.5-25.7k	.1-95.2k	550	22	1-9.9	10-169	170-95.2k
PH-50	50	3-52k	.1-75k	1500	80	1-99	100-999	1k-75k
PH-100	100	5-35k	.1-50k	1700	186	1-99	100-999	1k-50k

* Consult factory for extended values. † Consult factory for values below 1 ohm and for special T.C. requirements.

ELECTRICAL SPECIFICATIONS

Resistance Tolerance: ± 3%, ± 1%, ± .5%, ± .25%, ± .10%, ± .05%.

Dielectric Strength: 1000 VAC on PH-10-1.

2500 VAC on PH-25, PH-25A, PH-50 and PH-100.

Maximum Working Voltage: Maximum working voltage determined at .001" diameter wire resistance values.

ENVIRONMENTAL PERFORMANCE

General: Testing of PH resistors is done according to the procedures and test methods described in MIL-R-18546.

MATERIAL SPECIFICATIONS

Core: Ceramic steatite or alumina, depending on physical size.

Element: Copper-nickel alloy or nickel-chrome alloy, depending on resistance value.

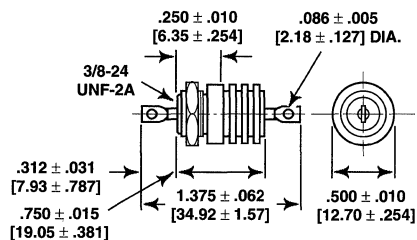
End Caps: Stainless steel.

Housing: Aluminum with hard anodic coating.

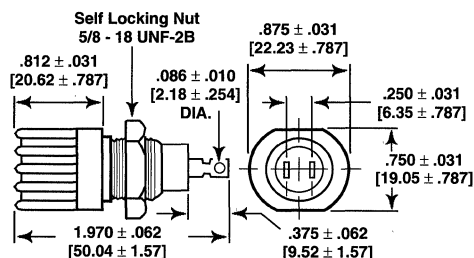
Standard Terminal(s): Tinned Copperweld® on PH-10-1, 180 alloy on PH-25A, PH-25, PH-50 and PH-100.

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

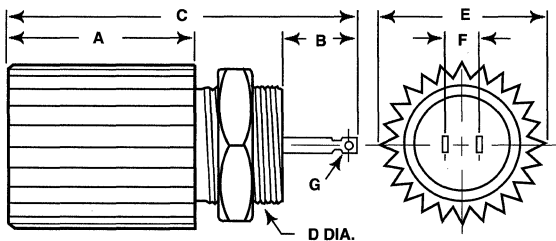
PH-10-1



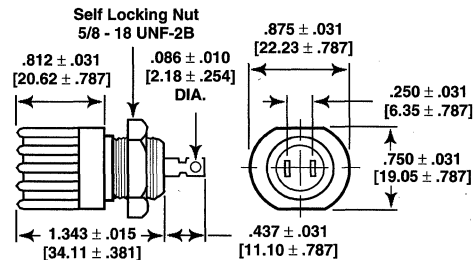
PH-25



PH-50 & PH-100



PH-25A Smaller Version of PH-25



MODEL	A	B	C	D	E	F	G
PH-50	1.675 ± .031 [42.55 ± .787]	.700 ± .031 [17.78 ± .787]	3.0 ± .062 [76.2 ± 1.57]	7/8 - 20 UNEF - 2A	1.188 ± .031 [30.18 ± .787]	.187 ± .031 [4.75 ± .787]	.093 ± .010 [2.36 ± .254]
PH-100	2.0 ± .031 [50.8 ± .787]	.780 ± .031 [19.81 ± .787]	3.75 ± .062 [95.25 ± 1.57]	1-1/4 - 18 UNEF - 2A	1.75 ± .031 [44.45 ± .787]	.375 ± .031 [9.52 ± .787]	.093 ± .010 [2.36 ± .254]

MODEL PH

APPLICABLE MIL SPECIFICATIONS

The Dale® PH models meet the electrical and environmental requirements of MIL-R-18546. There are, however, no direct mil equivalents in this configuration.

POWER RATING

Dale PH resistor ratings are based on the following requirements:

1. 275°C maximum internal hotspot temperature.
2. 1% maximum ΔR in 1000-hours load life for PH-10-1, PH-25 and PH-50.
3% maximum ΔR in 1000-hours load life for PH-100.
3. Proper heat sink
 - 4 x 6 x 2 x .040 aluminum chassis = PH-10-1.
 - 5 x 7 x 2 x .040 aluminum chassis = PH-25.
 - 12 x 12 x .125 aluminum panel = PH-50 and PH-100.

SPECIAL MODIFICATIONS

1. Special resistance-temperature characteristics.
2. Special terminal configurations and materials.
3. Non-inductive type resistor.
4. Special resistances and tolerances.
5. Special exterior finishes and platings.

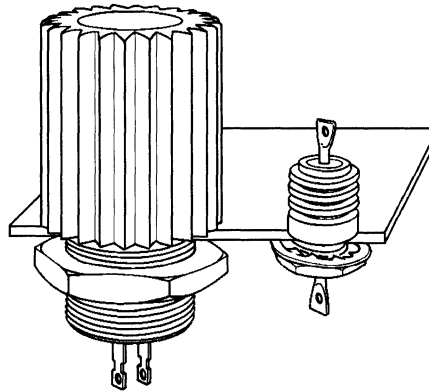
PH — NON-INDUCTIVE

Models of equivalent physical and electrical specifications are available with non-inductive (Aryton-Perry) winding.

Two conditions apply:

1. Maximum resistance value must be divided by two.
2. Maximum working voltage must be multiplied by .707.

MOUNTING INFORMATION

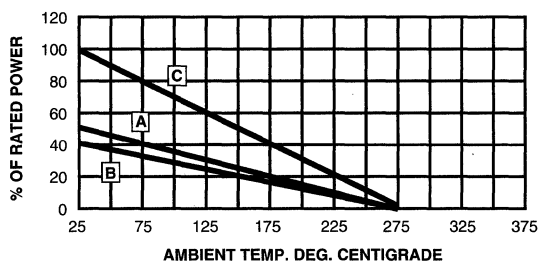


Two Terminal Configurations (PH-10-1, PH-25, PH-50 and PH-100)
Thru chassis mounting

DERATING

Dale PH resistors have an operating temperature range of - 55°C to + 275°C. Derating is required for reduced chassis mounting area and for high ambient temperatures. The following curves apply to the operation of unmounted resistors:

A = PH-10-1, PH-25, unmounted. **B** = PH-50, PH-100, unmounted.
C = Mounted to aluminum chassis.



PART MARKING

- Dale
- Style
- Value and tolerance
- Wattage
- Date code

HOW TO ORDER

PH-100
MODEL

10
RESISTANCE

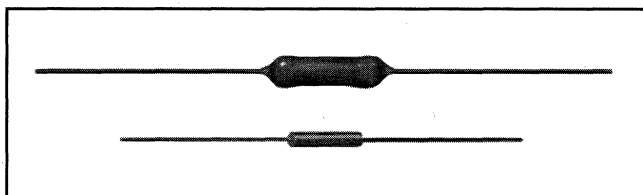
1%
TOLERANCE



MODEL G Wirewound Resistors

Military, MIL-R-26 Qualified, Type RW

Precision Power, Silicone Coated and Molded



FEATURES

- From 1.4 to 4 times higher power ratings than conventional resistors of equivalent size
- Completely welded construction
- High temperature silicone coated and molded
- Available in non-inductive styles (Type GN)
- Covered by U.S. Patent 3,295,090

STANDARD ELECTRICAL SPECIFICATIONS

DALE MODEL	MIL-R-26 TYPE	DALE RATING		RESISTANCE RANGE (Ohms)				MAXIMUM * WORKING VOLTAGE		MAXIMUM WEIGHT (Grams)
		.05% thru 5%	3% & 5%	MIL. Range shown in bold face				U	V	
G-1-80	RW81	1.0 W	—	1-1k	.499-1k	.499-3.4k	.1-3.4k	33	—	.20
—		1.0 W	—	—	.499-1k	.499-1k	.1-1k	33	—	.20
G-2	RW80	1.5 W	—	1-1.3k	.499-1.3k	.499-4.9k	.1-4.9k	42	—	.21
G-3-80		2.0 W	—	1-2.74k	.499-2.74k	.499-10.4k	.1-10.4k	80	—	.34
—	2.0 W	—	—	.499-2.74k	.499-2.74k	.1-2.74k	.1-2.74k	80	—	.34
G-5	—	4.0 W	5.0 W	.499-6.5k	.499-6.5k	.1-24.5k	.1-24.5k	162	184	.80
G-5C	—	5.0 W	7.0 W	.499-8.6k	.499-8.6k	.1-32.3k	.1-32.3k	194	230	1.20
G-10	—	7.0 W	10.0 W	.499-25.7k	.499-25.7k	.1-95.2k	.1-95.2k	425	508	3.60

* Maximum working voltage determined at .0008" diameter wire resistance values.
 NOTE: All resistance ranges shown conform to military specifications unless otherwise indicated.

ELECTRICAL SPECIFICATIONS

Resistance Tolerance: $\pm 5\%$, $\pm 3\%$, $\pm 1\%$, $\pm .5\%$, $\pm .25\%$, $\pm .10\%$, $\pm .05\%$.

Temperature Coefficient: $\pm 90\text{PPM}/^\circ\text{C}$, below 1 ohm. $\pm 50\text{PPM}/^\circ\text{C}$, 1 ohm - 9.9 ohm. $\pm 20\text{PPM}/^\circ\text{C}$, 10 ohm and above. Consult factory for special T.C. requirements.

Dielectric Strength: 500 VAC for G-1-80, G-2, G-3-80 models. 1000 VAC for all others.

Insulation Resistance: 1000 Megohm minimum dry, 100 Megohm minimum after moisture test.

Short Time Overload: 5 seconds at 5 times rated power = G-1-80 thru G-5C (Characteristic U). 5 seconds at 10 times rated power = all others.

MECHANICAL SPECIFICATIONS

Terminal Strength: 5 pound pull test = G-1-80, G-2 and G-3-80. 10 pound pull test = all others.

Solderability: MIL-R-26 Type - Meets requirements of MIL-STD-202, Method 208. Standard G (Non-MIL Models) - 60/40 electro tin plated terminals to facilitate soldering.

Termination: When G resistors will be operated at full rated power, resistance welding or high temperature solder are the recommended termination methods. Termination should be made within 1/2 inch from end of resistor body.

MATERIAL SPECIFICATIONS

Core: Beryllium oxide or alumina depending on power requirements.

Element: Copper-nickel alloy or nickel-chrome alloy, depending on resistance value.

End Caps: Stainless steel.

Coating: Special high temperature silicone.

Standard Terminals: Tinned Copperweld®.

Weldable Leads: The following weldable lead materials are available from Dale® on a standard stocking basis and can be specified by adding the dash number shown below to the standard part number.

Grade "A" Nickel, untinned -53.

Gold-plated Dumet (50 microinch) -52.

(Example: G-1-53 or G-1-52.)

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

	MODEL	A	B (Max.)	C	D
MOLDED	G-1-80	.250 \pm .015 [6.35 \pm .381]	—	.078 \pm .015 [1.98 \pm .381]	.020 [.508]
	G-2	.312 \pm .015 [7.92 \pm .381]	—	.078 \pm .015 [1.98 \pm .381]	.020 [.508]
	G-3-80	.422 \pm .015 [10.72 \pm .381]	—	.110 \pm .015 [2.79 \pm .381]	.020 [.508]
COATED	G-5	.562 \pm .062 [14.27 \pm 1.57]	.640 [16.26]	.188 \pm .032 [4.78 \pm .813]	.032 [.813]
	G-5C	.500 \pm .062 [12.70 \pm 1.57]	.593 [15.06]	.218 \pm .032 [5.54 \pm .813]	.040 [1.02]
	G-10	.875 \pm .062 [22.23 \pm 1.57]	1.0 [25.40]	.312 \pm .032 [7.92 \pm .813]	.040 [1.02]

MODEL G

APPLICABLE MIL-SPECIFICATIONS

MIL-R-26E: This is a military specification designed especially for precision and non-precision power wirewound resistors. The G models meet the requirements of this specification as well as the older MIL-R-26C and MIL-R-23379 specifications.

SPECIAL MODIFICATIONS

1. Terminals can be supplied in any commercial material with several type finishes.
2. Terminal lengths and diameters can be varied.
3. Various elements available for special T.C.
4. Special configuration available on request.
5. Tolerances available to .01% on most types.
6. Special matching available (T.C. and tolerance).

GN - NON-INDUCTIVE

Models of equivalent physical and electrical specifications are available with non-inductive (Aryton-Perry) winding. They are identified by adding the letter N to the letter G in the part number (GN-5, for example). Three conditions apply:

1. For GN Types, divide maximum resistance values by two.
2. For GN Types, multiply maximum working voltage by .707.
3. For GN Types, maximum weights may slightly exceed those shown on low values.

- | | |
|---------|--------|
| GN-1-80 | GN-5 |
| GN-2 | GN-5C* |
| GN-3-80 | GN-10 |

* Body O.D. may exceed that of the G-5C by .010" [.254].

ENVIRONMENTAL PERFORMANCE *		
TEST	MIL-R-26E REQUIREMENT	DALE MAXIMUM
Moisture Resistance	$\pm (.2\% + .05\Omega) \Delta R$	$\pm (.2\% + .05\Omega) \Delta R$
Load Life	$\pm (.5\% + .05\Omega) \Delta R$	$\pm (.5\% + .05\Omega) \Delta R$
Temperature Coefficient	30-90PPM/°C Max.	See Elec. Specs.
Thermal Shock	$\pm (.2\% + .05\Omega) \Delta R$	$\pm (.2\% + .05\Omega) \Delta R$
Short Time Overload	$\pm (.2\% + .05\Omega) \Delta R$	$\pm (.2\% + .05\Omega) \Delta R$
Dielectric	$\pm (.1\% + .05\Omega) \Delta R$	$\pm (.1\% + .05\Omega) \Delta R$
Low Temperature Storage	$\pm (.2\% + .05\Omega) \Delta R$	$\pm (.2\% + .05\Omega) \Delta R$
High Temperature Exposure	$\pm (.5\% + .05\Omega) \Delta R$	$\pm (.5\% + .05\Omega) \Delta R$
Shock	$\pm (.1\% + .05\Omega) \Delta R$	$\pm (.1\% + .05\Omega) \Delta R$
Vibration	$\pm (.1\% + .05\Omega) \Delta R$	$\pm (.1\% + .05\Omega) \Delta R$
Terminal Strength	$\pm (.1\% + .05\Omega) \Delta R$	$\pm (.1\% + .05\Omega) \Delta R$

* All ΔR figures shown are maximum, based on units with an initial tolerance of 1% and maximum operating temperature of 275°C.

DERATING

Ambient Temperature: Dale G coated resistors have an operating temperature range of - 55°C to + 350°C. Dale G molded resistors have an operating temperature range of - 55°C to + 275°C. They must be derated at higher temperatures according to the curve below.

CHARACTERISTIC U:
Coated or molded resistors are available in any tolerance.

CHARACTERISTIC V:
Coated resistors are available in 3% and 5% tolerance.

POWER RATING

Power ratings of Dale G resistors are 1.4 to 4 times higher than those of conventional wirewound resistors of equivalent size. At the higher ratings, Dale G resistors will meet the same environmental and life stability requirements of the lower rated conventional resistors.

CHARACTERISTIC U:

1. 275°C maximum hotspot temperature.
2. .5% maximum ΔR in 2000 hour load life.

CHARACTERISTIC V:

1. 350°C maximum hotspot temperature.
2. 3% maximum ΔR in 2000 hour load life.

PART MARKING

- Dale
- Model
- Value
- Tolerance
- Date code

HOW TO ORDER

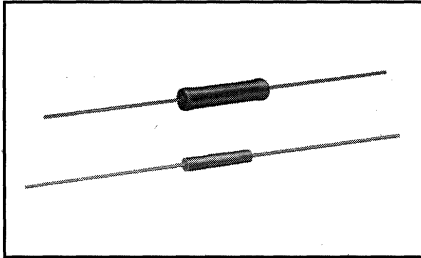
G-3-80	10	1%
MODEL	RESISTANCE	TOLERANCE

MODEL RS

Wirewound Resistors

Military, MIL-R-26 Qualified, Type RW

Precision Power, Silicone Coated and Molded



FEATURES

- Complete welded construction
- High-temperature silicone coating and molding
- Meets applicable requirements of MIL-R-26
- Available in non-inductive styles (Type NS) with Aryton-Perry winding for lowest reactive components
- Over 44 million unit-hours of testing with no catastrophic failures have proven failure rate of less than 0.0066% per 1000 hours (at 60% confidence) with full rated power at 25°C. A failure is defined as $\pm 1\%$ resistance change.
- Coated models: RS-2, 2B, 2C, 5, 7 and 10. Molded models: RS-1/8 thru RS-1A.

STANDARD ELECTRICAL SPECIFICATIONS

	DALE MODEL	MIL-R-26 TYPE	DALE RATING		RESISTANCE RANGE (Ohms)				MAXIMUM * WORKING VOLTAGE		WEIGHT (Grams)
			U .05% thru 5%	V 3% & 5%	MIL. Range shown in bold face				U	V	
					.05%	.1%	.25%	.5%, 1%, 3%, 5%			
MOLDED	RS-1/8	—	.125 W	—	—	—	—	.1-1.4K	8.5	—	.15
	RS-1/4	—	.4 W	—	1-1k	.499-1k	.499-3.4k	.1-3.4k	20	—	.21
	RS-1/2	—	.75 W	—	1-1.3k	.499-1.3k	.499-4.9k	.1-4.9k	29	—	.23
	RS-1A	RW70	1.0 W 1.0 W	—	1-2.74k	.499-2.74k .499-2.74k	.499-10.4k .499-2.74k	.1-10.4k .1-2.74k	52	—	—	.34
COATED	RS-2	—	4.0 W	5.5 W	.499-12.7k	.499-12.7k	.1-47.1k	.1-47.1k	210	250	2.10
	RS-2B**	—	3.0 W	3.75 W	.499-6.5k	.499-6.5k	.1-24.5k	.1-24.5k	140	157	.70
		RW79	3.0 W	—	—	.499-6.49k	.1-6.49k	.1-6.49k	—	—	—
	RS-2C	—	2.5 W	3.25 W	.499-8.6k	.499-8.6k	.1-32.3k	.1-32.3k	138	157	1.6
	RS-2C-17	—	2.5 W	3.25 W	.499-8.6k	.499-8.6k	.1-32.3k	.1-32.3k	138	157	1.6
	RS-2C-23***	—	2.5 W	3.25 W	—	—	—	.1-19.9k	130	150	1.6
		RW69	2.5 W	3.25 W	—	—	—	.1-2.0k	130	150	1.6
	RS-5**	—	5.0 W	6.5 W	.499-25.7k	.499-25.7k	.1-95.2k	.1-95.2k	360	410	4.2
	RS-5-69	—	5.0 W	6.5 W	.499-24.5k	.499-24.5k	.1-91.0k	.1-91.0k	350	400	4.2
		RW74	5.0 W	—	—	.499-24.3k	.1-24.3k	.1-24.3k	—	—	—
RS-5-70***	—	5.0 W	6.5 W	—	—	—	.1-58.5k	320	365	4.2	
	RW67	5.0 W	6.5 W	—	—	—	.1-8.5k	320	365	4.2	
RS-7	—	7.0 W	9.0 W	.499-41.4k	.499-41.4k	.1-154k	.1-154k	504	576	4.7	
RS-10	—	10.0 W	13.0 W	.499-73.4k	.499-73.4k	.1-273k	.1-273k	858	978	9.0	
RS-10-38	—	10.0 W	13.0 W	.499-71.5k	.499-71.5k	.1-265k	.1-265k	846	966	9.0	
	RW78	10.0 W	—	—	.499-71.5k	.1-71.5k	.1-71.5k	—	—	—	
RS-10-39***	—	10.0 W	13.0 W	—	—	—	.1-167k	765	875	9.0	
	RW68	10.0 W	13.0 W	—	—	—	.1-20k	765	875	9.0	

* Maximum working voltage determined at .0008" diameter wire resistance values.
 ** Values available down to .005 ohm in 1%, 3% and 5% tolerances.

*** Standard tolerance is $\pm 5\%$.1 ohm and above, $\pm 10\%$ below 1 ohm. 3% available.

ELECTRICAL SPECIFICATIONS

Resistance Tolerance: $\pm 5\%$, $\pm 3\%$, $\pm 1\%$, $\pm .5\%$, $\pm .25\%$, $\pm .1\%$, $\pm .05\%$.

Temperature Coefficient:

$\pm 90\text{PPM}/^\circ\text{C}$, below 1 ohm.
 $\pm 50\text{PPM}/^\circ\text{C}$, 1 ohm - 9.9 ohm.
 $\pm 20\text{PPM}/^\circ\text{C}$, 10 ohm and above.
 (Consult factory for special T.C. requirements.)

Dielectric Strength: 500 VAC for RS-1/8 through RS-1A models. 1000 volts for all others.

Insulation Resistance: 1000 Megohm minimum dry.
 100 Megohm minimum after moisture test.

Short Time Overload: 5 seconds at 5 times rated power for 3.25 watt size and smaller. 5 seconds at 10 times rated power for 4 watt size and larger.

MECHANICAL SPECIFICATIONS

Solderability: MIL-R-26 Type - Meets requirements of MIL-STD-202, Method 208. Standard RS (Non-MIL Styles)-60/40 electro tin plated terminals to facilitate soldering.

Terminal Strength: 5 pound pull test = RS-1/8 thru RS-1A models. 10 pound pull test = all others.

MATERIAL SPECIFICATIONS

Core: Ceramic, steatite or alumina, depending on physical size.

Element: Copper-nickel alloy or nickel-chrome alloy depending on resistance value.

End Caps: Stainless steel.

Coating: Special high temperature silicone.

Standard Terminals: Tinned Copperweld®.

Weldable Leads: The following weldable lead materials are available from Dale® on a standard stocking basis and can be specified by adding the dash number shown below to the standard part number. Consult factory for charges on special lead materials.

Grade "A" Nickel, untinned -53 (Example: RS-1A-53).

Gold-plated Dumet (50 microinch) -52 (Example: RS-1A-52).

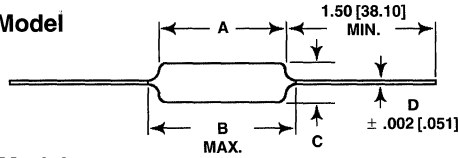
Deviations for RS-1/8: Endcaps will be nickel-silver alloy and terminals will be tinned copper.

MODEL RS

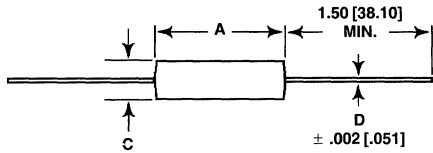
DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]

Coated Model



Molded Model

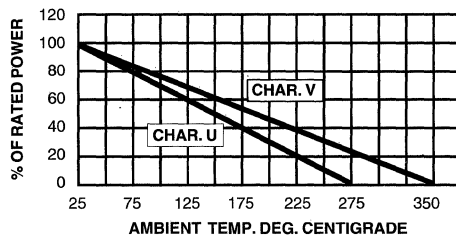


	MODEL	A	B (Max.)	C	D
MOLDED	RS-1/8	.155 ± .015 [3.94 ± .381]	—	.065 ± .015 [1.65 ± .381]	.020 [.508]
	RS-1/4	.250 ± .015 [6.35 ± .381]	—	.078 ± .015 [1.98 ± .381]	.020 [.508]
	RS-1/2	.312 ± .015 [7.92 ± .381]	—	.078 ± .015 [1.98 ± .381]	.020 [.508]
	RS-1A	.422 ± .015 [10.72 ± .381]	—	.110 ± .015 [2.79 ± .381]	.020 [.508]
COATED	RS-2	.625 ± .062 [15.88 ± 1.57]	.765 [19.43]	.250 ± .031 [6.35 ± .787]	.040 [1.02]
	RS-2B	.560 ± .062 [14.22 ± 1.57]	.622 [15.80]	.187 ± .031 [4.75 ± .787]	.032 [.813]
	RS-2C	.500 ± .062 [12.70 ± 1.57]	.593 [15.06]	.218 ± .031 [5.54 ± .787]	.040 [1.02]
	RS-2C-17	.500 ± .062 [12.70 ± 1.57]	.593 [15.06]	.218 ± .031 [5.54 ± .787]	.032 [.813]
	RS-2C-23	.500 ± .062 [12.70 ± 1.57]	.593 [15.06]	.218 ± .031 [5.54 ± .787]	.032 [.813]
	RS-5	.875 ± .062 [22.23 ± 1.57]	1.0 [25.4]	.312 ± .031 [7.92 ± .787]	.040 [1.02]
	RS-5-69	.875 ± .062 [22.23 ± 1.57]	.937 [23.80]	.312 ± .031 [7.92 ± .787]	.040 [1.02]
	RS-5-70	.875 ± .062 [22.23 ± 1.57]	1.0 [25.4]	.312 ± .031 [7.92 ± .787]	.040 [1.02]
	RS-7	1.22 ± .062 [30.94 ± 1.57]	1.28 [32.54]	.312 ± .031 [7.92 ± .787]	.040 [1.02]
	RS-10	1.78 ± .062 [45.21 ± 1.57]	1.87 [47.50]	.375 ± .031 [9.53 ± .787]	.040 [1.02]
RS-10-38	1.78 ± .062 [45.21 ± 1.57]	1.84 [46.79]	.375 ± .031 [9.53 ± .787]	.040 [1.02]	
RS-10-39	1.78 ± .062 [45.21 ± 1.57]	1.87 [47.50]	.375 ± .031 [9.53 ± .787]	.040 [1.02]	

* NOTE: RS-1/8 terminal length will be 1.0" [25.4] minimum.

DERATING

Dale RS coated resistors have an operating temperature range of -55°C to +350°C. Dale RS molded resistors have an operating temperature range of -55°C to +275°C. They must be derated at high ambient temperatures according to the curves below.



CHARACTERISTIC U:

Coated or molded resistors are available in any tolerance.

CHARACTERISTIC V:

Coated resistors are available in 3% and 5% tolerance.

ENVIRONMENTAL PERFORMANCE *

TEST	DALE MAXIMUM
Temperature Coefficient	± 90PPM/°C, below 1Ω ± 50PPM/°C, 1Ω-9.9Ω ± 20PPM/°C, 10Ω and above
Thermal Shock	± (.2% + .05Ω) ΔR
Short Time Overload	± (.2% + .05Ω) ΔR
Dielectric	± (.1% + .05Ω) ΔR
Low Temperature Storage	± (.2% + .05Ω) ΔR
High Temperature Exposure	± (.5% + .05Ω) ΔR
Moisture Resistance	± (.2% + .05Ω) ΔR
Shock	± (.1% + .05Ω) ΔR
Vibration	± (.1% + .05Ω) ΔR
Load Life	± (.5% + .05Ω) ΔR
Terminal Strength	± (.1% + .05Ω) ΔR

* All ΔR figures shown are maximum, based on units with an initial tolerance of 1% and maximum operating temperature of 275°C.

APPLICABLE MIL SPECIFICATIONS

MIL-R-26E: Designed especially for precision and non-precision power wirewound resistors. The RS series meet the requirements of this specification as well as the older MIL-R-26C and MIL-R-23379 specifications. However, this does not imply qualification. Contact factory for latest Government QPL information.

SPECIAL MODIFICATIONS

1. Terminals can be supplied in any commercial material with several type finishes.
2. Terminal lengths and diameters can be varied.
3. Various elements available for special T.C.
4. Special configuration available on request.
5. Tolerances available to .01% on most models.
6. Special matching available (T.C. and tolerance).

NS - NON-INDUCTIVE

Models of equivalent physical and electrical specifications are available with non-inductive (Aryton-Perry) winding.

They are identified by substituting the letter N for R in the part number (NS-5, for example). Four conditions apply:

1. For NS models, divide maximum resistance values by two.
2. For NS models, multiply maximum working voltage by .707.
3. For NS models, maximum weights may slightly exceed those shown on low values.
4. Body O.D. on NS-2C may exceed that of the RS-2C by .010" [.254].

NS-1/8 NS-1/2 NS-2 NS-2C NS-7
NS-1/4 NS-1A NS-2B NS-5 NS-10

POWER RATING

Dale RS models have two power ratings, depending on operating temperature and stability requirements.

CHARACTERISTIC U

1. 275°C maximum hotspot temperature.
2. .5% maximum ΔR in 2000 hour load life.

CHARACTERISTIC V

1. 350°C maximum hotspot temperature.
2. 3% maximum ΔR in 2000 hour load life.

PART MARKING

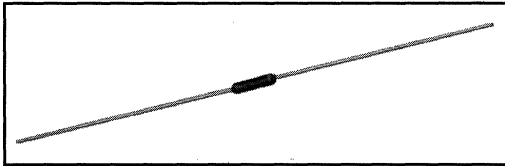
— Dale
— Model
— Value
— Tolerance
— Date code

HOW TO ORDER

RS-1A 10 1%
MODEL RESISTANCE TOLERANCE

MODEL RS Wirewound Resistors

Miniature, Precision Power, Coated



FEATURES

- High performance for low cost
- High power/size ratio
- High-temperature silicone coating
- Excellent stability in operation
- Complete welded construction
- Available in non-inductive styles (NS)

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	POWER RATING	RESISTANCE RANGE (Ohms)				MAXIMUM WORKING VOLTAGE *	MAXIMUM WEIGHT (Grams)
		.05%	.1%	.25%	.5%, 1% 3%, 5%		
RS-1/4-90	.4 W	1-1k	.499-1k	.499-3.4k	.1-3.4k	20	.21
RS-1/2-90	.75 W	1-1.3k	.499-1.3k	.499-4.9k	.1-4.9k	29	.23
RS-1A-90	1.0 W	1-2.74k	.499-2.74k	.499-10.4k	.1-10.4k	52	.34
RS-1M	1.0 W	1-1.67k	.499-1.67k	.499-6.85k	.1-6.85k	41	.30
RS-2M	3.0 W	.499-4.49k	.499-4.49k	.1-18.74k	.1-18.74k	95	.65

* Maximum working voltage determined at .0008" diameter wire resistance value.

ELECTRICAL SPECIFICATIONS

Resistance Tolerance: $\pm 5\%$, $\pm 3\%$, $\pm 1\%$, $\pm .5\%$, $\pm .25\%$, $\pm .1\%$, $\pm .05\%$.

Temperature Coefficient: (-55°C to +275°C).
 $\pm 90\text{PPM}/^\circ\text{C}$ below 1 ohm.
 $\pm 50\text{PPM}/^\circ\text{C}$ 1.0 ohm - 9.9 ohm.
 $\pm 20\text{PPM}/^\circ\text{C}$ 10 ohm and above.

Short Time Overload: 5 seconds at 5 times rated power.

Dielectric Strength: 1000 VAC minimum for RS-2M. 500 VAC minimum for all other styles.

Insulation Resistance: 1000 Megohm minimum dry. 100 Megohm minimum after moisture test.

MATERIAL SPECIFICATIONS

Core Ceramic: Alumina.

Element: Copper-nickel alloy or nickel-chrome alloy, depending on resistance value.

End Caps: Stainless steel.

Coating: Special high temperature silicone.

Standard Terminals: Tinned Copperweld®.

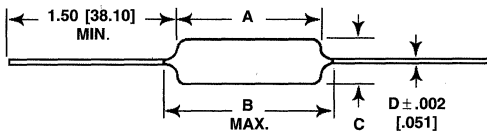
MECHANICAL SPECIFICATIONS

Terminal Strength: 10 pound pull test = RS-2M.
5 pound pull test = all other styles.

Solderability: 60/40 electro tin plated terminals to facilitate soldering.

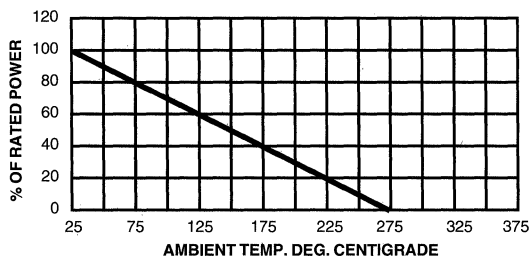
DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



MODEL	A	B (Max.)	C	D
RS-1/4-90	.250 \pm .015 [6.35 \pm .381]	.265 [6.73]	.078 \pm .015 [1.98 \pm .381]	.020 [.508]
RS-1/2-90	.312 \pm .015 [7.92 \pm .381]	.327 [8.30]	.078 \pm .015 [1.98 \pm .381]	.020 [.508]
RS-1A-90	.422 \pm .015 [10.72 \pm .381]	.437 [11.10]	.110 \pm .015 [2.79 \pm .381]	.020 [.508]
RS-1M	.295 \pm .015 [7.50 \pm .381]	.311 [7.90]	.110 \pm .015 [2.79 \pm .381]	.020 [.508]
RS-2M	.500 \pm .062 [12.70 \pm 1.57]	.562 [14.27]	.185 \pm .015 [4.70 \pm .381]	.032 [.813]

DERATING



NS - NON-INDUCTIVE

Models of equivalent physical and electrical specifications are available with non-inductive (Aryton-Perry) winding. They are identified by substituting the letter N for R in the part number (NS-5, for example). Four conditions apply:

1. For NS models, divide maximum resistance values by two.
2. For NS models, multiply maximum working voltage by .707.
3. For NS models, maximum weights may slightly exceed those shown on low values.
4. Body O.D. on NS-2M may exceed that of the RS-2M by .015" [.381].

NS-1/4-90

NS-1/2-90

NS-1A-90

NS-1M

NS-2M

ENVIRONMENTAL PERFORMANCE *

TEST	DALE® MAXIMUM
Temperature Coefficient	$\pm 90\text{PPM}/^\circ\text{C}$ below 1 Ω $\pm 50\text{PPM}/^\circ\text{C}$ 1.0 Ω - 9.9 Ω $\pm 20\text{PPM}/^\circ\text{C}$ 10 Ω and above
Thermal Shock	$\pm (.2\% + .05\Omega) \Delta R$
Short Time Overload	$\pm (.2\% + .05\Omega) \Delta R$
Dielectric	$\pm (.1\% + .05\Omega) \Delta R$
Low Temperature Storage	$\pm (.2\% + .05\Omega) \Delta R$
High Temperature Exposure	$\pm (.5\% + .05\Omega) \Delta R$
Moisture Resistance	$\pm (.2\% + .05\Omega) \Delta R$
Shock	$\pm (.1\% + .05\Omega) \Delta R$
Vibration	$\pm (.1\% + .05\Omega) \Delta R$
Load Life	$\pm (.5\% + .05\Omega) \Delta R$
Terminal Strength	$\pm (.1\% + .05\Omega) \Delta R$

* All ΔR figures shown are maximum based on units with an initial tolerance of 1% and maximum operating temperature of 275°C.

POWER RATING

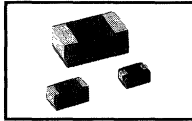
- 275°C maximum hotspot temperature.
- .5% maximum ΔR in 2000 hour load life.

NOTE: For Part Marking and How To Order Information see the RS Precision Power, MIL-R-26, data sheet. In the How To Order Information, substitute RS-1M for Model.



MODEL WSC Wirewound Resistors

Precision Power, Surface Mount



FEATURES

- Molded high-temperature encapsulation
- Available in non-inductive styles with Aryton-Perry windings for lowest reactive components

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	POWER RATING	RESISTANCE RANGE (Ohms)				MAXIMUM WORKING VOLTAGE*
		.05%	.1%	.25%	.5%, 1% 3%, 5%	
WSC-1/2	1/2 W	0.5-527	.30-527	.20-1.41k	0.1-1.41k	22.9 V
WSC-1	1 W	0.62-1k	0.43-1k	0.43-2.77k	0.1-2.77k	28.2 V
WSC-2	2 W	1.0-2.74k	.499-2.74k	.499-10.4k	.005-10.4k	52.4 V

* Maximum working voltage determined @ .0008 diameter resistance value.

MATERIAL SPECIFICATIONS

Element: Copper-nickel alloy or nickel-chrome alloy, depending on resistance value.

End Caps: Nickel silver alloy.

Molding: Special high temperature encapsulation.

Standard Terminals: Tinned copper alloy.

ELECTRICAL SPECIFICATIONS

Resistance Tolerance: 5%, 3%, 1%, .5%, .25%, .1%, .05%.

Temperature Coefficient:

± 90PPM/°C, 0.1 ohm-0.99 ohm.

± 50PPM/°C, 1.0 ohm-9.9 ohm.

± 20PPM/°C, 10 ohm and above.

(Below 0.1 ohm, consult factory).

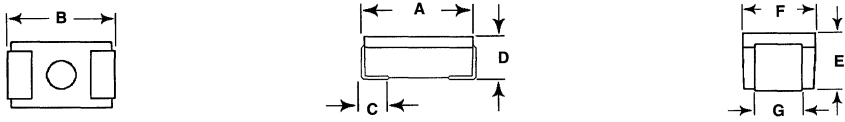
Dielectric Strength: 500 VAC.

Insulation Resistance: 1000 Megohm minimum dry, 100 Megohm after moisture test.

Short Time Overload: 5 seconds at 5 times rated power.

Solderability: 60/40 electro tin plated terminals to facilitate soldering.

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



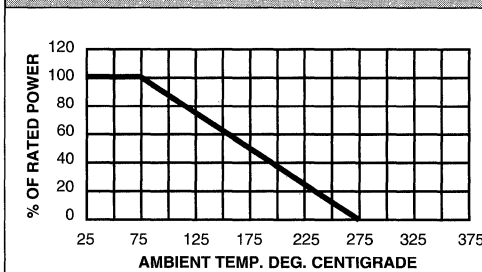
MODEL	A	B	C	D	E	F	G
WSC-1/2	.188 ± .005 [4.77 ± .127]	.200 ± .020 [5.08 ± .508]	.040 ± .010 [1.02 ± .254]	.096 ± .015 [2.44 ± .381]	.090 ± .005 [2.29 ± .127]	.125 ± .005 [3.18 ± .127]	.050 ± .010 [1.27 ± .254]
WSC-1	.238 ± .005 [6.05 ± .127]	.250 ± .020 [6.35 ± .508]	.045 ± .010 [1.14 ± .254]	.110 ± .015 [2.79 ± .381]	.104 ± .005 [2.64 ± .127]	.150 ± .005 [3.81 ± .127]	.098 ± .005 [2.49 ± .127]
WSC-2	.433 ± .005 [11.0 ± .127]	.445 ± .032 [11.30 ± .813]	.100 ± .010 [2.54 ± .254]	.162 ± .015 [4.11 ± .381]	.156 ± .005 [3.96 ± .127]	.275 ± .005 [6.98 ± .127]	.215 ± .005 [5.46 ± .127]

ENVIRONMENTAL PERFORMANCE

TEST	DALE MAXIMUM
Temperature Coefficient	20 to 90 PPM/°C
Thermal Shock	± (.2% + .05Ω) ΔR
Short Time Overload	± (.2% + .05Ω) ΔR
Dielectric	± (.1% + .05Ω) ΔR
Low Temp. Storage	± (.2% + .05Ω) ΔR
High Temp. Exposure	± (.5% + .05Ω) ΔR
Moisture Resistance	± (.2% + .05Ω) ΔR
Shock	± (.1% + .05Ω) ΔR
Vibration	± (.1% + .05Ω) ΔR
Load Life	± (.5% + .05Ω) ΔR

NOTE: Environmental specifications referenced @ 25°C.

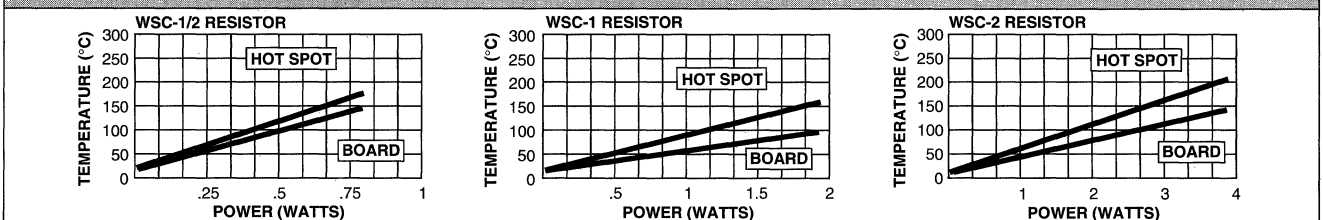
DERATING



PART MARKING

- 1/2 WATT STYLE**
- Dale logo
 - Value
- 1 WATT STYLE**
- Style
 - Value and tolerance
 - Date code
- 2 WATT STYLE**
- Dale logo
 - Style
 - Value and tolerance
 - Date code

SURFACE TEMPERATURE VS POWER



PACKAGING

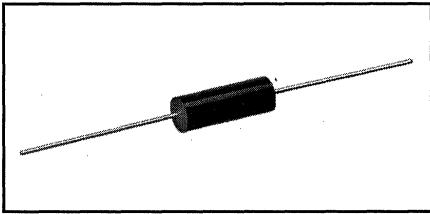
Embossed Carrier Tape per EIA-481-1, 2.
Tape Widths: WSC-1/2 = 12mm/2000 pieces/13" reel. WSC-1 = 16mm/2000 pieces/13" reel. WSC-2 = 24mm/1200 pieces/13" reel.

HOW TO ORDER

WSC-1	10	1%
MODEL	RESISTANCE	TOLERANCE

MODELS LVR-1, LVR-3, LVR-5 Wirewound Resistors

Military, MIL-R-49465 Qualified, Type RLV
and Commercial, Precision Power, Low Value



FEATURES

- Ideal for all types of current sensing applications including switching and linear power supplies, instruments and power amplifiers
- Proprietary processing technique produces extremely low resistance values
- Excellent load life stability
- Low temperature coefficient
- 275°C maximum operating temperature
- Low inductance
- MIL-R-49465 styles available
- Cooler operation for high power to size ratio

STANDARD ELECTRICAL SPECIFICATIONS

DALE MODEL	MIL-R-49465 TYPE	POWER RATING (Watts)	RESISTANCE RANGE* (Ohms) MIL Range shown in bold face	MAXIMUM WEIGHT (Grams)
LVR-1	—	1 W	.01-1	2
LVR-3	RLV30	3 W 3 W	.01-.2 .005-.2	2
LVR-5	RLV31	5 W 5 W	.01-.3 .005-.3	2

* Resistance must be measured 3/8" [9.52] from the body of resistor, or at a 1.315" [33.40] or 1.675" [42.545] spacing for the LVR-3 or -5 respectively.

ELECTRICAL SPECIFICATIONS

Resistance Range: .005 ohm to .3 ohm. Values stocked at $\pm 3\%$ tolerance include: .005, .01, .015, .02, .025, .3, .04, .05, .07, .08.

Resistance Tolerance: $\pm 1\%$, $\pm 3\%$, $\pm 5\%$, $\pm 10\%$. Lower tolerances available as specials.

Temperature Coefficient: Measured from -55°C to +125°C, referenced to +25°C.

Dielectric Strength: 500 VAC.

Insulation Resistance: 10,000 Megohm minimum dry.

Short Time Overload: 5 seconds at 5 times rated power.

MECHANICAL SPECIFICATIONS

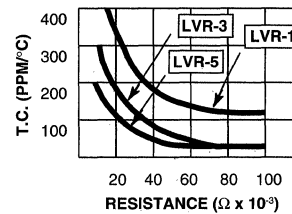
Terminal Strength: 5 pound pull test = LVR-1.

10 pound pull test = LVR-3, LVR-5.

Solderability: Satisfactory when tested in accordance with Method 208 of MIL-STD-202.

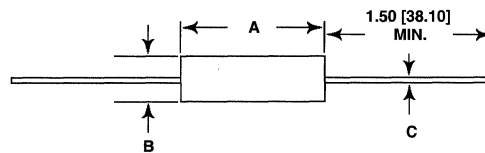
T.C. VS RESISTANCE VALUE

The improved T.C. characteristics of this type LVR from -55°C to 125°C (referenced to 25°C) are as follows:



DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]

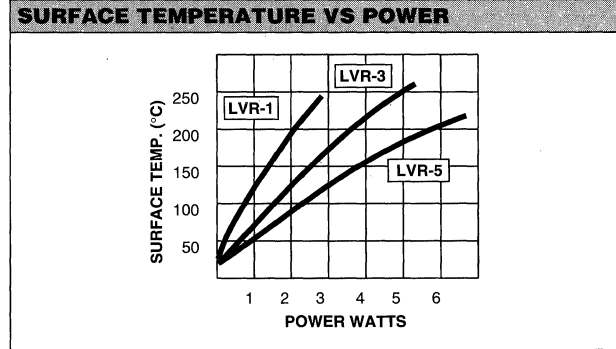
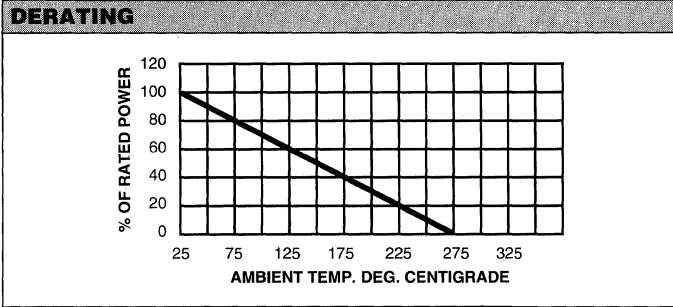


DALE MODEL	A $\pm .010$ [.254]	B $\pm .010$ [.254]	C $\pm .002$ [.051]
LVR-1	.427 [10.85]	.115 [2.92]	.020 [.508]
LVR-3	.560 [14.22]	.205 [5.20]	.032 [.813]
LVR-5	.925 [23.50]	.330 [8.38]	.040 [1.02]

ENVIRONMENTAL PERFORMANCE

TEST	MIL-R-49465 MAXIMUM	UNITS
Resistance-Temperature Characteristic	(See chart)	Parts/Million/°C
Maximum Ambient Temperature at Rated Wattage	25	Degrees Celsius
Maximum Ambient Temperature at Zero Power	275	
Thermal Shock	$\pm 0.2\%$	Maximum percent change in resistance (.0005 ohm additional allowed for measurement error).
Short Time Overload	$\pm 0.5\%$	
Terminal Strength	$\pm 0.1\%$	
Dielectric Withstanding Voltage	$\pm 0.1\%$	
Insulation Resistance	1.000M Ω	Maximum percent change in resistance (.0005 ohm additional allowed for measurement error).
High Temperature Exposure	$\pm 1.0\%$	
Moisture Resistance	$\pm 0.2\%$	
Low Temperature Storage	$\pm 0.2\%$	
Shock, Specified Pulse	$\pm 0.1\%$	
Vibration, High Frequency	$\pm 0.1\%$	
Life	$\pm 1.0\%$	
Tolerance	1%, 3%, 5%	Percent

MODELS LVR-1, LVR-3, LVR-5



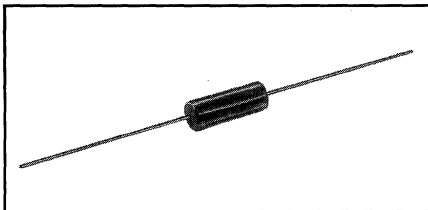
PART MARKING

- Dale
- Model
- Value
- Tolerance
- Date code

HOW TO ORDER

LVR-3	.05	1%
MODEL	VALUE	TOLERANCE

MODEL LVR-10
Wirewound Resistors
Military, MIL-R-49465 Qualified, Type RLV32
and Commercial, Precision Power, Low Value



FEATURES

- Extremely low resistance values
- High power rating
- Low temperature coefficient
- 275°C maximum operating temperature
- MIL-R-49465 style available, LVR-10-26

ELECTRICAL SPECIFICATIONS

Resistance Range: .01 ohm to .8 ohm, Commercial. .01 ohm to .5 ohm, Military. Resistance must be measured 3/8" [9.52] from body of resistor.

Resistance Tolerance: ± 1%, ± 3%, ± 5%, ± 10%. Lower tolerances available as specials.

Power Rating: 10 watt.

Dielectric Strength: 500 VAC.

Insulation Resistance: 10,000 Megohm minimum dry.

Short-Time Overload: 5 seconds at 10 times rated power.

Temperature Coefficient: Varies with resistance values. Consult factory.

MECHANICAL SPECIFICATIONS

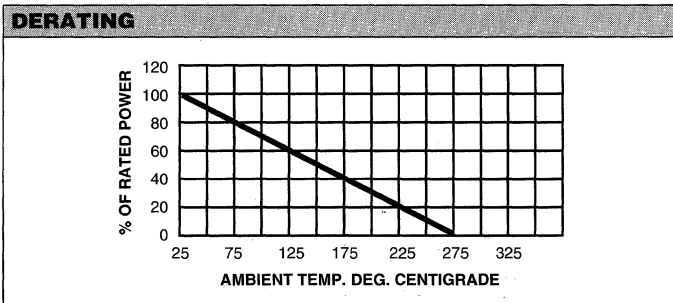
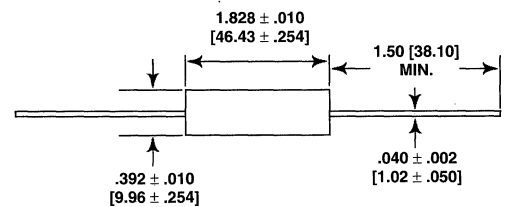
Terminal Strength: 10 pound pull test.

Solderability: Satisfactory when tested in accordance with Method 208 of MIL-STD-202.

Maximum Weight: 11.0 grams.

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



PART MARKING

- Dale
- Model
- Value and tolerance
- Wattage
- Date code

ORDERING SPECIFICATIONS

Wirewound Resistors

Industrial Power (HL)



ELECTRICAL SPECIFICATIONS

Resistance Tolerance:

HL (flat/tubular), NHL, HLM, HLW = $\pm 5\%$ standard on values 1 ohm and above. $\pm 10\%$ standard on values below 1 ohm.

HLA = $\pm 5\%$ standard.

HLT and HLZ = $\pm 10\%$ standard.

(For HLZ, $\pm 5\%$ available.)

Temperature Coefficient:

$\pm 90\text{PPM}/^\circ\text{C}$, below 1 ohm.

$\pm 50\text{PPM}/^\circ\text{C}$, 1 ohm to 9.9 ohm.

$\pm 30\text{PPM}/^\circ\text{C}$, 10 ohm and above.

Dielectric Strength: 1000 VAC minimum.

Short Time Overload: In intermittent duty the applied power can greatly exceed the wattage rating. However, since each pulse application is somewhat unique, the factory should be contacted for specific requirements.

MATERIAL SPECIFICATIONS

Core: Steatite. Chemically inert - will withstand severe thermal shock and is impervious to moisture.

Element: Highest quality copper-nickel alloy or nickel-chrome alloy, depending on resistance value. Special alloys available upon request.

Coating: HL - special high temperature silicone, cured at much lower temperatures than vitreous enamels.

REACTANCE

All resistors have capacitance and inductance as well as pure resistance, and these factors can become significant at high frequencies.

For wirewound resistors, inductive effects are predominant in low value resistors (below 1,000 ohm) and capacitive effects become predominant in higher resistance values. Dale® uses specialized non-inductive winding techniques to minimize reactance for specific customer requirements. Consult your local representative or contact the factory direct for assistance with low reactance resistors.

TEMPERATURE COEFFICIENT

All resistive materials are temperature sensitive to some extent, therefore, the resistance value will vary from the original 25°C value as the ambient temperature increases or decreases. The curve of resistance over the whole operating temperature range is usually a non-linear curve that fits within predictable maximum limits. Any individual resistor will trace essentially the same curve on each excursion.

The magnitude of this temperature-dependent resistance change is identified by the temperature coefficient - the maximum amount of resistance change for each degree change in temperature - and is most commonly expressed in parts per million per degree centigrade (PPM/°C). T.C. in PPM/°C is calculated with the following formula:

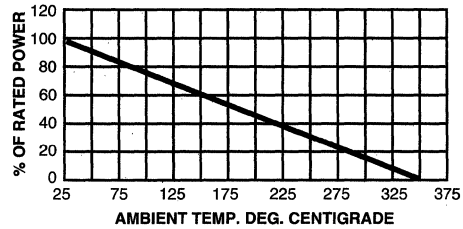
$$\text{T.C.} = \frac{R_2 - R_1}{(T_2 - T_1) R_1} \times 10^6$$

R_1 = resistance at T_1
 R_2 = resistance at T_2
 T_1 = reference temperature (°C)
 T_2 = test temperature

T.C. as low as $\pm 20\text{PPM}/^\circ\text{C}$ or as high as $+ 5500\text{PPM}/^\circ\text{C}$ can be obtained on many values. Contact the Dale factory for your special T.C. needs.

DERATING

Industrial wirewound resistors have an operating temperature range of $- 55^\circ\text{C}$ to $+ 350^\circ\text{C}$. They must be derated at high ambient temperatures according to the curve at the right.



POWER RATING

Power rating is based on:

- 325°C heat rise for HL Models.
- 375°C heat rise for HLZ Models.
- 3% maximum ΔR in 2000 hour load life test.

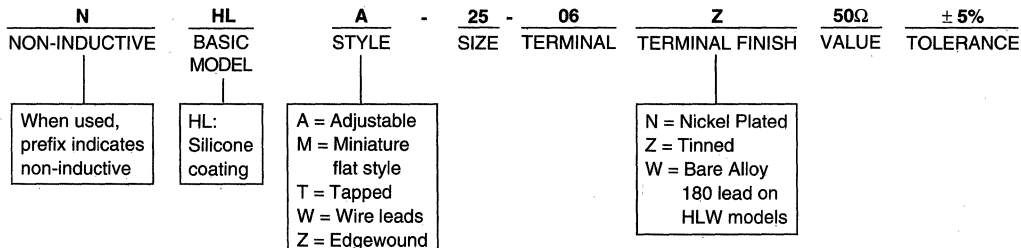
PART MARKING

- Dale
- Model
- Value and tolerance
- Wattage
- Date code

Orders must have complete information including:

- Resistor type, model and wattage.
- Resistor value (total and each section if tapped).
- Resistor tolerance.
- If lug style: Terminal style.
- Mounting brackets and other accessories should be listed as separate items by bracket type.
- Power rating in amperes, volts or watts for each section (applies to tapped resistors only).
- Temperature Coefficient (if non-standard).
- Include Dale Electronics quotation number, if any.
- If you have a drawing covering the part, specify your part number

HOW TO ORDER



EXAMPLES:

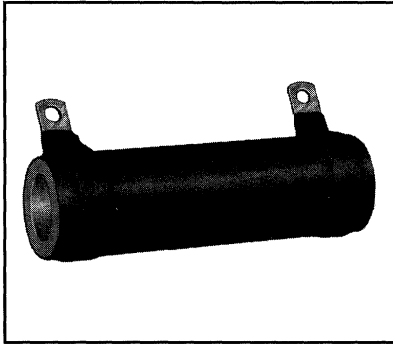
NHL-50-06N, 100Ω $\pm 5\%$ = Non-inductive 50 watt unit, 06 nickel plated terminals. HLA-20-02N, 50Ω $\pm 5\%$ = Adjustable 20 watt unit, 02 nickel plated terminals. HL-12-05Z, 50Ω $\pm 5\%$ = Standard 12 watt power resistor, 05 tinned terminals.

and drawing number, and supply a copy with the order. Including the Dale specification number on your drawing will assure exact duplication on all your future orders.

- Specify quantity of each item.
- Prices will be quoted on request on specific items and quantities. Quantity of each item ordered at one time determines unit price for manufacturers' orders.
- Specify routing.

MODELS HL and NHL Wirewound Resistors

Industrial Power, Tubular (HL), Non-Inductive Tubular (NHL)



APPLICATIONS - HL

Special applications include grid resistors, voltage dropping resistors, high voltage bleeder resistors in power supplies, bias supply resistors, voltage divider networks, filament dropping resistors, load resistors, shunt resistors.

Dale® HL resistors for inexpensively dissipating larger amounts of power in DC or low frequency AC circuits.

APPLICATIONS - NHL

Dummy antennas, terminating resistors, any resistance function where low effective inductance is needed.

Dale NHL resistors utilize Aryton-Perry winding (two single-layer parallel windings in opposite directions) to cancel most of the inductive effects.

STANDARD ELECTRICAL SPECIFICATIONS			
MODEL	WATTAGE RATING	MAXIMUM * RESISTANCE (Ohms)	MAXIMUM WORKING VOLTAGE
HL-12	12	50k	500
NHL-12		3.9k	166
HL-20	20	120k	880
NHL-20		6.8k	316
HL-25	25	155k	1.3k
NHL-25		8.8k	432
HL-50	50	136k	1.9k
NHL-50		21.5k	866
HL-100	100	306k	2.5k
NHL-100		48.5k	1.9k
HL-175	175	606k	5.2k
NHL-175		112k	3.7k
HL-225	225	760k	6.1k
NHL-225		121k	4.5k

* Minimum resistance is .1 ohm for HL, 1 ohm for NHL.
5% tolerance is standard on values 1 ohm and above,
10% on values below 1 ohm. Lower tolerances available.

TYPICAL INDUCTANCE		
RESISTANCE (Ohms)	DALE STANDARD WINDING	DALE NON-INDUCTIVE WINDING
90	HL-12 = 9.5 microhenrys	NHL-12 = 0.2 microhenry
300	HL-25 = 50 microhenrys	NHL-25 = 0.25 microhenry
1k	HL-100 = 310 microhenrys	NHL-100 = 0.7 picofarads

Also available as a modification of HLW, HL Flat or HL Miniature styles.

NOTE: NHL resistors utilize the same cores, terminals and mounting hardware as HL models. However, resistance values are lower because of spacing allowances which must be made in the Aryton-Perry winding.

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]								
<p>(Includes coating and terminal band)</p>	MODEL	CORE DIMENSIONS			TERMINAL SETBACK ± 1/32 [.794]	STANDARD* TERMINAL DESIGNATION	MOUNTING HARDWARE OPTIONS	
		A MAX.	LENGTH ± 1/16 [1.59]	O.D.				I.D. ± 1/32 [.794]
		HL-12	13/32	1-3/4				5/16	3/16	3/32 [2.38]	05	101, 204, 301
NHL-12	[10.32]	[44.45]	[7.94]	[7.94]	—			
HL-20	9/16	2	7/16	5/16	3/32 [2.38]	02	101, 203, 301	
NHL-20	[14.29]	[50.80]	[11.11]	[7.94]	—			
HL-25	11/16	2	9/16	5/16	3/32 [2.38]	06	101, 203, 301	
NHL-25	[17.46]	[50.80]	[14.29]	[7.94]	—			
HL-50	11/16	4	9/16	5/16	3/32 [2.38]	06	101, 203, 301	
NHL-50	[17.46]	[101.60]	[14.29]	[7.94]	—			
HL-100	29/32	6-1/2	3/4	1/2	1/8 [3.18]	06	102, 206, 303	
NHL-100	[23.02]	[165.10]	[19.05]	[12.70]	—			
HL-175	1-5/16	8-1/2	1-1/8	3/4	7/32 [5.56]	07	103, 205, 303	
NHL-175	[33.34]	[215.90]	[28.58]	[19.05]	—			
HL-225	1-5/16	10-1/2	1-1/8	3/4	7.32 [5.56]	07	103, 205, 303	
NHL-225	[33.34]	[266.70]	[28.58]	[19.05]	—			

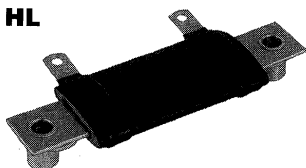
* Contact factory for optional, non-standard terminals, including quick disconnect types. See page 69 for dimensions.



MODELS HL and HLM Wirewound Resistors

Industrial Power, Flat (HL), Miniature Flat (HLM)

Model HL



FEATURES

- High power-to-size ratio
- Mounting accommodations ideally suited to high density packaging
- Self-stacking hardware for horizontal or vertical placement
- Withstands high vibration without loosening
- Mountings function as heat sinks allowing greater heat dissipation and less derating of stacked units

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	WATTAGE RATING	MAXIMUM* RESISTANCE (Ohms)	MAXIMUM WORKING VOLTAGE
HL-24	30	11k	575
HL-35	40	27k	1040
HL-55	55	61k	1.8KV
HL-95	95	111k	2.6KV

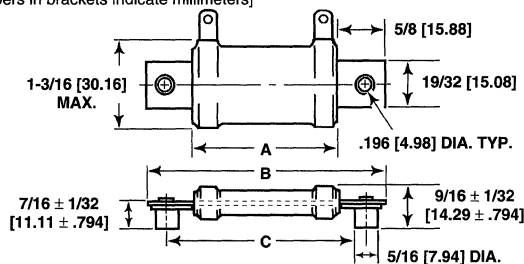
* Minimum resistance is .1 ohm for all models.
5% tolerance is standard on values 1 ohm and above, 10% on values below 1 ohm.
Lower tolerances available.

DERATING STACK MOUNTED UNITS

NO. OF RESISTORS IN STACK	PERCENT OF SINGLE UNIT RATING		
	MINIATURE	WITH 1/4" [6.35] SPACER	STANDARD
2	72	80	70
3	61	73	60
4	51	64	50

DIMENSIONAL CONFIGURATIONS

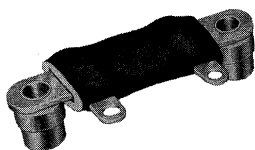
[Numbers in brackets indicate millimeters]



MODEL	A ± 1/16 [1.59]	B ± 1/16 [1.59]	C ± 1/32 [.794]	TERMINAL SETBACK ± 1/32 [.794]	STANDARD* TERMINAL DESIGNATION
HL-24	1-1/4 [31.75]	2-1/2 [63.50]	2 [50.80]	5/64 [1.98]	09
HL-35	2 [50.80]	3-1/4 [82.55]	2-3/4 [69.85]	5/64 [1.98]	09
HL-55	3-1/2 [88.90]	4-3/4 [120.65]	4-1/4 [107.95]	5/64 [1.98]	09
HL-95	6 [152.40]	7-1/4 [184.15]	6-3/4 [171.45]	5/64 [1.98]	09

* Contact factory for optional, non-standard terminals, including quick disconnect types.
See page 69 for dimensions.

Model HLM



STANDARD ELECTRICAL SPECIFICATIONS

MODEL	WATTAGE* RATING	MAXIMUM** RESISTANCE (Ohms)	MAXIMUM WORKING VOLTAGE
HLM-10	10	15k	300
HLM-20	20	65k	1000

* Mounted horizontally on 10" x 10" x .04" [250.40 x 250.40 x 1.02] steel plate.
** Minimum resistance .1 ohm for all models.
5% tolerance is standard on values 1 ohm and above, 10% on values below 1 ohm.
Lower tolerances available.

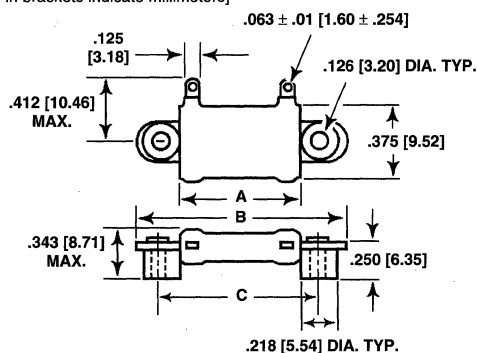
EXCLUSIVE BRACKET DESIGN *

Mounting strap fits snugly through core and is bound tightly against unit by two eccentric spacers. Eliminates expensive cements and improves heat transfer and power handling capabilities.

* Patent 3390367

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]

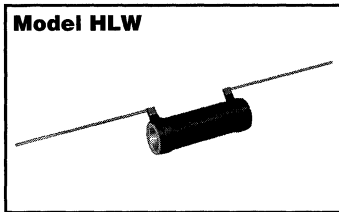


MODEL	A ± 1/16 [1.59]	B ± 1/16 [1.59]	C ± 1/64 [.400]	STANDARD* TERMINAL DESIGNATION
HLM-10	.750 [19.05]	1.312 [33.32]	1.0 [25.40]	10
HLM-20	2.062 [52.37]	2.625 [66.68]	2.313 [58.75]	10

* Contact factory for optional, non-standard terminals.
See page 69 for dimensions.

MODELS HLW and HLZ Wirewound Resistors

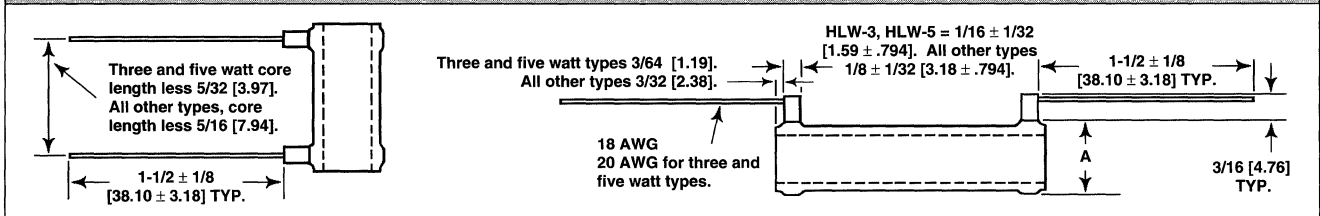
Industrial Power, Tubular (HLW), Edgewound (HLZ)



STANDARD ELECTRICAL SPECIFICATIONS		
MODEL	WATTAGE RATING	MAXIMUM* RESISTANCE (Ohms)
HLW-3	3	6k
HLW-5	5-1/4	15k
HLW-6	8	25k
HLW-12	12	70k
HLW-20	20	120k

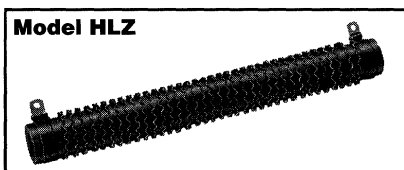
ELECTRICAL SPECIFICATIONS
Resistance Tolerance: 5% tolerance standard 1 ohm and above. 10% below 1 ohm. Lower tolerances available.
MATERIAL SPECIFICATIONS
Construction: Identical to Model HL, but with lug-attached leads to facilitate direct electrical connection by soldering.

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



MODEL	CORE DIMENSIONS			A (Max.)	AXIAL** TERMINAL DESIGNATION	RADIAL** TERMINAL DESIGNATION	MOUNTING HARDWARE
	LENGTH ± 1/16 [1.59]	O.D.	I.D. ± 1/32 [.794]				
HLW-3	7/16 [11.11]	13/64 [5.16]	1/8 [3.18]	19/64 [7.54]	A2	R2	—
HLW-5	5/8 [15.88]	1/4 [6.35]	1/8 [3.18]	11/32 [8.73]	A2	R2	—
HLW-6	1 [25.40]	5/16 [7.94]	3/16 [4.76]	13/32 [10.32]	A1	R1	101, 204, 301
HLW-12	1-3/4 [44.55]	5/16 [7.94]	3/16 [4.76]	13.32 [10.32]	A1	R1	101, 204, 301
HLW-20	2 [50.80]	7/16 [11.11]	5/16 [7.94]	9.16 [14.29]	A1	R1	102, 203, 301

* Minimum resistance is .1 ohm for all models. Consult factory for higher values. ** See page 69 for dimensions.



FEATURES

- Designed to meet heavy-duty requirements where space is at a premium
- High thermal capacity for intermittent or short duration
- Silicone coating allows maximum heat transfer from wire surface

STANDARD ELECTRICAL SPECIFICATIONS			
MODEL	WATTAGE RATING	RESISTANCE RANGE (Ohms)	
		(Min.)	(Max.)
HLZ-33	35	.05	1.9
HLZ-90	90	.15	5.7
HLZ-165	165	.36	13.0
HLZ-300	300	.23	25.0

ELECTRICAL SPECIFICATIONS

Resistance Tolerance: ± 10% standard. ± 5% available.

Dielectric Strength: 1000 V from terminals to mounting hardware.

Temperature Rise: 375°C at full power. Slightly higher temperatures will occur in maximum resistance units.

DIMENSIONAL CONFIGURATIONS					
MODEL	CORE DIMENSIONS			STANDARD* TERMINAL DESIGNATION	MOUNTING HARDWARE
	LENGTH ± 1/16 [1.59]	O.D.	I.D. ± 1/32 [.794]		
HLZ-33	2 [50.8]	9/16 [14.29]	5/16 [7.94]	06	101, 203, 301
HLZ-90	4 [101.6]	9/16 [14.29]	5/16 [7.94]	06	101, 203, 301
HLZ-165	6-1/2 [165.1]	3/4 [19.05]	1/2 [12.70]	06	102, 206, 303
HLZ-300	8-1/2 [215.9]	1-1/8 [28.58]	3/4 [19.05]	07	103, 205, 303

[Numbers in brackets indicate millimeters]

* Contact factory for optional non-standard terminals including quick disconnect types. See page 69 for dimensions.

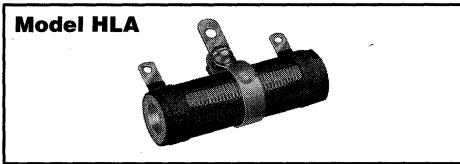
MATERIAL SPECIFICATIONS

Construction: A ribbon element is edgewound onto a ceramic tube and is coated with silicone. Silicone coating holds ribbon wire firmly against core while allowing maximum exposure of wire surface for heat transfer by radiation and convection.



MODELS HLA and HLT Wirewound Resistors

Industrial Power, Adjustable (HLA), Tapped (HLT)



FEATURES

- Adjustable resistor or voltage divider
- Can be used to quickly obtain odd resistance values
- Can be used as multi-tap resistor
- One or more adjustable lugs can be provided for voltage-divider applications

STANDARD ELECTRICAL SPECIFICATIONS			
MODEL	WATTAGE RATING	MAXIMUM * RESISTANCE (Ohms)	MAXIMUM WORKING VOLTAGE
HLA-12	12	10k	350
HLA-20	20	18k	600
HLA-25	25	25k	790
HLA-50	50	100k	1.9K
HLA-100	100	100k	2.5K
HLA-175	175	100k	4.1K
HLA-225	225	100k	4.75K

* Minimum resistance is 1 ohm for all models.

ELECTRICAL SPECIFICATIONS

Tolerance: The standard tolerance on the total resistance is $\pm 5\%$ and is checked with the adjustable terminal removed from the unit, in accordance with MIL-R-19365C.

Wattage Rating: To avoid overloading any section of an adjustable resistor, do not exceed the maximum rated current based on total resistance. The wattage ratings shown on the chart apply only when the entire resistance is in the circuit. The adjustable lug divides the wattage rating in proportion to the divided resistance.

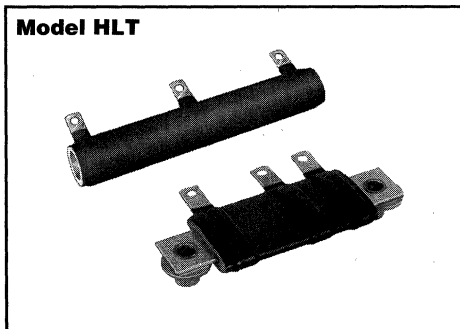
DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]									
MODEL	A (Max.)	CORE DIMENSIONS			TERMINAL SETBACK $\pm 1/32$ [.794]	STANDARD* TERMINAL DESIGNATION	ADJ. SLIDER	MOUNTING HARDWARE	
		LENGTH $\pm 1/16$ [1.59]	O.D.	I.D. $\pm 1/32$ [.794]					
		HLA-12	13/32 [10.32]	1-3/4 [44.45]					5/16 [7.94]	3/16 [4.76]	3/32 [2.38]	05	70	101, 204, 301
HLA-20	9/16 [14.29]	2 [50.80]	7/16 [11.11]	5/16 [7.94]	3/32 [2.38]	02	71	101, 203, 301	
HLA-25	11/16 [17.46]	2 [50.80]	9/16 [14.29]	5/16 [7.94]	3/32 [2.38]	06	72	101, 203, 301	
HLA-50	11/16 [17.46]	4 [101.60]	9/16 [14.29]	5/16 [7.94]	3/32 [2.38]	06	72	101, 203, 301	
HLA-100	29/32 [23.02]	6-1/2 [165.10]	3/4 [19.05]	1/2 [12.70]	1/8 [3.18]	06	73	102, 206, 303	
HLA-175	1-5/16 [33.34]	8-1/2 [215.90]	1-1/8 [28.58]	3/4 [19.05]	7/32 [5.56]	07	74	103, 205, 303	
HLA-225	1-5/16 [33.34]	10-1/2 [266.70]	1-1/8 [28.58]	3/4 [19.05]	7/32 [5.56]	07	74	103, 205, 303	

** Contact factory for optional, non-standard terminals including quick disconnect types. See page 69 for dimensions.



(Includes coating and terminal band)

ADJUSTABLE RESISTOR INFORMATION					
Moving Adjustable Lugs: The coatings protect the resistance wire from shifting and shorting to other turns during adjustment. However, the following three steps should always be taken whenever adjustments are made: (1) Turn off current to avoid possible operator injury and damage to the unit. (2) Loosen adjustable lug until it will slide completely free, without touching the exposed wire. (3) When adjustment point has been selected, retighten lug only enough to assure a firm contact, do not tighten beyond this point. Failure to follow these three steps in order can result in damage to the resistor.	SLIDER MODEL NUMBER		WIDTH	HEIGHT	HOLE DIAMETER
		70	3/16 [4.76]	33/64 [13.10]	.125 [3.18]
71		1/4 [6.35]	19/32 [15.08]	.156 [3.96]	
72		1/4 [6.35]	23/32 [18.26]	.141 [3.58]	
73		1/4 [6.35]	25/32 [19.84]	.141 [3.58]	
74		5/16 [7.94]	25/32 [19.84]	.170 [4.32]	



FEATURES

- Provides fixed taps for voltage dividers

ELECTRICAL SPECIFICATIONS

Tolerance: The standard tolerance is $\pm 10\%$ for the total resistance. Closer tolerance can be supplied upon request.

Power Rating & Maximum Resistance: The winding space is slightly reduced by the additional terminals, resulting in a small reduction of power rating and maximum resistance. Consult the factory for information on specific applications. To insure proper resistor design, the power rating for each section must be specified.

Available as a modification of HL Tubular, HL Flat or HL Miniature Flat models.

SPECIFICATIONS

Wirewound Resistors

Industrial Power (HL)



TERMINAL DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]										
Terminals for HL, HLM and HLW										
		TERMINAL DESIGNATION	02	05	06	07	09	10	A1, R1	A2, R2
		WIDTH	3/16 [4.76]	3/16 [4.76]	1/4 [6.35]	3/8 [9.52]	3/16 [4.76]	1/8 [3.18]	1-1/2 [38.10]	1-1/2 [38.10]
		HEIGHT	13/32 [10.32]	7/16 [11.11]	9.16 [14.29]	5/8 [15.88]	1/2 [12.70]	3/16 [4.76]	18 AWG Lead	20 AWG Lead
		HOLE DIA.	.093 [2.36]	.104 [2.64]	.166 [4.22]	.173 [4.39]	.104 [2.64]	.063 [1.60]		
		THICKNESS	.020 [.508]	.020 [.508]	.020 [.508]	.020 [.508]	.020 [.508]	.030 [.762]		

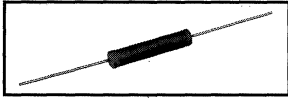
All terminals will be supplied in tinned finish (Z) unless otherwise specified. Optional finishes are nickel plated (N) for HL's, bare alloy 180 (W) for HLW lead styles. Specify proper suffix in part number designation when ordering.

MOUNTING DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]								
Horizontal Thru-Bolt								
(Threaded Rod Supplied as Standard on HL-50 thru HL-225 Sizes)								
BRACKET TYPE	X	Y	Z	H	MOUNTING SLOT	C	B	
101	1-1/16 [26.99]	1/2 [12.70]	55/64 [21.83]	1 [25.40]	7/32 x 7/16 [5.56 x 11.11]	3/4 [19.05]	1-3/8 [34.92]	
102	1-1/16 [26.99]	3/4 [19.05]	55/64 [21.83]	1-1/4 [31.75]	7/32 x 7/16 [5.56 x 11.11]	3/4 [19.05]	1-3/4 [44.45]	
103	1-1/16 [26.99]	1-1/4 [31.75]	1 [25.40]	1-1/2 [38.10]	9/32 x 9/16 [7.14 x 14.29]	7/8 [22.22]	2-1/8 [53.98]	
NOTE: Flat washers are supplied on resistor cores through 9/16" [14.29] diameter.								

Push-In					
BRACKET TYPE	X	H	Y	Z	HOLE
203	5/8 [15.88]	43/64 [17.06]	1/4 [6.35]	15/32 [11.91]	.161 DIA. [4.09]
204	3/8 [9.52]	9/32 [7.14]	1/4 [6.35]	11/32 [8.73]	.144 DIA. [3.66]
205	13/16 [20.64]	1-25/64 [35.32]	1/2 [12.70]	11/16 [17.46]	.196 x .260 [4.98 x 6.60]
206	23/32 [18.26]	31/32 [24.61]	3/8 [9.52]	5/8 [15.88]	.196 x .375 [4.98 x 9.52]

Vertical Thru-Bolt		
(Threaded rod supplied as standard on HL-50 thru HL-225 sizes)		
BRACKET TYPE	X (Approximate)	THREAD
301	7/16 [11.11]	8-32
303	1/2 [12.7]	10-32
NOTE: Flat washers are supplied on resistor cores through 9/16" [14.29] diameter.		

MODEL CW Wirewound Resistors Coated



FEATURES

- High performance for low cost
- Complete welded construction
- High power/size ratio
- High-temperature silicone coating
- Excellent stability in operation

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	POWER RATING (Max. Hot Spot)		RESISTANCE RANGE (Ohms)	MAX. WT. (Grams)	MAXIMUM * WORKING VOLTAGE	
	275°C	350°C			275°C	350°C
CW-2	4.0	5.5	.1-28.7k	2.1	200	235
CW-2B**	3.0	3.75	.1-15k	.70	125	140
CW-2C	2.5	3.25	.1-19.9k	1.6	130	150
CW-2C-14	2.5	3.25	.1-19.9k	1.6	130	150
CW-5**	5.0	6.5	.1-58.5k	4.2	320	365
CW-5-2	4.0	5.0	.1-40.3k	4.2	240	265
CW-5-3	5.0	6.5	.1-58.5k	4.2	320	365
CW-7	7.0	9.0	.1-95.2k	4.7	460	520
CW-10	10.0	13.0	.1-167k	9.0	765	875
CW-10-3	10.0	13.0	.1-167k	9.0	765	875

* Maximum working voltage determined at .0008" diameter wire resistance values.

** Values available down to .005 ohm in 10% tolerance.

ELECTRICAL SPECIFICATIONS

Resistance Tolerance: ± 5% standard 1 ohm and above.
± 10% standard below 1 ohm. ± 2% and ± 3% available.

Temperature Coefficient: (- 55°C to + 350°C).

± 90PPM/°C below 1 ohm.
± 50PPM/°C 1 ohm to 9.9 ohm.
± 30PPM/°C 10 ohm and above.

Short Time Overload: 5 seconds at 5 times rated power for 3.75 watt size and smaller. 5 seconds at 10 times rated power for 4 watt size and larger.

Dielectric Strength: 1000 VAC minimum.

MECHANICAL SPECIFICATIONS

Terminal Strength: 10 pound pull test.

Solderability: 60/40 electro tin plated terminals to facilitate soldering.

MATERIAL SPECIFICATIONS

Core: Ceramic: Steatite or alumina, depending on physical size.

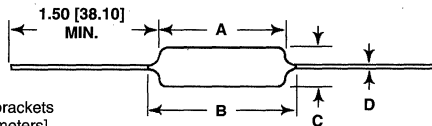
Element: Copper-nickel alloy or nickel-chrome alloy, depending on resistance value.

End Caps: Stainless steel.

Coating: Special high temperature silicone.

Standard Terminals: Tinned Copperweld®.

DIMENSIONAL CONFIGURATIONS



[Numbers in brackets indicate millimeters]

MODEL	A ± .062 [1.57]	B (Max.)	C ± .032 [.813]	D ± .002 [.051]
CW-2	.625 [15.87]	.765 [19.43]	.250 [6.35]	.040 [1.02]
CW-2B	.562 [14.27]	.622 [15.80]	.188 [4.78]	.032 [.813]
CW-2C	.500 [12.70]	.593 [15.06]	.218 [5.54]	.040 [1.02]
CW-2C-14	.500 [12.70]	.593 [15.06]	.218 [5.54]	.032 [.813]
CW-5	.875 [22.22]	1.0 [25.40]	.312 [7.92]	.040 [1.02]
CW-5-2	.875 [22.22]	1.0 [25.40]	.250 [6.35]	.032 [.813]
CW-5-3	.875 [22.22]	1.0 [25.40]	.312 [7.92]	.032 [.813]
CW-7	1.218 [30.94]	1.281 [32.54]	.312 [7.92]	.040 [1.02]
CW-10	1.781 [45.24]	1.875 [47.62]	.375 [9.52]	.040 [1.02]
CW-10-3	1.781 [45.24]	1.875 [47.62]	.375 [9.52]	.032 [.813]

ENVIRONMENTAL PERFORMANCE *

TEST	DALE® MAXIMUM
Temperature Coefficient	± 90PPM/°C below 1Ω ± 50PPM/°C 1Ω to 9.9Ω ± 30PPM/°C 10Ω and above
Thermal Shock	± (2% + .05Ω) ΔR
Short Time Overload	± (2% + .05Ω) ΔR
Dielectric	± (.1% + .05Ω) ΔR
Low Temperature Storage	± (2% + .05Ω) ΔR
High Temperature Exposure	± (2% + .05Ω) ΔR
Moisture Resistance	± (2% + .05Ω) ΔR
Shock	± (.2% + .05Ω) ΔR
Vibration	± (.2% + .05Ω) ΔR
Load Life	± (3% + .05%) ΔR
Terminal Strength	± (1% + .05Ω) ΔR

* All ΔR figures shown are maximum, based upon testing requirements per MIL-R-26 at a maximum operating temperature of 350°C. ΔR maximum figures are considerably lower when tested at a maximum operating temperature of 275°C.

POWER RATING

Dale Model CW have two power ratings, depending on operating temperature and stability requirements.

CHARACTERISTIC U:

1. 275°C maximum hot spot temperature.
2. .5% maximum ΔR in 2000 hour load life.

CHARACTERISTIC V:

1. 350°C maximum hot spot temperature.
2. .3% maximum ΔR in 2000 hour load life.

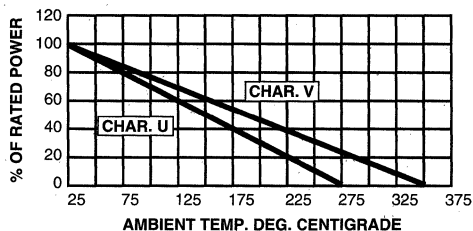
PART MARKING

- Dale
- Model
- Value
- Tolerance
- Date code

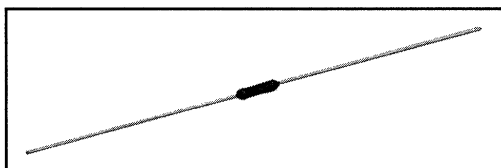
HOW TO ORDER

CW - 5 - 3 - 3k - ± 5%
MODEL WATTAGE STYLE RESISTANCE TOLERANCE

DERATING



MODEL CW Wirewound Resistors Commercial, Miniature, Coated



FEATURES

- High performance for low cost
- High-temperature silicone coating
- Complete welded construction
- High power/size ratio
- Excellent stability in operation

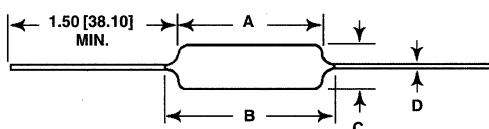
STANDARD ELECTRICAL SPECIFICATIONS

MODEL	POWER RATING	RESISTANCE RANGE (Ohms)	MAXIMUM WORKING VOLTAGE*	MAXIMUM WEIGHT (Grams)
CW-1/2	.5 W	0.1-1.54k	19.6 V	.21
CW-1	1.0 W	0.1-5.50k	45.9 V	.34
CW-1M	1.0 W	0.1-3.30k	37.4 V	.30
CW-2M	3.0 W	0.1-8.38k	83.0 V	.65

* Maximum working voltage determined at .0008" diameter wire resistance value.

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



MODEL	A	B (Max.)	C	D
CW-1/2	.250 ± .015 [6.35 ± .381]	.265 [6.73]	.078 ± .015 [1.98 ± .381]	.020 ± .002 [.508 ± .051]
CW-1	.422 ± .015 [10.72 ± .381]	.437 [11.10]	.110 ± .015 [2.79 ± .381]	.020 ± .002 [.508 ± .051]
CW-1M	.295 ± .015 [7.50 ± .381]	.311 [7.90]	.110 ± .015 [2.79 ± .381]	.020 ± .002 [.508 ± .051]
CW-2M	.500 ± .062 [12.70 ± 1.57]	.562 [14.27]	.185 ± .015 [4.70 ± .381]	.032 ± .002 [.813 ± .051]

ENVIRONMENTAL PERFORMANCE *

TEST	DALE® MAXIMUM
Temperature Coefficient	± 90 PPM/°C below 1Ω ± 50 PPM/°C 1.0Ω - 9.9Ω ± 30 PPM/°C 10Ω and above
Thermal Shock	± (2% + .05Ω) ΔR
Short Time Overload	± (2% + .05Ω) ΔR
Dielectric	± (.1% + .05Ω) ΔR
Low Temperature Storage	± (2% + .05Ω) ΔR
High Temperature Exposure	± (2% + .05Ω) ΔR
Moisture Resistance	± (2% + .05Ω) ΔR
Shock	± (.2% + .05Ω) ΔR
Vibration	± (.2% + .05Ω) ΔR
Load Life	± (3% + .05Ω) ΔR
Terminal Strength	± (1% + .05Ω) ΔR

* All ΔR figures shown are maximum based on a maximum operating temperature of 275°C.

PART MARKING

- Dale
- Model
- Value
- Tolerance
- Date code

ELECTRICAL SPECIFICATIONS

Resistance Tolerance: ± 5% standard 1 ohm and above.
± 10% standard below 1 ohm. ± 2% and ± 3% available.

Temperature Coefficient: (- 55°C to + 275°C).
± 90PPM/°C below 1 ohm.
± 50PPM/°C 1 ohm - 9.9 ohm.
± 30PPM/°C 10 ohm and above.

Dielectric Strength:

1000 VAC minimum for CW-2M.
500 VAC minimum for CW-1/2, CW-1, CW-1M.

Short Time Overload: 5 seconds at 5 times rated power.

MECHANICAL SPECIFICATIONS

Terminal Strength: 10 pound pull test = CW-2M.
5 pound pull test = CW-1/2, CW-1, CW-1M.

Solderability: 60/40 electro tin plated terminals to facilitate soldering.

MATERIAL SPECIFICATIONS

Core: Heat conductive ceramic.

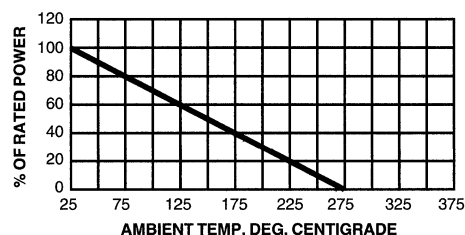
Element: Copper-nickel alloy or nickel-chrome alloy,
depending on resistance value.

End Caps: Weldable metal alloy.

Coating: Special high-temperature silicone.

Standard Terminals: Tinned Copperweld®.

DERATING



POWER RATING

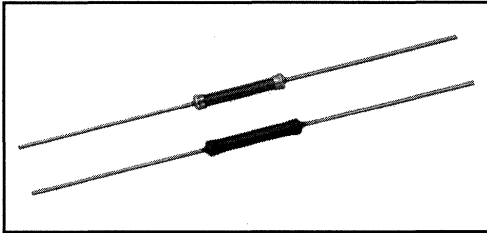
- 275°C maximum hotspot temperature.
- 3% maximum ΔR in 2000 hour load life.

HOW TO ORDER

<u>CW-1</u>	<u>10</u>	<u>5%</u>
MODEL	RESISTANCE	TOLERANCE

MODEL CA Wirewound Resistors

Commercial, Power



FEATURES

- Low cost, high performance
- CA-5000 Models available with special silicone coating for corrosion and abrasion protection

APPLICATIONS

Kitchen appliances: percolators, blenders, mixers, ranges, toasters, deep fryers. Automotive devices: horns, ignitions, windshield wipers, voltage regulators, instrument gauges. Entertainment devices: radios, televisions. Computers and power supplies.

STANDARD ELECTRICAL SPECIFICATIONS				DIMENSION A
MODEL	POWER RATING	OHMIC VALUE		"A" ± .031 [.787]
		(Min.)	(Max.)	
CA-4050	2.0 W	.10	270	.50 [12.70]
CA-4055	2.2 W	.10	300	.55 [13.97]
CA-4060	2.4 W	.11	350	.60 [15.24]
CA-4070	2.8 W	.13	430	.70 [17.78]
CA-4080	3.2 W	.16	510	.80 [20.32]
CA-4090	3.6 W	.18	590	.90 [22.86]
CA-4100	4.0 W	.20	670	1.00 [25.40]
CA-4150	6.0 W	.33	1,080	1.50 [38.10]
CA-4200	8.0 W	.45	1,480	2.00 [50.80]
CA-4220	8.8 W	.50	1,640	2.20 [55.88]
CA-5050	2.5 W	.10	2,400	.50 [12.70]
CA-5055	2.75 W	.10	2,700	.55 [13.97]
CA-5060	3.0 W	.11	3,100	.60 [15.24]
CA-5070	3.5 W	.13	3,900	.70 [17.78]
CA-5080	4.0 W	.16	4,600	.80 [20.32]
CA-5090	4.5 W	.18	5,300	.90 [22.86]
CA-5100	5.0 W	.20	6,000	1.00 [25.40]
CA-5150	7.5 W	.33	9,700	1.50 [38.10]
CA-5200	10.0W	.45	13,300	2.00 [50.80]
CA-5220	11.0 W	.50	14,800	2.20 [55.88]

NOTE: CA-4000 Model also available with silicone coating, maximum resistance value will be the same as CA-5000 Model. Consult factory.

ELECTRICAL SPECIFICATIONS

Resistance Tolerance: ± 10% standard. ± 5% available.

Temperature Coefficient: Below 1 ohm $0 \pm 800\text{PPM}/^\circ\text{C}$.
1 ohm and above $0 \pm 400\text{PPM}/^\circ\text{C}$.

Power Rating: CA-4000 Model = 4 watts per inch.
CA-5000 Model = 5 watts per inch.

Maximum Working Voltage: \sqrt{PR} .

NOTE: For fusible version, see page 81.

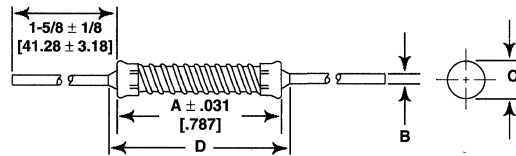
MECHANICAL SPECIFICATIONS

Leads: Standard lead material is tinned copper. Axial lead pull strength is 7 pounds. Lead forming available. Consult factory for needs.

Construction: High quality, premium resistance wire is wound on a woven fiberglass core impregnated and coated with a special grade silicone.

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]

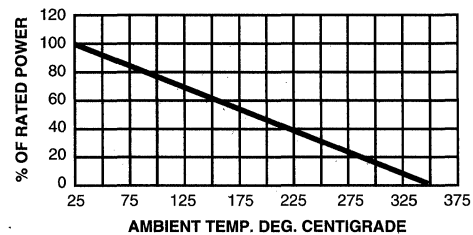


(CA-4000 Model shown.)

MODEL	A	B ± .001 [.025]	C ± .140 [3.56]	D* ± 1/32 [.794]
CA-4000	See Table	.032 [.813]	.140 [3.56]	A + .062 [1.57]
CA-5000	at Left	.036 [.914]	.160 [4.06]	A + .093 [2.36]

* Dimension D on CA-5000 Model is clean lead to clean lead length.

DERATING



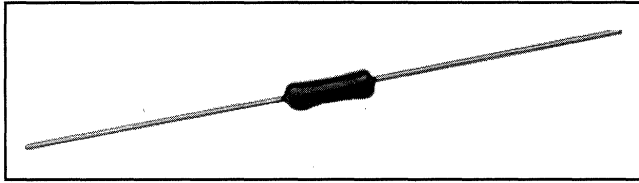
HOW TO ORDER

CA	-	4	150	350	10%
MODEL		WATTS	RESISTOR BODY LENGTH	RESISTANCE	TOLERANCE

EXAMPLE: A 1.50" [38.10] unit, 4 watts per inch; 350 ohms, ± 10% radial lead unit is designated as shown. Total wattage of unit is 6 watts (4 watts/inch x 1.50").

MODELS CA-1 and CA-2 Wirewound Resistors

Commercial, Power



FEATURES

- High performance for low cost
- Axial leads
- Special grade silicone for additional environmental protection
- Auto insertable
- Value and tolerance printed

APPLICATIONS

Kitchen appliances: Percolators, blenders, mixers, ranges, toasters, deep fryers. Automotive devices: Horns, ignitions, windshield wipers, voltage regulators, instrument gauges. Entertainment devices: Radios, televisions. Also computers and power supplies.

ELECTRICAL SPECIFICATIONS

Resistance Range:

- CA-1 = .1 ohm to 1000 ohm.
- CA-2 = .1 ohm to 2400 ohm.

Resistance Tolerance:

± 10% standard. ± 5% available.

Temperature Coefficient:

- ± 600PPM/°C below 1 ohm.
- ± 300PPM/°C 1 ohm and above.

Power Rating:

- CA-1 = 1 watt.
- CA-2 = 2 watt.

Maximum Working Voltage: \sqrt{PR} .

Dielectric Withstanding Voltage: 600 V RMS.

MECHANICAL SPECIFICATIONS

Terminal Strength: 7 pound pull test.

MATERIAL SPECIFICATIONS

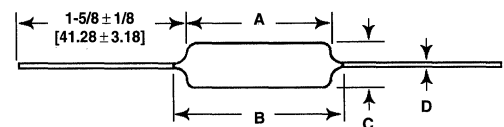
Standard Terminals: Tinned copper.

CONSTRUCTION

The CA-1 and CA-2 models have a high quality, premium resistance wire wound on woven fiberglass core, impregnated and coated with a special grade silicone for added environmental protection. For other sizes/wattage ranges, see Model CA.

DIMENSIONAL CONFIGURATIONS

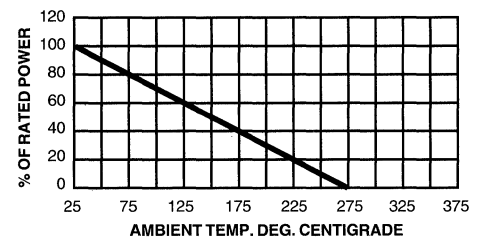
[Numbers in brackets indicate millimeters]



MODEL	A Typical	B Maximum	C Maximum	D ± .001 [.025]
CA-1	.400 [10.16]	.460 [11.68]	.170 [4.32]	.032 [.813]
CA-2	.570 [14.48]	.630 [16.00]	.170 [4.32]	.032 [.813]

DERATING

For High Ambient Temperature (NEMA)



PART MARKING

- Value
- Tolerance

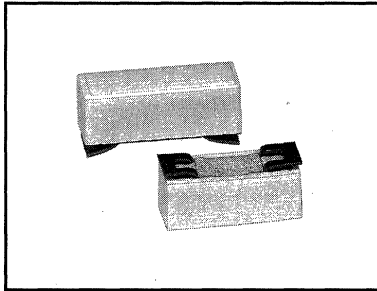
HOW TO ORDER

$\frac{CA}{MODEL}$ - $\frac{1}{WATTAGE}$ $\frac{150}{RESISTANCE}$ $\frac{\pm 10\%}{TOLERANCE}$

NOTE: Other wattages available through CA-4000 and CA-5000 models.

MODEL CPSM Wirewound Resistors

Commercial, Power, Surface Mount



FEATURES

- Direct mounting on printed circuit board
- Fireproof inorganic construction
- High wattage capabilities, low board temperatures
- Suitable for pick and place equipment
- Meets or exceeds EIA-RS-344 requirement
- Consult factory for special applications
- Special inorganic potting compound provides high thermal conductivity and moisture resistance for aqueous board wash systems

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	POWER AT 25°C (Watts)	RESISTANCE RANGE (Ohms)
CPSM-3	3	.1-600
CPSM-5	5	.1-700

ELECTRICAL SPECIFICATIONS

Power Rating: 3 and 5 watt.

Resistance Tolerance: ± 10%, ± 5%.

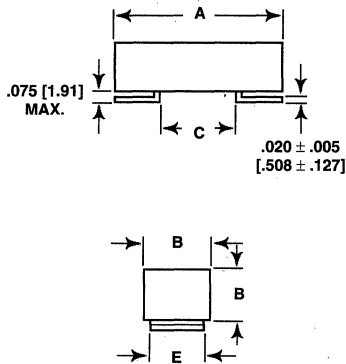
Temperature Coefficient: Below 1 ohm, 0 ± 800PPM/°C.
1 ohm and above, 0 ± 400PPM/°C.

Maximum Working Voltage: \sqrt{PR} .

Operating Temperature: - 55°C to + 275°C.

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]

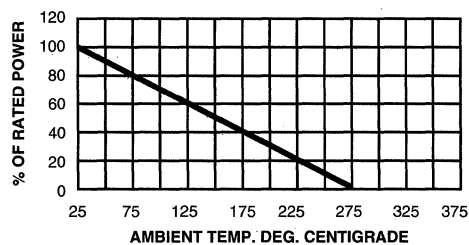


MATERIAL SPECIFICATIONS

Construction: Resistance wire is a high quality, premium grade wound onto a woven core. Tin plated terminals are crimped to wound core. The assembly is then potted into a high quality steatite ceramic case using a high temperature, high thermal conducting inorganic potting compound. This results in a completely fireproof inorganic package.

MODEL	A ± .040 [1.02]	B ± .040 [1.02]	C ± .060 [1.52]	E ± .012 [.305]
CPSM-3	.906 [23.01]	.374 [9.50]	.500 [1.27]	.287 [7.29]
CPSM-5	1.06 [26.92]	.374 [9.50]	.590 [14.99]	.287 [7.29]

DERATING



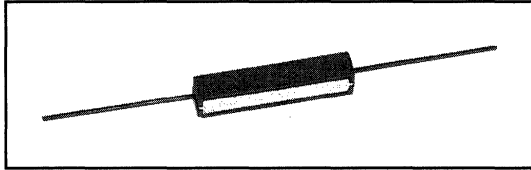
PART MARKING

- Dale
- Model
- Value
- Tolerance
- Date code

HOW TO ORDER

CPSM - 5 100 5%
MODEL WATTAGE RESISTANCE TOLERANCE

MODEL CP Wirewound Resistors Commercial, Power, Axial Lead



FEATURES

- Fireproof inorganic construction
- Fuse styles (Model RF) available
- Meets or exceeds requirements of EIA Standard RS-344
- Special inorganic potting compound provides high thermal conductivity and moisture resistance for aqueous board wash systems

STANDARD ELECTRICAL SPECIFICATIONS			
MODEL	WATTAGE RATING	EIA STANDARD RS-344 TYPE	RESISTANCE RANGE (Ohms)
CP-2	2	CRU2A	.1-2.4k
CP-2-3	2	—	.1-2.4k
CP-3	3	CRU3	.1-7.5k
CP-3-3	3	—	.1-7.5k
CP-5	5	CRU5	.1-8.5k
CP-5-3	5	—	.1-8.5k
CP-7	7	CRU7	.1-18k
CP-7-3	7	—	.1-18k
CP-10	10	CRU10	.1-30k
CP-10-3	10	—	.1-30k
CP-15	15	CRU15	.1-30k
CP-15-3	15	—	.1-30k
CP-20	20	—	.1-30k
CP-20-3	20	—	.1-30k
CP-22	22	—	.1-30k
CP-22-3	22	—	.1-30k

ELECTRICAL SPECIFICATIONS

Resistance Tolerance: $\pm 10\%$ standard.
 $\pm 5\%$ available.

Temperature Coefficient:
Below 1 ohm $0 \pm 800\text{PPM}/^\circ\text{C}$ (Typical).
1 ohm and above $0 \pm 400\text{PPM}/^\circ\text{C}$ (Typical).

Maximum Working Voltage: $\sqrt{\text{PR}}$.

Operating Temperature: -55°C to $+275^\circ\text{C}$.

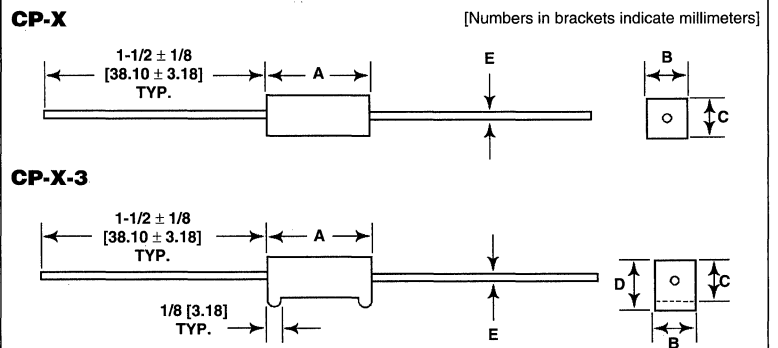
MECHANICAL SPECIFICATIONS

Terminal Strength: 5 pounds minimum.

Construction: Resistance wire is a high quality, premium grade wound onto a woven fiberglass core. Terminals are tinned copper crimped to the wound core with a special alloy cap. The assembly is then potted into a high quality steatite ceramic case using a high temperature, high thermal conducting inorganic potting compound. This results in a completely fireproof inorganic package.

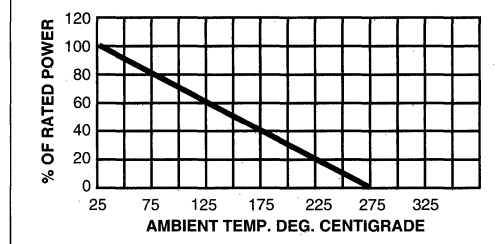
NOTE: CP-(X)F resistors can reliably function both as a fuse and as a wirewound resistor. Such components involve compromise between fusing and resistive functions and, therefore, each design should be tailored to the application to insure optimum performance. These resistors are similar in appearance to the CP resistors, but are manufactured with special materials and processes conforming to performance required. Contact factory for design assistance.

DIMENSIONAL CONFIGURATIONS



MODEL	A $\pm 1/32$ [.790]	B $\pm 1/32$ [.790]	C $\pm 1/32$ [.790]	D $\pm 1/32$ [.790]	E $\pm .001$ [.025]
CP-2	11/16 [17.46]	1/4 [6.35]	1/4 [6.35]	—	.032 [.813]
CP-2-3	11/16 [17.46]	1/4 [6.35]	1/4 [6.35]	5/16 [7.94]	.032 [.813]
CP-3	7/8 [22.22]	5/16 [7.94]	5/16 [7.94]	—	.036 [.914]
CP-3-3	7/8 [22.22]	5/16 [7.94]	5/16 [7.94]	3/8 [9.52]	.036 [.914]
CP-5	7/8 [22.22]	3/8 [9.52]	11/32 [8.73]	—	.036 [.914]
CP-5-3	7/8 [22.22]	3/8 [9.52]	11/32 [8.73]	13/32 [10.32]	.036 [.914]
CP-7	1-25/64 [35.32]	3/8 [9.52]	11/32 [8.73]	—	.036 [.914]
CP-7-3	1-25/64 [35.32]	3/8 [9.52]	11/32 [8.73]	15/32 [11.91]	.036 [.914]
CP-10	1-7/8 [47.62]	3/8 [9.52]	11/32 [8.73]	—	.036 [.914]
CP-10-3	1-7/8 [47.62]	3/8 [9.52]	11/32 [8.73]	15/32 [11.91]	.036 [.914]
CP-15	1-7/8 [47.62]	1/2 [12.70]	1/2 [12.70]	—	.036 [.914]
CP-15-3	1-7/8 [47.62]	1/2 [12.70]	1/2 [12.70]	5/8 [15.88]	.036 [.914]
CP-20	2-1/2 [63.50]	1/2 [12.70]	1/2 [12.70]	—	.036 [.914]
CP-20-3	2-1/2 [63.50]	1/2 [12.70]	1/2 [12.70]	5/8 [15.88]	.036 [.914]
CP-22	2-1/2 [63.50]	1/2 [12.70]	1/2 [12.70]	—	.036 [.914]
CP-22-3	2-1/2 [63.50]	1/2 [12.70]	1/2 [12.70]	5/8 [15.88]	.036 [.914]

DERATING



PART MARKING

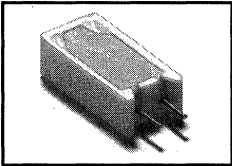
- Dale
- Model
- Value
- Tolerance
- Date code

HOW TO ORDER

CP - 5 - 3 - 100 - $\pm 10\%$
MODEL WATTAGE MOUNTING PADS RESISTANCE TOLERANCE
IF DESIRED

MODELS CPCL, CPCC, CPCP, CPCF Wirewound Resistors

Commercial, Power, Vertical Mount

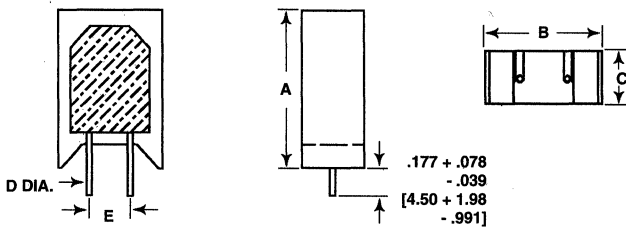


FEATURES

- Space saving
- Direct mounting on printed circuit board
- Meets or exceeds requirements of EIA-Standard RS-344
- Fireproof inorganic construction
- Special inorganic potting compound provides high thermal conductivity and moisture resistance for aqueous board wash systems

STANDARD ELECTRICAL SPECIFICATIONS			
MODEL	WATTAGE RATING	TOLERANCE (%)	RESISTANCE RANGE (Ohms)
CPCL-2	2 W	3, 5, 10	.01-.1
CPCC-2	2 W	5, 10	.1-500
CPCP-2	2 W	1, 3, 5	.1-4k
CPCF-2	2 W	1, 3, 5, 10	10-150k
CPCL-3	3 W	3, 5, 10	.01-.1
CPCC-3	3 W	5, 10	.1-800
CPCP-3	3 W	1, 3, 5	.1-5k
CPCF-3	3 W	1, 3, 5, 10	10-150k
CPCL-5	5 W	3, 5, 10	.01-.1
CPCC-5	5 W	5, 10	.1-800
CPCP-5	5 W	1, 3, 5	.1-5k
CPCF-5	5 W	1, 3, 5, 10	10-150k
CPCL-10	10 W	5, 10	.01-.1
CPCP-10	10 W	1, 3, 5	.1-8k
CPCC-10	10 W	5, 10	.2-1500

DIMENSIONAL CONFIGURATIONS



[Numbers in brackets indicate millimeters]

MODEL	A ± .020 [.508]	B ± .020 [.508]	C ± .010 [.254]	D ± .005 [.127]	E ± .059 [1.50]
CPCL-2	.807	.430	.280	.032	.197
CPCC-2	[20.50]	[10.92]	[7.11]	[.813]	[5.0]
CPCP-2					
CPCF-2					
CPCL-3	.984	.470	.310	.032	.197
CPCC-3	[24.99]	[11.94]	[7.87]	[.813]	[5.0]
CPCP-3					
CPCF-3					
CPCL-5	1.003	.512	.354	.032	.197
CPCC-5	[25.48]	[13.0]	[8.99]	[.813]	[5.0]
CPCP-5					
CPCF-5					
CPCL-10	1.50	.630	.520	.040	.290
CPCP-10	[38.10]	[16.0]	[13.21]	[1.02]	[7.37]
CPCC-10				.036 [.914]	

PACKAGING

Layered bulk packaging standard.

ELECTRICAL SPECIFICATIONS

Temperature Coefficient:

- CPCL-X: ± 400PPM/°C, .01 ohm - .049 ohm.
± 100PPM/°C, .05 ohm - .1 ohm.
- CPCC-X: ± 800PPM/°C, .1 ohm - .99 ohm.
± 400PPM/°C, 1 ohm - 100 ohm.
- CPCP-X: ± 90PPM/°C, .1 ohm - .99 ohm.
± 50PPM/°C, 1 ohm - 9.9 ohm.
± 20PPM/°C, 10 ohm and above.
- CPCF-X: ± 50PPM/°C, 10 ohm - 150 kilohm.

Dielectric Strength: 1000 VAC.

Maximum Working Voltage: \sqrt{PR} .

Operating Temperature: -55°C to +275°C. (-55°C to +225°C for CPCF model.)

CONSTRUCTION

CPCL: A completely welded assembly using a nickel-chrome alloy element, with tinned copper terminals.

CPCC: A high quality, premium resistance wire is wound onto a woven fiberglass core. Terminals are tinned copper crimped to the woven core with a brass alloy cap.

CPCP: A completely welded assembly using a ceramic core, copper-nickel or nickel-chrome alloy element, with tinned Copperweld® terminals. Non-inductive styles available upon request. Contact factory.

CPCF: A high grade metal film element utilizing a ceramic core. Terminals are solder-coated copper. All assemblies are potted into a high quality steatite ceramic case using a high temperature, high thermal conducting inorganic potting compound. This results in a completely fireproof inorganic package.

PART MARKING

- Dale
- Model
- Value
- Tolerance
- Date code

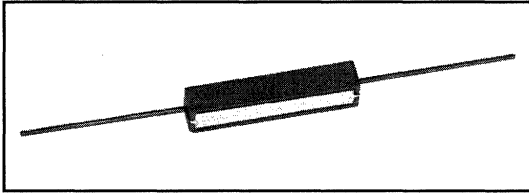
HOW TO ORDER

CPC L - 2 .1 ±5%
MODEL STYLE WATTAGE RESISTANCE TOLERANCE

- L = Low value
- C = Commercial (fiberglass core)
- P = Precision (ceramic core)
- F = Film (ceramic core)

MODEL CPL Wirewound Resistors

Military, MIL-R-49465 Qualified, Type RLV
and Commercial, Power, Axial Lead



FEATURES

- Fireproof inorganic construction
- Extremely low resistance values
- Complete welded construction
- MIL-R-49465 styles available
- Special inorganic potting compound provides high thermal conductivity and moisture resistance for aqueous board wash systems

STANDARD ELECTRICAL SPECIFICATIONS		
DALE MODEL	MIL-R-49465 TYPE	DALE RATING
CPL-3	—	3 W
CPL-3-3	—	
CPL-3-6	RLV-40	
CPL-5	—	5 W
CPL-5-3	—	
CPL-5-6	RLV-41	
CPL-7	—	7 W
CPL-7-3	—	
CPL-7-6	RLV-42	
CPL-10	—	10 W
CPL-10-3	—	
CPL-10-6	RLV-43	
CPL-15	—	15 W
CPL-15-3	—	

ELECTRICAL SPECIFICATIONS

Resistance Range: .01 ohm to .10 ohm. (Resistance is measured 3/8" [9.50] from resistor body.)

Resistance Tolerance: ± 5% standard. Lower tolerances available. Military tolerances ± 5%, ± 10%, (Characteristic L).

Temperature Coefficient: Varies with resistance values. ± 550PPM/°C maximum. Consult factory.

Dielectric Strength: 1000 VAC.

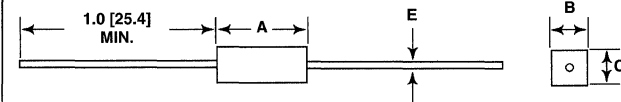
MECHANICAL SPECIFICATIONS

Terminal Strength: 5 pounds minimum.

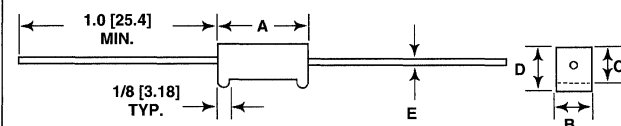
DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]

CPL-X

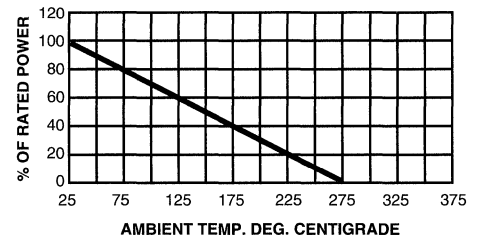


CPL-X-3



DALE MODEL	A	B	C	D	E
	± 1/32 [.790]	± 1/32 [.790]	± 1/32 [.790]	± 1/32 [.790]	± .001 [.025]
CPL-3	7/8	5/16	5/16	—	.036
CPL-3-6	[22.22]	[7.94]	[7.94]	—	[.910]
CPL-3-3	7/8	5/16	5/16	3/8	.036
	[22.22]	[7.94]	[7.94]	[9.52]	[.910]
CPL-5	7/8	3/8	11/32	—	.036
CPL-5-6	[22.22]	[9.52]	[8.73]	—	[.910]
CPL-5-3	7/8	3/8	11/32	13/32	.036
	[22.22]	[9.52]	[8.73]	[10.32]	[.910]
CPL-7	1-25/64	3/8	11/32	—	.036
CPL-7-6	[35.32]	[9.52]	[8.73]	—	[.910]
CPL-7-3	1-25/64	3/8	11/32	15/32	.036
	[35.32]	[9.52]	[8.73]	[11.91]	[.910]
CPL-10	1-7/8	3/8	11/32	—	.036
CPL-10-6	[47.62]	[9.52]	[8.73]	—	[.910]
CPL-10-3	1-7/8	3/8	11/32	15/32	.036
	[47.62]	[9.52]	[8.73]	[11.91]	[.910]
CPL-15	1-7/8	1/2	1/2	—	.036
	[47.62]	[12.70]	[12.70]	—	[.910]
CPL-15-3	1-7/8	1/2	1/2	5/8	.036
	[47.62]	[12.70]	[12.70]	[15.88]	[.910]

DERATING



PART MARKING

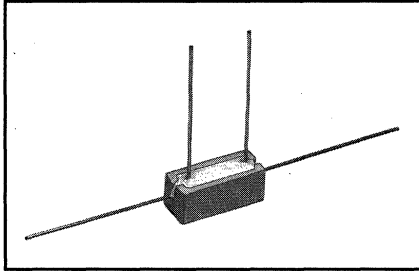
- Dale
- Model
- Value
- Tolerance
- Date code

HOW TO ORDER

CPL - 10 3 100 5%
MODEL WATTAGE MOUNTING PADS RESISTANCE TOLERANCE
IF DESIRED

MODEL CPSL Wirewound Resistors

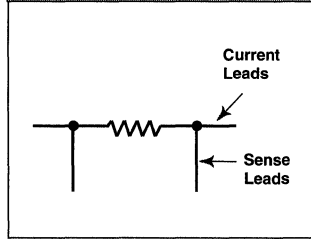
Military, MIL-R-49465 Qualified, Type RLV
and Commercial, Power, Four Lead



FEATURES

- Fireproof inorganic construction
- Extremely low resistance values
- Current sensing
- Low temperature coefficients
- High power/size ratio
- MIL-R-49465 styles available
- Complete welded construction
- Special inorganic potting compound provides high thermal conductivity and moisture resistance for aqueous board wash systems

SCHEMATIC



STANDARD ELECTRICAL SPECIFICATIONS		
MODEL	MIL-R-49465 TYPE	WATTAGE RATING
CPSL-3-5	—	3 W
CPSL-3-6	RLV-20	—
CPSL-3-3	—	3 W
CPSL-5-5	—	5 W
CPSL-5-6	RLV-21	—
CPSL-5-3	—	5 W
CPSL-7-5	—	7 W
CPSL-7-6	RLV-22	—
CPSL-10-5	—	10 W
CPSL-10-6	RLV-23	—
CPSL-15-5	—	15 W

ELECTRICAL SPECIFICATIONS

Resistance Range: .01 ohm to .10 ohm.

Resistance Tolerance: ± 5% standard.
± 3% available. Military Tolerance ± 5% and ± 10%, (Characteristic L).

Temperature Coefficient: ± 100PPM/°C maximum.

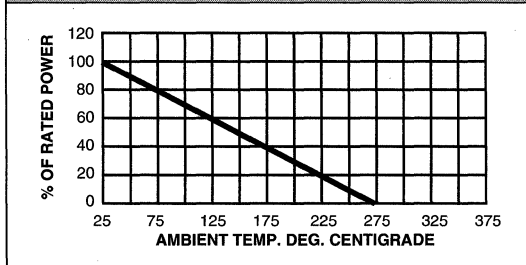
Dielectric Strength: 1000 VAC.

Operating Temperature: - 55°C to + 275°C.

MECHANICAL SPECIFICATIONS

Terminal Strength: 5 pounds minimum.

DERATING



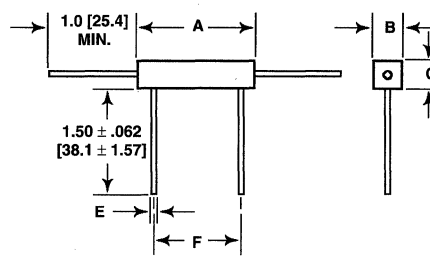
PART MARKING

- Dale
- Model
- Value
- Tolerance
- Date code

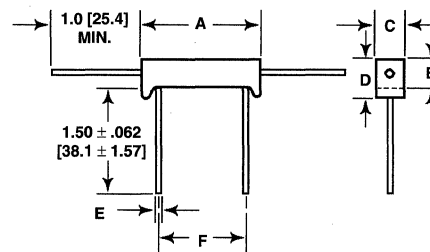
DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]

CPSL-X and CPSL-X-6



CPSL-X-3



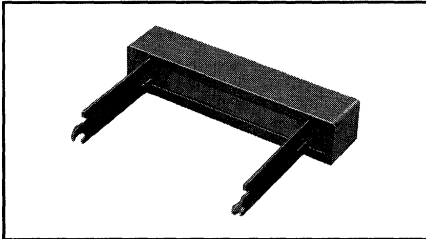
MODEL	A ± 1/32 [.794]	B ± 1/32 [.794]	C ± 1/32 [.794]	D ± 1/32 [.794]	E ± .001 [.025]	F ± 1/16 [1.59]
CPSL-3-5	7/8	5/16	5/16	—	.036	9/16
CPSL-3-6	[22.22]	[7.94]	[7.94]	—	[.914]	[14.30]
CPSL-3-3	7/8	5/16	5/16	3/8	.036	9/16
	[22.22]	[7.94]	[7.94]	[9.52]	[.914]	[14.30]
CPSL-5-5	7/8	3/8	11/32	—	.036	9/16
CPSL-5-6	[22.22]	[9.52]	[8.73]	—	[.914]	[14.30]
CPSL-5-3	7/8	3/8	11/32	7/16	.036	9/16
	[22.22]	[9.52]	[8.73]	[11.11]	[.914]	[14.30]
CPSL-7-5	1-25/64	3/8	11/32	—	.036	1.0
CPSL-7-6	[35.32]	[9.52]	[8.73]	—	[.914]	[25.4]
CPSL-10-5	1-7/8	3/8	11/32	—	.036	1-3/8
CPSL-10-6	[47.62]	[9.52]	[8.73]	—	[.914]	[34.93]
CPSL-15-5	1-7/8	1/2	1/2	—	.036	1-3/8
	[47.62]	[12.70]	[12.70]	—	[.914]	[34.93]

HOW TO ORDER

CPSL	-	3	3	100	± 10%
MODEL		WATTAGE	MOUNTING PAD (IF DESIRED)	RESISTANCE	TOLERANCE

MODEL CPR Wirewound Resistors

Commercial, Power, Radial Terminals



FEATURES

- Radial terminals
- Fireproof inorganic construction
- Direct mounting on printed circuit board
- Circuit board lock-in mounting tabs
- Fuse styles (Model RF) available
- Meets or exceeds requirements of EIA Standard RS-344
- Special inorganic potting compound provides high thermal conductivity and moisture resistance for aqueous board wash systems

STANDARD ELECTRICAL SPECIFICATIONS		
MODEL	POWER AT 25°C	RESISTANCE RANGE (Ohms)
CPR-3	3 W	.1-600
CPR-5	5 W	.1-700
CPR-7	7 W	.1-1000
CPR-10	10 W	.1-1600
CPR-15	15 W	.1-1600
CPR-20	20 W	.15-2000

ELECTRICAL SPECIFICATIONS

Resistance Tolerance: $\pm 5\%$, $\pm 10\%$.

Temperature Coefficient:

Below 1 ohm $0 \pm 800\text{PPM}/^\circ\text{C}$.
1 ohm and above $0 \pm 400\text{PPM}/^\circ\text{C}$.

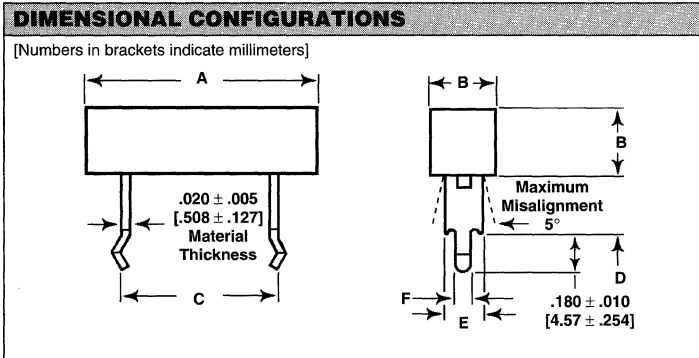
Power Rating: 3 watt to 20 watt.

Maximum Working Voltage: $\sqrt{\text{PR}}$.

Operating Temperature: -55°C to $+275^\circ\text{C}$.

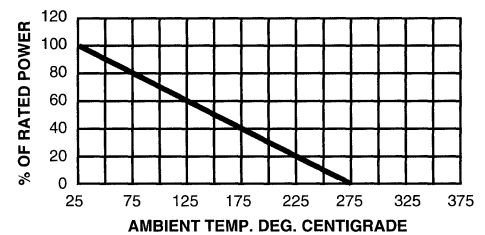
MATERIAL SPECIFICATIONS

Construction: Resistance wire is a high quality, premium grade wound onto a woven fiberglass core. Tin plated terminals are crimped to wound core. The assembly is then potted into a high quality steatite ceramic case using a high temperature, high thermal conducting inorganic potting compound. This results in a completely fireproof inorganic package.



MODEL	A $\pm .04$ [± 1.0]	B $\pm .04$ [± 1.0]	C $\pm .06$ [± 1.5]	D $+ .08 [+ 2.0]$ $- .04 [- 1.0]$	E $\pm .012$ [$\pm .30$]	F $\pm .008$ [$\pm .20$]
CPR-3	.906 [23.0]	.374 [9.50]	.500 [12.70]	.394 [10.01]	.287 [7.29]	.055 [1.39]
CPR-5	1.060 [26.92]	.374 [9.50]	.590 [14.99]	.394 [10.01]	.287 [7.29]	.055 [1.39]
CPR-7	1.398 [35.51]	.374 [9.50]	.886 [22.50]	.984 [24.99]	.287 [7.29]	.055 [1.39]
CPR-10	1.888 [47.96]	.374 [9.50]	1.38 [35.05]	.984 [24.99]	.287 [7.29]	.055 [1.39]
CPR-15	1.888 [47.96]	.492 [12.50]	1.28 [32.51]	1.18 [29.97]	.394 [10.01]	.106 [2.692]
CPR-20	2.498 [63.45]	.492 [12.50]	1.87 [47.50]	1.18 [29.97]	.394 [10.01]	.106 [2.692]

DERATING



PART MARKING

- Dale
- Model
- Value
- Tolerance
- Date code

FUSE RESISTOR, MODEL CPR-(X)F

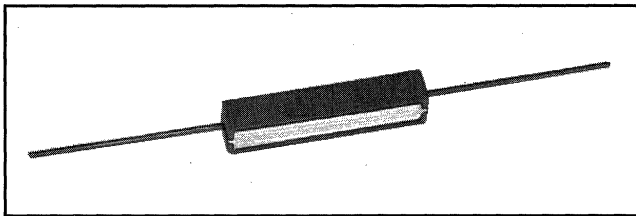
Dale® CPR-(X)F resistors can reliably function both as a fuse and as a wirewound resistor. Such components involve compromise between fusing and resistive functions and, therefore, each design should be tailored to the application to insure optimum performance. These resistors are wound with special wire conforming to performance required. Contact factory for design assistance.

HOW TO ORDER

CPR - 5 - 100 ±5%
MODEL WATTAGE RESISTANCE TOLERANCE

MODEL CPW Wirewound Resistors

Commercial, Power, Axial Lead



FEATURES

- Fireproof inorganic construction
- Complete welded construction
- High surge capabilities
- Non-inductive styles available
- Special inorganic potting compound provides high thermal conductivity and moisture resistance for aqueous board wash systems

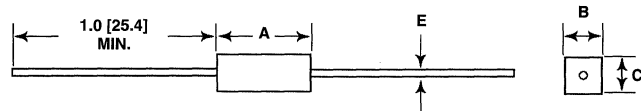
STANDARD ELECTRICAL SPECIFICATIONS

MODEL	WATTAGE RATING	RESISTANCE RANGE (Ohms)
CPW-2 CPW-2-3	2	.1-7k
CPW-3 CPW-3-3	3	.1-7.5k
CPW-5 CPW-5-3	5	.1-8.5k
CPW-7 CPW-7-3	7	.1-18k
CPW-10 CPW-10-3	10	.12-30k
CPW-15 CPW-15-3	15	.12-30k
CPW-20 CPW-20-3	20	.18-45k

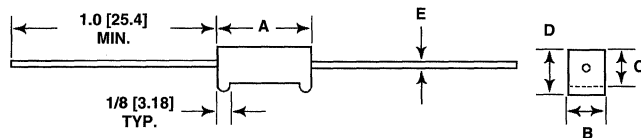
DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]

CPW-X



CPW-X-3



ELECTRICAL SPECIFICATIONS

Resistance Tolerance: $\pm 1\%$, $\pm 2\%$, $\pm 3\%$, $\pm 5\%$.

Temperature Coefficient:

Below 9.9 ohm $\pm 50\text{PPM}/^\circ\text{C}$.
10 ohm and above $\pm 30\text{PPM}/^\circ\text{C}$.

Maximum Working Voltage: $\sqrt{\text{PR}}$.

Operating Temperature: -55°C to $+275^\circ\text{C}$.

MECHANICAL SPECIFICATIONS

Terminal Strength: 10 pounds minimum.

Construction: This resistor is a completely welded unit utilizing an element of copper-nickel alloy or nickel-chrome alloy (depending on resistance value) and a ceramic core. The assembly is then potted into a high quality steatite ceramic case using a high temperature, high thermal conducting inorganic potting compound. This results in high surge capabilities and a completely fireproof inorganic package. Non-inductive units utilize Ayrton-Perry winding, with one-half the maximum resistance value available.

MODEL	A $\pm 1/32$ [.794]	B $\pm 1/32$ [.794]	C $\pm 1/32$ [.794]	D $\pm 1/32$ [.794]	E $\pm .001$ [.025]
CPW-2 CPW-2-3	11/16 [17.46]	1/4 [6.35]	1/4 [6.35]	5/16 [7.94]	.032 [.813]
CPW-3 CPW-3-3	7/8 [22.22]	5/16 [7.94]	5/16 [7.94]	3/8 [9.52]	.032 [.813]
CPW-5 CPW-5-3	7/8 [22.22]	3/8 [9.52]	11/32 [8.73]	13/32 [10.32]	.032 [.813]
CPW-7 CPW-7-3	1-25/64 [35.32]	3/8 [9.52]	11/32 [8.73]	15/32 [11.91]	.032 [.813]
CPW-10 CPW-10-3	1-7/8 [47.62]	3/8 [9.52]	11/32 [8.73]	15/32 [11.91]	.032 [.813]
CPW-15 CPW-15-3	1-7/8 [47.62]	1/2 [12.70]	1/2 [12.70]	5/8 [15.88]	.032 [.813]
CPW-20 CPW-20-3	2-1/2 [63.50]	1/2 [12.70]	1/2 [12.70]	5/8 [15.88]	.032 [.813]

PART MARKING

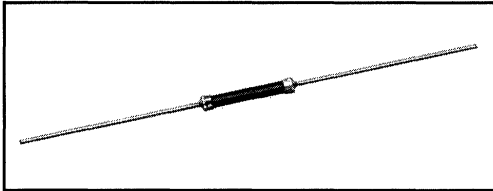
- Dale
- Model
- Date code
- Value
- Tolerance

HOW TO ORDER

CPW - 5 3 500 $\pm 2\%$
MODEL WATTAGE MOUNTING PADS VALUE TOLERANCE

Non-inductive available. Contact factory.

MODEL CA-(X)F Wirewound Fuse Resistors Commercial, Power



FEATURES

- Multiple physical configurations available

APPLICATIONS

Kitchen appliances: percolators, blenders, mixers, ranges, toasters, deep fryers. Automotive devices: horns, ignitions, windshield wipers, voltage regulators, instrument gauges. Entertainment devices: radios, televisions. Computers, power supplies and many others.

STANDARD ELECTRICAL SPECIFICATIONS				DIMENSION A
MODEL	POWER RATING 25°C	OHMIC VALUE (Min.) (Max.)		"A" ± .031 [.787]
CA-4050F	2.0 W	.05	270	.50 [12.70]
CA-4055F	2.2 W	.06	300	.55 [13.97]
CA-4060F	2.4 W	.07	350	.60 [15.24]
CA-4070F	2.8 W	.08	430	.70 [17.78]
CA-4080F	3.2 W	.09	510	.80 [20.32]
CA-4090F	3.6 W	.10	590	.90 [22.86]
CA-4100F	4.0 W	.10	670	1.00 [25.40]
CA-4150F	6.0 W	.14	1080	1.50 [38.10]
CA-4200F	8.0 W	.18	1480	2.00 [50.80]
CA-4220F	8.8 W	.18	1640	2.20 [55.88]

DIMENSIONAL CONFIGURATIONS					
[Numbers in brackets indicate millimeters]					
MODEL	A (See Table at Left)		B	C ± .001 [.025]	D ± 1/32 [.794]
	(Min.)	(Max.)			
CA-4000F	.500 [12.70]	2.20 [55.88]	A + .062 [1.57]	.032 [.813]	.140 [3.56]

ELECTRICAL SPECIFICATIONS

Maximum Working Voltage: \sqrt{PR} .

Resistance Tolerance: ± 10% standard. ± 5% available.

Power Rating: Model 4000 = 4 watts per inch.

MATERIAL SPECIFICATIONS

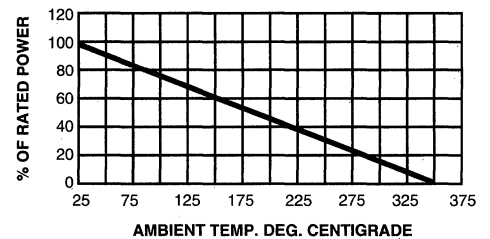
Leads: Standard lead material is tinned copper. Axial lead pull strength is 7 pounds.

Construction: Resistors have a high quality, premium resistance wire wound on woven fiberglass core impregnated and coated with a special grade silicone.

NOTE: Generally standard processed units will fuse before 60 seconds when subjected to 12 x rated power minimum. By combining special alloys, materials and other techniques, faster fusing times may be accomplished.

DERATING

For High Ambient Temperature (NEMA)



NOTE: Continuous power rating must be derated at high ambient temperatures per above curve.

HOW TO ORDER

CA	-	4	150F	350	± 10%
MODEL		WATTS	RESISTOR BODY LENGTH AND FUSE DESIGNATION	RESISTANCE	TOLERANCE

EXAMPLE: A 1.50" [38.10] unit, 4 watts per inch; 350 ohm, ± 10% radial lead unit is designated as shown. Total wattage of unit is 6 watts, (4 watts/inch x 1.50" [38.10]).

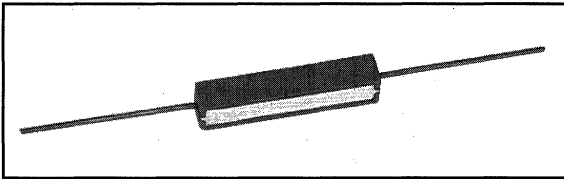
Please include the following information. It will enable us to choose the best design for your application.

1. Operating wattage or current and ambient temperature.
2. Fusing wattage or current and maximum "blow" time, if applicable.
3. Nominal resistance and maximum allowable resistance tolerance, 5% minimum.
4. Maximum allowable physical size.
5. Voltage to be interrupted.
6. Frequency of power source, wave form and a brief description of your application.

Contact factory for design assistance.

MODEL CP-(X)F Wirewound Fuse Resistors

Commercial, Power, Axial Lead



FEATURES

- Fireproof inorganic construction
- Multiple physical configurations available
- Terminal strength - 7 pound pull test
- Special inorganic potting compound provides high thermal conductivity and moisture resistance for aqueous board wash systems

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	WATTAGE RATING AT 25°C	RESISTANCE RANGE (Ohms)
CP-2F	2	.05-200
CP-3F	3	.06-250
CP-5F	5	.06-250
CP-7F	7	.1-550
CP-10F	10	.1-850
CP-15F	15	.1-850
CP-20F	20	.15-1200
CP-22F	22	.15-1200

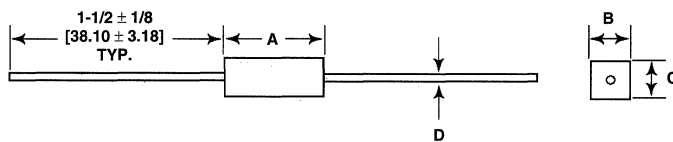
MECHANICAL SPECIFICATIONS

Construction: Resistance wire is a high quality, premium grade wound onto a woven fiberglass core. Terminals are tinned copper crimped to the wound core with a special alloy cap. The assembly is then potted into a high quality steatite ceramic case using a high temperature, high thermal conducting inorganic potting compound. This results in a completely fireproof inorganic package.

NOTE: Generally standard processed units will fuse before 60 seconds when subjected to 15 x rated power minimum. By combining special alloys, materials and other techniques faster fusing times may be accomplished.

DIMENSIONAL CONFIGURATIONS

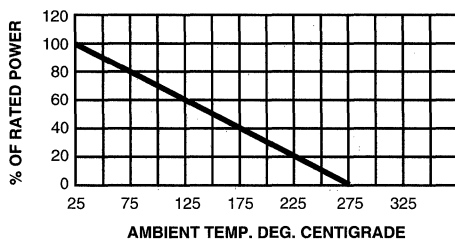
[Numbers in brackets indicate millimeters]



Mounting pads available upon request. See CP product, page 75, for dimensions.

MODEL	A ± 1/32 [± .794]	B ± 1/32 [± .794]	C ± 1/32 [± .794]	D + .001 [+ .025]
CP-2F	11/16 [17.46]	1/4 [6.35]	1/4 [6.35]	.032 [.813]
CP-3F	7/8 [22.22]	5/16 [7.94]	5/16 [7.94]	.036 [.914]
CP-5F	7/8 [22.22]	3/8 [9.52]	11/32 [8.73]	.036 [.914]
CP-7F	1-25/64 [35.32]	3/8 [9.52]	11/32 [8.73]	.036 [.914]
CP-10F	1-7/8 [47.62]	3/8 [9.52]	11/32 [8.73]	.036 [.914]
CP-15F	1-7/8 [47.62]	1/2 [12.70]	1/2 [12.70]	.036 [.914]
CP-20F	2-1/2 [63.50]	1/2 [12.70]	1/2 [12.70]	.036 [.914]
CP-22F	2-1/2 [63.50]	1/2 [12.70]	1/2 [12.70]	.036 [.914]

DERATING



PART MARKING

- Model
- Wattage
- Value
- Tolerance
- Date code

HOW TO ORDER

CP MODEL 5F WATTAGE AND FUSE DESIGNATION 100 RESISTANCE ± 5% TOLERANCE

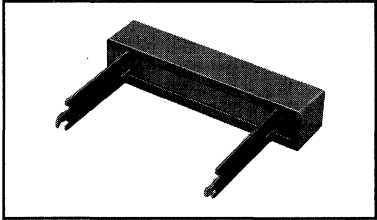
Please include the following information. It will enable us to choose the best design for your application.

1. Operating wattage or current and ambient temperature.
2. Fusing wattage or current and maximum "blow" time. Also, minimum "blow" time, if applicable.
3. Nominal resistance and maximum allowable resistance tolerance, 5% minimum.
4. Maximum allowable physical size.
5. Voltage to be interrupted.
6. Frequency of power source, wave form and a brief description of your application.

Contact factory for design assistance.

MODEL CPR-(X)F Wirewound Fuse Resistors

Commercial, Power, Radial Terminal



FEATURES

- Fireproof inorganic construction
- Direct mounting on printed circuit board
- Circuit board lock-in mounting tabs
- Multiple physical configurations available
- Terminal strength - 7 pound pull test
- Special inorganic potting compound provides high thermal conductivity and moisture resistance for aqueous board wash systems

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	POWER AT 25°C (Watts)	RESISTANCE RANGE (Ohms)
CPR-5F	5	.1-400
CPR-7F	7	.1-550
CPR-10F	10	.1-850
CPR-15F	15	.1-850
CPR-20F	20	.15-1100

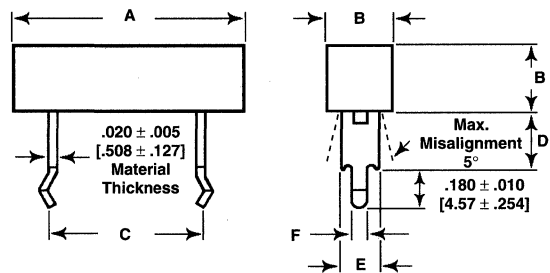
MECHANICAL SPECIFICATIONS

Construction: Resistance wire is a high quality, premium grade wound onto a woven fiberglass core. Tin plated terminals are crimped to wound core. The assembly is then potted into a high quality steatite ceramic case using a high temperature, high thermal conducting inorganic potting compound. This results in a completely fireproof inorganic package.

NOTE: Generally standard processed units will fuse before 60 seconds when subjected to 15 x rated power minimum. By combining special alloys, materials, and other techniques faster fusing times may be accomplished.

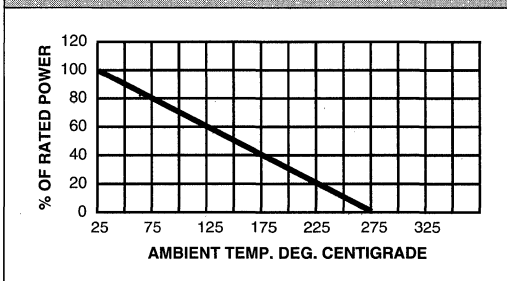
DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



MODEL	A ± .040 [± 1.02]	B ± .040 [± 1.02]	C ± .060 [± 1.52]	D + .080 [+ 2.03]	E ± .012 [± .305]	F ± .008 [± .203]
CPR-5F	1.06 [26.92]	.374 [9.50]	.590 [14.99]	.394 [10.01]	.287 [7.29]	.055 [1.40]
CPR-7F	1.398 [35.51]	.374 [9.50]	.886 [22.50]	.984 [24.99]	.287 [7.29]	.055 [1.40]
CPR-10F	1.888 [47.96]	.374 [9.50]	1.38 [35.05]	.984 [24.99]	.287 [7.29]	.055 [1.40]
CPR-15F	1.888 [47.96]	.492 [12.50]	1.28 [32.51]	1.18 [29.97]	.394 [10.01]	.106 [2.69]
CPR-15F	2.498 [63.45]	.492 [12.50]	1.87 [47.50]	1.18 [29.97]	.394 [10.01]	.106 [2.69]

DERATING



PART MARKING

- Model
- Wattage
- Value
- Tolerance
- Date code

HOW TO ORDER

CPR - 5F - 100 ± 5%
MODEL WATTAGE AND FUSE RESISTANCE TOLERANCE DESIGNATION

Please include the following information. It will enable us to choose the best design for your application.

1. Operating wattage or current and ambient temperature.
2. Fusing wattage or current and maximum "blow" time. Also, minimum "blow" time, if applicable.
3. Nominal resistance and maximum allowable resistance tolerance, 5% minimum.
4. Maximum allowable physical size.
5. Voltage to be interrupted.
6. Frequency of power source, wave form and a brief description of your application.

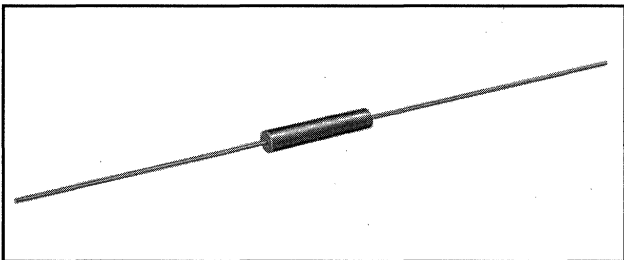
Contact factory for design assistance.

MODEL RS-1F

Wirewound Fuse Resistors

Molded, Fast Acting

Custom Designed For Your Application



FEATURES

- Low temperature coefficient typical of wirewound resistor
- High temperature silicone molded package
- Performs function of resistor and series fuse and provides predictable fusing times
- Complete welded construction
- No flaming or distortion of unit under fusing conditions
- Ideal for Squibb circuit applications and protection of semi-conductor devices
- Negligible noise and voltage coefficient

TYPICAL PARAMETERS

The following are offered as examples of reliable designs. Hundreds of possible combinations are available for meeting your requirements. Contact factory for assistance. Higher wattages available.

1.0 WATT CONTINUOUS POWER*

FUSING CURRENT (Amperes)	TYPICAL FUSING TIME (Milliseconds)	RESISTANCE RANGE (Ohms)	CONT. CURRENT (Amperes)	CROSSOVER VALUE (Ohms)
.5	4	49-500	.10	100.0
1.0	9	6.8-185	.25	16.0
1.25	8	4.7-107	.30	11.11
1.5	15	3.5-68	.35	8.16
2.0	15	2.2-35	.40	6.25
2.5	23	1.7-23	.45	4.94
3.0	48	1.1-12	.55	3.31
4.0	47	.72-6.44	.75	1.78
6.0	70	.35-2.17	1.0	1.0
8.0	48	.29-1.61	1.25	.64
10.0	50	.23-1.16	1.50	.44
15.0	35	.19-.82	1.75	.33
20.0	46	.12-.42	2.0	.25

* The Continuous Current Rating applies only to values equal to or less than the Crossover Value. The Continuous Power Rating applies only to values equal to or higher than the Crossover Value.

ELECTRICAL SPECIFICATIONS

Resistance Tolerance: $\pm 3\%$, $\pm 5\%$, $\pm 10\%$.

Temperature Coefficient:

$\pm 50\text{PPM}/^\circ\text{C}$, 1 ohm thru 9.9 ohm.

$\pm 30\text{PPM}/^\circ\text{C}$, 10 ohm and up.

Power Rating: 1.0 watt standard, higher power ratings available.

Dielectric Strength: 750 VAC.

Insulation Resistance: 10,000 Megohm minimum dry.

Fusing Times: 1 millisecond to 1 second.

Minimum Fusing Current: Approximately 4 times the continuous operating current obtainable on some designs. Larger ratios produce better designs.

MECHANICAL SPECIFICATIONS

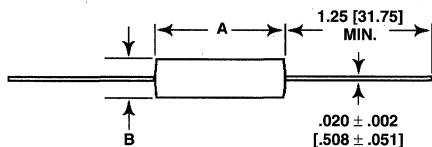
Terminal Strength: 5 pound pull test.

Solderability: Continuous satisfactory coverage when tested in accordance with MIL-STD-202, Method 208.

NOTE: No standard part numbers are shown since these units are tailored to meet individual needs. Note that the inherent compromise involved between resistive and fusing functions sometimes makes certain exact combinations unattainable. However, in nearly all cases, this does not prevent the production of a functional, reliable fuse resistor thoroughly capable of meeting application requirements.

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]

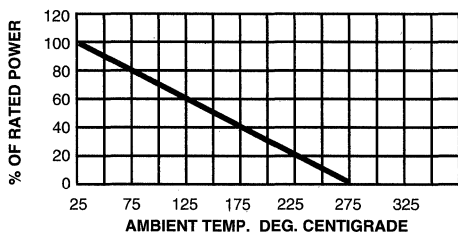


MODEL	A	B
1.0 Watt	.422 ± .015 [10.72 ± .381]	.110 ± .015 [2.79 ± .381]

PART MARKING

- Dale
- Model
- Value
- Tolerance
- Date code

DERATING



NOTE: Continuous power rating must be derated at high ambient temperature per above curve.

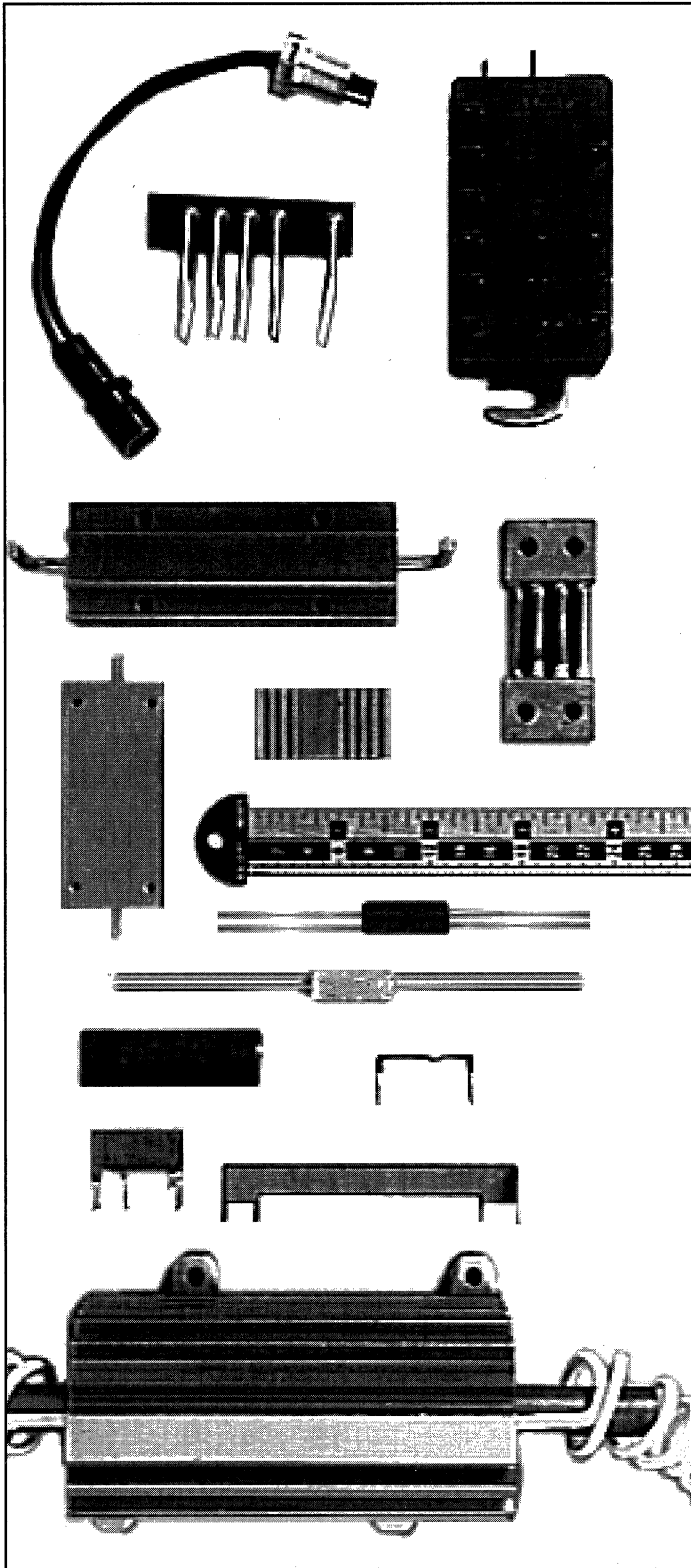
HOW TO ORDER

Please include the following information. It will enable us to choose the best design for your application.

1. Operating wattage or current, ambient temperature and required resistance stability. ($\% \Delta R/1000$ hours).
2. Fusing wattage or current and maximum "blow" time. Also, minimum "blow" time, if applicable.
3. Nominal resistance and maximum allowable resistance tolerance, (5% to 10% preferred).
4. Maximum allowable physical size.
5. Voltage to be interrupted.
6. Frequency of power source, wave form and a brief description of your application.

SPECIAL PURPOSE Wirewound Resistors

Engineered to Your Special Requirements



The photo at left illustrates only a few of the many special purpose wirewound resistors built by the Dale® Special Products Section in the Wirewound Division.

Full-time engineers assigned to this section draw on the industry's largest file of non-standard resistor design and production information. Often, in a matter of minutes, these engineers determine a fast, practical route to the production of your non-standard part.

The list below shows some of the options and combinations which can be achieved:

WIREWOUND OPTIONS

Construction: Heat sink, silicone coated, epoxy or silicone molded (single or multi-element), hermetic seal (ceramic tube or metal can encapsulated), clip mounted or fireproof inorganic construction.

Leads: Radial and axial type, special materials and dimensions, spaded, threaded, insulated, quick-disconnect eyelet, printed circuit, ferrule.

Matching: By pairs or sets for T.C., tolerance or ratio.

Special Types: Extended low or high resistance range, adjustable, low reactance, special wire alloys, very low or high T. C., high stability, special tolerances, tapped, water cooled, temperature sensitive, inductive.

Pre-conditioning: Power aging, temperature cycling, temperature and power, short-time overload, thermal shock, X-ray, temperature aging.

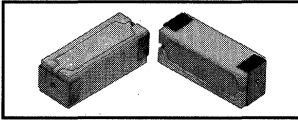
Shunts: Low value, 4-terminal resistors built to customer specifications or designed by our engineers to meet your current sensing requirements.

Fuse Resistors: Our hybrid components designed to act as an ordinary resistor under normal circuit conditions, and as a fuse under fault conditions. Dale offers a variety of standard types, physical sizes and basic styles. Each application should be referred to Dale for an individual design to insure optimum performance in any particular circuit. See our special pages on fuse resistors.

For Fast Attention to Your Special Resistor Requirements, Call or Write:

Special Products Section
Wirewound Division
DALE ELECTRONICS, INC.
1122 23rd Street, Columbus, NE 68601-3647
Phone (402) 563-6506

MODEL CP-2M Wirewound Resistors Surface Mount



FEATURES

- High wattage capabilities
- Suitable for pick and place equipment
- Compact size
- Fireproof inorganic construction. Special inorganic potting compound provides high thermal conductivity and moisture resistance for use in aqueous board wash systems.

ELECTRICAL SPECIFICATIONS

Resistance Range: .1 ohm to 2.74 kilohm.

Resistance Tolerance: $\pm 5\%$ standard.
 $\pm 3\%$, $\pm 1\%$ available.

Temperature Coefficient: Below 1 ohm, $\pm 90\text{PPM}/^\circ\text{C}$.
Above 1 ohm, $\pm 50\text{PPM}/^\circ\text{C}$.

Power Rating: 5 watts.

Maximum Working Voltage: $\sqrt{\text{PR}}$.

MATERIAL SPECIFICATIONS

Element: Copper-nickel alloy or nickel-chrome.

Terminals: Copper, tinned with high temperature solder.

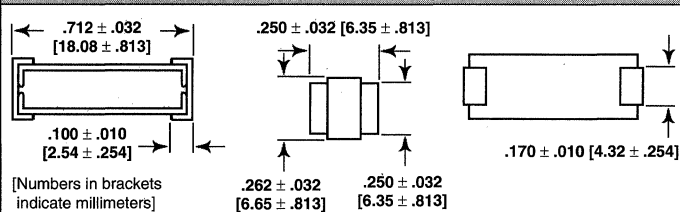
Case: High quality ceramic.

Potting Compound: High temperature, thermally conductive, moisture resistant and inorganic, creating a completely fireproof package.

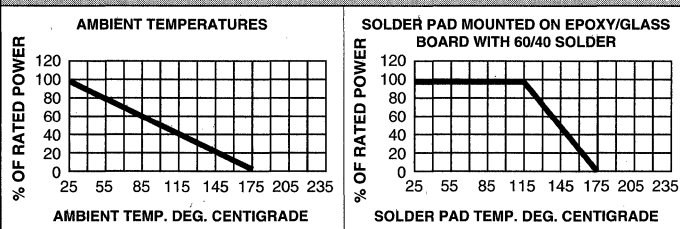
Packaging: Bulk pack standard. Tube pack available.

Solderability: Hot solder dipped terminals to facilitate soldering.

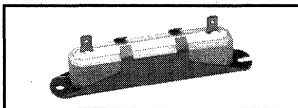
DIMENSIONAL CONFIGURATIONS



DERATING



MODELS SPR-2213 and SPR-2214 Wirewound Resistors Special Purpose, Commercial High Power, Flameproof



FEATURES

- High power/size ratio
- Fireproof inorganic construction
- Quick disconnect terminals
- Completely welded construction
- Options include center terminal, high surge capability and non-inductive styles

ELECTRICAL SPECIFICATIONS

Resistance Range: SPR-2213, .5 ohm to 24 kilohm.
SPR-2214, 1 ohm to 44 kilohm.

Resistance Tolerance: $\pm 5\%$, $\pm 10\%$.

T. C.: $\pm 50\text{PPM}/^\circ\text{C}$, below 10 ohm.
 $\pm 30\text{PPM}/^\circ\text{C}$, 10 ohm and above.

Dielectric Strength: 2500 VAC.

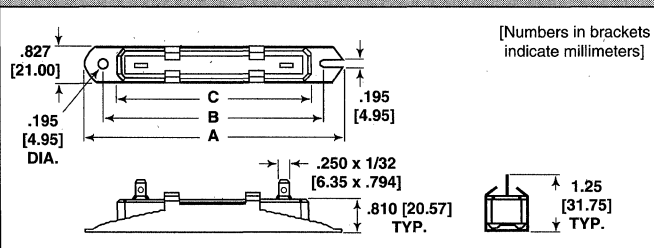
Maximum Working Voltage: $\sqrt{\text{PR}}$.

Operating Temperature: -55°C to $+275^\circ\text{C}$.

Wattage Rating: SPR-2213, 70 watts with heat sink and 40 watts without heat sink. SPR-2214, 100 watts with heat sink and 50 watts without heat sink.

Construction: A completely welded assembly using a ceramic core, copper-nickel or nickel-chrome alloy element, with nickel plated steel terminals. The element is potted into a high quality steatite ceramic case using a high temperature, high thermal conducting inorganic potting compound. The result is a completely fireproof inorganic package. The unit is centered and secured with a zinc-plated steel bracket, designed for maximum dielectric strength, heat transfer and ease of mounting.

DIMENSIONAL CONFIGURATIONS



MODEL	A (Typical)	B $\pm .031$ [.787]	C $\pm .031$ [.787]
SPR-2213	3.375 [85.72]	3.00 [76.20]	2.50 [63.50]
SPR-2214	4.563 [115.90]	4.125 [104.78]	3.625 [92.08]

PART MARKING

- Dale logo
- Model — Value
- Tolerance
- Date code

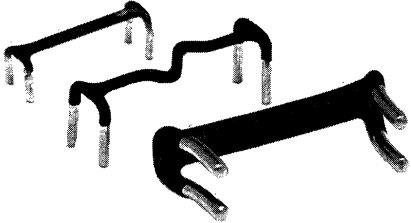
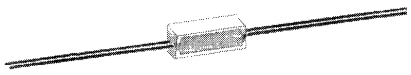
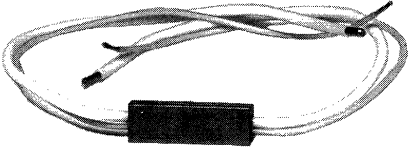

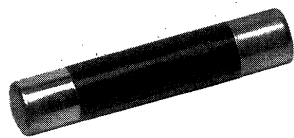
HOW TO ORDER

SPR - 2214 160 5%
MODEL STYLE RESISTANCE TOLERANCE
Skin Packed Standard

SPECIAL PURPOSE Wirewound Resistors

Four Terminal, Current Sensing For Instrumentation and Control

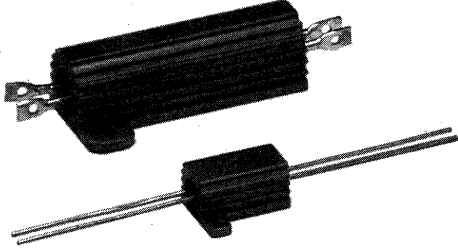
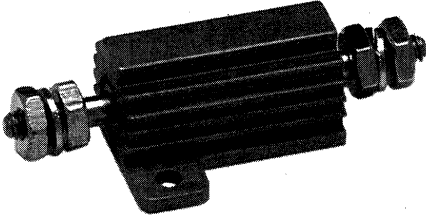

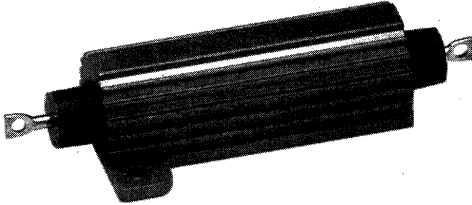
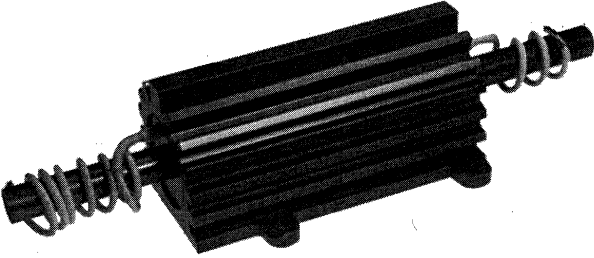


	<p>MODELS SPR-676 SPR-2039, SPR-2093</p> <p>Wirewound Resistors</p> <p>Special Purpose Open Style Designed for Printed Circuit Boards</p>	STANDARD ELECTRICAL SPECIFICATIONS																							
		<table border="1"> <thead> <tr> <th>MODEL</th> <th>WATTAGE</th> <th>RESISTANCE RANGE (Ohms)</th> <th colspan="2">TYPICAL TOLERANCE</th> </tr> </thead> <tbody> <tr> <td>SPR-676</td> <td>1</td> <td>.0015-.05</td> <td colspan="2">.5%</td> </tr> <tr> <td>SPR-2039</td> <td>3.5</td> <td>.0033-.05</td> <td colspan="2">1%</td> </tr> <tr> <td>SPR-2093</td> <td>13*</td> <td>.0005-.002</td> <td colspan="2">1.5%</td> </tr> </tbody> </table> <p>* Limited to 115 Amps.</p>	MODEL	WATTAGE	RESISTANCE RANGE (Ohms)	TYPICAL TOLERANCE		SPR-676	1	.0015-.05	.5%		SPR-2039	3.5	.0033-.05	1%		SPR-2093	13*	.0005-.002	1.5%		DIMENSIONAL CONFIGURATIONS		
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	<p>MODELS SPR-2073 SPR-2123, SPR-2091</p> <p>Wirewound Resistors</p> <p>Special Purpose Ceramic Potted Designed for Rugged Applications</p>	STANDARD ELECTRICAL SPECIFICATIONS																							
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	<p>MODEL SPR-383</p> <p>Wirewound Resistors</p> <p>Special Purpose Heat Sink Style, Silicone Molded Aluminum Housed Unit Featuring Flexible Teflon Insulated Leads to Meet Those Tough Environmental Requirements</p>	STANDARD ELECTRICAL SPECIFICATIONS																							
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	<p>MODEL SPR-1005</p> <p>Wirewound Resistors</p> <p>Special Purpose Silicone Molded SPR-1005-26/MIL-R-49465/1 Qualified, Type RLV-10</p>	STANDARD ELECTRICAL SPECIFICATIONS																							
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	<p>MODEL SPR-1014</p> <p>Wirewound Resistors</p> <p>Special Purpose Fuse Clip Mounted Style</p>	FEATURES																							
		<ul style="list-style-type: none"> Designed for use in equipment requiring an easily changeable resistor for calibration of equipment to specific installation requirements. The 1 1/4" x 1/4" [31.75 x 6.35] unit mounts in a standard fuse clip. The value range is 1 ohm to 1 kilohm in 5% or 10% tolerance and dissipates 3 watts at 25°C. Extended value range and lower tolerances are available on request. 																							

SPECIAL PURPOSE Wirewound Resistors

Housed, Terminal Variations



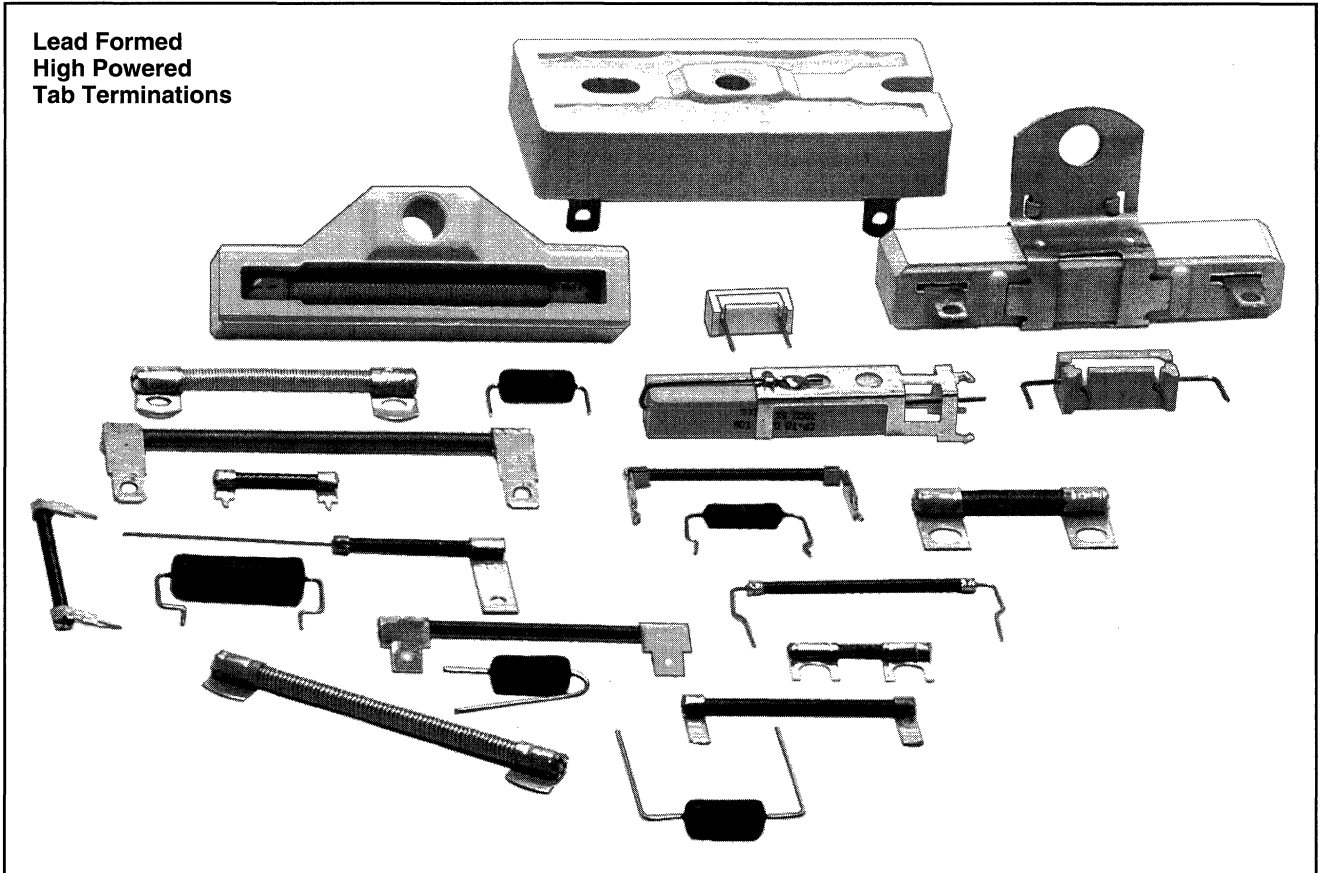
	<p>MODELS RH-10, RH-25, RH-50 Four Terminals</p> <p>Available in RH-10, RH-25 and RH-50 package size. Except for the terminals all physical and electrical characteristics are the same as standard RH type (page 52). Non-inductive styles available. Contact Columbus factory at address below.</p>
	<p>MODELS RH-5, RH-10, RH-25, RH-50 Threaded Terminals</p> <p>Available in RH-5, RH-10, RH-25 and RH-50 package size. Except for the terminals all physical and electrical characteristics are the same as standard RH type (page 52). Non-inductive styles available. Contact Columbus factory at address below.</p>
	<p>MODELS RH-10, RH-25, RH-50 Teflon Insulated, Flexible Terminals</p> <p>Available in RH-10, RH-25 and RH-50 package size. Except for the terminals all physical and electrical characteristics are the same as standard RH type (page 52). Non-inductive styles available. Contact Columbus factory at address below.</p>
	<p>MODEL RH-50 High Voltage Design</p> <p>Available in RH-50 package size, the high voltage design incorporates extended molding compound at the terminals to give longer voltage creep distance of .405" [10.29]. Physical dimensions are the same as standard RH-50 (page 52) except that over all length is 2.843" + .032" [72.21 + .813]. Non-inductive styles available. Contact Columbus factory at address below.</p>
	<p>MODEL SPR-1002 High Wattage, Water Cooled</p> <p>The SPR-1002 is a variation of the NH-250 (non-inductive) resistor that incorporates water cooling for increased power dissipation. The unit is rated at 450 watts when mounted on the standard NH-250 except terminals are #12 AWG teflon insulated flexible wire and 1/2" [12.70] diameter copper water cooling tube extends 1.5" [38.10] from each end. Electrical characteristics are same as standard NH-250 (page 52) except that the dielectric strength is 3000 VRC.</p>

SPECIAL PURPOSE Wirewound Resistors

Engineered to Your Special Requirements



Lead Formed
High Powered
Tab Terminations



LEAD FORMED PRODUCTS

A variety of standard lead forms are available for use where auto-insertion is not available or practical. Forms vary from simple right angle lead bends, vertical hair pin bends, to lock in styles that lock into the circuit board. This provides for a positive stand-off while holding the part securely in place during further handling.

HIGH POWERED RESISTORS

High power, low cost, ceramic cased resistors are available in a range of wattage ratings and termination styles. From 25 watts to 50 watts (even more with proper heat sinks) these resistors can be supplied with wire leads or quick disconnects and several mounting techniques. Frequently used in power supplies, motor controllers, and automotive applications, these products can be custom tailored to individual needs.

TAB TYPE TERMINATIONS

These resistors, widely used in automotive applications, provide high wattage and easy mounting by directly mounting to binding posts, soldering or welding, or by use of quick disconnect terminals.

BRACKETS

CHASSIS MOUNTS

CIRCUIT BOARD MOUNTING

A variety of brackets are available for mounting ceramic cased resistors directly to a chassis or heat sink, or directly onto a circuit board. Benefits include higher heat dissipation and positive mounting where quick disconnect or hand solderable terminals are used, or a very minimal amount of board space is available making a vertical mount necessary. In addition, several styles can be supplied for mounting in circuit boards, with or without a ceramic case.

Contact Dale® Engineering For All Your Special Purpose Wirewound Resistor Requirements:

- Heaters
- High T. C.
- Surface Mount
- Special Lead Forming
- Special Length, Flexible Resistors
- Fusible Types
- Current Sensing
- Special Mounting
- High Pulse Capabilities
- Lightning Surge/Power Cross Capabilities

CHECKLIST FOR ORDERING FILM RESISTORS



ORDERS MUST HAVE COMPLETE INFORMATION INCLUDING THE FOLLOWING:

1. Resistor type and model number
2. Resistor wattage rating
3. Resistor value
4. Resistor tolerance
5. Temperature Coefficient
6. Special quantity of each item
7. Specify routing
8. Desired delivery
9. If you have a drawing covering the part, specify your part number and drawing number and supply a copy with the order. Including the Dale® specification number on your drawings will assure you of exact duplication on all future orders.
10. Priority rating under DMS regulations and contract number (if applicable).
11. Specify if Letter of Certification is required.
12. Prices on specific items and quantities will be quoted on request. Quantity of each item ordered at one time determines unit price for manufacturers' orders.

STANDARD DECADE RESISTANCE VALUES

The following table lists four established number series which are used as preferred values in electronic design. Each series is shown under an associated value of tolerance %. The number series under the 10% column is known as the E12 Series because there are 12 standard values within a decade range. 2% and 5% utilize the E24 Series, 1% uses E96 and .1%, .25% and .5% use E192. Successive values within a decade series are related (approximately) by a factor of $^{12}\sqrt{10}$ for the E12 Series, $^{24}\sqrt{10}$ for the E24 Series, $^{96}\sqrt{10}$ for the E96 Series and $^{192}\sqrt{10}$ for the E192 Series.

Use of standard values is encouraged because stocking programs are designed around them. However, intermediate values can be special ordered where permitted. Consult factory.

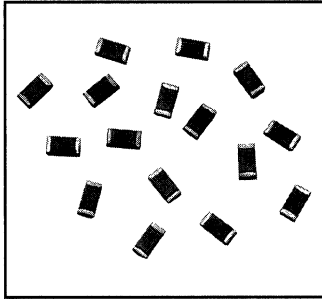
.1%, .25%, .5%		.1%, .25%, .5%		.1%, .25%, .5%		.1%, .25%, .5%		.1%, .25%, .5%		.1%, .25%, .5%		.1%, .25%, .5%		2%, 5%		10%	
10.0	10.0	13.3	13.3	17.8	17.8	23.7	23.7	31.6	31.6	42.2	42.2	56.2	56.2	75.0	75.0	10	10
10.1		13.5		18.0		24.0		32.0		42.7		56.9		75.9		11	—
10.2	10.2	13.7	13.7	18.2	18.2	24.3	24.3	32.4	32.4	43.2	43.2	57.6	57.6	76.8	76.8	12	12
10.4		13.8		18.4		24.6		32.8		43.7		58.3		77.7		13	—
10.5	10.5	14.0	14.0	18.7	18.7	24.9	24.9	33.2	33.2	44.2	44.2	59.0	59.0	78.7	78.7	15	15
10.6		14.2		18.9		25.2		33.6		44.8		59.7		79.6		16	—
10.7	10.7	14.3	14.3	19.1	19.1	25.5	25.5	34.0	34.0	45.3	45.3	60.4	60.4	80.6	80.6	18	18
10.9		14.5		19.3		25.8		34.4		45.9		61.2		81.6		20	—
11.0	11.0	14.7	14.7	19.6	19.6	26.1	26.1	34.8	34.8	46.4	46.4	61.9	61.9	82.5	82.5	22	22
11.1		14.9		19.8		26.4		35.2		47.0		62.6		83.5		24	—
11.3	11.3	15.0	15.0	20.0	20.0	26.7	26.7	35.7	35.7	47.5	47.5	63.4	63.4	84.5	84.5	27	27
11.4		15.2		20.3		27.1		36.1		48.1		64.2		85.6		30	—
11.5	11.5	15.4	15.4	20.5	20.5	27.4	27.4	36.5	36.5	48.7	48.7	64.9	64.9	86.6	86.6	33	33
11.7		15.6		20.8		27.7		37.0		49.3		65.7		87.6		36	—
11.8	11.8	15.8	15.8	21.0	21.0	28.0	28.0	37.4	37.4	49.9	49.9	66.5	66.5	88.7	88.7	39	39
12.0		16.0		21.3		28.4		37.9		50.5		67.3		89.8		43	—
12.1	12.1	16.2	16.2	21.5	21.5	28.7	28.7	38.3	38.3	51.1	51.1	68.1	68.1	90.9	90.9	47	47
12.3		16.4		21.8		29.1		38.8		51.7		69.0		92.0		51	—
12.4	12.4	16.5	16.5	22.1	22.1	29.4	29.4	39.2	39.2	52.3	52.3	69.8	69.8	93.1	93.1	56	56
12.6		16.7		22.3		29.8		39.7		53.0		70.6		94.2		62	—
12.7	12.7	16.9	16.9	22.6	22.6	30.1	30.1	40.2	40.2	53.6	53.6	71.5	71.5	95.3	95.3	68	68
12.9		17.2		22.9		30.5		40.7		54.2		72.3		96.5		75	—
13.0	13.0	17.4	17.4	23.2	23.2	30.9	30.9	41.2	41.2	54.9	54.9	73.2	73.2	97.6	97.6	82	82
13.2		17.6		23.4		31.2		41.7		55.6		74.1		98.8		91	—

Standard resistance values are obtained from the decade table by multiplying by powers of 10. As an example, 13.3 can represent ohms, 133 ohms, 1.33k, 13.3k, 133k, 1.33 Megohm.

MODEL TNPWM

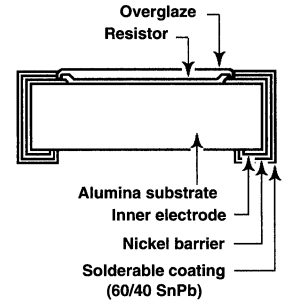
Thin Film Chip Resistors

Military/Established Reliability
MIL-R-55342/7 Qualified, Type RM, Precision



FEATURES

- Internationally standardized size
- Meets requirements of MIL-R-55342
- Established Reliability - Verified failure rate (contact factory)
- Operating temperature range is - 55°C to + 150°C
- 8mm reel, tray or bulk packaging
- Flow solderable
- 100% screen tested
- Thin film resistance element and wraparound termination
- Inner electrode protection
- Automatic placement compatibility



STANDARD ELECTRICAL SPECIFICATIONS					
DALE MODEL	MIL-R-55342 TYPE	MILITARY SHEET NUMBER	CHAR.	RESISTANCE RANGE (Ohms)	TOLERANCE
TNPWM-1206	RM1206	07	H	49.9-1M	1%, 2%, 5%
			E, H	49.9-1M	1%, 2%
			E, H	100-500k	0.1%, 1%, 2%

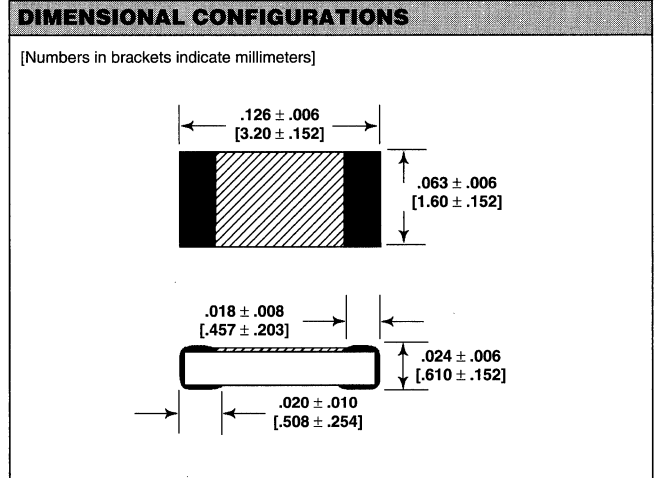
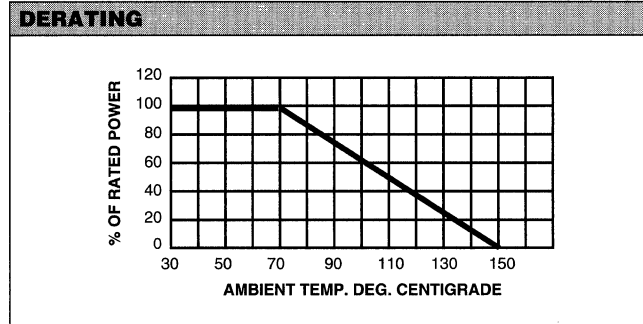
CODE LETTERS FOR TOLERANCE AND MULTIPLIER					
± 0.1%	± 1%	± 2%	± 5%	MULTIPLIER	VALUE RANGE (Ohms)
A	D	G	J	1	1-9xx
B	E	H	K	1,000	1k-9xxk
C	F	T	L	1,000,000	1M-9xxM
Examples:					
102A = 102Ω ± 0.1%	49D9 = 49.9Ω ± 1%	75G0 = 75Ω ± 2%	68J0 = 68Ω ± 5%		
1B00 = 1kΩ ± 0.1%	10E0 = 10kΩ ± 1%	10H0 = 10kΩ ± 2%	10K0 = 10kΩ ± 5%		
100B = 100kΩ ± 0.1%	332D = 332Ω ± 1%	33H0 = 33kΩ ± 2%	560K = 560kΩ ± 5%		

ELECTRICAL SPECIFICATIONS

Power Rating at 70°C: .125 W.

Maximum Operating Voltage: 100 V.

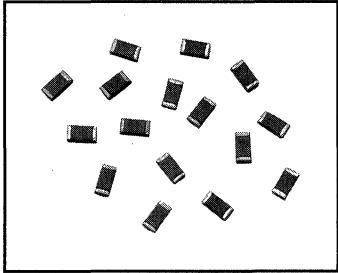
Termination Material: Pretinned nickel barrier wraparound.



HOW TO ORDER - MILITARY PART NUMBER					
D55342 MIL SPEC. NO. INDICATING MIL-R-55342	E CHARACTERISTIC	07 MIL SPEC. SHEET NUMBER (STYLE)	B TERMINATION MATERIAL	1B00 RESISTANCE AND TOLERANCE	R LIFE FAILURE RATE
	E = ± 25PPM/°C H = ± 50PPM/°C	07 = RM1206	B = Pretinned Nickel Barrier Wraparound	See Examples Above	M = 1%/1,000 hours P = .1%/1,000 hours R = .01%/1,000 hours

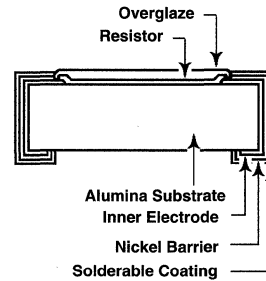
MODEL TNPW Thin Film Chip Resistors

Industrial, Precision



FEATURES

- Internationally standardized size
- Automatic placement compatibility
- Reflow solderable
- Thin film resistance element
- Wraparound termination
- Inner electrode protection
- 8mm reel or bulk packaging
- Operating temperature range is - 55°C to + 125°C



STANDARD ELECTRICAL SPECIFICATIONS

MODEL	RESISTANCE TEMPERATURE COEFFICIENT	RESISTANCE RANGE (Ohms)	TOLERANCE	MAXIMUM OPERATING VOLTAGE	POWER RATING @ 70°C
TNPW-0603	± 25PPM/°C	100-33k	± 0.5%	75	.062 W
TNPW-0603	± 50PPM/°C	10-91	± 0.5%	75	.062 W
TNPW-0603	± 100PPM/°C	36k-100k	± 0.5%	75	.062 W
TNPW-0805	± 25PPM/°C	100-100k	± 0.1%, 0.5%	100	.100 W
TNPW-0805	± 50PPM/°C	10-91	± 0.5%	100	.100 W
TNPW-1206	± 25PPM/°C	49.9-1M	± 0.1%, 0.5%, 1.0%	100	.125 W
TNPW-1206	± 25PPM/°C	22.1-48.7	± 0.5%, 1.0%	100	.125 W
TNPW-1206	± 15PPM/°C	1k-1M	± 0.1%, 0.5%, 1.0%	100	.125 W
TNPW-1206	± 10PPM/°C	1k-1M	± 0.1%, 0.5%, 1.0%	100	.125 W
TNPW-1210	± 25PPM/°C	49.9-1M	± 0.1%, 0.5%, 1.0%	100	.250 W

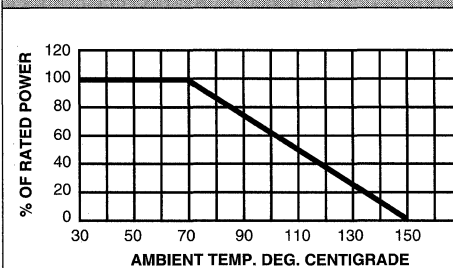
DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

MODEL	A	B	C	D	E
TNPW-0603	.063 ± .008 [1.60 ± .203]	.032 ± .008 [.813 ± .203]	.016 ± .004 [.406 ± .102]	.012 ± .008 [.305 ± .203]	.012 ± .008 [.305 ± .203]
TNPW-0805	.080 ± .008 [2.03 ± .203]	.049 ± .008 [1.24 ± .203]	.016 ± .004 [.406 ± .102]	.016 ± .010 [.406 ± .254]	.016 ± .008 [.406 ± .203]
TNPW-1206	.126 ± .006 [3.20 ± .152]	.063 ± .006 [1.60 ± .152]	.024 ± .006 [.610 ± .152]	.018 ± .008 [.457 ± .203]	.018 ± .004 [.457 ± .102]
TNPW-1210	.126 ± .006 [3.20 ± .152]	.098 ± .006 [2.49 ± .152]	.024 ± .006 [.610 ± .152]	.018 ± .008 [.457 ± .203]	.018 ± .004 [.457 ± .102]

ENVIRONMENTAL PERFORMANCE

TEST	MAX. ΔR (Typical Test Lots)
Thermal Shock	± 0.1% Max. + .05Ω
Short Time Overload	± 0.1% Max. + .05Ω
Low Temperature Operation	± 0.1% Max. + .05Ω
High Temperature Exposure	± 0.1% Max. + .05Ω
Moisture Resistance	± 0.1% Max. + .05Ω
Resistance to Bonding Exposure	± 0.1% Max. + .05Ω
Solderability	230°C, 5 sec., 95% Coverage
Life	± 0.1% Max. + .05Ω

DERATING



PART MARKING

TNPW-0603 and TNPW-0805
— 3 digit code
(E-24 decade values)

TNPW-1206
— 4 digit code
(E-96 decade values)

TNPW-1210
Contact factory.

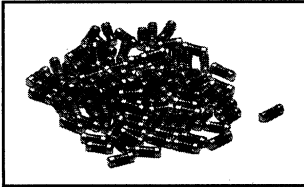
HOW TO ORDER

TNPW MODEL	SIZE	XXX or XXXX VALUE	B TOLERANCE	T-9 TEMPERATURE COEFFICIENT
	0603 0805 1206 1210	3 Digit Code: First two digits are significant figures. Last digit specifies the number of zeros to follow. 4 Digit Code: First three digits are significant figures. Last digit specifies the number of zeros to follow.	B = ± 0.1% D = ± 0.5% F = ± 1.0%	T-1 = 100PPM/°C T-2 = 50PPM/°C T-9 = 25PPM/°C T-10 = 15PPM/°C T-13 = 10PPM/°C

MODEL SMM0204

Cylindrical Thin Film Chip Resistors

Industrial, Precision



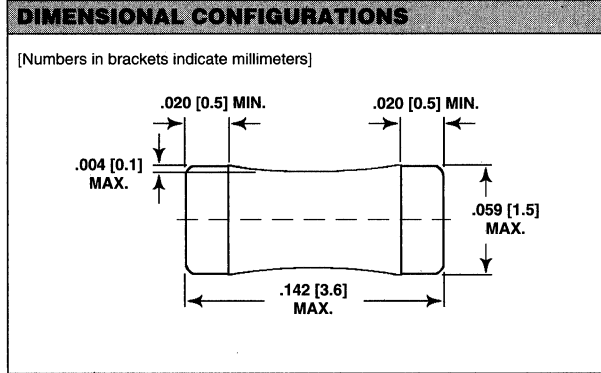
FEATURES

- Cylindrical, leadless body style (MELF)
- Automatic placement compatibility
- Reflow and wave solderable
- Thin film resistance element
- Solderable end cap construction
- Color band marking
- 8mm tape width reel or bulk packaging
- Maximum operating voltage is 200 V
- Power rating at 70°C is 0.25 W

STANDARD ELECTRICAL SPECIFICATIONS				
MODEL	TEMPERATURE COEFFICIENT	RESISTANCE RANGE (Ohms)	DECADE VALUES	TOLERANCE
SMM0204	± 15 PPM/°C	43-221k	E24-E192	± 0.1%
		22-221k	E24-E192	± 0.25%
		10-221k	E24-E192	± 0.5%
SMM0204	± 25PPM/°C	43-330k	E24-E192	± 0.1%
		22-330k	E24-E192	± 0.25%
		10-475k	E24-E192	± 0.5%
SMM0204	± 50PPM/°C	10-475k	E24-E192	± 0.5%
		1-2.2M	E24-E96	± 1%
SMM0204	± 100PPM/°C	1-10M	E24	± 2% & 5%
SMM0204 HF*	± 50PPM/°C	10-470	E96	± 1%

OMM0204 = Zero-ohm resistor. Rmax.: 15mΩ. Imax.: 2A

* HF = High Frequency Version.

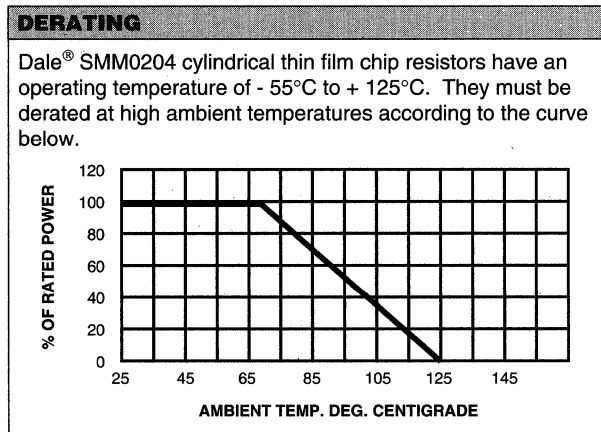
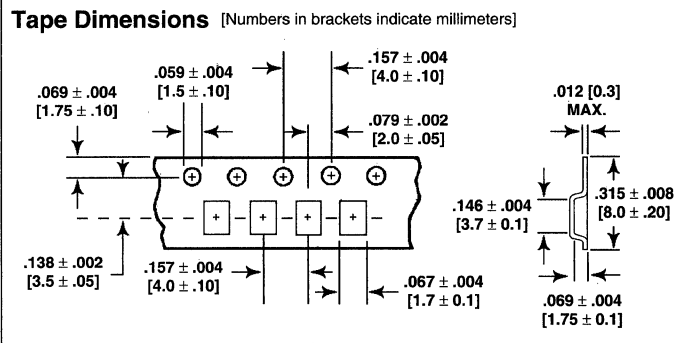


TAPE AND REEL SPECIFICATIONS

SMM0204 are packed in quantities of 2,500 pieces in 180mm diameter reels. Larger reels of 10,000 pieces are available on request. The resistors are also available bulk packed in plastic boxes with styrofoam overpacking, in quantities of 1,000 or 5,000 pieces. SMM0204 in T.C.'s of 15PPM/°C or 25PPM/°C are also available in quantities of 1000 pieces on 180mm diameter reels.

ENVIRONMENTAL PERFORMANCE

TEST	MAX. ΔR (Typical Test Lots)
Thermal Shock	± 0.10% Max. + .05Ω
Short Time Overload	± 0.10% Max. + .05Ω
Resistance to Bonding Exposure	± 0.10% Max. + .05Ω
56 Day Damp Heat	± 0.50% Max. + .05Ω
Life 1,000 Hours @ 70°C	± 0.25% Max. + .05Ω



PART MARKING

Depending on the tolerance, the marking consists of a four band (± 5% and ± 2%) or five band (± 1% and ± 0.1%) color code.

The color of the resistor body identifies the T.C.:
 Bright green = 100PPM and 50PPM.
 Pink = 25PPM.
 Violet = 15PPM.

The HF type has a beige coating. Zero ohm resistors are bright green with a black band.

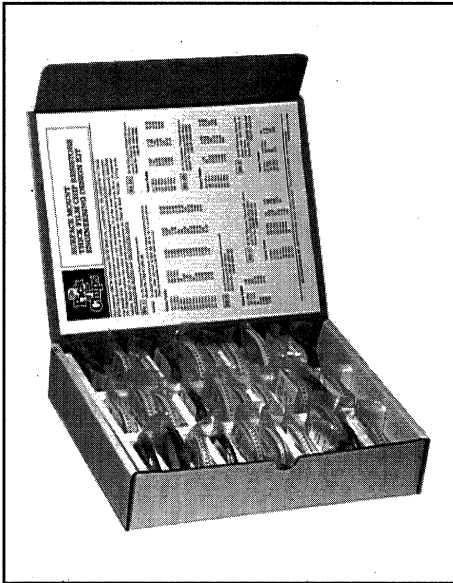
HOW TO ORDER

SMM	0204	332k	25	± 0.5%	TAPE AND REEL
MODEL	SIZE	VALUE	T.C.	TOLERANCE	PACKAGING

Manufactured in Germany

"THE PICK OF THE CHIPS" Thick Film Chip Resistors

Engineering Design Kit Surface Mount



Our popular CRCW1206 and CRCW0805 - 1%, ± 100PPM/°C and 5% ± 200PPM/°C - Thick Film Chip Resistors are now conveniently packaged in a choice of different engineering design kits. You can choose a kit containing 74 of the most frequently specified 1% tolerance values (*see value tables*) or you can choose kits with 30 or 15 popular values. Each kit is packaged with components on Tape and Reel "Strips," along with application notes and technical data.

KIT 1 - ORDER # CRCW1206-101

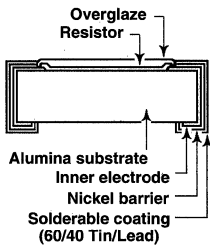
74 1% Tolerance Values/500 pieces each. Kit 1 available in CRCW1206 size only.

Value Table (in ohms)

51.1	301.0	825.0	2.61k	4.75k	8.25k	22.1k	47.5k	150.0k
60.4	332.0	1.0k	2.67k	4.87k	9.09k	24.9k	49.9k	200.0k
80.6	402.0	1.02k	3.01k	4.99k	10.0k	26.7k	51.1k	
100.0	475.0	1.1k	3.16k	5.11k	11.5k	27.4k	56.2k	
130.0	511.0	1.5k	3.32k	5.62k	12.1k	28.0k	68.1k	
133.0	604.0	2.0k	3.48k	6.19k	14.0k	30.1k	75.0k	
178.0	619.0	2.15k	4.02k	6.81k	15.0k	31.6k	88.7k	
196.0	681.0	2.21k	4.32k	7.32k	17.4k	32.4k	90.9k	
200.0	806.0	2.49k	4.64k	7.5k	20.0k	40.2k	100.0k	

NOTE: For 100 pieces each of all 74 values, order one each of Kits 2A, 2B and 3 as shown below.

DIMENSIONAL CONFIGURATIONS



[Numbers in brackets indicate millimeters]

MODEL	A	B	C	D	E
CRCW0805	.079 ± .008 [2.0 ± .20]	.049 ± .008 [1.25 ± .20]	.020 ± .008 [.50 ± .20]	.016 ± .010 [.40 ± .25]	.016 ± .010 [.40 ± .25]
CRCW1206	.126 ± .006 [3.20 ± .15]	.063 ± .006 [1.60 ± .15]	.022 ± .006 [.56 ± .15]	.020 ± .010 [.50 ± .25]	.020 ± .010 [.50 ± .25]

KIT 4 - ORDER #S CRCW1206-104/CRCW0805-104

30 5% Tolerance Values/100 pieces each 10Ω to 1MΩ.

Value Table (in ohms)

10.0	220.0	820.0	4.7k	100.0k
33.0	270.0	1.0k	5.1k	1.0M
47.0	300.0	2.0k	10.0k	
51.0	330.0	2.2k	20.0k	
100.0	470.0	2.7k	22.0k	
150.0	510.0	3.0k	47.0k	
200.0	680.0	3.3k	68.0k	

KIT 2A - ORDER #S CRCW1206-102A/CRCW0805-102A

30 1% Tolerance Values/100 pieces each 51.1Ω to 150kΩ.

Value Table (in ohms)

51.1	332.0	806.0	2.61k	4.32k	7.5k	22.1k	32.4k	150.0k
100.0	475.0	1.02k	3.01k	4.75k	9.09k	27.4k	49.9k	
133.0	511.0	1.5k	3.16k	5.11k	11.5k	30.1k	68.1k	
200.0	619.0	2.15k	3.48k	6.19k	15.0k	31.6k	90.9k	

KIT 2B - ORDER #S CRCW1206-102B/CRCW0805-102B

30 1% Tolerance Values/100 pieces each 60.4Ω to 200kΩ.

Value Table (in ohms)

60.4	825.0	4.64k	17.4k	100.0k
130.0	1.1k	4.87k	24.9k	200.0k
178.0	2.0k	5.62k	28.0k	
301.0	2.21k	6.81k	31.6k	
402.0	2.67k	8.25k	40.2k	
511.0	3.16k	10.0k	51.1k	
681.0	4.02k	12.1k	75.0k	

KIT 3 - ORDER #S CRCW1206-103/CRCW0805-103

15 1% Tolerance Values/100 pieces each 80.6Ω to 88.7kΩ.

Value Table (in ohms)

80.6	1.0k	4.99k	14.0k	47.5k
196.0	2.49k	7.32k	20.0k	56.2k
604.0	3.32k	10.0k	26.7k	88.7k

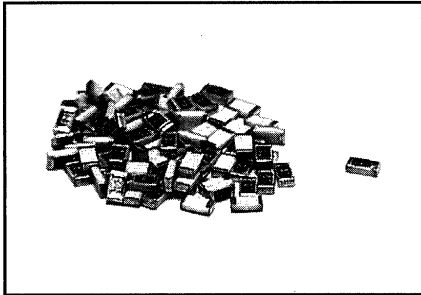
KIT 5 - ORDER #S CRCW1206-105/CRCW0805-105

15 5% Tolerance Values/100 pieces each 33Ω to 100kΩ.

Value Table (in ohms)

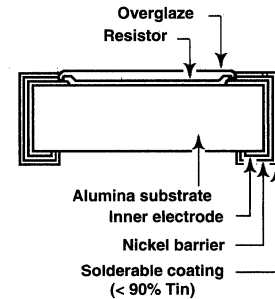
33.0	300.0	820.0	2.7k	5.1k
47.0	470.0	1.0k	3.0k	10.0k
100.0	510.0	2.0k	4.7k	100.0k

MODEL CRCW0603 Thick Film Chip Resistors Industrial



FEATURES

- Internationally standardized size
- Automatic placement compatibility
- Flow solderable
- Inner electrode protection
- Thick film resistance element
- Wraparound termination
- Standard resistance values = E-24
- Operating temperature range is - 55°C to + 125°C



ELECTRICAL SPECIFICATIONS

Maximum RCWV: 50 V. Rated continuous working voltage (RCWV) shall be determined from $RCWV = \sqrt{\text{The square root of Rated Power} \times \text{Resistance Value}}$ or from maximum RCWV (50 V) whichever is less.

Resistance Range: 10 ohm to 1 Megohm.

Resistance Tolerance: 1%, 5%.

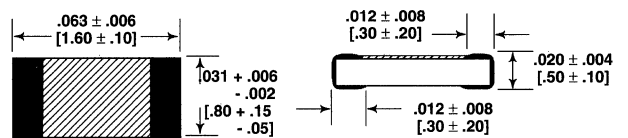
Power Rating at 70°C: 1/16 watt.

Maximum Overload Voltage: 100 V.

Dielectric Withstanding Voltage: 200 V.

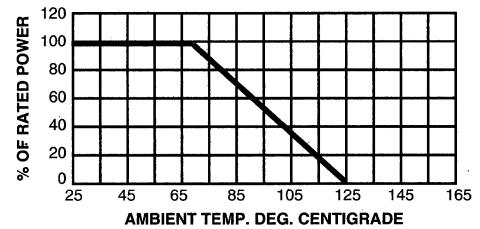
DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



ENVIRONMENTAL PERFORMANCE		
TEST	REQUIREMENT	SPECIFICATION
Thermal Shock	$\pm (1.0\% + .05\Omega)$	EIA STD.IS-30
Short Time Overload	$\pm (2.0\% + 0.1\Omega)$	EIA STD.IS-30
Low Temperature Operation	$\pm (1.5\% + 0.1\Omega)$	EIA STD.IS-30
High Temperature Exposure	$\pm (1.5\% + 0.1\Omega)$	EIA STD.IS-30
Moisture Resistance	$\pm (1.0\% + .05\Omega)$	EIA STD.IS-30
Life	$\pm (3.0\% + 0.1\Omega)$	EIA STD.IS-30
Effect of Soldering	$\pm (1.0\% + .05\Omega)$	EIA STD.IS-30
Solderability & Leach Resistance	95% min. coverage	EIA STD.IS-30
Termination Adhesion	0.5 Kg min.	AXIAL PULL
TC of R	$\pm 200\text{PPM}/^\circ\text{C}$	EIA STD.IS-30

DERATING



HOW TO ORDER

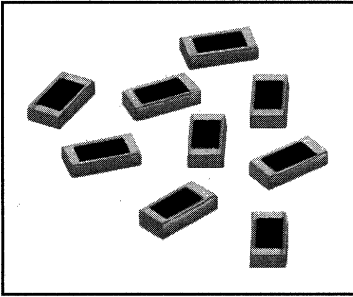
CRCW MODEL	0603 SIZE	XXX RESISTANCE VALUE CODE First two digits are significant; last digit is the multiplier.	X TOLERANCE F = $\pm 1\%$ J = $\pm 5\%$	RT-1 PACKAGING RT1 = Paper Tape 5,000 pieces per reel
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TAPE AND REEL SPECIFICATIONS

Marking: All required marking to be on unit package. Individual part marking is 3 digit value code. **Packaging:** 8mm Reel - 5,000 pieces per reel per EIA Std. RS-481.

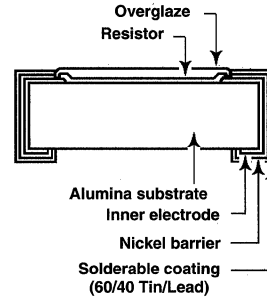
<h3>Reel</h3> <p>Reel Dimensions</p> <ul style="list-style-type: none"> Outer diameter: $.512 \pm .008$ [13 ± .20] Inner diameter: $.56$ [14.4] MAX. Reel width: 1.969 [50] MIN. Flange thickness: $.331 + .059$ - 0.0 [8.4 + 1.5] - 0.0 (Measured at hub) Reel hole diameter: $7.00 \pm .079$ [178 ± 2] 	<h3>Tape</h3> <p>(USER DIRECTION OF FEED)</p> <p>Trailer Components Leader (Note 1)</p> <p>NOTE 1. There shall be a leader of 230mm minimum which may consist of carrier and/or cover tape followed by a minimum of 160mm of carrier tape with sealed cover tape not to exceed 560mm combined total.</p> <p>NOTE 2. There shall be a minimum of 40 empty component pockets sealed with cover tape.</p>	<h3>Tape Dimensions</h3> <p>NOTE: Net weight per 1000 pieces is .0044 pounds (2 grams).</p>
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MODEL CRCW Thick Film Chip Resistors Industrial



FEATURES

- Internationally standardized size
- Automatic placement compatibility
- Flow solderable
- Thick film resistance element
- Wraparound termination
- Inner electrode protection
- Operating temperature range is - 55°C to + 150°C

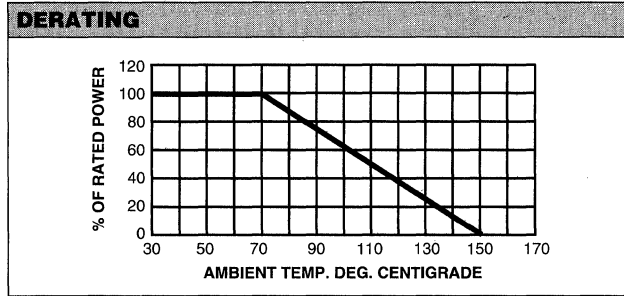


STANDARD ELECTRICAL SPECIFICATIONS							DIMENSIONAL CONFIGURATIONS							
MODEL	RESISTANCE, TOLERANCE & TEMPERATURE COEFFICIENT RANGE						Power Rating and Max. Operating Voltage (@ 70°C) (See derating curve)	Zero Ohm Jumper						
	E-12 Std. Res. Values	E-24 Std. Res. Values		E-96 Std. Res. Values					[Numbers in brackets indicate millimeters]					
	± 10% & ± 20%	± 5%	± 5%	± 1%	± 1%	± .5%			A	B	C	D	E	
	± 300 PPM/°C	± 300 PPM/°C	± 200 PPM/°C	± 200 PPM/°C	± 100 PPM/°C	± 100 PPM/°C								
CRCW 0805		5.1Ω to 9.1Ω and 1.1 Meg to 5 Meg	10Ω to 1 Meg		10Ω to 1 Meg		1/10 W 100 V	0.05Ω Max. 1 AMP Max.	.079 ± .008 [2.00 ± .20]	.049 ± .008 [1.25 ± .20]	.020 ± .008 [.50 ± .20]	.016 ± .010 [.40 ± .25]	.016 ± .010 [.40 ± .25]	
CRCW 1206	3.3Ω to 8.2Ω and 2.7 Meg to 22 Meg	3Ω to 9.1Ω and 2.4 Meg to 22 Meg	10Ω to 2.2 Meg	1.01 Meg to 2.15 Meg	10Ω to 1 Meg	1k to 5k	1/8 W 200 V	0.05Ω Max. 2 AMP Max.	.126 ± .006 [3.20 ± .15]	.063 ± .006 [1.60 ± .15]	.022 ± .006 [.56 ± .15]	.020 ± .010 [.50 ± .25]	.020 ± .010 [.50 ± .25]	
CRCW 1210			10Ω to 1.5 Meg	221k to 1.5 Meg	10Ω to 215k		1/4 W 200 V	0.05Ω Max. 4 AMP Max.	.126 ± .008 [3.20 ± .20]	.098 ± .008 [2.50 ± .20]	.022 ± .006 [.56 ± .15]	.020 ± .010 [.50 ± .25]	.020 ± .010 [.50 ± .25]	
CRCW 2010		3Ω to 9.1Ω	10Ω to 1 Meg		10Ω to 1 Meg		1/2 W 200 V		.200 + .009 - .006 [5.08 + .23 - .15]	.100 + .009 - .006 [2.54 + .23 - .15]	.022 ± .006 [.56 ± .15]	.020 ± .010 [.50 ± .25]	.020 ± .010 [.50 ± .25]	
CRCW 2512		3Ω to 9.1Ω	10Ω to 240k		10Ω to 237k		1 W 200 V		.250 + .009 - .006 [6.35 + .23 - .15]	.126 + .008 - .006 [3.20 + .20 - .15]	.022 ± .006 [.56 ± .15]	.020 ± .010 [.50 ± .25]	.020 ± .010 [.50 ± .25]	

□ = Factory Stocked Resistance Range □ = Contact Factory for Delivery ■ = Contact Factory for Availability

MODEL CRCW

ENVIRONMENTAL PERFORMANCE			
TEST	REQUIREMENT		SPECIFICATION
	1% TOLERANCE	5% TOLERANCE	
Thermal Shock	$\pm (0.5\% + 0.05\Omega)$	$\pm (1.0\% + 0.1\Omega)$	EIA STD.IS-30, Para. 3.5
Short Time Overload	$\pm (0.5\% + 0.05\Omega)$	$\pm (2.5\% + 0.1\Omega)$	EIA STD.IS-30, Para. 3.7
Low Temperature Operation	$\pm (0.5\% + 0.05\Omega)$	$\pm (1.5\% + 0.1\Omega)$	EIA STD.IS-30, Para. 3.6
High Temperature Exposure	$\pm (1.0\% + 0.05\Omega)$	$\pm (1.5\% + 0.1\Omega)$	EIA STD.IS-30, Para. 3.8
Moisture Resistance	$\pm (0.5\% + 0.05\Omega)$	$\pm (3.0\% + 0.1\Omega)$	EIA STD.IS-30, Para. 3.10
Life	$\pm (2.0\% + 0.05\Omega)$	$\pm (3.0\% + 0.1\Omega)$	EIA STD.IS-30, Para. 3.13
Effect of Soldering	$\pm (0.25\% + 0.05\Omega)$	$\pm (3.0\% + 0.1\Omega)$	EIA STD.IS-30, Para. 3.9
Solderability and Leach Resistance	95% min. coverage of termination	95% min. coverage of termination	EIA STD.IS-30, Para. 3.12
Termination Adhesion	0.5 Kg min.	0.5 Kg min.	AXIAL PULL (soldered-on #26 nailhead lead with .037" dia. head)



PART MARKING

(PER EIA STD. IS-30)

— Resistance Code

(1% units = 4 digit value code)

(5% units = 3 digit value code)

HOW TO ORDER

CRCW MODEL	XXXX SIZE	XXX OR XXXX RESISTANCE VALUE CODE	X TOLERANCE	XXX PACKAGING *
	0805 2010 1206 2512 1210	First two digits (three for "F" tolerance) are significant; last digit is the multiplier.	F = $\pm 1\%$ J = $\pm 5\%$	B02 = Bulk - 1,000 pieces per plastic bag RT1 = Paper Tape - 5,000 pieces per reel RT2 = Punched Plastic Tape - 5,000 pieces per reel RT3 = Punched Plastic Tape - 10,000 pieces per reel (Contact factory) RT5 = Punched Paper Tape - 10,000 pieces per reel (Contact factory) * Contact factory for packaging on 2010 and 2512 models

TAPE AND REEL SPECIFICATIONS

Packaging: Per EIA Std. RS-481.

Reel

Reel Dimensions

Tape

(USER DIRECTION OF FEED) →

Trailer (Note 2) Components Leader (Note 1)

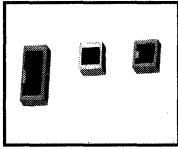
NOTE 1. There shall be a leader of 230mm minimum which may consist of carrier and/or cover tape followed by a minimum of 160mm of carrier tape with sealed cover tape not to exceed 560mm combined total.

NOTE 2. There shall be a minimum of 40 empty component pockets sealed with cover tape.

Tape Dimensions

MODEL	A ± .005 [1.3]	B ± .005 [1.3]
CRCW0805	.070 [1.78]	.100 [2.54]
CRCW1206	.080 [2.03]	.142 [3.61]
CRCW1210	.115 [2.92]	.142 [3.61]

MODELS RC, RCWP, RCW Thick Film Chip Resistors Industrial



FEATURES

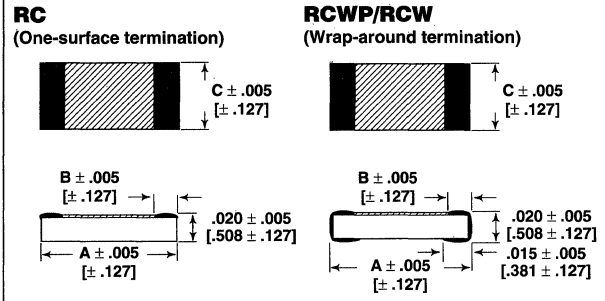
- Wide design flexibility for use with hybrid circuitry
- Operating temperature range: - 55°C to + 150°C
- 95% minimum alumina body
- Custom sizes designed for special applications
- Termination: Solder pre-tinned electrodes standard. Gold, platinum gold or palladium silver available
- Dale has capability to develop specific reliability programs designed to customer requirements

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	RESISTANCE (Ohms) & T.C. RANGE*			MAXIMUM OPERATING VOLTAGE	POWER RATING @ 70°C
	1% to 2% 100PPM/°C	2% to 20% 200PPM/°C	300PPM/°C		
RC-550 RCWP/RCW-550	10-1M	5-2M	5-4.7M	50 VDC	100 mW
RC-575 RCWP/RCW-575	10-1M	5-5M	5-10M	70 VDC	150 mW
RC-5100 RCWP/RCW-5100	10-1M	10-5M	10-15M	100 VDC	200 mW
RC-5150 RCWP/RCW-5150	10-1M	10-5M	10-15M	125 VDC	350 mW
RC-1100 RCWP/RCW-1100	10-1M	5-5M	5-7.5M	100 VDC	400 mW
RC-7225 RCWP/RCW-7225	10-1M	10-5M	10-15M	200 VDC	600 mW
RC-2010 RCWP/RCW-2010	10-1M	10-5M	10-15M	200 VDC	800 mW
RC-2512 RCWP/RCW-2512	10-1M	10-5M	10-15M	200 VDC	1000 mW
RC-1206 RCWP/RCW-1206	10-1M	10-5M	10-10M	100 VDC	250 mW
RC-540 RCWP/RCW-540	10-1M	5-2M	5-4.7M	40 VDC	80 mW

* Consult factory for extended resistance range.

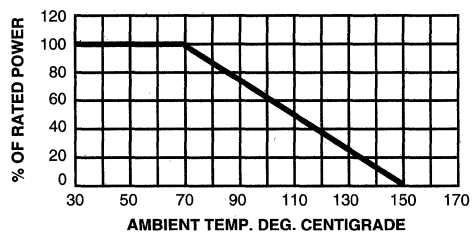
DIMENSIONAL CONFIGURATIONS



[Numbers in brackets indicate millimeters]

MODEL	A	B	C
RC-550	.050 [1.27]	.010 [2.54]	.050 [1.27]
RCWP/RCW-550	.055 [1.40]	.010 [2.54]	.050 [1.27]
RC-575	.075 [1.91]	.015 [3.81]	.050 [1.27]
RCWP/RCW-575	.080 [2.03]	.015 [3.81]	.050 [1.27]
RC-5100	.100 [2.54]	.015 [3.81]	.050 [1.27]
RCWP/RCW-5100	.105 [2.67]	.015 [3.81]	.050 [1.27]
RC-5150	.150 [3.81]	.015 [3.81]	.050 [1.27]
RCWP/RCW-5150	.155 [3.94]	.015 [3.81]	.050 [1.27]
RC-1100	.100 [2.54]	.015 [3.81]	.100 [2.54]
RCWP/RCW-1100	.105 [2.67]	.015 [3.81]	.100 [2.54]
RC-7225	.225 [5.72]	.015 [3.81]	.075 [1.91]
RCWP/RCW-7225	.230 [5.84]	.015 [3.81]	.075 [1.91]
RC-2010	.200 [5.08]	.015 [3.81]	.100 [2.54]
RCWP/RCW-2010	.205 [5.21]	.015 [3.81]	.100 [2.54]
RC-2512	.250 [6.35]	.015 [3.81]	.125 [3.18]
RCWP/RCW-2512	.255 [6.48]	.015 [3.81]	.125 [3.18]
RC-1206	.120 [3.05]	.015 [3.81]	.060 [1.52]
RCWP/RCW-1206	.125 [3.18]	.015 [3.81]	.060 [1.52]
RC-540	.050 [1.27]	.010 [2.54]	.040 [1.02]
RCWP/RCW-540	.055 [1.40]	.010 [2.54]	.040 [1.02]

DERATING



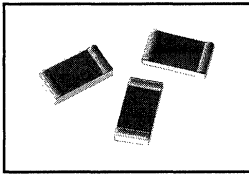
HOW TO ORDER

RC MODEL	5100 SIZE	103 RESISTANCE	G TOLERANCE	40 TERMINATION
RC = One-surface termination RCW = Wrap-around termination RCWP = Wrap-around termination, pre-tinned nickel barrier	540 1100 550 7225 575 2010 5100 2512 5150 1206	First two digits (three for "F" tolerance) are significant figures. Last digit specifies the number of zeros to follow.	F = ± 1% G = ± 2% J = ± 5% K = ± 10% M = ± 20%	No Code = Solder Pre-tinned (standard) 20 = Gold (RC only) 40 = Platinum Gold (RC and RCW only) 42 = Palladium Silver (RC and RCW only)

MODELS RCM, RCWPM, RCWM Thick Film Chip Resistors

Military/Established Reliability

MIL-R-55342/2/3/4/5/6/7/8/9 Qualified, Type RM



FEATURES

- Allows wide design flexibility for use with hybrid circuitry
- Meets requirements of MIL-R-55342
- Established Reliability - Verified failure rate (contact factory)
- Operating Temperature Range is - 55°C to + 150°C
- 100% screen tested per Group A, Subgroup 1 of MIL-R-55342

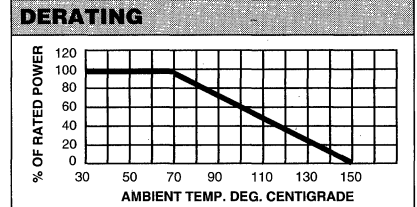
- Variety of termination material
- One-surface and wraparound terminations
- 95% minimum alumina body

STANDARD ELECTRICAL SPECIFICATIONS								
DALE MODELS RCM, RCWPM, RCWM	MIL-R- 55342 STYLE	MIL SHEET NO.	TERMINATIONS	CHAR.	RESISTANCE RANGE (Ohms)	TOL.	MAXIMUM OPERATING VOLTAGE	POWER RATING @ 70°C
-550	RM0505	02	S, R, T, U, B, C	M	5.6-470k	10%	40	50 mW
				K, M	10-470k	2%-10%		
-5100	RM1005	03	S, R, T, U, B, C	M	5.6-1M	10%	40	100 mW
				K, M	10-1M	1%-10%		
-5150	RM1505	04	S, R, T, U, B, C	M	5.6-4.7M	10%	40	150 mW
				K, M	10-4.7M	2%-10%		
-7225	RM2008	05	S, R, B, C	M	5.6-15M	10%	40	225 mW
				K, M	10-15M	2%-10%		
-575	RM0705	06	S, R, T, U, B, C	M	5.6-1M	10%	50	100 mW
				K, M	10-1M	1%-10%		
-1206	RM1206	07	S, R, T, U, B, C	M	5.6-1M	10%	100	250 mW
				K, M	10-1M	2%-10%		
-2010	RM2010	08	S, R, T, U, B, C	M	5.6-15M	10%	150	800 mW
				K, M	10-1M	1%-10%		
-2512	RM2512	09	S, R, T, U, B, C	M	5.6-15M	10%	200	1000 mW
				K, M	10-1M	1%-10%		

CODE LETTERS (Tol. & Multipliers)					
TOLERANCE					VALUE RANGE
± 1%	± 2%	± 5%	± 10%	MULTIPLIER	(Ohms)
D	G	J	M	1	1-9xx
E	H	K	N	1,000	1k-9xxk
F	T	L	P	1,000,000	1M-10M

Examples:

11D3 = 11.3Ω ± 1%	15J0 = 15Ω ± 5%
10E0 = 10kΩ ± 1%	10K0 = 10kΩ ± 5%
332D = 332Ω ± 1%	560K = 560kΩ ± 5%
2F21 = 2.21MΩ ± 1%	8L20 = 8.2MΩ ± 5%
51G0 = 51Ω ± 2%	10M0 = 10Ω ± 10%
10H0 = 10kΩ ± 2%	10N0 = 10kΩ ± 10%
33H0 = 33kΩ ± 2%	2P70 = 2.7MΩ ± 10%
22T0 = 22MΩ ± 2%	8P20 = 8.2MΩ ± 10%

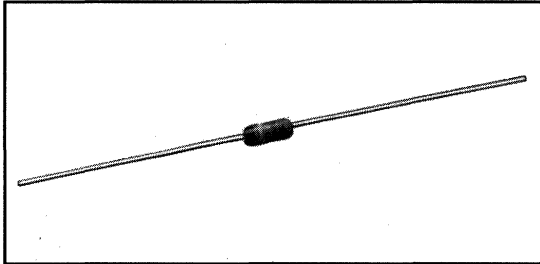


DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]							
RCM (One-surface termination)	RCWPM/RCWM (Wraparound termination)	DALE MODELS	MIL-R-55342 STYLE	MIL SHEET NO.	A	B	C
		RCM-550	RM0505	02	.050 [1.27]	.010 [254]	.050 [1.27]
		RCWPM/RCWM-550	RM0505		.055 [1.40]	.010 [254]	.050 [1.27]
		RCM-5100	RM1005	03	.100 [2.54]	.015 [381]	.050 [1.27]
		RCWPM/RCWM-5100	RM1005		.105 [2.67]	.015 [381]	.050 [1.27]
		RCM-5150	RM1505	04	.150 [3.81]	.015 [381]	.050 [1.27]
		RCWPM/RCWM-5150	RM1505		.155 [3.94]	.015 [381]	.050 [1.27]
		RCM-7225	RM2208	05	.225 [5.72]	.015 [381]	.075 [1.91]
		RCWPM/RCWM-7225	RM2208		.230 [5.84]	.015 [381]	.075 [1.91]
		RCM-575	RM0705	06	.075 [1.91]	.015 [381]	.050 [1.27]
		RCWPM/RCWM-575	RM0705		.080 [2.03]	.015 [381]	.050 [1.27]
		RCM-1206	RM1206	07	.120 [3.05]	.015 [381]	.060 [1.52]
		RCWPM/RCWM-1206	RM1206		.125 [3.18]	.015 [381]	.060 [1.52]
		RCM-2010	RM2010	08	.200 [5.08]	.015 [381]	.100 [2.54]
		RCWPM/RCWM-2010	RM2010		.205 [5.21]	.015 [381]	.100 [2.54]
		RCM-2512	RM2512	09	.250 [6.35]	.015 [381]	.125 [3.18]
		RCWPM/RCWM-2512	RM2512		.255 [6.48]	.015 [381]	.125 [3.18]

HOW TO ORDER - MILITARY PART NUMBER					
M55342 MIL. SPEC. NO. INDICATING MIL-R-55342	M CHARACTERISTIC	02 MIL. SPEC. SHEET NO.	B TERMINATION MATERIAL	10E0 RESISTANCE AND TOLERANCE	R LIFE FAILURE RATE
D55342 applies to Style 07 (RM1206) only. M55342 applies to all other styles.	M = ± 300PPM/°C K = ± 100PPM/°C		B & R = Pre-tinned Nickel Barrier, wraparound (RCWPM) ("B" code is stocked) C = Untinned Palladium Silver, wraparound (RCWM) S = Pretinned Platinum-Gold, one-surface (RCM) T = Untinned Platinum-Gold, one-surface (RCM) U = Untinned Platinum-Gold, wraparound (RCWM)	See Examples Above	M = 1.0%/1000 hours P = 0.1%/1000 hours R = 0.01%/1000hours

MODEL CCF-07 Metal Film Resistors

Industrial, 2% and 5% Tolerance



FEATURES

- 1/4 watt at 70°C power rating
- 2% and 5% tolerance
- 100PPM/°C and 200PPM/°C temperature coefficient
- Tape and reel packaging for automatic insertion. Meets EIA 296-E, Class I.
- Flame retardant epoxy conformal coating
- Standard 4 band color code marking for ease of identification after mounting

ELECTRICAL SPECIFICATIONS

Resistance Range:

10 ohm to 1 Megohm for $\pm 2\%$ tolerance.
10 ohm to 2 Megohm for $\pm 5\%$ tolerance.

Resistance Tolerance: $\pm 2\%$, $\pm 5\%$.

Temperature Coefficient: (- 65°C to + 150°C).

$\pm 100\text{PPM}/^\circ\text{C}$ for 2% tolerance.
 $\pm 200\text{PPM}/^\circ\text{C}$ for 5% tolerance.

Power Rating: 1/4 watt at + 70°C.

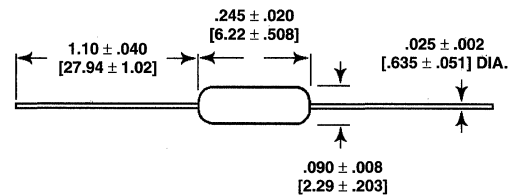
Maximum Working Voltage: 250 V RMS.

Insulation Resistance: 10,000 Megohm.

Operating Temperature Range: - 65°C to + 150°C.

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]

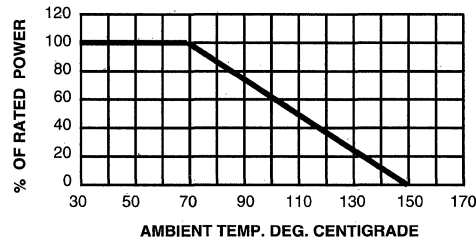


ENVIRONMENTAL PERFORMANCE

(Test Methods per MIL-STD-202)

TEST	MAX. ΔR
Thermal Shock	1.0%
Short Time Overload	0.5%
Low Temperature Operation	0.5%
Moisture Resistance	1.5%
Resistance to Soldering Heat	0.5%
Shock	0.5%
Vibration	0.5%
Terminal Strength	0.5%
Dielectric Withstanding Voltage	0.5%
Life	2.0%

DERATING



PART MARKING

— Colorband

RESISTANCE VALUES

Dale® Model CCF-07 is available in the standard 24 resistance values per decade. Values are obtained from the following decade table by multiplying by powers of 10. As an example: 24 can represent 24 ohm, 240 ohm, 2.4k, 24k or 240k.

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

HOW TO ORDER

CCF-07
MODEL

241
RESISTANCE

G
TOLERANCE

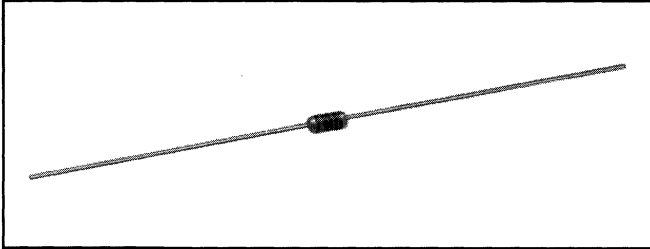
First two digits are significant figures. Last digit specifies the number of zeros to follow.

G = $\pm 2\%$
J = $\pm 5\%$

MODELS CCF-50, CCF-55, CCF-60

Metal Film Resistors

Industrial, 1% Tolerance



FEATURES

- Power Ratings: 1/4 and 1/2 watt at 70°C
- 100PPM/°C temperature coefficient
- Superior electrical performance
- Flame retardant epoxy conformal coating
- Standard 5 band color code marking for ease of identification after mounting
- Tape and reel packaging for automatic insertion. Meets EIA 296-E, Class I.

ELECTRICAL SPECIFICATIONS

Resistance Range: 10 ohm to 1 Megohm.
Resistance Tolerance: ± 1%.
Temperature Coefficient: (- 65°C to + 165°C) ± 100PPM/°C.
Power Rating at 70°C:
 CCF-50 = 1/4 watt.
 CCF-55 = 1/4 watt, 1/2 watt.
 CCF-60 = 1/2 watt, 3/4 watt.
Maximum Working Voltage:
 200 V RMS for CCF-50.
 250 V RMS for CCF-55.
 350 V RMS for CCF-60.
Insulation Resistance: 10,000 Megohm.
Operating Temperature Range: - 65°C to + 165°C.

ENVIRONMENTAL PERFORMANCE

(Test Methods per MIL-R-202)		
POWER RATING at 70°C		
CCF-50	1/4 Watt	—
CCF-55	1/4 Watt	1/2 Watt
CCF-60	1/2 Watt	3/4 Watt
TEST	MAX. ΔR	
Thermal Shock	0.5%	0.5%
Short Time Overload	0.5%	0.5%
Low Temperature Operation	0.5%	0.5%
Moisture Resistance	1.5%	1.5%
Resistance to Soldering Heat	0.5%	0.5%
Shock	0.5%	0.5%
Vibration	0.5%	0.5%
Life	1.0%	1.0%
Terminal Strength	0.2%	0.2%
Dielectric Withstanding Voltage	0.5%	0.5%

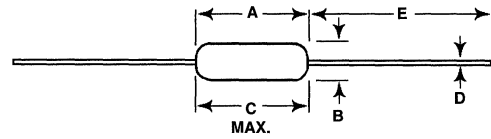
RESISTANCE VALUES

Dale® Models CCF-50, CCF-55 and CCF-60 are available in the standard 96 resistance values per decade. Values are obtained from the following decade table by multiplying by powers of 10. As an example: 30.1 can represent 30.1 ohms, 301 ohms, 3.01k, 30.1k or 301k.

10.0, 10.2, 10.5, 10.7, 11.0, 11.3, 11.5, 11.8, 12.1, 12.4, 12.7, 13.0, 13.3, 13.7, 14.0, 14.3, 14.7, 15.0, 15.4, 15.8, 16.2, 16.5, 16.9, 17.4, 17.8, 18.2, 18.7, 19.1, 19.6, 20.0, 20.5, 21.0, 21.5, 22.1, 22.6, 23.2, 23.7, 24.3, 24.9, 25.5, 26.1, 26.7, 27.4, 28.0, 28.7, 29.4, 30.1, 30.9, 31.6, 32.4, 33.2, 34.0, 34.8, 35.7, 36.5, 37.4, 38.3, 39.2, 40.2, 41.2, 42.2, 43.2, 44.2, 45.3, 46.4, 47.5, 48.7, 49.9, 51.1, 52.3, 53.6, 54.9, 56.2, 57.6, 59.0, 60.4, 61.9, 63.4, 64.9, 66.5, 68.1, 69.8, 71.5, 73.2, 75.0, 76.8, 78.7, 80.6, 82.5, 84.5, 86.6, 88.7, 90.9, 93.1, 95.3, 97.6.

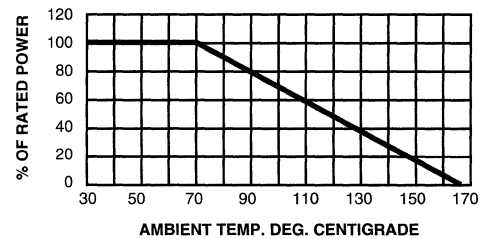
DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



MODEL	A	B	(Max.) C	D	E
CCF-50	.133 ± .010 [3.38 ± .254]	.062 ± .004 [1.57 ± .102]	.143 [3.63]	.020 ± .002 [.508 ± .051]	1.125 ± .040 [28.58 ± 1.02]
CCF-55	.245 ± .020 [6.22 ± .508]	.090 ± .008 [2.29 ± .203]	.265 [6.73]	.025 ± .002 [.635 ± .051]	1.10 ± .040 [27.94 ± 1.02]
CCF-60	.344 ± .031 [8.74 ± .787]	.139 ± .009 [3.53 ± .229]	.400 [10.16]	.025 ± .002 [.635 ± .051]	1.0 ± .040 [25.4 ± 1.02]

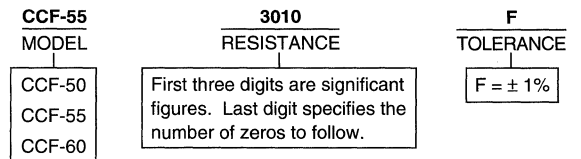
DERATING



PART MARKING

— Color band

HOW TO ORDER

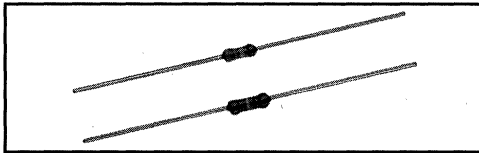


* Four Digit Figure Examples: 49R9 = 49.9 ohm, 1000 = 100 ohm, 1001 = 1k ohm, 1004 = 1 Megohm

EXAMPLE: CCF-55 3010F = Model CCF-55 metal film resistor with ± 100PPM/°C T.C., resistance of 301 ohm and tolerance of ± 1%

MODELS SMA and OMA Metal Film Resistors

Semi-Precision, Zero Ohm Jumpers (OMA)



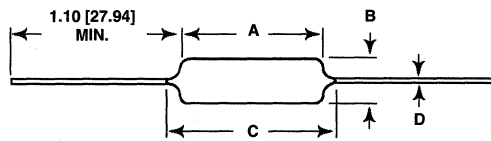
FEATURES

- Leads are electroplated, high purity copper
- Dual rated parts provide high density board mounting
- Temperature coefficient for SMA 0207S, 1% is $\pm 50\text{PPM}/^\circ\text{C}$
- Green, multilayer liquid epoxy system provides excellent moisture and mechanical protection

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	WATTAGE RATING			VOLTAGE RATING	RESISTANCE RANGE (Ohms)	STANDARD TOLERANCE	TEMPERATURE COEFFICIENT PPM/ $^\circ\text{C}$
	STANDARD	DUAL					
		70 $^\circ\text{C}$	125 $^\circ\text{C}$					70$^\circ\text{C}$
SMA 0204	1/8	1/10	1/2	200	1-1M	1, 5%	100
SMA 0207S	1/4	1/8	1/2	300	1-5.1M	1%	50
SMA 0207S	1/4	1/8	1/2	300	1-5.1M	2, 5%	100
SMA 0309S	1/2	1/4	1	350	1-2.21M	1%	100
SMA 0309S	1/2	1/4	1	350	1-5.1M	2, 5%	100
OMA 0207	(Zero Ohm Jumper)						
OMA 0204	(Zero Ohm Jumper)						

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



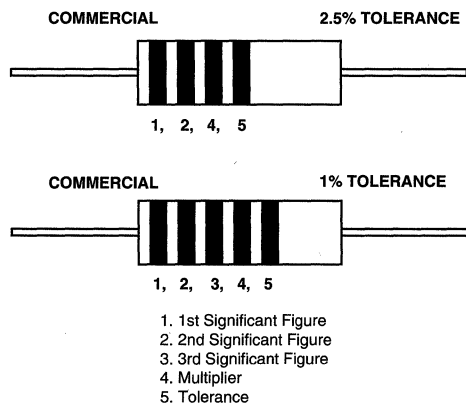
MODEL	A	B	C	D
SMA 0204/ OMA 0204	.142 \pm .010 [3.61 \pm .254]	.071 [1.80] MAX.	.160 [4.06] MAX.	.020 [.508]
SMA 0207S/ OMA 0207	.235 \pm .020 [5.97 \pm .508]	.090 \pm .008 [2.29 \pm .203]	.281 [7.14]	.024 [.610]
SMA 0309S	.303 \pm .020 [7.70 \pm .508]	.110 \pm .008 [2.79 \pm .203]	.375 [9.53]	.026 [.660]

ENVIRONMENTAL PERFORMANCE

MODEL	THERMAL SHOCK ΔR MAX. \pm %	SHORT TIME OVERLOAD ΔR MAX. \pm %	LOW TEMP. OPERATION ΔR MAX. \pm %	MOISTURE RESISTANCE ΔR MAX. \pm %	SHOCK ΔR MAX. \pm %	VIBRATION ΔR MAX. \pm %	LOAD LIFE 1000 HOURS STANDARD RATING ΔR MAX. \pm %	TERMINAL STRENGTH ΔR MAX. \pm %	D. W. V. ΔR MAX. \pm %	EFFECT SOLDER HEAT ΔR MAX. \pm %
SMA 0204	0.25	0.25	0.25	1.0	0.1	0.1	0.5*	0.1	0.1	0.1
SMA 0207S	0.25	0.25	0.25	0.5**	0.1	0.1	0.5*	0.1	0.1	0.1
SMA 0207S	0.25	0.25	0.25	0.5**	0.1	0.1	0.5*	0.1	0.1	0.1
SMA 0309S	0.25	0.25	0.25	0.5**	0.1	0.1	0.5*	0.1	0.1	0.1
SMA 0309S	0.25	0.25	0.25	0.5**	0.1	0.1	0.5*	0.1	0.1	0.1
OMA 0207	(Zero Ohm Jumper)									
OMA 0204	(Zero Ohm Jumper)									

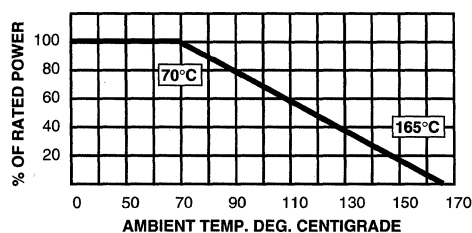
* 1000 hours ΔR for Dual Rating is $\pm 1\%$. ** Resistance Values: 1 ohm-10 ohm $\Delta R \pm (2.5\% + 0.05 \text{ ohm})$. 1 Megohm-5.1 Megohm $\Delta R \pm (1\% + 0.05 \text{ ohm})$.

PART MARKING



OMA 0204 and OMA 0207 zero ohm type resistors are marked with a single black color band. All band widths and spacing shown are for reference only.

DERATING



HOW TO ORDER

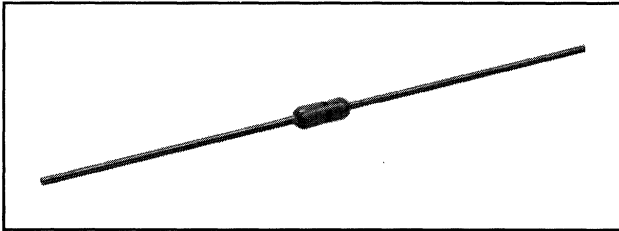
SMA MODEL	0207S CASE SIZE	100k STANDARD	$\pm 1\%$ TOLERANCE
		100k = 100,000 Ω	$\pm 1\%$, $\pm 2\%$, $\pm 5\%$

For Zero Ohm Resistors, OMA 0204 or OMA 0207 is sufficient callout.

Manufactured in Germany

MODELS FRJ-50 and FRJ-55 Metal Film Resistors

Industrial, Jumper Resistor



FEATURES

- Provides low resistance circuit interconnections
- Color band marking for ease of identification after mounting
- Flame retardant coating
- Compatible with automatic insertion equipment
- Tape and reel packaging

ELECTRICAL SPECIFICATIONS

Resistance: 0.01 ohm maximum.

Dielectric Strength: Atmospheric 500 V RMS;
reduced 325 V RMS.

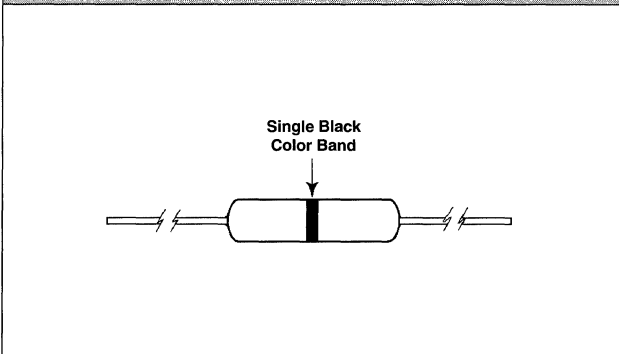
Insulation Resistance: Dry 10,000 Megohm;
wet 100 Megohm.

Current Rating: 25 amps at 25°C, derating to 0 amps
at 150°C.

Insulation Flammability: Self extinguishing 10 seconds
after flame is removed.

Lead Material: Tin-plated copper (maximum 98% tin).

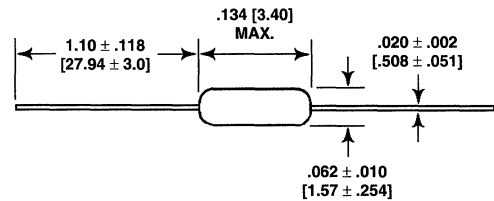
PART MARKING



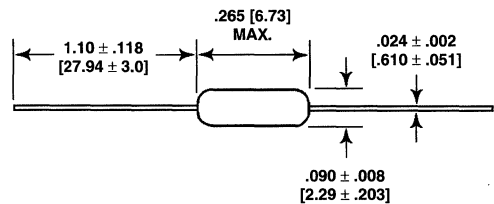
DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]

FRJ-50



FRJ-55



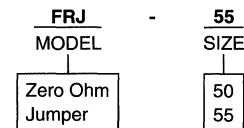
PACKAGING

Taped Lead and Reel Package per EIA 296-E Class I.

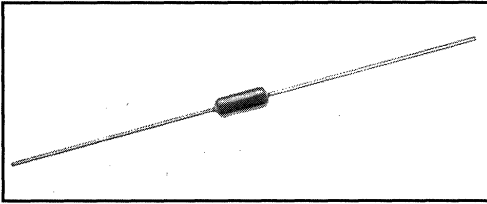
NOTES:

1. Quantity per reel: 5,000 pieces in 5,000-piece increments.
2. A minimum of 12.0" [304.80] bare tape leader shall be provided at each end of the reel.
3. Paper separator protection between layers of components.
4. Reel arbor hole is 1.25" [31.75].

HOW TO ORDER



MODEL CMF Metal Film Resistors Industrial



FEATURES

- Small size - conformal coated
- Flame retardant epoxy coating
- Controlled temperature coefficient
- Excellent high frequency characteristics
- Low noise
- Low voltage coefficient

FOR MILITARY
VERSIONS
See pages 122-123

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	MAXIMUM WORKING VOLTAGE	RESISTANCE RANGE (Ohms) VS - BEST AVAILABLE TOL./T. C.				
		± 2%** T-00	± 1% T-0	± 1% T-1	± 1% T-2	± 0.1% T-9
CMF-50	200 V	—	10-1M	10-1M	10-500k	10-500k
CMF-55	250 V	.1-.49	.5-22.1M	1-22.1M	10-5M	10-2.5M
CMF-07*	250 V	—	1-5M	5-5M	—	—
CMF-60	350 V	.1-.49	.5-8M	1-8M	10-8M	10-2.5M
CMF-20*	350 V	—	1-8M	5-8M	—	—
CMF-65	500 V	.1-.49	.5-15M	1-15M	10-10M	10-2.5M
CMF-70	500 V	—	1-15M	1-15M	10-10M	10-2.5M

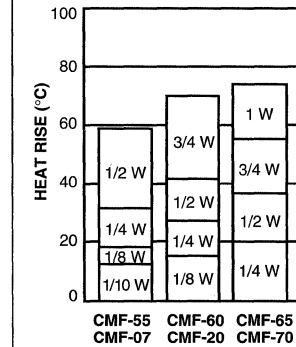
* CMF-07 and CMF-20 are available in 2% (G) or 5% (J) tolerances only.
** A .0005 ohm bridge error is allowed in resistance measurement. It has the greatest effect on values in this range and should be taken into account when verifying Tolerance and T. C.

TEMP. COEFFICIENT CODES

T. C. CODE	TEMPERATURE COEFFICIENT	TEMPERATURE RANGE
T-00	0 ± 200PPM/°C	-55°C to +175°C
T-0	0 ± 150PPM/°C	-55°C to +175°C
T-1	0 ± 100PPM/°C	-55°C to +175°C
T-2	0 ± 50PPM/°C	-55°C to +175°C
T-9	0 ± 25PPM/°C	-55°C to +175°C
T-3	0 + 100PPM/°C	-55°C to +175°C
T-4	0 - 100PPM/°C	-55°C to +175°C
T-5	0 ± 25PPM/°C	+25°C to +145°C
T-6	0 + 50PPM/°C	-55°C to +175°C
T-7	0 - 50PPM/°C	-55°C to +175°C
T-8	0 ± 35PPM/°C 0 ± 25PPM/°C	-55°C to +25°C +25°C to +175°C

HEAT RISE

The increase in resistor surface temperature due to the rated load is shown below. Resistor surface temperature = heat rise + ambient temperature.



COMMERCIAL POWER RATING

WATTAGE	70°C	125°C
1/20	CMF-50	CMF-50
1/10	CMF-50, -55	CMF-50, -55
1/8	CMF-50, -55, -60	CMF-50, -55, -60
1/4	CMF-55, -60, -65, -70, -07	CMF-55, -60, -65, -70
1/2	CMF-55, -60, -65, -70, -20	CMF-60, -65, -70
3/4	CMF-60*, -65*, -70	CMF-65*, -70
1	CMF-65*, -70	—

* .032 [.813] lead

ELECTRICAL SPECIFICATIONS

Resistance Tolerance: ± 5%, ± 2%, ± 1%, ± .5%, ± .25%, ± .1% standard. Special tolerance and/or T. C. matching is available on request.

Noise: Dale® metal film resistors have exceptionally low noise level. Average for standard resistance range is 0.10 micro-volts per volt over a decade of frequency, with low and intermediate resistance values typically below 0.05 micro-volts per volt.

Voltage Coefficient: Maximum voltage coefficient is 5PPM per volt when measured between 10% and full rated voltage.

Dielectric Strength:

450 VAC for CMF-50, CMF-55, CMF-07. 750 VAC for CMF-60, CMF-20. 900 VAC for all others.

Insulation Resistance: 10,000 Megohm minimum dry, 100 Megohm minimum after moisture test.

MECHANICAL SPECIFICATIONS

Terminal Strength: 2 pound pull test for CMF-50, CMF-55, CMF-60 and CMF-65. 5 pound test for all others.

Solderability: Continuous satisfactory coverage when tested in accordance with MIL-R-10509.

MATERIAL SPECIFICATIONS

Element: Vacuum-deposited nickel-chrome alloy.

Core: Fire-cleaned high purity ceramic.

Coating: Flame retardant epoxy, formulated for superior moisture protection.

Termination: Standard lead material is solder-coated copper. Solderable and weldable.

ENVIRONMENTAL SPECIFICATIONS

Temperature Coefficient: CMF resistors are available in 11 standard T. C. codes of which 100PPM, 50PPM and 25PPM are the most commonly required.

Shelf Life: Resistance shifts due to storage at room temperature are negligible.

Power Rating: Power ratings are based on full power at temperatures and typical ΔR shown in the Environmental Table (1,000 hours load life).

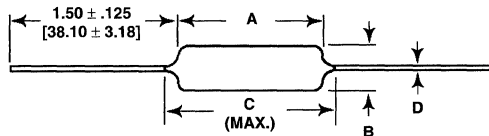
SPECIAL MODIFICATIONS

1. Terminals may be supplied in any commercial material with several type finishes.
2. Special pre-conditioning (power aging, temperature cycling, etc.) to customer specifications.
3. Non-helixed resistors can be supplied for critical high frequency applications.
4. Fusible, flameproof versions available.

MODEL CMF

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



MODEL	A	B	C (Max.)	D
CMF-50	.150 ± .020 [3.81 ± .508]	.065 ± .015 [1.65 ± .381]	.244 [6.20]	.016 ± .002 [.406 ± .051]
CMF-55	.240 ± .020*** [6.10 ± .508]	.090 ± .008 [2.29 ± .203]	.278 [7.06]**	.025 ± .002 [.635 ± .051]
CMF-60	.344 ± .031 [8.74 ± .787]	.145 ± .015 [3.68 ± .381]	.425 [10.80]	.025 ± .002* [.635 ± .051]
CMF-65	.562 ± .031 [14.27 ± .787]	.180 ± .015 [4.57 ± .381]	.687 [17.45]	.025 ± .002* [.635 ± .051]
CMF-70	.562 ± .031 [14.27 ± .787]	.180 ± .015 [4.57 ± .381]	.687 [17.45]	.032 ± .002 [.813 ± .051]
CMF-07	.240 ± .020 [6.10 ± .508]	.090 ± .008 [2.29 ± .203]	.278 [7.06]	.025 ± .002 [.635 ± .051]
CMF-20	.375 ± .040 [9.53 ± 1.02]	.145 ± .015 [3.68 ± .381]	.425 [10.80]	.032 ± .002 [.813 ± .051]

* Available with .032 [.813] lead. ** 290 [7.37] for ±.25% and ±.1% resistance tolerances and values above 1Megohm. *** .260 ± .020 [6.60 ± .508] for values above 5 Megohm.

ENVIRONMENTAL PERFORMANCE

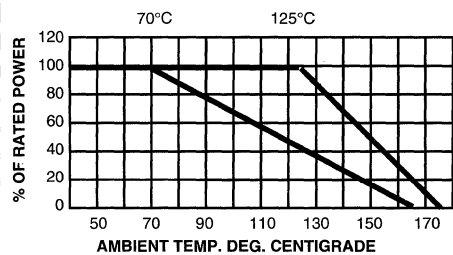
(Test methods per MIL-STD-202)

MODEL	POWER RATING					
	AT 70°C			AT 125°C		
CMF-50	1/10 Watt	1/8 Watt	—	1/20 Watt	1/10 Watt	1/8 Watt
CMF-55	1/8 Watt	1/4 Watt	1/2 Watt	1/10 Watt	1/8 Watt	1/4 Watt
CMF-60	1/4 Watt	1/2 Watt	3/4 Watt	1/8 Watt	1/4 Watt	1/2 Watt
CMF-65	1/2 Watt	3/4 Watt	—	1/4 Watt	1/2 Watt	—
CMF-70	1/2 Watt	3/4 Watt	1 Watt	1/4 Watt	1/2 Watt	3/4 Watt
CMF-07	—	1/4 Watt	—	—	—	—
CMF-20	—	1/2 Watt	—	—	—	—

TEST	MAX. ΔR (Typical Test Lots)					
Short Time Overload	± 0.05%	± 0.05%	± 0.05%	± 0.05%	± 0.05%	± 0.05%
Low Temperature Operation	± 0.05%	± 0.05%	± 0.05%	± 0.05%	± 0.05%	± 0.05%
Moisture Resistance	± 0.05%	± 0.05%	± 0.05%	± 0.05%	± 0.05%	± 0.05%
Shock	± 0.01%	± 0.01%	± 0.01%	± 0.01%	± 0.01%	± 0.01%
Vibration	± 0.04%	± 0.04%	± 0.04%	± 0.04%	± 0.04%	± 0.04%
Temperature Cycling	± 0.15%	± 0.15%	± 0.15%	± 0.15%	± 0.15%	± 0.15%
Load Life	± 0.15%	± 0.5%	± 1.0%	± 0.15%	± 0.5%	± 1.0%
Dielectric Withstanding Voltage	± 0.01%	± 0.01%	± 0.01%	± 0.01%	± 0.01%	± 0.01%
Effect of Solder	± 0.03%	± 0.03%	± 0.03%	± 0.03%	± 0.03%	± 0.03%

DERATING

CMF resistors have an operating temperature range of - 65°C to + 175°C. They must be derated at high ambient temperatures according to the derating curve.



PART MARKING

- Dale
- Value
- Tolerance and T. C.
- Date code

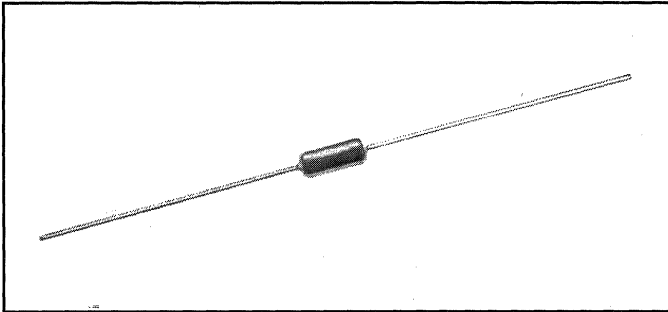
HOW TO ORDER

CMF-55 MODEL CMF-50 CMF-70 CMF-55 CMF-07 CMF-60 CMF-20 CMF-65	3010 RESISTANCE VALUE * First three digits are significant. (Two for 2% and 5% tolerance.) Last digit specifies the number of zeros to follow.	F TOLERANCE B = ± .1% C = ± .25% D = ± .5% F = ± 1% G = ± 2% J = ± 5% (CMF-07 and CMF-20 available only in 2% and 5% tolerances.)	T-1 TEMPERATURE COEFFICIENT T-00 = ± 200PPM/°C T-0 = ± 150PPM/°C T-1 = ± 100PPM/°C T-2 = ± 50PPM/°C T-9 = ± 25PPM/°C (Tolerances of ± 0.5% (D), ± 0.25% (C) and ± 0.10% (B) are available only in T-2 and T-9 temperature coefficients.)
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* Examples: R27 = 0.27 ohm, 49R9 = 49.9 ohm, 1000 = 100 ohm, 1001 = 1 kilohm, 1004 = 1 Megohm, R511 = 0.511 ohm.

MODEL PTF Metal Film Resistors

Industrial, Precision Low T.C. - Tight Tolerance



FEATURES

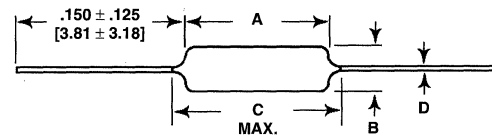
- Extremely low temperature coefficients of resistance
- Very low noise and voltage coefficient
- Wide precision resistance range in small package
- 100% laser spiralled
- Very good high frequency characteristics
- Acceptance testing available
- Can replace wirewound bobbins
- Proprietary epoxy coating provides superior moisture protection

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	85°C RATING	MAXIMUM WEIGHT (Grams)	MAXIMUM WORKING VOLTAGE	RESISTANCE RANGE (Ohms)	AVAILABLE TOLERANCE RANGE
PTF-51	1/20 W	.11	200	50-100k	± 1% to ± 0.02%
PTF-56	1/8 W	.35	300	50-500k	± 1% to ± 0.01%
PTF-65	1/4 W	.75	500	50-1M	± 1% to ± 0.05%

DIMENSIONAL SPECIFICATIONS

[Numbers in brackets indicate millimeters]



MODEL	A	B	(Max.) C	D
PTF-51	.150 ± .020 [3.81 ± .508]	.070 ± .010 [1.78 ± .254]	.200 [5.08]	.016 [.406]
PTF-56	.250 + .031 - .046 [6.35 + .787 - 1.17]	.091 ± .009 [2.31 ± .229]	.300 [7.62]	.025 [.635]
PTF-65	.375 ± .062 [9.53 ± 1.57]	.145 ± .016 [3.68 ± .406]	.475 [12.07]	.025 [.635]

MATERIAL SPECIFICATIONS

Element: Precision deposited nickel-chrome alloy with controlled annealing.

Core: Fire-cleaned high purity ceramic.

Encapsulant: Specially formulated epoxy compounds. Coated construction.

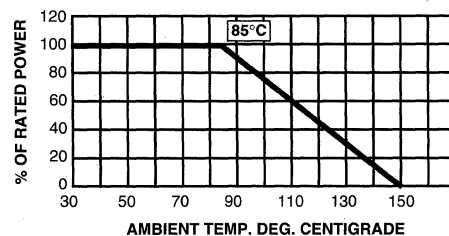
Termination: Standard lead material is solder-coated copper. Solderable and weldable per MIL-STD-1276, Type C.

ENVIRONMENTAL PERFORMANCE

TEST DESCRIPTION	MAX. ΔR (Typical Test Lots)	TEST SPECIFICATION
Thermal Shock (- 55°C to + 85°C)	.02%	MIL-STD-202, Method 107
Short Time Overload	.01%	MIL-R-10509, Para. 4.6.6
Low Temperature Operation	.02%	MIL-STD-55182, Methods 4.7.9
Moisture	.08%	MIL-R-202, Method 106
Resistance to Soldering Heat	.02%	MIL-STD-202, Methods 210
Damp Heat	.08%	IEC Publication #68-2-3 (56 days)
Life (1000 hours rated power @ 85°C)	.04%	MIL-R-55182, Para. 4.7.17
Dielectric Withstanding Voltage	.01%	MIL-STD-202, Methods 301 & 105

DERATING

PTF resistors have an operating temperature range of - 55°C to + 150°C. They must be derated according to the curve below.



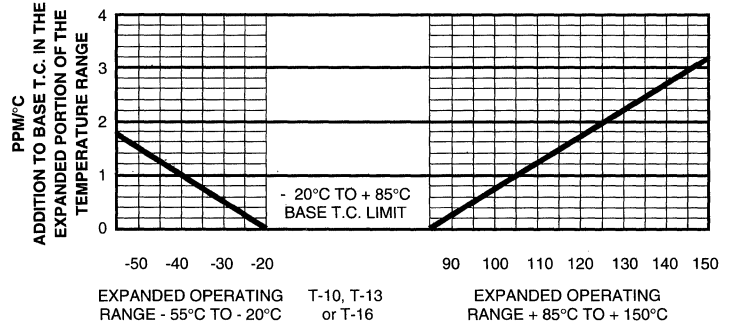
MODEL PTF

TEMPERATURE COEFFICIENT OF RESISTANCE

Temperature coefficient (T.C.) of resistance is normally stated as the maximum amount of resistance change from the original 25°C value as the ambient temperature increases or decreases. This is most commonly expressed in parts per million per degree centigrade (PPM/°C).

The resistance curve over the operating temperature range is usually a non-linear curve within predictable maximum limits. PTF resistors have a very uniform resistance temperature characteristic when measured over the operating range of - 20°C to + 85°C. The standard temperature coefficients available are T-10 = ± 15PPM/°C, T-13 = ± 10PPM/°C and T-16 = ± 5PPM/°C.

Some applications of the PTF require operation beyond the specifications of - 20°C to + 85°C. The change in temperature coefficient of resistance is very small (less than 0.05PPM/°C) over the expanded temperature range of - 55°C to + 150°C. Therefore, when operating outside the range of - 20°C to + 85°C, the designer can plan for a worst case addition of 0.05PPM/°C for each degree C beyond either - 20°C or + 85°C as indicated in the graph. This applies to all three temperature coefficient codes.



EXAMPLE: Assume the operating characteristics demand a temperature range from - 55°C to + 125°C. This requires a 35°C Δ below - 20°C and a 40°C Δ above + 85°C. The extreme Δ being 40°C means that the worst case addition to the specified T.C. limit of ± 0.05PPM/°C times 40°C or 2PPM/°C. Therefore, a T-16 which is characterized by a base T.C. limit of ± 5PPM/°C over the temperature range of - 20°C to + 85°C will exhibit a maximum temperature coefficient of ± 7PPM/°C over the expanded portion of the temperature range of - 55°C to + 125°C.

MATCHED SETS - NETWORKS

Dale's® many years of experience in matching resistors for sets and networks, combined with the superb performance of the PTF product, provide the best and most economical solution to your precision resistor requirements. Why? Because most applications for precision resistors depend on two or more discretes having an initial tolerance ratio and a resistance tracking capability over temperature rather than each discrete resistor meeting the absolute requirements of the application.

Cost savings approaching 50% can be realized when relatively tight matching requirements are specified while permitting the absolute parameters of the discrete resistors to have more relaxed specifications.

Dale® application engineers are available to assist you in specifying your requirements in the most economical way possible.

PART MARKING

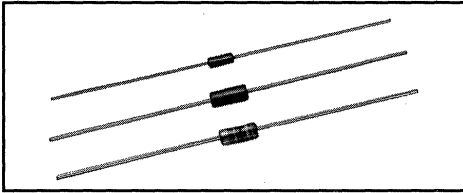
- Model
- Value
- Tolerance
- T.C.
- Date Code

HOW TO ORDER

PTF MODEL	56 SIZE	20K01 VALUE	B TOLERANCE	T-13 TEMPERATURE COEFFICIENT
<p>EXAMPLE: PTF-56, 20K01, B, T-13 = A precision thin film resistor, 1/8 watt with resistance of 20,010 ohms, tolerance of ± 0.1% and 0 ± 10PPM/°C TCR.</p>				
<p>DECIMAL LOCATOR/MULTIPLIER EXAMPLES CODE RESISTANCE R = x 1, K = x 1000, M = x 1,000,000 50R = 50Ω 62R2 = 62.2Ω 100R1 = 100.1Ω 1K001 = 1001Ω 10K1 = 10,100Ω 100K1 = 100,100Ω 1M0 = 1,000,000Ω</p>			<p>F = ± 1% D = ± 0.5% C = ± 0.25% B = ± 0.1% A = ± 0.05% BC = ± 0.02% BB = ± 0.01%</p>	<p>T-10 = 0 ± 15PPM/°C T-13 = 0 ± 10PPM/°C T-16 = 0 ± 5PPM/°C</p>

MODELS FL and LO Metal Film Resistors

Low Resistance



FEATURES

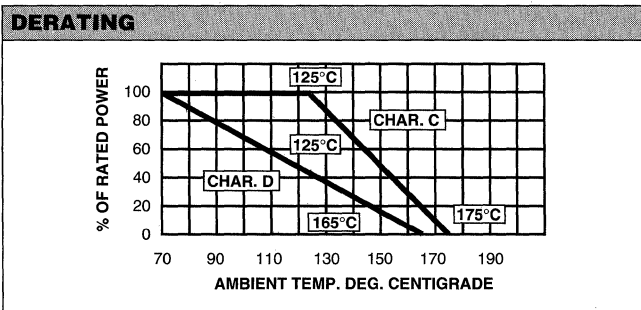
- Low value: 1 ohm to 48.7 ohm
- Temperature Coefficient as low as $\pm 50\text{PPM}/^\circ\text{C}$
- Available in both flameproof (FL) and nonflameproof (LO) construction

STANDARD ELECTRICAL SPECIFICATIONS					
MODEL	WATTAGE RATING		RESISTANCE RANGE (Ohms)	STANDARD* TOLERANCE	TEMPERATURE COEFFICIENT PPM/ $^\circ\text{C}$
	70 $^\circ\text{C}$	125 $^\circ\text{C}$			
FL4C	1/2	1/4	1-48.7	1, 2, 5%	50
FL5C	1	1/2	1-48.7	1, 2, 5%	50
FL4D	1/2	1/4	1-9.98	1, 2, 5%	100
FL5D	1	1/2	1-9.98	1, 2, 5%	100
LO4C	1/2	1/4	1-48.7	1, 2, 5%	50
LO5C	1	1/2	1-48.7	1, 2, 5%	50
LO4D	1/2	1/4	1-9.98	1, 2, 5%	100
LO5D	1	1/2	1-9.98	1, 2, 5%	100

* Standard tolerance below 2 ohms is 2% and 5%.

DIMENSIONAL CONFIGURATIONS			
[Numbers in brackets indicate millimeters]			
MODEL	A	B	D
FL4C	.235 ± .020 [5.97 ± .508] - .025 - .635]	.088 ± .010 [2.24 ± .254]	.025 [.635]
FL5C	.350 ± .030 [8.89 ± .762]	.130 ± .015 [3.30 ± .381] - .025 - .635]	.032 [.813]
FL4D	.235 ± .020 [5.97 ± .508] - .025 - .635]	.088 ± .010 [2.24 ± .254]	.025 [.635]
FL5D	.350 ± .030 [8.89 ± .762]	.130 ± .015 [3.30 ± .381] - .025 - .635]	.032 [.813]
LO4C	.235 ± .020 [5.97 ± .508]	.090 ± .008 [2.29 ± .203]	.025 [.635]
LO5C	.355 ± .020 [9.02 ± .508]	.148 ± .000 [3.76 + .000] - .023 - .584]	.032 [.813]
LO4D	.235 ± .020 [5.97 ± .508]	.090 ± .008 [2.29 ± .203]	.025 [.635]
LO5D	.355 ± .020 [9.02 ± .508]	.148 ± .000 [3.76 + .000] - .023 - .584]	.032 [.813]

ENVIRONMENTAL PERFORMANCE	
TEST	MAX. ΔR (Typical Test Lots)
Thermal Shock	$\pm 0.25\%$
Short Time Overload	$\pm 0.25\%$
Low Temperature Operation	$\pm 0.25\%$
Moisture Resistance	$\pm 1.0\%$
Shock	$\pm 0.1\%$
Vibration	$\pm 0.1\%$
Load Life (1000 hours MIL Rating)	$\pm 0.5\%$
Terminal Strength	$\pm 0.1\%$
Effect Solder Heat	$\pm 0.25\%$
Dielectric Withstanding Voltage	$\pm 0.1\%$



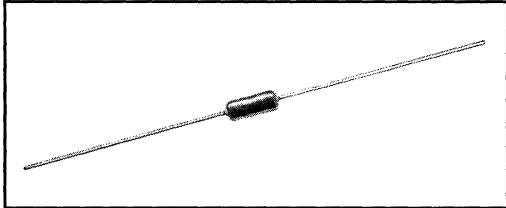
PART MARKING

- Company name
- Value
- Tolerance
- Model, Case Size and T. C.

HOW TO ORDER

FL MODEL	4 CASE SIZE	D TEMPERATURE COEFFICIENT	26R4 VALUE	$\pm 1\%$ TOLERANCE
FL = Flameproof LO = Nonflameproof	4 5	C = $\pm 50\text{PPM}/^\circ\text{C}$ D = $\pm 100\text{PPM}/^\circ\text{C}$	R = Ohm 26R4 = 26.6 ohm	$\pm 1\%$ $\pm 2\%$ $\pm 5\%$

MODEL CMH-55-100 Metal Film Resistors Industrial, High Value



FEATURES

- 1/4 watt at 70°C power rating
- ± 0.5%, ± 1%, ± 2% tolerance
- Non decade values available
- Tape and reel packaging for automatic insertion available. Meets EIA 296-E.
- Flame retardant epoxy conformal coating
- Small dimensional size to value ratio
- 50PPM/°C and 100PPM/°C temperature coefficient

ELECTRICAL SPECIFICATIONS

Resistance Range: 5.01 Megohm thru 15 Megohm.

Resistance Tolerance:

- 5.01 Megohm - 10 Megohm = ± 0.5%, ± 1%, ± 2%.
- 10.1 Megohm - 15 Megohm = ± 1%, ± 2%.

Temperature Coefficient: (- 20°C to + 125°C)

- 5.01 Megohm - 10 Megohm = 0 ± 50PPM/°C, 0 ± 100PPM/°C.
- 10.1 Megohm - 15 Megohm = 0 ± 100PPM/°C.

Power Rating: Limited by maximum working voltage.

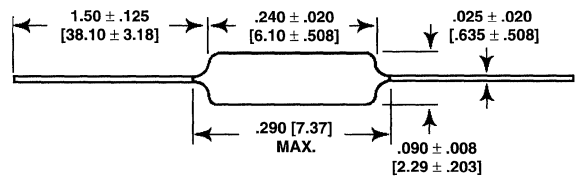
Maximum Working Voltage: 250 V RMS.

Insulation Resistance: 10,000 Megohm, minimum.

Operating Temperature Range: - 65°C to + 165°C.

DIMENSIONAL CONFIGURATIONS

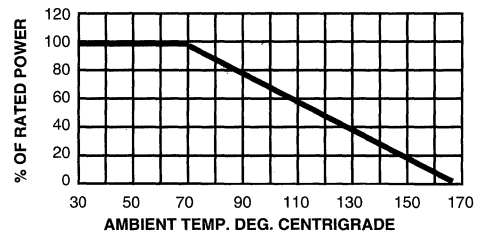
[Numbers in brackets indicate millimeters]



ENVIRONMENTAL PERFORMANCE

TEST	MAX. ΔR (Typical Test Lots)	
	5M to 10M	10M to 15M
Thermal Shock	.10%	.10%
Short Time Overload (500 V maximum, 10 seconds)	.25%	.25%
Low Temperature Operation	.10%	.10%
Moisture Resistance (no load or polar over 10M)	.10%	1.0%
Resistance to Soldering Heat	.10%	.10%
Shock	.10%	.10%
Vibration	.05%	.05%
Load Life 1,000 Hours @ 125°C	.50%	2.0%
Terminal Strength	.10%	.10%
Dielectric Withstanding Voltage	.05%	.05%

DERATING



PART MARKING

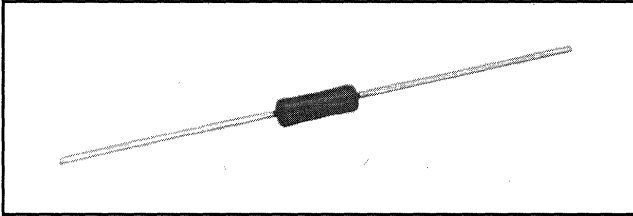
- Dale
- Value
- Tolerance
- T.C.
- Date code

HOW TO ORDER

MODEL	VALUE	TOLERANCE	TEMPERATURE COEFFICIENT
CMF-55-100	3744	F	T-1
First three digits are significant (two for 2% tolerance.) Last digit specifies the number of zeros to follow. (3.74 Megohm illustrated.)		D = ± 0.5% F = ± 1.0% G = ± 2.0%	T-2 = ± 50PPM/°C T-1 = ± 100PPM/°C

MODEL CPF Metal Film Resistors

Industrial, Power, Flameproof



FEATURES

- High power rating, small size
- Flameproof, high temperature coating
- Special filming and coating processes
- Excellent high frequency characteristics
- Low noise
- Low voltage coefficient

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	WATTAGE RATING 70°C	VOLTAGE RATING	RESISTANCE RANGE 1% AND ABOVE (Ohms)
CPF-1	1	250	0.1-150k
CPF-2	2	350	0.1-150k
CPF-3	3	500	0.1-150k

Contact factory for resistance range in precision tolerance.

ELECTRICAL SPECIFICATIONS

Resistance Tolerance: .1%, .25%, .5%, 1%, 5%.

Temperature Coefficient: (-55°C to +125°C)
± 100PPM/°C, ± 50PPM/°C, ± 25PPM/°C.

Dielectric Strength: 900 VAC.

Insulation Resistance: 10,000 Megohm, minimum.

Operating Temperature Range: -65°C to +230°C.

MATERIAL SPECIFICATIONS

Element: Proprietary nickel-chrome alloy.

Core: Fire-cleaned high purity ceramic.

Coating: Special high temperature conformal coat.

Termination: Standard lead material is solder-coated copper. Solderable and weldable per MIL-STD-1276, Type "C".

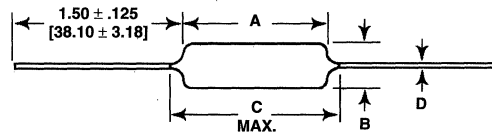
MECHANICAL SPECIFICATIONS

Terminal Strength: 2 pound pull test.

Solderability: Continuous satisfactory coverage when tested in accordance with MIL-STD-202, Method 208.

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]

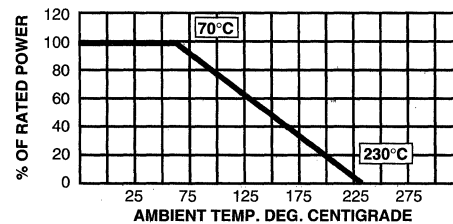


MODEL	A	B	C (Max.)	D
CPF-1	.240 ± .020 [6.10 ± .508]	.090 ± .008 [2.29 ± .203]	.310 [7.87]	.025 ± .002 [.635 ± .051]
CPF-2	.344 ± .031 [8.74 ± .787]	.145 ± .015 [3.68 ± .381]	.425 [10.80]	.032 ± .002 [.813 ± .051]
CPF-3	.555 ± .041 [14.10 ± 1.04]	.180 ± .015 [4.57 ± .381]	.650 [16.51]	.032 ± .002 [.813 ± .051]

ENVIRONMENTAL PERFORMANCE

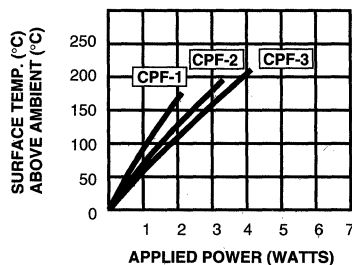
TEST	MAX. ΔR (Typical Test Lots)
Thermal Shock	± 1.0%
Short Time Overload	± .5%
Low Temperature Operation	± .5%
Moisture Resistance	± 1.5%
Resistance To Soldering Heat	± .5%
Shock	± .5%
Vibration	± .5%
Terminal Strength	± .5%
Dielectric Withstanding Voltage	± .5%
Life	± 2.0%

DERATING



SURFACE TEMPERATURE VS. POWER

Surface temperatures were taken with an infrared pyrometer in +25°C still air. Resistors were supported by their leads in test clips at a point .500" [12.70] out from the resistor body ends.



PART MARKING

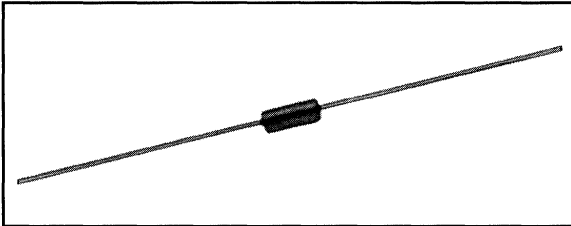
- Model
- Resistance
- Tolerance
- Date code

HOW TO ORDER

CPF-1 MODEL	XXX or XXXX RESISTANCE	F TOLERANCE	T-1 TEMPERATURE COEFFICIENT
CPF-1 CPF-2 CPF-3	First three digits are significant (two for 5% tolerance). Last digit specifies number of zeros to follow.	B = ± 0.10% C = ± 0.25% D = ± 0.5% F = ± 1% J = ± 5%	T-1 = 100PPM/°C T-2 = 50PPM/°C T-9 = 25PPM/°C

MODELS FP55E, 60E, 55C, 60C, 55D Metal Film Resistors

Precision, Flameproof



FEATURES

- Flameproof coating
- Ideal for circuits where high power overloads may be encountered
- Tolerances down to .1%
- Temperature Coefficient: $\pm 25\text{PPM}/^\circ\text{C}$, $\pm 50\text{PPM}/^\circ\text{C}$
- Leads are electroplated, high purity copper
- Meets IEC-695-2-2 requirements for flammability
- 96% alumina substrate has superior thermal properties which reduce hot spot temperatures and long-term aging effects

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	WATTAGE RATING 70°C	VOLTAGE RATING	RESISTANCE RANGE (Ohms)	STANDARD TOLERANCE	TEMPERATURE COEFFICIENT PPM/°C
FP55E	1/4	200	49.9-499k	.1, .25, .5, 1%	25
FP60E	1/2	250	49.9-1M	.1, .25, .5, 1%	25
FP55C	1/4	200	49.9-499k	.1, .25, .5, 1%	50
FP60C	1/2	250	49.9-1M	.1, .25, .5, 1%	50
FP55D	1/4	250	10-499k	1, 2, 5%	100

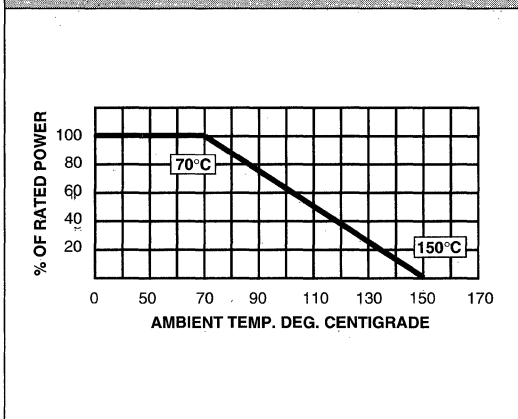
DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

MODEL	A	B	D
FP55E	.235 \pm .020 [5.97 \pm .508]	.100 [2.54] Max.	.025 [.635]
FP60E	.350 \pm .030 [8.89 \pm .762]	.130 \pm .015 [3.30 \pm .381] -.025 [-.635]	.025 [.635]
FP55C	.235 \pm .020 [5.97 \pm .508]	.100 [2.54] Max.	.025 [.635]
FP60C	.350 \pm .030 [8.89 \pm .762]	.130 \pm .015 [3.30 \pm .381] -.025 [-.635]	.025 [.635]
FP55D	.235 \pm .020 [5.97 \pm .508] -.025 [-.635]	.090 \pm .008 [2.29 \pm .203]	.025 [.635]

ENVIRONMENTAL PERFORMANCE

MODEL	THERMAL SHOCK ΔR MAX. \pm %	SHORT TIME OVERLOAD ΔR MAX. \pm %	LOW TEMP. OPERATION ΔR MAX. \pm %	MOISTURE RESISTANCE ΔR MAX. \pm %	SHOCK ΔR MAX. \pm %	VIBRATION ΔR MAX. \pm %	LOAD LIFE 1000 HOURS MIL RATING ΔR MAX. \pm %	TERMINAL STRENGTH ΔR MAX. \pm %	D. W. V. ΔR MAX. \pm %	EFFECT SOLDER HEAT ΔR MAX. \pm %
FP55E	0.25	0.25	0.25	1.0	0.1	0.1	0.5	0.1	0.1	0.1
FP60E	0.25	0.25	0.25	1.0	0.1	0.1	0.5	0.1	0.1	0.1
FP55C	0.25	0.25	0.25	1.0	0.1	0.1	0.5	0.1	0.1	0.1
FP60C	0.25	0.25	0.25	1.0	0.1	0.1	0.5	0.1	0.1	0.1
FP55D	0.50	0.50	0.50	1.0	0.5	0.5	1.0	0.25	0.5	0.25

DERATING



PART MARKING

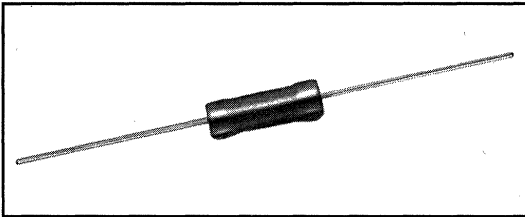
— Company name
— Value
— Tolerance
— Model, Case Size and Temperature Coefficient

HOW TO ORDER

FP MODEL	55 SIZE	E TEMPERATURE COEFFICIENT	51k1 VALUE	$\pm 1\%$ TOLERANCE
	55 60	E = $\pm 25\text{PPM}/^\circ\text{C}$ C = $\pm 50\text{PPM}/^\circ\text{C}$ D = $\pm 100\text{PPM}/^\circ\text{C}$	R = Ohm k = Thousand ohm M = Million ohm (51k1 = 51,000 ohm, 51R1 = 51.1 ohm.)	$\pm .1\%$ $\pm 2\%$ $\pm .25\%$ $\pm 5\%$ $\pm .5\%$ $\pm 10\%$ $\pm 1\%$

MODEL FP Metal Film Resistors

Industrial, Flameproof



FEATURES

- Small physical size
- Low cost
- Exceptional frequency characteristics
- FP resistors have the ability to withstand overloads up to 100 times rated power without any trace of flame
- Especially suited for circuitry where functions, environments and duty cycles demand low power resistors

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	WATTAGE RATING			VOLTAGE RATING	RESISTANCE RANGE (Ohms)	STANDARD* TOLERANCE	TEMPERATURE COEFFICIENT PPM/°C
	25°C	40°C	70°C				
FP1/2	—	—	1/2	350	10-1M	1, 2, 5, 10%	150
FP1	—	—	1	500	10-1M	1, 2, 5, 10%	150
FP2	3 1/2	3	2	500	9-1.5M	1, 2, 5, 10%	150
FP3	4	4	3	500	9-1M	1, 2, 5, 10%	150
FP4	5 1/2	5	4	500	6-1M	1, 2, 5, 10%	150
FP5	6 1/2	6	5	600	7-1M	1, 2, 5, 10%	150
FP7	7 1/2	—	7	700	8-1M	1, 2, 5, 10%	150
FP10	—	10	—	700	8-1M	1, 2, 5, 10%	150
FP67	5	—	—	500	5-19k	1, 2, 5, 10%	150
FP69	3	—	2	500	2.6-1.5M	1, 2, 5, 10%	150

* Available in $\pm .5\%$ as special order.

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

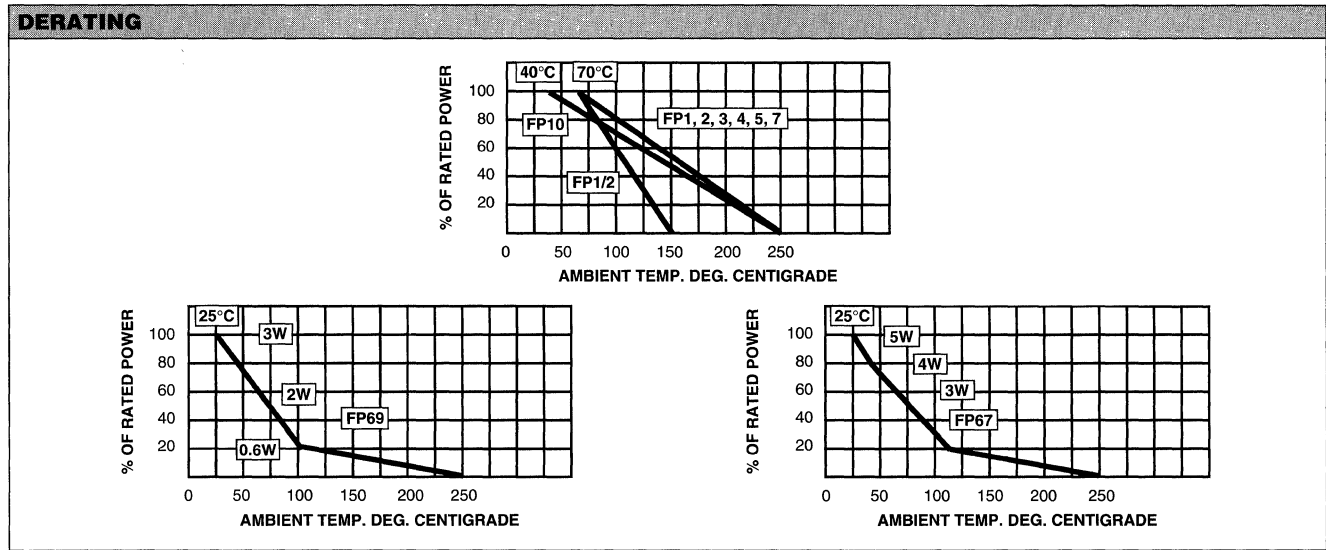
MODEL	A	B	D
FP1/2	.360 \pm .020 [9.14 \pm .508]*	.138 \pm .012 [3.51 \pm .305] - .023 - .584]	.032 [.813]
FP1	.560 \pm .031 [14.22 \pm .787]	.190 \pm .007 [4.83 \pm .178] - .015 - .381]	.032 [.813]
FP2	.687 \pm .031 [17.45 \pm .787]	.300 \pm .020 [7.62 \pm .508]	.032 [.813]
FP3	.900 \pm .031 [22.86 \pm .787]	.300 \pm .020 [7.62 \pm .508]	.032 [.813]
FP4	1.53 \pm .035 [38.86 \pm .889]	.300 \pm .020 [7.62 \pm .508]	.032 [.813]
FP5	1.71 \pm .035 [43.43 \pm .889]	.300 \pm .020 [7.62 \pm .508]	.032 [.813]
FP7	2.04 \pm .035 [51.82 \pm .889]	.300 \pm .020 [7.62 \pm .508]	.032 [.813]
FP10	2.04 \pm .035 [51.82 \pm .889]	.300 \pm .020 [7.62 \pm .508]	.032 [.813]
FP67	.900 \pm .031 [22.86 \pm .787]	.300 \pm .020 [7.62 \pm .508]	.032 [.813]
FP69	.516 \pm .021 [13.11 \pm .533]	.225 \pm .012 [5.72 \pm .305]	.032 [.813]

* Clean lead to clean lead dimensions on FP1/2 are .437 [11.10] maximum.

ENVIRONMENTAL PERFORMANCE

MODEL	SHORT TIME OVERLOAD ΔR MAX. \pm %	LOW TEMP. OPERATION ΔR MAX. \pm %	MOISTURE RESISTANCE ΔR MAX. \pm %	SHOCK ΔR MAX. \pm %	VIBRATION ΔR MAX. \pm %	TEMPERATURE CYCLE ΔR MAX. \pm %	LOAD LIFE 1000 HOURS RATED COND. ΔR MAX. \pm %	TERMINAL STRENGTH ΔR MAX. \pm %	D. W. V. ΔR MAX. \pm %	EFFECT SOLDER HEAT ΔR MAX. \pm %
FP1/2	0.5	0.5	1.0	0.5	0.5	1.0	1.0	0.5	0.5	0.5
FP1	1.0	0.5	1.5	0.5	0.5	1.0	2.0	0.5	0.5	0.5
FP2	0.5	0.5	1.0	0.5	0.5	0.5	5.0	0.5	0.5	0.5
FP3	0.5	0.5	1.0	0.5	0.5	1.0	5.0	0.5	0.5	0.5
FP4	0.5	0.5	1.0	0.5	0.5	1.0	5.0	0.5	0.5	0.5
FP5	0.5	0.5	1.0	0.5	0.5	1.0	5.0	0.5	0.5	0.5
FP7	0.5	0.5	1.0	0.5	0.5	1.0	5.0	0.5	0.5	0.5
FP10	0.5	0.5	1.0	0.5	0.5	1.0	5.0	0.5	0.5	0.5
FP67	0.5	0.25	1.0	0.5	0.5	1.0	5.0	0.25	0.25	0.25
FP69	0.5	0.25	1.0	0.5	0.5	0.5	3.0	0.5	0.25	0.25

MODEL FP



PART MARKING

- Company name
- Value
- Tolerance
- Model and case size
(Date and source code included on some styles.)

1% Tolerance Parts are marked with 5 color bands.
5 band, EIA Standard RS196.

2, 5 and 10% Tolerance Parts are marked with 4 color bands.
4 band Commercial, EIA Standard.

The diagrams show the layout of color bands on a resistor. For a 5-band code, the bands are labeled: First significant figure, Second significant figure, Third significant figure, Multiplier, and Tolerance, 1-1/2 times size. For a 4-band code, the bands are labeled: First significant figure, Second significant figure, Multiplier, and Tolerance.

EIA COLOR CODE

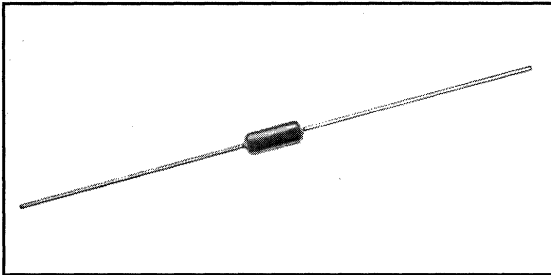
SIGNIFICANT FIGURES		MULTIPLIER (Number of zeros to follow)	TOLERANCE
Black = 0	Green = 5	Black = None	Brown = ± 1%
Brown = 1	Blue = 6	Brown = 0	Red = ± 2%
Red = 2	Violet = 7	Red = 00	Gold = ± 5%
Orange = 3	Grey = 8	Orange = 000	Silver = ± 10%
Yellow = 4	White = 9	Yellow = 0000	No Band = ± 20%
		Green = 00000	
		Blue = 000000	
		Gold = X.1	
		Silver = X.01	

HOW TO ORDER

FP MODEL	2 SIZE	51k1 VALUE	± 1% TOLERANCE
	1/2 5	51k1 = 51,100 ohm	± 1%
	1 7	10R0 = 10 ohm	± 2%
	2 10		± 5%
	3 67		± 10%
	4 69		

MODEL ERL Metal Film Resistors

Military/Established Reliability,
MIL-R-39017 Qualified, Type RLR



FEATURES

- Meets requirements of MIL-R-39017
- Failure Rate: Verified Failure Rate (Contact factory for current level)
- Excellent high frequency performance
- Epoxy coated construction provides superior moisture protection
- Traceability of materials and processing
- Monthly lot acceptance testing
- Very low noise
- Extensive stocking program at distributors and factory in 1% and 2% tolerances
- Dale® has complete capability to develop specific reliability programs designed to customer requirements

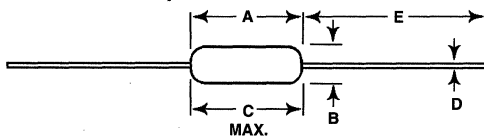
STANDARD ELECTRICAL SPECIFICATIONS

DALE MODEL	MIL-R-39017 TYPE	70°C RATING	MAXIMUM WEIGHT (Grams)	MAXIMUM WORKING VOLTAGE	RESISTANCE* RANGE (Ohms) T-1 (100PPM)
ERL-05	RLR05	1/8 W	.11	200	4.7-1M
ERL-07	RLR07	1/4 W	.35	250	10-10M
ERL-20	RLR20	1/2 W	.75	350	4.3-155k

* Consult factory for values on QPL.

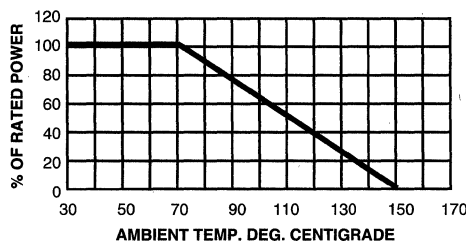
DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



MODEL	A	B	C (Max.)	D	E
ERL-05	.150 ± .020 [3.81 ± .508]	.066 ± .008 [1.68 ± .203]	.187 [4.75]	.016 [.406]	1.25 ± .266 [31.75 ± 6.76]
ERL-07	.250 + .031 - .046 [6.35 + .787 - 1.17]	.090 ± .008 [2.29 ± .203]	.300 [7.62]	.025 [.635]	1.50 ± .125 [38.10 ± 3.18]
ERL-20	.375 ± .041 [9.53 ± 1.04]	.138 ± .023 [3.51 ± .584]	.450 [11.43]	.032 [.813]	1.50 ± .125 [38.10 ± 3.18]

DERATING



PART MARKING

— Per MIL-R-39017

DOCUMENTATION: Qualification and failure rate verification test data is maintained by Dale and is available upon request. Lot traceability and identification data is maintained by Dale for five years.

HOW TO ORDER - MILITARY PART NUMBER

RLR MILITARY TYPE Per MIL-R-39017	07 SIZE 05 = 1/8 watt 07 = 1/4 watt 20 = 1/2 watt	C LEAD MATERIAL Solderable/ Weldable	3001 VALUE First three digits are significant figures. (Two for 5% tolerance.) Last digit specifies the number of zeros to follow. (3000 ohm illustrated.)	F TOLERANCE F = ± 1% G = ± 2% J = ± 5%	R FAILURE RATE %/100 HOURS M = 1% P = .1% R = .01% S = .001%
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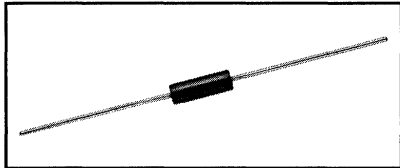


MODEL HN

Metal Film Resistors

Military/Established Reliability

MIL-R-39017 Qualified, Type RLR, Semi-Precision



FEATURES

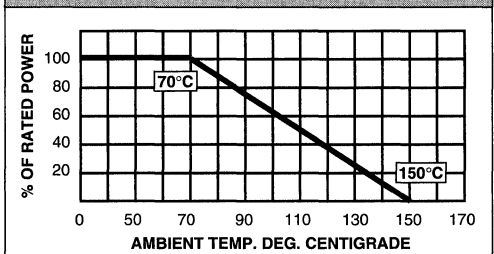
- "S" level failure rate
- High purity copper leads in accordance with MIL-STD-1276. Two solder finishes are available, electroplated 60/40 solder and hot dipped 60/40 solder.
- Blue epoxy insulation over polyimide varnish provides superior moisture resistance properties

STANDARD ELECTRICAL SPECIFICATIONS

DALE MODEL	MIL-R-39017 TYPE	WATTAGE RATING 70°C	VOLTAGE RATING	RESISTANCE RANGE (Ohms)	STANDARD * TOLERANCE	TEMPERATURE COEFFICIENT PPM/°C
HN3	RLR05C	1/8	200	4.7-300k	1, 2, 5%	100
HN4	RLR07C	1/4	250	10-1M	1, 2, 5%	100
HN5	RLR20C	1/2	350	10-1M	1, 2, 5%	100
HN6	RLR32C	1	500	10-1M	1, 2, 5%	100

* 5% tolerance is inactive for new design.

DERATING



DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

DALE MODEL	MIL-R-39017 TYPE	A	B	D
HN3	RLR05C	.145 ± .015 [3.68 ± .381]	.066 ± .008 [1.68 ± .203]	.016 [.406]*
HN4	RLR07C	.235 ± .020 [5.97 ± .508]	.090 ± .008 [2.29 ± .203]	.025 [.635]
HN5	RLR20C	.375 ± .025 [9.53 ± .635] -.040 -1.02	.135 ± .020 [3.43 ± .508] -.005 -1.27	.032 [.813]
HN6	RLR32C	.560 ± .030 [14.22 ± .762]	.190 ± .007 [4.83 ± .178] -.015 -.381	.040 [1.02]

* Leads are 1.25 ± .265 [31.75 ± 6.73] long.

ENVIRONMENTAL PERFORMANCE

DALE MODEL	MIL-R-39017 TYPE	POWER CONDITIONING ΔR MAX. ± %	THERMAL SHOCK ΔR MAX. ± %	SHORT TIME OVERLOAD ΔR MAX. ± %	LOW TEMP. STORAGE ΔR MAX. ± %	LOW TEMP. OPERATION ΔR MAX. ± %	MOISTURE RESISTANCE ΔR MAX. ± %	SHOCK & VIBRATION ΔR MAX. ± %	LOAD LIFE 2000 HOURS MIL RATING ΔR MAX. ± %	TERMINAL STRENGTH ΔR MAX. ± %	D. W. V. ΔR MAX. ± %	EFFECT SOLDER HEAT ΔR MAX. ± %
HN3	RLR05C	0.50	0.25	0.50	0.10	0.10	0.50	0.05	1.0	0.05	0.05	0.10
HN4	RLR07C	0.50	0.25	0.50	0.10	0.10	0.50	0.05	1.0	0.05	0.05	0.10
HN5	RLR20C	0.50	0.25	0.25	0.10	0.10	0.50	0.05	1.0	0.05	0.05	0.10
HN6	RLR32C	0.50	0.25	0.25	0.25	0.25	0.50	0.10	2.0	0.10	0.10	0.10

PART MARKING

RLR05

- Year, week of year, lot code
- Coded resistance value*
- Tolerance, FR, JAN, manufacturer symbol

RLR07

- Year, week of year, lot code, JAN
- Model, lead material
- Coded resistance value*, tolerance
- FR, manufacturer symbol

RLR20 & RLR32

- Year, week of year, lot code, JAN
- Model, lead material
- Coded resistance value*, tolerance, FR
- Source code
- Company name

* ± 5% tolerance parts are marked with 3 digit resistance value code, e.g. 103. ± 2% tolerance parts are marked with 4 digit code but may be special ordered with 3 digit code. All ± 5% parts and ± 2% parts with 3 digit coding are inactive for new design.

HOW TO ORDER - MILITARY PART NUMBER

RLR MODEL	20 SIZE	C LEAD MATERIAL	1003 VALUE	G TOLERANCE	S FAILURE RATE
	05 07 20 32	Type C solderable/weldable	First 3 digits are significant figures, fourth digit is the multiplier.	F = ± 1% G = ± 2% J = ± 5%	1000 Hours (60% confidence) M = 1.0% P = .1% R = .01% S = .001%

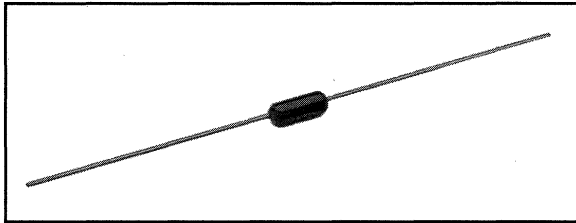
HOW TO ORDER - DALE MODEL

HN MODEL	3 SIZE	1003 VALUE	± 1% TOLERANCE
	3 4 5 6	First 3 digits are significant figures, fourth digit is the multiplier.	± 1% ± 2% ± 5%

MODEL ERC

Metal Film Resistors

Military/Established Reliability,
MIL-R-55182, Qualified, Type RNC



FEATURES

- Meets requirements of MIL-R-55182
- Very low noise
- Verified Failure Rate (Contact factory for current level)
- 100% stabilization and screening tests. Group A Testing, if desired, to customer requirements.
- Controlled temperature coefficient
- Excellent high frequency performance
- Epoxy coating provides superior moisture protection
- Standard lead on RNC product is solderable and weldable
- Traceability of materials and processing
- Monthly acceptance testing
- Dale[®] has complete capability to develop specific reliability programs designed to customer requirements
- Extensive stocking program at distributors and factory on RNC50, RNC55, RNC60 and RNC65

TEMPERATURE COEFFICIENT CODE			
T.C. CODE	MIL. CHAR.	TEMPERATURE COEFFICIENT	TEMPERATURE RANGE
T-1	K	0 ± 100PPM/°C	- 55°C to + 175°C
T-2	H	0 ± 50PPM/°C	- 55°C to + 175°C
T-9	J	0 ± 25PPM/°C	- 55°C to + 175°C

STANDARD ELECTRICAL SPECIFICATIONS								
DALE MODEL	MIL-R-55182 TYPE	70°C RATING (Watts)	125°C RATING (Watts)	MAXIMUM WEIGHT (Grams)	MAXIMUM WORKING VOLTAGE	RESISTANCE RANGE (Ohms)*		
						T-1 (K)	T-2 (H)	T-9 (J)
ERC-50	RNC50	1/10	1/20	.11	200	10-796k	10-796k	10-796k
ERC-55	RNC55	1/8	1/10	.35	200	10-2.0M	10-2.0M	10-2.0M
ERC-55-200	RNC60	1/4	1/8	.35	250	10-2.0M	10-2.0M	10-2.0M
ERC-60	RNC60	1/4	1/8	.75	250	10-3.01M	10-3.01M	10-3.01M
ERC-65	RNC65	1/2	1/4	.84	300	10-3.01M	10-3.01M	10-3.01M
ERC-70	RNC70	3/4	1/2	1.60	350	10-3.01M	10-3.01M	10-3.01M

* Consult factory for values on QPL.
Standard Resistance Tolerances: .1% (B), .5% (D) and 1% (F). .1% not applicable to characteristic K.

ELECTRICAL SPECIFICATIONS

Resistance Tolerance: 1%, .5%, .1%.

Voltage Coefficient: Maximum voltage coefficient is 5PPM per volt when measured between 10% and full rated voltage.

Dielectric Strength: 450 VAC on ERC-50, ERC-55 and ERC-60. 900 VAC on ERC-65 and ERC-70.

Insulation Resistance: 10,000 Megohm minimum dry, 100 Megohm minimum after moisture test. Typical after moisture test is 200,000 Megohm.

MECHANICAL SPECIFICATIONS

Terminal Strength: 2 pound pull test on ERC-50, ERC-55, ERC-60 and ERC-65. 4.5 pound pull test on ERC-70.

Solderability: Continuous, satisfactory coverage when tested in accordance with MIL-STD-202, Method 208.

MATERIAL SPECIFICATIONS

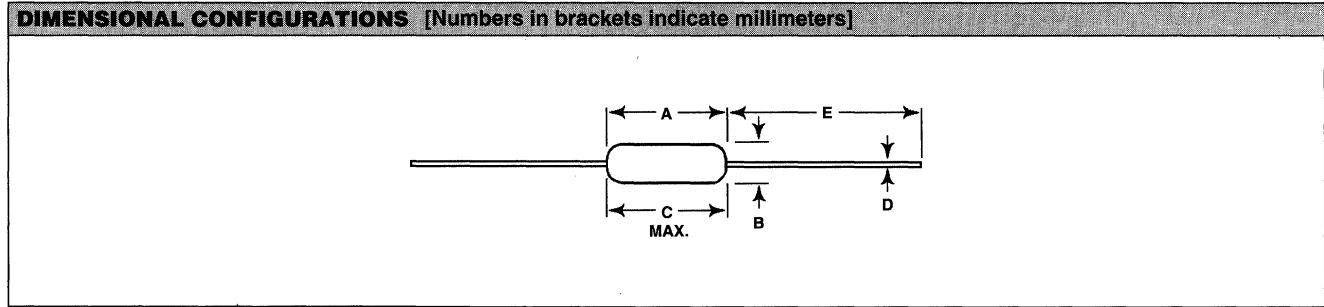
Core: Fire-cleaned high purity ceramic.

Element: Vacuum-deposited nickel-chrome alloy.

Encapsulant: Specially formulated epoxy compound.

Termination: Standard lead material is solder-coated copper. Solderable and weldable per MIL-STD-1276, Type "C".

MODEL ERC



MODEL	A	B	C (Max.)	D	E
ERC-50	.150 ± .020 [3.81 ± .508]	.070 ± .010 [1.78 ± .254]	.187 [4.75]	.016 [.406]	1.25 ± .266 [31.75 ± 6.76]
ERC-55	.250 + .031 - .046 [6.35 + .787 - 1.17]	.091 ± .009 [2.31 ± .229]	.300 [7.62]	.025 [.635]	1.50 ± .125 [38.10 ± 3.18]
ERC-55-200	.280 ± .020 [7.11 ± .508]	.094 ± .009 [2.39 ± .229]	.350 [8.89]	.025 [.635]	1.50 ± .125 [38.10 ± 3.18]
ERC-60	.375 ± .062 [9.53 ± 1.57]	.145 ± .016 [3.68 ± .406]	.450 [11.43]	.025 [.635]	1.50 ± .125 [38.10 ± 3.18]
ERC-65	.562 ± .031 [14.27 ± .787]	.175 ± .015 [4.45 ± .381]	.687 [17.45]	.025 [.635]	1.50 ± .125 [38.10 ± 3.18]
ERC-70	.562 ± .031 [14.27 ± .787]	.175 ± .015 [4.45 ± .381]	.687 [17.45]	.032 [.813]	1.50 ± .125 [38.10 ± 3.18]

APPLICABLE MIL-SPECIFICATIONS

MIL-R-55182: The ERC Models meet or exceed the electrical, environmental and dimensional requirements of MIL-R-55182.

MIL-R-10509: MIL-R-55182 supersedes MIL-R-10509 on new design. The ERC models meet or exceed MIL-R-10509 requirements.

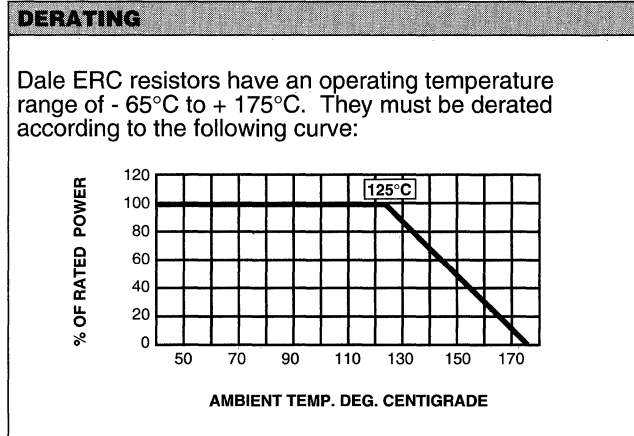
DOCUMENTATION

Qualification and failure rate verification test data is maintained by Dale and is available upon request. Lot traceability test data and identification data is maintained by Dale for 5 years.

POWER RATING

Dale ERC power ratings are based on the following two conditions:

1. 2% maximum ΔR in 10,000 hours load life.
2. 175°C maximum operating temperature.



PART MARKING

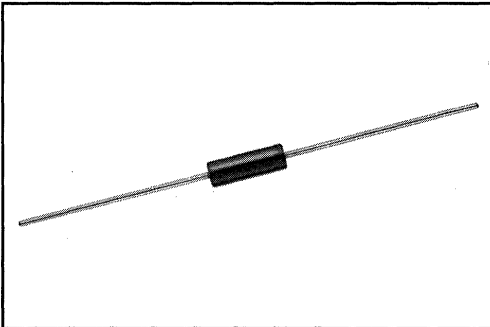
— Per MIL-R-55182

HOW TO ORDER - MILITARY PART NUMBER

<p>RNC MIL. TYPE Per MIL-R-55182</p> <p>RNC = Solderable/weldable leads RNR = Solderable only leads</p>	<p>55 SIZE</p> <p>50 = 1/20 watt 55 = 1/10 watt 60 = 1/8 watt 65 = 1/2 watt</p>	<p>H CHARACTERISTIC (NON-HERMETIC)</p> <p>J = ± 25PPM°C H = ± 50PPM°C K = ± 100PPM°C</p>	<p>2152 VALUE</p> <p>First three digits are significant figures. Last digit specifies the number of zeros to follow. (21.5 kilohm illustrated.)</p>	<p>F TOLERANCE</p> <p>B = ± .1% D = ± .5% F = ± 1%</p>	<p>R FAILURE RATE %/100 HOURS</p> <p>S = .001% R = .01% P = .1% M = 1%</p>
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MODELS CJ and CH Metal Film Resistors

**Military/Established Reliability, MIL-R-55182 Qualified
Types RNC and RNR, Precision**



FEATURES

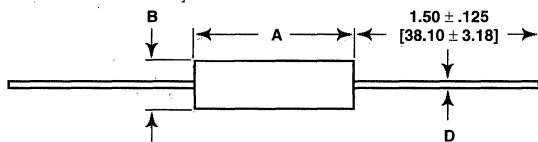
- RNC and RNR resistors are designed for the many military applications where established reliability is a must
- Extended life tests of over one-half billion unit test hours have proven the reliability inherent in the manufacturing process
- All CH and CJ resistors are "S" level failure rate
- These resistors are provided with high purity copper leads in accordance with MIL-STD-1276. Two solder finishes are available: Electroplated 60/40 solder and hot dipped 60/40 solder.
- Blue epoxy insulation coating over polyimide varnish provides superior moisture resistance properties
- NOTE: Users ordering characteristic K will be provided characteristic H or J in accordance with paragraph 3.27.5 of MIL-R-55182

STANDARD ELECTRICAL SPECIFICATIONS

DALE MODEL	MIL-R-55182 TYPE	WATTAGE RATING			RESISTANCE RANGE (Ohms)	STANDARD TOLERANCE	TEMPERATURE COEFFICIENT PPM/°C
		70°C	125°C	VOLTAGE RATING			
CJ50	RNC50J/ RNR50J	1/10	1/20	200	49.9-150k	.1, .5, 1%	25
CH50	RNC50H/ RNR50H	1/10	1/20	200	10-150k 49.9-150k	.5, 1% .1%	50
CJ55	RNC55J/ RNR55J	1/8	1/10	200	49.9-301k	.1, .5, 1%	25
CH55	RNC55H/ RNR55H	1/8	1/10	200	10-301k 49.9-301k	.5, 1% .1%	50
CJ60	RNC60J/ RNR60J	1/4	1/8	250	49.9-499k	.1, .5, 1%	25
CH60	RNC60H/ RNR60H	1/4	1/8	250	10-499k 49.9-499k	.5, 1% .1%	50
CJ65	RNC65J/ RNR65J	1/2	1/4	300	49.9-1M	.1, .5, 1%	25
CH65	RNC65H/ RNR65H	1/2	1/4	300	10-1M 49.9-1M	.5, 1% .1%	50

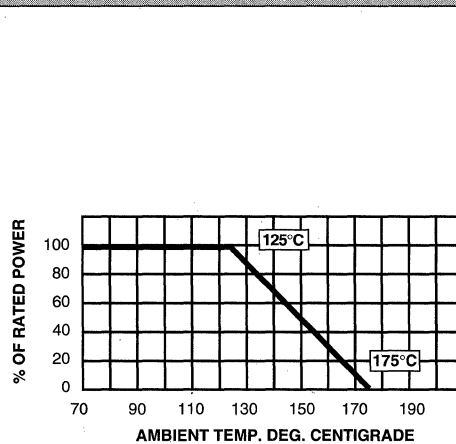
DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



DALE MODEL	MIL-R-55182 TYPE	A	B	D
CJ50	RNC50J/ RNR50J	.145 ± .015 [3.68 ± .381]	.066 ± .008 [1.68 ± .203]	.016 [.406]
CH50	RNC50H/ RNR50H			
CJ55	RNC55J/ RNR55J	.235 ± .020 [5.97 ± .508]	.090 + .008 [2.29 + .203] - .005 - .127]	.025 [.635]
CH55	RNC55H/ RNR55H			
CJ60	RNC60J/ RNR60J	.375 + .025 [9.53 + .635] - .040 - 1.02]	.135 + .020 [3.43 + .508] - .005 - .127]	.025 [.635]
CH60	RNC60H/ RNR60H			
CJ65	RNC65J/ RNR65J	.560 ± .030 [14.22 ± .762]	.190 + .007 [4.83 + .178] - .015 - .381]	.025 [.635]
CH65	RNC65H/ RNR65H			

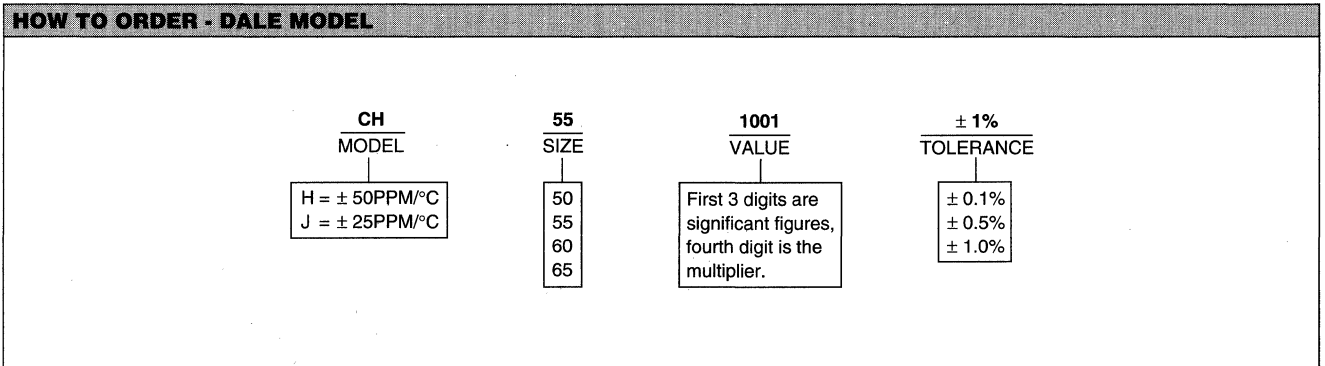
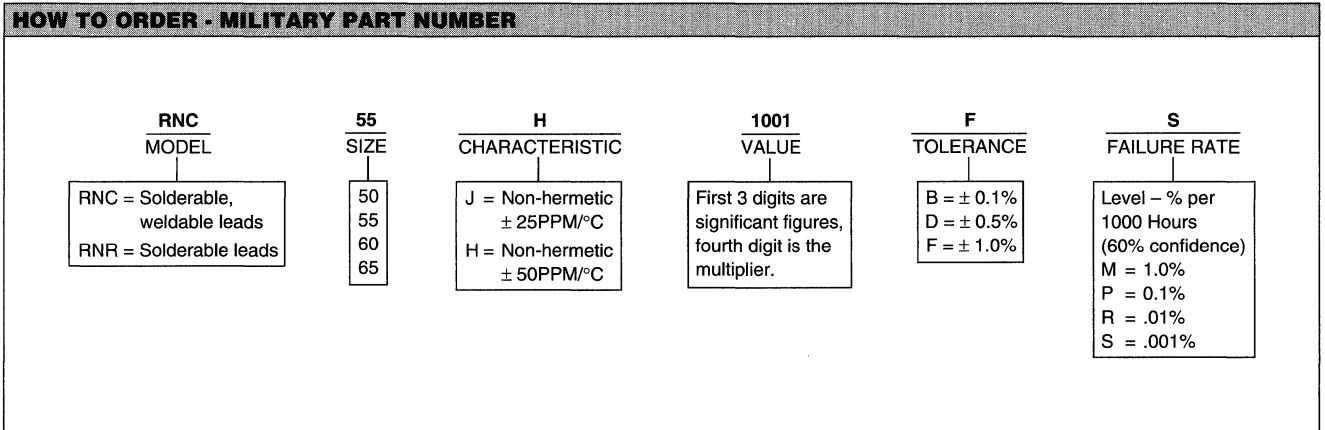
DERATING



MODELS CJ and CH

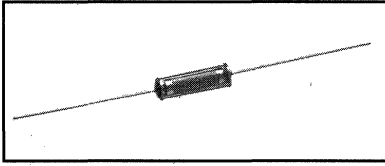
ENVIRONMENTAL PERFORMANCE											
DALE MODEL	MIL-R-55182 TYPE	OVERLOAD & THERMAL SHOCK ΔR MAX. \pm %	LOW TEMP. OPERATION ΔR MAX. \pm %	HIGH TEMP. EXPOSURE ΔR MAX. \pm %	MOISTURE RESISTANCE ΔR MAX. \pm %	SHOCK ΔR MAX. \pm %	VIBRATION ΔR MAX. \pm %	LOAD LIFE 2000 HOURS MIL RATING ΔR MAX. \pm %	TERMINAL STRENGTH ΔR MAX. \pm %	D. W. V. ΔR MAX. \pm %	EFFECT SOLDER HEAT ΔR MAX. \pm %
CJ50	RNC50J/ RNR50J	0.2	0.15	0.5	0.4	0.2	0.2	0.5	.02	0.15	0.1
CH50	RNC50H/ RNR50H										
CJ55	RNC55J/ RNR55J	0.2	0.1	0.5	0.4	0.05	0.05	0.5	0.05	0.1	0.1
CH55	RNC55H/ RNR55H										
CJ60	RNC60J/ RNR60J	0.2	0.1	0.5	0.4	0.05	0.05	0.5	0.05	0.1	0.1
CH60	RNC60H/ RNR60H										
CJ65	RNC65J/ RNR65J	0.2	0.1	0.5	0.4	0.05	0.05	0.5	0.05	0.1	0.1
CH65	RNC65H/ RNR65H										

PART MARKING		
<p>RNC55</p> <ul style="list-style-type: none"> — Date Code, Characteristic — Style and Terminal — Value — Tolerance, FR, Terminal, JAN, Manufacturer Symbol 	<p>RNC60 & RNC65</p> <ul style="list-style-type: none"> — Source Code — Date Code and JAN — Style, Terminal, (60/65) and Characteristic — Value, Tolerance and FR — Production Lot Code 	<p>RNC50</p> <ul style="list-style-type: none"> — Date Code, Characteristic — Value — Tolerance, FR, Terminal, JAN — Lot Code, Manufacturer Symbol



MODELS HN, HS, HT, HY Metal Film Resistors

**Military/Established Reliability, MIL-R-55182 Qualified
Type RNR and RNN, Hermetically Sealed**



FEATURES

- Qualified to MIL-R-55182 Characteristics C and E
- Performance exceeds requirements of MIL-R-55182
- Excellent high frequency performance
- Hermetic glass enclosure is impervious to harmful environments
- Inert gas filled
- Very low noise
- Highest reliability
- Excellent long term stability

STANDARD ELECTRICAL SPECIFICATIONS

ANGSTROHM MODEL	MIL-R-55182 TYPE	MILITARY POWER RATING		MAXIMUM WORKING VOLTAGE	QUALIFIED RESISTANCE RANGE (Ohms)	
		125°C	70°C		MIN.	MAX.
HT/HS/HY55 HN55	RNR55 RNN55	1/10	1/8	200	10.0	1.21M
HS/HN57 HN57	RNR57 RNN57	1/8	1/4	250	49.9	200K
HT/HS/HN60 HN60	RNR60 RNN60	1/8	1/4	250	10.0	2.49M
HT/HS/HY65 HN65	RNR65 RNN65	1/4	1/2	300	24.9	4.99M
HS/HY70 HN70	RNR70 RNN70	1/2	3/4	350	24.9	7.5M

ELECTRICAL SPECIFICATIONS

Resistance Tolerance: 1.0%, Code F.
0.5%, Code D. 0.1%, Code B.

Temperature Coefficient:

Military Code C = 0 ± 50 PPM/°C.
Military Code E = 0 ± 25 PPM/°C.

Failure Rate: M = 1.0%. P = 0.1%.
R = 0.01%. S = 0.001%.

Operating Temperature Range: - 65°C to + 175°C. (See Derating Curve.)

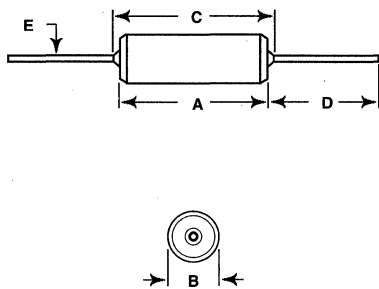
MECHANICAL SPECIFICATIONS

Termination:

RNR = Solderable leads.
RNN = Weldable Leads.

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

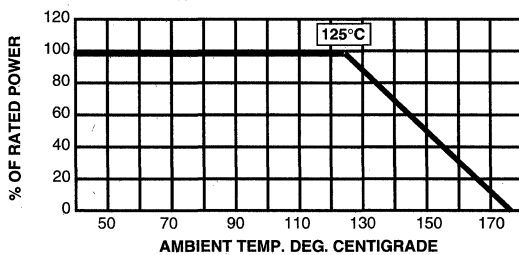
Dimensions shown are maximum allowable per MIL-R-55182.



MILITARY STYLE	A LENGTH	B DIAMETER	C CL to CL* (Max.)	D LENGTH ($\pm .125$ [3.18])	E DIAMETER ($\pm .002$ [.051])	APPROX. WEIGHT (Grams)
RNR55 RNN55	.250 + .031 - .046 [6.35 + .787 - 1.17]	.109 ± .031 [2.77 ± .787]	.379 [9.63]	1.50 [38.10]	.025 [.635]	.314
RNR57 RNN57	.281 ± .062 [7.14 ± 1.57]	.155 ± .015 [3.94 ± .381]	.467 [11.86]	1.25 [31.75]	.020 [.508]	.317
RNR60 RNN60	.375 ± .062 [9.53 ± 1.57]	.125 ± .040 - .031 [3.18 + 1.02 - .787]	.561 [14.25]	1.50 [38.10]	.025 [.635]	.485
RNR65 RNN65	6.25 + .031 - .094 [15.88 + .787 - 2.39]	.188 ± .062 - .031 [4.78 + 1.57 - .787]	.780 [19.81]	1.50 [38.10]	.025 [.635]	.950
RNR70 RNN70	.750 + .125 - .062 [19.05 + 3.18 - 1.57]	.250 ± .078 - .031 [6.35 + 1.98 - .787]	.939 [23.85]	1.50 [38.10]	.032 [.813]	1.30

* CL to CL is Clean Lead to Clean Lead.

DERATING



PART MARKING

RNR55

- Date Code, Characteristic
- Resistance Code
- Tolerance, FR, Terminal, JAN
- Manufacturer Identification

RNR60, RNR65, RNR70

- Source Code
- Date Code, JAN
- Style, Terminal, (60/65/70) and Characteristic
- Resistance Code, Tolerance, FR

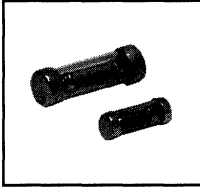
NOTE: ANGSTROHM PRECISION, INC., is marketed through Dale Electronics, Inc., Film Division, Norfolk, Nebraska.

HOW TO ORDER

MILITARY STYLE	55 SIZE	C CHARACTERISTIC (HERMETICALLY SEALED)	2152 RESISTANCE VALUE	B TOLERANCE	R FAILURE RATE
RNR RNN	55 = 1/10 watt 57 = 1/8 watt 60 = 1/8 watt 65 = 1/4 watt 70 = 1/2 watt		First three digits are significant. Last digit specifies the number of zeros to follow.		

MODEL SMH Metal Film Resistors

Industrial, Hermetically Sealed
Surface Mountable, MELF Resistors



FEATURES

- Although not Military Qualified, the SMH is designed to meet the electrical performance of MIL-R-10509 and MIL-R-55182
- Excellent long term stability and high frequency performance
- Hermetically sealed construction
- Very low noise

ELECTRICAL SPECIFICATIONS

Resistance Range: 10 ohm to 2.49 Megohm.

Resistance Tolerance: $\pm .05\%$, $\pm .1\%$, $\pm .25\%$, $\pm .5\%$, $\pm 1\%$.

Temperature Coefficient: $\pm 25\text{PPM}/^\circ\text{C}$, $\pm 50\text{PPM}/^\circ\text{C}$, $\pm 100\text{PPM}/^\circ\text{C}$.
Contact factory for special TCRs.

Power Rating: 1/5, 1/4 watt at 70°C.

Voltage Coefficient: 5PPM/V maximum.

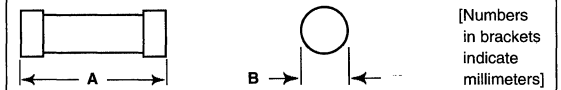
Dielectric Strength: 450 VAC.

Insulation Resistance: 50,000 Megohm (minimum).

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	POWER RATING (Watts)		MAXIMUM WORKING VOLTAGE	RESISTANCE RANGE (Ohms)	
	70°C	125°C		(Min.)	(Max.)
SMH55	1/5	1/10	200	10	1.21M
SMH60	1/4	1/8	250	10	2.49M

DIMENSIONAL CONFIGURATIONS



MODEL	A (Max.)	B (Max.)	APPROXIMATE WEIGHT (Grams)
SMH55	.335 [8.50]	.124 [3.17]	.200
SMH60	.511 [12.99]	.164 [4.18]	.520

THE ANGSTROHM FAMILY Of Metal Film Resistive Products

Resistors - Hermetically Sealed and Conformal Coated
Resistor Networks - High Precision



	<p>MODELS H55, H57, H60, H65, H70 Metal Film Resistors</p> <p>Excellent High Frequency Performance and a Hermetic Glass Enclosure which is Impervious to Harmful Environments</p>	<p>ELECTRICAL SPECIFICATIONS</p> <p>Resistance Range: 10 ohm to 7.5 Megohm. Resistance Tolerance: Tolerances to $\pm 0.05\%$. Special TCRs, contact factory. Power Rating: 1/10 watt thru 1/2 watt.</p>
	<p>MODELS C50, C55, C60, C65, C70 Metal Film Resistors</p> <p>Excellent High Frequency Performance, Excellent Long Term Stability and a very Low Noise Level</p>	<p>ELECTRICAL SPECIFICATIONS</p> <p>Resistance Range: 10 ohm to 7.5 Megohm. Resistance Tolerance: Tolerances to $\pm 0.05\%$. Special TCRs, contact factory. Power Rating: 1/20 watt thru 1/2 watt.</p>
<p>RESISTOR NETWORKS</p> <p>Angstrohm's high precision resistor networks provide design engineers with the flexibility to package several resistors in a small space while maintaining tight resistance ratio matching, close tolerance coefficient of resistance tracking and minimum temperature gradients between resistors. Models are available in a wide variety of body styles and ranges.</p>		

MATCHED SETS

Angstrohm offers matched sets which provide an economical method of achieving a resistive matching in a critical circuit without resorting to networks. Angstrohm hermetic or non-hermetic discrete metal film resistors (2 - 20 or more) are matched to the customer's exacting specifications. The matched set is supplied in a single package. Resistance Values: 10Ω to 7.5MΩ. Resistance Tolerances: $\pm .05\%$ to 1.0%. Resistance Match: .01% to 1.0%. T. C.: $\pm 25\text{PPM}/^\circ\text{C}$. Contact factory for complete details.

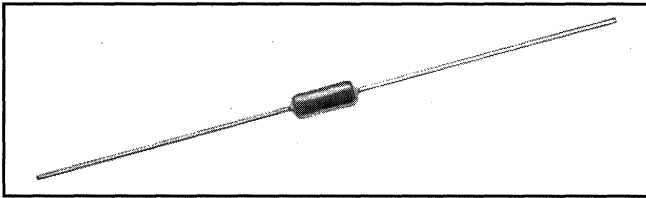
IMPROVED PERFORMANCE TESTING

Angstrohm metal film resistors are designed and manufactured to the most demanding quality standards and highest reliability levels possible. Our resistors are used in military aircraft, missiles and aerospace programs which demand the most exacting specifications and highest levels of reliability. Angstrohm has the facilities and capabilities to supply product to these specifications by employing **improved performance testing**. Contact factory for complete details.

ANGSTROHM Precision, Inc., is marketed through Dale Electronics, Inc., Film Division, Norfolk, Nebraska.

MODEL CMF Metal Film Resistors

Military, MIL-R-10509 Qualified, Type RN
Military, MIL-R-22684 Qualified, Type RL



FEATURES

- Very low noise
- Very low voltage coefficient
- Controlled temperature coefficient
- Excellent high frequency characteristics
- Flame retardant epoxy coating

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	MAXIMUM WORKING VOLTAGE	DALE MILITARY APPROVED VALUE RANGE (Ohms)			
		MIL-R-10509			MIL-R-22684
		CHARACTERISTIC D	CHARACTERISTIC C	CHARACTERISTIC E	
CMF-50	200	—	10-100k	10-100k	—
CMF-55	200	10-301k	49.9-100k	49.9-100k	—
CMF-07	250	—	—	—	51-150k
CMF-60	300	10-1M	49.9-499k	49.9-499k	—
CMF-20	350	—	—	—	4.3-470k
CMF-65	350	10-2M	49.9-1M	49.9-1M	—
CMF-70	500	10-2.49M	24.9-1M	24.9-1M	—

Dale Commercial Value Range: Extended resistance ranges are available in commercial equivalent types. Consult factory.

MECHANICAL SPECIFICATIONS

Terminal Strength: 5 pound pull test for CMF-07 and CMF-20; 2 pound pull test for all others.

Solderability: Continuous satisfactory coverage when tested in accordance with MIL-R-10509 and MIL-R-22684.

MATERIAL SPECIFICATIONS

Core: Fire-cleaned high purity ceramic.

Element: Nickel-chrome alloy.

Coating: Flame retardant epoxy, formulated for superior moisture protection.

Termination: Standard lead material is solder-coated copper, solderable and weldable.

ENVIRONMENTAL SPECIFICATIONS

General: Environmental performance is shown in the table below. Test methods are those specified in MIL-R-10509 and MIL-R-22684.

Shelf Life: Resistance shifts due to storage at room temperature are negligible.

APPLICABLE MIL-SPECIFICATIONS

MIL-R-10509 and MIL-R-22684: The CMF models meet or exceed the electrical, environmental and dimensional requirements of MIL-R-10509 and MIL-R-22684.

Noise: Dale® metal film resistors have exceptionally low noise level. Average for standard resistance range is 0.10 micro-volt per volt over a decade of frequency, with low and intermediate resistance values typically below 0.05 micro-volt per volt.

Voltage Coefficient: Maximum voltage coefficient is 5PPM per volt when measured between 10% and full rated voltage.

Dielectric Strength:

450 VAC for CMF-50, CMF-55 and CMF-60.

500 VAC for CMF-07.

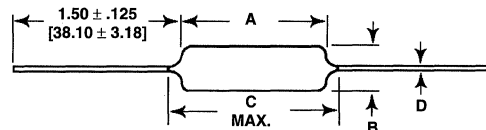
700 VAC for CMF-20.

900 VAC for CMF-65 and CMF-70.

Insulation Resistance: 10,000 Megohm minimum dry; 100 Megohm minimum after moisture test.

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



MODEL	A	B	C (Max.)	D
CMF-50	.150 ± .020 [3.81 ± .508]	.065 ± .015 [1.65 ± .381]	.244 [6.20]	.016 ± .002 [.406 ± .051]
CMF-55	.240 ± .020 [6.10 ± .508]	.090 ± .008 [2.29 ± .203]	.278 [7.06]*	.025 ± .002 [.635 ± .051]
CMF-60	.344 ± .031 [8.74 ± .787]	.145 ± .015 [3.68 ± .381]	.425 [10.80]	.025 ± .002 [.635 ± .051]
CMF-65	.562 ± .031 [14.27 ± .787]	.180 ± .015 [4.57 ± .381]	.687 [17.45]	.025 ± .002 [.635 ± .051]
CMF-70	.562 ± .031 [14.27 ± .787]	.180 ± .015 [4.57 ± .381]	.687 [17.45]	.032 ± .002 [.813 ± .051]
CMF-07	.240 ± .020 [6.10 ± .508]	.090 ± .008 [2.29 ± .203]	.278 [7.06]	.025 ± .002 [.635 ± .051]
CMF-20	.375 ± .040 [9.53 ± 1.02]	.145 ± .015 [3.68 ± .381]	.425 [10.80]	.032 ± .002 [.813 ± .051]

* .290 [7.37] for ± .25% and ± .1% resistance tolerances.

TEMPERATURE COEFFICIENT CODE

COMMERCIAL T.C. CODE	10509 MIL. CHAR.	TEMPERATURE COEFFICIENT	TEMPERATURE RANGE
T-1	D	0 ± 100PPM/°C	-55°C to +175°C
T-2	C	0 ± 50PPM/°C	-55°C to +175°C
T-9	E	0 ± 25PPM/°C	-55°C to +175°C
T-00	MIL-R-22684	0 ± 200PPM/°C	-55°C to +150°C

MODEL CMF

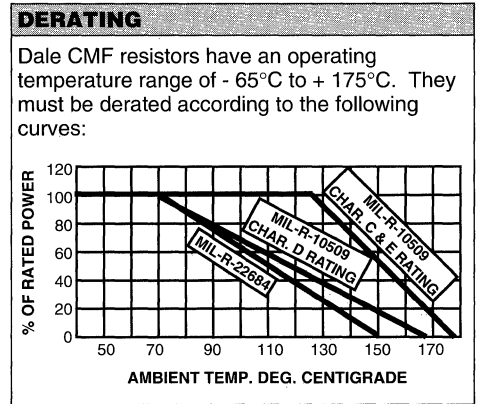
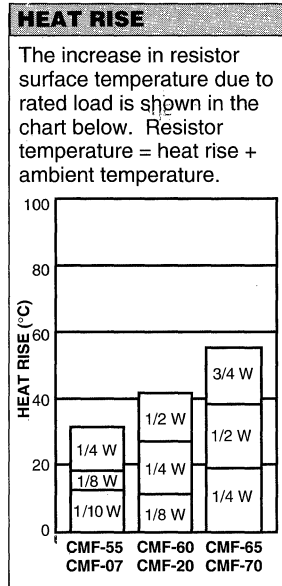
ENVIRONMENTAL PERFORMANCE				
REQUIREMENT	MIL-R-10509			MIL-R-22684
	CHARACTERISTIC D	CHARACTERISTIC C	CHARACTERISTIC E	
RN50	CMF-50	CMF-50	CMF-50	—
RN55	CMF-55	CMF-55	CMF-55	—
RN60	CMF-60	CMF-60	CMF-60	—
RN65	CMF-65	CMF-65	CMF-65	—
RN70	CMF-70	CMF-70	CMF-70	—
RL07	—	—	—	CMF-07
RL20	—	—	—	CMF-20
Mil. Temp. Coefficient	+ 200-500PPM	± 50PPM	± 25PPM	± 200PPM
Applicable T.C. Code	T-1 (100PPM), T-0 (150PPM)	T-2 (50PPM)	T-9 (25PPM)	T-00 (± 200PPM)
POWER RATING	at 70°C	at 125°C	at 125°C	at 70°C
RN50	—	1/20 Watt	1/20 Watt	—
RN55	1/8 Watt	1/10 Watt	1/10 Watt	—
RN60	1/4 Watt	1/8 Watt	1/8 Watt	—
RN65	1/2 Watt	1/4 Watt	1/4 Watt	—
RN70	3/4 Watt	1/2 Watt	1/2 Watt	—
RL07	—	—	—	1/4 Watt
RL20	—	—	—	1/2 Watt
TEST	MIL. MAX.	MIL. MAX.	MIL. MAX.	MIL. MAX.
Thermal Shock	± 0.50% ΔR	± 0.25% ΔR	± 0.25% ΔR	± 1.00% ΔR
Short Time Overload	± 0.50% ΔR	± 0.25% ΔR	± 0.25% ΔR	± 0.50% ΔR
Low Temperature Operation	± 0.50% ΔR	± 0.25% ΔR	± 0.25% ΔR	± 0.50% ΔR
Moisture Resistance	± 1.50% ΔR	± 0.50% ΔR	± 0.50% ΔR	± 1.50% ΔR
Shock	± 0.50% ΔR	± 0.25% ΔR	± 0.25% ΔR	± 0.50% ΔR
Vibration	± 0.50% ΔR	± 0.25% ΔR	± 0.25% ΔR	± 0.50% ΔR
Load Life	± 1.00% ΔR	± 0.50% ΔR	± 0.50% ΔR	± 2.00% ΔR
Dielectric Withstanding Voltage	± 0.50% ΔR	± 0.25% ΔR	± 0.25% ΔR	± 0.50% ΔR
Effect of Solder	± 0.50% ΔR	± 0.10% ΔR	± 0.10% ΔR	± 0.50% ΔR

MILITARY POWER RATING			
WATTAGE	MILITARY QUALIFIED		
	MIL-R-10509		MIL-R-22684
	70°C (D)	125°C (C & E)	70°C
1/20	—	CMF-50 (RN50)	—
1/10	—	CMF-55 (RN55)	—
1/8	CMF-55 (RN55)	CMF-60 (RN60)	—
1/4	CMF-60 (RN60)	CMF-65 (RN65)	CMF-07 (RL07)
1/2	CMF-65 (RN65)	CMF-70 (RN70)	CMF-20 (RL20)
3/4	CMF-70 (RN70)	—	—

NOTE: Commercial equivalents of military styles are available with higher power ratings. Consult factory.

POWER RATING

Dale CMF resistors have two power ratings depending on operating temperatures of 70°C and 125°C. Both are based on a maximum ΔR of .5% in 1,000 hour load life.



PART MARKING

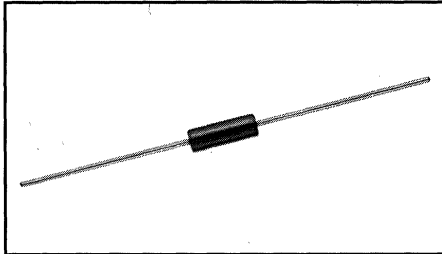
— RN, per MIL-R-10509
— RL, per MIL-R-22684

HOW TO ORDER - MILITARY PART NUMBER

<p>RN</p> <p>MIL. TYPE</p> <p>Per MIL-R-10509</p>	<p>60</p> <p>SIZE</p> <p>50 65 55 70 60</p>	<p>D</p> <p>CHARACTERISTIC</p> <p>E = ± 25PPM/°C C = ± 50PPM/°C D = + 200PPM/°C - 500PPM/°C</p>	<p>3483</p> <p>VALUE</p> <p>First three digits are significant figures. Last digit specifies the number of zeros to follow. (348 kilohm illustrated.)</p>	<p>F</p> <p>TOLERANCE</p> <p>B = ± .1% C = ± .25% D = ± .5% F = ± 1%</p>
<p>RL</p> <p>MIL. TYPE</p> <p>Per MIL-R-22684</p>	<p>07</p> <p>SIZE</p> <p>07 20</p>	<p>S</p> <p>LEAD</p> <p>S = Solderable</p>	<p>471</p> <p>VALUE</p> <p>First two digits are significant figures. Last digit specifies the number of zeros to follow. (470 ohm illustrated.)</p>	<p>J</p> <p>TOLERANCE</p> <p>G = ± 2% J = ± 5%</p>

MODELS NE, NC, CT, NA Metal Film Resistors

Military, MIL-R-10509, Qualified, Type RN, Precision



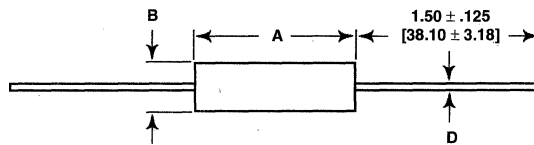
FEATURES

- Low noise and low inductance characteristics
- Blue epoxy encapsulation over moisture resistant polyimide varnish undercoat
- Special marking available
- Controlled Temperature Coefficient: ± 25 , ± 50 and ± 100 PPM/ $^{\circ}$ C
- Excellent high frequency characteristics
- Low voltage coefficient
- These resistors are provided with high purity copper leads in accordance with MIL-STD-1276. Two solder finishes are available: Electroplated 60/40 solder and hot dipped 60/40 solder.

STANDARD ELECTRICAL SPECIFICATIONS

DALE MODEL	MIL-R-10509 TYPE	WATTAGE RATING						RESISTANCE RANGE (Ohms)	STANDARD TOLERANCE	TEMPERATURE COEFFICIENT PPM/ $^{\circ}$ C
		MILITARY			INDUSTRIAL					
		70 $^{\circ}$ C	125 $^{\circ}$ C	VOLTAGE RATING	70 $^{\circ}$ C	125 $^{\circ}$ C	VOLTAGE RATING			
NE50	RN50E	—	1/20	200	1/4	1/8	200	10-499k	.5, 1%	25
NE55	RN55E	—	1/10	200	1/2	1/4	250	49.9-1M	.1, .25, .5, 1%	25
NE60	RN60E	—	1/8	250	1	1/2	350	49.9-1M	.1, .25, .5, 1%	25
NE65	RN65E	—	1/4	300	1	1/2	350	49.9-1M	.1, .25, .5, 1%	25
NC50	RN50C	—	1/20	200	1/4	1/8	200	10-499k	.5, 1%	50
NC55	RN55C	—	1/10	200	1/2	1/4	250	49.9-1M	.1, .25, .5, 1%	50
NC60	RN60C	—	1/8	250	1	1/2	350	49.9-1M	.1, .25, .5, 1%	50
NC65	RN65C	—	1/4	300	1	1/2	350	49.9-1M	.1, .25, .5, 1%	50
CT50	—	—	—	—	1/4	1/8	200	2-499k	1%	100
CT55	RN55D	1/8	—	200	1/2	1/4	300	10-1M	1%	100
NA60	RN60D	1/4	—	300	1	1/2	350	10-1M	1%	100
NA65	RN65D	1/2	1/4	350	1	1/2	350	49.9-1M 10-2M	.5% 1%	100

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

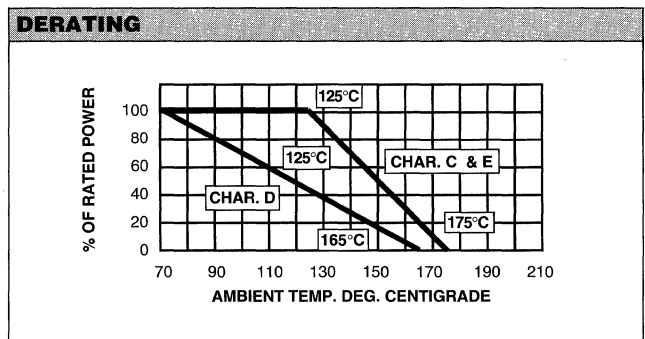


DALE MODEL	MIL-R-10509 TYPE	A	B	D
NE50	RN50E	.145 \pm .015 [3.68 \pm .381]	.066 \pm .008 [1.68 \pm .203]	.016 [.406]
NE55	RN55E	.245 \pm .030 [6.22 \pm .762]	.088 \pm .010 [2.24 \pm .254]	.025 [.635]
NE60	RN60E	.375 \pm .025 [9.53 \pm .635] -.040 -1.02]	.135 \pm .020 [3.43 \pm .508] -.005 - .127]	.025 [.635]
NE65	RN65E	.560 \pm .030 [14.22 \pm .762]	.190 \pm .007 [4.83 \pm .178] -.015 - .381]	.025 [.635]
NC50	RN50C	.145 \pm .015 [3.68 \pm .381]	.066 \pm .008 [1.68 \pm .203]	.016 [.406]
NC55	RN55C	.245 \pm .030 [6.22 \pm .762]	.088 \pm .010 [2.24 \pm .254]	.025 [.635]
NC60	RN60C	.375 \pm .025 [9.53 \pm .635] -.040 -1.02]	.135 \pm .020 [3.43 \pm .508] -.005 - .127]	.025 [.635]
NC65	RN65C	.560 \pm .030 [14.22 \pm .762]	.190 \pm .007 [4.83 \pm .178] -.015 - .381]	.025 [.635]
CT50	—	.145 \pm .015 [3.68 \pm .381]	.066 \pm .008 [1.68 \pm .203]	.016 [.406]
CT55	RN55D	.235 \pm .020 [5.97 \pm .508]	.090 \pm .008 [2.29 \pm .203]	.025 [.635]
NA60	RN60D	.355 \pm .020 [9.02 \pm .508]	.148 \pm .000 [3.76 \pm .000] -.023 - .584]	.025 [.635]
NA65	RN65D	.554 \pm .021 [14.07 \pm .533]	.190 \pm .007 [4.83 \pm .178] -.015 - .381]	.025 [.635]

MODELS NE, NC, CT, NA

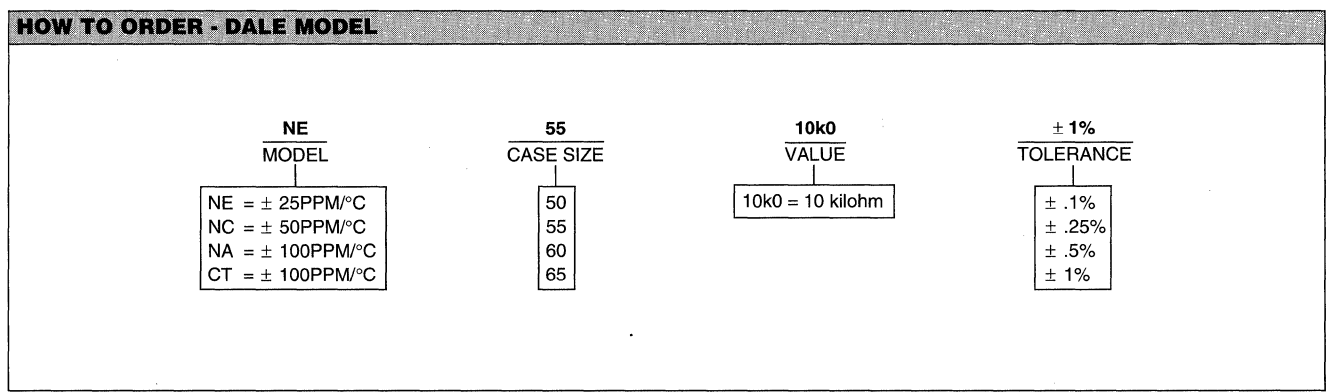
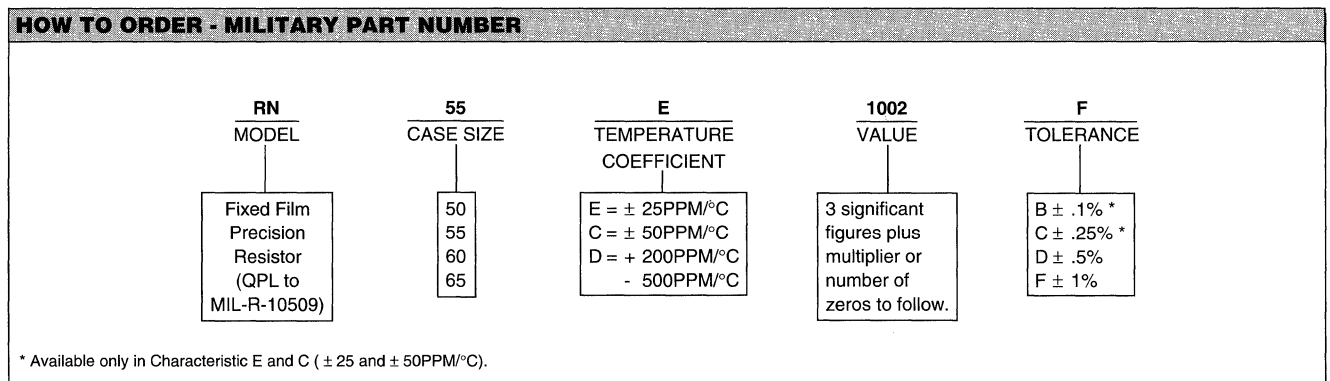
ENVIRONMENTAL PERFORMANCE											
DALE MODEL	MIL-R-10509 TYPE	THERMAL SHOCK ΔR MAX. $\pm\%$	SHORT TIME OVERLOAD ΔR MAX. $\pm\%$	LOW TEMP. OPERATION ΔR MAX. $\pm\%$	MOISTURE RESISTANCE ΔR MAX. $\pm\%$	SHOCK ΔR MAX. $\pm\%$	VIBRATION ΔR MAX. $\pm\%$	LOAD LIFE 1000 HOURS MIL RATING ΔR MAX. $\pm\%$	TERMINAL STRENGTH ΔR MAX. $\pm\%$	D. W. V. ΔR MAX. $\pm\%$	EFFECT SOLDER HEAT ΔR MAX. $\pm\%$
NE50	RN50E	0.1	0.1	0.1	0.5	0.05	0.05	0.5	0.05	0.05	0.1
NE55	RN55E	0.1	0.1	0.1	0.5	0.05	0.05	0.5	0.05	0.05	0.1
NE60	RN60E	0.1	0.1	0.1	0.5	0.05	0.05	0.5	0.05	0.05	0.1
NE65	RN65E	0.1	0.1	0.1	0.5	0.05	0.05	0.5	0.05	0.05	0.1
NC50	RN50C	0.25	0.1	0.1	0.5	0.05	0.05	0.5	0.05	0.05	0.1
NC55	RN55C	0.1	0.1	0.1	0.5	0.05	0.05	0.5	0.05	0.05	0.1
NC60	RN60C	0.1	0.1	0.1	0.5	0.05	0.05	0.5	0.05	0.05	0.1
NC65	RN65C	0.1	0.1	0.1	0.5	0.05	0.05	0.5	0.05	0.05	0.1
CT50	—	0.25	0.1	0.1	0.5	0.05	0.05	0.5	0.05	0.05	0.1
CT55	RN55D	0.25	0.1	0.1	0.5	0.05	0.05	0.5	0.05	0.05	0.1
NA60	RN60D	0.25	0.1	0.1	0.5	0.05	0.05	0.5 1.0*	0.05	0.05	0.1
NA65	RN65D	0.25	0.1	0.1	0.5	0.05	0.05	0.5 1.0*	0.05	0.05	0.1

*Commercial load life rating.



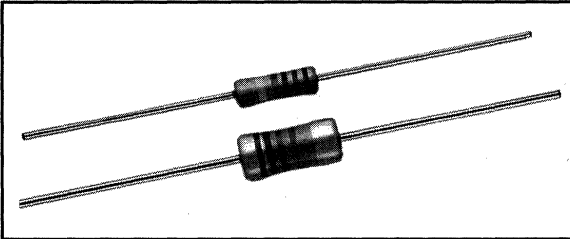
PART MARKING

- Company name
- MIL designation
- Value
- Tolerance & JAN



MODELS CT, C, FP Metal Film Resistors

Military, MIL-R-22684 Qualified, Type RL
Semi-Precision



FEATURES

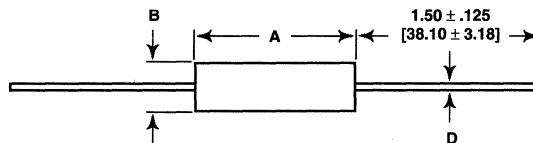
- All models except CT3 and FP60 (industrial) QPL to MIL-R-22684
- Electroplated tin-lead solder finish leads
- RL07S, FP60, C6 and CT3 have blue epoxy insulation
- FP32 and FP42 have light blue ceramic cured paint insulation
- Semi-Precision resistors combine long-term stability with low inductance, low noise and low cost
- Ideal for preamplifiers, RF and IF circuits and other general purpose usage

STANDARD ELECTRICAL SPECIFICATIONS

DALE MODEL	MIL-R-22684 TYPE	WATTAGE RATING						RESISTANCE RANGE (Ohms)	STANDARD TOLERANCE	TEMPERATURE COEFFICIENT PPM/°C
		EQUIV. MILITARY			INDUSTRIAL					
		70°C	125°C	VOLTAGE RATING	70°C	125°C	VOLTAGE RATING			
CT4	RL07S	1/4	—	250	1/2	1/8	300	10-1M	1, 2, 5%	100
C6	RL32S	1	—	500	—	1/2	500	10-2M	1, 2, 5%	100
CT3	—	—	—	—	1/4	1/8	200	1-499k	2, 5, 10%	100
FP32	RL32S	1	—	500	—	—	—	10-1M	2, 5, 10%	100
FP42*	RL42S*	2	—	500	—	—	—	10-1.5M	2, 5, 10%	150
FP60	—	—	—	350	1/2	1/2	350	10-1M	1, 2, 5%	100

* Available in RL42TX.

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



DALE MODEL	MIL-R-22684 TYPE	A	B	D
CT3	—	.145 ± .015 [3.68 ± .381]	.066 ± .008 [1.68 ± .203]	.016 [.406]*
CT4	RL07S	.235 ± .020 [5.97 ± .508]	.090 ± .008 [2.29 ± .203]	.025 [.635]
C6	RL32S	.554 ± .021 [14.07 ± .533]	.190 + .007 [4.83 + .178] - .015 - .381]	.040 [1.02]
FP32	RL32S	.560 ± .030 [14.22 ± .762]	.190 + .007 [4.83 + .178] - .015 - .381]	.040 [1.02]
FP42	RL42S	.687 ± .031 [17.45 ± .787]	.300 ± .020 [7.62 ± .508]	.045 [1.14]
FP60	—	.355 ± .020 [9.02 ± .508]	.148 + .000 [3.76 + .000] - .023 - .584]	.032 [.813]

* .020 [.508] also available.

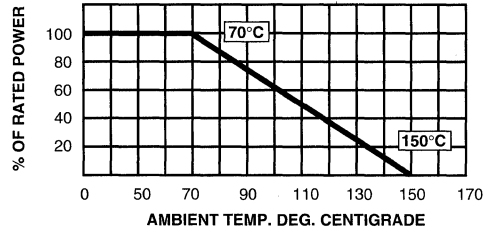
ENVIRONMENTAL PERFORMANCE

DALE MODEL	MIL-R-22684 TYPE	THERMAL SHOCK ΔR MAX. ± %	SHORT TIME OVERLOAD ΔR MAX. ± %	LOW TEMP. OPERATION ΔR MAX. ± %	MOISTURE RESISTANCE ΔR MAX. ± %	SHOCK ΔR MAX. ± %	VIBRATION ΔR MAX. ± %	LOAD LIFE 1000 HOURS MIL RATING ΔR MAX. ± %	TERMINAL STRENGTH ΔR MAX. ± %	D. W. V. ΔR MAX. ± %	EFFECT SOLDER HEAT ΔR MAX. ± %
CT4	RL07S	0.25	0.25	0.25	0.5	0.1	0.1	0.5	0.1	0.1	0.1
C6	RL32S	0.25	0.25	0.25	0.5	0.1	0.1	2.0	0.1	0.1	0.1
CT3	—	0.25	0.50	0.25	0.5	0.1	0.1	1.0	0.2	0.1	0.1
FP32	RL32S	1.0	0.50	0.50	1.5	0.5	0.5	2.0	0.5	0.5	0.5
FP42	RL42S*	1.0	0.50	0.50	1.0	0.5	0.5	2.0	0.5	0.5	0.5
FP60	—	0.5	0.50	0.50	1.0	0.5	0.5	1.0	0.5	0.5	0.5

* Available in RL42TX.

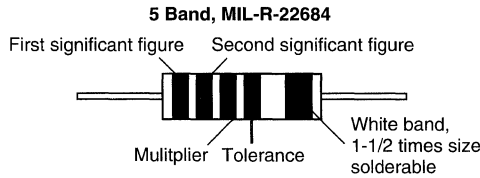
MODELS CT, C, FP

DERATING



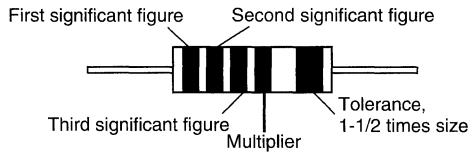
PART MARKING

MILITARY

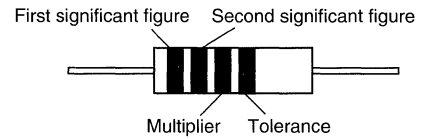


INDUSTRIAL

1% Tolerance Parts are marked with 5 color bands.
5 band, EIA Standard RS 196.



2, 5 and 10% Tolerance Parts are marked with 4 color bands.
4 band Industrial, EIA Standard.



EIA COLOR CODE

SIGNIFICANT FIGURES

Black = 0	Green = 5
Brown = 1	Blue = 6
Red = 2	Violet = 7
Orange = 3	Grey = 8
Yellow = 4	White = 9

**MULTIPLIER
(Number of zeros to follow)**

Black = None
Brown = 0
Red = 00
Orange = 000
Yellow = 0000
Green = 00000
Blue = 000000
Gold = X.1
Silver = X.01

TOLERANCE

Brown = ± 1%
Red = ± 2%
Gold = ± 5%
Silver = ± 10%
No Band = ± 20%

HOW TO ORDER - MILITARY PART NUMBER

RL
MODEL

07
SIZE

S
SOLDERABLE LEAD

104
VALUE

G
TOLERANCE

07
32
42

First 2 digits are significant figures, third digit is the multiplier.

G = ± 2%
J = ± 5%

HOW TO ORDER - DALE MODEL

CT
MODEL

4
SIZE

100k
VALUE

2%
TOLERANCE

CT
FP

3 32
4 42
6 60

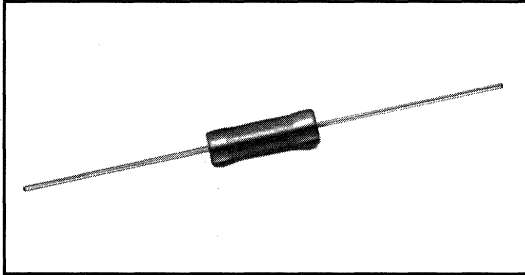
100k =
100,000 ohm

± 1%
± 2%
± 5%
± 10%

MODELS FP1/2P, 1P, 2P, 3P, 69P

Metal Film Resistors

Pulse Withstanding Protective



FEATURES

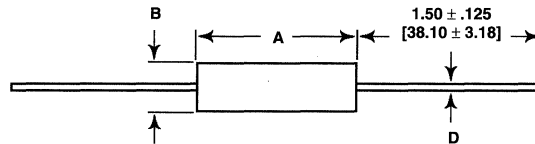
- Special Dale® design provides lightning withstand characteristics along with resistor functionality
- A thicker tin oxide power film system provides lightning surge absorption capabilities
- Higher turns ratio and glass substrate provide sharper fusing characteristic than the standard flameproof product line
- Protect against a variety of electrical hazards which can change or destroy sensitive electronic equipment including high energy voltage surges caused by power line anomalies (direct power crosses or inductively coupled effects) and other momentary overvoltages

STANDARD ELECTRICAL SPECIFICATIONS

Pulse withstanding capabilities are value dependent.
Value above the cutoff value, shown below, will meet all the surge test requirements shown on page 129.

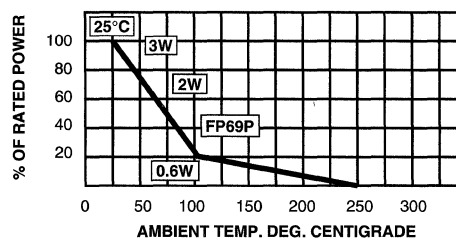
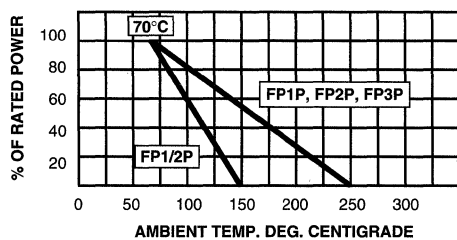
MODEL	WATTAGE RATING @ 70°C	RESISTANCE RANGE (Ohms)	TOLERANCE	CUTOFF VALUE
FP1/2P	1/2	10-1M	1, 2, 5%	2k00
FP1P	1	10-1M	1, 2, 5%	1k00
FP2P	2	10-1.5M	1, 2, 5%	300R
FP3P	3	10-1M	1, 2, 5%	250R
FP69P	2	10-1M	1, 2, 5%	400R

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



MODEL	A	B	D
FP1/2P	.360 ± .020 [9.14 ± .508]	.138 + .012 [3.51 + .305] - .023 - .584]	.032 ± .002 [.813 ± .051]
FP1P	.560 ± .031 [14.22 ± .787]	.190 + .007 [4.83 + .178] - .015 - .381]	.032 ± .002 [.813 ± .051]
FP2P	.687 ± .031 [17.45 ± .787]	.300 ± .020 [7.62 ± .508]	.032 ± .002 [.813 ± .051]
FP3P	.900 ± .055 [22.86 ± 1.40]	.300 ± .020 [7.62 ± .508]	.032 ± .002 [.813 ± .051]
FP69P	.516 ± .021 [13.11 ± .533]	.225 ± .012 [5.72 ± .305]	.032 ± .002 [.813 ± .051]

DERATING



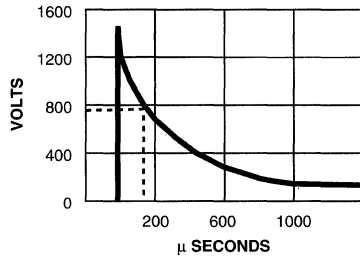
MODELS FP1/2P, FP1P, FP2P, FP3P, FP69P

LIGHTNING PULSE WAVE FORMS

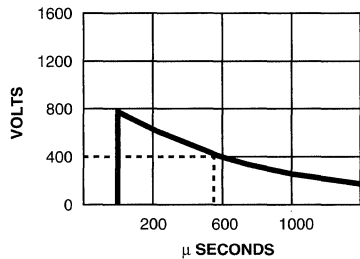
Lightning pulse wave forms are defined by three numbers:

- Maximum time to reach peak voltage level (typically 10 μ seconds).
- Minimum time for voltage to decrease to half value.
- The peak voltage level.

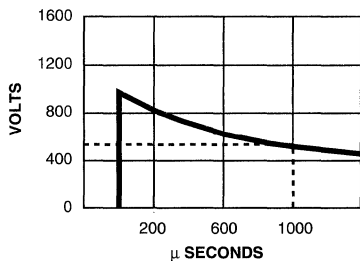
Three examples are shown below.



10 by 160 — 1500 Volts FCC — Longitudinal Surge

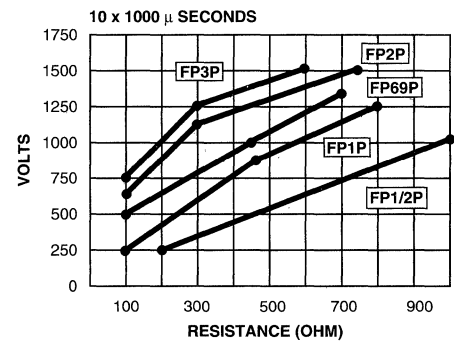
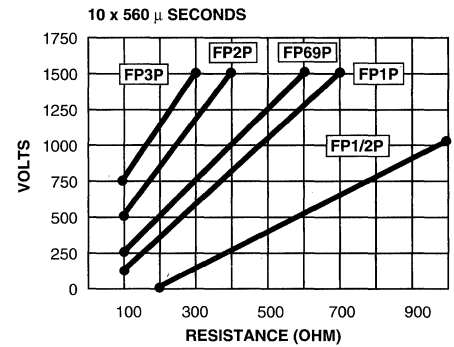
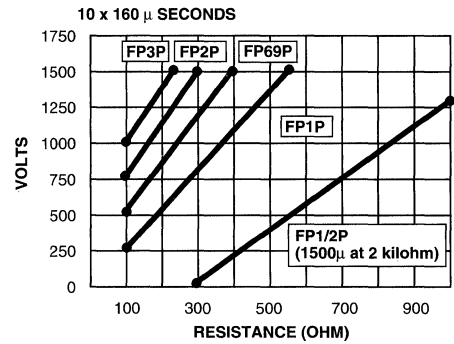


10 by 560 — 800 Volts FCC — Metallic Surge



10 by 1000 — 1000 Volts REA — Current Surge

These graphs show the relationship between resistance value and pulse withstanding voltage for FP1/2P thru FP3P using a 1.0% resistance shift after 10 pulses as the figure of merit. The stable operating region of each package is on the right side of the appropriate line.



PART MARKING

- Company name
- Value
- Tolerance
- Style and case size
- Date code (year/week)

HOW TO ORDER

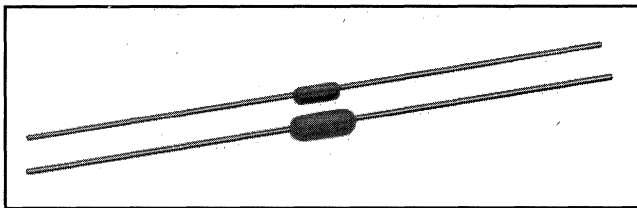
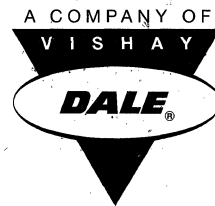
FP2P
MODEL
FP1/2P
FP1P
FP2P
FP3P
FP69P

1k00
VALUE
1k00 = 1000 ohm

± 1%
TOLERANCE
± 1%
± 2%
± 5%

MODELS CMF-55-39 and CMF-60-64 Metal Film Resistors

Special Purpose, Fusible, Flameproof



FEATURES

- Special filming and coating processes
- Fusible - Circuit protection in case of other component failure
- Flameproof - Meets EIA RS-325, will not flame when overloaded

ELECTRICAL SPECIFICATIONS

Resistance Range: 5 ohm to 10 kilohm.

Resistance Tolerance: $\pm 1\%$.

Temperature Coefficient: (-65°C to +165°C)
 $\pm 100\text{PPM}/^\circ\text{C}$.

Power Rating: CMF-55-39 = 1/4 watt at +70°C,
CMF-60-64 = 1/2 watt at +70°C (Derate linearly from
rated power at +70°C to zero power at +165°C).

Maximum Flame Test Voltage:

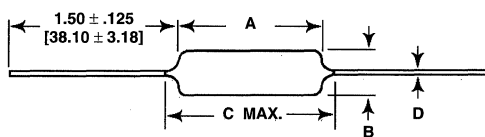
CMF-55-39 = 350 V RMS or DC.
CMF-60-64 = 500 V RMS or DC.

Insulation Resistance: 10,000 Megohm.

Operating Temperature Range: -65°C to +165°C.

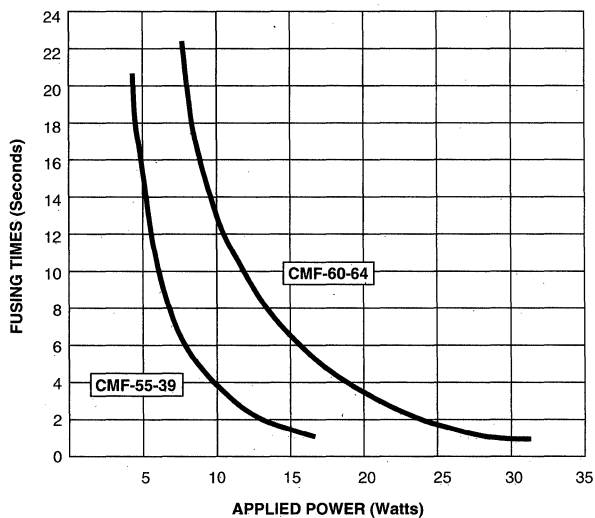
DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



MODEL	A	B	C (Max.)	D
CMF-55-39	.240 \pm .020 [6.10 \pm .508]	.090 \pm .008 [2.29 \pm .203]	.278 [7.06]	.025 \pm .002 [.635 \pm .051]
CMF-60-64	.370 \pm .035 [9.40 \pm .889]	.145 \pm .010 [3.68 \pm .254]	.425 [10.80]	.032 \pm .002 [.813 \pm .051]

FUSIBLE, FLAMEPROOF (Typical Fusing Times)



PART MARKING

- Dale
- Value
- Tolerance
- Date code

HOW TO ORDER

CMF-55-39
MODEL

CMF-55-39 =
1/4 watt size
CMF-60-64 =
1/2 watt size

1000
VALUE

First three digits
are significant
figures. Last
digit specifies the
number of zeros
to follow.
(100 ohm
illustrated.)

F
TOLERANCE

F = $\pm 1\%$

T-1
TEMPERATURE
COEFFICIENT

T-1 = $\pm 100\text{PPM}/^\circ\text{C}$

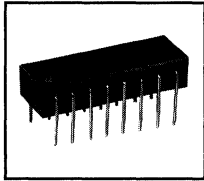


MODEL R-1C-16A

Metal Film Resistor Networks

Discrete, Special Purpose, Dual-In-Line

Molded, Schematic - Isolated

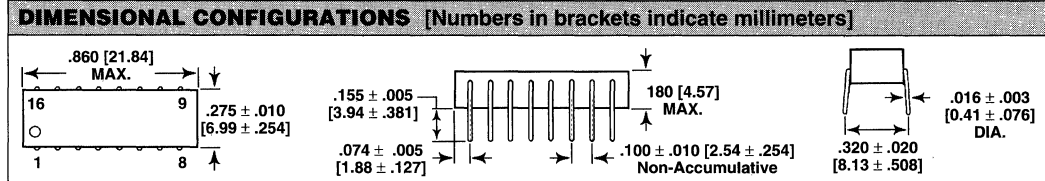
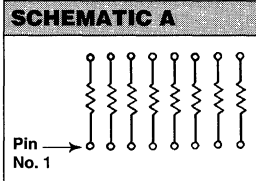


FEATURES

- 16 pin package
- Designed to combine precision metal film resistor performance with advantages of network packaging

ELECTRICAL SPECIFICATIONS

Resistance Range: 10 ohm to 604 kilohm.
Resistance Tolerance: $\pm 0.1\%$, $\pm 0.25\%$, $\pm 0.5\%$, $\pm 1.0\%$, $\pm 2.0\%$.
Resistance Temperature Coefficient: $\pm 10\text{PPM}/^\circ\text{C}$ (B), $\pm 25\text{PPM}/^\circ\text{C}$ (J), $\pm 50\text{PPM}/^\circ\text{C}$ (H), $\pm 100\text{PPM}/^\circ\text{C}$ (K).
Resistor Power Rating: 0.2 watts at 70°C .
Package Power Rating: 1.6 watts at 70°C (derated to 0 at 125°C).



- #### PART MARKING
- Dale
 - Model
 - Value code
 - T.C. code
 - Tolerance code
 - Date code
 - Dot for pin one

HOW TO ORDER

R-1C - **16** **A** **1000*** **J** **B**
 TYPE NUMBER OF PINS SCHEMATIC VALUE T. C. TOLERANCE

* For values less than 100 ohm, use an "R" for the decimal point. Eg: 10 ohm is 10R0; 25.2 ohm is 25R2.

First 3 digits represent significant figures, the last digit specifies the number of zeros to follow.

B = $\pm 0.1\%$ F = $\pm 1.0\%$
 C = $\pm 0.25\%$ G = $\pm 2.0\%$
 D = $\pm 0.5\%$

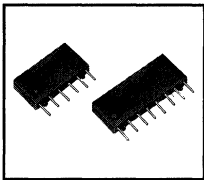


MODELS R-4C and R-5C

Metal Film Resistor Networks

Discrete, Special Purpose, Single-In-Line

Molded, Schematics - Isolated or Pin One Common

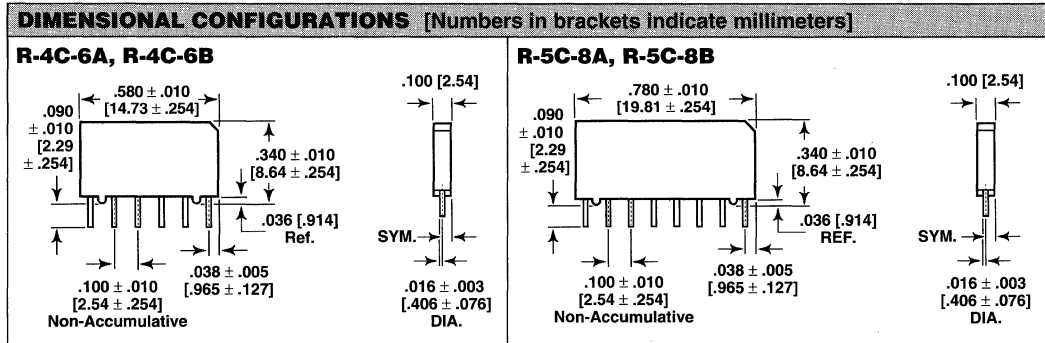
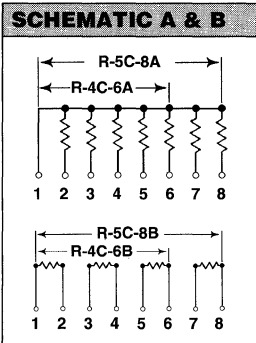


FEATURES

- 6 or 8 pin package
- Designed to combine precision metal film resistor performance with advantages of network packaging

ELECTRICAL SPECIFICATIONS

Resistance Range: 10 ohm to 604 kilohm.
Resistance Tolerance: $\pm 0.1\%$, $\pm 0.25\%$, $\pm 0.5\%$, $\pm 1.0\%$.
Resistance Temperature Coefficient: $\pm 10\text{PPM}/^\circ\text{C}$ (B), $\pm 25\text{PPM}/^\circ\text{C}$ (J), $\pm 50\text{PPM}/^\circ\text{C}$ (H), $\pm 100\text{PPM}/^\circ\text{C}$ (K).
Resistor Power Rating: 0.1 to 0.2 watts at 70°C .
Package Power Rating: 1 watt at 70°C (derated to 0 at 125°C).



- #### PART MARKING
- Dale
 - Model
 - Value code
 - T.C. code
 - Tolerance code
 - Pin one indicator

HOW TO ORDER

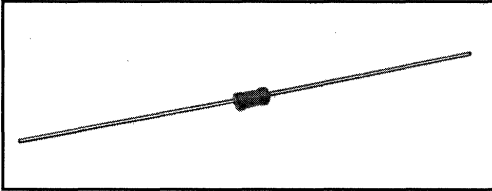
R-4C - **6** **B** **1000*** **B** **B**
 TYPE NUMBER OF PINS SCHEMATIC VALUE T. C. TOLERANCE

* For values less than 100 ohm, use an "R" for the decimal point. Eg: 10 ohm is 10R0; 25.2 ohm is 25R2.

First 3 digits represent significant figures, the last digit specifies the number of zeros to follow.

B = $\pm 0.1\%$ F = $\pm 1.0\%$
 C = $\pm 0.25\%$ G = $\pm 2.0\%$
 D = $\pm 0.5\%$

MODEL RNX Metal Oxide Resistors High Voltage, Special Purpose



FEATURES

- For oil bath or open air operation
- Low T.C.: $\pm 200\text{PPM}/^\circ\text{C}$ standard. $\pm 100\text{PPM}/^\circ\text{C}$, $\pm 50\text{PPM}/^\circ\text{C}$ available.
- Tolerance: $\pm 1\%$ standard to 1 Gigohm. $\pm 5\%$ above 1 Gigohm. $\pm 0.5\%$ available in $50\text{PPM}/^\circ\text{C}$ only. Special tolerances and/or T.C. matching available upon request.

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	WATTAGE RATING*			VOLTAGE RATING	RESISTANCE (Ohms)**			
	25°C	70°C	125°C		M	K	H	N***
RNX-1/4	.5	.36	.25	750 V	1k-100M	1k-100M	1M-22M	100-100k
RNX-3/8	1.0	.72	.50	1.5KV	1k-1G	1k-100M	1M-50M	100-100k
RNX-1/2	1.2	.86	.60	2.0KV	1k-2.0G	1k-250M	1M-100M	100-100k
RNX-3/4	2.0	1.44	1.0	3.0KV	1k-3G	1k-500M	1M-100M	100-100k
RNX-1	2.5	1.80	1.25	4.0KV	1k-5G	1k-500M	1M-100M	100-1M
RNX-1-1/4	3.0	2.16	1.50	5.0KV	2k-10G	1k-500M	—	100-1M
RNX-1-1/2	4.0	2.88	2.0	6.0KV	2k-10G	1k-500M	—	100-1M
RNX-2	5.0	3.60	2.50	8.0KV	2k-10G	1k-500M	—	100-1M

* Increase wattage by 25% for .032 [.813] diameter leads. ** For resistance values above and below those listed, contact factory. *** Non-inductive $\pm 200\text{PPM}/^\circ\text{C}$ T.C. only. All resistance readings referenced at 100 VDC. Other voltages upon request.

ELECTRICAL SPECIFICATIONS

Dielectric Strength: 750 VDC all styles.

Insulation Resistance: 10,000 Megohm minimum.

MECHANICAL SPECIFICATIONS

Terminal Strength: 5 pound pull test for all styles.

Solderability: Continuous satisfactory coverage when tested in accordance with MIL-R-10509.

MATERIAL SPECIFICATIONS

Element: High temperature fired cermet film.

Core: High purity 96% alumina.

Coating: Flameproof silicone or flame-retardant epoxy.

Termination: Standard lead material is solder-coated copper. Solderable and weldable.

SPECIAL MODIFICATIONS

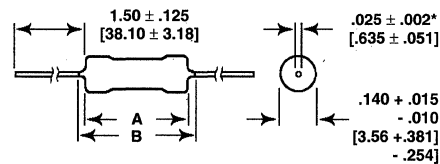
1. Special preconditioning (power aging, temperature cycling, etc.) to customer specifications.
2. Non-helixed resistors can be supplied for critical high frequency applications. (Non-inductive.)
3. Matched sets available.
4. Flameproof silicone coating available.

TEMPERATURE COEFFICIENT CODE

CODE	T.C.	RANGE
M	$\pm 200\text{PPM}/^\circ\text{C}$	- 55°C to + 125°C
K	$\pm 100\text{PPM}/^\circ\text{C}$	+ 25°C to + 125°C
H	$\pm 50\text{PPM}/^\circ\text{C}$	+ 25°C to + 125°C

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



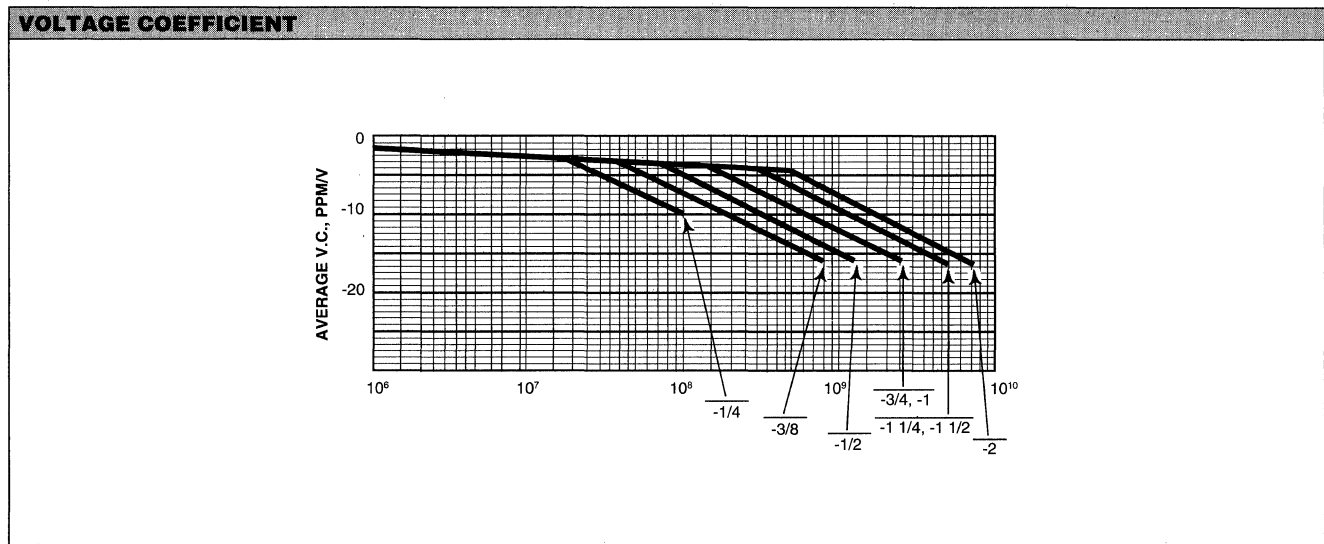
MODEL	A	B (Max.)
RNX-1/4	.290 \pm .020 [7.37 \pm .508]	.358 [9.09]
RNX-3/8	.420 \pm .020 [10.67 \pm .508]	.470 [11.94]
RNX-1/2	.540 \pm .020 [13.72 \pm .508]	.595 [15.11]
RNX-3/4	.790 \pm .020 [20.07 \pm .508]	.845 [21.46]
RNX-1	1.04 \pm .020 [26.42 \pm .508]	1.10 [27.81]
RNX-1-1/4	1.29 \pm .020 [32.77 \pm .508]	1.35 [34.16]
RNX-1-1/2	1.54 \pm .020 [39.12 \pm .508]	1.60 [40.51]
RNX-2	2.04 \pm .020 [51.82 \pm .508]	2.10 [53.34]

* Available with .032 [.813] leads \pm .002 [.051].

ENVIRONMENTAL PERFORMANCE

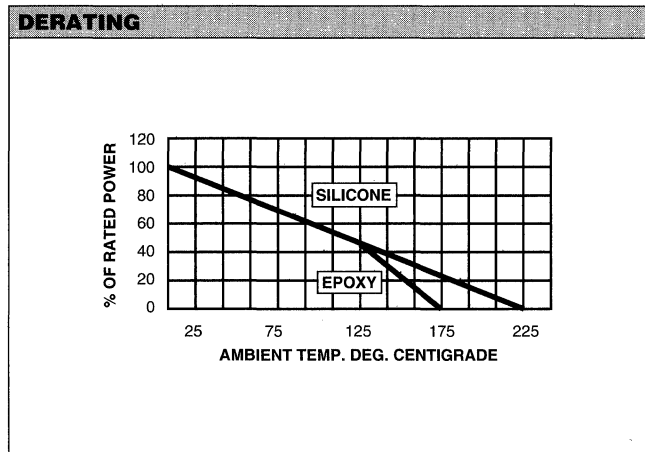
TEST	MAX. ΔR (Typical Test Lots)
Short Time Overload	$< \pm 0.20\%$
Moisture Resistance	$< \pm 0.50\%$
Shock	$< \pm 0.20\%$
Vibration	$< \pm 0.20\%$
Temperature Cycling	$< \pm 0.50\%$
Load Life	$< \pm 1.0\%$
Dielectric Withstanding Voltage	$< \pm 0.15\%$
Effect of Soldering	$< \pm 0.10\%$

MODEL RNX



RESISTANCE VALUE CODES

K KILO 10 ³		M MEGA 10 ⁶		G GIGA 10 ⁹		T TERA 10 ¹²	
VALUE	CODE	VALUE	CODE	VALUE	CODE	VALUE	CODE
1k	1k0	1M	1M0	1KM	1G0	1MM	1T0
5.5k	5k5	5.5M	5M5	5.5KM	5G5	5.5MM	5T5
9.99k	9k99	9.99M	9M99	9.99KM	9G99	9.99MM	9T99



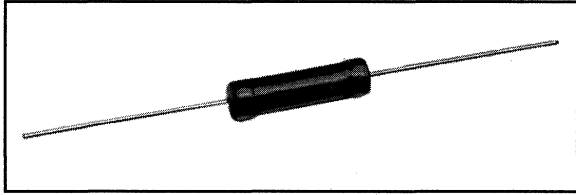
PART MARKING

RNX-1/4	Other RNX
— Company name	— Company name
— Value	— Model
— Tolerance, T.C.	— Value
	— Tolerance, T.C.
	— Date code

HOW TO ORDER

RNX-1/2 MODEL	E OPTIONAL CONSTRUCTION	10k1 VALUE	K TOLERANCE	K TEMPERATURE COEFFICIENT
	E = Epoxy N = Non-inductive P = .032" [.813] Diameter leads		K = ± 10% J = ± 5% G = ± 2% F = ± 1% D = ± .5%	M = ± 200PPM/°C K = ± 100PPM/°C H = ± 50PPM/°C

MODEL ROX Metal Oxide Resistors High Voltage, Special Purpose



FEATURES

- Low T.C.: $\pm 200\text{PPM}/^\circ\text{C}$ standard. $\pm 100\text{PPM}/^\circ\text{C}$, $\pm 50\text{PPM}/^\circ\text{C}$ available.
- Tolerances: $\pm 10\%$, $\pm 5\%$, $\pm 2\%$, $\pm 1\%$
- For oil bath or open air operation
- Matched sets available
- Special testing available upon request

STANDARD ELECTRICAL SPECIFICATIONS												
MODEL	WATTAGE RATING*			MAXIMUM VOLTAGE	RESISTANCE RANGE (Ohms)							
	25°C	70°C	125°C		T.C. $\pm 200\text{PPM}/^\circ\text{C}$		T.C. $\pm 100\text{PPM}/^\circ\text{C}$		T.C. $\pm 50\text{PPM}/^\circ\text{C}$		NON-INDUCTIVE T.C. $\pm 200\text{PPM}/^\circ\text{C}$	
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
ROX-1/2	2.0	1.4	1.0	2.0KV	1k	1G	1k	100M	1M	100M	—	—
ROX-3/4	3.0	2.16	1.5	5.0KV	1k	4G	1k	500M	1M	100M	100	1M
ROX-1	4.0	2.88	2.0	7.5KV	1k	5G	1k	500M	1M	100M	100	1M
ROX-1-1/2	5.0	3.6	2.5	11.0KV	1.5k	7.5G	1.5k	500M	1M	100M	100	1M
ROX-2	6.0	4.32	3.0	15.0KV	2k	10G	2k	1G	1M	500M	100	1M
ROX-3	10.0	7.2	5.0	22.5KV	3k	15G	3k	1G	1M	500M	400	10M
ROX-4	12.0	8.64	6.0	30.0KV	4k	20G	4k	1G	1M	500M	500	10M
ROX-5	16.0	11.52	8.0	37.5KV	5k	25G	5k	1G	1M	500M	500	10M
ROX-6	20.0	14.4	10.0	45.0KV	6k	30G	6k	1G	1M	500M	500	10M

* Wattage increases by 25% with .040" [1.02] lead. All resistance readings referenced at 100 VDC. Other voltages available on request. 1% not available above 10G.

ELECTRICAL SPECIFICATIONS

Insulation Resistance: 10^{11} ohm minimum.

MECHANICAL SPECIFICATIONS

Terminal Strength: 10 pound pull test.

Solderability: Continuous satisfactory coverage when tested in accordance with MIL-R-10509.

MATERIAL SPECIFICATIONS

Element: High temperature fired cermet film.

Core: High purity 96% alumina.

Coating: Flameproof silicone or flame-retardant epoxy.

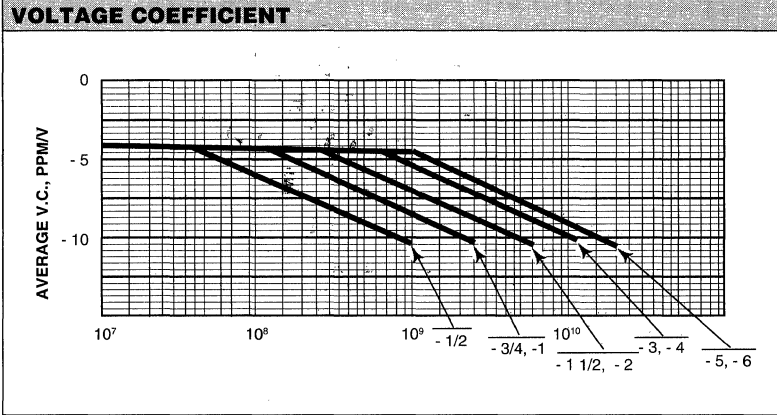
Termination: Standard lead material is solder-coated copper. Solderable and weldable.

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]					
Styles N, P and S 			Style Y 		
Style T 		Style Z 			
STYLE N, P, S		STYLE T	STYLE Y	STYLE Z	
MODEL	A	B	C	C (Max.)	C
ROX-1/2	.600 ± .032 [15.24 ± .813]	.700 [17.78]	NA	NA	NA
ROX-3/4	.800 ± .032 [20.32 ± .813]	.900 [22.86]	1.168 ± .022 [29.72 ± .559]	1.05 [26.67]	.780 ± .022 [19.81 ± .559]
ROX-1	.920 ± .032 [23.37 ± .813]	1.02 [25.91]	1.288 ± .022 [32.77 ± .559]	1.17 [29.72]	.900 ± .022 [22.86 ± .559]
ROX-1-1/2	1.55 ± .032 [39.37 ± .813]	1.65 [41.91]	1.918 ± .022 [48.77 ± .559]	1.80 [45.72]	1.53 ± .022 [38.86 ± .559]
ROX-2	2.05 ± .032 [52.07 ± .813]	2.15 [54.61]	2.418 ± .022 [61.47 ± .559]	2.30 [58.42]	2.03 ± .022 [51.56 ± .559]
ROX-3	3.05 ± .032 [77.47 ± .813]	3.15 [80.01]	3.418 ± .022 [86.87 ± .559]	3.30 [83.82]	3.03 ± .022 [76.96 ± .559]
ROX-4	4.05 ± .032 [102.87 ± .813]	4.15 [105.41]	4.418 ± .022 [112.27 ± .559]	4.30 [109.22]	4.03 ± .022 [102.36 ± .559]
ROX-5	5.05 ± .032 [128.27 ± .813]	5.15 [130.81]	5.418 ± .022 [137.67 ± .559]	5.30 [134.62]	5.03 ± .022 [127.76 ± .559]
ROX-6	6.05 ± .032 [153.67 ± .813]	6.15 [156.21]	6.418 ± .022 [163.07 ± .559]	6.30 [160.02]	6.03 ± .022 [153.16 ± .559]

MODEL ROX

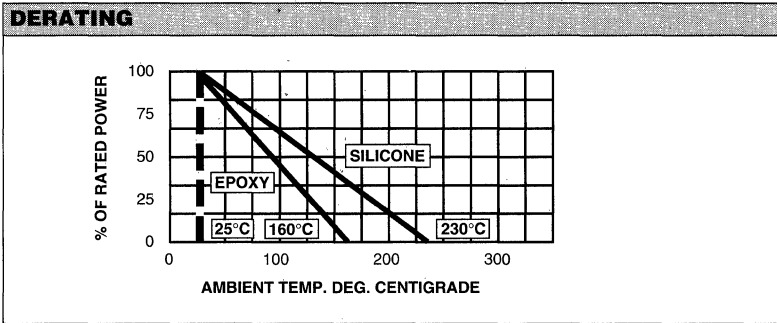
RESISTANCE VALUE CODES							
K KILO		M MEGA		G GIGA		T TERA	
10 ³		10 ⁶		10 ⁹		10 ¹²	
VALUE	CODE	VALUE	CODE	VALUE	CODE	VALUE	CODE
1k	1k0	1M	1M0	1KM	1G0	1MM	1T0
5.5k	5k5	5.5M	5M5	5.5KM	5G5	5.5MM	5T5
9.99k	9k99	9.99M	9M99	9.99KM	9G99	9.99MM	9T99

TEMPERATURE COEFFICIENT CODE		
CODE	TEMPERATURE COEFFICIENT	RANGE
M	± 200PPM/°C	- 55°C to + 125°C
K	± 100PPM/°C	+ 25°C to + 125°C
H	± 50PPM/°C	+ 25°C to + 125°C



ENVIRONMENTAL PERFORMANCE

TEST	MAX. ΔR (Typical Test Lots)
Short Time Overload	< ± 0.20%
Moisture Resistance	< ± 0.50%
Shock	< ± 0.20%
Vibration	< ± 0.20%
Temperature Cycling	< ± 0.50%
Load Life	< ± 1.5%
Dielectric Withstanding Voltage	< ± 0.15%
Effect of Soldering	< ± 0.10%



PART MARKING

- Company name
- Model
- Value
- Tolerance, T.C.
- Date code

HOW TO ORDER

ROX-i/2
MODEL

N
OPTIONAL CONSTRUCTION

100M5
VALUE

F
TOLERANCE

M
TEMPERATURE COEFFICIENT

None = Silicone coated, axial leads, tubular body.
 N = Silicone coated, axial leads, non-inductive.
 P = Silicone coated, .040" [1.02] diameter axial leads, tubular body (Add 25% to wattage for .040" [1.02] diameter leads).
 S = Silicone coated, axial terminals, solid body.
 T = Silicone coated, threaded terminals, tubular body.
 Y = Silicone coated, one end axial, one end threaded terminals.
 Z = Silicone coated, plated ferrules, tubular body.

K = ± 10%

J = ± 5%

G = ± 2%

F = ± 1%

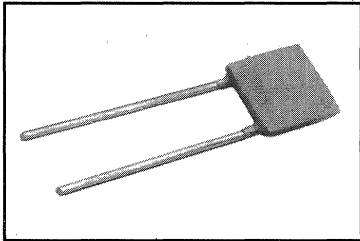
M = ± 200PPM/°C

K = ± 100PPM/°C

H = ± 50PPM/°C

NOTE: 1% tolerance not available above 10G.

MODEL FHV Metal Oxide Resistors High Voltage, Special Purpose



FEATURES

- Non-inductive design
- Matched sets available
- Ratio dividers available
- Special testing available
- Low T.C.: $\pm 200\text{PPM}/^\circ\text{C}$ standard. $\pm 100\text{PPM}/^\circ\text{C}$ available.
- Tolerance: $\pm 10\%$, $\pm 5\%$, $\pm 2\%$, $\pm 1\%$. Standard tolerance and/or T.C. matching available upon request. 1% tolerance not available above 1 Gighm.

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	WATTAGE RATING		MAXIMUM VOLTAGE (KV)	RESISTANCE RANGE* (Ohms)	
	70°C	125°C		$\pm 200\text{PPM}$	$\pm 100\text{PPM}$
FHV-025	.25	.125	.75	10k-100M	10k-100M
FHV-050	.50	.25	1.5	10k-500M	10k-100M
FHV-075	.25	.125	3.75	100-1G	500-500M
FHV-100	1.0	.50	7.5	100-2G	500-1G
FHV-150	1.5	.75	11.25	10k-2G	1M-1G
FHV-160	1.0	.50	3.5	100-2G	500-1G
FHV-200	2.0	1.0	15.0	200-8G	500M-1G
FHV-400	2.0	1.0	7.5	20k-2G	1M-1G
FHV-500	4.0	2.0	15.0	30k-10G	1M-1G

* Resistances are at 100 VDC. Resistances at other voltages available.

TEMPERATURE COEFFICIENT CODE

CODE	T.C.	RANGE
M	$\pm 200\text{PPM}$	-55°C to +125°C
K	$\pm 100\text{PPM}$	-55°C to +125°C

MECHANICAL SPECIFICATIONS

Terminal Strength: 5 pound pull test.

Solderability: Continuous satisfactory coverage when tested in accordance with MIL-R-10509.

MATERIAL SPECIFICATIONS

Element: High temperature fired cermet film.

Core: High purity 96% alumina.

Coating: Flameproof silicone standard on FHV's.

Termination: Standard lead material is solder coated copper. Solderable and weldable per MIL-STD-1276 Type C.

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

Figure 1

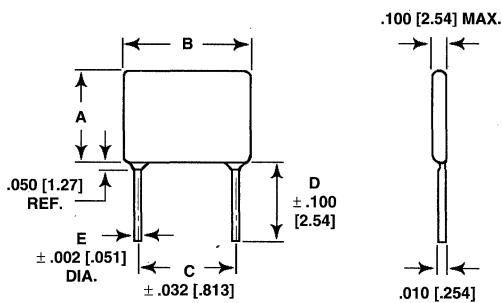
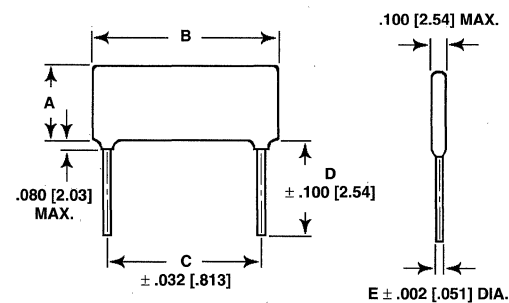


Figure 2



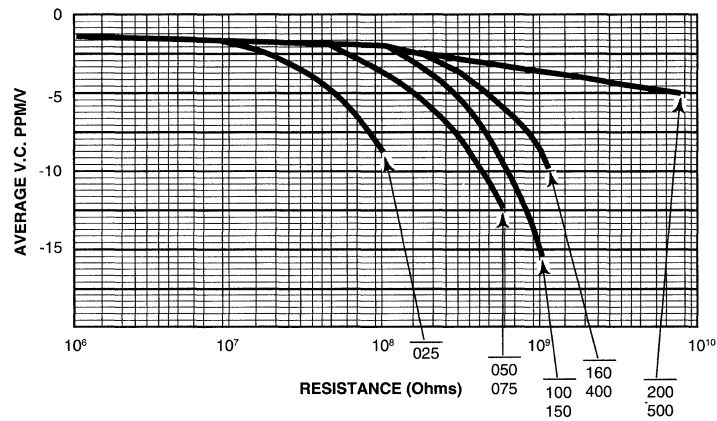
MODEL	A (Max.)	B (Max.)	C	D	E	FIGURE
FHV-025	.300 [7.62]	.300 [7.62]	.200 [5.08]	.250 [6.35]	.018 [.457]	1
FHV-050	.350 [8.89]	.350 [8.89]	.200 [5.08]	.360 [9.14]	.020 [.508]	1
FHV-075	.210 [5.33]	.570 [14.48]	.400 [10.16]	1.50 [38.10]	.025 [.635]	2
FHV-100	.280 [7.11]	1.07 [21.18]	.900 [22.86]	1.50 [38.10]	.032 [.813]	2
FHV-150	.330 [8.38]	1.57 [39.88]	1.40 [35.56]	1.50 [38.10]	.032 [.813]	2
FHV-160	.520 [13.21]	.520 [13.21]	.400 [10.16]	1.50 [38.10]	.032 [.813]	2
FHV-200	.330 [8.38]	2.02 [51.31]	1.90 [48.26]	1.50 [38.10]	.032 [.813]	2
FHV-400	.520 [13.21]	1.02 [25.91]	.900 [22.86]	1.50 [38.10]	.032 [.813]	2
FHV-500	.520 [13.21]	2.07 [52.58]	1.90 [48.26]	1.50 [38.10]	.032 [.813]	2

MODEL FHV

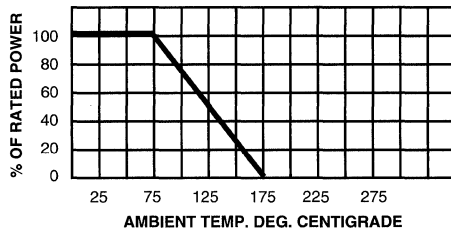
ENVIRONMENTAL PERFORMANCE	
TEST	MAX. ΔR (Typical Test Lots)
Short Time Overload	< ± 0.2%
Moisture Resistance	< ± 0.5%
Shock	< ± 0.2%
Vibration	< ± 0.2%
Temperature Cycling	< ± 0.5%
Load Life	< ± 1.0%
Dielectric Withstanding Voltage	< ± 0.15%
Effects of Soldering	< ± 0.1%

RESISTANCE VALUE CODES							
K KILO		M MEGA		G GIGA		T TERA	
10 ³		10 ⁶		10 ⁹		10 ¹²	
VALUE	CODE	VALUE	CODE	VALUE	CODE	VALUE	CODE
1k	1k0	1M	1M0	1KM	1G0	1MM	1T0
5.5k	5k5	5.5M	5M5	5.5KM	5G5	5.5MM	5T5
9.99k	9k99	9.99M	9M99	9.99KM	9G99	9.99MM	9T99

VOLTAGE COEFFICIENT



DERATING



PART MARKING

- Company name
- Model
- Value
- Tolerance, T.C.
- Date code

HOW TO ORDER

FHV
MODEL

XXX
SIZE

100M5
VALUE

F
TOLERANCE

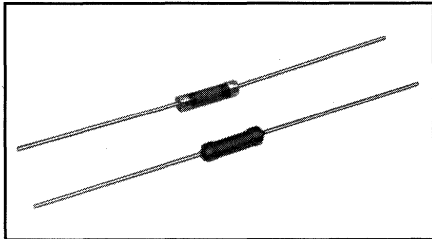
- K = 10%
- J = 5%
- G = 2%
- F = 1%

M
TEMPERATURE COEFFICIENT

- M = ± 200PPM/°C
- K = ± 100PPM/°C

NOTE: 1% tolerance not available above 1G.

MODELS HVW, MVW, HVX Metal Alloy Resistors High Voltage, Special Purpose



FEATURES

- HVW and MVW are uncoated. HVX is silicone coated.
- Semi-precision: $\pm 5\%$, $\pm 10\%$, $\pm 20\%$. Closer tolerances available on HVX.
- Axial leads: HVW and HVX = Tinned copper. MVW = Copper clad steel.

MATERIAL SPECIFICATIONS

Element: Metal alloy.

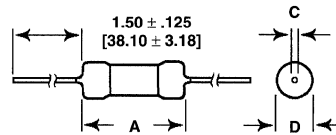
Core: Alkaline earth porcelain.

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	WATTAGE RATING	VOLTAGE RATING	RESISTANCE (Ohms)		
	@ 70°C		(Min.)	(Max.)	
UNCOATED	HVW-1/2	1.0	3.5KV	100	25M
	MVW-1/2	1.0	3.5KV	100	25M
	HVW-3/4	1.5	7.5KV	100	50M
	MVW-3/4	1.5	7.5KV	100	50M
	HVW-1	2.5	7.5KV	100	75M
	HVW-2	5.0	15.0KV	100	200M
@ 70°C					
COATED	HVX-1/2	1.0	3.5KV	100	25M
	HVX-3/4	1.5	7.5KV	100	50M
	HVX-1	2.5	7.5KV	100	75M
	HVX-2	5.0	15.0KV	100	200M

DIMENSIONAL CONFIGURATIONS

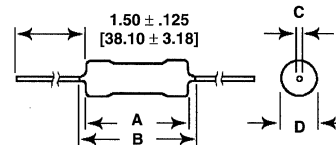
HVW/MVW (Uncoated)



[Numbers in brackets indicate millimeters]

MODEL	A	C	D (Max.)
HVW-1/2	.575 \pm .010 [14.61 \pm .254]	.032 [.813]	.155 [3.94]
MVW-1/2	.575 \pm .010 [14.61 \pm .254]	.032 [.813]	.155 [3.94]
HVW-3/4	.895 \pm .010 [22.73 \pm .254]	.032 [.813]	.155 [3.94]
MVW-3/4	.895 \pm .010 [22.73 \pm .254]	.032 [.813]	.155 [3.94]
HVW-1	.920 \pm .020 [23.37 \pm .508]	.032 [.813]	.275 [6.99]
HVW-2	2.08 \pm .030 [52.38 \pm .762]	.032 [.813]	.275 [6.99]

HVX (Silicone Coated)



MODEL	A (Max.)	B (Max.)	C	D (Max.)
HVX-1/2	.651 [16.54]	.680 [17.27]	.032 [.813]	.180 [4.57]
HVX-3/4	.988 [25.10]	1.06 [26.92]	.032 [.813]	.180 [4.57]
HVX-1	.988 [25.10]	1.06 [26.92]	.032 [.813]	.310 [7.87]
HVX-2	2.15 [54.61]	2.20 [55.88]	.032 [.813]	.310 [7.87]

HOW TO ORDER

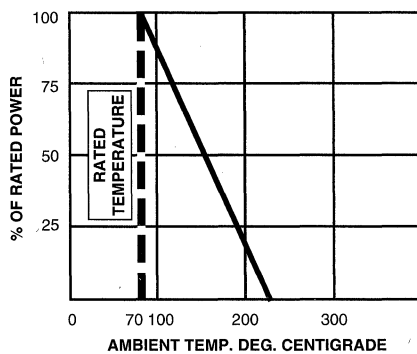
HVW MODEL	1 SIZE	26.4k VALUE	$\pm 10\%$ TOLERANCE
HVW MVW HVX	1/2 1 3/4 2		$\pm 5\%$ $\pm 10\%$ $\pm 20\%$

NOTE: Parts are not marked.

RESISTANCE VALUE CODES

K KILO		M MEGA		G GIGA		T TERA	
10 ³		10 ⁶		10 ⁹		10 ¹²	
VALUE	CODE	VALUE	CODE	VALUE	CODE	VALUE	CODE
1k	1k0	1M	1M0	1KM	1G0	1MM	1T0
5.5k	5k5	5.5M	5M5	5.5KM	5G5	5.5MM	5T5
9.99k	9k99	9.99M	9M99	9.99KM	9G99	9.99MM	9T99

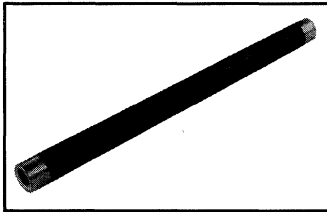
DERATING



NOTE: For operation in oil or inert atmosphere derating, consult factory.

MODEL SPW Carbon Film Resistors

Special Purpose, High Frequency Load (Tubes)



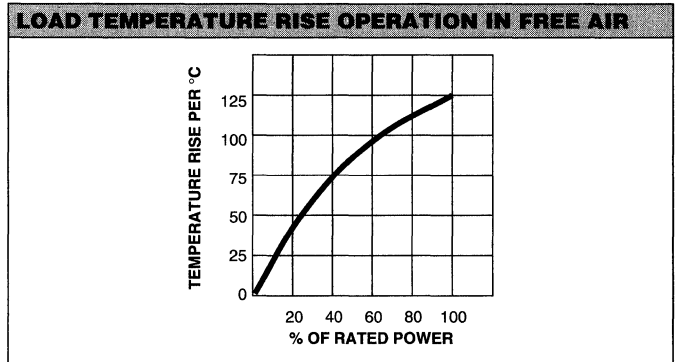
FEATURES

- High stability and excellent high frequency characteristics
- Particularly suited for high frequency applications involving high power, high accuracy RF measurements
- Carbon film construction

APPLICATIONS

High frequency wattmeters for output measurement in Radio, TV and Radar Transmitters, dielectric heating and similar RF generating equipment. Ideal for use as non-reactive radio frequency terminations. Special high power designs with internal water cooling are available. Contact factory.

STANDARD ELECTRICAL SPECIFICATIONS		
MODEL	WATTAGE FREE AIR (25°C)	RESISTANCE RANGE
SPW-236	120	50 ohm standard. Other values available on special order.
SPW-227	55	
SPW-210	40	
SPW-214	10	
SPW-212*	2	



ELECTRICAL SPECIFICATIONS

Resistance Tolerance: $\pm 5\%$ and $\pm 2\%$ standard.
Linearity tolerance $\pm 10\%$.

Cooling: Approximate increase in wattage when forced air cooling is employed is 3 times wattages shown and for liquid cooling (with heat exchanger) is 60 times wattages shown. The limiting factor insofar as the resistor is concerned is the film temperature. This should not exceed 200°C and for maximum stability should not exceed 150°C.

Temperature Coefficient: 200PPM/°C average.
250PPM/°C maximum.

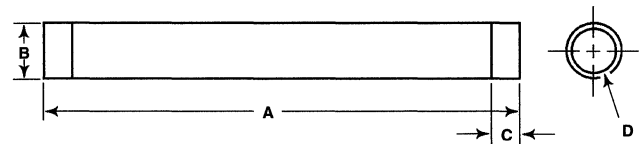
MECHANICAL SPECIFICATIONS

Identification: Type designation resistance value, tolerance and code date of manufacture are printed on each unit.

Terminations: All types electroplated copper except SPW-212. The SPW-212 has silver coated termination bands.

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



NOTE: 1. C dimension may be varied on special order.
2. Wattage ratings do not allow for mounting hardware.

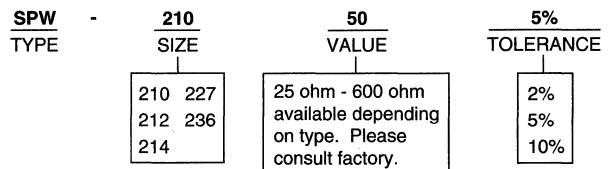
MODEL	A	B	C (O.D.)	D (I.D.)
SPW-236	18.0 \pm .062 [457.20 \pm 1.57]	1.75 \pm .025 [44.45 \pm .635]	1.0 \pm .063 [25.40 \pm 1.60]	1.25 \pm .025 [31.75 \pm .635]
SPW-227	12.0 \pm .062 [304.80 \pm 1.57]	1.125 \pm .025 [28.58 \pm .635]	.500 \pm .032 [12.70 \pm .813]	.875 \pm .020 [22.23 \pm .508]
SPW-210	12.0 \pm .062 [304.80 \pm 1.57]	.875 \pm .010 [22.23 \pm .254]	.625 \pm .032 [15.88 \pm .813]	.625 \pm .020 [15.88 \pm .508]
SPW-214	5.0 \pm .032 [127.0 \pm .813]	.562 \pm .006 [14.27 \pm .813]	.500 \pm .032 [12.70 \pm .813]	.375 \pm .013 [9.53 \pm .330]
SPW-212*	2.0 \pm .062 [50.80 \pm 1.57]	.250 \pm .006 [6.35 \pm .152]	.250 \pm .032 [6.35 \pm .813]	Solid Rod

* Representative types only. Consult factory for special requirements.

PART MARKING

- Dale
- Model
- Value
- Tolerance
- Date code

HOW TO ORDER



MODELS B, H, D, G Carbon Film Resistors

High Voltage, Special Purpose



Models B and H



FEATURES

- Single units to 10 W, 40 KV, $\pm 5\%$ and matched pairs (BP) to 20 W, 80 KV, $\pm 1\%$
- Radial lug or axial lead
- Supplied with Mylar® heat shrink protective sleeve .002" [.051] thick
- Model B is general purpose. Model H is high megohm, varnish coated.

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	WATTAGE RATING 25°C	VOLTAGE RATING	RESISTANCE (Ohms)		STYLE
			(Min.)	(Max.)	
() AEW	0.5	2.5KV	10k	1T	B
() AKW	1.0	5.0KV	20k	5T	B
() BF	1.0	3.5KV	10k	25T	A
() BFW	1.0	3.5KV	10k	25T	B
() BM	2.0	7.5KV	10k	50T	A
() BMW	2.0	7.5KV	10k	50T	B
() BR	3.0	15.0KV	20k	100T	A
() BRW	3.0	15.0KV	20k	100T	B
() BV	5.0	30.0KV	40k	100T	A
() FQ	4.0	15.0KV	20k	100T	A
() FT	6.0	25.0KV	40k	100T	A
() FW	10.0	40.0KV	70k	100T	A

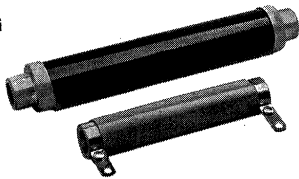
DIMENSIONAL CONFIGURATIONS

Style A	MODEL	A	B
() AEW	.750 [19.05]	.250 [6.35]	
() AKW	1.50 [38.10]	.250 [6.35]	
() BF	1.0 [25.40]	.313 [7.95]	
() BFW	1.0 [25.40]	.313 [7.95]	
() BM	1.75 [44.45]	.313 [7.95]	
() BMW	1.75 [44.45]	.313 [7.95]	
() BR	3.0 [76.20]	.313 [7.95]	
() BRW	3.0 [76.20]	.313 [7.95]	
() BV	5.50 [139.70]	.313 [7.95]	
() FQ	2.50 [63.50]	.563 [14.30]	
() FT	4.0 [101.60]	.563 [14.30]	
() FW	6.50 [165.10]	.563 [14.30]	

Model B axial leads are #20 AWG tinned copper. Dimensional tolerances are $\pm .016$ [.406] or $\pm 1\%$, whichever is greater.

NOTE: Resistance Tolerance: $\pm 5\%$, $\pm 10\%$, $\pm 15\%$ all models. First letter of nomenclature in charts variable depending on Model B or H, required.

Models D and G



FEATURES

- Ratings to 100 W, 125 KV, $\pm 5\%$
- Radial bands or ferrule terminals
- Standard models varnish coated, vinyl protective sleeve available
- Model D is general purpose. Model G is non-inductive, varnish coated.

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	WATTAGE RATING 25°C	VOLTAGE RATING	RESISTANCE (Ohms)		STYLE
			(Min.)	(Max.)	
() JU	10	25KV	20	100G	C
() PW	20	35KV	20	100G	C
() PW-1	20	35KV	20	100G	D
() PX	30	65KV	30	100G	C
() PX-1	30	65KV	30	100G	D
() VY	60	90KV	35	100G	C
() VY-1	60	90KV	35	100G	D
() ZW	35	40KV	20	100G	C
() ZW-1	35	40KV	20	100G	D
() ZZ	100	125KV	30	100G	C
() ZZ-1	100	125KV	30	100G	D

DIMENSIONAL CONFIGURATIONS

Style C	Style D
.172 [4.37] DIA. .313 [7.95] .781 [19.84]	.516 [13.11]

[Numbers in brackets indicate millimeters]

MODEL	A	B*	C	D
() JU	4.50 [114.30]	.750 [19.05]	.500 [12.70]	N/A
() PW	6.50 [165.10]	1.13 [28.70]	.750 [19.05]	N/A
() PW-1	7.69 [195.33]	1.13 [28.70]	N/A	.812 [20.62]
() PX	10.50 [266.70]	1.13 [28.70]	.750 [19.05]	N/A
() PX-1	11.69 [296.93]	1.13 [28.70]	N/A	.812 [20.62]
() VY	14.50 [368.30]	1.50 [38.10]	1.13 [28.70]	N/A
() VY-1	15.69 [398.53]	1.50 [38.10]	N/A	1.14 [28.96]
() ZW	6.50 [165.10]	2.0 [50.80]	1.56 [39.62]	N/A
() ZW-1	7.69 [195.33]	2.0 [50.80]	N/A	1.14 [28.96]
() ZZ	18.50 [469.90]	2.0 [50.80]	1.56 [39.62]	N/A
() ZZ-1	19.69 [500.13]	2.0 [50.80]	N/A	1.14 [28.96]

* Dimensional tolerances are $\pm .016$ [.406] or $\pm 1\%$, whichever is greater.

PART MARKING

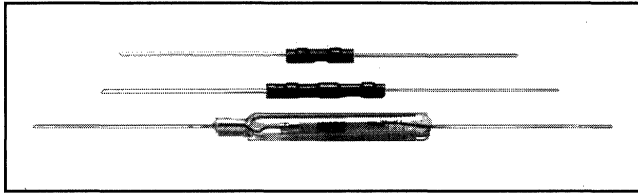
- B, H, D, G**
- Company name
 - Model
 - Value
 - Tolerance
 - Date code

HOW TO ORDER - B, H, D, G

() AEW	2M50	$\pm 15\%$
MODEL	VALUE	TOLERANCE
		$\pm 15\%$
		$\pm 10\%$
		$\pm 5\%$

MODELS HACW-2, HADW-2, M-51 Oxide & Carbon Film Resistors

Ultra High Value, Special Purpose



FEATURES

- Ultra high values with superior stability and consistent voltage coefficient
- Small size
- M5-1 hermetically sealed, minimizing effects of moisture or contamination
- HACW-2 and HADW-2 insulation is flame retardant

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	WATTAGE RATING 40°C	MAXIMUM VOLTS	RESISTANCE RANGE (Ohms)
HACW-2	.25	1500	10G-1T
HADW-2	.50	5KV	10G-1T
M-51	.50	500V	100M-10T

ELECTRICAL SPECIFICATIONS

Tolerance:

M-51 = 1%, 2%, 5%, 10%.
HACW-2 and HADW-2 = 5%, 10%, 20%.

Temperature Coefficient:

10^7 - 10^9 = 1500PPM/°C.
Over 10^9 - 10^{11} = 2000PPM/°C.
Over 10^{11} - 10^{12} = 2800PPM/°C.
(T.C.'s are typical only and are ALWAYS NEGATIVE.)

Noise: Not normally measurable.

Shelf life: < 0.5% per year.

Load Life at 85°C: Under DC cyclic load average ΔR < 1%.
Maximum 2%.

Maximum Temperature: 125°C.

Temperature Cycling: < 0.5% per MIL-R-14293.

Moisture Cycle: M-51 hermetically sealed;
effects of moisture nil.

MECHANICAL SPECIFICATIONS

Identification: Type designation, resistance value and tolerance are stamped on each unit.

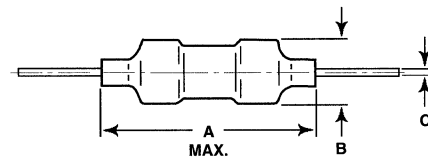
Insulation:

HACW-2 and HADW-2 = heat shrunk polyolefin.
M-51 = glass sealed.

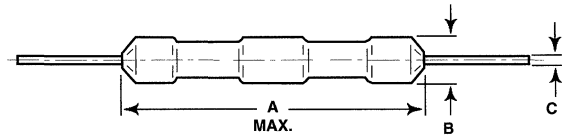
DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]

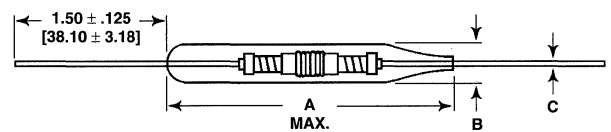
HACW-2



HADW-2



M-51



MODEL	A (Max.)	B	C
HACW-2	.600 [15.24]	.140 ± .010 [3.56 ± .254]	.025 [.635]
HADW-2	1.07 [27.18]	.140 ± .010 [3.56 ± .254]	.025 [.635]
M-51	1.88 [47.75]	.220 ± .010 [5.59 ± .254]	.020 [.635]

PART MARKING

- Company name
- Model
- Value
- Tolerance
- Date Code

HOW TO ORDER

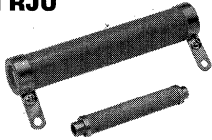
M-51 MODEL	250G VALUE	5% TOLERANCE
		1% M-51 only 2% M-51 only 5% 10% 20%



MODELS RJU and RDX Metal Oxide Resistors

Special Purpose, High Power, Ultra High Value - RJU
Special Purpose, High Voltage, Ratio Divider - RDX

Model RJU



FEATURES

- Wattages to 400 watt at 25°C
- Derated to 0 at 230°C
- Voltages to 125KV
- Tolerances: ± 1%, ± 2%, ± 5%, ± 10%
- Two terminal styles, Style C - Tab Terminal and Style D - Ferrule Terminal

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	WATTAGE RATING 125°C	VOLTAGE RATING	RESISTANCE (Ohms)	
			(Min.)	(Max.)
RJU-40	40	25KV	500	1G
RJU-50	50	33KV	1k	1G
RJU-70	70	40KV	1k	1G
RJU-95	95	35KV	1k	1G
RJU-95-1				
RJU-140	140	65KV	1k	1G
RJU-140-1				
RJU-275	275	90KV	100k	1G
RJU-275-1				
RJU-150	150	40KV	100k	1G
RJU-150-1				
RJU-400	400	125KV	100k	1G
RJU-400-1				

DIMENSIONAL CONFIGURATIONS

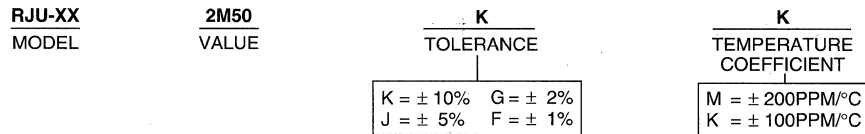
MODEL	LENGTH	DIAMETER	STYLE
RJU-40	4.50 [114.30]	.750 [19.05]	C
RJU-50	6.0 [152.40]	.750 [19.05]	C
RJU-70	8.0 [203.20]	.750 [19.05]	C
RJU-95	6.50 [165.10]	1.13 [28.70]	C
RJU-95-1	7.69 [195.33]	1.13 [28.70]	D
RJU-140	10.50 [266.70]	1.13 [28.70]	C
RJU-140-1	11.69 [296.93]	1.13 [28.70]	D
RJU-275	14.50 [368.30]	1.50 [38.10]	C
RJU-275-1	15.69 [398.53]	1.50 [38.10]	D
RJU-150	6.50 [165.10]	2.0 [50.80]	C
RJU-150-1	7.69 [195.33]	2.0 [50.80]	D
RJU-400	18.50 [469.90]	2.0 [50.80]	C
RJU-400-1	19.69 [500.13]	2.0 [50.80]	D

[Numbers in brackets indicate millimeters]

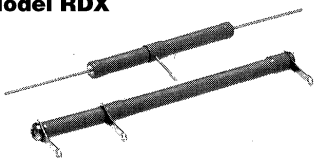
PART MARKING

- Company name
- Style
- Value
- Tolerance
- Date code

HOW TO ORDER



Model RDX



FEATURES

- Available with leads and/or mounting lugs in any required combination
- Higher ranges and different sizes available on request
- 100PPM/°C available
- T.C. matching

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	WATTAGE RATING 125°C	VOLTAGE R ₁	RESISTANCE (Ohms)		MAXIMUM RATIO
			(Min. R ₁)	(Max. R ₂)	
R ₁					
RDX-2	2.0	7.5KV	1k	1G	5000:1
RDX-3	3.0	15KV	2k	10G	10000:1
RDX-4	5.0	22.5KV	3k	15G	10000:1
RDX-5	6.0	30KV	4k	20G	10000:1
RDX-6	8.0	37.5KV	5k	25G	10000:1
RDX-7	10.0	45KV	6k	30G	10000:1
R ₂	2.0	7.5KV	1k	1G	

DIMENSIONAL CONFIGURATIONS

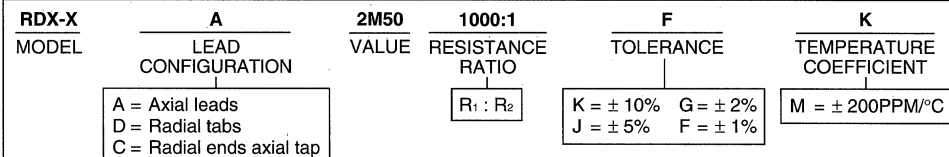
MODEL	LENGTH MAXIMUM	DIAMETER MAXIMUM
R ₁		
RDX-2	1.29 [32.77]	.325 [8.26]
RDX-3	2.42 [61.47]	.325 [8.26]
RDX-4	3.42 [86.87]	.325 [8.26]
RDX-5	4.42 [112.27]	.325 [8.26]
RDX-6	5.42 [137.67]	.325 [8.26]
RDX-7	6.42 [163.07]	.325 [8.26]
R ₂	1.29 [32.77]	.325 [8.26]

[Numbers in brackets indicate millimeters]

PART MARKING

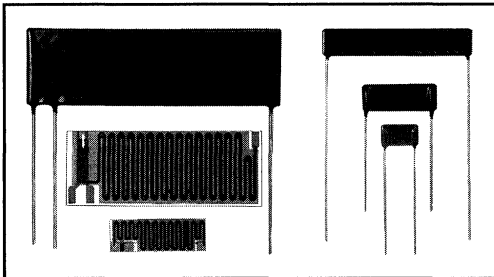
- Company name
- Style
- Value
- Ratio
- Date code

HOW TO ORDER



MODELS TR and TD Thick Film Resistors and Dividers

Special Purpose, High Voltage



FEATURES

- 0.25 watt to 3.0 watt at 25°C
- Outstanding stability under adverse conditions
- Stable cermet resistive element bonded to a high-purity alumina substrate
- Tough epoxy-based coating and high voltage stability
- Designs built from customer supplied schematics
- Dividers available leaded or non-leaded
- Typical resistance ratios of 1000:1, 2000:1, etc.
- TCR tracking to 10PPM/°C depending on values
- Typical thickness of .055" [1.40] for space preservation

APPLICATIONS

Applications include power supplies, transformers and any application requiring operation within an environment where high voltages are used.

ELECTRICAL SPECIFICATIONS

- Resistance Range:** 500 ohm to 1000 Megohm.
- Resistance Tolerance:** ± 1% to ± 20% standard.
- Ratio Tolerance:** 0.25% to 5% standard.
- Temperature Coefficient:** < 200PPM/°C; Ratio TC to 5PPM/°C.
- Maximum Voltage:** 25,000 volts.
- Insulation Resistance:** 10,000 Megohm minimum.
- Voltage Coefficient:** 2PPM/°C per volt standard, tighter available.
- Dielectric Strength:** 5,000 volts, $\Delta \leq \pm 1\%$.
- Moisture Resistance:** 0.5%, 240 hour test.
- Load Life:** 0.5%, 1000 hours at rated power.

MECHANICAL SPECIFICATIONS

- Resistive Element:** Thick film.
- Substrate:** 96% pure alumina.
- Encapsulation:** Epoxy base, conformal coating.
- Terminals:** 60/40 solder coated copper.
- Terminal Strength:** 4.5 pounds for 30 seconds.
- Power:** Derated from ambient temperature 25°C.

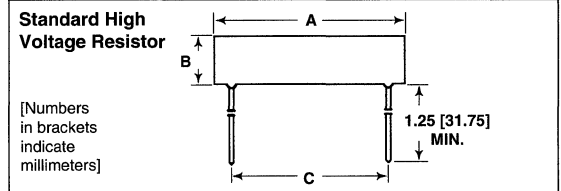
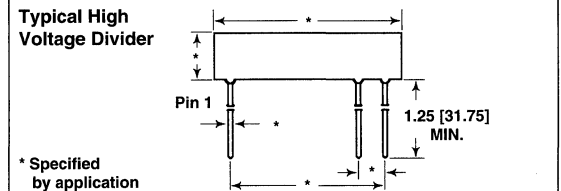
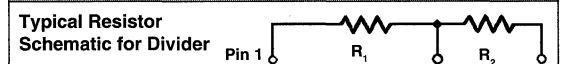
ENVIRONMENTAL SPECIFICATIONS

- Temp. Range:** - 55°C to + 125°C for resistors, to + 150°C for dividers.
- Thermal Shock:** .25% (5 cycles, - 55°C to + 125°C).

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	RESISTANCE (Ohms)		POWER RATING (Watts)	MAXIMUM VOLTAGE (Volts)
	(Min.)	(Max.)		
TR03	300	40M	0.25	0.8K
TR05	500	75M	0.5	1.5K
TR10	1000	1000M	1.0	10K
TR15	1500	1000M	1.5	15K
TR20	2000	1000M	2.0	20K
TR30	3000	1500M	3.0	30K

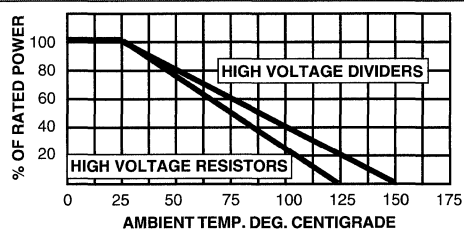
DIMENSIONAL CONFIGURATIONS



Dimensions (± 10%)

MODEL	A (Length)	B (Height)	C (Lead Spacing)
TR02	.300 [7.62]	.210 [5.33]	.200 [5.08]
TR05	.500 [12.70]	.300 [7.62]	.400 [10.16]
TR10	1.0 [25.40]	.350 [8.89]	.900 [22.86]
TR15	1.50 [38.10]	.350 [8.89]	1.40 [35.56]
TR20	2.0 [50.80]	.350 [8.89]	1.90 [48.26]
TR30	3.0 [76.20]	.400 [10.16]	2.90 [73.66]

DERATING



PART MARKING

- Part number
- Date code
- Resistance value
- Power rating
- Tolerance value

HOW TO ORDER - HIGH VOLTAGE RESISTORS

TR	20	G	1001	H
MODEL	LENGTH (± 10%)	POWER RATING	VALUE	TOLERANCE
First digit is number of inches, next digit is tenths of an inch.	C = 0.25 D = 0.5 F = 1.0 G = 1.5 H = 2.0 J = 3.0	First three digits are significant. The last digit specifies the number of zeros.	F = ± 1% G = ± 2% H = ± 3% J = ± 5% K = ± 10% M = ± 20%	

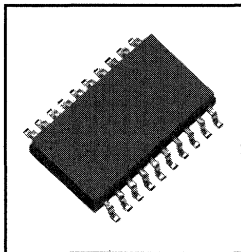
Shipment on Strip Pack

HOW TO ORDER - HIGH VOLTAGE DIVIDERS

TD	20	S	1006/3300	F	L
MODEL	LENGTH (± 10%)	RATIO TCR (PPM)	VALUE/RATIO	RATIO TOLERANCE	STYLE
First digit is number of inches, next digit is tenths of an inch.	S = 10 R = 25 H = 50 K = 100 L = 200 M = 300	Resistance Value of R1: First three digits are significant. The last digit specifies the number of zeros. Ratio: R1/R2.	C = 0.25% D = 0.50% F = 1.0% G = 2.0% H = 3.0% J = 5.0%	L = Leaded N = Non-leaded	

MODEL SOGC Thick Film Resistor Networks

Dual-In-Line, Small Outline Molded Dip 01, 03, 05 Schematics - 16 or 20 Pins

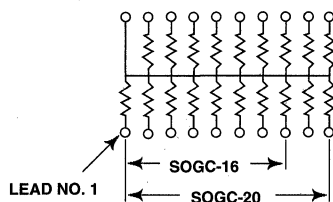


FEATURES

- .110" [2.79] maximum seated height
- Rugged, molded case construction
- Highly stable thick film
- .050" [1.27] lead spacing
- Low temperature coefficient, (- 55°C to + 125°C) ± 100 PPM/°C
- Reduces total assembly costs
- Compatible with automatic surface mounting equipment
- Wide resistance range
- Uniform performance characteristics
- Meets EIA PDP 100, SOGN-0003 outline dimensions
- Available in tube pack or tape and reel pack

CIRCUIT APPLICATIONS

01 Schematic

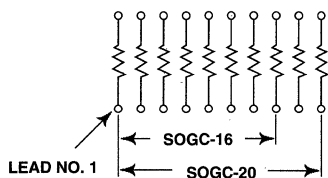


15 or 19 resistors with one pin common

The SOGC-XX01 circuit provides a choice of 15 or 19 nominally equal resistors, each connected between a common lead (16 or 20) and a discrete P.C. board pin. Commonly used in the following applications:

- MOS/ROM Pull-up/Pull-down
- Open Collector Pull-up
- "Wired OR" Pull-up
- Power Driven Pull-up
- TTL Input Pull-down
- Digital Pulse Squaring
- TTL Unused Gate Pull-up
- High Speed Parallels Pull-up

03 Schematic

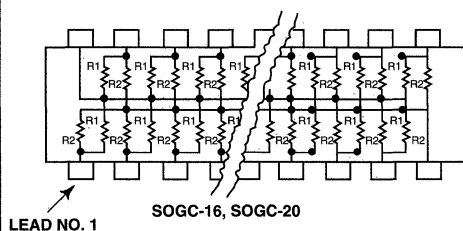


8 or 10 isolated resistors

The SOGC-XX03 circuit provides a choice of 8 or 10 nominally equal resistors with each resistor isolated from all others and wired directly across. Commonly used in the following applications:

- "Wired OR" Pull-up
- Power Driven Pull-up
- Powergate Pull-up
- Line Termination
- Long-line Impedance Balancing
- LED Current Limiting
- ECL Output Pull-down
- TTL Input Pull-down

05 Schematic



TTL dual-line terminator; pulse squaring, 14 or 18 pairs of resistors

(R_1 Resistors are common to leads 16 or 20)

(R_2 Resistors are common to leads 8 or 10)

The SOGC-XX05 circuit contains 14 or 18 pairs of resistors. Each pair is connected between ground and a common line. The junctions of these resistor pairs are connected to the input leads.

The 05 circuits are designed for TTL dual-line termination and pulse squaring.

ELECTRICAL SPECIFICATIONS

Resistance Range: 10 ohm to 1 Megohm standard.
Zero ohm jumpers available on request.

Tolerance: 01 and 03 schematic: $\pm 2\%$ standard. $\pm 1\%$, $\pm 5\%$, $\pm 10\%$ and $\pm 20\%$ available. 05 schematic: $\pm 2\%$ standard. $\pm 5\%$ available. 100 milliohm maximum on zero ohm jumper.

Temperature Coefficient: (- 55°C to + 125°C)
 ± 100 PPM/°C typical.

Resistor Power Rating: (Maximum at 70°C)
01, 05 schematic = .10 watt. 03 schematic = .19 watt.

Package Power Rating: (Maximum at 70°C)
SOGC-16 = 1.6 watts. SOGC-20 = 2.0 watts.

T.C. Tracking: (- 55°C to + 125°C) 50PPM/°C .

Voltage Coefficient of Resistance: < 50PPM/V typical.

Maximum Operating Voltage: 50 VDC.

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

Storage Temperature Range: - 55°C to + 150°C.

MECHANICAL SPECIFICATIONS

Marking: Model number, schematic number, value code, tolerance code.

Marking Resistance to Solvents: Permanency testing per MIL-STD-202, Method 215.

Maximum Solder Reflow Temperature: 290°C.

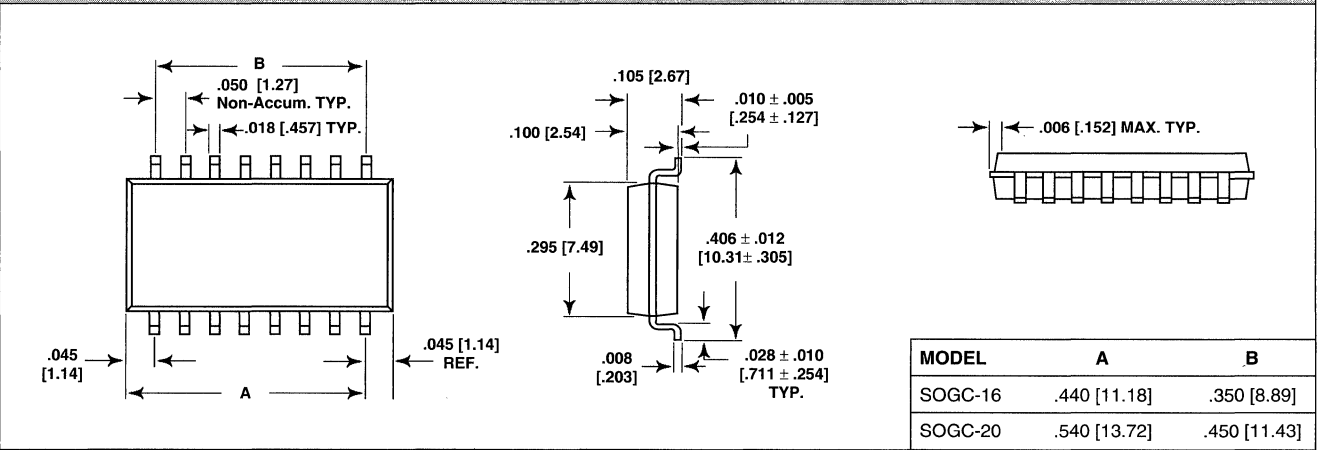
Solderability: Per MIL-STD-202, Method 208E.

Terminals: Copper alloy. 60/40 solder dipped terminal.

Body: Molded epoxy.

MODEL SOGC

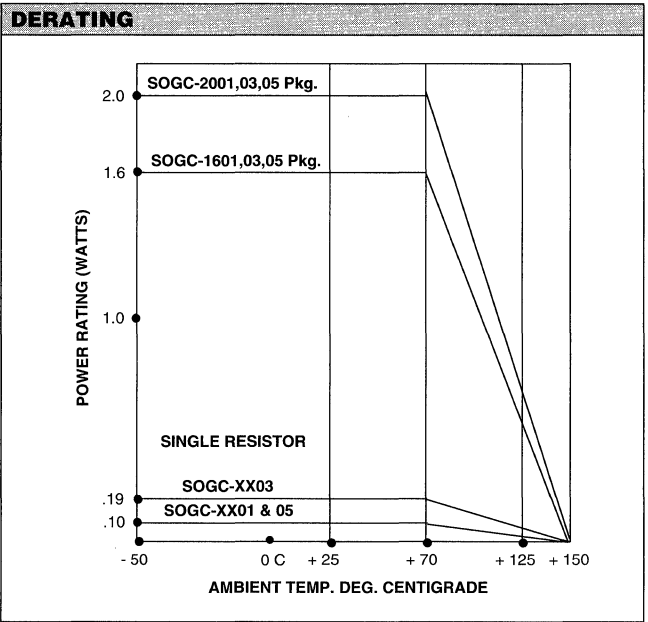
DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



ENVIRONMENTAL PERFORMANCE *

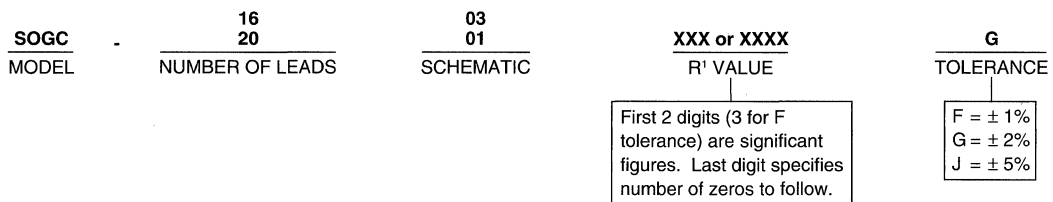
TEST	MAX. ΔR (Typical Test Lots)
Power Conditioning	± 0.50% ΔR
Thermal Shock	± 0.50% ΔR
Short Time Overload	± 0.25% ΔR
Low Temperature Operation	± 0.25% ΔR
Moisture Resistance	± 0.50% ΔR
Resistance to Soldering Heat	± 0.25% ΔR
Shock	± 0.25% ΔR
Vibration	± 0.25% ΔR
Load Life	± 0.50% ΔR
Terminal Strength	± 0.25% ΔR
Insulation Resistance	10,000 Megohm (minimum)
Dielectric Withstanding Voltage	No evidence of arcing or damage (200 V RMS for 1 minute)

* Test methods per MIL-R-202.

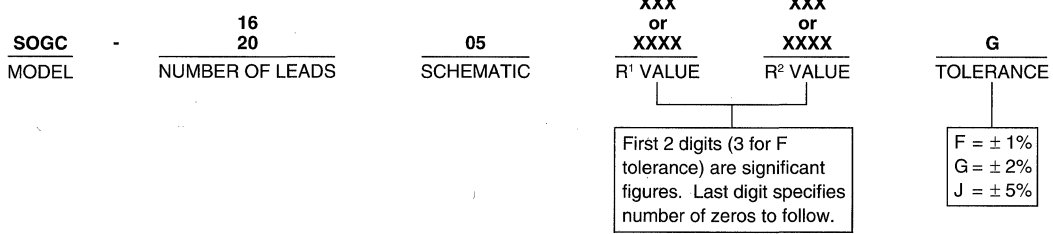


HOW TO ORDER

01, 03 Schematic



05 Schematic

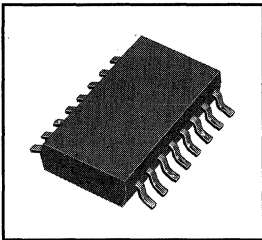


MODEL SOMC

Thick Film Resistor Networks

Dual-in-Line, Small Outline Molded Dip

01, 03, 05 Schematics - 14 or 16 Pins

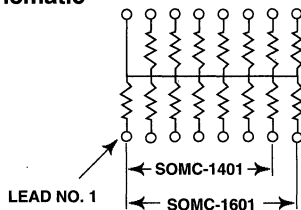


FEATURES

- .090" [2.29] maximum seated height
- Rugged, molded case construction
- Highly stable thick film
- .050" [1.27] lead spacing
- Low temperature coefficient, (- 55°C to + 125°C) ± 100PPM/°C
- Reduces total assembly costs
- Compatible with automatic surface mounting equipment
- Wide resistance range
- Uniform performance characteristics
- Meets EIA PDP100, SOGN-0002 outline dimensions
- Available in tube pack or tape and reel pack

CIRCUIT APPLICATIONS

01 Schematic

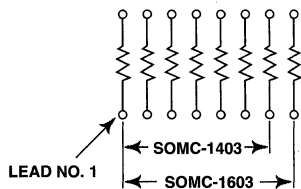


15 or 19 resistors with one pin common

The SOMC-XX01 circuit provides a choice of 13 or 15 nominally equal resistors, each connected between a common pin (14 or 16) and a discrete P.C. board pin. Commonly used in the following applications:

- MOS/ROM Pull-up/Pull-down
- Open Collector Pull-up
- "Wired OR" Pull-up
- Power Driven Pull-up
- TTL Input Pull-down
- Digital Pulse Squaring
- TTL Unused Gate Pull-up
- High Speed Parallels Pull-up

03 Schematic

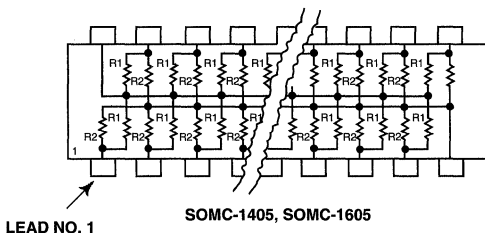


7 or 8 isolated resistors

The SOMC-XX03 circuit provides a choice of 7 or 8 nominally equal resistors with each resistor isolated from all others and wired directly across. Commonly used in the following applications:

- "Wired OR" Pull-up
- Power Driven Pull-up
- Powergate Pull-up
- Line Termination
- Long-line Impedance Balancing
- LED Current Limiting
- ECL Output Pull-down
- TTL Input Pull-down

05 Schematic



TTL dual-line terminator;
pulse squaring, 12 or 14 pairs of resistors
(R₁ Resistors are common to leads 14 or 16)
(R₂ Resistors are common to leads 7 or 8)

The SOMC-XX05 circuit contains 12 or 14 pairs of resistors. Each pair is connected between ground and a common line. The junctions of these resistor pairs are connected to the input leads.

The 05 circuits are designed for TTL dual-line termination and pulse squaring.

ELECTRICAL SPECIFICATIONS

Resistance Range: 10 ohm to 1 Megohm standard.
Zero ohm jumpers available.

Tolerance: 01 and 03 schematic = ± 2% standard. ± 1%, ± 5%, ± 10% and ± 20% available. 05 schematic = ± 2% standard. ± 5% available. 100 milliohm maximum on zero ohm jumpers.

Temperature Coefficient: (- 55°C to + 125°C) ± 100PPM/°C typical.

Resistor Power Rating: (Maximum at 70°C)
01, 05 schematic = .080 watt.
03 schematic = .160 watt.

Package Power Rating: (Maximum at 70°C)
01, 05 schematic = 14 pin 1.05 watts, 16 pin 1.200 watts.
03 schematic = 14 pin 1.125 watts, 16 pin 1.280 watts.

T.C. Tracking: (- 55°C to + 125°C) 50PPM/°C.

Voltage Coefficient of Resistance: < 50PPM/V typical.

Maximum Operating Voltage: 50 VDC.

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

Storage Temperature Range: - 55°C to + 150°C.

MECHANICAL SPECIFICATIONS

Marking: Model number, schematic number, value code, tolerance code.

Marking Resistance to Solvents: Permanency testing per MIL-STD-202, Method 215.

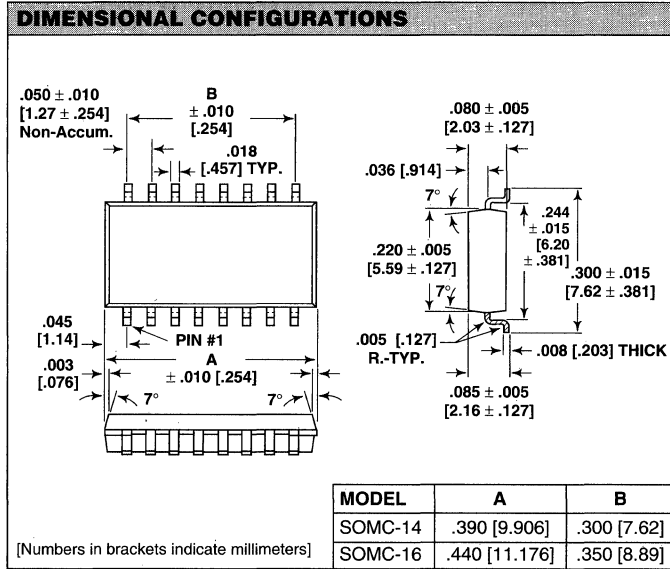
Maximum Solder Reflow Temperature: 290°C.

Solderability: Per MIL-STD-202, Method 208E.

Terminals: Copper alloy. 60/40 solder dipped terminal.

Body: Molded Epoxy.

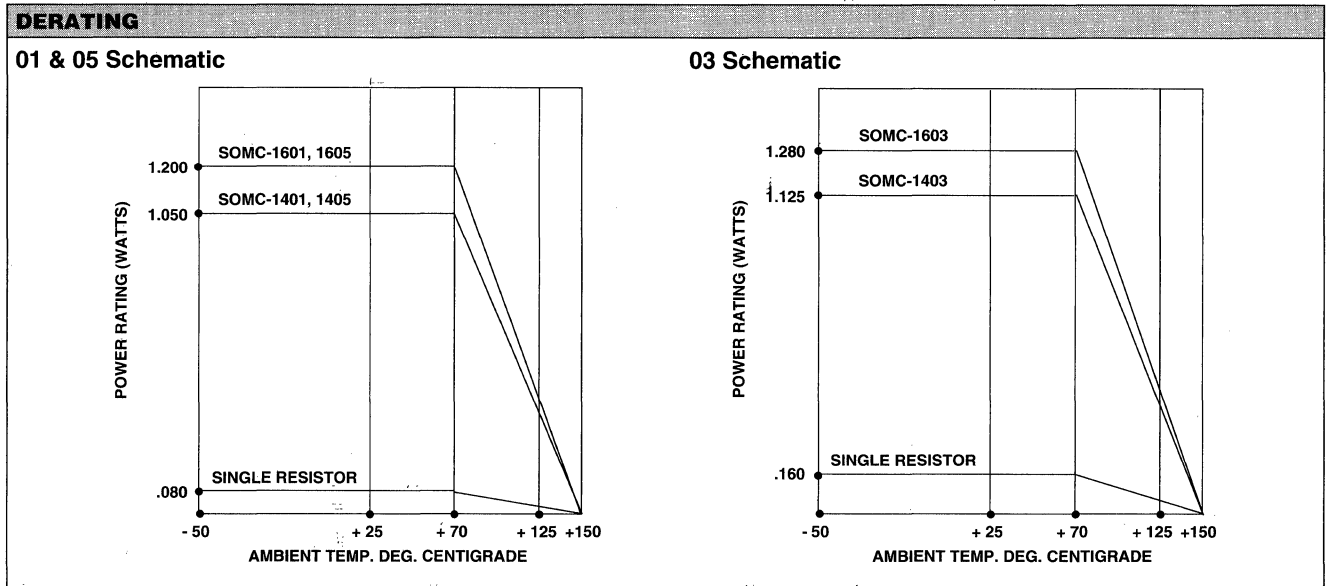
MODEL SOMC



ENVIRONMENTAL PERFORMANCE *

TEST	MAX. ΔR (Typical Test Lots)
Power Conditioning	± 0.50% ΔR
Thermal Shock	± 0.50% ΔR
Short Time Overload	± 0.25% ΔR
Low Temperature Operation	± 0.25% ΔR
Moisture Resistance	± 0.50% ΔR
Resistance to Soldering Heat	± 0.25% ΔR
Shock	± 0.25% ΔR
Vibration	± 0.25% ΔR
Load Life	± 0.50% ΔR
Terminal Strength	± 0.25% ΔR
Insulation Resistance	10,000 Megohm (minimum)
Dielectric Withstanding Voltage	No evidence of arcing or damage (200 V RMS for 1 minute)

* Test methods per MIL-STD-202.



HOW TO ORDER

01 & 03 Schematic

SOMC	14 16	03 01	XXX or XXXX	G
MODEL	NUMBER OF LEADS	SCHEMATIC	RESISTANCE VALUE	TOLERANCE

First 2 digits (3 for F tolerance) are significant figures. Last digit specifies number of zeros to follow.

F = ± 1%
G = ± 2%
J = ± 5%

05 Schematic

SOMC	14 16	05	XXX or XXXX	G
MODEL	NUMBER OF LEADS	SCHEMATIC	R ₁ VALUE R ₂ VALUE	TOLERANCE

First 2 digits (3 for F tolerance) are significant figures. Last digit specifies number of zeros to follow.

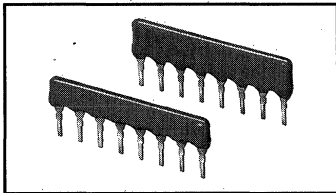
F = ± 1%
G = ± 2%
J = ± 5%

MODEL CSC

Thick Film Resistor Networks

Single-In-Line, Coated - 01, 03, 05 Schematics

4 thru 10 Pins "A" Profile, 4 thru 12 Pins "B" Profile

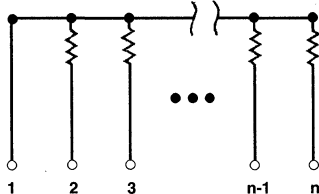


FEATURES

- .195" [4.95] "A" or .250" [6.35] "B" maximum seated height
- Highly stable thick film
- Low temperature coefficient (- 55°C to + 125°C) ± 100PPM/°C
- Reduces total assembly costs
- Resistor elements protected by tough epoxy conformal coating
- Wide resistance range
- Available in bag pack or tube pack

CIRCUIT APPLICATIONS

01 Schematic



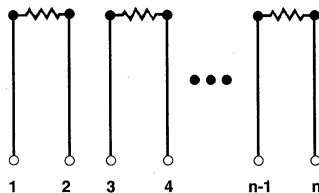
"A" Profile = 3 through 9 resistors with one pin common
 "B" Profile = 3 through 11 resistors with one pin common

The CSCXXX-01 single-in-line resistor networks provide the user with a choice of 3, 4, 5, 6, 7, 8, 9, 10* or 11* nominally equal resistors, each connected to a common pin (Pin No. 1). Commonly used in the following applications:

- "Wired OR" Pull-up
- Power Gate Pull-up
- MOS/ROM Pull-up/Pull-down
- Open Collector Pull-up
- TTL Input Pull-down
- TTL Unused Gate Pull-up

* Available in "B" profile only.

03 Schematic



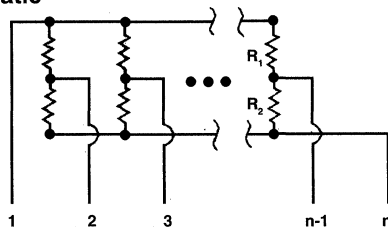
"A" Profile = 2 through 5 isolated resistors
 "B" Profile = 2 through 6 isolated resistors

The CSCXXX-03 single-in-line resistor networks provide the user with a choice of 2, 3, 4, 5, or 6* nominally equal resistors. Each resistor is isolated from all others. Commonly used in the following applications:

- "Wired OR" Pull-up
- Power Driven Pull-up
- Power Gate Pull-up
- Line Termination
- Long-Line Impedance Balancing
- LED Current Limiting
- ECL Output Pull-down
- TTL Input Pull-down

* Available in "B" profile only.

05 Schematic



Pulse squaring and TTL dual-line terminators

The CSCXXX-05 circuits contain 2, 3, 4, 5, 6, 7, 8, 9 or 10 series pairs of resistors. Each series pair is connected between two common lines. The junction of these resistor pairs is connected to the input terminals. The 05 circuits are designed for TTL dual-line termination and pulse squaring.

ELECTRICAL SPECIFICATIONS

Resistance Range: 10 ohm to 2.2 Megohm standard.

Tolerance:

01 and 03 schematic: ± 2% standard.
 ± 1%, ± 5%, ± 10% and ± 20% available.
 05 schematic: ± 2% standard.
 ± 5% available.

Temperature Coefficient: (- 55°C to + 125°C)
 ± 100PPM/°C typical.

Temperature Coefficient of R Tracking: (- 55°C to + 125°C)
 01 and 03 schematic: 50PPM/°C maximum.
 05 schematic: 150PPM/°C standard.
 (Tighter tracking available.)

Isolation Resistance: 03 schematic: > 100 Megohm.

Resistor Power Rating: (Maximum at 25°C) See derating curve.

Resistor Power Rating: (Maximum at 70°C)

Schematic	"A" Profile	"B" Profile
01	.20 watt	.25 watt
03	.30 watt	.40 watt
05	.20 watt	.25 watt

Package Power Rating: See derating curve.
 Higher power rated C Profile available.

Voltage Coefficient of Resistance: < 50PPM/V typical.

Maximum Operating Voltage: 100 VDC.

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

MECHANICAL SPECIFICATIONS

Marking Resistance to Solvents:

Permanency testing per MIL-STD-202, Method 215.

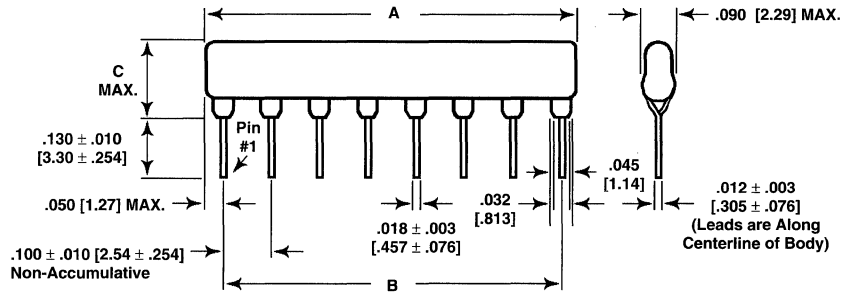
Solderability: Per MIL-STD-202, Method 208E.

Body: High alumina, epoxy coated.

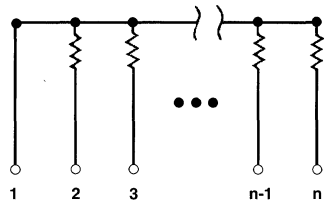
Terminals: Copper alloy, tin-lead plated.

MODEL CSC

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

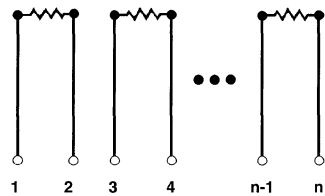


01 Schematic



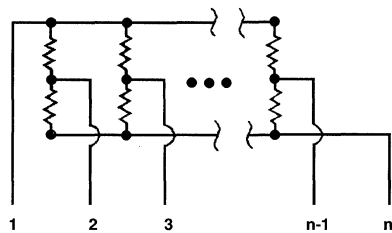
MODEL	NUMBER OF RESISTORS	A (Maximum)	B	C (Maximum)
CSC04	3	.390 [9.91]	.300 [7.62]	
CSC05	4	.490 [12.45]	.400 [10.16]	
CSC06	5	.590 [14.99]	.500 [12.70]	
CSC07	6	.690 [17.53]	.600 [15.24]	
CSC08	7	.790 [20.07]	.700 [17.78]	"A" Profile = .195 [4.95] "B" Profile = .250 [6.35]
CSC09	8	.890 [22.61]	.800 [20.32]	
CSC10	9	.990 [25.15]	.900 [22.86]	
CSC11*	10	1.09 [27.69]	1.00 [25.40]	
CSC12 *	11	1.19 [30.23]	1.10 [27.94]	

03 Schematic



MODEL	NUMBER OF RESISTORS	A (Maximum)	B	C (Maximum)
CSC04	2	.390 [9.91]	.300 [7.62]	
CSC06	3	.590 [14.99]	.500 [12.70]	
CSC08	4	.790 [20.07]	.700 [17.78]	"A" Profile = .195 [4.95] "B" Profile = .250 [6.35]
CSC10	5	.990 [25.15]	.900 [22.86]	
CSC12 *	6	1.19 [30.23]	1.10 [27.94]	

05 Schematic



MODEL	NUMBER OF RESISTORS	A (Maximum)	B	C (Maximum)
CSC04	4	.390 [9.91]	.300 [7.62]	
CSC05	6	.490 [12.45]	.400 [10.16]	
CSC06	8	.590 [14.99]	.500 [12.70]	
CSC07	10	.690 [17.53]	.600 [15.24]	
CSC08	12	.790 [20.07]	.700 [17.78]	"A" Profile = .195 [4.95] "B" Profile = .250 [6.35]
CSC09	14	.890 [22.61]	.800 [20.32]	
CSC10	16	.990 [25.15]	.900 [22.86]	
CSC11	18	1.09 [27.69]	1.00 [25.40]	
CSC12 *	20	1.19 [30.23]	1.10 [27.94]	

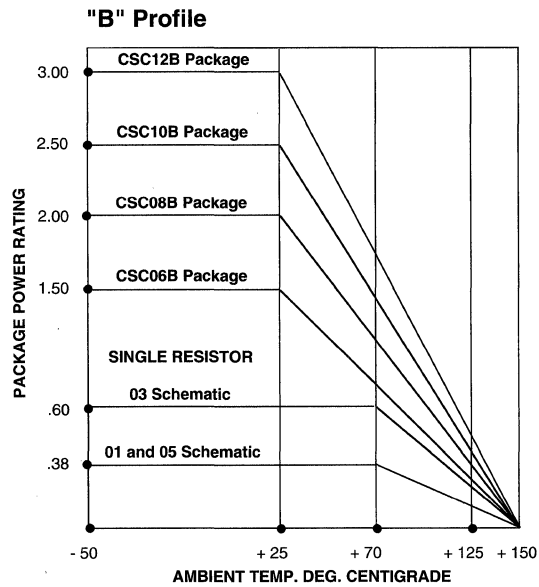
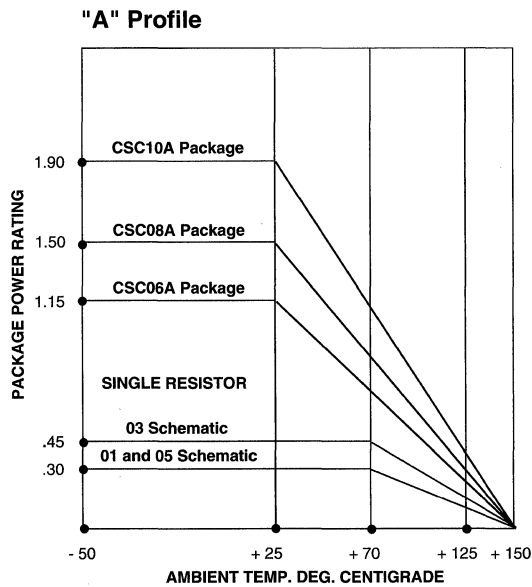
* "B" Profile Only.

MODEL CSC

ENVIRONMENTAL PERFORMANCE *		
TEST	CONDITIONS	MAX. ΔR (Typical Test Lots)
Thermal Shock	5 cycles between - 65°C and + 125°C	± 0.50% ΔR
Short Time Overload	2 1/2 x rated working voltage 5 seconds	± 0.25% ΔR
Low Temperature Operation	45 minutes at full rated working voltage at - 65°C	± 0.25% ΔR
Moisture Resistance	240 hours with humidity ranging from 80% RH to 98% RH	± 1.00% ΔR
Resistance to Soldering Heat	Leads immersed in 350°C solder to within 1/16" of body for 3 seconds	± 0.25% ΔR
Shock	Total of 18 shocks at 100 G's	± 0.25% ΔR
Vibration	12 hours at maximum of 20 G's between 10 and 2,000 Hz	± 0.25% ΔR
Load Life	1,000 hours at 70°C, rated power applied 1 1/2 hours on, 1/2 hour off for full 1,000 hour period. Derated according to the curve.	± 1.00% ΔR
Terminal Strength	4 1/2 pound pull for 30 seconds	± 0.25% ΔR
Insulation Resistance	10,000 Megohm (minimum)	
Dielectric Withstanding Voltage	No evidence of arcing or damage (200 V RMS for 1 minute)	

* Test methods per MIL-STD-202.

DERATING



"A" Profile

70°C Package Ratings

CSC10A	1.25 watts
CSC09A	1.12 watts
CSC08A	1.00 watts
CSC07A	.87 watts
CSC06A	.75 watts
CSC05A	.62 watts
CSC04A	.50 watts

"B" Profile

70°C Package Ratings

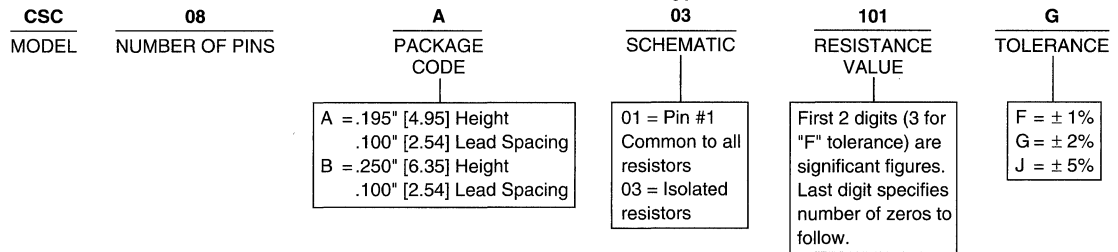
CSC12B	1.90 watts
CSC11B	1.75 watts
CSC10B	1.60 watts
CSC09B	1.45 watts
CSC08B	1.30 watts
CSC07B	1.15 watts
CSC06B	1.00 watts
CSC05B	.80 watts
CSC04B	.60 watts

MODEL CSC

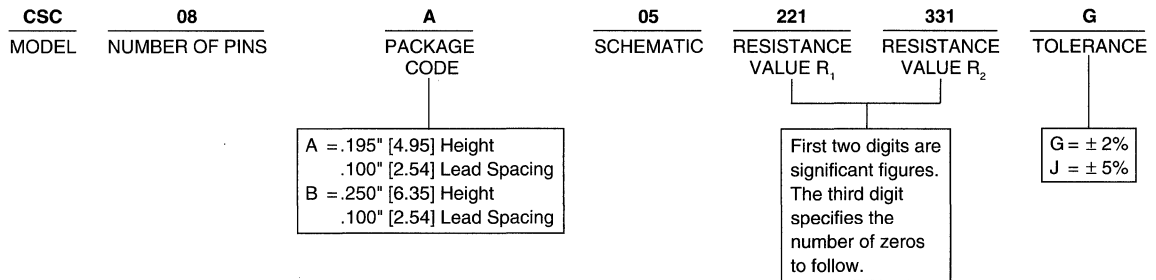
STOCKED RESISTANCE VALUES IN OHMS ("G" Tolerance)											
01 Schematic					03 Schematic				05 Schematic		
22	220	1.0k	5.6k	33k	56	470	2.7k	18k	R₁/R₂	Z₀	
33	270	1.2k	6.8k	47k	100	510	3.3k	22k	220/270	121	
56	330	1.5k	10k	68k	120	560	4.7k	27k	180/390	123	
68	390	2.0k	12k	100k	150	1.0k	6.8k	47k	220/330	132	
100	470	2.2k	15k	220k	180	1.5k	10k	100k	330/390	179	
120	510	2.7k	18k	1 Meg	220	2.0k	12k	220k	330/470	194	
150	560	3.3k	22k		330	2.2k	15k	1 Meg	330/680	222	
180	680	4.7k	27k						1.5k/3.3k	1031	

HOW TO ORDER

01 and 03 Schematic

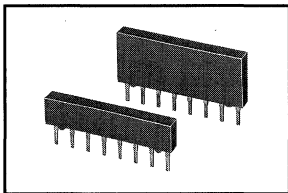


05 Schematic



MODEL MSP Thick Film Resistor Networks

Single-In-Line, Molded - 01, 03, 05 Schematics
6, 8, 9 & 10 Pin "A" Profile - 6, 8 & 10 Pin "C" Profile

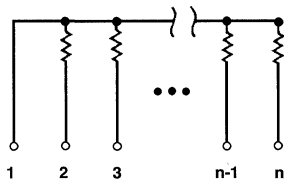


FEATURES

- .195" [4.95] "A" or .350" [8.89] "C" maximum seated height
- Highly stable thick film
- Low temperature coefficient (- 55°C to + 125°C) ± 100PPM/°C
- Rugged, molded case construction
- Reduces total assembly costs
- Compatible with automatic insertion equipment
- Reduces P.C. board space
- Wide resistance range
- Available in tube pack or side-by-side pack

CIRCUIT APPLICATIONS

01 Schematic



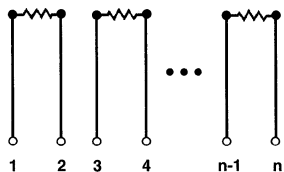
5, 7, 8* or 9 resistors with one pin common

The MSPXXX-01 circuit contains 5, 7, 8* or 9 nominally equal resistors, each connected between a common pin (Pin No. 1) and a discrete P.C. board pin. Commonly used in the following applications:

- "Wired OR" Pull-up
- Power Gate Pull-up
- TTL Input Pull-down
- MOS/ROM Pull-up/Pull-down
- Open Collector Pull-up
- TTL Unused Gate Pull-up

* Available in "A" profile only

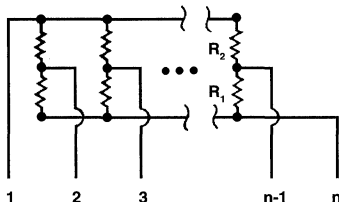
03 Schematic



3, 4 or 5 isolated resistors

The MSPXXX-03 circuit contains 3, 4 or 5 resistors of nominally equal value in a compact package. Each resistor is connected to two discrete P.C. pins.

05 Schematic



Pulse squaring and TTL dual-line terminators

The MSPXXX-05 circuits contain 4, 6, 7* or 8 series pairs of resistors. Each series pair is connected between two common lines. The junction of these resistor pairs is connected to the input terminals.

The 05 circuits are designed for TTL dual-line termination and pulse squaring.

* Available in "A" profile only

ELECTRICAL SPECIFICATIONS

Resistance Range: 10 ohm to 2.2 Megohm standard.

Tolerance: 01 and 03 schematic: ± 2% standard.

± 1%, ± 5%, ± 10% and ± 20% available.

05 schematic: ± 2% standard. ± 5% available.

Temperature Coefficient: (- 55°C to + 125°C) ± 100PPM/°C typical.

Temperature Coefficient of R Tracking: (- 55°C to + 125°C)

01 and 03 schematic: 50PPM/°C maximum.

05 schematic: 150PPM/°C standard.

(Tighter tracking available.)

Isolation Resistance: 03 schematic: > 100 Megohm.

Resistor Power Rating: (Maximum at 25°C) See derating curve.

Resistor Power Rating: (Maximum at 70°C)

Schematic	"A" Profile	"C" Profile
01	.20 watt	.25 watt
03	.30 watt	.40 watt
05	.20 watt	.25 watt

Package Power Rating: (Maximum at 25°C and 70°C) See derating curve.

Voltage Coefficient of Resistance: < 50PPM/V typical.

Maximum Operating Voltage: 100 VDC.

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

Storage Temperature Range: - 55°C to + 150°C.

MECHANICAL SPECIFICATIONS

Marking Resistance to Solvents: Permanency testing per MIL-STD-202, Method 215.

Solderability: Per MIL-STD-202, Method 208E.

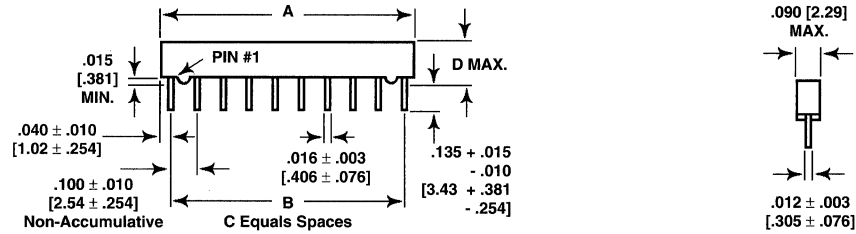
Body: Molded epoxy.

Terminals: Copper alloy, tin-lead plated.

Weight: MSP06A = 0.4 gram MSP06C = 0.7 gram
 MSP08A = 0.5 gram MSP08C = 0.9 gram
 MSP09A = .55 gram MSP10C = 1.1 gram
 MSP10A = 0.6 gram

MODEL MSP

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



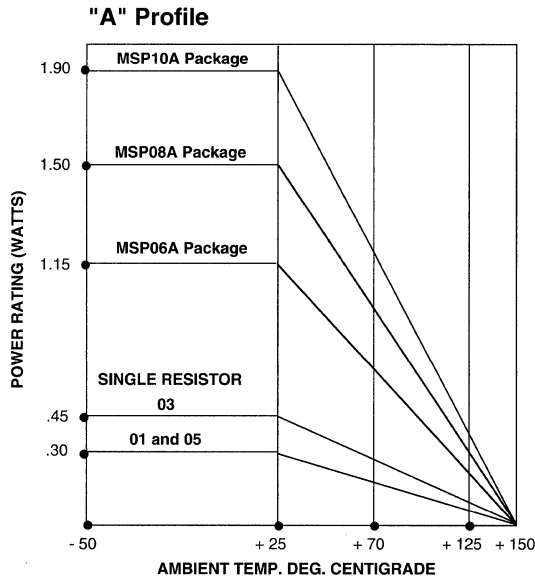
MODEL	A (Max.)	B	C	D
MSP06	.590 [14.99]	.500 [12.70]	5	
MSP08	.790 [20.07]	.700 [17.78]	7	MSPXXA = .195 [4.95] MSPXXC = .350 [8.89]
MSP10	.990 [25.15]	.900 [22.86]	9	
MSP09	.890 [22.61]	.800 [20.32]	8	.195 [4.95] ONLY

ENVIRONMENTAL PERFORMANCE *

TEST	CONDITIONS	MAX. ΔR (Typical Test Lots)
Power Conditioning	1 1/2 x rated power, applied 1 1/2 hours on and 1/2 hour off for 100 hours ± 4 hours at 25°C ambient temperature	± 0.50% ΔR
Thermal Shock	5 cycles between - 65°C and + 125°C	± 0.50% ΔR
Short Time Overload	2 1/2 x rated working voltage 5 seconds	± 0.25% ΔR
Low Temperature Operation	45 minutes at full rated working voltage at - 65°C	± 0.25% ΔR
Moisture Resistance	240 hours with humidity ranging from 80% RH to 98% RH	± 0.50% ΔR
Resistance to Soldering Heat	Leads immersed in 350°C solder to within 1/16" of device body for 3 seconds	± 0.25% ΔR
Shock	Total of 18 shocks at 100 G's	± 0.25% ΔR
Vibration	12 hours at maximum of 20 G's between 10 and 2,000 Hz	± 0.25% ΔR
Load Life	1,000 hours at 70°C, rated power applied 1 1/2 hours on, 1/2 hour off for full 1,000 hour period. Derated according to the curve.	± 1.00% ΔR
Terminal Strength	4 1/2 pound pull for 30 seconds	± 0.25% ΔR
Insulation Resistance	10,000 Megohm (minimum)	
Dielectric Withstanding Voltage	No evidence of arcing or damage (200 V RMS for 1 minute)	

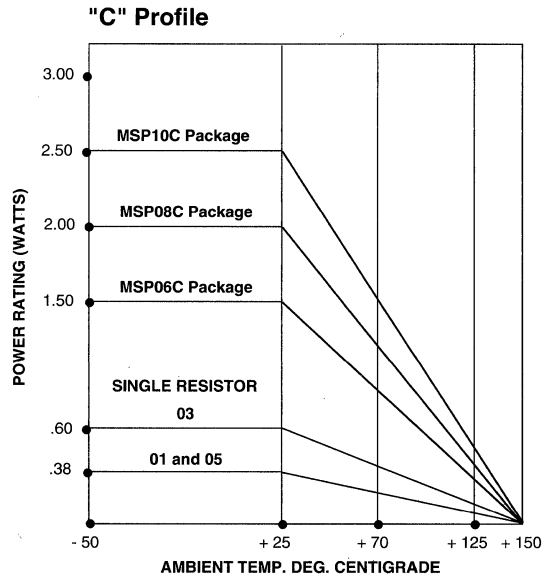
* Test methods per MIL-STD-202.

DERATING



**"A" Profile
70°C Package Ratings**

MSP10A	1.25 watts
MSP09A	1.12 watts
MSP08A	1.00 watts
MSP06A	.75 watts



**"C" Profile
70°C Package Ratings**

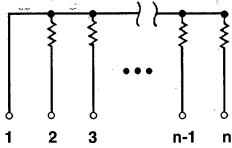
MSP10C	1.60 watts
MSP08C	1.30 watts
MSP06C	1.00 watts

Higher power ratings available. Contact factory.

MODEL MSP

STOCKED RESISTANCE VALUES IN OHMS ("G" Tolerance)

01 Schematic

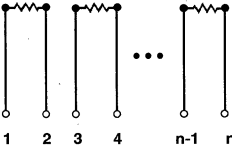


22*	68	150	390	820	2.0k	4.7k	10k	22k	51k*	120k*	470k
33	82	180	470	1.0k	2.2k	5.6k	12k	27k	56k	150k*	500k*
39	100	220	510	1.2k	2.7k	6.0k*	15k	33k	68k	180k*	1Meg
47	110*	270	560	1.5k	3.3k	6.8k	18k	39k	82k	220k	
56	120	330	680	1.8k	3.9k	8.2k	20k*	47k	100k	330k	

*MSPXXA only.

Additional resistance values are constantly being added. Please contact your local Dale® Distributor or Representative to check availability of values not shown.

03 Schematic

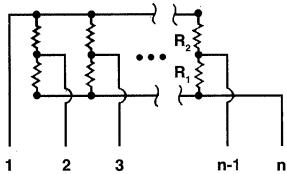


22	47	110*	270	560*	1.5k	3.3k	6.8k	18k*	47k	120k*	470k
27*	56	120	330	680	1.8k*	3.9k*	8.2k*	22k	56k*	150k*	1Meg
29*	68	150	390	820*	2.0k*	4.7k	10k	27k*	68k	180k*	
33	82*	180	470	1.0k	2.2k	5.6k*	12k*	33k	82k*	220k	
39*	100	220	510*	1.2k*	2.7k*	6.0k*	15k	39k*	100k	330k*	

*MSPXXA only.

Additional resistance values are constantly being added. Please contact your local Dale Distributor or Representative to check availability of values not shown.

05 Schematic



R_1/R_2	Z_o	R_1/R_2	Z_o
220/270	121	330/470	194
180/390	123	330/680	222
220/330	132	1.5k/3.3k	1031
330/390	179		

HOW TO ORDER

01 Schematic

MSP
MODEL 08
NUMBER OF PINS

A
PACKAGE CODE

01
SCHEMATIC

101
RESISTANCE VALUE

G
TOLERANCE

A = .195" [4.95] Height
.100" [2.54] Lead Spacing
C = .350" [8.89] Height
.100" [2.54] Lead Spacing

First 2 digits (3 for "F" tolerance) are significant figures. Last digit specifies number of zeros to follow.

F = ± 1%
G = ± 2%
J = ± 5%

03 Schematic

MSP
MODEL 06
NUMBER OF PINS

A
PACKAGE CODE

03
SCHEMATIC

102
RESISTANCE VALUE

G
TOLERANCE

A = .195" [4.95] Height
.100" [2.54] Lead Spacing
C = .350" [8.89] Height
.100" [2.54] Lead Spacing

First 2 digits (3 for "F" tolerance) are significant figures. Last digit specifies number of zeros to follow.

F = ± 1%
G = ± 2%
J = ± 5%

05 Schematic

MSP
MODEL 06
NUMBER OF PINS

A
PACKAGE CODE

05
SCHEMATIC

221
RESISTANCE VALUE R_1

331
RESISTANCE VALUE R_2

G
TOLERANCE

A = .195" [4.95] Height
.100" [2.54] Lead Spacing
C = .350" [8.89] Height
.100" [2.54] Lead Spacing

First two digits are significant figures. Last digit specifies the number of zeros to follow.

G = ± 2%
J = ± 5%

EXAMPLE:

MSP08A-01-101G = A molded single-in-line thick film resistor network with 8 pins on .100" [2.54] centers, .195" [4.95] maximum seated height, 01 schematic, resistance value of 100 ohm and a tolerance of ± 2%.

EXAMPLE:

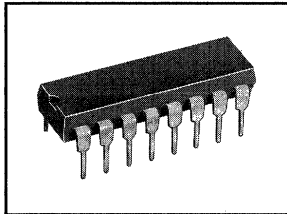
MSP06A-03-102G = A molded single-in-line thick film resistor network with 6 pins on .100" [2.54] centers, .195" [4.95] maximum seated height, 03 schematic, resistance value of 1000 ohm and a tolerance of ± 2%.

EXAMPLE:

MSP06A-05-221/331G = A molded single-in-line thick film resistor network with 6 pins on .100" [2.54] centers, .195" [4.95] maximum seated height, 05 schematic with resistances of $R_1 = 220$ ohm and $R_2 = 330$ ohm and a tolerance ± 2%.

MODELS MDP14, MDP16, MDP18 Thick Film Resistor Networks

Dual-In-Line, Molded
01, 03, 05 Schematics

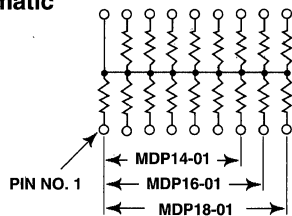


FEATURES

- .160" [4.06] maximum seated height
- Rugged, molded case construction
- Highly stable thick film
- Low temperature coefficient
(- 55°C to + 125°C) $\pm 100\text{PPM}/^\circ\text{C}$
- Reduces total assembly costs
- Compatible with automatic inserting equipment
- Wide resistance range
- Uniform performance characteristics
- Available in tube pack

CIRCUIT APPLICATIONS

01 Schematic

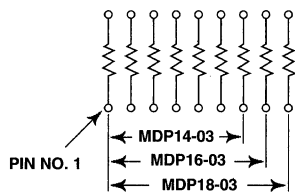


13, 15 or 17 resistors with one pin common

The MDPXX-01 circuit provides a choice of 13, 15 or 17 nominally equal resistors, each connected between a common pin (14, 16 or 18) and a discrete P.C. board pin. Commonly used in the following applications:

- MOS/ROM Pull-up/Pull-down
- TTL Input Pull-down
- Open Collector Pull-up
- Digital Pulse Squaring
- "Wired OR" Pull-up
- TTL Unused Gate Pull-up
- Power Driven Pull-up
- High Speed Parallel Pull-up

03 Schematic

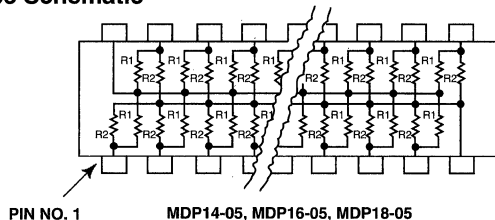


7, 8 or 9 isolated resistors

The MDPXX-03 provides a choice of 7, 8 or 9 nominally equal resistors, each resistor isolated from all others and wired directly across. Commonly used in the following applications:

- "Wired OR" Pull-up
- Long-line Impedance Balancing
- Power Driven Pull-up
- LED Current Limiting
- Powergate Pull-up
- ECL Output Pull-down
- Line Termination
- TTL Input Pull-down

05 Schematic



TTL dual-line terminator; pulse squaring

The MDPXX-05 circuit contains 12, 14 or 16 series pairs of resistors. Each series pair is connected between ground and a common line. The junction of these resistor pairs is connected to the input terminals. The 05 circuits are designed for TTL dual-line termination and pulse squaring.

ELECTRICAL SPECIFICATIONS

Resistance Range:

01 and 03 schematics: 10 ohm to 2.2 Megohm standard.

Tolerance:

01 and 03 schematic: $\pm 2\%$ standard.
 $\pm 1\%$ and $\pm 5\%$ available.
05 schematic: $\pm 2\%$ standard.
 $\pm 1\%$ and $\pm 5\%$ available.

Temperature Coefficient: (- 55°C to + 125°C)
 $\pm 100\text{PPM}/^\circ\text{C}$ typical.

Temperature Coefficient of T.C. Tracking:

(- 55°C to + 125°C)
01 and 03 schematics: $\pm 50\text{PPM}/^\circ\text{C}$.
05 schematic: $\pm 150\text{PPM}/^\circ\text{C}$ standard.
(Tighter tracking available).

Resistor Power Rating: (Maximum at 25°C)
See derating curve.

Resistor Power Rating: (Maximum at 70°C).

01 and 05 schematics = .125 watt. 03 schematic = .250 watt.

Package Power Rating: (Maximum at 25°C and 70°C)
See derating curve.

Voltage Coefficient of Resistance: < 50PPM/V typical.

Maximum Operating Voltage: 100 VDC.

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

Storage Temperature Range: - 55°C to + 150°C.

MECHANICAL SPECIFICATIONS

Marking Resistance to Solvents: Permanency testing per MIL-STD-202, Method 215.

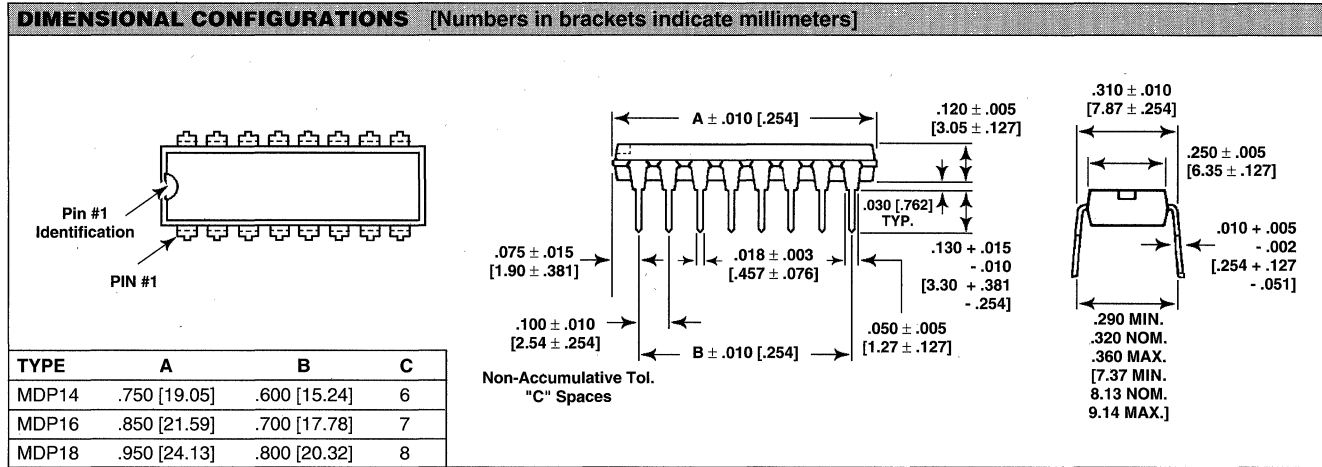
Solderability: Per MIL-STD-202, Method 208E.

Body: Molded epoxy.

Terminals: Copper alloy, tin-lead plated.

Weight: 14 pin = 1.3 grams; 16 pin = 1.5 grams;
18 pin = 1.7 grams.

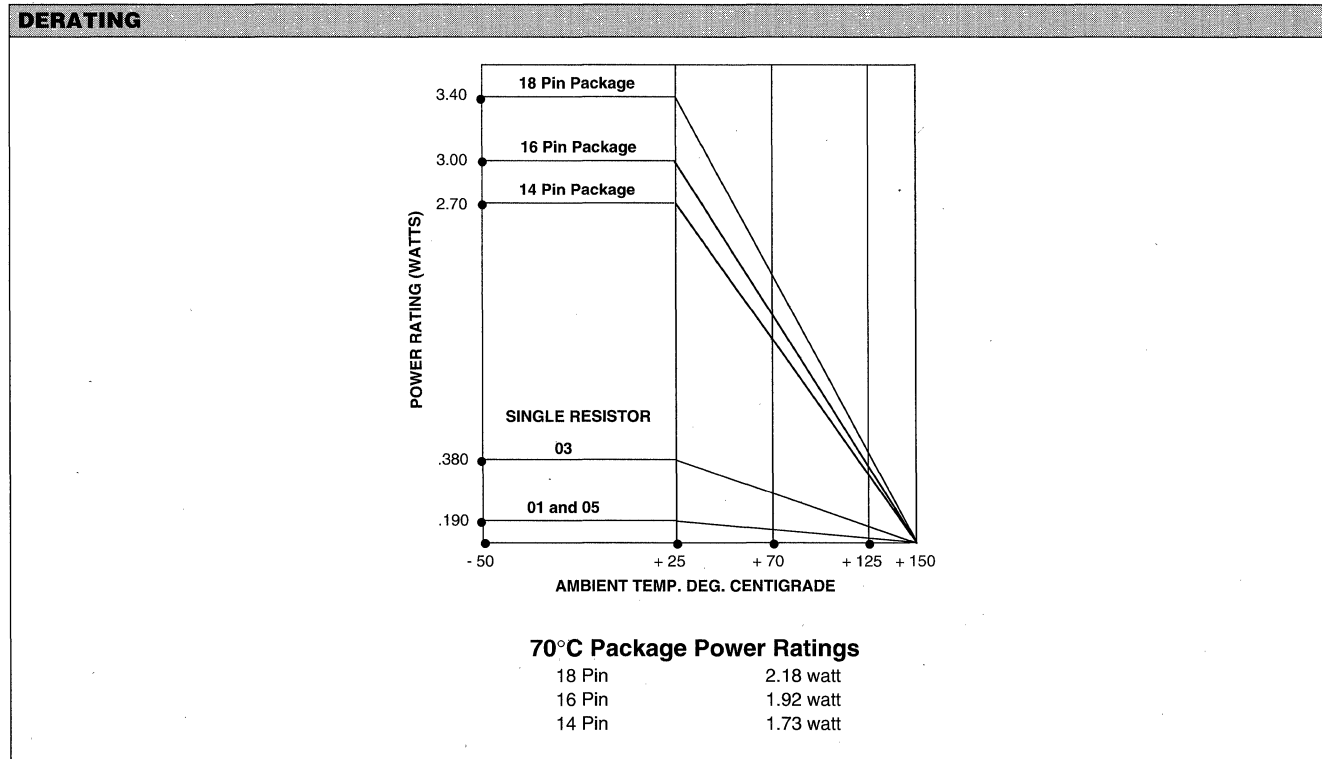
MODELS MDP14, MDP16, MDP18



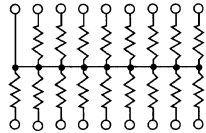
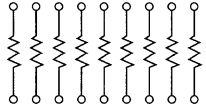
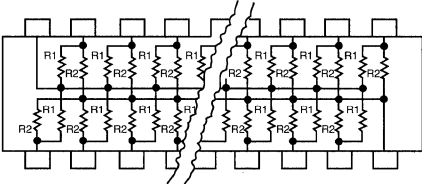
ENVIRONMENTAL PERFORMANCE *

TEST	CONDITIONS	MAX. ΔR (Typical Test Lots)
Power Conditioning	1 1/2 rated power, applied 1 1/2 hours on and 1/2 hour off for 100 hours ± 4 hours at 25°C ambient temperature	± 0.50% ΔR
Thermal Shock	5 cycles between - 65°C and + 125°C	± 0.50% ΔR
Short Time Overload	2 1/2 x rated working voltage 5 seconds	± 0.25% ΔR
Low Temperature Operation	45 minutes at full rated working voltage at - 65°C	± 0.25% ΔR
Moisture Resistance	240 hours with humidity ranging from 80% RH to 98% RH	± 0.05% ΔR
Resistance to Soldering Heat	Leads immersed in 350°C solder to within 1/16" of device body for 3 seconds	± 0.25% ΔR
Shock	Total of 18 shocks at 100 G's	± 0.25% ΔR
Vibration	12 hours at maximum of 20 G's between 10 and 2,000 Hz	± 0.25% ΔR
Load Life	1,000 hours at 70°C, rated power applied 1 1/2 hours on, 1/2 hour off for full 1,000 hour period. Derated according to the curve.	± 1.00% ΔR
Terminal Strength	4 1/2 pound pull for 30 seconds	± 0.25% ΔR
Insulation Resistance	10,000 Megohm (minimum)	
Dielectric Withstanding Voltage	No evidence of arcing or damage (200 VRMS for 1 minute)	

* Test methods per MIL-STD-202.



MODELS MDP14, MDP16, MDP18

STOCKED RESISTANCE VALUES IN OHMS ("G" Tolerance) *																
01 Schematic 	Model MDP14-01				Models MDP16-01 and MDP18-01											
	22	75	180	510	1.5k	3.3k	8.2k	22k	100k	22	110	470	1.8k	6.0k	27k	120k
	27	82	200	560	1.6k	3.9k	9.1k	27k	120k	33	120	510	2.0k	6.8k	33k	150k
	33	91	220	620	1.8k	4.7k	10k	33k	150k	39	150	560	2.2k	8.2k	39k	180k
	39	100	240	680	2.0k	5.1k	11k	39k	180k	47	180	680	2.7k	10k	47k	220k
	47	120	270	820	2.2k	5.6k	12k	47k	220k	56	220	820	3.3k	12k	56k	330k
	51	130	330	1.0k	2.4k	6.0k	15k	56k	330k	68	270	1.0k	3.9k	15k	68k	470k
	56	150	390	1.2k	2.7k	6.8k	18k	68k	470k	82	330	1.2k	4.7k	18k	82k	1 Meg
	68	160	470	1.3k	3.0k	7.5k	20k	82k	1Meg	100	390	1.5k	5.6k	22k	100k	
	03 Schematic 	Model MDP14-03				Models MDP16-03 and MDP18-03										
22		56	150	390	1.0k	2.7k	6.2k	16k	82k	22	120	820	4.7k	27k	180k	
24		62	160	430	1.1k	3.0k	6.8k	18k	100k	33	150	1.0k	5.6k	33k	220k	
27		68	180	470	1.2k	3.3k	7.5k	20k	120k	39	180	1.2k	6.0k	39k	330k	
30		75	200	510	1.3k	3.6k	8.2k	22k	150k	47	220	1.5k	6.8k	47k	470k	
33		82	220	560	1.5k	3.9k	9.1k	27k	180k	56	270	1.8k	8.2k	56k	680k	
36		91	240	620	1.6k	4.3k	10k	33k	220k	62	330	2.0k	10k	68k	1 Meg	
39		100	270	680	1.8k	4.7k	11k	39k	330k	68	390	2.2k	12k	82k		
43		110	300	750	2.0k	5.1k	12k	47k	470k	82	470	2.7k	15k	100k		
47		120	330	820	2.2k	5.6k	13k	56k	1Meg	100	560	3.3k	18k	120k		
51	130	360	910	2.4k	6.0k	15k	68k		110	680	3.9k	22k	150k			
05 Schematic 	Models MDP14-05, MDP16-05 AND MDP18-05															
	VALUE		Zo		VALUE		Zo									
	180/390		123		330/470		194									
	220/270		121		330/680		222									
	220/330		132		1.5k/3.3k		1.03k									
330/390		179														

* Other values from 10 ohm to 3.3 Megohm.

HOW TO ORDER

01 and 03 Schematic

<u>MDP</u> MODEL	<u>14</u> NUMBER OF PINS	<u>01</u> <u>03</u> SCHEMATIC	<u>101</u> RESISTANCE VALUE	<u>G</u> TOLERANCE
			First 2 digits (3 for "F" tolerance) are significant figures. Last digit specifies number of zeros to follow.	F = ± 1% G = ± 2% J = ± 5%

05 Schematic

<u>MDP</u> MODEL	<u>14</u> NUMBER OF PINS	<u>05</u> SCHEMATIC	<u>221</u> RESISTANCE VALUE R ₁	<u>271</u> RESISTANCE VALUE R ₂	<u>G</u> TOLERANCE
			First two digits (3 for "F" tolerance) are significant figures. The last digit specifies the number of zeros to follow.		F = ± 1% G = ± 2% J = ± 5%

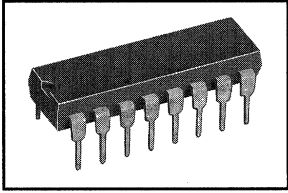
EXAMPLE:
MDP14-03-101G = A dual-in-line thick film resistor network with 14 pins on .100" [2.54] centers, 03 schematic, resistance of 100 ohm and a tolerance of ± 2%.

EXAMPLE:
MDP14-05-221/271G = A 14-pin dual-in-line thick film resistor network with 12 series pairs of resistors of 220 ohm and 270 ohm per pair and a tolerance of ± 2%.

MODELS MDP16-45 and MDP16-46

Thick Film Resistor Networks

Dual-In-Line, Molded

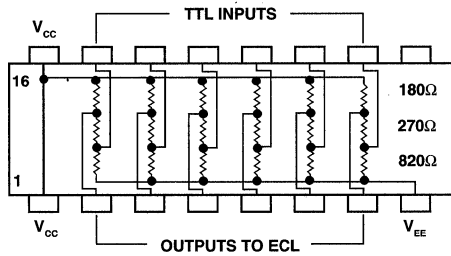


FEATURES

- .190" [4.83] maximum seated height
- Rugged, molded case construction
- Low temperature coefficient (- 55°C to + 125°C)
MDP16-45: $\pm 100\text{PPM}/^\circ\text{C}$, MDP16-46: $\pm 250\text{PPM}/^\circ\text{C}$
- Compatible with automatic insertion equipment
- Highly stable thick film
- Reduces P.C. board space
- Available in tube pack
- Reduces total assembly costs

CIRCUIT APPLICATIONS

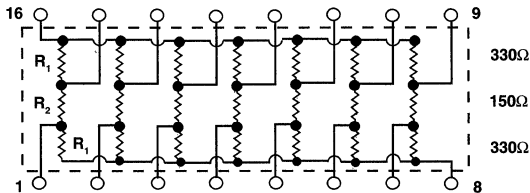
MDP16-45 Schematic



TTL to ECL translator

The MDP16-45 network consists of 18 resistors of 3 different values, internally divided into six (6) identical three (3) resistor sections for TTL to ECL translation.

MDP16-46 Schematic



SCSI-BUS signal terminator

The MDP16-46 network consists of 21 resistors of 2 different values, internally divided into seven (7) identical three (3) resistor sections for SCSI-BUS terminator applications.

ELECTRICAL SPECIFICATIONS

Resistance Values:

MDP16-45: 180 ohm, 270 ohm and 820 ohm in each of six (6) sections.

MDP16-46: 330 ohm, 150 ohm and 330 ohm in each of seven (7) sections.

Resistance Tolerance:

MDP16-45: $\pm 2\%$. MDP16-46: $\pm 5\%$.

Resistance Temperature Coefficient: (- 55°C to + 125°C)

MDP16-45: $\pm 100\text{PPM}/^\circ\text{C}$ typical.

MDP16-46: $\pm 250\text{PPM}/^\circ\text{C}$ typical.

Temperature Coefficient of R Tracking: $\pm 150\text{PPM}/^\circ\text{C}$.

Resistor Power Rating: (Maximum at 25°C) .125 watt.

Package Power Rating: (Maximum at 25°C) 2.0 watts.

Voltage Coefficient of Resistance: $< 50\text{PPM}/\text{V}$ typical.

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

Storage Temperature Range: - 55°C to + 150°C.

MECHANICAL SPECIFICATIONS

Marking Resistance to Solvents: Permanency testing per MIL-STD-202, Method 215.

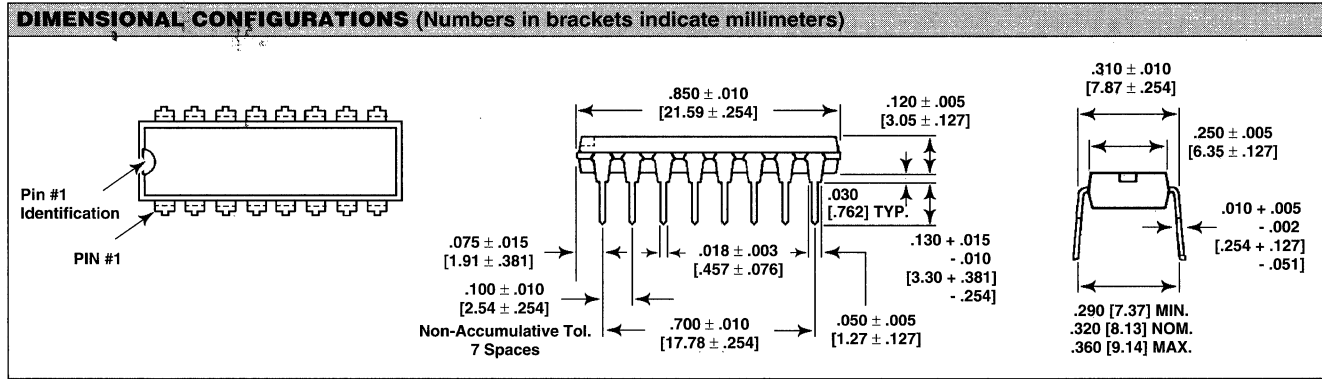
Solderability: Per MIL-STD-202, Method 208E.

Terminals: Copper alloy, tin-lead plated.

Body: Molded epoxy.

Weight: 1.5 grams.

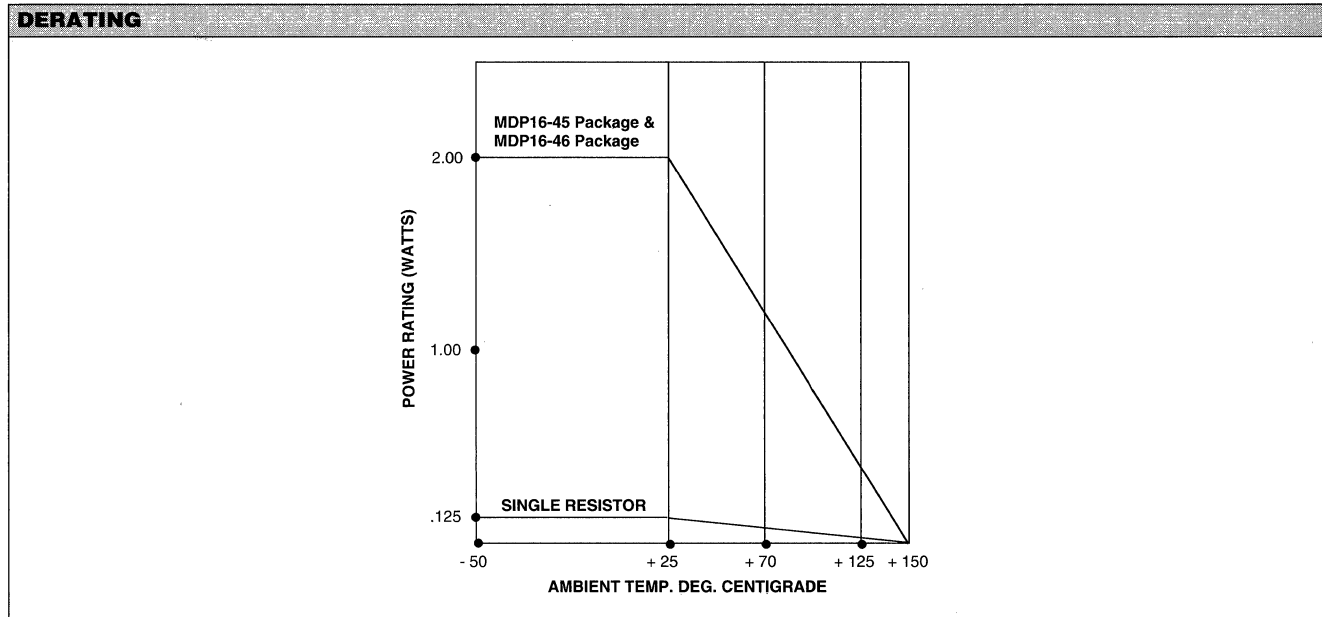
MODELS MDP16-45 and MDP16-46



ENVIRONMENTAL PERFORMANCE *

TEST	CONDITIONS	MAX. ΔR (Typical Test Lots)
Thermal Shock	5 cycles between - 65°C and + 125°C	± 0.50% ΔR
Short Time Overload	2 1/2 x rated working voltage 5 seconds	± 0.25% ΔR
Low Temperature Operation	45 minutes at full rated working voltage at - 65°C	± 0.25% ΔR
Moisture Resistance	240 hours with humidity ranging from 80% RH to 98% RH	± 0.50% ΔR
Resistance to Soldering Heat	Leads immersed in 350°C solder to within 1/16" of body for 3 seconds	± 0.25% ΔR
Shock	Total of 18 shocks at 100 G's	± 0.25% ΔR
Vibration	12 hours at maximum of 20 G's between 10 and 2,000 Hz	± 0.25% ΔR
Load Life	1,000 hours at 70°C, rated power applied 1 1/2 hours on, 1/2 hour off for full 1,000 hour period. Derated according to the curve	± 0.50% ΔR
Terminal Strength	4 1/2 pound pull for 30 seconds	± 0.25% ΔR
Insulation Resistance	10,000 Megohm (minimum)	
Dielectric Withstanding Voltage	No evidence of arcing or damage (200 V RMS for 1 minute)	

* Test methods per MIL-STD-202.

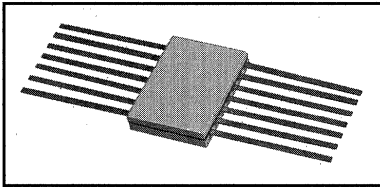


HOW TO ORDER

MDP MODEL	16 NUMBER OF PINS	45 46 SCHEMATIC
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MODELS DFP14 and DFP16 Thick Film Resistor Networks

Flat Pack, 01, 02, 11, 12 Schematics

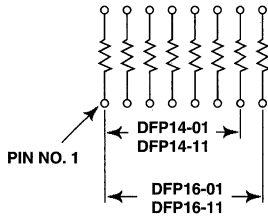


FEATURES

- 01 and 02 schematics - gold plated leads
- 11 and 12 schematics - tin-lead plated leads
- .065" [1.65] height for high density packaging
- Low temperature coefficient (-55°C to +125°C) ± 100PPM/°C
- Hot-solder dipped or gold-plated leads
- Highly stable thick film
- Wide resistance range
- All devices are capable of passing the MIL-STD-202, Method 210, Condition E "Resistance to Soldering Heat" test

CIRCUIT APPLICATIONS

01, 11 Schematic

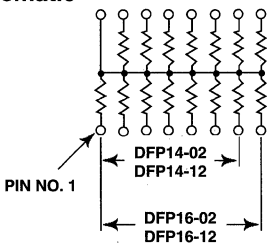


7 or 8 isolated resistors

The DFPXX-01 and DFPXX-11 provide the user with 7 or 8 nominally equal resistors with each resistor isolated from all others. Commonly used in the following applications:

- "Wired OR" Pull-up
- Power Driven Pull-up
- Power Gate Pull-up
- Line Termination
- Long-line Impedance Balancing
- LED Current Limiting
- ECL Output Pull-down
- TTL Input Pull-down

02, 12 Schematic



13 or 15 resistors with one pin common

The DFPXX-02 and DFPXX-12 provide the user with a choice of 13 or 15 nominally equal resistors, each connected to a common pin (14 or 16). Commonly used in the following applications:

- MOS/ROM Pull-up/Pull-down
- Open Collector Pull-up
- "Wired OR" Pull-up
- Power Driven Pull-up
- TTL Input Pull-down
- Digital Pulse Squaring
- TTL Unused Gate Pull-up
- High Speed Parallel Pull-up

ELECTRICAL SPECIFICATIONS

- Resistance Range:** 10 ohm to 1 Megohm.
- Tolerance:** ± 2% standard. ± 1% and ± 5% available.
- Temperature Coefficient:** (-55°C to +125°C) ± 100PPM/°C typical.
- Isolation Resistance:** 01 and 11 schematic: >100 Megohm.
- Resistor Power Rating:** (Maximum at 25°C)
01, 11 schematics = 0.25 watt. 02, 12 schematics = 0.15 watt.
- Package Power Rating:** (Maximum at 25°C) 0.65 watt.
- T. C. Tracking:** (-55°C to +125°C) 50PPM/°C.
- Voltage Coefficient of Resistance:** < 50PPM/V typical.
- Maximum Operating Voltage:** 75 VDC.

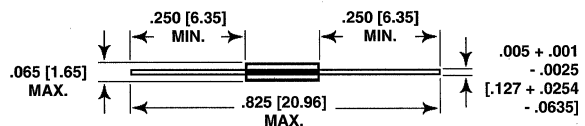
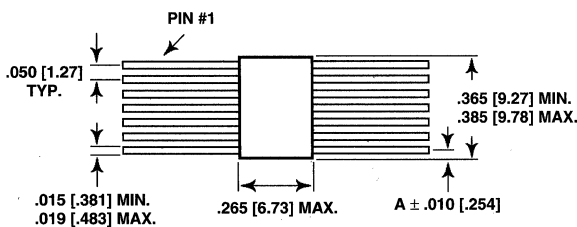
Operating Temperature Range: -55°C to +125°C.

Storage Temperature Range: -55°C to +150°C.

MECHANICAL SPECIFICATIONS

- Marking Resistance to Solvents:** Permanency testing per MIL-STD-202, Method 215.
- Solderability:** Per MIL-STD-202, Method 208E.
- Body:** Epoxy filled ceramic sandwich.
- Terminals:** Per MIL-STD-1276:
DFPXX-01, DFPXX-02 = Type G (gold plated).
DFPXX-11, DFPXX-12 = Type G (hot-solder dipped).
Hot-solder dipped leads supplied as standard finish unless otherwise specified.

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



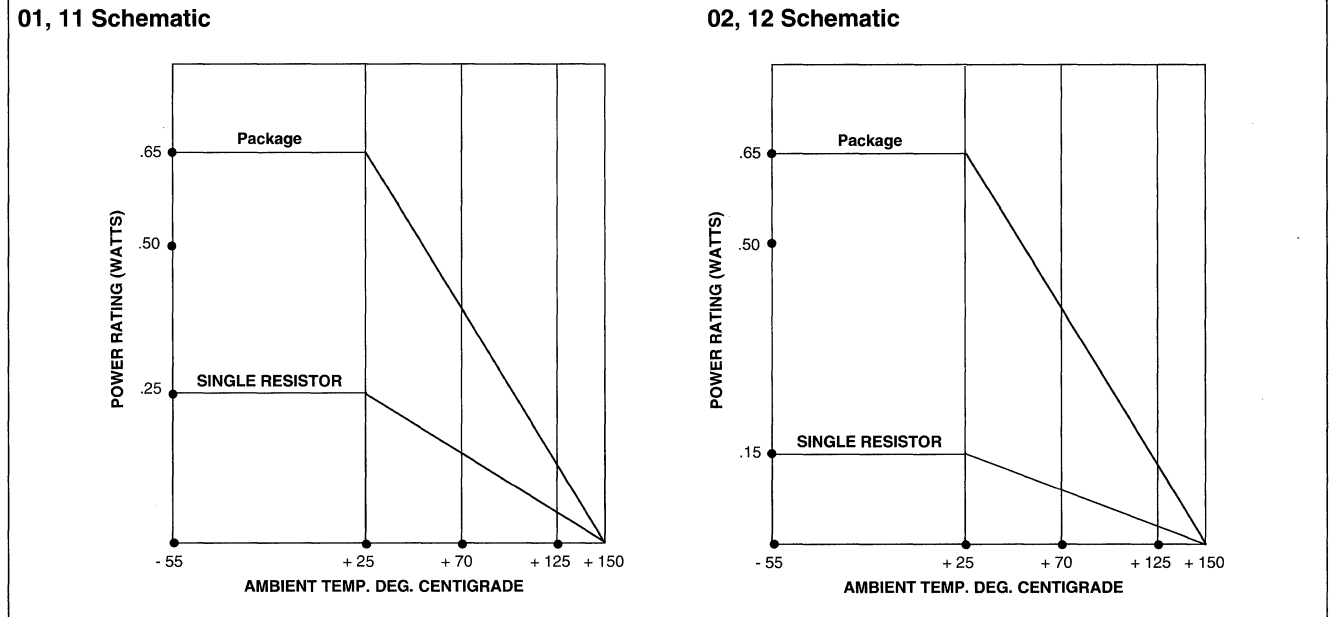
MODEL	A
DFP14	.037 [.940]
DFP16	.012 [.305]

MODELS DFP14 and DFP16

ENVIRONMENTAL PERFORMANCE *		
TEST	CONDITIONS	MAX. ΔR (Typical Test Lots)
Power Conditioning	1 1/2 x rated power, applied 1 1/2 hours on and 1/2 hour off for 100 hours ± 4 hours at 25°C ambient temperature	± 0.50% ΔR
Thermal Shock	5 cycles between - 65°C and + 125°C	± 0.50% ΔR
Short Time Overload	2 1/2 x rated working voltage 5 seconds	± 0.25% ΔR
Low Temperature Operation	45 minutes at full rated working voltage at - 65°C	± 0.25% ΔR
Moisture Resistance	240 hours with humidity ranging from 80% RH to 98% RH	± 0.50% ΔR
Resistance to Soldering Heat	Leads immersed in 350°C solder to within 1/16" of body for 3 seconds	± 0.25% ΔR
Shock	Total of 18 shocks at 100 G's	± 0.25% ΔR
Vibration	12 hours at maximum of 20 G's between 10 and 2,000 Hz	± 0.25% ΔR
Load Life	1,000 hours at 70°C, rated power applied 1 1/2 hours on, 1/2 hour off for full 1,000 hour period. Derated according to the curve	± 0.50% ΔR
Terminal Strength	4 1/2 pound pull for 30 seconds	± 0.25% ΔR
Insulation Resistance	10,000 Megohm (minimum)	
Dielectric Withstanding Voltage	No evidence of arcing or damage (200 V RMS for 1 minute)	

* Test methods per MIL-STD-202.

DERATING



STOCKED RESISTANCE VALUES IN OHMS ("G" Tolerance)

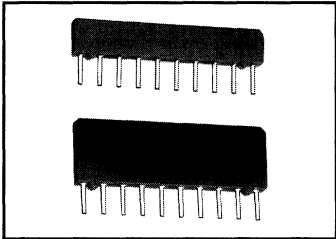
100	330	510	1.0k	2.0k	3.0k	4.7k	6.8k	22k
200	470	680	1.5k	2.2k	3.3k	5.1k	10k	100k

HOW TO ORDER

DFP	14	-	0	2	-	102	G
MODEL	NUMBER OF PINS		TERMINAL FINISH	SCHEMATIC		RESISTANCE VALUE	TOLERANCE
			0 = Type G gold, optional. 1 = Type G hot-solder dipped, standard.			The first three digits are significant figures and the last digit specifies the number of zeros to follow.	F = ± 1% G = ± 2% J = ± 5%
<p>EXAMPLE: DFP14-01-102G = A flat pack thick film network with 14 pins on .050" [1.27] centers, 01 schematic, resistance of 1,000 ohms and tolerance of ± 2%, with Type G gold plated terminals.</p>				<p>EXAMPLE: DFP14-02-102G = A flat pack thick film network with 14 pins on .050" [1.27] centers, 02 schematic, resistance of 1,000 ohms and tolerance of ± 2%, with Type G gold plated terminals.</p>			

M83401/04, 05, 06, 07, 08, 09 Thick Film Resistor Networks

Military, MIL-R-83401 Qualified
Single-In-Line Package, C & G Schematics

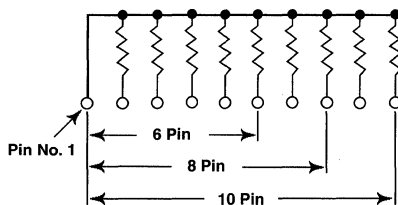


FEATURES

- .36 watt to 1.8 watt at 70°C
- Qualified to MIL-R-83401
- Designed for automatic insertion
- Withstands thermal stress from -65°C to +125°C
- Conforms to IC package configurations
- High temperature solder joints
- Techno's capabilities include designing special resistor networks from customer supplied schematics. We welcome the opportunity to work with customer engineers during the initial design phase.

CIRCUIT APPLICATIONS

C Schematic



Standard Profile

6 pin (M8340104XXXXXXC)
8 pin (M8340105XXXXXXC)
10 pin (M8340106XXXXXXC)

Low Profile

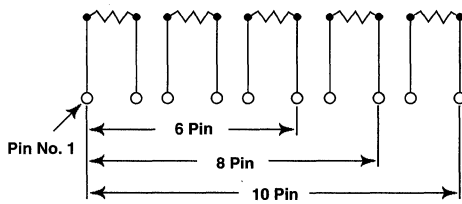
6 pin (M8340107XXXXXXC)
8 pin (M8340108XXXXXXC)
10 pin (M8340109XXXXXXC)

5, 7 or 9 resistors with one pin common

This model provides the user with a choice of 5, 7 or 9 nominally equal resistors, each connected to a common pin (Pin No.1). Commonly used in the following applications:

- "Wired OR" Pull-up
- Power Gate Pull-up
- MOS/ROM Pull-up/Pull-down
- Open Collector Pull-up
- TTL Input Pull-down
- TTL Unused Gate Pull-up

G Schematic



Standard Profile

6 pin (M8340104XXXXXXG)
8 pin (M8340105XXXXXXG)
10 pin (M8340106XXXXXXG)

Low Profile

6 pin (M8340107XXXXXXG)
8 pin (M8340108XXXXXXG)
10 pin (M8340109XXXXXXG)

3, 4 or 5 isolated resistors

This model provides the user with a choice of 3, 4 or 5 nominally equal resistors. Each resistor is isolated from all others. Commonly used in the following applications:

- "Wired OR" Pull-up
- Power Driven Pull-up
- Power Gate Pull-up
- Line Termination
- Long-line Impedance Balancing
- LED Current Limiting
- ECL Output Pull-down
- TTL Input Pull-down

ELECTRICAL SPECIFICATIONS

Resistance Range: 100 ohm to 1 Megohm standard profile, 27 ohm to 1 Megohm low profile.

Resistance Tolerance: ± 1%, ± 2%, ± 5% standard. Tighter tolerances available.

Temperature Coefficient: (-65°C to +125°C)
"K" = ± 100PPM/°C, "M" = ± 300PPM/°C.

Package Power Rating:

Schematic	Standard Profile	Low Profile
C	1.0 watt to 1.8 watt	0.6 watt to 1.08 watt
G	0.6 watt to 1.0 watt	.36 watt to .60 watt

Maximum Operating Voltage: 50 volts per resistor.

Dielectric Strength: 200 V RMS, 1 minute.

Insulation Resistance: 10,000 Megohm minimum.

MECHANICAL SPECIFICATIONS

Resistive Element: Thick film.

Encapsulation: Phthalate.

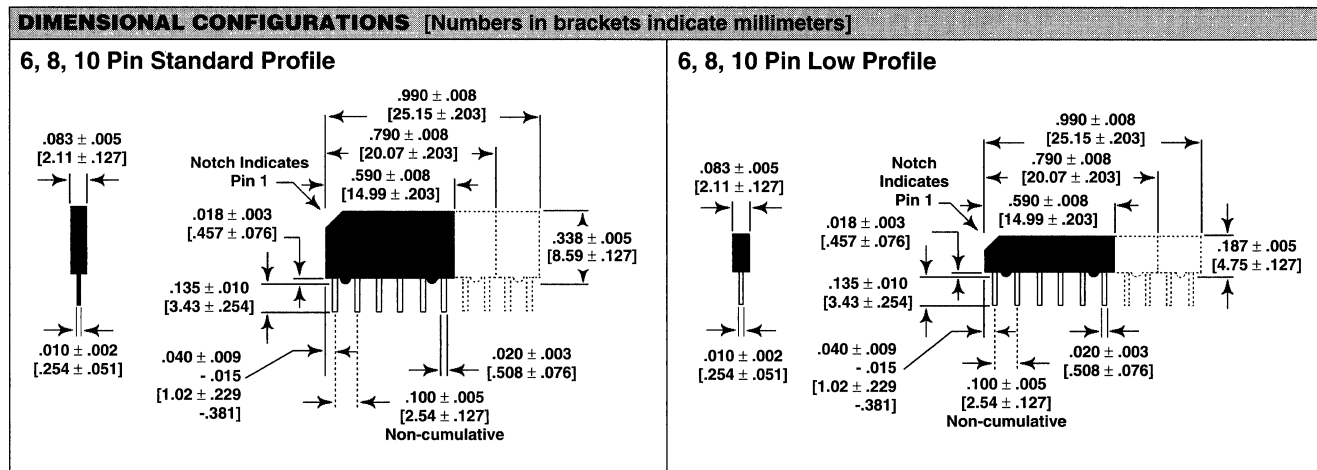
Terminals: Solderable leads.

Terminal Strength: 4.5 pounds applied to 5 terminals for 30 seconds.

Solderability: Meets MIL-STD-202, Method 208.

ENVIRONMENTAL SPECIFICATIONS

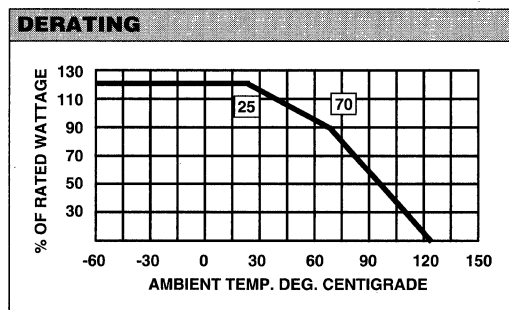
Temperature Limits: -65°C to +125°C.



ENVIRONMENTAL PERFORMANCE

TEST ¹	CONDITIONS	MIL-R-83401 REQUIREMENT ³	TYPICAL ΔR
Power Conditioning (108)	100 hours at 1.5 times rated power at 25°C, 90°/30° cycle	Group A Combined	ΔR < 0.10%
Thermal Shock (107)	5 cycles, - 65°C to + 125°C	ΔR ≤ 0.70% ²	
Thermal Shock Group C (107)	25 cycles, - 65°C to + 125°C	ΔR ≤ 0.70% ²	ΔR < 0.10%
Short Time Overload	2.5 times rated voltage not to exceed 2 times rated power for 5 seconds	ΔR ≤ 0.25% ²	ΔR < 0.02%
Low Temperature Storage	24 hours, no load at - 65°C	ΔR ≤ 0.25% ²	ΔR < 0.02%
Low Temperature Operation	1 hour storage, 45 minutes rated power at - 65°C	ΔR ≤ 0.25% ²	ΔR < 0.02%
High Temperature Exposure	100 hours, no load at 125°C	ΔR ≤ 0.50% ²	ΔR < 0.06%
Moisture Resistance (106)	240 hours with humidity ranging from 80% RH to 98% RH	ΔR ≤ 0.50% ²	ΔR < 0.20%
Resistance to Soldering Heat (210)	350° for 3 seconds	ΔR ≤ 0.25% ²	ΔR < 0.05%
Shock (213)	18 shocks, 100 g, 6 ms, sawtooth, 3 axes	ΔR ≤ 0.25% ²	ΔR < 0.04%
Vibration (204)	10 to 2000 Hz, 20 g, 12 hours, 3 axes	ΔR ≤ 0.25% ²	ΔR < 0.04%
Load Life (108)	1000 hours at rated power at 75°C and at rated power at 25°C, 90°/30° cycle	ΔR ≤ 0.50% ²	ΔR < 0.20%

1. Numbers in parenthesis refer to test method of MIL-STD-202 as modified by the detail specification.
 2. For values below 100 ohm, add 0.05 ohm to the allowable change.
 3. The referenced tests also require that setting stability change shall not exceed ± 0.05 percent plus the specified maximum resolution.



POWER RATING

The power rating listed for each network is based on continuous full-load operation at an ambient temperature of 70°C. When the network is operated at temperatures other than 70°C, the power rating should be scaled linearly as shown.

- PART MARKING**
- Complete part number
 - Resistance value
 - Tolerance value
 - Manufacturer's name or code
 - Date code
 - Pin identifier

HOW TO ORDER - MILITARY PART NUMBER

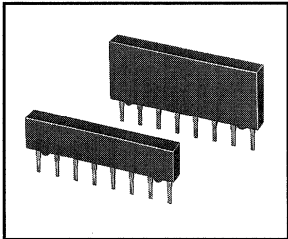
<p>M83401 MILITARY SPECIFICATION NO.</p>	<p>06 SIZE</p>	<p>K M CHARACTERISTIC</p>	<p>1003 VALUE</p>	<p>F TOLERANCE</p>	<p>C G SCHEMATIC</p>
	<p>04 = 6 Pin Standard Profile SIP 05 = 8 Pin Standard Profile SIP 06 = 10 Pin Standard Profile SIP 07 = 6 Pin Low Profile SIP 08 = 8 Pin Low Profile SIP 09 = 10 Pin Low Profile SIP</p>	<p>K = ± 100PPM/°C M = ± 300PPM/°C</p>	<p>First three digits are significant figures. Last digit specifies number of zeros. Use R as decimal point for value less than 100 ohm. Example: 30R0 = 30Ω.</p>	<p>F = ± 1% G = ± 2% J = ± 5%</p>	

EXAMPLE:
M8340106M1003FC = A single-in-line resistor network with 10 pins, a standard profile, a T.C.R. of ± 300 PPM/°C, resistance value of 100 kilohms, tolerance of 1% and to schematic "C".

MODEL MSM

Thick Film Resistor Networks

Military, MIL-R-83401 Qualified, Type RZ
Single-In-Line, Molded - 01, 03, 05 Schematics



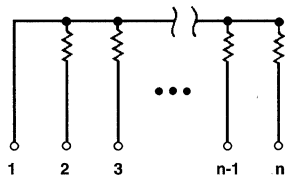
FEATURES

- MIL-R-83401 qualified
- .195" [4.95] "A" and .350" [8.89] "C" maximum seated heights
- Highly stable thick film
- T.C.R. available in "K" ($\pm 100\text{PPM}/^\circ\text{C}$) or "M" ($\pm 300\text{PPM}/^\circ\text{C}$) characteristic
- All device leads are hot-solder dipped
- Rugged molded case construction
- Compatible with automatic insertion equipment
- 100% screen tested per Group A, Subgroup 1 of MIL-R-83401
- All devices are capable of passing the MIL-STD-202, Method 210, Condition E "Resistance to Soldering Heat" test
- Available in tube pack

CIRCUIT APPLICATION

01 Schematic

5, 7 or 9 resistors with one pin common



"A" Profile

"C" Profile

MSM06A-01 (M8340107XXXXXXC)

MSM06C-01 (M8340104XXXXXXC)

MSM08A-01 (M8340108XXXXXXC)

MSM08C-01 (M8340105XXXXXXC)

MSM10A-01 (M8340109XXXXXXC)

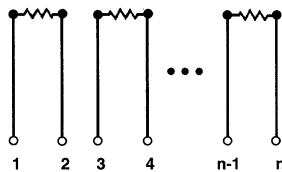
MSM10C-01 (M8340106XXXXXXC)

The MSM06A-01, MSM08A-01, MSM10A-01, MSM06C-01, MSM08C-01 and MSM10C-01 molded single-in-line resistor networks provide the user with a choice of 5, 7 or 9 nominally equal resistors, each connected to a common pin (Pin No. 1). Commonly used in the following applications:

- "Wired OR" Pull-up
- Power Gate Pull-up
- MOS/ROM Pull-up/Pull-down
- Open Collector Pull-up
- TTL Input Pull-down
- TTL Unused Gate Pull-up

03 Schematic

3, 4 or 5 isolated resistors



"A" Profile

"C" Profile

MSM06A-03 (M8340107XXXXXXG)

MSM06C-03 (M8340104XXXXXXG)

MSM08A-03 (M8340108XXXXXXG)

MSM08C-03 (M8340105XXXXXXG)

MSM10A-03 (M8340109XXXXXXG)

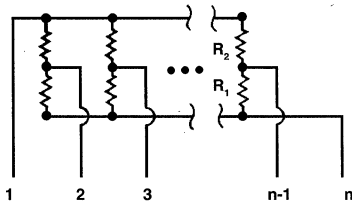
MSM10C-03 (M8340106XXXXXXG)

The MSM06A-03, MSM08A-03, MSM10A-03, MSM06C-03, MSM08C-03 and MSM10C-03 molded single-in-line resistor networks provide the user with a choice of 3, 4 or 5 nominally equal resistors. Each resistor is isolated from all others. Commonly used in the following applications:

- "Wired OR" Pull-up
- Power Driven Pull-up
- Power Gate Pull-up
- Line Termination
- Long-Line Impedance Balance
- LED Current Limiting
- ECL Output Pull-down
- TTL Input Pull-down

05 Schematic

4, 6 or 8 isolated resistors



"A" Profile

"C" Profile

MSM06A-05 (M8340107XXXXXXH)

MSM06C-05 (M8340104XXXXXXH)

MSM08A-05 (M8340108XXXXXXH)

MSM08C-05 (M8340105XXXXXXH)

MSM10A-05 (M8340109XXXXXXH)

MSM10C-05 (M8340106XXXXXXH)

The MSM06A-05, MSM08A-05, MSM10A-05, MSM06C-05, MSM08C-05 and MSM10C-05 molded single-in-line resistor networks provide the user with a choice of 4, 6 or 8 pairs of R_1/R_2 resistor values for pulse squaring and TTL dual-line terminating requirements.

MODEL MSM

ELECTRICAL SPECIFICATIONS

Resistance Range: 01 and 03 schematics: 10 ohm to 1 Megohm. 05 schematic: See values in table.

Tolerance: ± 2% standard. ± 1% and ± 5% available.

Temperature Coefficient: (- 55°C to + 125°C)
 "K" = ± 100PPM/°C, "M" = ± 300PPM/°C.

Resistor Power Rating: (Maximum at 70°C .2 watt)
 MSMXXA-01, MSMXXC-01 and MSMXXC-03 = .2 watt
 MSMXXA-03 = .12 watt MSMXXC-05 = .11 watt
 MSMXXA-05 = .07 watt

Package Power Rating: (Maximum at 70°C)
 MSM06A-01 = .60 watt MSM06A-03 = .36 watt
 MSM08A-01 = .84 watt MSM08A-03 = .48 watt
 MSM10A-01 = 1.08 watt MSM10A-03 = .60 watt
 MSM06C-01 = 1.00 watt MSM06C-03 = .60 watt
 MSM08C-01 = 1.40 watt MSM08C-03 = .80 watt
 MSM10C-01 = 1.80 watt MSM10C-03 = 1.00 watt

MSM06A-05 = .56 watt MSM06C-05 = .88 watt
 MSM08A-05 = .84 watt MSM08C-05 = 1.32 watt
 MSM10A-05 = 1.12 watt MSM10C-05 = 1.76 watt

Maximum Operating Voltage: 50 VDC.

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

MECHANICAL SPECIFICATIONS

Body: Molded epoxy.

Terminals: Copper alloy, hot-solder dipped.

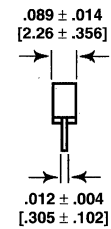
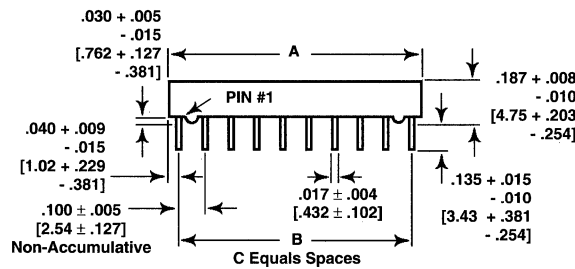
Solderability: Per MIL-R-83401.

Weight:

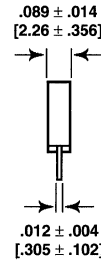
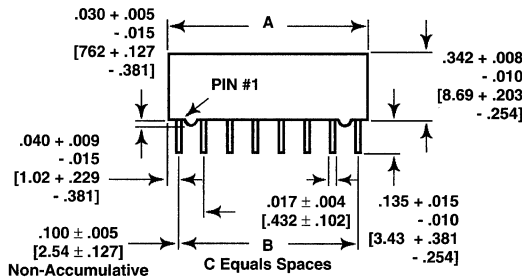
"A" Profile	"C" Profile
6 pin = .4 gram	6 pin = .7 gram
8 pin = .5 gram	8 pin = .9 gram
10 pin = .6 gram	10 pin = 1.1 gram

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

"A" Profile



"C" Profile



MODEL	A	B	C
MSM06	.583 ± .015 [14.81 ± .381]	.500 [12.70]	5
MSM08	.783 ± .015 [19.89 ± .381]	.700 [17.78]	7
MSM10	.983 ± .015 [24.97 ± .381]	.900 [22.86]	9

ENVIRONMENTAL PERFORMANCE *

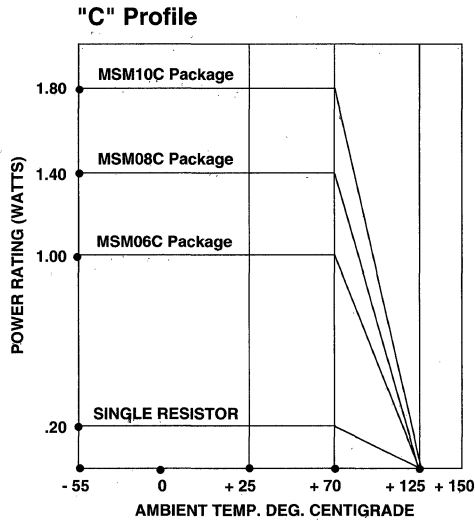
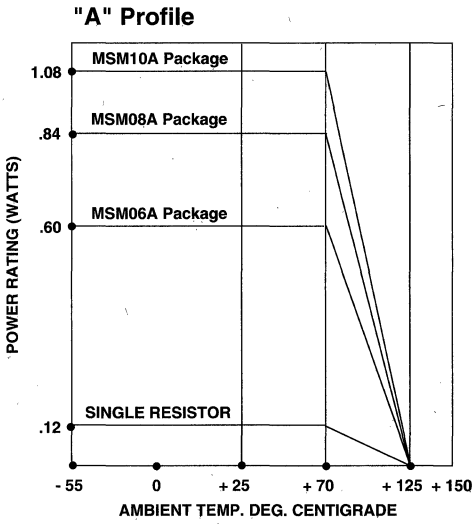
TEST	CONDITIONS	MAX. ΔR (Typical Test Lots)
Power Conditioning	1 1/2 x rated power, applied 1 1/2 hours on and 1/2 hour off for 100 hours ± 4 hours at 25°C ambient temperature	± 0.50% ΔR
Thermal Shock	5 cycles between - 65°C and + 125°C	± 0.50% ΔR
Short Time Overload	2 1/2 x rated working voltage 5 seconds	± 0.25% ΔR (Characteristic K) ± 0.50% ΔR (Characteristic M)
Low Temperature Operation	45 minutes at full rated working voltage at - 65°C	± 0.25% ΔR (Characteristic K) ± 0.50% ΔR (Characteristic M)
Moisture Resistance	240 hours with humidity ranging from 80% RH to 98% RH	± 0.50% ΔR
Resistance to Soldering Heat	Leads immersed in 350°C solder to within 1/16" of body for 3 seconds	± 0.25% ΔR
Shock	Total of 18 shocks at 100 G's	± 0.25% ΔR
Vibration	12 hours at maximum of 20 G's between 10 and 2,000 Hz	± 0.25% ΔR
Load Life	1,000 hours at 70°C, rated power applied 1 1/2 hours on, 1/2 hour off for full 1,000 hour period	± 0.50% ΔR (Characteristic K) ± 2.00% ΔR (Characteristic M)
Terminal Strength	4 1/2 pound pull for 30 seconds	± 0.25% ΔR
Insulation Resistance	10,000 Megohm (minimum)	
Dielectric Withstanding Voltage	No evidence of arcing or damage (200 V RMS for 1 minute)	

* Reference MIL-R-83401.

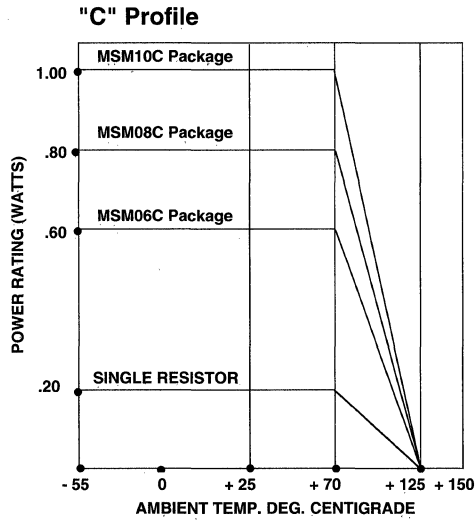
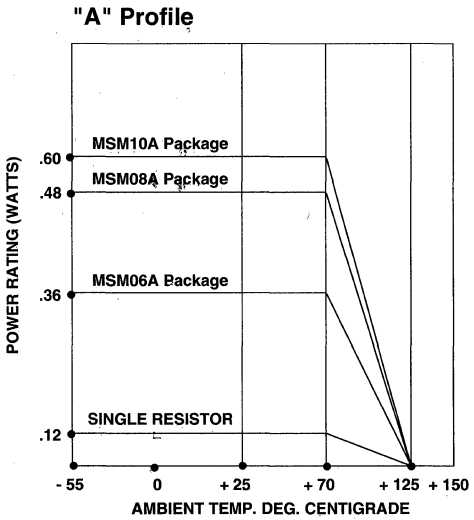
MODEL MSM

DERATING

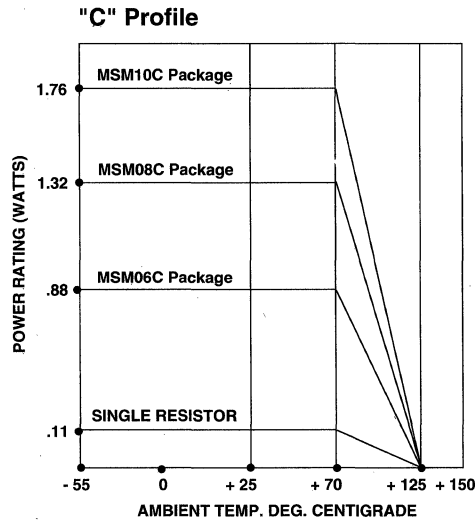
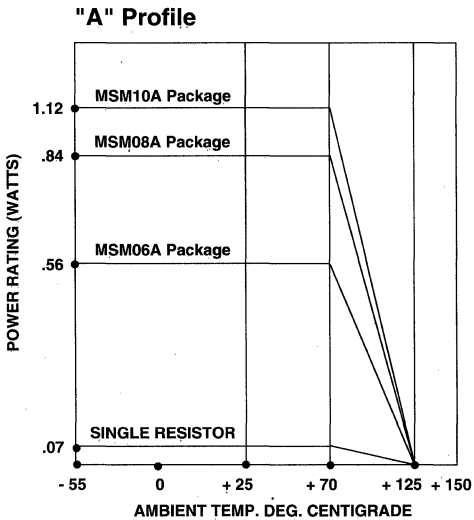
01 Schematic



03 Schematic



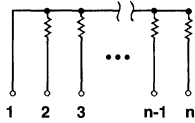
05 Schematic



MODEL MSM

STOCKED RESISTANCE VALUES IN OHMS ("G TOLERANCE)

01 Schematic



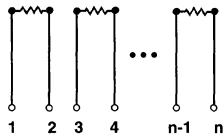
MSM06A-01, MSM08A-01, MSM10A-01

100	1.0k	4.7k	10k	100k	1Meg
510	3.3k	5.6k	22k	470k	

MSM06C-01, MSM08C-01, MSM10C-01

33	330	1.5k	6.8k	82k
39	470	2.0k	8.2k	100k
47	510	2.2k	10k	220k
68	560	2.7k	15k	470k
82	680	3.3k	22k	1 Meg
100	820	4.7k	27k	
150	1.0k	5.1k	47k	
220	1.2k	5.6k	56k	

03 Schematic



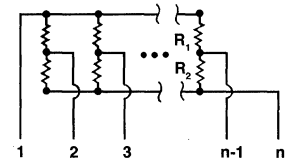
MSM06A-03, MSM08A-03, MSM10A-03

100	1.0k	10k	100k
-----	------	-----	------

MSM06C-03, MSM08C-03, MSM10C-03

10	330	3.3k	10k	100k
100	680	4.7k	20k	220k
220	1.0k	6.8k	22k	680k

05 Schematic

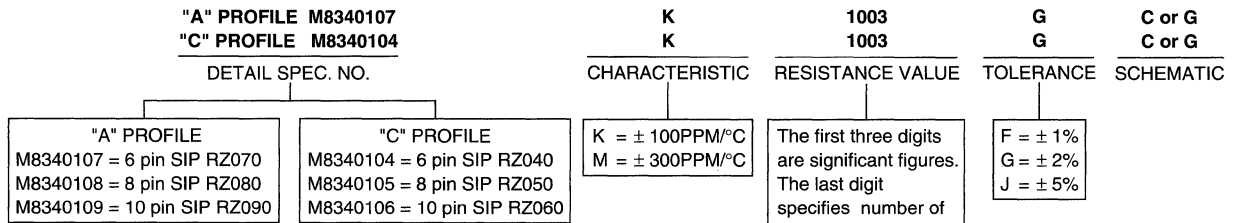


**MSM06A-05, MSM08A-05, MSM10A-05
MSM06C-05, MSM08C-05, MSM10C-05**

Consult factory for stocked values.

HOW TO ORDER - MILITARY PART NUMBER

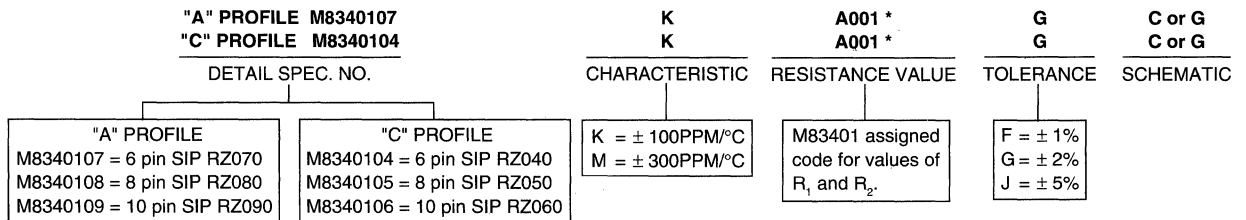
01, 03 Schematic



EXAMPLE:
M8340107K003GC = A low profile single-in-line resistor network with 6 pins and a T.C.R. of ± 100PPM/°C, resistance value of 100 kilohm, tolerance of 2% and a "C" schematic.

EXAMPLE:
M8340104K003GG = A high profile single-in-line resistor network with 6 pins and a T.C.R. of ± 100PPM/°C, resistance value of 100 kilohm, tolerance of 2% and "G" schematic.

05 Schematic



EXAMPLE:
M8340107KA001GH = A low profile single-in-line resistor network with 6 pins, a T.C.R. of ± 100PPM/°C, R₁ resistance value of 82 ohm, R₂ resistance value of 130 ohm, tolerance of ± 2% and "H" schematic.

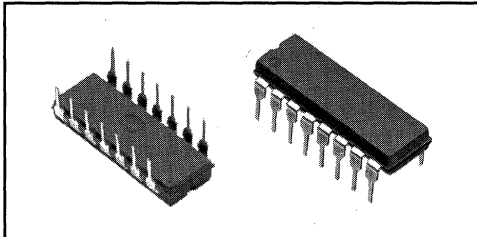
EXAMPLE:
M8340104KA001GH = A high profile single-in-line resistor network with 6 pins, a T.C.R. of ± 100PPM/°C, R₁ resistance value of 82 ohm, R₂ resistance value of 130 ohm, tolerance of ± 2% and "H" schematic.

* The H-schematic resistance values are specified by a 4-digit code, which comes from MIL-R-83401. The codes and corresponding resistance values are:

CODE	R ₁ (Ohms)	R ₂ (Ohms)	CODE	R ₁ (Ohms)	R ₂ (Ohms)	CODE	R ₁ (Ohms)	R ₂ (Ohms)
A001	82	130	A007	220	270	A013	3k	6.2k
A002	120	200	A008	220	330	A014	180	270
A003	130	210	A009	330	390	A015	270	270
A004	160	260	A010	330	470	A016	560	560
A005	180	240	A011	330	680	A017	560	1.2k
A006	180	390	A012	1.5k	3.3k	A018	620	2.7k

M8340101 and M8340102 Thick Film Resistor Networks

Military, MIL-R-83401 Qualified
Dual-In-Line Package, A and B Schematics

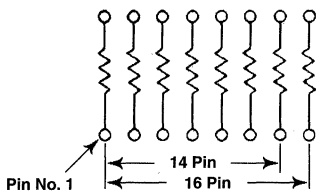


FEATURES

- 1.3 watt to 1.6 watt at 70°C
- Qualified to MIL-R-83401
- Designed for automatic insertion
- Withstands thermal stress from -65°C to +125°C
- Conforms to IC package configurations
- High temperature solder joints
- Techno's capabilities include designing special resistor networks from customer supplied schematics. We welcome the opportunity to work with customer engineers during the initial design phase.

CIRCUIT APPLICATIONS

A Schematic



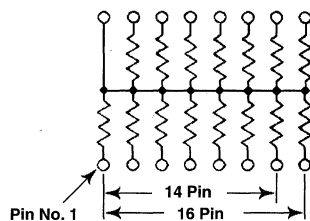
M8340101XXXXXXA
M8340102XXXXXXA

7 or 8 isolated resistors

This model provides the user with a choice of 7 or 8 nominally equal resistors with each resistor isolated from all others. Commonly used in the following applications:

- "Wired OR" Pull-up
- Power Driven Pull-up
- Power Gate Pull-up
- Line Termination
- Long-line Impedance Balancing
- LED Current Limiting
- ECL Output Pull-down
- TTL Input Pull-down

B Schematic



M8340101XXXXXXB
M8340102XXXXXXB

13 or 15 resistors with one pin common

This model provides the user with a choice of 13 or 15 nominally equal resistors, each connected to a common pin. Commonly used in the following applications:

- MOS/ROM Pull-up/Pull-down
- Open Collector Pull-up
- "Wired OR" Pull-up
- Power Driven Pull-up
- TTL Input Pull-down
- Digital Pulse Squaring
- TTL Unused Gate Pull-up
- High Speed Parallel Pull-up

ELECTRICAL SPECIFICATIONS

Resistance Range: 27.0 ohm to 1 Megohm.

Resistance Tolerance: ± 1%, ± 2%, ± 5% standard.
Tighter tolerances available.

Temperature Coefficient: (-65°C to +125°C)
"K" = ± 100PPM/°C, "M" = ± 300PPM/°C.

Package Power Rating:

Schematic	14 Pin	16 Pin
A	1.3 watts	1.5 watts
B	1.4 watts	1.6 watts

Maximum Operating Voltage: 100 volts per resistor.

Dielectric Strength: 200 V RMS, 1 minute.

Insulation Resistance: 10,000 Megohm minimum.

MECHANICAL SPECIFICATIONS

Resistive Element: Thick film.

Encapsulation: Phthalate.

Terminals: Solderable leads.

Terminal Strength: 4.5 pounds applied to 5 terminals for 30 seconds.

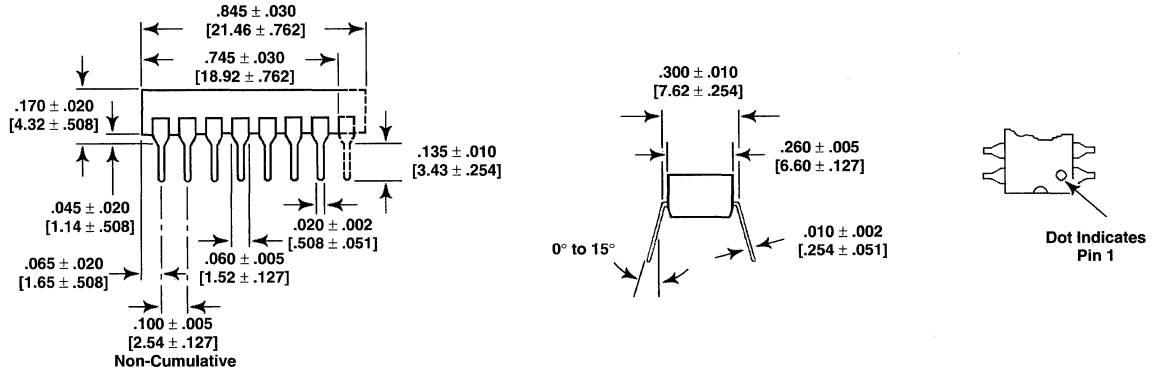
ENVIRONMENTAL SPECIFICATIONS

Temperature Limits: -65°C to +125°C.

M8340101 and M8340102

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

14, 16 Pin DIP

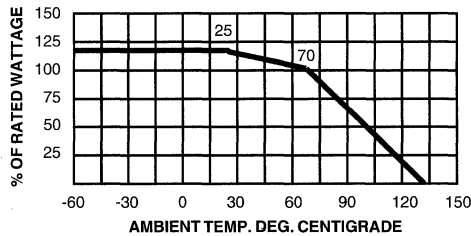


ENVIRONMENTAL PERFORMANCE

TEST ¹	CONDITIONS	MIL-R-83401 REQUIREMENT ³	MAX. ΔR (Typical Test Lots)
Power Conditioning	(108) 100 hours at 1.5 times rated power at 25°C, 90°/30° cycle	Group A Combined	ΔR < 0.10%
Thermal Shock	(107) 5 cycles, - 65°C to + 125°C	ΔR ≤ 0.70% ²	
Thermal Shock Group C	(107) 25 cycles, - 65°C to + 125°C	ΔR ≤ 0.70% ²	ΔR < 0.10%
Short Time Overload	2.5 times rated voltage not to exceed 2 times rated power for 5 seconds	ΔR ≤ 0.25% ²	ΔR < 0.02%
Low Temperature Storage	24 hours, no load at - 65°C	ΔR ≤ 0.25% ²	ΔR < 0.02%
Low Temperature Operation	1 hour storage, 45 minutes rated power at - 65°C	ΔR ≤ 0.25% ²	ΔR < 0.02%
High Temperature Exposure	100 hours, no load at 125°C	ΔR ≤ 0.50% ²	ΔR < 0.06%
Moisture Resistance	(106) 240 hours with humidity ranging from 80% RH to 98% RH	ΔR ≤ 0.50% ²	ΔR < 0.03%
Resistance to Soldering Heat	(210) 350° for 3 seconds	ΔR ≤ 0.25% ²	ΔR < 0.05%
Shock	(213) 18 shocks, 100 g, 6 ms, sawtooth, 3 axes	ΔR ≤ 0.25% ²	ΔR < 0.04%
Vibration	(204) 10 to 2000 Hz, 20 g, 12 hours, 3 axes	ΔR ≤ 0.25% ²	ΔR < 0.04%
Load Life	(108) 1000 hours at rated power at 75°C and at rated power at 25°C, 90°/30° cycle	ΔR ≤ 0.50% ²	ΔR < 0.22%

1. Numbers in parenthesis refer to test method of MIL-STD-202 as modified by the detail specification.
 2. For values below 100 ohm, add 0.05 ohm to the allowable change.
 3. The referenced tests also require that setting stability change shall not exceed ± 0.05 percent plus the specified maximum resolution.

DERATING



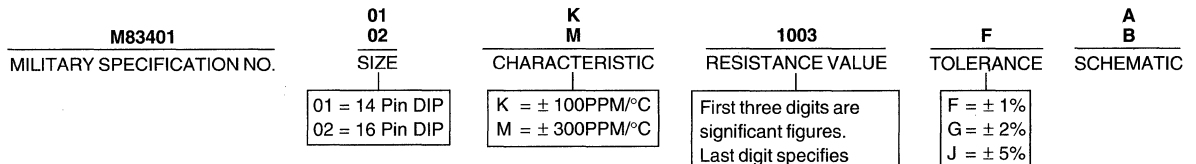
POWER RATING

The power rating listed for each network is based on continuous full-load operation at an ambient temperature of 70°C. When the network is operated at temperatures other than 70°C, the power rating should be scaled linearly as shown.

PART MARKING

- Complete part number
- Resistance value
- Tolerance value
- Manufacturer's name or code
- Date code
- Pin identifier

HOW TO ORDER - MILITARY PART NUMBER

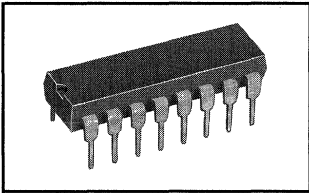


EXAMPLE:

M8340102M1003FB = A dual-in-line resistor network with 16 pins, a T.C.R. of ± 300 PPM/°C, resistance value of 100 kilohms, tolerance of 1% and to schematic "B".

MODELS MDM14 and MDM16 Thick Film Resistor Networks

Military, MIL-R-83401 Qualified, Type RZ
Dual-In-Line Package - 01, 03, 05 Schematics

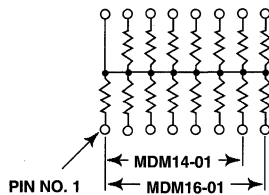


FEATURES

- MIL-R-83401 Qualified
- Epoxy molded construction
- All device leads are hot-solder dipped
- Available in tube pack
- T.C.R. available in "K" ($\pm 100\text{PPM}/^\circ\text{C}$) or "M" ($\pm 300\text{PPM}/^\circ\text{C}$) depending on style
- 100% screen tested per Group A, Subgroup 1 of MIL-R-83401
- All devices are capable of passing the MIL-STD-202, Method 210, Condition E "Resistance to Soldering Heat" test

CIRCUIT APPLICATIONS

01 Schematic



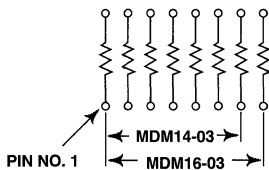
MDM14-01 (M8340101XXXXXXB)
MDM16-01 (M8340102XXXXXXB)

13 or 15 resistors with one pin common

The MDMXX-01 provides the user with a choice of 13 or 15 nominally equal resistors, each connected to a common pin. Commonly used in the following applications:

- MOS/ROM Pull-up/Pull-down
- Open Collector Pull-up
- "Wired OR" Pull-up
- Power Driven Pull-up
- TTL Input Pull-down
- Digital Pulse Squaring
- TTL Unused Gate Pull-up
- High Speed Parallel Pull-up

03 Schematic



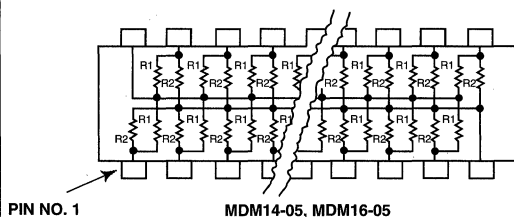
MDM14-03 (M8340101XXXXXXA)
MDM16-03 (M8340102XXXXXXA)

7 or 8 isolated resistors

The MDMXX-03 provides the user with a choice of 7 or 8 nominally equal resistors, with each resistor isolated from all others. Commonly used in the following applications:

- "Wired OR" Pull-up
- Power Driven Pull-up
- Power Gate Pull-up
- Line Termination
- Long-line Impedance Balancing
- LED Current Limiting
- ECL Output Pull-down
- TTL Input Pull-down

05 Schematic



MDM14-05 (M8340101XXXXXXJ)
MDM16-05 (M8340102XXXXXXJ)

12 or 14 resistor pairs

The MDMXX-05 provides the user with a choice of 12 or 14 pairs of R1/R2 resistor values for pulse squaring and TTL dual-line terminating requirements.

ELECTRICAL SPECIFICATIONS

Resistance Range:

01 and 03 schematics: 10 ohm to 1 Megohm.
05 schematic: See values in table.

Tolerance: $\pm 1\%$, $\pm 2\%$ and $\pm 5\%$.

Temperature Coefficient: (- 55°C to + 125°C)

"K" = $\pm 100\text{PPM}/^\circ\text{C}$.

"M" = $\pm 300\text{PPM}/^\circ\text{C}$.

Maximum Operating Voltage: 100 VDC.

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

Resistor Power Rating: (Maximum at 70°C)

01 schematic = 0.1 watt, 03 schematic = 0.2 watt

05 schematic = 0.05 watt.

Package Power Rating: (Maximum at 70°C)

Schematic	14 Pin	16 Pin
01	1.30 watts	1.50 watts
03	1.40 watts	1.60 watts
05	1.20 watts	1.40 watts

MECHANICAL SPECIFICATIONS

Marking Resistance to Solvents: Permanency testing per MIL-R-83401.

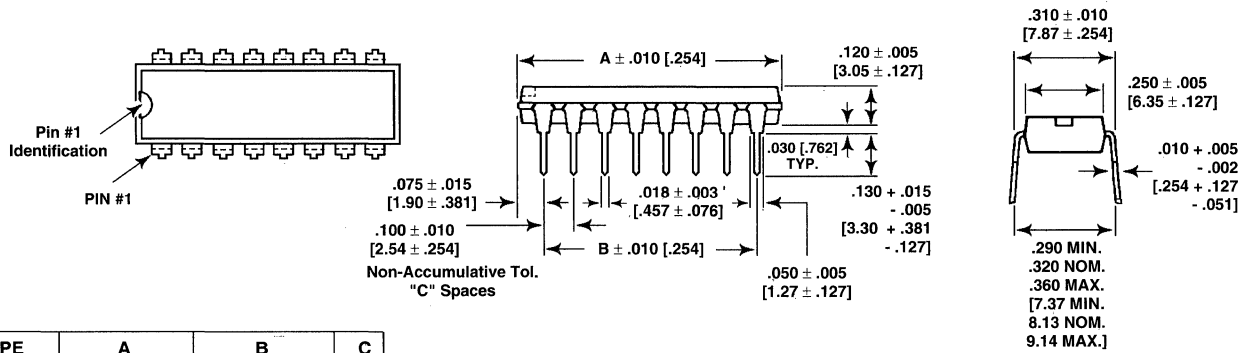
Solderability: Per MIL-R-83401.

Body: Molded epoxy.

Terminals: Copper alloy, hot-solder dipped.

MODELS MDM14 and MDM16

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



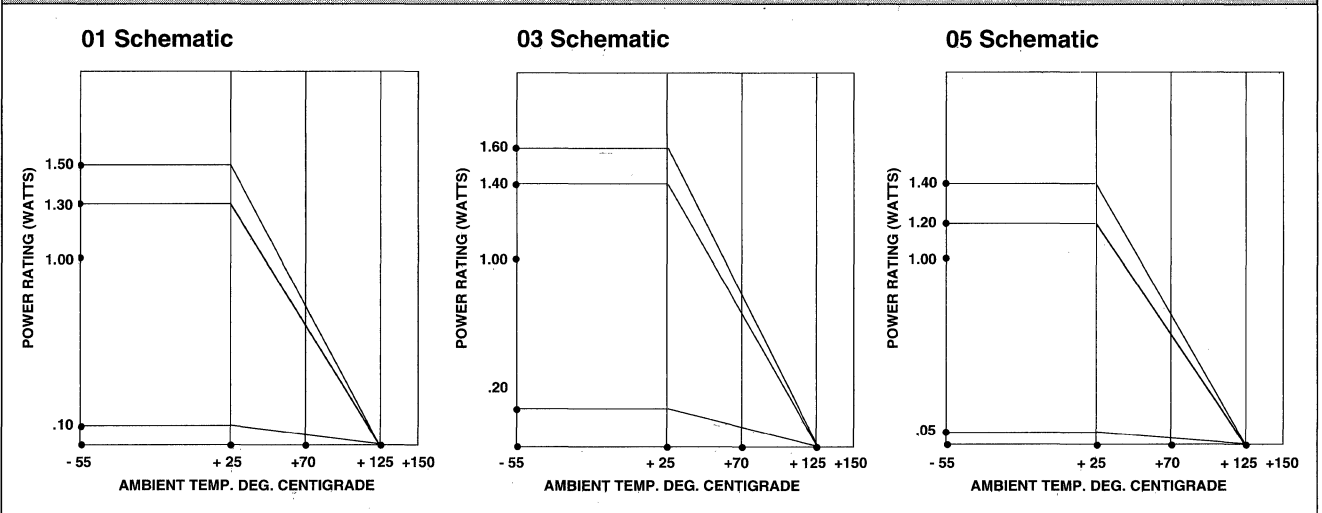
TYPE	A	B	C
MDM14	.750 [19.05]	.600 [15.24]	6
MDM16	.850 [21.59]	.700 [17.78]	7

ENVIRONMENTAL PERFORMANCE *

TEST	CONDITIONS	MAX. ΔR (Typical Test Lots)
Power Conditioning	1 1/2 x rated power, applied 1 1/2 hours on and 1/2 hour off for 100 hours ± 4 hours at 25°C ambient temperature	± 0.50% ΔR
Thermal Shock	5 cycles between - 65°C and + 125°C	± 0.50% ΔR
Short Time Overload	2 1/2 x rated working voltage 5 seconds	± 0.25% ΔR (Char. K) ± 0.50% ΔR (Char. M)
Low Temperature Operation	45 minutes at full rated working voltage at - 65°C	± 0.25% ΔR (Char. K) ± 0.50% ΔR (Char. M)
Moisture Resistance	240 hours with humidity ranging from 80% RH to 98% RH	± 0.50% ΔR
Resistance to Soldering Heat	Leads immersed in 350°C solder to within 1/16" of body for 3 seconds	± 0.25% ΔR
Shock	Total of 18 shocks at 100 G's	± 0.25% ΔR
Vibration	12 hours at maximum of 20 G's between 10 and 2,000 Hz	± 0.25% ΔR
Load Life	1,000 hours at 70°C, rated power applied 1 1/2 hours on, 1/2 hour off for full 1,000 hour period	± 0.50% ΔR (Char. K) ± 2.00% ΔR (Char. M)
Terminal Strength	4 1/2 pound pull for 30 seconds	± 0.25% ΔR
Insulation Resistance	10,000 Megohm (minimum)	
Dielectric Withstanding Voltage	No evidence of arcing or damage (200 V RMS for 1 minute)	

* Reference MIL-R-83401.

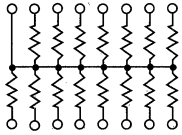
DERATING



MODELS MDM14 and MDM16

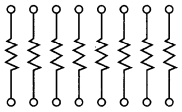
STOCKED RESISTANCE VALUES IN OHMS ("G" Tolerance)

01 Schematic



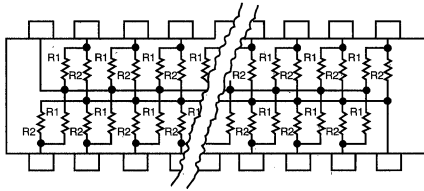
39	75	180	330	680	2.0k	3.3k	5.6k	20k	100k
51	100	200	390	1.0k	2.2k	3.9k	6.8k	22k	470k
56	120	220	470	1.2k	2.7k	4.7k	10k	30k	1 Meg.
68	150	270	510	1.5k	3.0k	5.1k	15k	47k	

03 Schematic



10	68	130	270	680	3.0k	5.6k	22k	470k
22	75	150	330	1.0k	3.3k	6.8k	27k	1 Meg.
39	100	180	390	1.5k	3.9k	10k	30k	
51	110	200	470	2.0k	4.7k	15k	47k	
56	120	220	510	2.2k	5.1k	20k	100k	

05 Schematic



MDM14-05, MDM16-05

Consult factory for stocked values.

HOW TO ORDER - MILITARY PART NUMBER

01 SCHEMATIC
03 SCHEMATIC
05 SCHEMATIC

M8340101
M8340102
M8340101

DETAIL SPEC. NO.

M8340101 = 14 Pin DIP RZ010
M8340102 = 16 Pin DIP RZ020

M
M
K

CHARACTERISTIC

"K" = ± 100PPM/°C
"M" = ± 300PPM/°C

2201
4701
A001*

RESISTANCE VALUE

The first three digits are significant figures and the last digit specifies the number of zeros to follow = 10 and 03 schematics. For 05 schematic see footnote (*).

G
G
G

TOLERANCE

F = ± 1%
G = ± 2%
J = ± 5%

B
A
J

SCHEMATIC

EXAMPLE:

M8340101M2201GB = A dual-in-line resistor network with 14 pins, a T.C.R. of ± 300PPM/°C, resistance value of 2.2k ohm, tolerance of 2% and to schematic "B".

EXAMPLE:

M8340102M4701GA = A dual-in-line resistor network with 16 pins, a T.C.R. of ± 300PPM/°C, resistance value of 4.7k ohm, tolerance of 2% and to schematic "A".

EXAMPLE:

M8340101KA001GJ = A dual-in-line resistor network with 14 pins, a T.C.R. of ± 100PPM/°C, R1 resistance value of 82 ohm, R2 resistance value of 130 ohm, tolerance of ± 2% and to schematic "J".

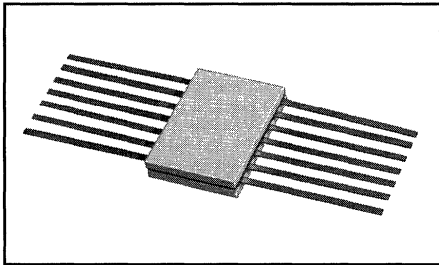
* The J-schematic resistance values are specified by a 4-digit code, which comes from MIL-R-83401. The codes and corresponding resistance values are:

CODE	R1 (Ohms)	R2 (Ohms)	CODE	R1 (Ohms)	R2 (Ohms)
A001	82	130	A010	330	470
A002	120	200	A011	330	680
A003	130	210	A012	1.5k	3.3k
A004	160	260	A013	3k	6.2k
A005	180	240	A014	180	270
A006	180	390	A015	270	270
A007	220	270	A016	560	560
A008	220	330	A017	560	1.2k
A009	330	390	A018	620	2.7k

MODEL DFM14

Thick Film Resistor Networks

Military, MIL-R-83401 Qualified, Type RZ
01, 02, 05, 11, 12, 15 Schematics

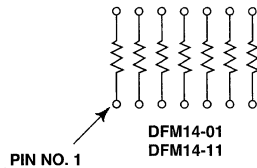


FEATURES

- 01, 02, 05 schematics - gold plated leads
- 11, 12, 15 schematics - hot solder dipped
- MIL-R-83401 qualified
- Highly stable thick film
- T.C.R. available in "K" ($\pm 100\text{PPM}/^\circ\text{C}$) or "M" ($\pm 300\text{PPM}/^\circ\text{C}$) characteristic
- 100% screen tested per Group A, Subgroup 1 of MIL-R-83401
- .065" [1.65] height for high density packaging
- All devices are capable of passing the MIL-STD-202, Method 210, Condition E "Resistance to Soldering Heat" test

CIRCUIT APPLICATIONS

01, 11 Schematic



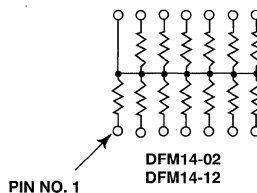
DFM14-01 (M8340103XXXXXA) DFM14-11 (M8340103XXXXXA)

7 isolated resistors

The DFM14-01 and DFM14-11 provide the user with 7 nominally equal resistors with each resistor isolated from all others. Commonly used in the following applications:

- "Wired OR" Pull-up
- Power Driven Pull-up
- Line Termination
- Long-line Impedance Balancing
- LED Current Limiting
- ECL Output Pull-down
- TTL Input Pull-down

02, 12 Schematic



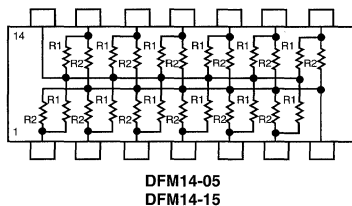
DFM14-02 (M8340103XXXXXB) DFM14-12 (M8340103XXXXXB)

13 resistors with one pin common

The DFM14-02 and DFM14-12 provide the user with a choice of 13 nominally equal resistors, each connected to a common pin. Commonly used in the following applications:

- MOS/ROM Pull-up/Pull-down
- Open Collector Pull-up
- "Wired OR" Pull-up
- Power Driven Pull-up
- TTL Input Pull-down
- Digital Pulse Squaring
- TTL Unused Gate Pull-up
- High Speed Parallel Pull-up

05, 15 Schematic



DFM14-05 (M8340103XXXXXH) DFM14-15 (M8340103XXXXXH)

12 pairs of resistors

The DFM14-05 and DFM14-15 provide the user with a choice of 12 pairs of R1/R2 resistor values for pulse squaring and TTL dual-line terminating requirements.

MODEL DFM14

ELECTRICAL SPECIFICATIONS

Resistance Range:

01 and 02 schematics: 10 ohm to 1 Megohm.
05 schematic: See values in table.

Tolerance: ± 2% standard. ± 1%, ± 5% available.

Temperature Coefficient: (- 55°C to + 125°C)
"K" = ± 100PPM/°C. "M" = ± 300PPM/°C.

Isolation Resistance: 01, 11 schematic = > 100 Megohm.

Resistor Power Rating: (Maximum at 70°C)

01, 11 schematics = 0.050 watt. 02, 12 schematics = 0.025 watt. 05, 15 schematics = 0.015 watt.

Package Power Rating: (Maximum at 70°C)

01, 11 schematics = 0.350 watt. 02, 12 schematics = 0.325 watt. 05, 15 schematics = 0.350 watt.

Maximum Operating Voltage: 50 VDC.

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

MECHANICAL SPECIFICATIONS

Marking Resistance to Solvents: Permanency testing per MIL-R-83401.

Solderability: Per MIL-R-83401.

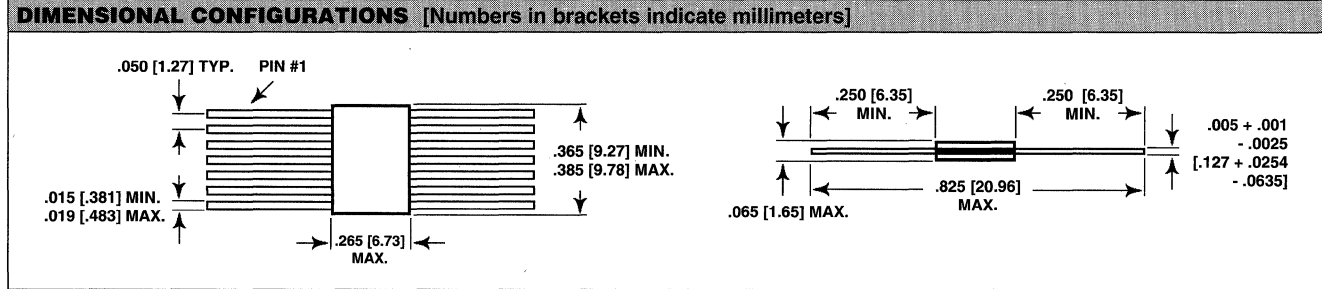
Body: Epoxy filled ceramic sandwich.

Terminals: Per MIL-STD-1276:

DFM14-01, 02, 05 = Type G (gold plated).

DFM14-11, 12, 15 = Type G (hot-solder dipped).

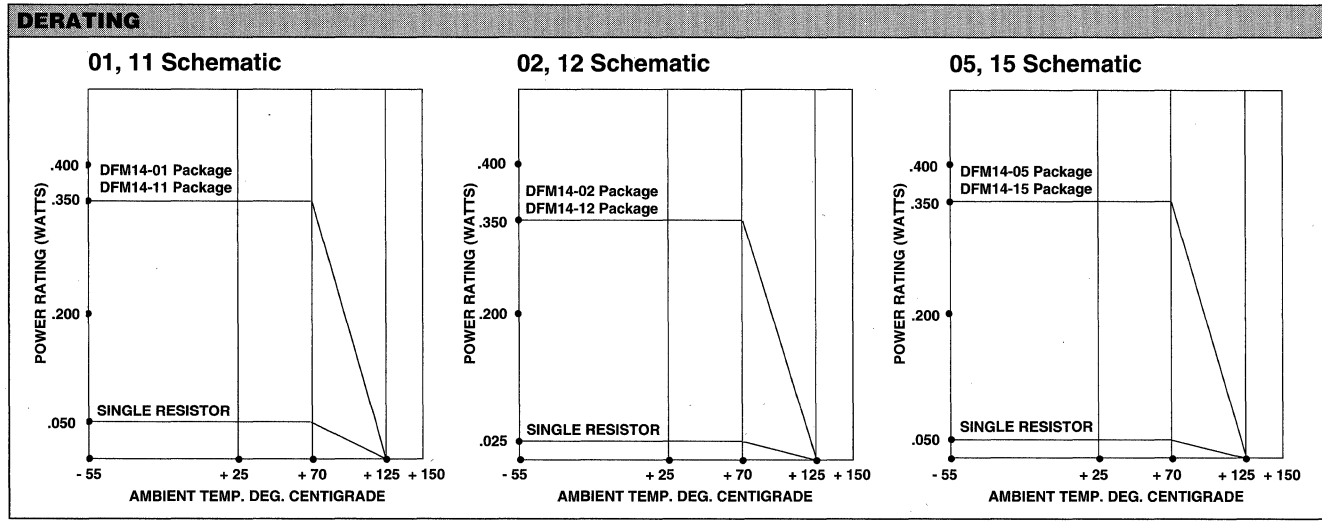
Hot-solder dipped leads supplied as standard finish unless otherwise specified.



ENVIRONMENTAL PERFORMANCE *

TEST	CONDITIONS	MAX. ΔR (Typical Test Lots)
Power Conditioning	1 1/2 x rated power, applied 1 1/2 hours on and 1/2 hour off for 100 hours ± 4 hours at 25°C ambient temperature	± 0.50% ΔR
Thermal Shock	5 cycles between - 65°C and + 125°C	± 0.50% ΔR
Short Time Overload	2 1/2 x rated working voltage 5 seconds	± 0.25% ΔR (Char. K) ± 0.50% ΔR (Char. M)
Low Temperature Operation	45 minutes at full rated working voltage at - 65°C	± 0.25% ΔR (Char. K) ± 0.50% ΔR (Char. M)
Moisture Resistance	240 hours with humidity ranging from 80% RH to 98% RH	± 0.50% ΔR
Resistance to Soldering Heat	Leads immersed in 350°C solder to within 1/16" of body for 3 seconds	± 0.25% ΔR
Shock	Total of 18 shocks at 100 G's	± 0.25% ΔR
Vibration	12 hours at maximum of 20 G's between 10 and 2,000 Hz	± 0.25% ΔR
Load Life	1,000 hours at 70°C, rated power applied 1 1/2 hours on, 1/2 hour off for full 1,000 hour period	± 0.50% ΔR (Char. K) ± 0.20% ΔR (Char. M)
Terminal Strength	4 1/2 pound pull for 30 seconds	± 0.25 % ΔR
Insulation Resistance	10,000 Megohm (minimum)	
Dielectric Withstanding Voltage	No evidence of arcing or damage (200 V RMS for 1 minute)	

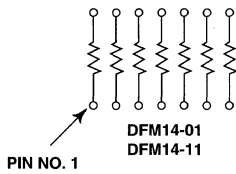
* Reference MIL-R-83401.



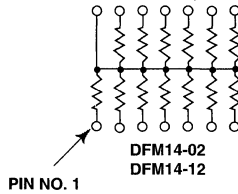
MODEL DFM14

STOCKED RESISTANCE VALUES IN OHMS ("G" Tolerance)

01, 11 Schematics



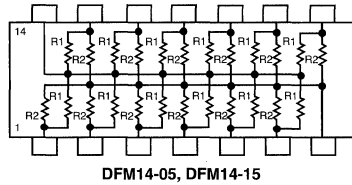
02, 12 Schematics



01, 11, 02, 12 SCHEMATICS

100	470	1.0k	2.2k	4.7k	10k
200	510	1.5k	3.0k	5.1k	22k
330	680	2.0k	3.3k	6.8k	100k

05, 15 Schematics



Consult factory for stocked values.

HOW TO ORDER - MILITARY PART NUMBER

01, 11 SCHEMATIC
02, 12 SCHEMATIC
05, 15 SCHEMATIC

M8340103
M8340103
M8340103

M
M
K

6801
6801
A001*

G
G
G

A
B
J

DETAIL SPEC. NO.

CHARACTERISTIC

RESISTANCE VALUE

TOLERANCE

SCHEMATIC

M8340103 =
14 Pin DIP RZ030

"K" = ± 100PPM/°C
"M" = ± 300PPM/°C

The first three digits are significant figures and the last digit specifies the number of zeros to follow = 01 and 02 schematics. For 05 schematic see footnote (*).

F = ± 1%
G = ± 2%
J = ± 5%

EXAMPLE:

M8340103M6801GA = A flat pack resistor network with 14 pins, a T.C.R. of ± 300PPM/°C, resistance value of 6.8k ohm, tolerance of 2% and to schematic "A".

EXAMPLE:

M8340103M6801GB = A flat pack resistor network with 14 pins, a T.C.R. of ± 300PPM/°C, resistance value of 6.8k ohm, tolerance of 2% and to schematic "B".

EXAMPLE:

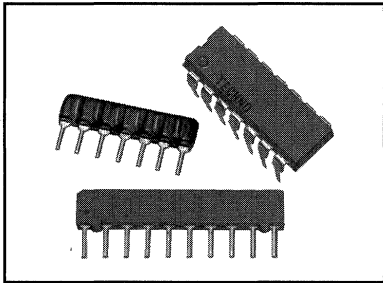
M8340103KA001GJ = A flat pack resistor network with 14 pins, a T.C.R. of ± 100PPM/°C, R1 resistance value of 82 ohm, R2 resistance value of 130 ohm, tolerance of ± 2% and schematic "J".

DFM14-01, 02, 05 = Type G (gold plated)
DFM14-11, 12, 15 = Type G (hot-solder dipped)
Hot-solder dipped leads supplied as standard finish, unless otherwise specified.

* The J-schematic resistance values are specified by a 4-digit code, which comes from MIL-R-83401. The codes and corresponding resistance values are:

CODE	R1 (Ohms)	R2 (Ohms)	CODE	R1 (Ohms)	R2 (Ohms)
A001	82	130	A010	330	470
A002	120	200	A011	330	680
A003	130	210	A012	1.5k	3.3k
A004	160	260	A013	3k	6.2k
A005	180	240	A014	180	270
A006	180	390	A015	270	270
A007	220	270	A016	560	560
A008	220	330	A017	560	1.2k
A009	330	390	A018	620	1.2k

CUSTOM NETWORKS DIPS, Molded SIPS, Coated SIPS

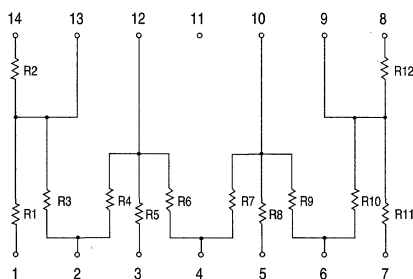
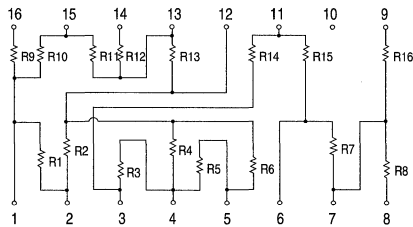
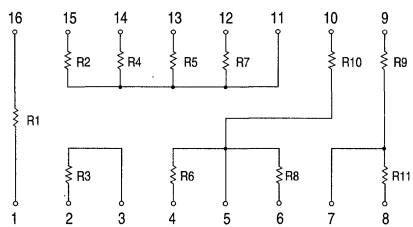


FEATURES

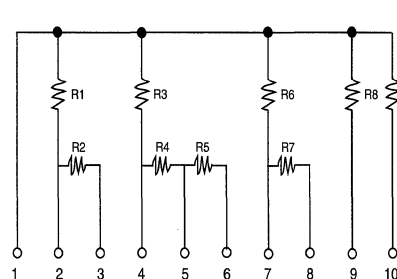
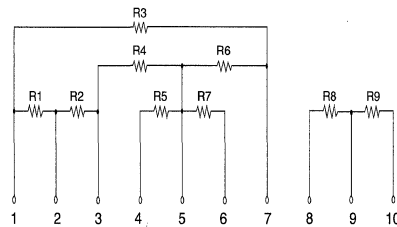
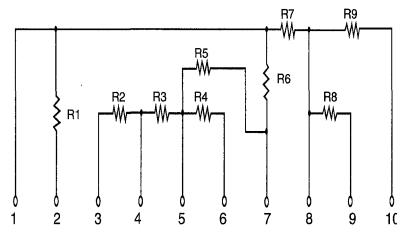
- Fast turnaround time
- Unlimited schematics possible
- Design through production
- Processed to MIL-R-83401
- High temperature solder joints
- Made in the U.S.A.
- Wide resistance range
- Ultra high precision laser trimming
- Double sided printing and through holes/ViAs
- High density circuit designs
- Tighter parameters available
- High power ratings available
- Custom resistor, capacitor, diode and inductor network combinations

SCHEMATICS

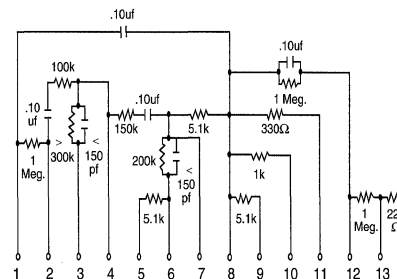
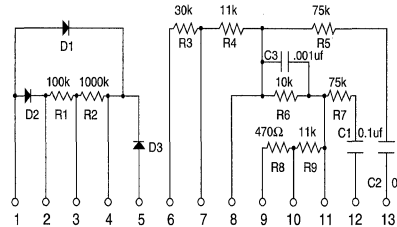
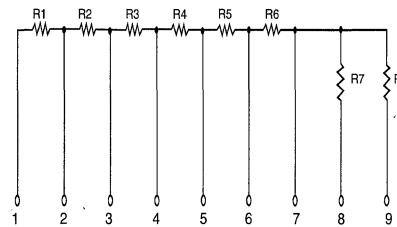
DIPS



SIPS, Molded



SIPS, Coated



ELECTRICAL SPECIFICATIONS

Resistance Range: 1 ohm to 20 Megohm.

Tolerance: $\pm 0.5\%$. Tighter tolerances available.

Temperature Coefficient: $\pm 50\text{PPM}/^\circ\text{C}$ available.

T. C. R. Tracking: $\pm 50\text{PPM}/^\circ\text{C}$ available.

Ratio Matching: $\pm 0.5\%$ available.

Power Per Resistor: 1/8 watt @ 70°C typical.

MECHANICAL SPECIFICATIONS

Resistive Element: Thick film.

Solder Joints: High temperature SN10.

Encapsulation: Phthalate for molded.

Epoxy for conformal coated.

Lead Lengths: .060" [1.52] to .190" [4.83] molded,
.060" [1.52] to .290" [7.37] coated.

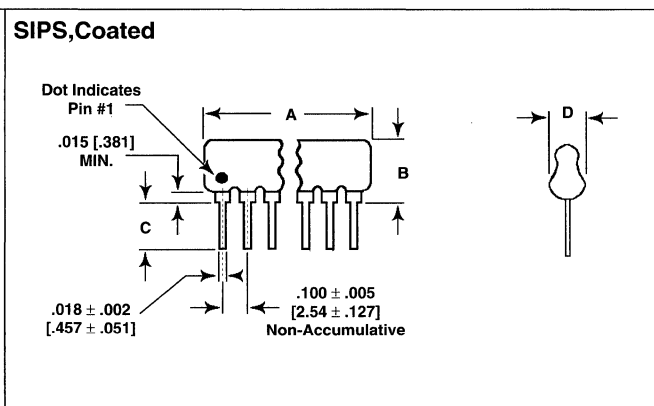
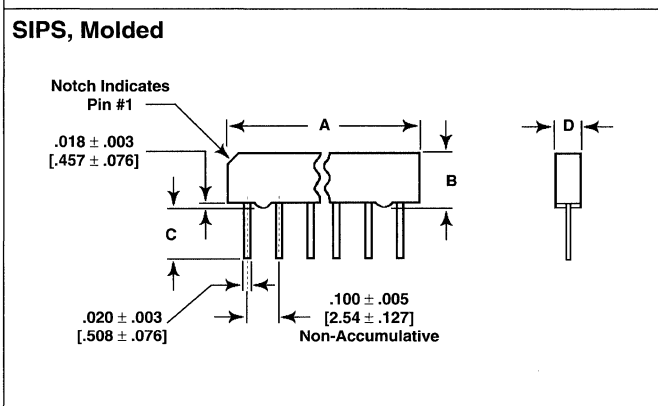
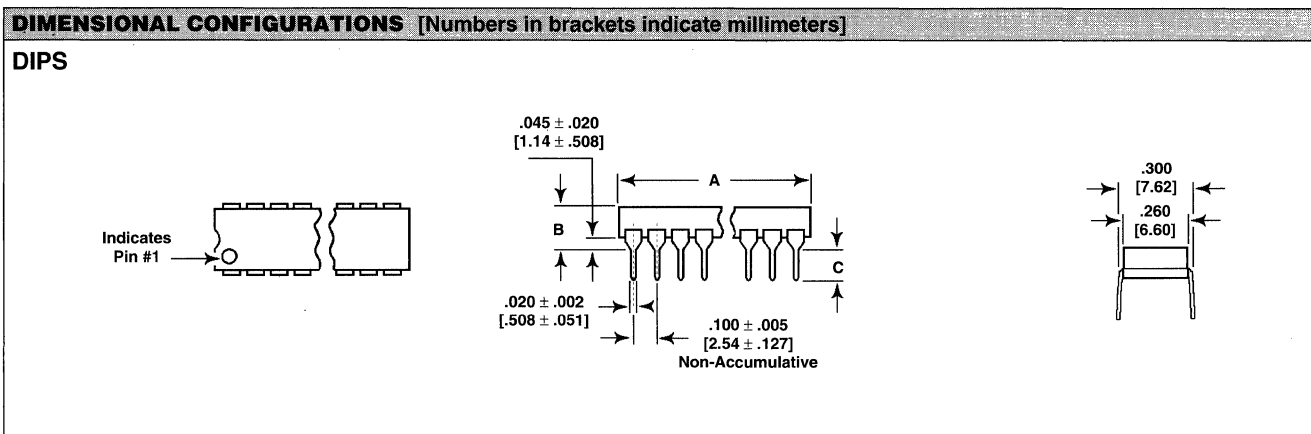
Substrates: 96% Alumina. Thicknesses: .020" [.508]
to .100" [2.54].

Resistor Coatings: Glass passivation, dielectrics for
crossovers.

ENVIRONMENTAL SPECIFICATIONS

Temperature Limits: -65°C to $+125^\circ\text{C}$.

DIPS, Molded SIPS, Coated SIPS



MODEL	NO. OF PINS	A (Max.)	B (Max.)	C (Max.)	D (Max.)
DIPS	14	.775 [19.69]	.190 [4.83]	.135 [3.43]	—
DIPS	16	.875 [22.23]	.190 [4.83]	.135 [3.43]	—
SIPS, Molded, Low Profile	6	.598 [15.19]	.192 [4.88]	.190 [4.83]	.088 [2.23]
SIPS, Molded, Low Profile	8	.798 [20.27]	.192 [4.88]	.190 [4.83]	.088 [2.23]
SIPS, Molded, Low Profile	10	.998 [25.35]	.192 [4.88]	.190 [4.83]	.088 [2.23]
SIPS, Molded, High Profile	6	.598 [15.19]	.340 [8.64]	.190 [4.83]	.088 [2.23]
SIPS, Molded, High Profile	8	.798 [20.27]	.340 [8.64]	.190 [4.83]	.088 [2.23]
SIPS, Molded, High Profile	10	.998 [25.35]	.340 [8.64]	.190 [4.83]	.088 [2.23]
SIPS, Coated	2	.200 [5.08]	.200 [5.08]	.290 [7.37]	.100 [2.54]
SIPS, Coated	3 thru 19	*	*	.290 [7.37]	*
SIPS, Coated	20	2.00 [50.80]	*	.290 [7.37]	*

* Depending on customer requirements.

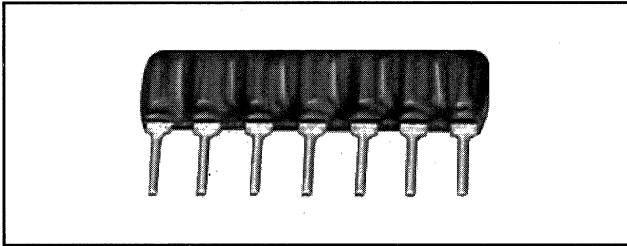
ENVIRONMENTAL PERFORMANCE

TEST ¹	MAX. ΔR (Typical Test Lots)
Power Conditioning (108)	ΔR < 0.10%
Thermal Shock (107)	ΔR < 0.10%
Thermal Shock Group C (107)	ΔR < 0.10%
Short Time Overload	ΔR < 0.03%
Low Temperature Storage	ΔR < 0.02%
Low Temperature Operation	ΔR < 0.02%
High Temperature Exposure	ΔR < 0.06%
Moisture Resistance (106)	ΔR < 0.10%
Resistance to Soldering Heat (210)	ΔR < 0.10%
Shock (213)	ΔR < 0.04%
Vibration (204)	ΔR < 0.04%
Load Life (108)	ΔR < 0.22%

1. Numbers in parenthesis refer to test method of MIL-STD-202 as modified by the detail specification.
 2. For values below 100 ohms, add 0.05 ohm to the allowable change.

MODEL TRC Resistor/Capacitor Networks

SIP, Coated



FEATURES

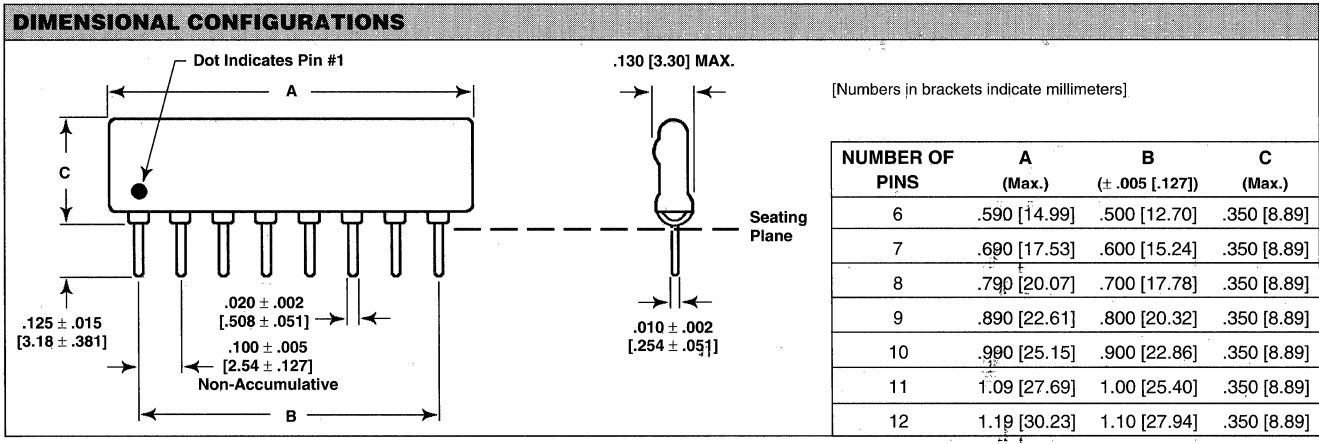
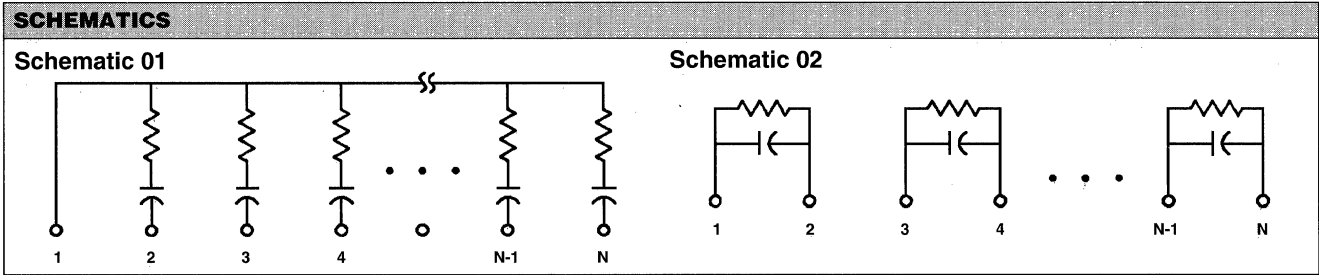
- Highly stable thick film resistors
- NPO or X7R capacitors for line terminator
- Wide operating temperature range
- Special Resistor/Capacitor schematics available

ELECTRICAL SPECIFICATIONS - RESISTORS

Resistance Range: 50 ohm to 1 kilohm. Others available.
Resistance Tolerance: $\pm 2\%$, $\pm 5\%$ standard. $\pm 1\%$ available.
Temperature Coefficient of Resistance: $\pm 150\text{PPM}/^\circ\text{C}$.
Operating Temperature Range: -55°C to $+125^\circ\text{C}$.
Operating Voltage: 50 VDC maximum. Higher voltage available.

ELECTRICAL SPECIFICATIONS - CAPACITORS

Type: NPO or X7R.
Standard Values: NPO Type = 56pF, 100pF, 220pF, 470pF. X7R Type = 1000pF, .010uF. Other values available.
Tolerance: NPO Type = $\pm 5\%$, $\pm 10\%$. X7R Type = $\pm 10\%$, $\pm 20\%$.
Voltage Rating: 50 VDC. Higher voltage available.



PART MARKING

- Complete part number
- Manufacturer's name/code
- Date code
- Pin 1 identifier

HOW TO ORDER

TRC 08 - 01 - 101 / 560 / K

MODEL NUMBER OF PINS SCHEMATIC RESISTANCE VALUE (Ohms) RESISTANCE TOLERANCE CAPACITANCE VALUE (Pico Farads) CAPACITANCE TOLERANCE

First two digits are significant, third digit signifies number of zeros to follow.

F = $\pm 1\%$
G = $\pm 2\%$
J = $\pm 5\%$

First two digits are significant, third digit signifies number of zeros to follow.

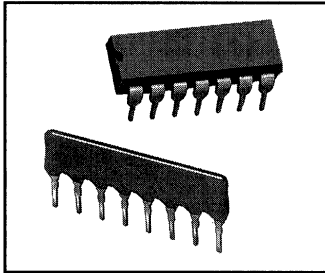
J = $\pm 5\%$
K = $\pm 10\%$
M = $\pm 20\%$

R/C NETWORKS

Resistor/Capacitor Networks

Single-In-Line, Dual-In-Line and Surface Mount

14 or 16 Pins



FEATURES

- Ideal where repetitive circuits are required
- Wide range of R/C values for special applications
- High density packaging for reduced assembly costs, improved performance and simplified board layout
- Utilize same thick film circuit materials as those qualified to MIL-R-83401
- Capacitors available to EIA RS 198

GENERAL ELECTRICAL SPECIFICATIONS

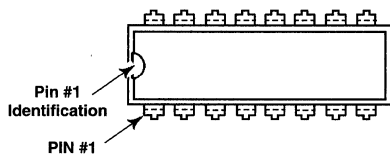
Value Range	SIP DIP Surface Mount	RESISTORS	CAPACITORS			
			NPO	BX	X7R	*
		10Ω-1M 10Ω-1M 10Ω-1M	33 pf-4700 pf 33 pf-4700 pf 33 pf-270 pf	500 pf-0.1 μf 500 pf-0.1 μf 270 pf-4700 μf	500 pf-0.1 μf 500 pf-0.1 μf 270 pf-4700 μf	33 pf-.01 μf 33 pf-.01 μf 33 pf-.001 μf
Tolerances		± 2% standard. ± 1%, ± 5%, ± 10%, ± 20% available.	± 5%, ± 10%	± 10%, ± 20%	± 10%, ± 20%	± 20%, ± 30%
Operating Temperature Range		- 55°C to + 125°C				

* Typical thick-film capacitor parameters. Temperature characteristics depend on package type and circuit complexity. Please consult the factory for specific applications.

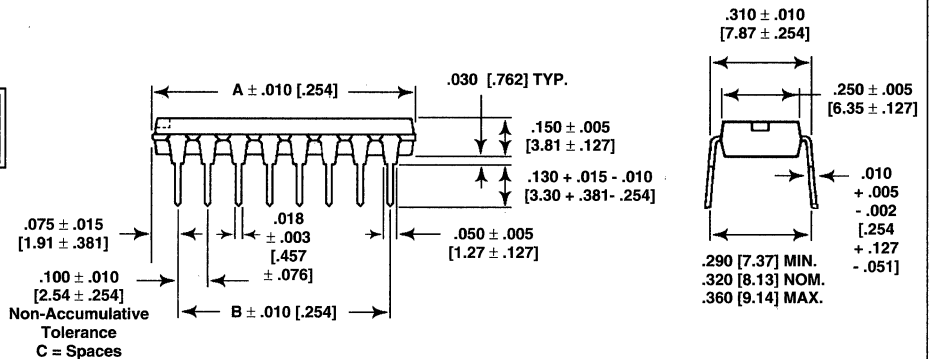
DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

Dual-In-Line

MDRC-14 and MDRC-16

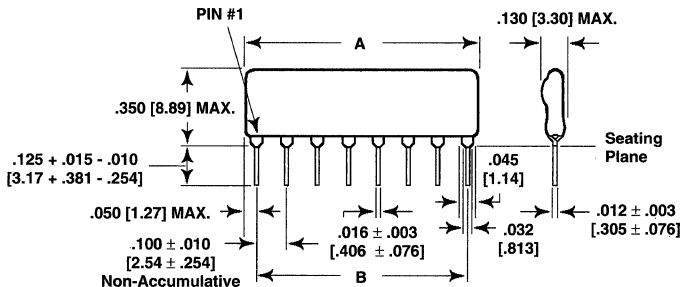


MODEL	A	B
MDRC-14	.750 [19.05]	.600 [15.24]
MDRC-16	.850 [21.59]	.700 [17.78]



Single-In-Line Coated

CSRC



NUMBER OF PINS	A (Max.)	B
4	.390 [9.91]	.300 [7.62]
5	.490 [12.45]	.400 [10.16]
6	.590 [14.99]	.500 [12.70]
7	.690 [17.53]	.600 [15.24]
8	.790 [20.07]	.700 [17.78]
9	.890 [22.61]	.800 [20.32]
10	.990 [25.15]	.900 [22.86]
11	1.09 [27.69]	1.00 [25.40]
12	1.19 [30.23]	1.10 [27.94]

R/C NETWORKS

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

Single-In-Line Molded MSRC

NUMBER OF PINS	A	B	C	D	E
6	.590 [14.99]	.500 [12.70]	5	.195 [4.95] .350 [8.89]	.090 [2.29] .090 [2.29]
8	.790 [20.07]	.700 [17.78]	7	.195 [4.95] .250 [6.35] .350 [8.89]	.090 [2.29] .090 [2.29] .090 [2.29]
8	.790 [20.07]	.700 [17.78]	7	.250 [6.35]	.150 [3.81]
10	.990 [25.15]	.900 [22.86]	9	.195 [4.95] .250 [6.35] .350 [8.89]	.090 [2.29] .090 [2.29] .090 [2.29]

Single-In-Line Molded SOMRC

MODEL	A	B
SOMRC-14	.390 [9.91]	.300 [7.62]
SOMRC-16	.440 [11.18]	.350 [8.89]

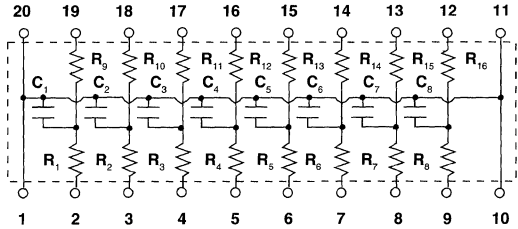
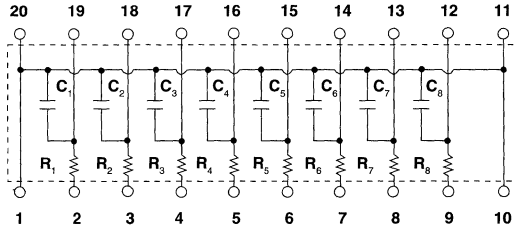
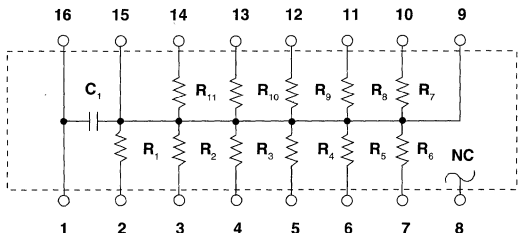
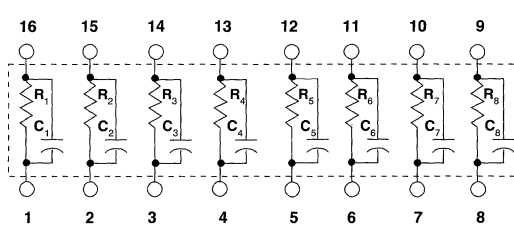
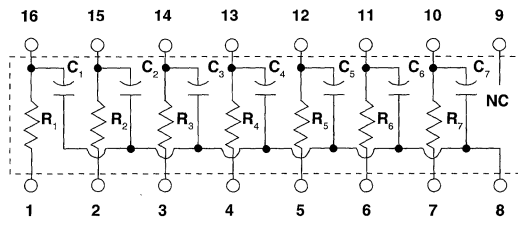
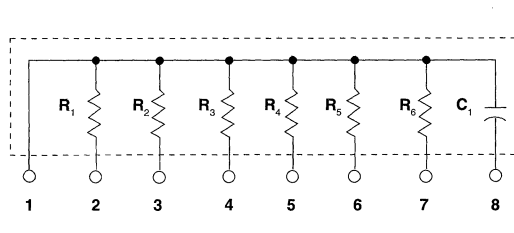
Single-In-Line Molded SOGRC

MODEL	A	B	C	D
SOGRC-16	.440 [11.18]	.350 [8.89]	.100 [2.54]	.105 [2.67]
SOGRC-20	.540 [13.72]	.450 [11.43]	.100 [2.54]	.105 [2.67]

R/C NETWORKS

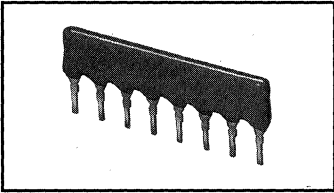
DESIGN CONSIDERATIONS

A wide variety of Capacitor and Resistor/Capacitor Network schematics can be provided for many applications. However, the exact capacitor and resistor parameters will depend on the specific application, the circuit complexity and the package style chosen. Please consult the factory for assistance with a design that optimizes your chosen circuit parameters.

TYPICAL SCHEMATICS	
<p>Schematic A</p>  <p>Typical Component Values: R = 10 ohm to 1 Megohm C = 33 pf to 220 pf</p> <p>Typical Packages: MDRC, SOGRC</p>	<p>Schematic B</p>  <p>Typical Component Values: R = 10 ohm to 1 Megohm C = 33 pf to 220 pf</p> <p>Typical Packages: MDRC, SOGRC</p>
<p>Schematic C</p>  <p>Typical Component Values: R = 10 ohm to 1 Megohm C = 33 pf, 220 pf, .01µf</p> <p>Typical Packages: MDRC, SOMRC, SOGRC</p>	<p>Schematic D</p>  <p>Typical Component Values: R = 50 ohm, 100 ohm, 1k C = 100 pf, 470 pf, .001 µf</p> <p>Typical Packages: MDRC</p>
<p>Schematic E</p>  <p>Typical Component Values: R = 100 ohm, 500 ohm C = 100 pf, 1000 pf</p> <p>Typical Packages: MDRC</p>	<p>Schematic F</p>  <p>Typical Component Values: R = 50 ohm, 100 ohm C = 0.001 µf, 0.01 µf</p> <p>Typical Packages: CSRC, MSRC</p>

MODEL CSRC Resistor/Capacitor Networks

Single-In-Line, Coated ECL and Line Terminator Schematics

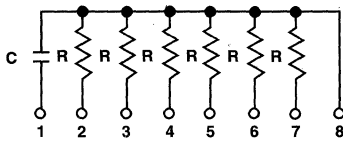


FEATURES

- Highly stable, thick film resistors, $\pm 150\text{PPM}/^\circ\text{C}$
- X7R type capacitor for ECL terminator
- NPO or X7R capacitors for line terminator
- Wide operating temperature range, -55°C to $+125^\circ\text{C}$

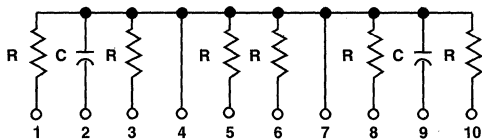
CIRCUIT APPLICATIONS

CSRC-08B20 Schematic



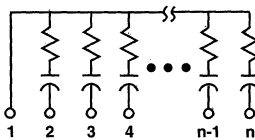
The CSRC-08B20 single-in-line 10k ECL terminator network is used for decoupling and line termination in systems using 10k ECL logic.

CSRC-10B21 Schematic



The CSRC-10B21 single-in-line 100k ECL terminator network is used for decoupling and line termination in systems using 100k ECL logic.

CSRC-XXC30 Schematic



The CSRC-XXC30 single-in-line terminator network is used for line termination and is available in 6, 7, 8, 9, 10, 11 and 12 pin sizes.

RESISTOR SPECIFICATIONS

Resistance Range:

CSRC-08B20, CSRC-10B21 = 50 ohm, 68 ohm, 100 ohm, 150 ohm.

CSRC-XXC30 = 50 ohm to 1 kilohm.
(Other values available on request.)

Tolerance: $\pm 5\%$ standard. $\pm 2\%$ available.

Temperature Coefficient: (-55°C to $+125^\circ\text{C}$)
 $\pm 150\text{PPM}/^\circ\text{C}$.

Operating Voltage:

CSRC-08B20, CSRC-10B21 = 8 VDC maximum.
CSRC-XXC30 = 50 VDC maximum.

CAPACITOR SPECIFICATIONS

Model: CSRC = 08B20, CSRC-10B21 = X7R.

CSRC-XXC30 = NPO or X7R.

Standard Values:

CSRC-08B20, CSRC-10B21 = .01 μf .

CSRC-XXC30: NPO type = 56 pf, 100 pf, 220 pf, 470 pf.

X7R type = 1000 pf, .01 μf . (Other values available on request.)

Tolerance:

CSRC-08B20, CSRC-10B21 = 20% standard.

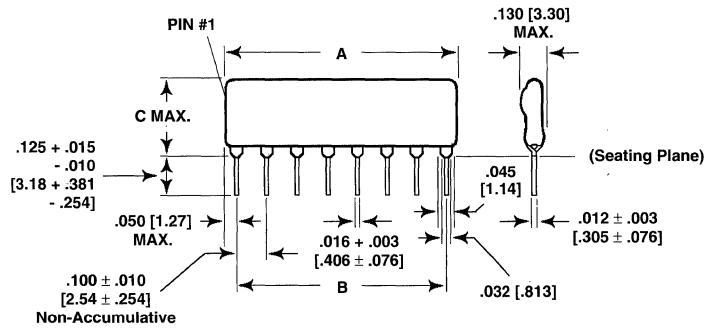
CSRC-XXC30, NPO type = $\pm 10\%$, X7R type = $\pm 20\%$.

Voltage Rating: CSRC-08B20, CSRC-10B21 = 25 VDC.

CSRC-XXC30 = 50 VDC.

MODEL CSRC

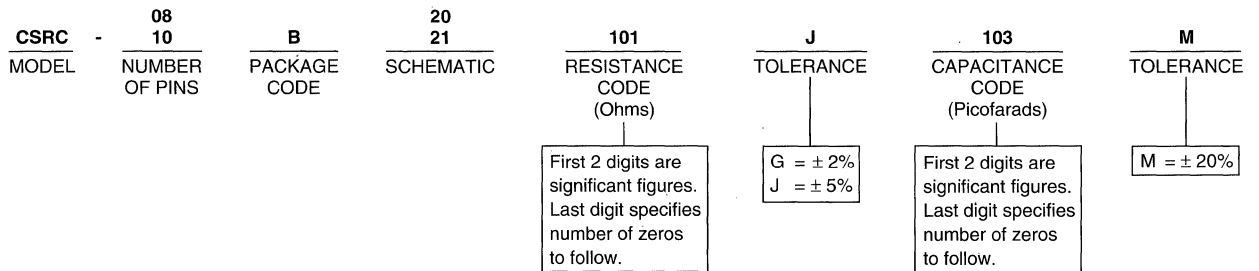
DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



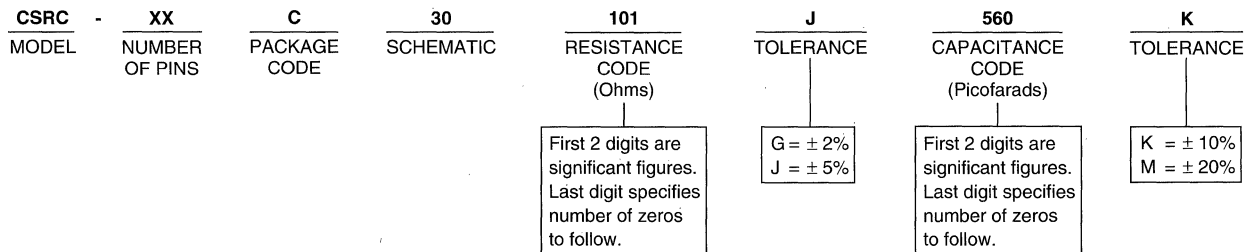
Model CSRC-08B20				Model CSRC-XXC30			
NUMBER OF PINS	A (Max.)	B	C	NUMBER OF PINS	A (Max.)	B	C
8	.790	.700	.250	6	.590 [14.99]	.500 [12.70]	.350 [8.89]
	[20.07]	[17.78]	[6.35]	7	.690 [17.53]	.600 [15.24]	.350 [8.89]
Model CSRC-10B21				8	.790 [20.07]	.700 [17.78]	.350 [8.89]
NUMBER OF PINS	A (Max.)	B	C	9	.890 [22.61]	.800 [20.32]	.350 [8.89]
10	.990	.900	.250	10	.990 [25.15]	.900 [22.86]	.350 [8.89]
	[25.15]	[22.86]	[6.35]	11	1.09 [27.69]	1.00 [25.40]	.350 [8.89]
				12	1.19 [30.23]	1.10 [27.94]	.350 [8.89]

HOW TO ORDER

CSRC-08B20 and CSRC-10B21

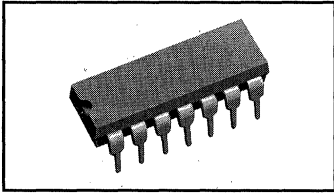


CSRC-XXC30



MODEL MDRC Resistor/Capacitor Networks

Dual-In-Line, Molded, 16 Pin

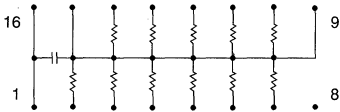


FEATURES

- .190" [4.83] maximum seated height
- Low temperature coefficient (-30°C to + 85°C) ± 100PPM/°C
- Rugged molded case construction
- Compatible with automatic insertion equipment
- Highly stable thick film
- Reduces total assembly cost
- Reduces P.C. board space

CIRCUIT APPLICATIONS

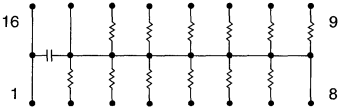
MDRC-1641 Schematic



- 2.0 and - 5.2 Volt ECL Terminator

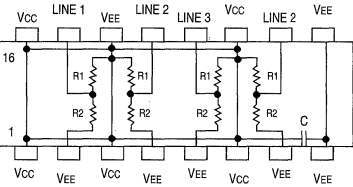
The MDRC-1641 circuit contains 11 resistors of nominally equal value and a .01 microfarad decoupling capacitor. The MDRC-1641 is designed for ECL Line Termination to a - 2.0 volt buss. The .01 microfarad decoupling capacitor is for bypassing transients between supply voltages.

MDRC-1642 Schematic



The MDRC-1642 circuit contains 12 resistors of 510 ohm each and a .01 microfarad decoupling capacitor. The MDRC-1642 is designed for ECL Pull-down to a - 5.2 volt buss. The .01 microfarad decoupling capacitor is for bypassing voltage transients on the voltage buss.

MDRC-1643 Schematic



Thevenin Equivalent Terminator

The MDRC-1643 contains four pairs of series resistors. The circuit is compatible with ECL pin configurations. Each terminator section (series pair) contains a voltage divider between Vcc (0 volts) and VEE (- 5.2 volt) providing a Thevenin equivalent voltage of - 2.0 volts. A .01 microfarad decoupling capacitor bypasses the VEE buss.

ELECTRICAL SPECIFICATIONS

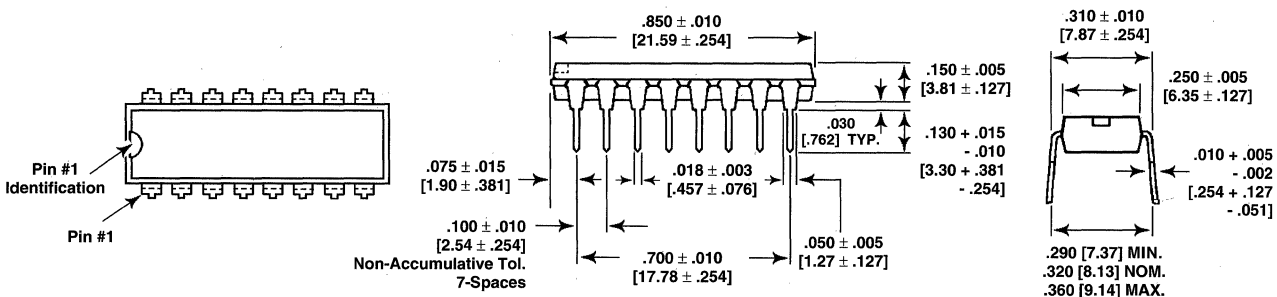
- Resistance Range:** See values in table.
- Tolerance:** ± 2% or 2 ohm, whichever is greater.
- Capacitor Tolerance:** .01 microfarad + 40%, - 20%.
- Capacitor Voltage Rating:** 25 volts maximum.
- Capacitor Dissipation Factor:** < 3%.
- Resistance Temperature Coefficient:** (- 30°C to + 85°C) ± 100PPM typical.
- Resistor Power Rating:** (Maximum at 25°C)
MDRC-1641, MDRC-1642 = .15 watt.
MDRC-1643 = .20 watt.
- Package Power Rating:** 2.0 watt maximum at 25°C.

- Temperature Coefficient of R Tracking:** ± 50PPM/°C.
- Voltage Coefficient of Resistance:** < 50PPM/V typical.
- Operating Temperature Range:** - 30°C to + 85°C.
- Storage Temperature Range:** - 30°C to + 85°C.

MECHANICAL SPECIFICATIONS

- Marking Resistance to Solvents:** Permanency testing per MIL-STD-202, Method 215.
- Solderability:** Per MIL-STD-202, Method 208E.
- Terminals:** Copper alloy, tin-lead plated.
- Body:** Molded epoxy.
- Weight:** 1.5 grams.

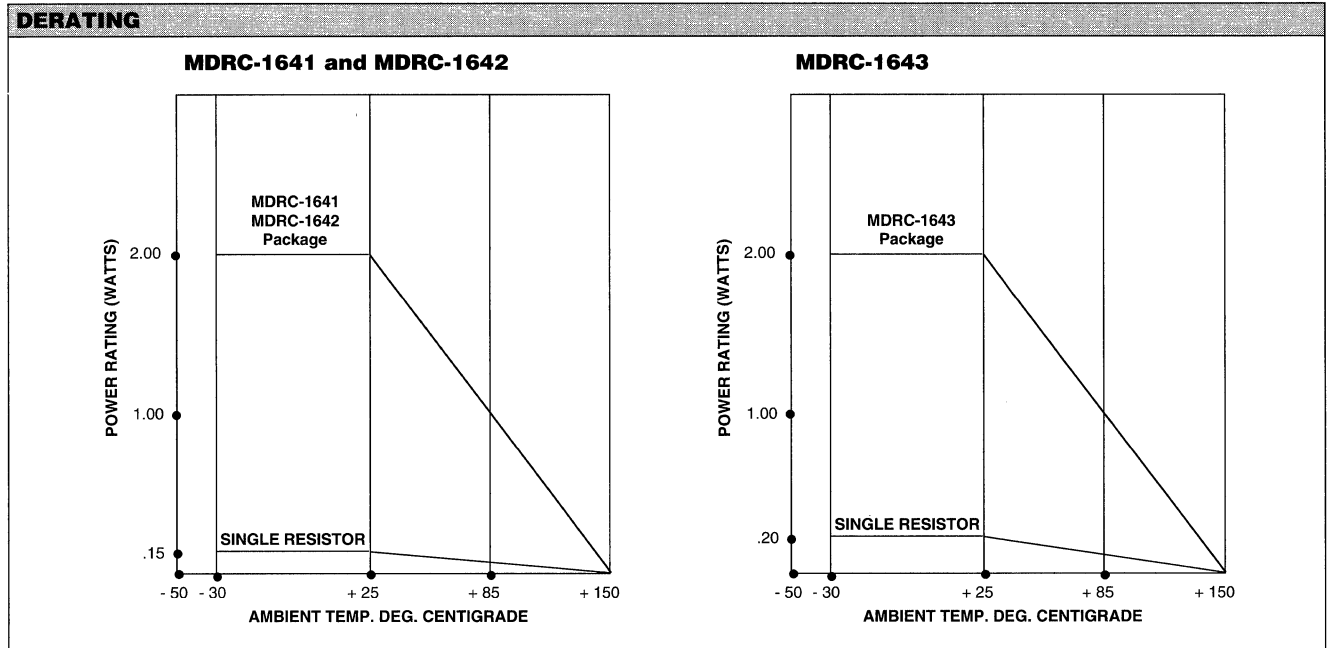
DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



MODEL MDRC

ENVIRONMENTAL PERFORMANCE *		
TEST	CONDITIONS	MAX. ΔR (Typical Test Lots)
Thermal Shock	MDRC-1641 and MDRC-1642, 5 cycles between - 30°C and + 85°C MDRC-1643, 5 cycles between - 65°C and + 125°C	± 0.50% ΔR
Short Time Overload	2 1/2 x rated working voltage 5 seconds	± 0.25% ΔR
Low Temperature Operation	MDRC-1641 and MDRC-1642, 45 minutes at full rated working voltage at - 30°C MDRC-1643, 45 minutes at full rated working voltage at - 65°C	± 0.25% ΔR
Moisture Resistance	240 hours with humidity ranging from 80% RH to 98% RH	± 0.50% ΔR
Resistance to Soldering Heat	Leads immersed in 350°C solder to within 1/16" of device body for 3 seconds	± 0.25% ΔR
Shock	Total of 18 shocks at 100 G's	± 0.25% ΔR
Vibration	12 hours at maximum of 20 G's between 10 and 2,000 Hz	± 0.25% ΔR
Load Life	1,000 hours at 70°C, rated power applied 1 1/2 hours on, 1/2 hour off for full 1,000 hour period. Derated according to the curve.	± 0.50% ΔR
Terminal Strength	4 1/2 pound pull for 30 seconds	± 0.25% ΔR
Insulation Resistance	10,000 Megohm (minimum)	
Dielectric Withstanding Voltage	(200 V RMS for 1 minute)	

* Test methods per MIL-STD-202.



RESISTANCE VALUES IN OHMS ("G" Tolerance)			
MDRC-1641	MDRC-1642	MDRC-1643	
50	510	R ₁	Z ₀
68		81	50
75		121	75
100		162	100

HOW TO ORDER

MDRC-1641 and MDRC-1642

MDRC - 16 - 41 - 500 - G

MODEL - NUMBER OF PINS - SCHEMATIC - RESISTANCE VALUE - TOLERANCE

First 2 digits are significant figures. Last digit specifies number of zeros to follow.

MDRC-1643

MDRC - 16 - 43 - 750 - G

MODEL - NUMBER OF PINS - SCHEMATIC - IMPEDANCE VALUE IN OHMS (Z₀) - TOLERANCE

First 2 digits are significant figures. Last digit specifies number of zeros to follow.

EXAMPLE: MDRC-1641-500G = A 16 pin dual-in-line resistor network with eleven 50 ohm resistors and a .01 microfarad decoupling capacitor.

MODEL TCN Capacitor Networks

SIP, Coated



FEATURES

- NPO or X7R capacitors for line terminator
- Wide operating temperature range
- Special Capacitor schematics available

ELECTRICAL SPECIFICATIONS

Type: NPO or X7R.

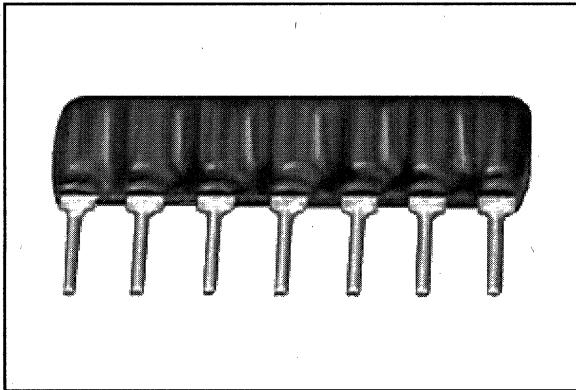
Standard Values: NPO Type = 56pF, 100pF, 220pF, 470pF.

X7R Type = 1000pF, .01uF. Other values available.

Tolerance: NPO Type = $\pm 5\%$, $\pm 10\%$. X7R Type = $\pm 10\%$, $\pm 20\%$.

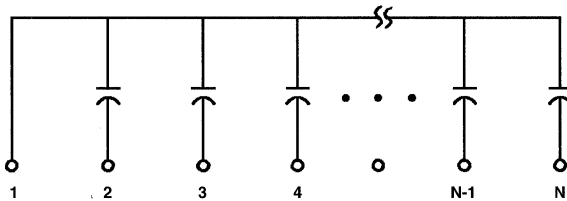
Voltage Rating: 50 VDC. Higher voltage available.

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

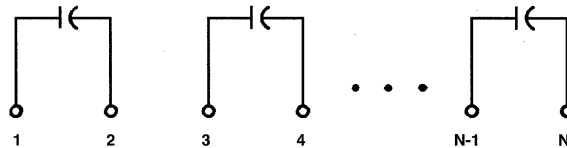


SCHEMATICS

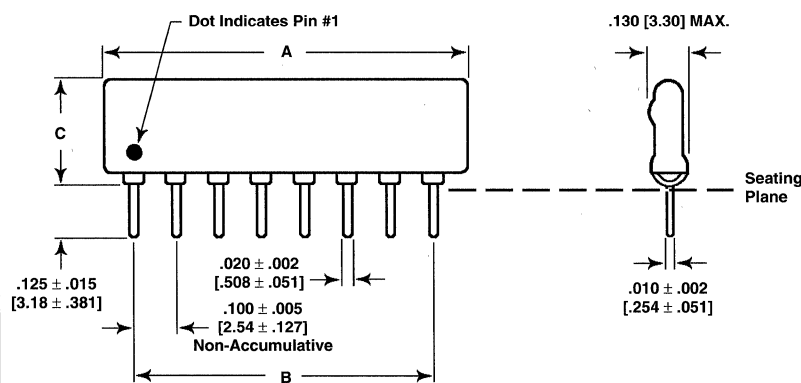
Schematic 01



Schematic 02



DIMENSIONAL CONFIGURATIONS



[Numbers in brackets indicate millimeters]

NUMBER OF PINS	A (Max.)	B ($\pm .005$ [.127])	C (Max.)
6	.590 [14.99]	.500 [12.70]	.350 [8.89]
7	.690 [17.53]	.600 [15.24]	.350 [8.89]
8	.790 [20.07]	.700 [17.78]	.350 [8.89]
9	.890 [22.61]	.800 [20.32]	.350 [8.89]
10	.990 [25.15]	.900 [22.86]	.350 [8.89]
11	1.09 [27.69]	1.00 [25.40]	.350 [8.89]
12	1.19 [30.23]	1.10 [27.94]	.350 [8.89]

PART MARKING

- Complete part number
- Manufacturer's name/code
- Date code
- Pin 1 identifier

HOW TO ORDER

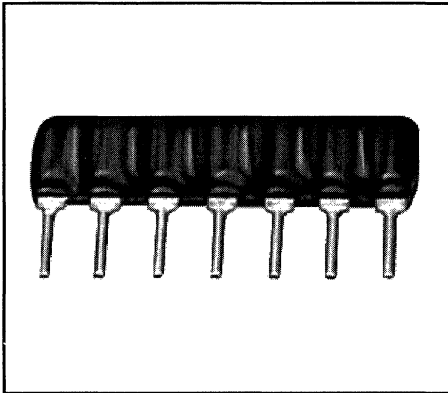
TCN MODEL 08 NUMBER OF PINS - 01 SCHEMATIC - 560 CAPACITANCE VALUE (Pico Farads) K CAPACITANCE TOLERANCE

First two digits are significant, third digit signifies number of zeros to follow.

J = $\pm 5\%$
K = $\pm 10\%$
M = $\pm 20\%$

MODEL TxxS, R/2R Ladder Networks

SIP, Coated, 4 Bits to 8 Bits



APPLICATIONS

R/2R Ladder networks for D/A and A/D converter with bi-polar or CMOS switches

ELECTRICAL SPECIFICATIONS

Ladder Network Accuracy on Linearity: $\pm 1/2$ LSB.

Ladder Network Resistance Tolerance: $\pm 2\%$.

Temperature Coefficient of Resistance: ± 100 PPM/ $^{\circ}$ C.

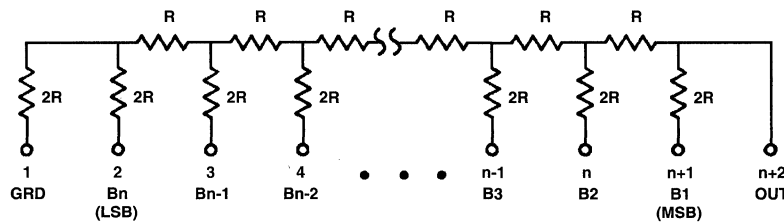
Operating Temperature Range: -55° C to $+125^{\circ}$ C.

Power Dissipation Rating at 70° C Ambient: 50 mW/element.

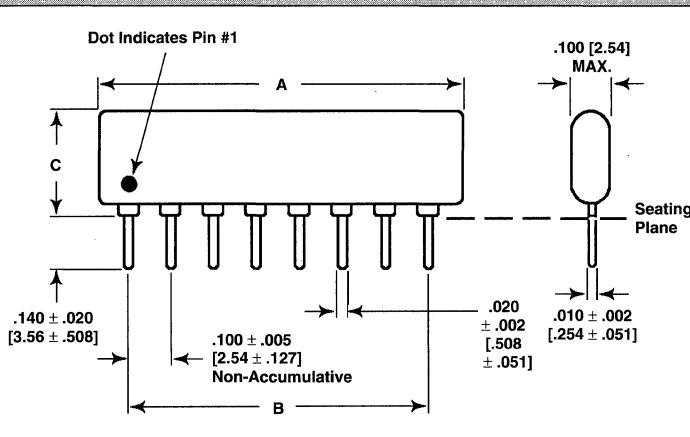
Standard Resistance Values (R): 5 kilohms, 10 kilohms, 25 kilohms, 50 kilohms and 100 kilohms.

SCHEMATIC

n BITS:
n = 4 thru 8



DIMENSIONAL CONFIGURATIONS



NO. OF PINS	A (Max.)	B \pm .005 [.127]	C (Max.)
6	.590 [14.99]	.500 [12.70]	.350 [8.89]
7	.690 [17.53]	.600 [15.24]	.350 [8.89]
8	.790 [20.07]	.700 [17.78]	.350 [8.89]
9	.890 [22.61]	.800 [20.32]	.350 [8.89]
10	.990 [25.15]	.900 [22.86]	.350 [8.89]

PART MARKING

- Complete part number
- Manufacturer's name/code
- Date code
- Pin 1 identifier

HOW TO ORDER

T10S
MODEL

T06S = 6 pin SIP
T07S = 7 pin SIP
T08S = 8 pin SIP
T09S = 9 pin SIP
T10S = 10 pin SIP

08
NUMBER OF BITS

6 pin = 4 Bits
7 pin = 5 Bits
8 pin = 6 Bits
9 pin = 7 Bits
10 pin = 8 Bits

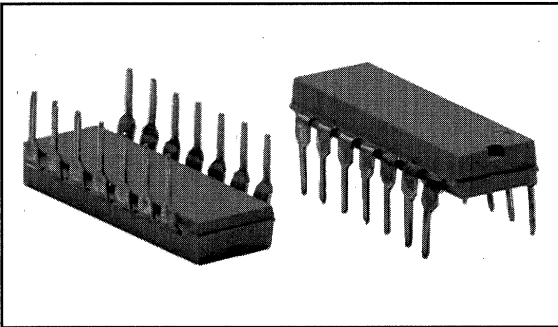
104
RESISTANCE VALUE

First two digits are significant, third digit signifies number of zeros to follow.
Example: 104 = R = 100K Ω .
(Reference, 2R = 200k Ω .)

MODEL T14L10

R/2R Ladder Networks

DIP, 10 Bit



APPLICATIONS

10 Bit, R/2R Ladder networks for D/A and A/D converter with bi-polar or CMOS switches

ELECTRICAL SPECIFICATIONS

Ladder Network Accuracy: ± 1 LSB from 0°C to $+70^{\circ}\text{C}$.

Ladder Network Resistance Tolerance: $\pm 2\%$.

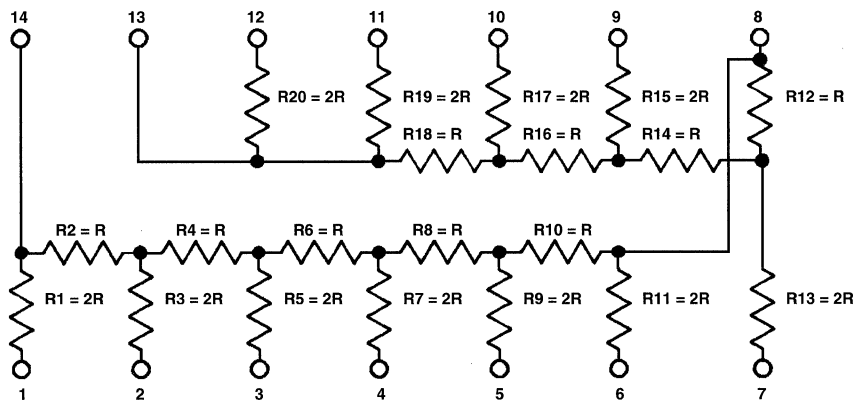
Temperature Coefficient of Resistance: $\pm 100\text{PPM}/^{\circ}\text{C}$.

Operating Temperature Range: 0°C to $+70^{\circ}\text{C}$.

Power Dissipation Rating at 70°C Ambient: 50 mW for individual resistor and 1.6 W total package rating.

Standard Resistance Values (R): 25 kilohm, 50 kilohm, 100 kilohm.

SCHEMATIC



RATIO MATCH TOLERANCE

$R1/R2 = 2 \pm 1\%$

$R1/R3 = 1 \pm 1\%$

$R1/R4 = 2 \pm 1\%$

$R1/R5 = 1 \pm 1\%$

$R1/R6 = 2 \pm 1\%$

$R1/R7 = 1 \pm 1\%$

$R1/R8 = 2 \pm 1\%$

$R9/R10 = 2 \pm 0.5\%$

$R11/R12 = 2 \pm 0.4\%$

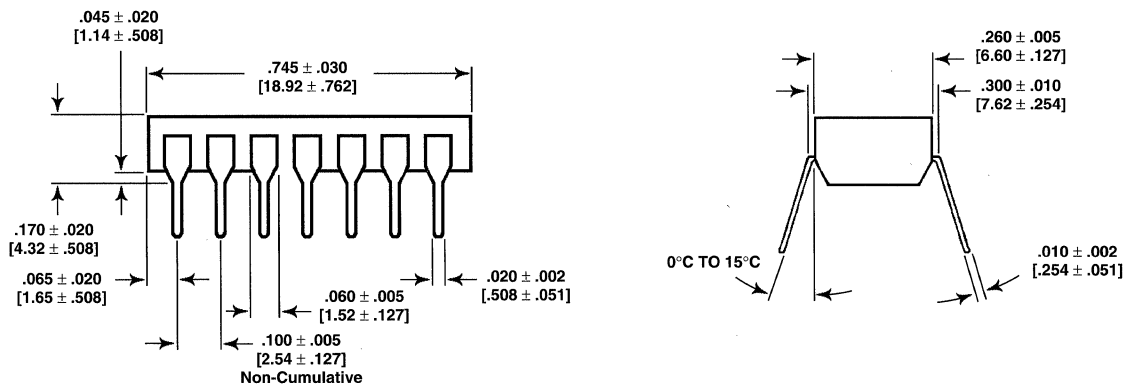
$R13/R14 = 2 \pm 0.2\%$

$R15/R16 = 2 \pm 0.2\%$

$R19/R17 = 1 \pm 0.1\%$

$R19/R18 = 2 \pm 0.1\%$

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



PART MARKING

- Complete part number
- Resistance Value
- Tolerance Value
- Manufacturer's name/code
- Date code
- Pin 1 identifier

HOW TO ORDER

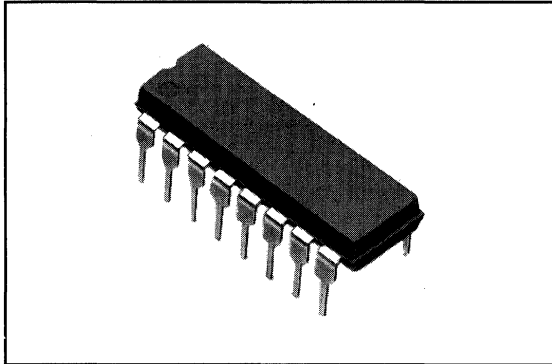
T14L10
MODEL

104
RESISTANCE VALUE (Ohms)

First two digits are significant, third digit signifies number of zeros to follow.

Example:
104 = R = 100kΩ.
Reference:
2R = 200kΩ.

MODELS T16L08 and T16LR8 R/2R Ladder Networks DIP, 8 Bit



APPLICATIONS

8 Bit, R/2R Ladder networks for D/A and A/D converter with bi-polar or CMOS switches

ELECTRICAL SPECIFICATIONS

Ladder Network Accuracy: $\pm 1/2$ LSB from 0°C to +70°C.

Ladder Network Resistance Tolerance: $\pm 2\%$.

Temperature Coefficient of Resistance: ± 100 PPM/°C.

Operating Temperature Range: 0°C to +70°C.

Power Dissipation Rating at 70°C Ambient: 50 mW for individual resistor and 1.8 W total package rating.

Standard Resistance Values (R): 25 kilohms, 50 kilohms and 100 kilohms.

RATIO MATCH TOLERANCE

R1/R2 = $2 \pm 1\%$.

R1/R6 = $2 \pm 1\%$.

R11/R12 = $2 \pm 0.4\%$.

R1/R3 = $1 \pm 1\%$.

R1/R7 = $1 \pm 1\%$.

R15/R13 = $1 \pm 0.2\%$.

R1/R4 = $2 \pm 1\%$.

R1/R8 = $2 \pm 1\%$.

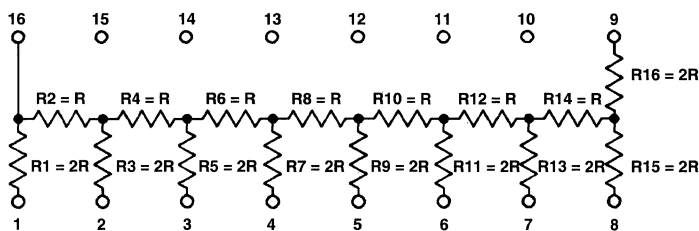
R15/R14 = $2 \pm 0.2\%$.

R1/R5 = $1 \pm 1\%$.

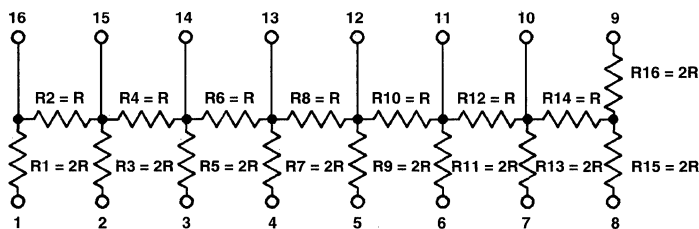
R9/R10 = $2 \pm 0.5\%$.

SCHEMATICS

T16L08

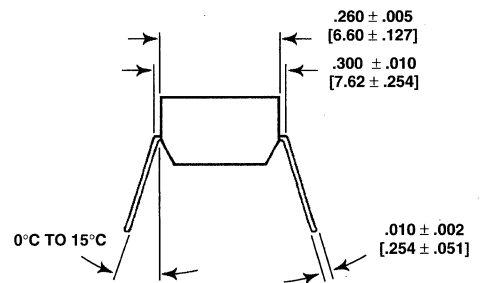
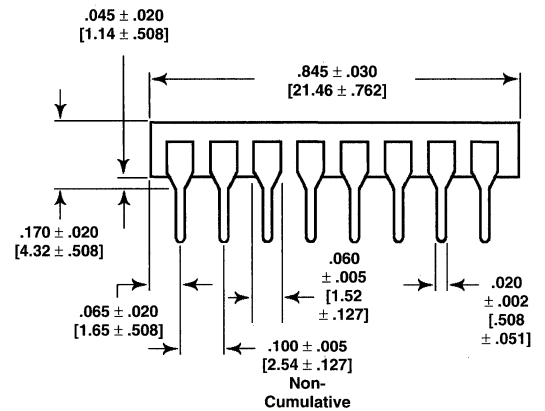


T16LR8



DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



PART MARKING

- Complete part number
- Resistance Value
- Tolerance Value
- Manufacturer's name/code
- Date code
- Pin 1 identifier

HOW TO ORDER

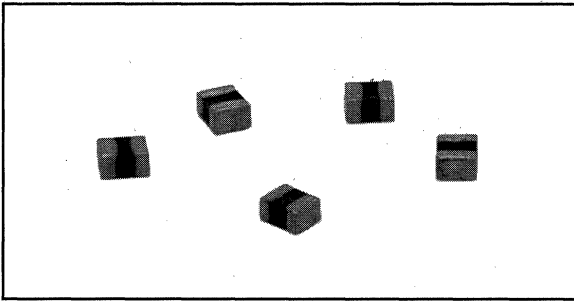
T16L08
MODEL
or
T16LR8
MODEL

104
RESISTANCE VALUE (Ohms)

First two digits are significant, third digit signifies number of zeros to follow.

Example:
104 = R = 100kΩ.
Reference:
2R = 200kΩ.

MODELS 7 and 8 NTC Thermistors Hybrid Chip



FEATURES

- Model 7 - Wraparound terminations
- Model 8 - Top and bottom terminations
- Flow solderable
- Can be mounted with conductive epoxy
- Automatic placement capability
- 8mm tape and reel available
- High density construction ensures long life and reliability

ELECTRICAL SPECIFICATIONS

Resistance Range: 5000 ohm to 1 Megohm.

Temperature Coefficient:
From - 3.9%/°C to - 5.26%/°C.

Tolerance: ± 10% at 25°C standard.
Tighter tolerances down to ± 5% or less are available.

Special resistance values and temperature coefficients are available to meet your requirements.

Techno Components hybrid chip thermistors are produced by the same exacting manufacturing process as the Leaded Chip Thermistor and demonstrate the same electrical characteristics. Only the configuration is changed in order that they may be mounted in hybrid circuits utilizing the same equipment and techniques employed in the installation of other hybrid components.

Techno Components hybrid chip thermistors are available with either silver or platinum-palladium-silver terminations to meet your process requirements.

RMF (Resistance Multiplying Factor)

TEMP. °C	MATERIAL/BETA 25°C/75°C				
	J/3964*	D/3477*	M/4437*	U/3925*	X/4842*
-55	96.77	53.4	126.1	—	176.4
-50	67.23	38.99	86.92	56.49	119.0
-40	33.72	21.45	42.69	29.49	98.0
-30	17.72	12.27	21.84	16.03	27.45
-20	9.713	7.278	11.66	9.04	18.981
-10	5.534	4.459	6.385	5.267	7.2731
0	3.266	2.815	3.621	3.166	4.018
10	1.990	1.826	2.123	1.958	2.236
20	1.249	1.215	1.277	1.243	1.3031
25	1.0	1.0	1.0	1.0	1.0
30	.8056	.8276	.7880	.8090	.7723
37	.6015	.6406	.5702	.6070	.5434
40	.5326	.5758	.4981	.5383	.4690
50	.3602	.4086	.3219	.3657	.2914
60	.2489	.2954	.2124	.2533	.1849
70	.1753	.2172	.1429	.1786	.1198
80	.1258	.1622	.09790	.1281	.07902
90	.09174	.1229	.06823	.09330	.05307
100	.06798	.09446	.04832	.06897	.03624
110	.05110	.07350	.03474	.05167	.02514
120	.03894	.05788	.02533	.03920	.01770
125	.03416	.05158	.02174	.03430	.01493
130	.03005	.04609	.01872	.03010	.01264
140	.02347	.03708	.01401	.02337	.00915
150	.01853	.03012	.01061	.01834	.00670

* The type material is defined in the part number by the letter following the first digit in the number.

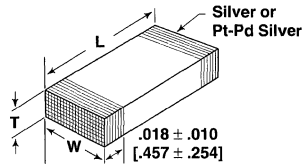
NOTE: For 1°C Ratio Tables - contact factory.

TO DETERMINE THE RESISTANCE of a thermistor at a specified temperature, select the appropriate material letter from the part number and using the column below for that material type, find the RMF at the desired temperature. Multiply that factor times the 25°C resistance of the thermistor.

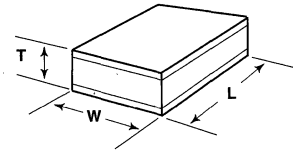
MODELS 7 and 8

STANDARD ELECTRICAL SPECIFICATIONS and DIMENSIONAL CONFIGURATIONS

MODEL 7



MODEL 8



[Numbers in brackets indicate millimeters]

R @ 25°C ± 10% (Ohms)	MODEL	T.C. %/°C	T ± .010 [254]	W ± .010 [254]	L ± .010 [254]
1,000,000	7M105-J	- 4.79	.014 [356]	.054 [1.37]	.102 [2.59]
500,000	7U504-J	- 4.30	.029 [734]	.053 [1.35]	.102 [2.59]
100,000	7J104-J	- 4.40	.016 [406]	.043 [1.09]	.107 [2.72]
80,000	7J803-J	- 4.40	.015 [381]	.053 [1.35]	.102 [2.59]
60,000	7J603-J	- 4.40	.019 [483]	.053 [1.35]	.102 [2.59]
50,000	7J503-J	- 4.40	.024 [610]	.051 [1.30]	.102 [2.59]
40,000	7J403-J	- 4.40	.028 [711]	.053 [1.35]	.102 [2.59]
30,000	7J303-J	- 4.40	.032 [813]	.060 [1.52]	.102 [2.59]
15,000	7D153-J	- 3.83	.016 [406]	.043 [1.09]	.102 [2.59]
10,000	7D103-J	- 3.83	.020 [508]	.051 [1.30]	.102 [2.59]
8,000	7D802-J	- 3.83	.024 [610]	.052 [1.32]	.102 [2.59]
7,000	7D702-J	- 3.83	.025 [635]	.056 [1.42]	.102 [2.59]
6,000	7D602-J	- 3.83	.029 [737]	.056 [1.42]	.102 [2.59]
5,000	7D502-J	- 3.83	.033 [838]	.058 [1.47]	.102 [2.59]
5,000	7D502-1206-J	- 3.83	.042 [1.07]	.063 [1.60]	.126 [3.20]
6,000	7D602-1206-J	- 3.83	.035 [889]	.063 [1.60]	.126 [3.20]
7,000	7D702-1206-J	- 3.83	.030 [762]	.063 [1.60]	.126 [3.20]
8,000	7D802-1206-J	- 3.83	.027 [686]	.063 [1.60]	.126 [3.20]
10,000	7D103-1206-J	- 3.83	.022 [559]	.063 [1.60]	.126 [3.20]
4,000	7D402-1208-J	- 3.83	.041 [1.04]	.079 [2.01]	.126 [3.20]
3,000	7D302-1210-J	- 3.83	.044 [1.12]	.098 [2.49]	.126 [3.20]
10,000	7J103-1012-N	- 4.40	.065 [1.65]	.126 [3.20]	.098 [2.49]
100,000	7J104-1205-N	- 4.40	.026 [660]	.049 [1.24]	.126 [3.20]
50,000	7J503-1206-N	- 4.40	.039 [991]	.063 [1.60]	.126 [3.20]
10,000	7D103-1206-N	- 3.83	.033 [838]	.063 [1.60]	.126 [3.20]
1,000,000	8X105-H	- 5.20	.020 [508]	.043 [1.09]	.043 [1.09]
500,000	8X504-H	- 5.20	.016 [406]	.053 [1.35]	.053 [1.35]
250,000	8X254-H	- 5.20	.016 [406]	.075 [1.91]	.075 [1.91]
200,000	8M204-H	- 4.79	.035 [889]	.041 [1.04]	.041 [1.04]
100,000	8X104-H	- 5.20	.016 [406]	.120 [3.05]	.120 [3.05]
100,000	8U104-H	- 4.30	.024 [610]	.049 [1.24]	.049 [1.24]
100,000	8M104-H	- 4.79	.032 [813]	.054 [1.37]	.054 [1.37]
80,000	8U803-H	- 4.30	.020 [508]	.049 [1.24]	.049 [1.24]
50,000	8U503-H	- 4.30	.015 [381]	.053 [1.35]	.053 [1.35]
50,000	8M503-H	- 4.79	.015 [381]	.051 [1.30]	.051 [1.30]
30,000	8U303-H	- 4.30	.013 [330]	.054 [1.37]	.072 [1.83]
30,000	8M303-H	- 4.79	.013 [330]	.066 [1.68]	.066 [1.68]
30,000	8J303-H	- 4.40	.032 [813]	.029 [737]	.029 [737]
20,000	8J203-H	- 4.40	.032 [813]	.036 [914]	.036 [914]
15,000	8J153-H	- 4.40	.032 [813]	.042 [1.07]	.042 [1.07]
10,000	8J103-H	- 4.40	.032 [813]	.051 [1.30]	.051 [1.30]
3,000	8J302-H	- 4.40	.015 [381]	.054 [1.37]	.068 [1.73]
2,000	8J202-H	- 4.40	.015 [381]	.054 [1.37]	.101 [2.57]
2,000	8D202-H	- 3.83	.037 [940]	.049 [1.24]	.049 [1.24]
1,000	8D102-H	- 3.83	.022 [559]	.053 [1.35]	.053 [1.35]
1,000	8J102-H	- 4.40	.015 [381]	.105 [2.67]	.105 [2.67]
500	8D501-H	- 3.83	.015 [381]	.060 [1.52]	.060 [1.52]
500	8J501-H	- 4.40	.015 [381]	.148 [3.76]	.148 [3.76]
300	8D301-H	- 3.83	.015 [381]	.077 [1.96]	.077 [1.96]
50	8D50R0-H	- 3.83	.015 [381]	.188 [4.78]	.188 [4.78]

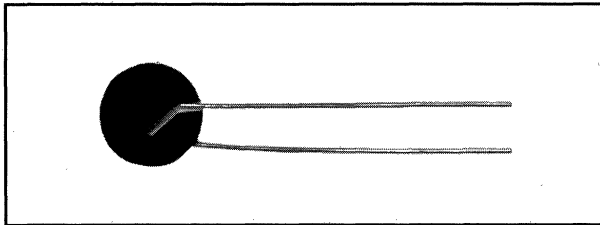
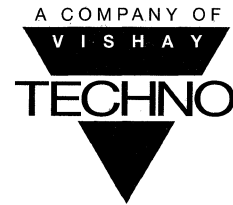
NOTE: Models with J Conductor also available in H and G Conductor. Gold terminations available as specials. Consult factory.

HOW TO ORDER

7 MODEL	D MATERIAL	103 VALUE	J CONDUCTOR TYPE	- 5 TOLERANCE
7 = Wraparound 8 = Top and Bottom	D = TC - 3.83% J = TC - 4.4% M = TC - 4.79% U = TC - 4.3% X = TC - 5.2%	First 2 digits are significant. The last digit is number of zeros in value. Example: 10k = 103	H = Silver G = Palladium Silver J = Platinum Palladium Silver N = Nickel Barrier	± 10% = None ± 5% = - 5

MODEL 1B NTC Thermistors

Uncoated Disc, Material 'B', 2.5Ω to 500Ω



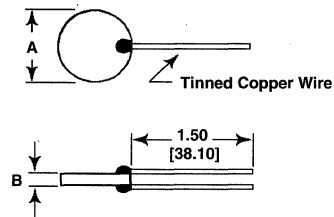
APPLICATIONS

- Engineered for
- Temperature compensation
 - Temperature measurement
 - Temperature control
 - Meter compensation
 - Voltage regulation
 - Amplitude control
 - Liquid level indication
 - Flow measurement
 - Surge suppression
 - Time delay

STANDARD ELECTRICAL SPECIFICATIONS and DIMENSIONAL CONFIGURATIONS

R @ 25°C ± 10% (Ohms)	PART NUMBER	DISSIPATION * CONSTANT	THERMAL** TIME CONSTANT	A	B	LEADS AWG #
500	1B07	2	3	.050 [1.27]	.080 [2.03]	30
400	1B08	2	3	.050 [1.27]	.070 [1.78]	30
300	1B09	2	3	.050 [1.27]	.050 [1.27]	30
250	1B095	2	2	.050 [1.27]	.040 [1.02]	30
200	1B10	2	2	.050 [1.27]	.030 [.762]	30
150	1B11	2	2	.050 [1.27]	.025 [.635]	30
100	1B12	2	2	.050 [1.27]	.020 [.508]	30
300	1B120	2.5	5	.070 [1.78]	.100 [2.54]	30
250	1B125	2	4.5	.070 [1.78]	.085 [2.16]	30
200	1B110	2	4	.070 [1.78]	.070 [1.78]	30
150	1B111	2	3	.070 [1.78]	.050 [1.27]	30
100	1B112	2	3	.070 [1.78]	.030 [.762]	30
150	1B113	4	14	.100 [2.54]	.100 [2.54]	28
125	1B115	4	12	.100 [2.54]	.085 [2.16]	28
100	1B13	3	10	.100 [2.54]	.070 [1.78]	28
80	1B14	3	8	.100 [2.54]	.050 [1.27]	28
70	1B145	3	7	.100 [2.54]	.045 [1.14]	28
60	1B147	3	7	.100 [2.54]	.040 [1.02]	28
50	1B15	3	6	.100 [2.54]	.030 [.762]	28
40	1B165	3	5	.100 [2.54]	.030 [.762]	28
30	1B16	3	5	.100 [2.54]	.020 [.508]	28
100	1B151	7	30	.150 [3.81]	.150 [3.81]	24
75	1B152	7	25	.150 [3.81]	.100 [2.54]	24
50	1B153	7	20	.150 [3.81]	.075 [1.91]	24
25	1B154	7	18	.150 [3.81]	.040 [1.02]	24
80	1B118	8	40	.200 [5.08]	.200 [5.08]	24
75	1B117	8	36	.200 [5.08]	.190 [4.83]	24
50	1B18	7	30	.200 [5.08]	.130 [3.30]	24
30	1B19	7	25	.200 [5.08]	.080 [2.03]	24
20	1B20	7	20	.200 [5.08]	.050 [1.27]	24
15	1B205	7	19	.200 [5.08]	.040 [1.02]	24
10	1B21	7	18	.200 [5.08]	.030 [.762]	24
30	1B22	9	75	.300 [7.62]	.180 [4.57]	24
20	1B225	8.5	60	.300 [7.62]	.120 [3.05]	24
10	1B23	8	48	.300 [7.62]	.050 [1.27]	24
7.5	1B235	8	42	.300 [7.62]	.045 [1.14]	24
5	1B24	8	35	.300 [7.62]	.030 [.762]	24
15	1B119	10	85	.400 [10.16]	.160 [4.06]	22
12.5	1B265	10	77	.400 [10.16]	.130 [3.30]	22
10	1B26	9	70	.400 [10.16]	.100 [2.54]	22
7.5	1B27	9	65	.400 [10.16]	.080 [2.03]	22
5	1B28	9	50	.400 [10.16]	.050 [1.27]	22
2.5	1B33	14	60	.500 [12.70]	.040 [1.02]	22

[Numbers in brackets indicate millimeters]



Composition "1B" thermistors are a part of a family of thermal sensors representing a new breakthrough in materials engineering. After more than a decade of engineering development and constant product improvement, Techno Components has formulated a thermal sensing material called THERMOCERAM. The "1B" composition offers a broad range of resistance values. The design engineer can specify from 2.5 ohms to 500 ohms from the same basic type of thermistor. In addition to this wide range of values, the Model "1B" is an excellent, highly stable, broad application thermal sensor that finds use in innumerable heat sensing designs.

Although not Military Qualified, all Model "1B" thermistors conform to AQL and confidence levels as specified in MIL-T-23648 as outlined by tables V and VI.

Coatings, encapsulations markings, probes and resistor/ thermistor networks...are also available to meet specific requirements by contacting our application engineering department.

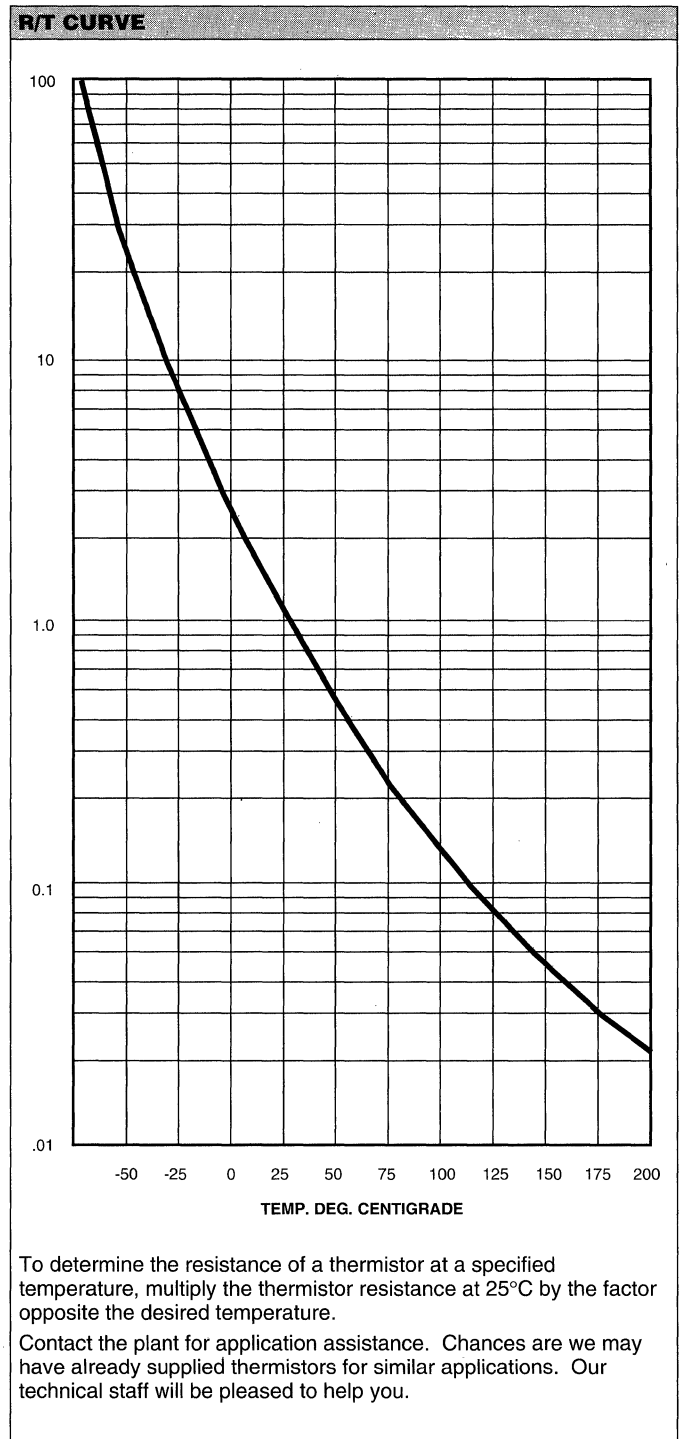
Resistance tolerances of ± 1% thru ± 20% are available and may be specified at 25°C or any temperature within the operating range.

* Dissipation Constant, expressed in mw/°C, represents the amount of power required to raise the temperature of a thermistor 1°C.

** Thermal Time Constant, expressed in seconds, is the time required for a thermistor dissipating zero power to change 63% of the difference between its initial temperature value and that of a new temperature environment.

MODEL 1B

R/T CONVERSION TABLE R_t/R₂₅							
R @ 0°C Ratio R @ 50°C 5.3 ± 3% Temperature Coefficient @ 25°C - 3.3%/°C Beta (25° to 75°C) 3082°K							
TEMP °C	R _t /R ₂₅	TEMP °C	R _t /R ₂₅	TEMP °C	R _t /R ₂₅	TEMP °C	R _t /R ₂₅
-60	43.0	-7	3.25	46	.522	99	.133
-59	40.4	-6	3.12	47	.507	100	.130
-58	38.0	-5	2.99	48	.492	101	.127
-57	35.8	-4	2.87	49	.477	102	.124
-56	33.8	-3	2.76	50	.464	103	.122
-55	31.9	-2	2.65	51	.452	104	.119
-54	30.2	-1	2.55	52	.438	104.4	.118
-53	28.6	0	2.45	53	.426	105	.117
-52	27.1	1	2.36	54	.414	106	.114
-51	25.7	2	2.27	55	.403	107	.112
-50	24.3	3	2.18	56	.393	108	.109
-49	23.0	4	2.10	57	.382	109	.107
-48	21.8	5	2.02	58	.372	110	.105
-47	20.7	6	1.95	59	.361	111	.103
-46	19.6	7	1.88	60	.350	112	.101
-45	18.6	8	1.81	61	.342	113	.0983
-44	17.6	9	1.74	62	.332	114	.0962
-43	16.7	10	1.68	63	.323	115	.0943
-42	15.9	11	1.62	64	.313	116	.0923
-41	15.1	12	1.57	65	.305	117	.0905
-40	14.4	13	1.52	66	.297	118	.0887
-39	13.7	14	1.47	67	.289	119	.0870
-38	13.1	15	1.42	68	.282	120	.0852
-37	12.5	16	1.37	69	.274	121	.0835
-36	11.8	17	1.32	70	.267	122	.0818
-35	11.3	18	1.27	71	.261	123	.0801
-34	10.8	19	1.22	72	.254	124	.0787
-33	10.3	20	1.18	73	.248	125	.0771
-32	9.79	21	1.14	74	.242	126	.0756
-31	9.32	22	1.11	75	.236	127	.0741
-30	8.93	23	1.07	76	.229	128	.0728
-29	8.51	24	1.03	77	.224	129	.0713
-28	8.12	25	1.00	78	.218	130	.0700
-27	7.78	26	.970	79	.213	131	.0686
-26	7.41	27	.939	80	.208	132	.0673
-25	7.10	28	.910	81	.203	133	.0660
-24	6.80	29	.881	82	.198	134	.0648
-23	6.49	30	.854	83	.193	135	.0636
-22	6.21	31	.828	84	.188	136	.0624
-21.5	6.09	32	.802	85	.183	137	.0612
-21	5.93	33	.779	86	.179	138	.0601
-20	5.69	34	.756	87	.175	139	.0590
-19	5.43	35	.732	88	.171	140	.0579
-18	5.20	36	.710	89	.167	141	.0569
-17	4.98	37	.689	90	.163	142	.0559
-16	4.75	37.8	.671	91	.159	143	.0548
-15	4.56	38	.668	92	.156	144	.0539
-14	4.37	39	.647	93	.152	145	.0529
-13	4.18	40	.628	94	.148	146	.0520
-12	4.01	41	.608	95	.145	147	.0511
-11	3.84	42	.589	96	.142	148	.0501
-10	3.68	43	.571	97	.139	149	.0492
-9	3.52	44	.554	98	.136	150	.0483
-8	3.39	45	.537				

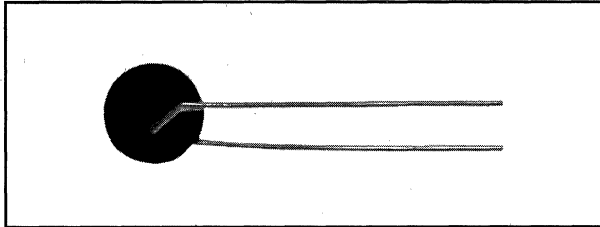


HOW TO ORDER

1B07
± 10%
PART NUMBER
TOLERANCE

MODEL 1D NTC Thermistors

Uncoated Disc, Material 'D', 25Ω to 5,000Ω



APPLICATIONS

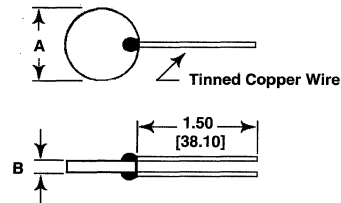
Engineered for

- Temperature compensation
- Temperature measurement
- Temperature control
- Meter compensation
- Voltage regulation
- Amplitude control
- Liquid level indication
- Flow measurement
- Surge suppression
- Time delay

STANDARD ELECTRICAL SPECIFICATIONS and DIMENSIONAL CONFIGURATIONS

R @ 25°C ± 10% (Ohms)	PART NUMBER	DISSIPATION * CONSTANT	THERMAL** TIME CONSTANT	A	B	LEADS AWG #
5000	1D07	2	3	.050 [1.27]	.080 [2.03]	30
4000	1D08	2	3	.050 [1.27]	.070 [1.78]	30
3000	1D09	2	3	.050 [1.27]	.050 [1.27]	30
2000	1D10	2	2	.050 [1.27]	.030 [.762]	30
1500	1D11	2	2	.050 [1.27]	.025 [.635]	30
1000	1D12	2	2	.050 [1.27]	.020 [.508]	30
3000	1D120	2.5	5	.070 [1.78]	.100 [2.54]	30
2500	1D125	2	4.5	.070 [1.78]	.085 [2.16]	30
2000	1D110	2	4	.070 [1.78]	.070 [1.78]	30
1500	1D111	2	3	.070 [1.78]	.050 [1.27]	30
1000	1D112	2	3	.070 [1.78]	.030 [.762]	30
1500	1D113	4	14	.100 [2.54]	.100 [2.54]	28
1250	1D115	4	12	.100 [2.54]	.085 [2.16]	28
1000	1D13	3	10	.100 [2.54]	.070 [1.78]	28
800	1D14	3	8	.100 [2.54]	.050 [1.27]	28
700	1D145	3	7	.100 [2.54]	.045 [1.14]	28
600	1D147	3	7	.100 [2.54]	.040 [1.02]	28
500	1D15	3	6	.100 [2.54]	.030 [.762]	28
400	1D165	3	5	.100 [2.54]	.030 [.762]	28
300	1D16	3	5	.100 [2.54]	.020 [.508]	28
1000	1D151	7	30	.150 [3.81]	.150 [3.81]	24
750	1D152	7	25	.150 [3.81]	.100 [2.54]	24
500	1D153	7	20	.150 [3.81]	.075 [1.91]	24
250	1D154	7	18	.150 [3.81]	.040 [1.02]	24
800	1D118	8	40	.200 [5.08]	.200 [5.08]	24
750	1D117	8	36	.200 [5.08]	.190 [4.83]	24
500	1D18	7	30	.200 [5.08]	.130 [3.30]	24
300	1D19	7	25	.200 [5.08]	.080 [2.03]	24
200	1D20	7	20	.200 [5.08]	.050 [1.27]	24
150	1D205	7	19	.200 [5.08]	.040 [1.02]	24
100	1D21	7	18	.200 [5.08]	.030 [.762]	24
300	1D22	9	75	.300 [7.62]	.180 [4.57]	24
200	1D225	8.5	60	.300 [7.62]	.120 [3.05]	24
100	1D23	8	48	.300 [7.62]	.060 [1.52]	24
75	1D235	8	42	.300 [7.62]	.045 [1.14]	24
50	1D24	8	35	.300 [7.62]	.030 [.762]	24
150	1D119	10	85	.400 [10.16]	.160 [4.06]	22
125	1D265	10	77	.400 [10.16]	.130 [3.30]	22
100	1D26	9	70	.400 [10.16]	.100 [2.54]	22
75	1D27	9	65	.400 [10.16]	.080 [2.03]	22
50	1D28	9	50	.400 [10.16]	.050 [1.27]	22
25	1D33	14	60	.500 [12.70]	.040 [1.02]	22

[Numbers in brackets indicate millimeters]



Composition "1D" thermistors are a part of a family of thermal sensors representing a new breakthrough in materials engineering. After more than a decade of engineering development and constant product improvement, Techno Components has formulated a thermal sensing material called THERMOCERAM. The "1D" composition offers a broad range of resistance values. The design engineer can specify from 25 ohms to 5,000 ohms from the same basic type of thermistor. In addition to this wide range of values, the Model "1D" is an excellent, highly stable, broad application thermal sensor that finds use in innumerable heat sensing designs.

Although not Military Qualified, all Model "1D" thermistors conform to AQL and confidence levels as specified in MIL-T-23648 as outlined by tables V and VI.

Coatings, encapsulations markings, probes and resistor/thermistor networks...are also available to meet specific requirements by contacting our application engineering department.

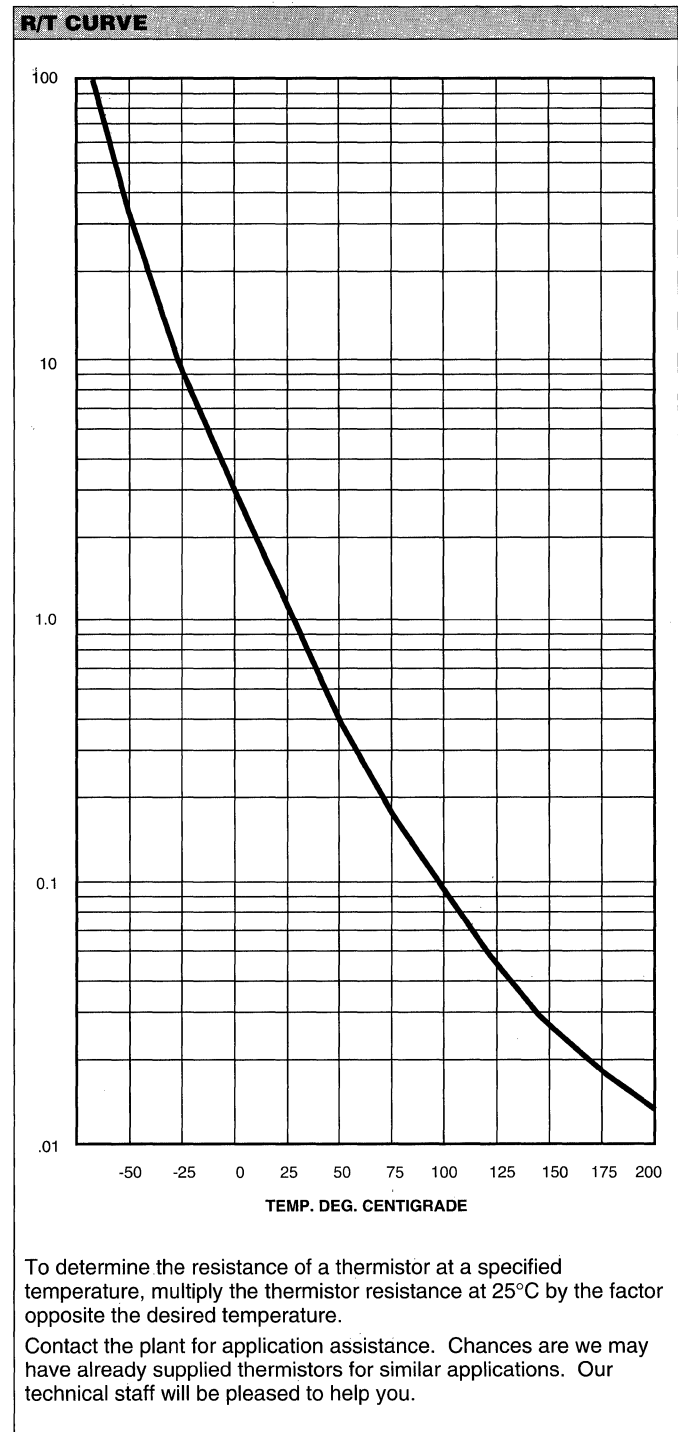
Resistance tolerances of ± 1% thru ± 20% are available and may be specified at 25°C or any temperature within the operating range.

* Dissipation Constant, expressed in mw/°C, represents the amount of power required to raise the temperature of a thermistor 1°C.

** Thermal Time Constant, expressed in seconds, is the time required for a thermistor dissipating zero power to change 63% of the difference between its initial temperature value and that of a new temperature environment.

MODEL 1D

R/T CONVERSION TABLE R_t/R₂₅							
R @ 0°C Ratio R @ 50°C 6.9 ± 3% Temperature Coefficient @ 25°C - 3.9%/°C Beta (25° to 75°C) 3530°K							
TEMP °C	R _t /R ₂₅	TEMP °C	R _t /R ₂₅	TEMP °C	R _t /R ₂₅	TEMP °C	R _t /R ₂₅
-55	53.40	-3	3.222	49	.4225	101	.0921
-54	50.10	-2	3.079	50	.4086	102	.0898
-53	47.02	-1	2.944	51	.3953	103	.0875
-52	44.16	0	2.815	52	.3824	104	.0853
-51	41.48	1	2.692	53	.3700	105	.0832
-50	38.99	2	2.576	54	.3581	106	.0811
-49	36.66	3	2.465	55	.3467	107	.0792
-48	34.48	4	2.360	56	.3356	108	.0772
-47	32.45	5	2.260	57	.3250	109	.0753
-46	30.55	6	2.164	58	.3147	110	.0735
-45	28.77	7	2.074	59	.3049	111	.0717
-44	27.11	8	1.987	60	.2954	112	.0700
-43	25.55	9	1.905	61	.2862	113	.0683
-42	24.09	10	1.826	62	.2774	114	.0667
-41	22.73	11	1.751	63	.2689	115	.0651
-40	21.45	12	1.680	64	.2607	116	.0636
-39	20.25	13	1.612	65	.2528	117	.0621
-38	19.13	14	1.547	66	.2451	118	.0607
-37	18.07	15	1.485	67	.2378	119	.0593
-36	17.08	16	1.426	68	.2306	120	.0579
-35	16.15	17	1.370	69	.2238	121	.0566
-34	15.28	18	1.316	70	.2172	122	.0553
-33	14.46	19	1.264	71	.2108	123	.0540
-32	13.68	20	1.215	72	.2046	124	.0528
-31	12.96	21	1.168	73	.1986	125	.0516
-30	12.27	22	1.123	74	.1929	126	.0504
-29	11.63	23	1.080	75	.1873	127	.0493
-28	11.03	24	1.039	76	.1820	128	.0482
-27	10.46	25	1.000	77	.1768	129	.0471
-26	9.918	26	.9624	78	.1717	130	.0461
-25	9.411	27	.9265	79	.1669	131	.0451
-24	8.934	28	.8921	80	.1622	132	.0441
-23	8.483	29	.8591	81	.1577	133	.0431
-22	8.058	30	.8276	82	.1533	134	.0422
-21	7.657	31	.7973	83	.1490	135	.0413
-20	7.278	32	.7684	84	.1449	136	.0404
-19	6.920	33	.7406	85	.1410	137	.0395
-18	6.582	34	.7140	86	.1371	138	.0387
-17	6.263	35	.6885	87	.1334	139	.0379
-16	5.960	36	.6641	88	.1298	140	.0371
-15	5.675	37	.6406	89	.1263	141	.0363
-14	5.404	38	.6181	90	.1229	142	.0355
-13	5.148	39	.5965	91	.1197	143	.0348
-12	4.906	40	.5758	92	.1165	144	.0341
-11	4.676	41	.5559	93	.1134	145	.0334
-10	4.459	42	.5368	94	.1105	146	.0327
-9	4.253	43	.5185	95	.1076	147	.0320
-8	4.058	44	.5008	96	.1048	148	.0314
-7	3.872	45	.4839	97	.1021	149	.0307
-6	3.697	46	.4676	98	.0995	150	.0301
-5	3.530	47	.4520	99	.0969		
-4	3.372	48	.4370	100	.0945		

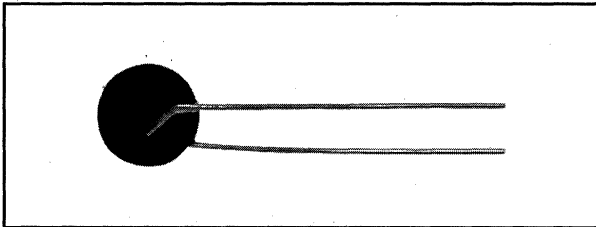


HOW TO ORDER

<u>1D07</u>	<u>± 10%</u>
PART NUMBER	TOLERANCE

MODEL 1J NTC Thermistors

Uncoated Disc, Material 'J', 200Ω to 30,000Ω



APPLICATIONS

Engineered for

- Temperature compensation
- Temperature measurement
- Temperature control
- Meter compensation
- Voltage regulation
- Amplitude control
- Liquid level indication
- Flow measurement
- Surge suppression
- Time delay

STANDARD ELECTRICAL SPECIFICATIONS and DIMENSIONAL CONFIGURATIONS

R @ 25°C ±10% (Ohms)	PART NUMBER	DISSIPATION * CONSTANT	THERMAL** TIME CONSTANT	A	B	LEADS AWG #	[Numbers in brackets indicate millimeters]
30k	1J09	2	3	.050 [1.27]	.075 [1.91]	30	
25k	1J095	2	3	.050 [1.27]	.060 [1.52]	30	
20k	1J10	2	3	.050 [1.27]	.050 [1.27]	30	
15k	1J11	2	2	.050 [1.27]	.035 [.889]	30	
10k	1J12	2	2	.050 [1.27]	.025 [.635]	30	
8k	1J01	2	2	.050 [1.27]	.020 [.508]	30	
20k	1J110	2.5	5	.070 [1.78]	.100 [2.54]	30	
15k	1J111	2	4	.070 [1.78]	.070 [1.78]	30	
10k	1J112	2	3	.070 [1.78]	.050 [1.27]	30	
8k	1J113	2	3	.070 [1.78]	.040 [1.02]	30	
6k	1J115	2	3	.070 [1.78]	.030 [.762]	30	
10k	1J13	4	12	.100 [2.54]	.100 [2.54]	28	
8k	1J14	3	10	.100 [2.54]	.080 [2.03]	28	
7k	1J145	3	10	.100 [2.54]	.070 [1.78]	28	
6k	1J147	3	9	.100 [2.54]	.060 [1.52]	28	
5k	1J15	3	8	.100 [2.54]	.050 [1.27]	28	
4k	1J165	3	7	.100 [2.54]	.040 [1.02]	28	
3k	1J16	3	5	.100 [2.54]	.030 [.762]	28	
2.5k	1J175	3	5	.100 [2.54]	.025 [.635]	28	
2k	1J17	3	5	.100 [2.54]	.020 [.508]	28	
7000	1J151	7	30	.150 [3.81]	.150 [3.81]	24	
6000	1J152	7	28	.150 [3.81]	.135 [3.43]	24	
5000	1J153	7	25	.150 [3.81]	.110 [2.79]	24	
4000	1J154	7	23	.150 [3.81]	.090 [2.29]	24	
3000	1J155	7	20	.150 [3.81]	.070 [1.78]	24	
2000	1J156	7	19	.150 [3.81]	.045 [1.14]	24	
1500	1J157	7	17	.150 [3.81]	.035 [.889]	24	
5000	1J18	8	36	.200 [5.08]	.190 [4.83]	24	
4000	1J185	7	32	.200 [5.08]	.160 [4.06]	24	
3000	1J19	7	30	.200 [5.08]	.120 [3.05]	24	
2500	1J195	7	28	.200 [5.08]	.100 [2.54]	24	
2000	1J20	7	25	.200 [5.08]	.080 [2.03]	24	
1500	1J205	7	23	.200 [5.08]	.060 [1.52]	24	
1000	1J21	7	18	.200 [5.08]	.040 [1.02]	24	
2000	1J23	9	75	.300 [7.62]	.180 [4.57]	24	
1500	1J235	9	70	.300 [7.62]	.135 [3.43]	24	
1000	1J24	8	48	.300 [7.62]	.080 [2.03]	24	
750	1J245	8	46	.300 [7.62]	.070 [1.78]	24	
500	1J119	8	35	.300 [7.62]	.045 [1.14]	24	
1000	1J26	10	85	.400 [10.16]	.160 [4.06]	22	
750	1J27	9	70	.400 [10.16]	.120 [3.05]	22	
500	1J28	9	65	.400 [10.16]	.080 [2.03]	22	
250	1J29	9	50	.400 [10.16]	.040 [1.02]	22	
200	1J35	14	60	.500 [12.70]	.050 [1.27]	22	

Composition "1J" thermistors are a part of a family of thermal sensors representing a new breakthrough in materials engineering. After more than a decade of engineering development and constant product improvement, Techno Components has formulated a thermal sensing material called THERMOCERAM. The "1J" composition offers a broad range of resistance values. The design engineer can specify from 200 ohm to 30,000 ohm from the same basic type of thermistor. In addition to this wide range of values, the Model "1J" is an excellent, highly stable, broad application thermal sensor that finds use in innumerable heat sensing designs. Although not Military Qualified, all Model "1J" thermistors conform to AQL and confidence levels as specified in MIL-T-23648 as outlined by tables V and VI. Coatings, encapsulations markings, probes and resistor/thermistor networks...are also available to meet specific requirements by contacting our application engineering department.

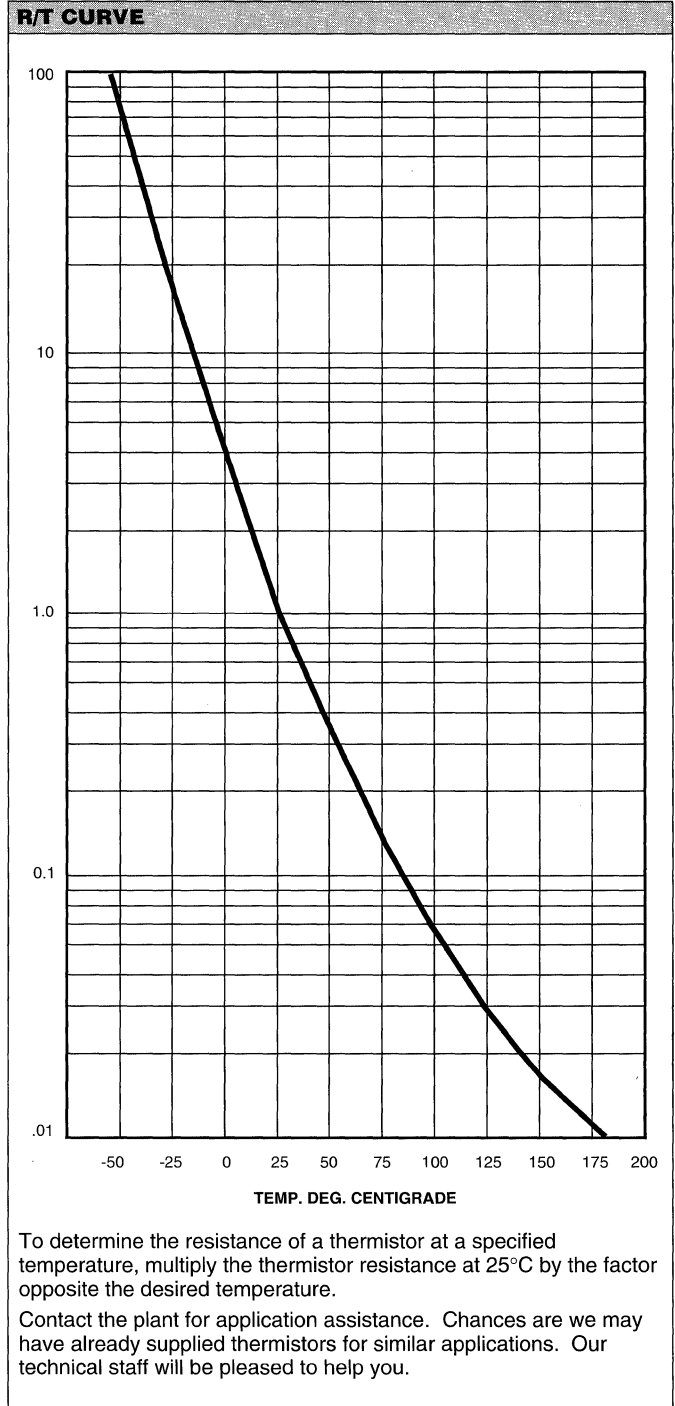
Resistance tolerances of ± 1% thru ± 20% are available and may be specified at 25°C or any temperature within the operating range.

* Dissipation Constant, expressed in mw/°C, represents the amount of power required to raise the temperature of a thermistor 1°C.

** Thermal Time Constant, expressed in seconds, is the time required for a thermistor dissipating zero power to change 63% of the difference between its initial temperature value and that of a new temperature environment.

MODEL 1J

R/T CONVERSION TABLE R _t /R ₂₅							
R @ 0°C Ratio R @ 50°C 9.1 ± 3% Temperature Coefficient @ 25°C - 4.4%/°C Beta (25° to 75°C) 3964°K							
TEMP °C	R _t /R ₂₅	TEMP °C	R _t /R ₂₅	TEMP °C	R _t /R ₂₅	TEMP °C	R _t /R ₂₅
-60	141.18	-7	4.708	46	.4201	99	.07000
-59	130.76	-6	4.464	47	.4041	100	.06798
-58	121.18	-5	4.234	48	.3888	101	.06602
-57	112.36	-4	4.017	49	.3742	102	.06413
-56	104.24	-3	3.812	50	.3602	103	.06231
-55	96.77	-2	3.620	51	.3468	104	.06054
-54	89.87	-1	3.438	52	.3340	105	.05884
-53	83.52	0	3.266	53	.3217	106	.05719
-52	77.65	1	3.104	54	.3099	107	.05559
-51	72.24	2	2.951	55	.2987	108	.05404
-50	67.23	3	2.806	56	.2878	109	.05255
-49	62.61	4	2.669	57	.2775	110	.05110
-48	58.33	5	2.540	58	.2675	111	.04970
-47	54.38	6	2.418	59	.2580	112	.04835
-46	50.71	7	2.302	60	.2489	113	.04704
-45	47.32	8	2.192	61	.2401	114	.04577
-44	44.18	9	2.089	62	.2317	115	.04454
-43	41.26	10	1.990	63	.2236	116	.04335
-42	38.56	11	1.897	64	.2158	117	.04219
-41	36.05	12	1.809	65	.2084	118	.04108
-40	33.72	13	1.726	66	.2012	119	.03999
-39	31.55	14	1.647	67	.1944	120	.03894
-38	29.54	15	1.571	68	.1878	121	.03793
-37	27.67	16	1.500	69	.1814	122	.03694
-36	25.93	17	1.432	70	.1753	123	.03598
-35	24.31	18	1.368	71	.1695	124	.03506
-34	22.80	19	1.307	72	.1638	125	.03416
-33	21.39	20	1.249	73	.1584	126	.03329
-32	20.08	21	1.194	74	.1532	127	.03244
-31	18.86	22	1.142	75	.1482	128	.03162
-30	17.72	23	1.092	76	.1433	129	.03083
-29	16.65	24	1.045	77	.1387	130	.03005
-28	15.66	25	1.000	78	.1342	131	.02930
-27	14.73	26	.9572	79	.1299	132	.02858
-26	13.86	27	.9165	80	.1258	133	.02787
-25	13.05	28	.8777	81	.1218	134	.02718
-24	12.29	29	.8408	82	.1179	135	.02652
-23	11.58	30	.8056	83	.1142	136	.02587
-22	10.92	31	.7721	84	.1106	137	.02524
-21	10.30	32	.7402	85	.1072	138	.02464
-20	9.713	33	.7098	86	.1039	139	.02404
-19	9.166	34	.6808	87	.1007	140	.02347
-18	8.654	35	.6531	88	.09759	141	.02291
-17	8.173	36	.6267	89	.09461	142	.02236
-16	7.722	37	.6015	90	.09174	143	.02184
-15	7.298	38	.5774	91	.08897	144	.02132
-14	6.900	39	.5545	92	.08630	145	.02082
-13	6.526	40	.5326	93	.08372	146	.02034
-12	6.175	41	.5116	94	.08123	147	.01987
-11	5.845	42	.4916	95	.07882	148	.01941
-10	5.534	43	.4725	96	.07650	149	.01896
-9	5.242	44	.4543	97	.07426	150	.01853
-8	4.967	45	.4368	98	.07209		

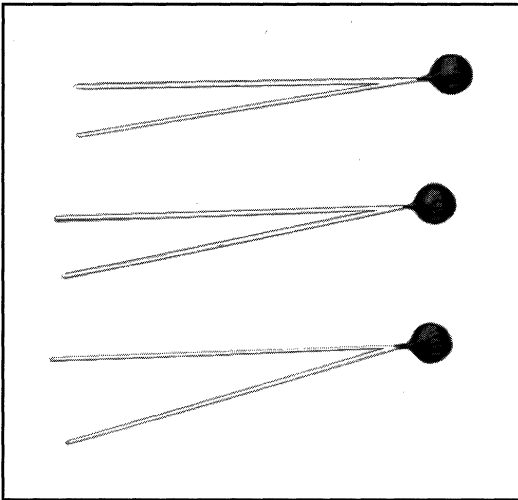
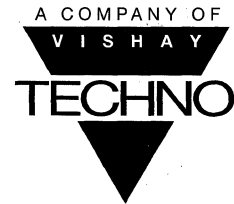


HOW TO ORDER	
1J09	± 10%
PART NUMBER	TOLERANCE

MODEL TC06 NTC Thermistors

MIL-T-23648 Qualified, Type RTH

High Stability, Thermoceram Thermistors, 0.5W at 25°C



FEATURES

- Qualified to MIL-T-23648
- Designed for unlimited operating life
- Large resistance changes with minute body temperature changes
- Additional testing can be performed as specified by customer

APPLICATIONS

These high stability thermistors were specifically designed for military applications. The characteristics of this material provide high reliability, small size (allowing for low time constants), extremely high temperature coefficients and close tolerances. Commonly used in the following applications:

- Temperature Compensation
- Temperature Measurement
- Temperature Control
- Meter Compensation
- Voltage Regulation
- Amplitude Control
- Liquid Level Indication
- Flow Measurement
- Surge Suppression
- Time Delay

STANDARD ELECTRICAL SPECIFICATIONS

TECHNO MODEL	MIL-T-23648 TYPE	VALUE (Min.) (Ohms)		VALUE (Max.) (Ohms)		POWER RATING @ + 25°C (Watts)	MAXIMUM ** THERMAL TIME CONSTANT (Sec)	MINIMUM *** DISSIPATION CONSTANT (mW/°C)
		RATIO * A	RATIO * B	RATIO * A	RATIO * B			
TC06	RTH06	68	680	560	4700	0.5	80	5.0

* The resistance ratio is equal to the zero-power resistance of the thermistor measured at 25°C divided by the zero-power resistance measured at 125°C.

** The thermal time constant is the time required for a thermistor dissipating zero-power to change 63% of the difference between its initial temperature value and that of a new temperature environment.

*** The dissipation constant measures the change in power dissipation resulting from a 1°C change in body temperature from a specified ambient temperature.

ELECTRICAL SPECIFICATIONS

Standard Tolerance: ± 1%, ± 2%, ± 5%, ± 10%.

Temperature Coefficient: (at 25°C) - 3.9%/°C for Ratio A, - 4.4%/°C for Ratio B.

Dielectric Strength: 500 V, 2 minutes.

Insulation Resistance: Not less than 500 Megohm.

MECHANICAL SPECIFICATIONS

Resistive Element: Various metal oxides.

Terminals: Tinned metals.

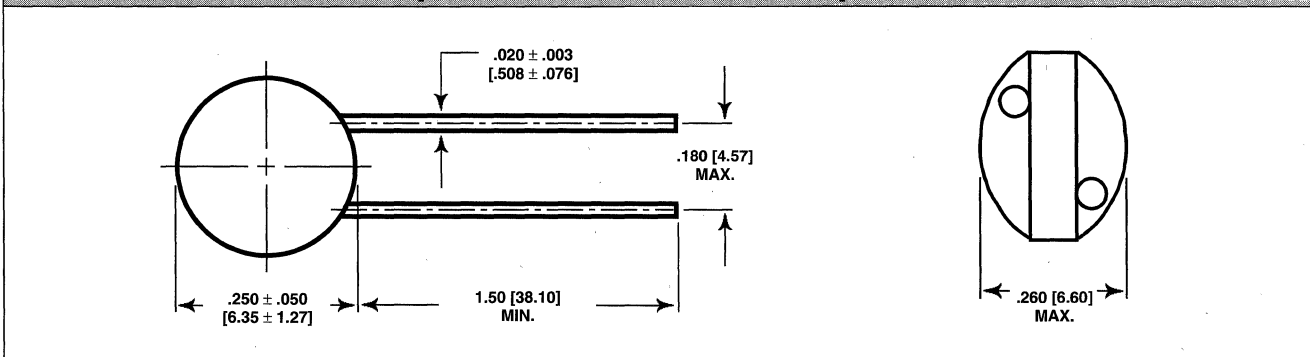
Encapsulation: Epoxy and synthetic organic materials available.

Terminal Strength: Direct load applied gradually to 4.5 pounds.

Solderability: Meets MIL-STD-202, Method 208.

Environmental Temperature Limits: - 55°C to + 125°C.

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



MODEL TC06

ENVIRONMENTAL PERFORMANCE				
TEST		CONDITIONS	MIL-T-23648 REQUIREMENTS	TYPICAL CHANGE
Thermal Shock	(107)	5 cycles, - 65°C to + 125°C	$\Delta R \leq 2.0\%$	$\Delta R < 1.00\%$
Short Time Overload		Maximum power for 2.5 hours in 5"/10" cycles	$\Delta R \leq 2.0\%$	$\Delta R < 0.80\%$
Low Temperature Storage		- 65°C, no load, for 3 hours	$\Delta R \leq 2.0\%$	$\Delta R < 0.45\%$
High Temperature Exposure		1000 hours, no load, at 125°C	$\Delta R \leq 2.0\%$	$\Delta R < 0.55\%$
Moisture Resistance	(106)	240 hours with humidity ranging from 80% RH to 98% RH	$\Delta R \leq 5.0\%$	$\Delta R < 2.00\%$
Resistance to Soldering Heat	(210)	300°C for 2.5 seconds	$\Delta R \leq 1.0\%$	$\Delta R < 0.20\%$
Shock	(213)	20 shocks, 50G, 11 ms, half-sine, 2 axes	$\Delta R \leq 2.0\%$	$\Delta R < 0.15\%$
Vibration	(204)	10 to 2000 Hz, 20G, 12 hours	$\Delta R \leq 2.0\%$	$\Delta R < 0.90\%$
Load Life	(108)	1000 hours at rated power at 25°C 90"/30" cycles	$\Delta R \leq 5.0\%$	$\Delta R < 1.50\%$

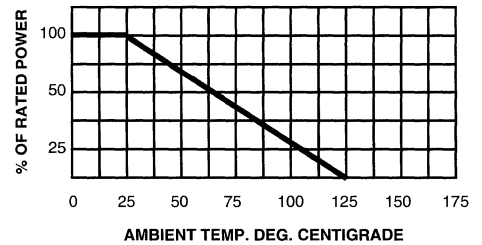
* Numbers in parenthesis refer to test method of MIL-STD-202 as modified by the detail specification.

R/T CONVERSION TABLE		
TEMP.	Ro (T)	Ro (T)
°C	RATIO A	RATIO B
- 55	54.90	100.0
- 50	38.95	67.0
- 40	21.51	33.7
- 30	12.33	17.7
- 21.5	—	10.6
- 20	7.307	9.71
- 10	4.476	5.53
0	2.825	3.27
10	1.830	1.99
20	1.216	1.25
25	1.000	1.00
30	.8267	.806
37.8	—	.583
40	.5742	.533
50	.405	.360
60	.2937	.249
70	.2160	.175
75	.184	.148
80	.1615	.126
90	.1229	.0916
100	.0923	.0679
104.4	—	.0598
110	.0739	.0511
120	.0584	.0389
125	.0503	.0340

To determine the resistance of a thermistor at a specified temperature, multiply the thermistor resistance at 25°C by the factor opposite the desired temperature in the appropriate column.

DERATING

The maximum allowable power supplied to the thermistor must be derated linearly from an ambient temperature of + 25°C to the maximum operating temperature of + 125°C since the dissipation of electrical power causes a corresponding rise in body temperature.



PART MARKING

- Manufacturer's name or code
- Resistance value at + 25°C

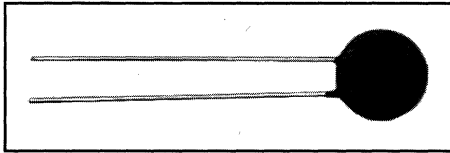
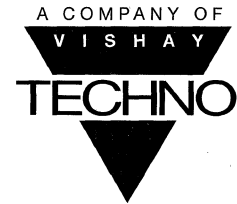
HOW TO ORDER

RTH MODEL RTH = General Purpose Thermistor	06 SIZE 06 = .30 inch maximum body diameter	B RESISTANCE RATIO A = $19.8 \pm 10\%$ B = $29.4 \pm 10\%$	S LEAD STYLE S = Solderable W = Weldable	102 VALUE (25°C) 3 digit code. First two digits are significant figures. Last digit is number of zeros.	F TOLERANCE F = 1.0% G = 2.0% J = 5.0% K = 10.0%
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MODEL "SOFT-START" NTC Thermistors

Inrush Current Suppressing Devices

1.5 A to 25 A at 65°C

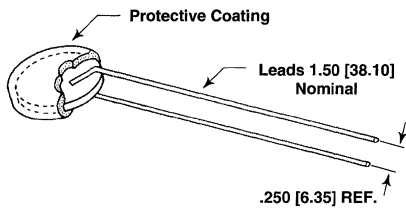


FEATURES

- Switching power supply applications
- Special marking is available upon request
- Protective silicone coating is standard and has a nominal thickness of .040" [1.0]. Other coatings are available upon request.

STANDARD ELECTRICAL SPECIFICATIONS and DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



"Soft-Start" devices display relatively high resistance to starting currents in a variety of electronic circuits. Having a negative temperature coefficient of resistance, these devices exhibit a large decrease in resistance when AC or DC current begins to flow at t_{op} .

Unlike circuit breakers and fuses, "Soft-Starts" prevent dangerous, short-duration, peak inrush currents present at turn-on. Especially useful in power supplies where charging capacitors initially present extremely low impedance. "Soft-Starts" actually limit inrush currents thereby extending the life of other critical components.

R @ 25°C ± 20% (Ohms)	PART NUMBER	I _{MAX} (Amps)	R @ I _{MAX} (Ohms) Reference	MAXIMUM DIAMETER	MAXIMUM THICKNESS	LEAD DIAMETER
1	25SS25	25	.01	1.10 [27.9]	.35 [8.9]	.040 [1.02]
1	20SS20	20	.015	.90 [22.9]	.30 [7.6]	.040 [1.02]
2	18SS36	18	.03	.90 [22.9]	.35 [8.9]	.040 [1.02]
2.5	15SS38	15	.03	.90 [22.9]	.30 [7.6]	.040 [1.02]
4	14SS56	14	.05	.90 [22.9]	.35 [8.9]	.040 [1.02]
5	12SS60	12	.06	.90 [22.9]	.50 [12.7]	.040 [1.02]
2.5	12SS30	12	.04	.90 [22.9]	.35 [8.9]	.040 [1.02]
5	10SS50	10	.06	.90 [22.9]	.35 [8.9]	.040 [1.02]
2.5	10SS25	10	.04	.90 [22.9]	.25 [6.4]	.040 [1.02]
5	9SS45	9	.06	.90 [22.9]	.25 [6.4]	.040 [1.02]
2.5	9SS23	9	.04	.90 [22.9]	.25 [6.4]	.040 [1.02]
5	8SS40	8	.05	.70 [17.8]	.25 [6.4]	.040 [1.02]
4	8SS32	8	.07	.70 [17.8]	.25 [6.4]	.040 [1.02]
5	7SS35	7	.07	.70 [17.8]	.25 [6.4]	.032 [.813]
2.5	7SS18	7	.05	.70 [17.8]	.25 [6.4]	.032 [.813]
10	6SS60	6	.15	.70 [17.8]	.35 [8.9]	.040 [1.02]
7	6SS42	6	.15	.60 [15.2]	.30 [7.6]	.040 [1.02]
5	6SS30	6	.07	.60 [15.2]	.25 [6.4]	.032 [.813]
10	5SS50	5	.20	.60 [15.2]	.35 [8.9]	.040 [1.02]
7	5SS35	5	.15	.60 [15.2]	.30 [7.6]	.040 [1.02]
4	5SS20	5	.15	.60 [15.2]	.25 [6.4]	.032 [.813]
12	4SS48	4	.22	.60 [15.2]	.30 [7.6]	.040 [1.02]
7	4SS28	4	.15	.60 [15.2]	.30 [7.6]	.040 [1.02]
5	4SS20	4	.15	.60 [15.2]	.25 [6.4]	.032 [.813]
10	3SS30	3	.20	.50 [12.7]	.30 [7.6]	.032 [.813]
7	3SS21	3	.14	.60 [15.2]	.25 [6.4]	.032 [.813]
5	3SS15	3	.17	.60 [15.2]	.25 [6.4]	.032 [.813]
2.5	3SS08	3	.15	.60 [15.2]	.25 [6.4]	.032 [.813]
40	2SS80	2	.60	.50 [12.7]	.25 [6.4]	.032 [.813]
20	2SS40	2	.28	.60 [15.2]	.25 [6.4]	.032 [.813]
10	2SS20	2	.20	.60 [15.2]	.25 [6.4]	.032 [.813]
5	2SS10	2	.40	.60 [15.2]	.25 [6.4]	.032 [.813]
60	1.5SS90	1.5	1.00	.50 [12.7]	.25 [6.4]	.032 [.813]
40	1.5SS60	1.5	.80	.50 [12.7]	.25 [6.4]	.032 [.813]
25	1.5SS38	1.5	.60	.50 [12.7]	.30 [7.6]	.032 [.813]
10	1.5SS15	1.5	.25	.50 [12.7]	.25 [6.4]	.032 [.813]

MODEL "SOFT-START"

ELECTRICAL SPECIFICATIONS

Standard Tolerance: 20% at 25°C. Closer tolerances available upon request.

Dielectric Strength: 500 V, 2 minutes.

Insulation Resistance: Not less than 500 Megohm.

MECHANICAL SPECIFICATIONS

Resistive Element: Various metal oxides.

Encapsulation: Silicone coating.

Terminals: Tinned copper-clad steel.

ENVIRONMENTAL SPECIFICATIONS

Temperature Limits: - 55°C to + 150°C.

DEFINITIONS

I_{max}: Represents the maximum rated steady state DC or RMS current and is expressed in amperes.

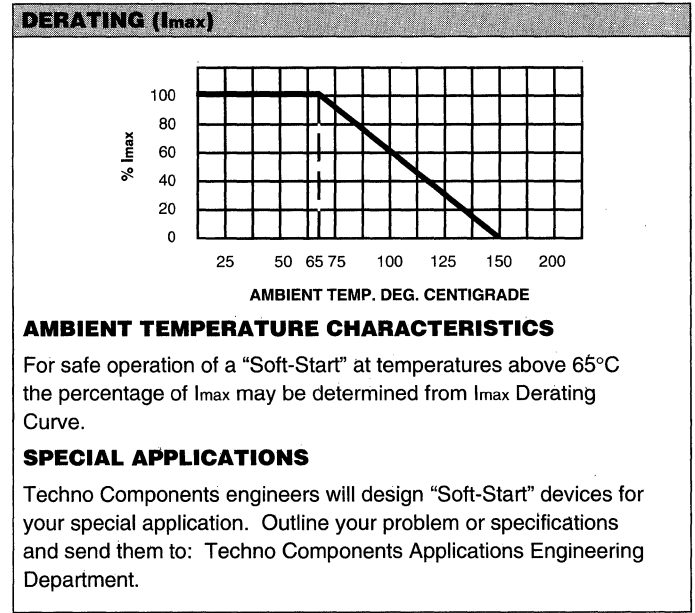
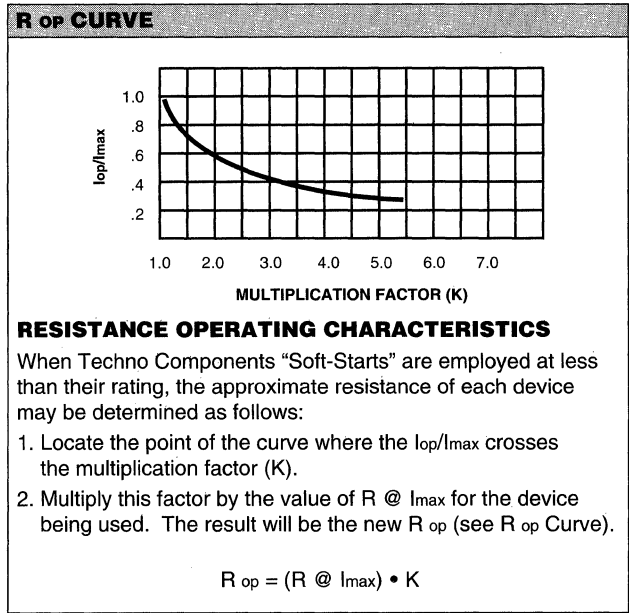
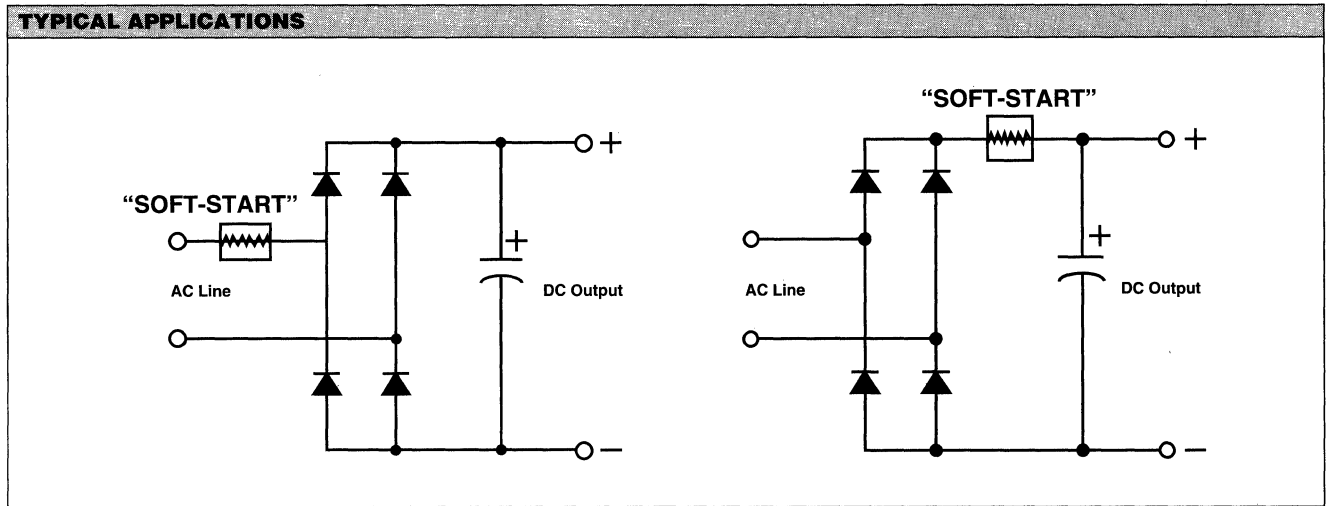
R @ 25°C: Represents the zero power resistance of the device at + 25°C and is expressed in ohms.

R @ I_{max}: Represents the approximate resistance at maximum steady state current conditions and is expressed in ohms.

Ambient Temperature: Full rated current may be applied in the ambient temperature range of + 25°C to + 65°C and must be derated in accordance with I_{max} derating curve.

I_{op}: Represents the actual operating current applied.

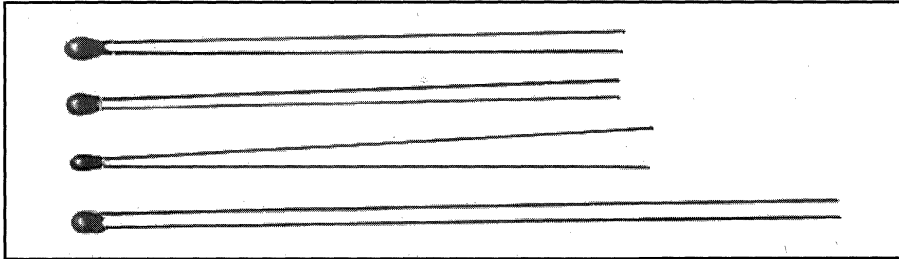
Cool-Down Time: Is the amount of time needed for a "Soft-Start" device to cool down enough to cause the necessary amount of resistance to limit the inrush current.



HOW TO ORDER

10SS25	± 10%
PART NUMBER	TOLERANCE (ONLY IF OTHER THAN ± 20%)

MODELS 10, 20, 30, 40, 50, 60 NTC Thermistors Coated

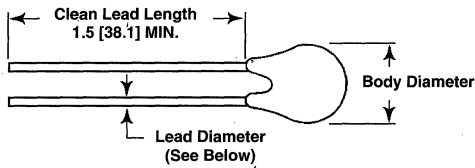


FEATURES

- Small size - conformal coated
- Wide resistance range
- Available in 7 different R-T curves
- Configured for standard P.C. board mounting or assembly in probes

STANDARD ELECTRICAL SPECIFICATIONS and DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



Models 10, 20, 30, 40, 50 and 60 are conformally coated, leaded thermistors for standard P.C. board mounting or assembly in probes. The coating is baked-on phenolic for durability and long-term stability. Leads are solid tinned copper, except Model 50 has solid nickel wires with Teflon[®] insulation to provide isolation when assembled in metal probes or housings.

MODEL 10 ± 10%, ± 5% R70 tolerance. Leads solid tinned copper 1.8 ± .2 [45.7 ± 5.1] long AWG30 (.0100").	R25 (Ohms)	R70 (Ohms)	PART NUMBER	MATERIAL TYPE	DISSIPATION CONSTANT (Nominal)	THERMAL TIME CONSTANT (Nominal)	BODY DIAMETER	
							(Max.)	(Min.)
	1.082M	130,000	X101303	X	—	—	.095 [2.4]	.070 [1.8]
	998.300	120,000	X101203	X	—	—	.095 [2.4]	.070 [1.8]
MODEL 20 ± 10%, ± 5%, ± 3%, ± 2%, ± 1% R25 tolerance. Leads solid tinned copper 1.8 ± .2 [45.7 ± 5.1] long AWG30 (.0100").	1.0M	—	X201004*	X	—	—	.087 [2.2]	.061 [1.55]
	200,000	—	M202003	M	2	12	.095 [2.4]	.070 [1.8]
	150,000	—	M201503	M	—	—	.100 [2.5]	.075 [1.9]
	100,000	—	M201003	M	—	—	.095 [2.4]	.070 [1.8]
	100,000	—	U201003	U	—	—	.095 [2.4]	.070 [1.8]
	100,000	—	A201003	A	2	12	.095 [2.4]	.070 [1.8]
	80,000	—	U208002	U	—	—	.095 [2.4]	.070 [1.8]
	50,000	—	U205002	U	—	—	.095 [2.4]	.070 [1.8]
	50,000	—	M205002	M	—	—	.095 [2.4]	.070 [1.8]
	50,000	—	A205002	A	2	10	.085 [2.2]	.060 [1.5]
	30,000	—	U203002	U	—	—	.095 [2.4]	.070 [1.8]
	30,000	—	A203002	A	2	10	.085 [2.2]	.060 [1.5]
	30,000	—	J203002	J	—	—	.095 [2.4]	.070 [1.8]
	25,000	—	J202502	J	—	—	.095 [2.4]	.070 [1.8]
	20,000	—	J202002	J	—	—	.095 [2.4]	.070 [1.8]
	17,500	—	J201752	J	—	—	.095 [2.4]	.070 [1.8]
	15,000	—	J201502	J	—	—	.095 [2.4]	.070 [1.8]
10,000	—	J201002	J	2	10	.085 [2.2]	.060 [1.5]	
6,000	—	J206001	J	2	10	.085 [2.2]	.060 [1.5]	
5,000	—	J205001	J	2	10	.085 [2.2]	.060 [1.5]	
2,252	—	J202251	J	3	12	.095 [2.4]	.070 [1.8]	
2,000	—	D202001	D	3	12	.100 [2.5]	.075 [1.9]	
1,000	—	D201001	D	3	12	.085 [2.2]	.060 [1.5]	

* Available in ± 10% and ± 5% R25 tolerance only.

MODELS 10, 20, 30, 40, 50, 60

STANDARD ELECTRICAL SPECIFICATIONS and DIMENSIONAL CONFIGURATIONS							
[Numbers in brackets indicate millimeters]	R25 (Ohms)	PART NUMBER	MATERIAL TYPE	DISSIPATION CONSTANT (Nominal)	THERMAL TIME CONSTANT (Nominal)	BODY DIAMETER	
						(Max.)	(Min.)
MODEL 30 ± 10%, ± 5%, ± 3%, ± 2%, ± 1% R25 tolerance. Leads solid tinned copper 1.8 ± .2 [45.7 ± 5.1] long, AWG28 (.0126").	500,000	X305003*	X	—	—	.102 [2.6]	.073 [1.9]
	250,000	X302503*	X	—	—	.133 [3.4]	.102 [2.6]
	150,000	X301503*	X	—	—	.163 [4.1]	.130 [3.3]
	100,000	X301003*	X	—	—	.192 [4.9]	.157 [4.0]
	100,000	M301003	M	3	12	.095 [2.4]	.070 [1.8]
	50,000	M305002	M	3	12	.095 [2.4]	.070 [1.8]
	30,000	M303002	M	—	—	.115 [2.9]	.090 [2.3]
	30,000	U303002	U	—	—	.095 [2.4]	.070 [1.8]
	30,000	A303002	A	2.5	12	.095 [2.4]	.070 [1.8]
	20,000	U302002	U	—	—	.130 [3.3]	.100 [2.5]
	20,000	M302002	M	—	—	.130 [3.3]	.105 [2.7]
	20,000	A302002	A	3	12	.095 [2.4]	.070 [1.8]
	10,000	J301002	J	3	12	.095 [2.4]	.070 [1.8]
	9,000	J309001	J	3	12	.095 [2.4]	.070 [1.8]
	8,000	J308001	J	3	12	.095 [2.4]	.070 [1.8]
	7,000	J307001	J	3	12	.095 [2.4]	.070 [1.8]
	6,000	J306001	J	3	12	.095 [2.4]	.070 [1.8]
	4,000	J304001	J	3	12	.095 [2.4]	.070 [1.8]
	3,000	J303001	J	3	12	.095 [2.4]	.070 [1.8]
	2,000	J302001	J	3.5	16	.095 [2.4]	.070 [1.8]
	1,500	J301501	J	—	—	.135 [3.4]	.110 [2.8]
	1,250	J301251	J	—	—	.145 [3.7]	.120 [3.1]
	1,000	J301001	J	—	—	.158 [4.0]	.128 [3.2]
	1,000	D301001	D	3	12	.095 [2.4]	.075 [1.9]
	900	D309000	D	3	12	.095 [2.4]	.075 [1.9]
	800	D308000	D	3	12	.095 [2.4]	.075 [1.9]
	700	D307000	D	3	12	.100 [2.5]	.075 [1.9]
	600	D306000	D	3	12	.100 [2.5]	.075 [1.9]
	500	D305000	D	3	12	.100 [2.5]	.075 [1.9]
	400	D304000	D	—	—	.120 [3.1]	.095 [2.4]
	300	D303000	D	—	—	.130 [3.3]	.105 [2.7]
	200	D302000	D	3.5	18	.150 [3.8]	.120 [3.1]
	150	D301500	D	—	—	.165 [4.2]	.135 [3.4]
100	D301000	D	4	20	.210 [5.3]	.180 [4.6]	
50	D305000	D	—	—	.272 [6.9]	.242 [6.2]	
MODEL 40 ± 10%, ± 5%, ± 3%, ± 2%, ± 1% R25 tolerance. Leads solid tinned copper 1.8 ± .2 [45.7 ± 5.1] long, AWG32 (.0080").	15,000	J401502	J	0.8	5	.072 [1.8]	.050 [1.3]
	10,000	J401002	J	0.8	5	.072 [1.8]	.050 [1.3]
	5,000	J405001	J	0.8	7	.072 [1.8]	.050 [1.3]
MODEL 50 ± 10%, ± 5%, ± 3%, ± 2%, ± 1% R25 tolerance. Leads Teflon® insulated solid nickel 3 ± .25 [76.2 ± 6.4] long, AWG30 (.0100").	100,000	U501003	U	—	—	.095 [2.4]	.070 [1.8]
	100,000	A501003	A	—	—	.095 [2.4]	.070 [1.8]
	50,000	U505002	U	—	—	.095 [2.4]	.070 [1.8]
	50,000	A505002	A	—	—	.085 [2.2]	.060 [1.5]
	30,000	U503002	U	—	—	.095 [2.4]	.070 [1.8]
	30,000	A503002	A	2	12	.085 [2.2]	.060 [1.5]
	20,000	J502002	J	—	—	.095 [2.4]	.070 [1.8]
	10,000	J501002	J	2	12	.085 [2.2]	.060 [1.5]
	5,000	J505001	J	2	12	.085 [2.2]	.060 [1.5]
	3,000	J503001	J	2	13	.095 [2.4]	.070 [1.8]
2,252	J502251	J	2	14	.095 [2.4]	.070 [1.8]	
MODEL 60 ± 10%, ± 5%, ± 3%, ± 2%, ± 1% R25 tolerance. Leads solid tinned copper 1.8 ± .2 [45.7 ± 5.1] long, AWG26 (.0159").	50,000	X605002	X	—	—	.252 [6.4]	.216 [5.5]
	20,000	A602002	A	—	—	.110 [2.8]	.090 [2.3]
	10,000	M601002	M	—	—	.190 [4.8]	.150 [3.8]
	10,000	A601002	A	—	—	.135 [3.4]	.110 [2.8]
	10,000	J601002	J	—	—	.122 [3.1]	.085 [2.2]
	8,000	J608001	J	—	—	.120 [3.1]	.080 [2.0]
	3,000	J603001	J	—	—	.150 [3.8]	.110 [2.8]
	2,252	J602251	J	—	—	.160 [4.1]	.115 [2.9]
	2,000	J602001	J	—	—	.160 [4.1]	.115 [2.9]
	500	D605000	D	—	—	.125 [3.2]	.085 [2.2]
	100	D601000	D	—	—	.270 [6.9]	.220 [5.6]
50	D600500	D	—	—	.350 [8.9]	.295 [7.5]	

* Available in ± 10% and ± 5% R25 tolerance only.

HOW TO ORDER

<p>X MATERIAL TYPE</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p>A = TC - 4.7% M = TC - 4.79% B = TC - 3.0% U = TC - 4.3% D = TC - 3.83% X = TC - 5.2% J = TC - 4.4%</p> </div>	<p>30 MODEL</p>	<p>2001 VALUE</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p>First three digits are significant. The last digit is the multiplier. (2000 ohm is illustrated.)</p> </div>	<p>- 5 TOLERANCE AT 25°C*</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p>± 10% = (none) ± 5% = - 5 ± 3% = - 3 ± 2% = - 2 ± 1% = - 1</p> </div>
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* Model X is toleranced at 70°C.

NTC Thermistors

Temperature Sensing Probes

FEATURES

Temperature Range: - 60°C to + 300°C.

Sensors: NTC Thermistor (- 4.4%/°C).

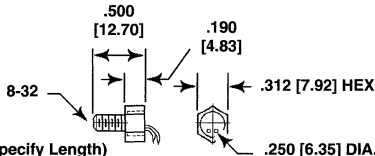
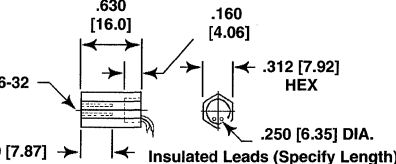
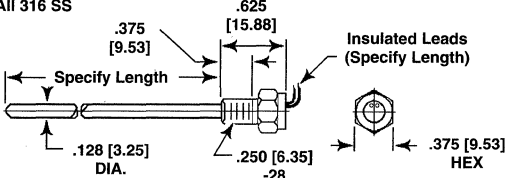
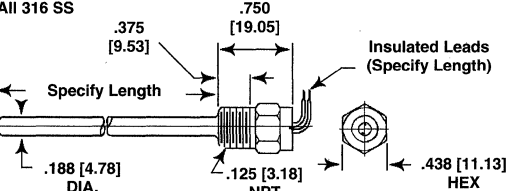
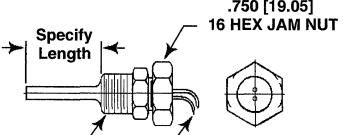
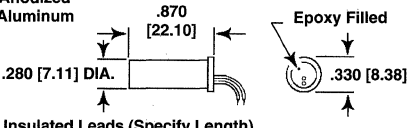
Tolerances: 10% to 0.5% or better (interchangeable).

Resistance Range: 50 ohm or 350 kilohm at 25°C.

APPLICATIONS

Techno Components probes are designed for air, surface and liquid temperature measurement and control applications. Special industrial probes can be produced to customer specifications. Techno Components engineers will design Temperature Sensing Probes for your special application. Outline your problem or specifications and send them to Techno Components Applications Engineering Department.

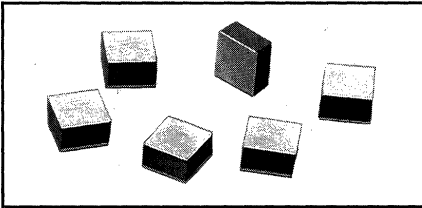
DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

<p>Material: Brass</p>  <p>8-32</p> <p>Insulated Leads (Specify Length)</p> <p>.250 [6.35] DIA.</p>	<p>NTC thermistor encapsulated in .312 [7.92] brass hex with 8-32 threaded stud. Also available in anodized aluminum with 10-32 threaded stud.</p>
<p>Material: Brass</p>  <p>6-32</p> <p>Insulated Leads (Specify Length)</p> <p>.250 [6.35] DIA.</p> <p>.310 [7.87]</p>	<p>NTC thermistor encapsulated in .312 [7.92] brass hex. Tapped for 6-32 screw to facilitate mounting.</p>
<p>Material: All 316 SS</p>  <p>Specify Length</p> <p>Insulated Leads (Specify Length)</p> <p>.128 [3.25] DIA.</p> <p>.250 [6.35] -28</p> <p>.375 [9.53] HEX</p>	<p>NTC thermistor encapsulated in stainless steel probe.</p>
<p>Material: All 316 SS</p>  <p>Specify Length</p> <p>Insulated Leads (Specify Length)</p> <p>.188 [4.78] DIA.</p> <p>.125 [3.18] NPT</p> <p>.438 [11.13] HEX</p>	<p>NTC thermistor encapsulated in stainless steel probe.</p>
<p>Material: 316 SS</p>  <p>Specify Length</p> <p>Insulated Leads (Specify Length)</p> <p>.500 [12.70] NPT</p> <p>.750 [19.05] 16 HEX JAM NUT</p>	<p>NTC thermistor encapsulated in stainless steel probe.</p>
<p>Material: Anodized Aluminum</p>  <p>Insulated Leads (Specify Length)</p> <p>.280 [7.11] DIA.</p> <p>.870 [22.10]</p> <p>Epoxy Filled</p> <p>.330 [8.38]</p>	<p>NTC thermistor sensor encapsulated in anodized aluminum cup.</p>

TEMPERATURE SENSING PROBES

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]	
	<p>One or more NTC thermistors encapsulated in anodized aluminum tube.</p>
	<p>One or more NTC thermistors encapsulated in anodized aluminum tube. Closed end probe, available in stainless steel or aluminum.</p>
	<p>NTC thermistor encapsulated in metal cup adapts to many temperature measurement and control applications.</p>
<p>Metal: Anodized Aluminum</p>	<p>NTC thermistor mounted in perforated anodized aluminum housing. Holes drilled in base facilitate flush mounting.</p>
	<p>NTC thermistor encapsulated in anodized aluminum head. Designed for wall or bulkhead mounting.</p>
	<p>NTC thermistor mounted on silver-plated clip.</p>
	<p>NTC thermistor epoxy mounted on thin aluminum or stainless steel disc. Designed for cementing or taping to a surface for temperature measurement applications.</p>
	<p>NTC thermistor mounted on a tinned brass plate provides high power handling capability. Mounting holes facilitate mounting.</p>
<p>Material: Epoxy Cup Epoxy Filled</p>	<p>NTC thermistor encapsulated in epoxy cup for mounting on P.C.B.</p>

MODEL W NTC Thermistors Surface Mount Chip

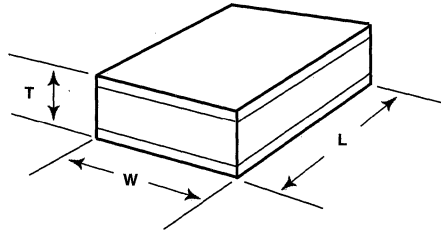


FEATURES

- Top and bottom surface terminations
- High-density monolithic ceramic construction
- Allows design flexibility for use with hybrid circuitry
- Model W is a thermistor die with silver conductors fired on the top and bottom surfaces. The bottom surface can be reflow soldered or conductive epoxied directly to a substrate bonding pad and the top surface wire bonded to complete the circuit connection.

STANDARD ELECTRICAL SPECIFICATIONS and DIMENSIONAL CONFIGURATIONS

± 10%, ± 5% R25 tolerance



[Numbers in brackets indicate millimeters]

R ₂₅ (Ohms)	PART NUMBER	CURVE NUMBER	L	W	T (Nominal)
1.0M	12W1004	12	.043 ± .004 [1.1 ± .10]	.043 ± .004 [1.1 ± .10]	.020 [.51]
500,000	12W5003	12	.053 ± .004 [1.4 ± .10]	.053 ± .004 [1.4 ± .10]	.016 [.41]
250,000	12W2503	12	.075 ± .006 [1.9 ± .15]	.075 ± .006 [1.9 ± .15]	.016 [.41]
200,000	7W2003	7	.041 ± .004 [1.0 ± .10]	.041 ± .004 [1.0 ± .10]	.035 [.89]
100,000	12W1003	12	.119 ± .008 [3.0 ± .20]	.119 ± .008 [3.0 ± .20]	.016 [.41]
100,000	8W1003	8	.049 ± .004 [1.2 ± .10]	.049 ± .004 [1.2 ± .10]	.024 [.61]
100,000	7W1003	7	.054 ± .005 [1.4 ± .13]	.054 ± .005 [1.4 ± .13]	.032 [.81]
80,000	8W8002	8	.049 ± .004 [1.3 ± .10]	.049 ± .004 [1.2 ± .10]	.020 [.51]
50,000	8W5002	8	.053 ± .004 [1.4 ± .10]	.053 ± .004 [1.4 ± .10]	.015 [.38]
50,000	7W5002	7	.051 ± .004 [1.3 ± .10]	.051 ± .004 [1.3 ± .10]	.015 [.38]
30,000	8W3002	8	.072 ± .005 [1.8 ± .13]	.054 ± .005 [1.4 ± .13]	.013 [.33]
30,000	7W3002	7	.066 ± .005 [1.7 ± .13]	.066 ± .005 [1.7 ± .13]	.013 [.33]
30,000	1W3002	1	.029 ± .003 [.74 ± .08]	.029 ± .003 [.74 ± .08]	.032 [.81]
20,000	1W2002	1	.036 ± .004 [.91 ± .10]	.036 ± .004 [.91 ± .10]	.032 [.81]
15,000	1W1502	1	.042 ± .004 [1.1 ± .10]	.042 ± .004 [1.1 ± .10]	.032 [.81]
10,000	1W1002	1	.051 ± .004 [1.3 ± .10]	.051 ± .004 [1.3 ± .10]	.032 [.81]
3,000	1W3001	1	.068 ± .005 [1.7 ± .13]	.054 ± .005 [1.4 ± .13]	.015 [.38]
2,000	1W2001	1	.101 ± .007 [2.6 ± .18]	.054 ± .005 [1.4 ± .13]	.015 [.38]
2,000	2W2001	2	.049 ± .004 [1.2 ± .10]	.049 ± .004 [1.2 ± .10]	.037 [.94]
1,000	2W1001	2	.053 ± .004 [1.4 ± .10]	.053 ± .004 [1.4 ± .10]	.022 [.56]
1,000	1W1001	1	.105 ± .007 [2.7 ± .18]	.105 ± .007 [2.7 ± .18]	.015 [.38]
500	2W5000	2	.060 ± .005 [1.5 ± .13]	.060 ± .005 [1.5 ± .13]	.015 [.38]
500	1W5000	1	.148 ± .010 [3.8 ± .25]	.148 ± .010 [3.8 ± .25]	.015 [.38]
300	2W3000	2	.077 ± .006 [2.0 ± .15]	.077 ± .006 [2.0 ± .15]	.015 [.38]
50	2W0500	2	.188 ± .012 [4.8 ± .31]	.188 ± .012 [4.8 ± .31]	.015 [.38]

HOW TO ORDER

8
CURVE NUMBER

W
MODEL

8002
RESISTANCE VALUE

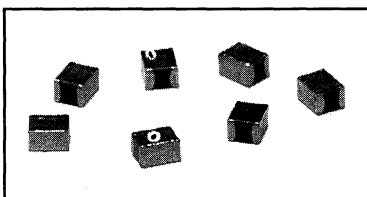
- 5
TOLERANCE AT 25°C

First three digits are significant. The last digit is the multiplier. (80,000 ohm is illustrated.)

± 10% = none
± 5% = - 5

MODEL NTHS NTC Thermistors

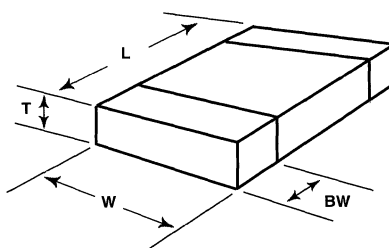
Surface Mount Chip



FEATURES

- Wraparound terminations
- Allows design flexibility for use with hybrid circuitry
- High-density monolithic ceramic construction
- Available in 8mm tape and reel

STANDARD ELECTRICAL SPECIFICATIONS and DIMENSIONAL CONFIGURATIONS



[Numbers in brackets indicate millimeters]

R ₂₅ * (Ohms)	PART ** NUMBER	CURVE NUMBER	L ± .008 [.20]	W ± .008 [.20]	T (Nominal)	BW ± .008 [.20]
5,000	NTHS-1206J02	2	.126 [3.2]	.063 [1.6]	.042 [1.1]	.018 [.46]
6,000	NTHS-1206J02	2	.126 [3.2]	.063 [1.6]	.035 [.89]	.018 [.46]
7,000	NTHS-1206J02	2	.126 [3.2]	.063 [1.6]	.030 [.76]	.018 [.46]
8,000	NTHS-1206J02	2	.126 [3.2]	.063 [1.6]	.027 [.69]	.018 [.46]
10,000	NTHS-1206J02	2	.126 [3.2]	.063 [1.6]	.022 [.56]	.018 [.46]
4,000	NTHS-1208J02	2	.126 [3.2]	.079 [2.0]	.041 [1.0]	.018 [.46]
3,000	NTHS-1210J02	2	.126 [3.2]	.098 [2.5]	.044 [1.1]	.018 [.46]
680	NTHS-1206J14	14	.126 [3.2]	.063 [1.6]	.027 [.69]	.018 [.46]
10,000	NTHS-1012N01	1	.098 [2.5]	.126 [3.2]	.065 [1.7]	.018 [.46]
100,000	NTHS-1205N01	1	.126 [3.2]	.049 [1.2]	.026 [.66]	.018 [.46]
50,000	NTHS-1206N01	1	.126 [3.2]	.063 [1.6]	.039 [.99]	.018 [.46]
10,000	NTHS-1206N02	2	.126 [3.2]	.063 [1.6]	.033 [.84]	.018 [.46]

* Consult factory for additional values.

** Part Number with J conductor also available with either H or G conductor.

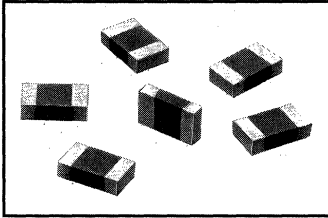
HOW TO ORDER

NTHS - **1206** **N** **02** **10k** **± 5% or ± 10%**
 MODEL (E.I.A.) DIMENSION CONDUCTOR TYPE CURVE NUMBER R₂₅ TOLERANCE

H Conductor = Silver
 G Conductor = Palladium/Silver
 J Conductor = Platinum/Palladium/Silver
 N Conductor = Nickel Barrier

MODEL J NTC Thermistors

Surface Mount Chip

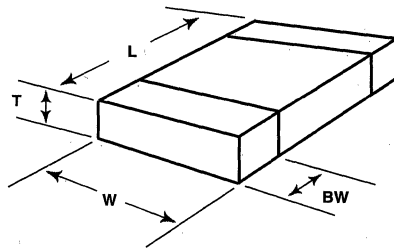


FEATURES

- Wraparound terminations
- Allows for design flexibility for use with hybrid circuitry
- High-density monolithic ceramic construction
- Available in 8mm tape and reel
- Model J chips are thermistor dies with wraparound terminations of fired-on platinum/palladium/silver for mounting directly to the bonding pads of a hybrid substrate. The use of low temperature 2% to 5% silver bearing solder paste or a suitable conductive epoxy is suggested for mounting.

STANDARD ELECTRICAL SPECIFICATIONS and DIMENSIONAL CONFIGURATIONS

± 10%, ± 5% R₂₅ tolerance



(Dimensions measured over termination)
[Numbers in brackets indicate millimeters]

R ₂₅ (Ohms)	PART ** NUMBER	CURVE NUMBER	L ± .010 [.25]	W ± .005 [.13]	T (Nominal)	BW ± .008 [.20]
1.0 M*	7J1004	7	.102 [2.6]	.054 [1.4]	.014 [.36]	.018 [.46]
500,000	8J5003	8	.102 [2.6]	.053 [1.3]	.029 [.74]	.018 [.46]
100,000	1J1003	1	.107 [2.7]	.043 [1.1]	.016 [.41]	.018 [.46]
80,000	1J8002	1	.102 [2.6]	.053 [1.3]	.015 [.38]	.018 [.46]
60,000	1J6002	1	.102 [2.6]	.053 [1.3]	.019 [.48]	.018 [.46]
50,000	1J5002	1	.102 [2.6]	.051 [1.3]	.024 [.61]	.018 [.46]
40,000	1J4002	1	.102 [2.6]	.053 [1.3]	.028 [.71]	.018 [.46]
30,000	1J3002	1	.102 [2.6]	.060 [1.5]	.032 [.81]	.018 [.46]
15,000	2J1502	2	.102 [2.6]	.043 [1.1]	.016 [.41]	.018 [.46]
10,000	2J1002	2	.102 [2.6]	.051 [1.3]	.020 [.51]	.018 [.46]
8,000	2J8001	2	.102 [2.6]	.052 [1.3]	.024 [.61]	.018 [.46]
7,000	2J7001	2	.102 [2.6]	.056 [1.4]	.025 [.64]	.018 [.46]
6,000	2J6001	2	.102 [2.6]	.056 [1.4]	.029 [.74]	.018 [.46]
5,000	2J5001	2	.102 [2.6]	.058 [1.5]	.033 [.84]	.018 [.46]

* Measured at 70°C. The value will be 144.7 kilohm.

** Also available in Model H with silver and Model G with palladium/silver terminations.

HOW TO ORDER

1
CURVE NUMBER

J
MODEL

8002
RESISTANCE VALUE

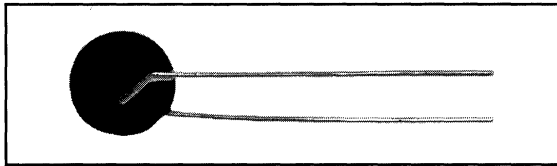
- 5
TOLERANCE AT 25°C

First three digits are significant. The last digit is the multiplier. (80,000 ohm is illustrated.)

± 10% = (none)
± 5% = - 5

PRELIMINARY - MODEL NTHD NTC Thermistors

Uncoated Disc, Curve 1 Series = 200Ω to 30,000Ω



FEATURES

- Resistance tolerance of $\pm 1\%$ thru $\pm 20\%$ are available and may be specified at 25°C or any temperature within the operating range.
- Coatings are also available to meet specific requirements by contacting our engineering department.

STANDARD ELECTRICAL SPECIFICATIONS and DIMENSIONAL CONFIGURATIONS

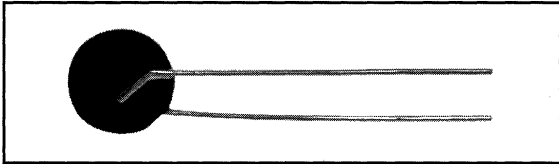
R at 25°C ± 10% (Ohms)	PART NUMBER	DISSIPATION CONSTANT	THERMAL TIME CONSTANT	A	B	LEADS AWG#	[Numbers in brackets indicate millimeters]
30k	NTHD-0050 B01	2	3	.050 [1.3]	.075 [1.9]	30	
25k	NTHD-0050 B01	2	3	.050 [1.3]	.060 [1.5]	30	
20k	NTHD-0050 B01	2	3	.050 [1.3]	.050 [1.3]	30	
15k	NTHD-0050 B01	2	2	.050 [1.3]	.035 [.89]	30	
10k	NTHD-0050 B01	2	2	.050 [1.3]	.025 [.64]	30	
8k	NTHD-0050 B01	2	2	.050 [1.3]	.020 [.51]	30	
20k	NTHD-0070 B01	2.5	5	.070 [1.8]	.100 [2.5]	30	
15k	NTHD-0070 B01	2	4	.070 [1.8]	.070 [1.8]	30	
10k	NTHD-0070 B01	2	3	.070 [1.8]	.050 [1.3]	30	
8k	NTHD-0070 B01	2	3	.070 [1.8]	.040 [1.0]	30	
6k	NTHD-0070 B01	2	3	.070 [1.8]	.030 [.76]	30	
10k	NTHD-0100 C01	4	12	.100 [2.5]	.100 [2.5]	28	
8k	NTHD-0100 C01	3	10	.100 [2.5]	.080 [2.0]	28	
7k	NTHD-0100 C01	3	10	.100 [2.5]	.070 [1.8]	28	
6k	NTHD-0100 C01	3	9	.100 [2.5]	.060 [1.5]	28	
5k	NTHD-0100 C01	3	8	.100 [2.5]	.050 [1.3]	28	
4k	NTHD-0100 C01	3	7	.100 [2.5]	.040 [1.0]	28	
3k	NTHD-0100 C01	3	5	.100 [2.5]	.030 [.76]	28	
2.5k	NTHD-0100 C01	3	5	.100 [2.5]	.025 [.64]	28	
2k	NTHD-0100 C01	3	5	.100 [2.5]	.020 [.51]	28	
7000	NTHD-0150 E01	7	30	.150 [3.8]	.150 [3.8]	24	
6000	NTHD-0150 E01	7	28	.150 [3.8]	.135 [3.4]	24	
5000	NTHD-0150 E01	7	25	.150 [3.8]	.110 [2.8]	24	
4000	NTHD-0150 E01	7	23	.150 [3.8]	.090 [2.3]	24	
3000	NTHD-0150 E01	7	20	.150 [3.8]	.070 [1.8]	24	
2000	NTHD-0150 E01	7	19	.150 [3.8]	.045 [1.1]	24	
1500	NTHD-0150 E01	7	17	.150 [3.8]	.035 [.89]	24	
5000	NTHD-0200 E01	8	36	.200 [5.1]	.190 [4.8]	24	
4000	NTHD-0200 E01	7	32	.200 [5.1]	.160 [4.1]	24	
3000	NTHD-0200 E01	7	30	.200 [5.1]	.120 [3.0]	24	
2500	NTHD-0200 E01	7	28	.200 [5.1]	.100 [2.5]	24	
2000	NTHD-0200 E01	7	25	.200 [5.1]	.060 [2.0]	24	
1500	NTHD-0200 E01	7	23	.200 [5.1]	.050 [1.3]	24	
1000	NTHD-0200 E01	7	18	.200 [5.1]	.040 [1.0]	24	
2000	NTHD-0300 E01	9	75	.300 [7.6]	.180 [4.6]	24	
1500	NTHD-0300 E01	9	70	.300 [7.6]	.135 [3.4]	24	
1000	NTHD-0300 E01	8	48	.300 [7.6]	.080 [2.0]	24	
750	NTHD-0300 E01	8	46	.300 [7.6]	.070 [1.8]	24	
500	NTHD-0300 E01	8	35	.300 [7.6]	.045 [1.2]	24	
1000	NTHD-0400 F01	10	85	.400 [10.2]	.160 [4.1]	22	
750	NTHD-0400 F01	9	70	.400 [10.2]	.120 [3.0]	22	
500	NTHD-0400 F01	9	65	.400 [10.2]	.080 [2.0]	22	
250	NTHD-0400 F01	9	50	.400 [10.2]	.040 [1.0]	22	
200	NTHD-0500 F01	14	60	.500 [12.7]	.050 [1.3]	22	

HOW TO ORDER

<u>NTHD</u> MODEL	-	<u>0050</u> DISC DIAMETER	<u>B</u> LEADS (AWG)	<u>01</u> CURVE	<u>30k</u> R ₂₅	<u>± 10%</u> TOLERANCE	<u>CROSS/LOOP</u> LEAD TYPE
<div style="border: 1px solid black; padding: 5px; display: inline-block;"> B = AWG 30 (.0100") C = AWG 28 (.0126") E = AWG 24 (.0201") F = AWG 22 (.0253") </div>							

PRELIMINARY - MODEL NTHD NTC Thermistors

Uncoated Disc, Curve 2 Series = 25Ω to 5,000Ω

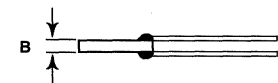
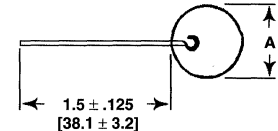
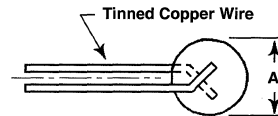


FEATURES

- Resistance tolerance of $\pm 1\%$ thru $\pm 20\%$ are available and may be specified at 25°C or any temperature within the operating range.
- Coatings are also available to meet specific requirements by contacting our engineering department.

STANDARD ELECTRICAL SPECIFICATIONS and DIMENSIONAL CONFIGURATIONS

R at 25°C ± 10% (Ohms)	PART NUMBER	DISSIPATION CONSTANT	THERMAL TIME CONSTANT	A	B	LEADS AWG#	[Numbers in brackets indicate millimeters]
5000	NTHD-0050 B02	2	3	.050 [1.3]	.080 [2.0]	30	
4000	NTHD-0050 B02	2	3	.050 [1.3]	.070 [1.8]	30	
3000	NTHD-0050 B02	2	3	.050 [1.3]	.050 [1.3]	30	
2000	NTHD-0050 B02	2	2	.050 [1.3]	.030 [.76]	30	
1500	NTHD-0050 B02	2	2	.050 [1.3]	.025 [.64]	30	
1000	NTHD-0050 B02	2	2	.050 [1.3]	.020 [.51]	30	
3000	NTHD-0070 B02	2.5	5	.070 [1.8]	.100 [2.5]	30	
2500	NTHD-0070 B02	2	4.5	.070 [1.8]	.085 [2.2]	30	
2000	NTHD-0070 B02	2	4	.070 [1.8]	.070 [1.8]	30	
1500	NTHD-0070 B02	2	3	.070 [1.8]	.050 [1.3]	30	
1000	NTHD-0070 B02	2	3	.070 [1.8]	.030 [.76]	30	
1500	NTHD-0100 C02	4	14	.100 [2.5]	.100 [2.5]	28	
1250	NTHD-0100 C02	4	12	.100 [2.5]	.085 [2.2]	28	
1000	NTHD-0100 C02	3	10	.100 [2.5]	.070 [1.8]	28	
800	NTHD-0100 C02	3	8	.100 [2.5]	.050 [1.3]	28	
700	NTHD-0100 C02	3	7	.100 [2.5]	.045 [1.1]	28	
600	NTHD-0100 C02	3	7	.100 [2.5]	.040 [1.0]	28	
500	NTHD-0100 C02	3	6	.100 [2.5]	.030 [.76]	28	
400	NTHD-0100 C02	3	5	.100 [2.5]	.030 [.76]	28	
300	NTHD-0100 C02	3	5	.100 [2.5]	.020 [.51]	28	
1000	NTHD-0150 E02	7	30	.150 [3.8]	.150 [3.8]	24	
750	NTHD-0150 E02	7	25	.150 [3.8]	.100 [2.5]	24	
500	NTHD-0150 E02	7	20	.150 [3.8]	.075 [1.9]	24	
250	NTHD-0150 E02	7	18	.150 [3.8]	.040 [1.0]	24	
800	NTHD-0200 E02	8	40	.200 [5.1]	.200 [5.1]	24	
750	NTHD-0200 E02	8	36	.200 [5.1]	.190 [4.8]	24	
500	NTHD-0200 E02	7	30	.200 [5.1]	.130 [3.3]	24	
400	NTHD-0200 E02	7	27	.200 [5.1]	.105 [2.7]	24	
300	NTHD-0200 E02	7	25	.200 [5.1]	.080 [2.0]	24	
270	NTHD-0200 E02	7	23	.200 [5.1]	.070 [1.8]	24	
200	NTHD-0200 E02	7	20	.200 [5.1]	.050 [1.3]	24	
150	NTHD-0200 E02	7	19	.200 [5.1]	.040 [1.0]	24	
100	NTHD-0200 E02	7	18	.200 [5.1]	.030 [.76]	24	
300	NTHD-0300 E02	9	75	.300 [7.6]	.180 [4.6]	24	
200	NTHD-0300 E02	8.5	60	.300 [7.6]	.120 [3.0]	24	
100	NTHD-0300 E02	8	48	.300 [7.6]	.060 [1.5]	24	
75	NTHD-0300 E02	8	42	.300 [7.6]	.045 [1.1]	24	
50	NTHD-0300 E02	8	35	.300 [7.6]	.030 [.76]	24	
150	NTHD-0400 F02	10	85	.400 [10.2]	.160 [4.1]	22	
125	NTHD-0400 F02	10	77	.400 [10.2]	.130 [3.3]	22	
100	NTHD-0400 F02	9	70	.400 [10.2]	.100 [2.5]	22	
75	NTHD-0400 F02	9	65	.400 [10.2]	.080 [2.0]	22	
50	NTHD-0400 F02	9	50	.400 [10.2]	.050 [1.3]	22	
25	NTHD-0500 F02	14	60	.500 [12.7]	.040 [1.0]	22	

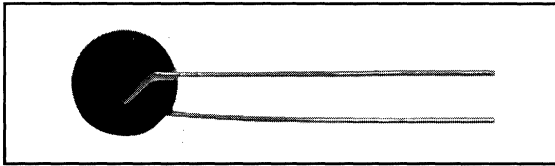


HOW TO ORDER

<u>NTHD</u> MODEL	-	<u>0050</u> DISC DIAMETER	<u>B</u> LEADS (AWG)	<u>02</u> CURVE	<u>5k</u> R ₂₅	<u>± 10%</u> TOLERANCE	<u>CROSS/LOOP</u> LEAD TYPE
			B = AWG 30 (.0100") C = AWG 28 (.0126") E = AWG 24 (.0201") F = AWG 22 (.0253")				

PRELIMINARY - MODEL NTHD NTC Thermistors

Uncoated Disc, Curve 14 Series = 2.5Ω to 500Ω



FEATURES

- Resistance tolerance of ± 1% thru ± 20% are available and may be specified at 25°C or any temperature within the operating range.
- Coatings are also available to meet specific requirements by contacting our engineering department.

STANDARD ELECTRICAL SPECIFICATIONS and DIMENSIONAL CONFIGURATIONS

R at 25°C ± 10% (Ohms)	PART NUMBER	DISSIPATION CONSTANT	THERMAL TIME CONSTANT	A	B	LEADS AWG#	[Numbers in brackets indicate millimeters]
500	NTHD-0050 B14	2	3	.050 [1.3]	.080 [2.0]	30	
400	NTHD-0050 B14	2	3	.050 [1.3]	.070 [1.8]	30	
300	NTHD-0050 B14	2	3	.050 [1.3]	.050 [1.3]	30	
250	NTHD-0050 B14	2	2	.050 [1.3]	.040 [1.0]	30	
200	NTHD-0050 B14	2	2	.050 [1.3]	.030 [.76]	30	
150	NTHD-0050 B14	2	2	.050 [1.3]	.025 [.64]	30	
100	NTHD-0050 B14	2	2	.050 [1.3]	.020 [.51]	30	
300	NTHD-0070 B14	2.5	5	.070 [1.8]	.100 [2.5]	30	
250	NTHD-0070 B14	2	4.5	.070 [1.8]	.085 [2.2]	30	
200	NTHD-0070 B14	2	4	.070 [1.8]	.070 [1.8]	30	
150	NTHD-0070 B14	2	3	.070 [1.8]	.050 [1.3]	30	
100	NTHD-0070 B14	2	3	.070 [1.8]	.030 [.76]	30	
150	NTHD-0100 C14	4	14	.100 [2.5]	.100 [2.5]	28	
125	NTHD-0100 C14	4	12	.100 [2.5]	.085 [2.2]	28	
100	NTHD-0100 C14	3	10	.100 [2.5]	.070 [1.8]	28	
80	NTHD-0100 C14	3	8	.100 [2.5]	.050 [1.3]	28	
70	NTHD-0100 C14	3	7	.100 [2.5]	.045 [1.1]	28	
60	NTHD-0100 C14	3	7	.100 [2.5]	.040 [1.0]	28	
50	NTHD-0100 C14	3	6	.100 [2.5]	.030 [.76]	28	
40	NTHD-0100 C14	3	5	.100 [2.5]	.030 [.76]	28	
30	NTHD-0100 C14	3	5	.100 [2.5]	.020 [.51]	28	
100	NTHD-0150 E14	7	30	.150 [3.8]	.150 [3.8]	24	
75	NTHD-0150 E14	7	25	.150 [3.8]	.100 [2.5]	24	
50	NTHD-0150 E14	7	20	.150 [3.8]	.075 [1.9]	24	
25	NTHD-0150 E14	7	18	.150 [3.8]	.040 [1.0]	24	
80	NTHD-0200 E14	8	40	.200 [5.1]	.200 [5.1]	24	
75	NTHD-0200 E14	8	36	.200 [5.1]	.190 [4.8]	24	
50	NTHD-0200 E14	7	30	.200 [5.1]	.130 [3.3]	24	
30	NTHD-0200 E14	7	25	.200 [5.1]	.080 [2.0]	24	
20	NTHD-0200 E14	7	20	.200 [5.1]	.050 [1.3]	24	
15	NTHD-0200 E14	7	19	.200 [5.1]	.040 [1.0]	24	
10	NTHD-0200 E14	7	18	.200 [5.1]	.030 [.76]	24	
30	NTHD-0300 E14	9	75	.300 [7.6]	.180 [4.6]	24	
20	NTHD-0300 E14	8.5	60	.300 [7.6]	.120 [3.0]	24	
10	NTHD-0300 E14	8	48	.300 [7.6]	.050 [1.3]	24	
7.5	NTHD-0300 E14	8	42	.300 [7.6]	.045 [1.1]	24	
5	NTHD-0300 E14	8	35	.300 [7.6]	.030 [.76]	24	
15	NTHD-0400 F14	10	85	.400 [10.2]	.160 [4.1]	22	
12.5	NTHD-0400 F14	10	77	.400 [10.2]	.130 [3.3]	22	
10	NTHD-0400 F14	9	70	.400 [10.2]	.100 [2.5]	22	
7.5	NTHD-0400 F14	9	65	.400 [10.2]	.080 [2.0]	22	
5	NTHD-0400 F14	9	50	.400 [10.2]	.050 [1.3]	22	
2.5	NTHD-0500 F14	14	60	.500 [12.7]	.040 [1.0]	22	

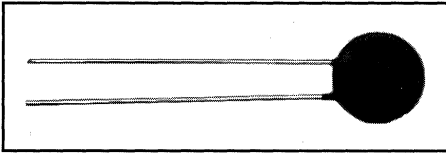
HOW TO ORDER

<u>NTHD</u> MODEL	-	<u>0050</u> DISC DIAMETER	<u>B</u> LEADS (AWG)	<u>14</u> CURVE	<u>500Ω</u> R ₂₅	<u>± 10%</u> TOLERANCE	<u>CROSS/LOOP</u> LEAD TYPE
			B = AWG 30 (.0100") C = AWG 28 (.0126") E = AWG 24 (.0201") F = AWG 22 (.0253")				

MODEL SSN "SOFT-START" NTC Thermistors (Preliminary)

For Inrush Current Suppressing Devices

1.5 A to 25 A at 65°C

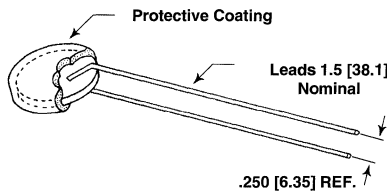


FEATURES

- Switching power supply applications
- Special marking is available upon request
- Protective silicone coating is standard and has a nominal thickness of .040" [1.0]. Other coatings are available upon request.

STANDARD ELECTRICAL SPECIFICATIONS and DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



G = AWG 20 (.032")
H = AWG 18 (.040")

"Soft-Start" devices display relatively high resistance to starting currents in a variety of electronic circuits. Having a negative temperature coefficient of resistance, these devices exhibit a large decrease in resistance when AC or DC current begins to flow at t_{op} .

Unlike circuit breakers and fuses, "Soft-Starts" prevent dangerous, short-duration, peak inrush currents present at turn-on. Especially useful in power supplies where charging capacitors initially present extremely low impedance. "Soft-Starts" actually limit inrush currents thereby extending the life of other critical components.

R @ 25°C (Ohms)	MODEL	I _{MAX} (Amps)	R @ I _{MAX} (Ohms) Reference	MAXIMUM DIAMETER	MAXIMUM THICKNESS	LEAD DIAMETER
1	SSN-1100H14	25	.01	1.10 [27.9]	.35 [8.9]	.040
1	SSN-0900H14	20	.015	.90 [22.9]	.30 [7.6]	.040
2	SSN-0900H14	18	.03	.90 [22.9]	.35 [8.9]	.040
2.5	SSN-0900H14	15	.03	.90 [22.9]	.30 [7.6]	.040
4	SSN-0900H03	14	.05	.90 [22.9]	.35 [8.9]	.040
5	SSN-0900H03	12	.06	.90 [22.9]	.50 [12.7]	.040
2.5	SSN-0900H14	12	.04	.90 [22.9]	.35 [8.9]	.040
5	SSN-0900H03	10	.06	.90 [22.9]	.35 [8.9]	.040
2.5	SSN-0900H14	10	.04	.90 [22.9]	.25 [6.4]	.040
5	SSN-0900H03	9	.06	.90 [22.9]	.25 [6.4]	.040
2.5	SSN-0900H14	9	.04	.90 [22.9]	.25 [6.4]	.040
5	SSN-0700H14	8	.05	.70 [17.8]	.25 [6.4]	.040
4	SSN-0700H14	8	.07	.70 [17.8]	.25 [6.4]	.040
5	SSN-0700G14	7	.07	.70 [17.8]	.25 [6.4]	.032
2.5	SSN-0700G14	7	.05	.70 [17.8]	.25 [6.4]	.032
10	SSN-0700H03	6	.15	.70 [17.8]	.35 [8.9]	.040
7	SSN-0600H14	6	.15	.60 [15.2]	.30 [7.6]	.040
5	SSN-0600G14	6	.07	.60 [15.2]	.25 [6.4]	.032
10	SSN-0600H03	5	.20	.60 [15.2]	.35 [8.9]	.040
7	SSN-0600H14	5	.15	.60 [15.2]	.30 [7.6]	.040
4	SSN-0600G14	5	.15	.60 [15.2]	.25 [6.4]	.032
12	SSN-0600H03	4	.22	.60 [15.2]	.30 [7.6]	.040
7	SSN-0600H14	4	.15	.60 [15.2]	.30 [7.6]	.040
5	SSN-0600G14	4	.15	.60 [15.2]	.25 [6.4]	.032
10	SSN-0500G14	3	.20	.50 [12.7]	.30 [7.6]	.032
7	SSN-0600G14	3	.14	.60 [15.2]	.25 [6.4]	.032
5	SSN-0600G14	3	.17	.60 [15.2]	.25 [6.4]	.032
2.5	SSN-0600G14	3	.15	.60 [15.2]	.25 [6.4]	.032
40	SSN-0500G03	2	.60	.50 [12.7]	.25 [6.4]	.032
20	SSN-0600G03	2	.28	.60 [15.2]	.25 [6.4]	.032
10	SSN-0600H03	2	.20	.60 [15.2]	.25 [6.4]	.032
5	SSN-0600G14	2	.40	.60 [15.2]	.25 [6.4]	.032
60	SSN-0500G03	1.5	1.00	.50 [12.7]	.25 [6.4]	.032
40	SSN-0500G03	1.5	.80	.50 [12.7]	.25 [6.4]	.032
25	SSN-0500G03	1.5	.60	.50 [12.7]	.30 [7.6]	.032
10	SSN-0500G14	1.5	.25	.50 [12.7]	.25 [6.4]	.032

MODEL SSN "SOFT-START"

ELECTRICAL SPECIFICATIONS

Standard Tolerance: 20% at 25°C. Closer tolerances available upon request.

Dielectric Strength: 500 V, 2 minutes.

Insulation Resistance: Not less than 500 Megohm.

MECHANICAL SPECIFICATIONS

Resistive Element: Various metal oxides.

Encapsulation: Silicone coating.

Terminals: Tinned copper-clad steel.

ENVIRONMENTAL SPECIFICATIONS

Temperature Limits: - 55°C to + 150°C.

DEFINITIONS

I_{max}: Represents the maximum rated steady state DC or RMS current and is expressed in amperes.

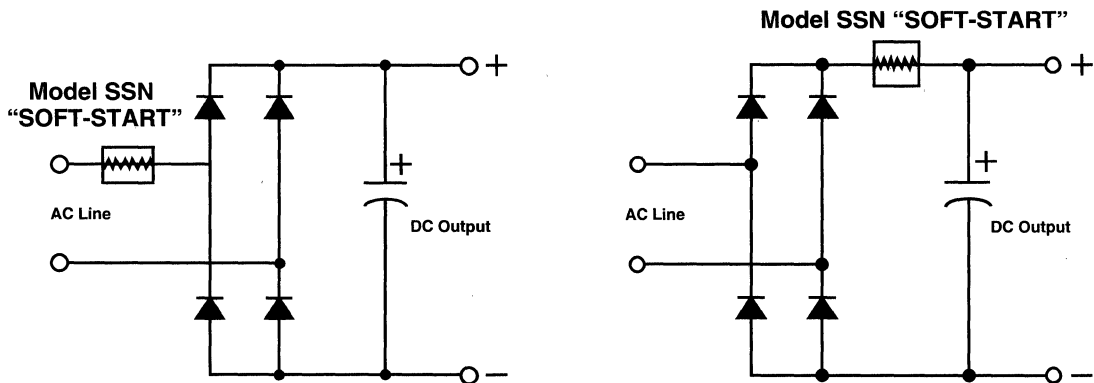
R @ 25°C: Represents the zero power resistance of the device at + 25°C and is expressed in ohms.

R @ I_{max}: Represents the approximate resistance at maximum steady state current conditions and is expressed in ohms.

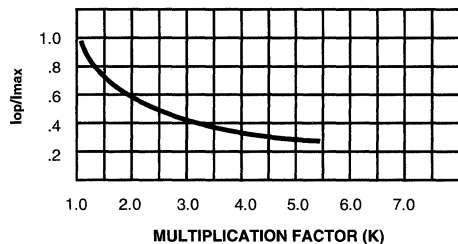
Ambient Temperature: Full rated current may be applied in the ambient temperature range of + 25°C to + 65°C and must be derated in accordance with I_{max} derating curve.

I_{op}: Represents the actual operating current applied.

TYPICAL APPLICATIONS



R_{OP} CURVE



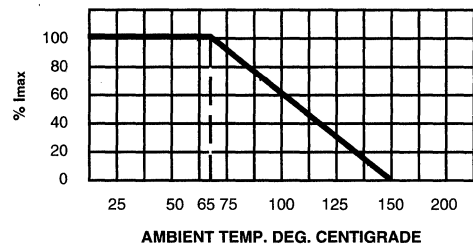
RESISTANCE OPERATING CHARACTERISTICS

When Dale Electronics, Inc. "Soft-Starts" are employed at less than their rating, the approximate resistance of each device may be determined as follows:

1. Locate the point of the curve where the I_{op}/I_{max} crosses the multiplication factor (K).
2. Multiply this factor by the value of R @ I_{max} for the device being used. The result will be the new R_{op} (see R_{op} Curve).

$$R_{op} = (R @ I_{max}) \cdot K$$

DERATING (I_{max})



AMBIENT TEMPERATURE CHARACTERISTICS

For safe operation of a "Soft-Start" at temperatures above 65°C the percentage of I_{max} may be determined from I_{max} Derating Curve.

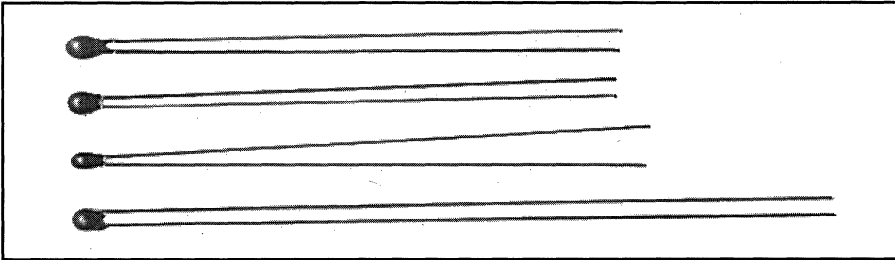
SPECIAL APPLICATIONS

Dale Electronics, Inc. engineers will design "Soft-Start" devices for your special application. Outline your problem or specifications and send them to: Dale Electronics, Inc. Applications Engineering Department.

HOW TO ORDER

SSN MODEL - 1100 DISC DIAMETER - H LEADS (AWG) - 14 CURVE - 1Ω R₂₅ - ±20% TOLERANCE - I_{max} = 25 AMPERES

MODELS X, M, C, F, T, B NTC Thermistors Coated

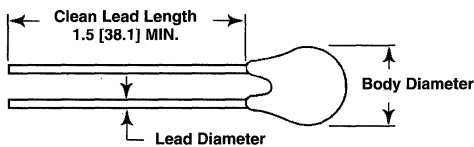


FEATURES

- Small size - conformal coated
- Wide resistance range
- Available in 11 different R-T curves
- Configured for standard P.C. board mounting or assembly in probes

STANDARD ELECTRICAL SPECIFICATIONS and DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



Models X, M, C, F, T and B are conformally coated, leaded thermistors for standard P.C. board mounting or assembly in probes. The coating is baked-on phenolic for durability and long-term stability. Leads are solid tinned copper, except T models have solid nickel wires with Teflon[®] insulation to provide isolation when assembled in metal probes or housings.

	R ₂₅ (Ohms)	R ₇₀ (Ohms)	PART NUMBER	CURVE NUMBER	DISSIPATION CONSTANT (Nominal)	THERMAL TIME CONSTANT (Nominal)	BODY DIAMETER		LEAD DIAMETER
							(Max.)	(Min.)	
MODEL X ± 10%, ± 5% R ₇₀ tolerance. Leads solid tinned copper 1.8 ± .2 [45.7 ± 5.1] long.	19.68M	1.6M	13X1604	13	—	—	.095 [2.4]	.070 [1.8]	AWG30 (.0100)
	9.84M	800,000	13X8003	13	—	—	.095 [2.4]	.070 [1.8]	AWG28 (.0126)
	4.92M	400,000	13X4003	13	—	—	.100 [2.5]	.080 [2.0]	AWG28 (.0126)
	3.08M	250,000	13X2503	13	—	—	.125 [3.2]	.100 [2.5]	AWG28 (.0126)
	1.082M	130,000	12X1303	12	—	—	.095 [2.4]	.070 [1.8]	AWG30 (.0100)
	998.300	120,000	12X1203	12	—	—	.095 [2.4]	.070 [1.8]	AWG30 (.0100)
MODEL M ± 10%, ± 5%, ± 3%, ± 2%, ± 1% R ₂₅ tolerance. Leads solid tinned copper 1.8 ± .2 [45.7 ± 5.1] long AWG30 (.0100").	1.0M	—	12M1004*	12	—	—	.087 [2.2]	.061 [1.55]	—
	200,000	—	7M2003	7	2	12	.095 [2.4]	.070 [1.8]	—
	150,000	—	7M1503	7	—	—	.100 [2.5]	.075 [1.9]	—
	100,000	—	7M1003	7	—	—	.095 [2.4]	.070 [1.8]	—
	100,000	—	8M1003	8	—	—	.095 [2.4]	.070 [1.8]	—
	100,000	—	4M1003	4	2	12	.095 [2.4]	.070 [1.8]	—
	80,000	—	8M8002	8	—	—	.095 [2.4]	.070 [1.8]	—
	50,000	—	8M5002	8	—	—	.095 [2.4]	.070 [1.8]	—
	50,000	—	7M5002	7	—	—	.095 [2.4]	.070 [1.8]	—
	50,000	—	4M5002	4	2	10	.085 [2.2]	.060 [1.5]	—
	30,000	—	8M3002	8	—	—	.095 [2.4]	.070 [1.8]	—
	30,000	—	4M3002	4	2	10	.085 [2.2]	.060 [1.5]	—
	30,000	—	1M3002	1	—	—	.095 [2.4]	.070 [1.8]	—
	25,000	—	1M2502	1	—	—	.095 [2.4]	.070 [1.8]	—
	20,000	—	9M2002	9	2	10	.095 [2.4]	.070 [1.8]	—
	20,000	—	1M2002	1	—	—	.095 [2.4]	.070 [1.8]	—
	17,500	—	1M1752	1	—	—	.095 [2.4]	.070 [1.8]	—
	15,000	—	1M1502	1	—	—	.095 [2.4]	.070 [1.8]	—
	10,000	—	9M1002	9	2	12	.095 [2.4]	.070 [1.8]	—
	10,000	—	1M1002	1	2	10	.085 [2.2]	.060 [1.5]	—
6,000	—	1M6001	1	2	10	.085 [2.2]	.060 [1.5]	—	
5,000	—	1M5001	1	2	10	.085 [2.2]	.060 [1.5]	—	
2,252	—	1M2251	1	3	12	.095 [2.4]	.070 [1.8]	—	
2,000	—	2M2001	2	3	12	.100 [2.5]	.075 [1.9]	—	
1,000	—	2M1001	2	3	12	.085 [2.2]	.060 [1.5]	—	

* Available in ± 10% and 5% R₂₅ tolerance only.

MODELS X, M, C, F, T, B

STANDARD ELECTRICAL SPECIFICATIONS and DIMENSIONAL CONFIGURATIONS							
[Numbers in brackets indicate millimeters]	R25 (Ohms)	PART NUMBER	CURVE NUMBER	DISSIPATION CONSTANT (Nominal)	THERMAL TIME CONSTANT (Nominal)	BODY DIAMETER	
						(Max.)	(Min.)
MODEL C ± 10%, ± 5%, ± 3%, ± 2%, ± 1% R25 tolerance. Leads solid tinned copper 1.8 ± .2 [45.7 ± 5.1] long, AWG28 (.0126").	500,000	12C5003*	12	—	—	.102 [2.6]	.073 [1.9]
	250,000	12C2503*	12	—	—	.133 [3.4]	.102 [2.6]
	150,000	12C1503*	12	—	—	.163 [4.1]	.130 [3.3]
	100,000	12C1003*	12	—	—	.192 [4.9]	.157 [4.0]
	100,000	7C1003	7	3	12	.095 [2.4]	.070 [1.8]
	50,000	7C5002	7	3	12	.095 [2.4]	.070 [1.8]
	30,000	7C3002	7	—	—	.115 [2.9]	.090 [2.3]
	30,000	8C3002	8	—	—	.095 [2.4]	.070 [1.8]
	30,000	4C3002	4	2.5	12	.095 [2.4]	.070 [1.8]
	20,000	8C2002	8	—	—	.130 [3.3]	.100 [2.5]
	20,000	7C2002	7	—	—	.130 [3.3]	.105 [2.7]
	20,000	4C2002	4	3	12	.095 [2.4]	.070 [1.8]
	10,000	1C1002	1	3	12	.095 [2.4]	.070 [1.8]
	9,000	1C9001	1	3	12	.095 [2.4]	.070 [1.8]
	8,000	1C8001	1	3	12	.095 [2.4]	.070 [1.8]
	7,000	1C7001	1	3	12	.095 [2.4]	.070 [1.8]
	6,000	1C6001	1	3	12	.095 [2.4]	.070 [1.8]
	4,000	1C4001	1	3	12	.095 [2.4]	.070 [1.8]
	3,000	1C3001	1	3	12	.095 [2.4]	.070 [1.8]
	2,000	1C2001	1	3.5	16	.095 [2.4]	.070 [1.8]
	1,500	1C1501	1	—	—	.135 [3.4]	.110 [2.8]
	1,250	1C1251	1	—	—	.145 [3.7]	.120 [3.1]
	1,000	1C1001	1	—	—	.158 [4.0]	.128 [3.2]
	1,000	2C1001	2	3	12	.095 [2.4]	.075 [1.9]
	900	2C9000	2	3	12	.095 [2.4]	.075 [1.9]
	800	2C8000	2	3	12	.095 [2.4]	.075 [1.9]
	700	2C7000	2	3	12	.100 [2.5]	.075 [1.9]
	600	2C6000	2	3	12	.100 [2.5]	.075 [1.9]
	500	2C5000	2	3	12	.100 [2.5]	.075 [1.9]
	400	2C4000	2	—	—	.120 [3.1]	.095 [2.4]
	300	2C3000	2	—	—	.130 [3.3]	.105 [2.7]
	200	2C2000	2	3.5	18	.150 [3.8]	.120 [3.1]
	150	2C1500	2	—	—	.165 [4.2]	.135 [3.4]
	100	2C1000	2	4	20	.210 [5.3]	.180 [4.6]
	50	2C0500	2	—	—	.272 [6.9]	.242 [6.2]
MODEL F ± 10%, ± 5%, ± 3%, ± 2%, ± 1% R25 tolerance. Leads solid tinned copper 1.8 ± .2 [45.7 ± 5.1] long, AWG32 (.0080").	30,000	9F3002	9	0.8	5	.072 [1.8]	.050 [1.3]
	15,000	1F1502	1	0.8	5	.072 [1.8]	.050 [1.3]
	10,000	1F1002	1	0.8	5	.072 [1.8]	.050 [1.3]
	5,000	1F5001	1	0.8	7	.072 [1.8]	.050 [1.3]
	MODEL T ± 10%, ± 5%, ± 3%, ± 2%, ± 1% R25 tolerance. Leads Teflon® insulated solid nickel 3 ± .25 [76.2 ± 6.4] long, AWG30 (.0100").	100,000	8T1003	8	—	—	.095 [2.4]	.070 [1.8]
100,000		4T1003	4	—	—	.095 [2.4]	.070 [1.8]
50,000		8T5002	8	—	—	.095 [2.4]	.070 [1.8]
50,000		4T5002	4	—	—	.085 [2.2]	.060 [1.5]
30,000		8T3002	8	—	—	.095 [2.4]	.070 [1.8]
30,000		4T3002	4	2	12	.085 [2.2]	.060 [1.5]
20,000		9T2002	9	2	12	.095 [2.4]	.070 [1.8]
20,000		1T2002	1	—	—	.095 [2.4]	.070 [1.8]
10,000		9T1002	9	2	14	.095 [2.4]	.075 [1.9]
10,000		1T1002	1	2	12	.085 [2.2]	.060 [1.5]
5,000		1T5001	1	2	12	.085 [2.2]	.060 [1.5]
3,000		1T3001	1	2	13	.095 [2.4]	.070 [1.8]
2,252		1T2251	1	2	14	.095 [2.4]	.070 [1.8]
MODEL B ± 10%, ± 5%, ± 3%, ± 2%, ± 1% R25 tolerance. Leads solid tinned copper 1.8 ± .2 [45.7 ± 5.1] long, AWG26 (.0159").	50,000	12B5002	12	—	—	.252 [6.4]	.216 [5.5]
	20,000	4B2002	4	—	—	.110 [2.8]	.090 [2.3]
	10,000	7B1002	7	—	—	.190 [4.8]	.150 [3.8]
	10,000	4B1002	4	—	—	.135 [3.4]	.110 [2.8]
	10,000	1B1002	1	—	—	.122 [3.1]	.085 [2.2]
	8,000	1B8001	1	—	—	.120 [3.1]	.080 [2.0]
	3,000	1B3001	1	—	—	.150 [3.8]	.110 [2.8]
	2,800	17B2801	17	—	—	.180 [4.6]	.150 [3.8]
	2,252	1B2251	1	—	—	.160 [4.1]	.115 [2.9]
	2,000	1B2001	1	—	—	.160 [4.1]	.115 [2.9]
	500	2B5000	2	—	—	.125 [3.2]	.085 [2.2]
	100	2B1000	2	—	—	.270 [6.9]	.220 [5.6]
50	2B0500	2	—	—	.350 [8.9]	.295 [7.5]	

* Available in ± 10% and 5% R25 tolerance only.

HOW TO ORDER			
1 CURVE NUMBER	C MODEL	2001 VALUE	- 5 TOLERANCE AT 25°C*
		First three digits are significant. The last digit is the multiplier. (2000 ohm is illustrated.)	± 10% = (none) ± 5% = - 5 ± 3% = - 3 ± 2% = - 2 ± 1% = - 1
* Model X is tolerated at 70°C.			

NTC (%/°C) VS. TEMPERATURE CURVES



NTC (- %/°C) is negative temperature coefficient of resistance at temperature (T) expressed in % resistance change per °C. Since one NTC resistance change is approximately equivalent to 1°C temperature change, NTC is useful in developing curve tracking thermistor specifications (e.g., Curve 1, 10,000 ohm ± 4.4% at 25°C; 32,660 ohm ± 5.1% at 0°C 1753 ohm ± 3.4% at 70°C results in a ± 1°C: curve tracking thermistor 0° to 70°C, .5 NTC = ± .5°C, etc.).

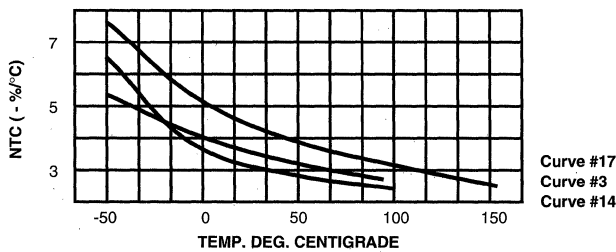
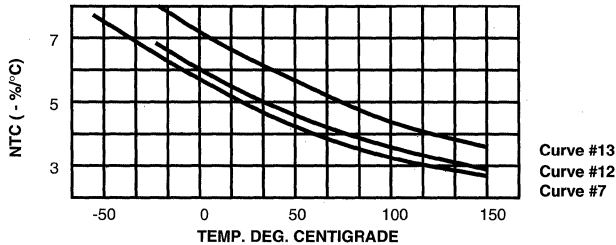
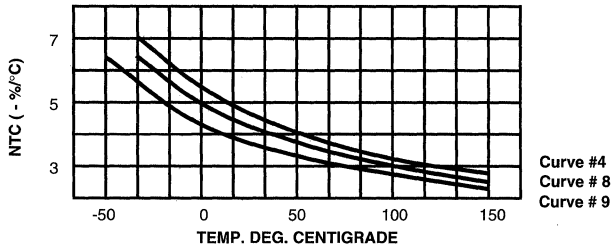
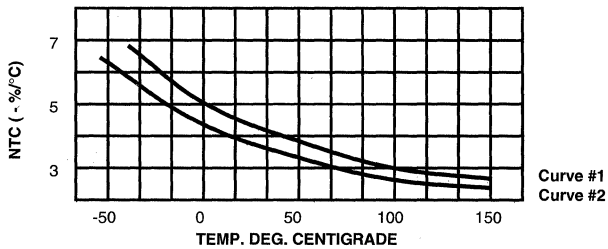
MT ± % is manufacturing tolerance at temperature. Add to resistance tolerance specified at 25°C. (e.g., Curve 1, 10 kilohm ± 10% at 25°C, 1258 ohm ± 12.1% at 80°C.) Not applicable to curve tracking thermistors.

RT-R25 Ratio is resistance at temperature T divided by resistance at 25°C. To determine the resistance of a NTC thermistor at temperatures other than 25°C, multiply the ratio selected from the appropriate curve column above by resistance at 25°C (e.g., Curve 1, 10 kilohm at 25°C, 1258 ohm at 80°C).

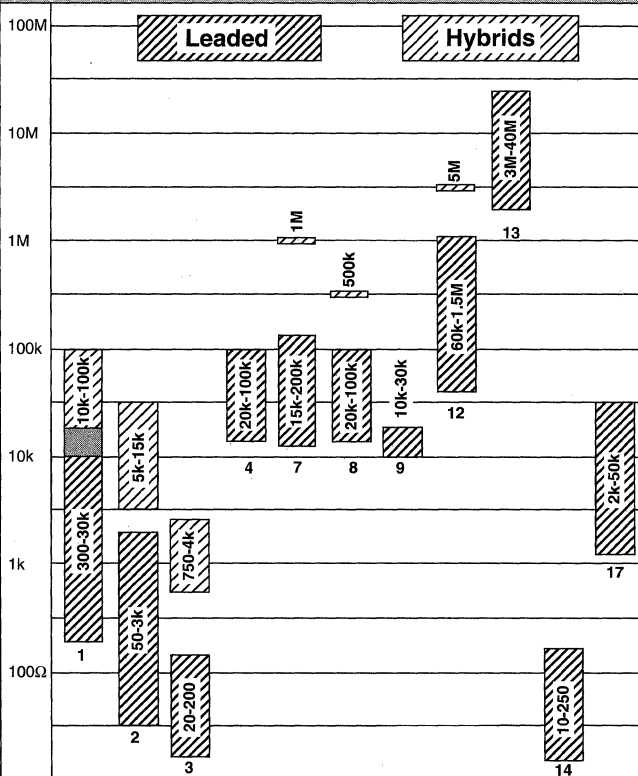
NOTE: For 1°C Ratio Tables, see pages 223 to 227.

MAXIMUM TEMPERATURE for thermistors listed is 150°C; however, continuous operation or cycling above 125°C (curve tracking above the specified temperature range) may cause thermistors to exceed the originally specified tolerances.

CURVES



AVAILABLE THERMISTOR VALUE RANGES (R25)



CURVE NUMBER	NTC @ 25°C (%/°C)	BETA 25°C/75°C
1	-4.40	3964
2	-3.83	3477
3	-3.70	3181
4	-4.68	4247
7	-4.83	4437
8	-4.30	3925
9	-4.03	3679
12	-5.23	4842
13	-6.22	5718
14	-3.10	3022
17	-4.54	4064

NTC (%/°C) VS. TEMPERATURE CURVES

RESISTANCE VS. TEMPERATURE CONVERSION TABLES												
TEMP. °C	CURVE 1			CURVE 2			CURVE 3			CURVE 4		
	RATIO	MT ± %	NTC	RATIO	MT ± %	NTC	RATIO	MT ± %	NTC	RATIO	MT ± %	NTC
-55	96.77	4.5	7.4	53.40	6.3		36.6					
-50	67.23	3.9	7.2	38.99	6.1	6.2	27.5	18.5	5.5			
-40	33.72	3.3	6.7	21.45	5.5	5.8	16.1	15.4	5.3	40.16	5.3	
-30	17.72	2.6	6.2	12.27	4.8	5.4	9.70	12.5	4.9	20.64	4.3	6.5
-20	9.713	2.1	5.8	7.278	4.0	5.1	6.05	9.9	4.5	11.03	3.5	6.1
-10	5.534	1.5	5.5	4.459	3.2	4.7	3.89	7.4	4.2	6.119	2.6	5.7
0	3.266	1.1	5.1	2.815	2.3	4.5	2.57	5.0	4.0	3.510	1.8	5.4
10	1.990	0.6	4.8	1.826	1.4	4.2	1.72	2.7	3.8	2.078	1.0	5.1
20	1.249	0.1	4.5	1.215	0.5	4.0	1.19	0.5	3.6	1.267	0.2	4.8
25	1.00	0.0	4.4	1.00	0.0	3.8	1.00	0.0	3.5	1.00	0.0	4.7
30	.8056	0.2	4.3	.8276	0.5	3.7	.841	1.4	3.4	.7942	0.4	4.6
37	.6015	0.6	4.1	.6406			.666			.5814	1.0	4.4
40	.5326	0.7	4.0	.5758	1.4	3.5	.604	3.2	3.2	.5105	1.1	4.3
50	.3602	1.1	3.8	.4086	2.3	3.3	.442	5.0	3.1	.3359	1.8	4.1
60	.2489	1.3	3.6	.2954	3.1	3.2	.328	6.7	2.9	.2259	2.4	3.9
70	.1753	1.8	3.4	.2172	4.1	3.0	.248	8.2	2.8	.1550	2.9	3.7
80	.1258	2.1	3.2	.1622	5.1	2.8	.189	9.8	2.6	.1084	3.4	3.5
90	.09174	2.3	3.1	.1229	5.5	2.7	.147	11.2	2.5	.0771	3.9	3.3
100	.06798	2.6	2.9	.09446	6.7	2.6	.115	12.6		.0557	4.4	3.2
110	.05110	2.7	2.8	.07350	7.4	2.4	.0917			.0408	4.9	3.0
120	.03894	3.2	2.7	.05788	8.5	2.3	.0733			.0303	5.3	2.9
125	.03416	3.3	2.6	.05158	8.7	2.3	.0660			.0263	5.5	2.9
130	.03005	3.4	2.5	.04609	8.9	2.2	.0593			.0228	5.7	2.8
140	.02347	3.7	2.4	.03708	9.7	2.1	.0487			.0173	6.0	2.7
150	.01853			.03012						.0133		
TEMP. °C	CURVE 7			CURVE 8			CURVE 9			CURVE 12		
	RATIO	MT ± %	NTC	RATIO	MT ± %	NTC	RATIO	MT ± %	NTC	RATIO	MT ± %	NTC
-55	126.1	6.0	7.6							176.4		8.0
-50	86.92	5.0	7.3	56.49	3.5	6.9	44.13	3.9		119.0		7.8
-40	42.69	4.2	6.9	29.49	3.0	6.3	23.98	3.3	5.9	55.98		7.3
-30	21.84	2.9	6.5	16.03	2.4	5.9	13.52	2.6	5.6	27.45		6.9
-20	11.61	2.7	6.2	9.040	1.9	5.6	7.891	2.1	5.2	13.98	13.7	6.6
-10	6.385	2.1	5.8	5.267	1.4	5.2	4.754	1.5	4.9	7.375	11.7	6.2
0	3.627	1.4	5.5	3.166	1.0	4.9	2.949	1.1	4.6	4.018	9.9	5.9
10	2.123	0.9	5.2	1.958	0.5	4.7	1.879	0.6	4.4	2.256	8.2	5.6
20	1.277	0.2	5.0	1.243	0.1	4.4	1.226	0.1	4.2	1.303	6.6	5.4
25	1.00	0.0	4.8	1.00	0.0	4.3	1.00	0.0	4.0	1.00	5.9	5.2
30	.7880	0.4	4.7	.8090	0.2	4.0	.8194	0.2	3.9	.7723	5.2	5.1
37	.5702		4.5	.6070			.6258	0.6	3.8	.5434		4.9
40	.4981	0.9	4.5	.5383	0.6	3.7	.5592	0.7	3.7	.4690	3.7	4.9
50	.3219	1.5	4.3	.3657	1.0	3.6	.3893	1.1	3.5	.2914	2.4	4.6
60	.2124	1.9	4.1	.2533	1.2	3.4	.2760	1.3	3.4	.1849	1.1	4.4
70	.1429	2.4	3.9	.1786	1.6	3.2	.1990	1.8	3.2	.1198	0.0	4.2
80	.09790	2.7	3.7	.1281	1.9	3.1	.1458	2.1	3.1	.07902	1.0	4.1
90	.06823	3.2	3.5	.09330	2.1	2.9	.1084	2.3	2.9	.05307	2.1	3.9
100	.04832	3.6	3.4	.06897	2.4	2.8	.08168	2.6	2.8	.03624	3.1	3.7
110	.03474	4.0	3.2	.05167	2.6	2.7	.06235	2.7	2.6	.02514	4.0	3.6
120	.02533	4.4	3.1	.03920	2.9	2.7	.04818	3.2	2.5	.01770	4.9	3.4
125	.02174	4.5	3.0	.03430	3.0	2.6	.04253	3.3		.01493	5.3	3.4
130	.01872	4.7	3.0	.03010	3.1	2.5	.03764	3.4	2.4	.01264	5.8	3.3
140	.01401	5.0	2.8	.02337	3.4	2.4	.02972	3.7	2.3	.00915	6.6	3.2
150	.01061		2.7	.01834	3.5	2.3	.02370			.00670	7.3	3.0
TEMP. °C	CURVE 13			CURVE 14			CURVE 17					
	RATIO	MT ± %	NTC	RATIO	MT ± %	NTC	RATIO	MT ± %	NTC			
-55	503.0		9.7	31.9								
-50	312.0		9.4	24.3	18.5	5.6	72.50	5.6	7.5			
-40	125.0		8.9	14.4	15.4	4.9	36.09	4.8	6.9			
-30	53.0		8.4	8.93	12.5	4.5	18.82	4.2	6.4			
-20	23.43		7.9	5.69	9.9	4.4	10.23	3.6	6.0			
-10	10.87		7.5	3.68	7.4	4.3	5.767	2.9	5.7			
0	5.25	13.2	7.1	2.45	5.0	3.9	3.363	2.2	5.3			
10	2.635	10.9	6.7	1.68	2.7	3.6	2.024	1.7	5.0			
20	1.370	8.7	6.4	1.18	0.5	3.4	1.256	1.4	4.7			
25	1.00		6.2	1.00	0.0	3.1	1.00	0.0	4.5			
30	.7358	6.8	6.1	.854	1.4	3.0	.8013	1.3	4.4			
37	.4850		5.9	.689			.5973	1.7	4.3			
40	.4075	4.9	5.8	.628	3.2	2.9	.5241	1.9	4.2			
50	.2322	3.2	5.5	.464	5.0	2.8	.3507	2.4	4.0			
60	.1358	1.5	5.2	.350	6.7	2.7	.2400	2.5	3.7			
70	.08146	0.0	5.0	.267	8.2	2.6	.1677	2.6	3.5			
80	.05000	1.4	4.8	.208	9.8	2.5	.1194	2.7	3.4			
90	.03137	2.8	4.6	.163	11.2	2.4	.08652	2.8	3.2			
100	.02009	4.1	4.4	.130	12.6	2.3	.06370	2.9	3.0			
110	.01311	5.2	4.2	.105			.04761	3.0	2.8			
120	.008715	6.4	4.0	.085			.03610	3.1	2.72			
125	.007151	7.0	3.9	.077			.03160	3.2	2.64			
130	.005892	7.6	3.8	.070			.02774	3.3	2.58			
140	.004048	8.6	3.7	.058			.02158	3.5	2.46			
150	.002824	9.6	3.5	.048			.01698	3.6	2.37			

NOTE: For 1°C
Ratio Tables, see
pages 223 to 227.



NTC Thermistors

Curve Tracking and Point Matched

Curve Tracking Thermistors are "curve matched" to desired temperature tolerances over selected temperature ranges. They allow component standardization and can reduce cost associated with assembly because they are curve tracking to within the tolerance and temperature range specified without re-calibration. They are ideally suited for use in microcomputer measurement and control circuits. The temperature tolerance corresponds to a

resistance tolerance based on the temperature coefficient at each temperature point within the specified range. Standard temperature tolerance and ranges are listed below, along with the available styles and resistances.

To specify, add the appropriate suffix from the following table to the part number.

Example: 1M1002-B3 = Curve 1, 10 kilohm at 25°C, curve tracking to $\pm .5^\circ\text{C}$ from 0° to 70°C.

STANDARD ELECTRICAL SPECIFICATIONS																
	TEMP. RANGE		0°C to + 70°C			- 20°C to + 50°C		0°C to + 100°C			+ 25°C to + 90°C			0°C to + 50°C		
	TEMP. TOLERANCE		$\pm 1^\circ\text{C}$	$\pm .5^\circ\text{C}$	$\pm .2^\circ\text{C}$	$\pm 1^\circ\text{C}$	$\pm .5^\circ\text{C}$	$\pm 1^\circ\text{C}$	$\pm .5^\circ\text{C}$	$\pm .2^\circ\text{C}$	$\pm 1^\circ\text{C}$	$\pm .5^\circ\text{C}$	$\pm .2^\circ\text{C}$	$\pm 1^\circ\text{C}$	$\pm .5^\circ\text{C}$	$\pm .2^\circ\text{C}$
CURVE NUMBER	PART NUMBER SUFFIX		- A3	- B3	- C3	- A2	- B2	- A4	- B4	- C4	- A5	- B5	- C5	- A8	- B8	- C8
	R25 (Ohms)*	MODELS														
1	2252	M, T	X	X	X	X	X	X	X					X	X	X
	3000	C, T	X	X	X	X	X	X	X					X	X	X
	5000	M, F, T	X	X	X			X	X		X	X	X	X	X	X
	10,000	M, F, T	X	X	X			X	X	X	X	X	X	X	X	X
	20,000	M, T	X	X	X			X	X		X	X	X	X	X	X
	30,000	M	X	X	X			X	X		X	X	X	X	X	X
2	1000	M				X								X	X	
4	30,000	M, T	X	X	X			X			X	X	X	X	X	X
	50,000	M, T	X	X	X			X			X	X	X	X	X	X
	100,000	M, T	X	X	X			X			X	X	X	X	X	X
8	30,000	M, T	X	X	X			X			X	X	X	X	X	X
	50,000	M, T	X	X	X			X			X	X	X	X	X	X
	100,000	M, T	X	X	X			X			X	X	X	X	X	X
9	10,000	M, T	X	X	X						X	X	X	X	X	X
	20,000	M	X	X	X						X	X	X	X	X	X
	30,000	F	X	X	X						X	X	X	X	X	X

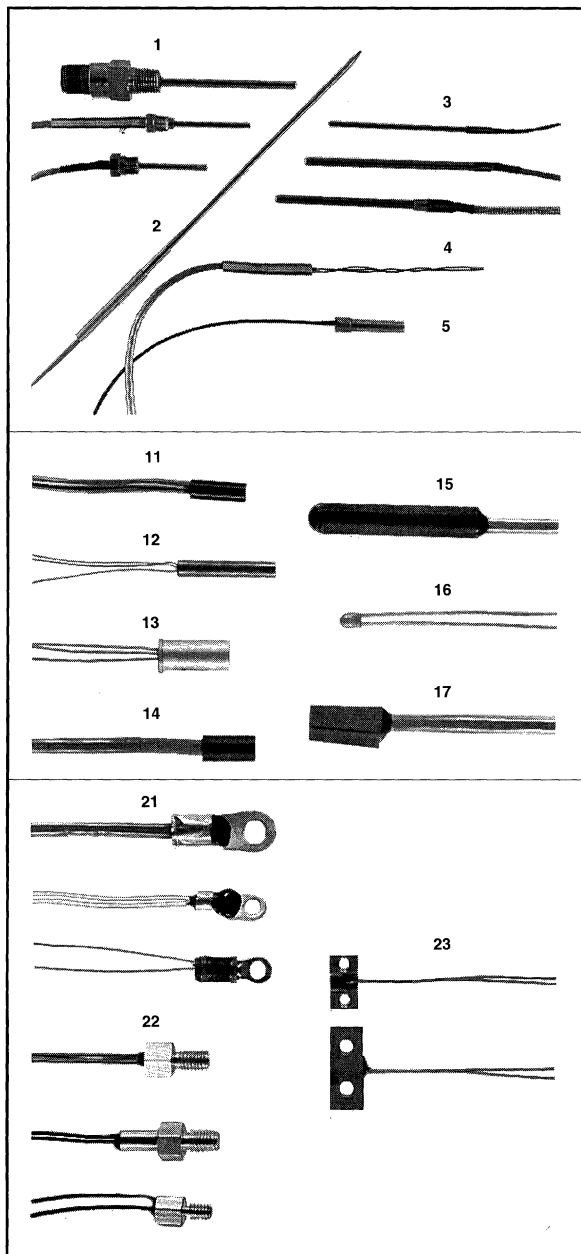
X = Available. Popular Values - contact factory for other values.
* = Standard R25 Values (25°C resistance).

Point Matched Thermistors are available for applications which require a specific resistance value matched to a specific temperature point. (Example: 10,000 ohm $\pm 2\%$ at 80°C). They are useful for applications which require temperature monitoring

at a critical temperature point to control, measure or shut-down. Consult factory with requirements.

NOTE: All thermistors listed in this catalog are point matched thermistors at 25°C. (X Models at 70°C).

NTC Thermistor Assemblies



NOTE: A variety of wire styles is available from stock. Depending on the probe and application, the wire will vary. Consult the factory for this and other information.

HOW TO ORDER

1. Choose Style: Immersion probe.
2. Select Style Type: "1" = thread mount.
3. Select Thermistor: 1M1002-C3.
4. Indicate style, type and thermistor to factory for part numbers.

Standard and custom assemblies are available in a variety of configurations. The choice of assembly style is dependent on the application. The primary factors which determine the optimum configuration of a thermistor assembly are the operating environment, mounting, time response and minimum dissipation constant.

The two factors which do vary considerably with assembly design are time constant and dissipation constant. The time constant will typically be of greater duration in encapsulated thermistors. This is, of course, due to additional mass surrounding the thermistor element; therefore, extending the thermal transfer time. Dissipation constant will also be greater in assemblies. The additional housing mass serves well as a heat sink. Greater power is therefore required to induce self-heating.

Both time constant and dissipation constant will vary with the selected thermistor and housing. Heat transfer properties of the housing, thermistor location, mass and wire type determine these constants. It is recommended to evaluate or consult the factory in applications where T.C. and D.C. are critical.

ASSEMBLY STYLES

■ Immersion Probes

- 1. Thread Mounted:** Features a stainless steel tube with a hermetically sealed threaded hex fitting. Available in 1/8", 3/16" and 1/4" outer diameter tubes with 1/8" or 1/4" NPT hex fittings. Ideal for pressured, closed systems.
- 2. Penetration Probe:** 7" long x 1/8" outer diameter stainless steel tube. Pointed tip easily penetrates soft and semi-frozen materials. Also ideal for soil and ground measurements.
- 3. Tubular Stainless Steel:** 1/8", 3/16" and 1/4" outer diameter tubes in variable lengths. Good for universal immersion applications. Adaptable to use with compression thread mounts to give designer variable immersion depths.
- 4. Tubular Pyrex®:** 6" long x 3/16" outer diameter glass tube. Excellent for lab use where a chemically inert probe is required.
- 5. Flexible Immersion:** 1.5" long x .280" outer diameter aluminum housing. Flexible 105°C PVC tubing to protect wire and thermistor element from the liquid medium. Ideal assembly for intermittent immersion in hard to reach areas.

■ General Purpose Sensors

- 11. Delrin® Housing:** 1/2" long x .170" outer diameter thermoplastic. Excellent for environmental controls and applications below 100°C.
- 12. Stainless Steel Rod:** .875" x .156" outer diameter. Good for environmental chamber measurement where corrosive gasses exist.
- 13. Gold Anodized Flanged Sensor:** .630" long x .275" outer diameter with a .298" flange diameter. An easy to mount press fitting.
- 14. ABS Housing:** .476" long x .230" outer diameter. Black thermoplastic and configuration suits it well in air flow temperature measurements.
- 15. Polyester Housing:** 1.50" long x .280" outer diameter. Heavy thermoplastic case makes it ideal for applications requiring delayed time responses. Ideal for process controls in refrigeration and heating.
- 16. Epoxy Tip Probe:** Durable epoxy encapsulation, small size, fast time response, versatility and low cost make this sensor universally accepted. Assembly size will vary with wire and thermistor choice.
- 17. Pipe Sensor:** .625" long with a cut-out radius of .250" suits this nylon thermoplastic as an ideal pipe sensor. Extensive use is seen in environmental and water heating/cooling systems.

■ Surface Sensors

- 21. Ring Tongue Lugs:** Surface mount with a #4, #6, #8 or #10 screw. Excellent for measurement and control of surfaces where fast time responses are necessary.
- 22. Heat Sink Sensors:** Available in brass, aluminum or stainless steel with various threads. A durable and practical surface sensor, especially where shock and vibration are present.
- 23. Rectangular Block Sensors:** Aluminum blocks for measurement and control of large surface areas. Easily mountable with #6 screws.

Refer to "How to Select an NTC Thermistor" for general design aids in choice of thermistor value, tolerance and R-T curve.



NTC Thermistors

TYPICAL APPLICATIONS

1. TELECOMMUNICATIONS APPLICATIONS

- Temperature Compensation of Crystal Oscillators (TCXO)
- Gain Stabilization
- Transistor Temperature Compensation
- Ambient Temperature Compensation

2. INDUSTRIAL APPLICATIONS

- Heat Pump Sensors
- Chiller Sensors
- Bearing Overtemp Protection
- Photographic Processing
- Copy Machines
- Gas Analyzers
- PH Monitors
- Compressor Controls
- Differential Temperature Control
- Industrial Process Controls
- Crystal Ovens
- Refrigeration
- Fan Motor Speed Control
- Commercial Vending Machines

3. CONSUMER APPLIANCES

- Thermostats
- Refrigerators
- Air Conditioners
- Dishwashers
- Microwave Meat Probes
- Small Appliances
- Coffee Makers
- Electronic Thermometers
- Energy Efficient Monitors
- Solar Collectors
- Smoke Detectors
- Portable Refrigerators/
Food Warmers

4. MEDICAL

- Kidney Dialysis
- Blood Oxygenator
- Blood Analysis Equipment
- Respirators
- Blood Gases Monitors
- Infant Incubators

5. INSTRUMENTATION, COMPUTERS PERIPHERALS

- Oscillator Stabilization
- LCD Compensation
- Thermal Printer Head Control
- Hard Disc Drive Control and Compensation
- Laboratory Grade Temperature Probes
- Compensation of Solid State Circuit Drift
- Solid State Circuit Overtemp Protection
- Thermocouple Cold-Junction Compensation

6. AUTOMOTIVE AND TRANSPORTATION

- Emission Controls
- Coolant Sensors
- Air Temperature Sensors
- Climate Control
- Windshield/Mirror Defroster
- Altimeter
- Oil Temperature Sensor
- Automatic Transmission Temperature Sensor

HOW TO SELECT AN NTC THERMISTOR

1. Dissipation Constant (D.C.)

The dissipation constant is the amount of power (expressed in milliwatts) required to self-heat the thermistor suspended by its two inch leads in still air 1°C above its environment. The dissipation constant of NTC thermistor/NTC thermistor sensor assembly is typically defined as the ratio (at a specified ambient temperature) of the power dissipated in the thermistor to the resultant change in the temperature of the thermistor.

This constant (expressed as the power in milliwatts required to self-heat the thermistor 1°C above ambient temperature) increases slightly with increasing temperature. The lead length and type of lead, the type of encapsulating material (epoxy, durez, stainless steel probe, thermoplastic probe, etc.) the mounting of the NTC thermistor/assembly, the medium of the surrounding environment (flowing gas, still air, water, oil, etc.) and other factors generally determine the dissipation constant of an NTC thermistor/NTC thermistor sensor assembly.

Given the variables that affect D.C., it is recommended that a prototype should be tested under actual operating conditions to determine the maximum allowable input current. The current through the thermistor must be small enough to produce negligible self-heating error in the thermistor at the maximum measuring or controlling temperature. At the same time, the current should be as large as possible to maximize system sensitivity. If the rate of heat loss under actual operating conditions could be fixed and was constant from system to system, the D.C. would only be a consideration for determining the maximum power dissipated and an offset allowance could be made. For example, if the D.C. of a thermistor assembly had been determined as 3mW/°C in a stirred oil bath (the medium to be measured) and it was desired to measure the oil bath to an absolute temperature accuracy of $\pm 0.1^\circ\text{C}$, the maximum power that should be developed in the thermistor by the measuring current is 0.15mW. This is to keep the self-heat factor to 50% or less of the measurement accuracy.

HOW TO SELECT AN NTC THERMISTOR

The formula for this is:

$$3\text{mW}/^{\circ}\text{C} \times 0.1^{\circ}\text{C} \times 50\% = 0.15 \text{ mW}$$

The D.C. of an NTC thermistor/NTC thermistor assembly can be determined by first measuring the zero-power resistance of the NTC thermistor at two temperature points 10°C to 25°C apart. The thermistor is then placed in series with a variable voltage supply, a current meter and sufficiently large resistor to prevent too much current flowing through the circuit and allowing the thermistor to "run-away." A high-resistance voltmeter is connected across the thermistor. The power supply is then gradually increased until the voltage across the thermistor and the current through it indicate a resistance equal to the measured resistance at the upper temperature. This is determined by using Ohm's Law $E \div I = R$ ($E = \text{volts}$, $I = \text{current}$, $R = \text{resistance}$). The D.C. is then calculated by dividing the power dissipated in the NTC thermistor by the temperature difference between the two measured temperatures. Power is calculated by using Ohm's Law, $P = E \times I$.

2. Time Constant (T.C.)

The time constant is the time in seconds required for the thermistor to change through 63.2% of the difference between its initial and final body temperatures, when subjected to a step change in temperature under zero-power conditions. Since the NTC thermistor's T.C. is determined by the same factors as D.C. (i.e., encapsulation, mounting, lead length, etc.), a prototype should be built if T.C. is important.

The time constant is determined by measuring the resistance of the thermistor at three temperature points, the middle point being 63.2% of the difference between the upper one and the lower one. A precision bridge is set for the middle temperature resistance with the bridge voltage supply set so as not to produce the self-heat error. An auxiliary bridge voltage is set for the higher temperature resistance. The thermistor is placed in the operating medium at the lower temperature and is connected to the auxiliary bridge. The auxiliary bridge is adjusted to balance the bridge, which in effect, will self-heat the thermistor to the upper temperature. The thermistor is then immediately switched to the precision bridge. The time required for the precision bridge to balance is the time constant of the NTC thermistor/NTC thermistor sensor assembly in the operating medium.

3. Selection of Resistance Value

Typically, NTC thermistors are specified and/or referenced to 25°C. However, it is equally important to consider the minimum and maximum resistance values at the extremes of the operating temperature range.

The minimum resistance at the maximum temperature point must not be too low to meet the input requirements of the measuring circuit. If the resistance is too low, errors due to contact resistance, line resistance and self-heating increase.

It is recommended to have at least 500 ohm-1000 ohm at the high end of the temperature range.

Conversely, the maximum resistance at the minimum temperature point must not be too high for the measurement circuit input. Range switching with two or more probes should be considered if the minimum/maximum resistance values cannot be met with one thermistor.

Sensitivity also is an important consideration in the selection of the correct resistance value. Usually, the minimum and maximum allowable resistance values typically limit this selection. It then must be determined which resistance values maximizes the output of the measuring system over the entire range, taking into consideration the maximum input current as determined by the dissipation constant and allowable self-heat error.

4. R-T Curve Selection

At present, eleven R-T curves are available from Dale Electronics, Inc. Each material has a different R-T characteristic. Given the different resistivities of the different R-T materials and the desirability of maintaining uniformity in size, not all resistance values (R_{25}) are available in all R-T curves.

Once the minimum resistance at the maximum temperature is determined, divide this resistance value by a given R_T/R_{25} ratio from one of any of the R-T curves to determine an approximate R_{25} value. (NOTE: R-T ratio tables in 1°C increments are included on pages 223 to 227.) If the R_{25} value is not available in one R-T curve, select another until an appropriate R-T curve is determined. Then select a standard R_{25} value that is closest to the approximate value. Calculate the maximum resistance at the minimum temperature by multiplying the selected R_{25} by the given R_T/R_{25} ratio. If the selected R-T curve and R_{25} value meet the pre-determined minimum resistance, maximum resistance and sensitivity of the measurement system, then tolerance is the next consideration.

5. Tolerance

Most temperature measurement or control applications express their limitations or accuracy in temperature units (i.e. $\pm 1.0^{\circ}\text{C}$). When designing a system, it is important to consider the overall measurement accuracy of all components. A $\pm 1.0^{\circ}\text{C}$ thermistor, coupled with a $\pm 1.0^{\circ}\text{C}$ system, will insure measurement accuracy to $\pm 2.0^{\circ}\text{C}$.

Thermistors may be specified with either a temperature tolerance or a resistance tolerance at either a single temperature point or over a temperature range. If the required temperature measurement accuracy is over a temperature range, it is more practical to specify a temperature tolerance in lieu of a resistance tolerance. This is because a resistance tolerance specification over a range will not necessarily guarantee that the required system accuracy will be met unless the non-linear NTC (negative temperature coefficient) is taken into consideration.

HOW TO SELECT AN NTC THERMISTOR

NTC is expressed in % resistance change per degree C. Since one NTC resistance change is approximately equivalent to a 1° temperature change, NTC is useful in specifying temperature tolerances.

NTC's are given on the Dale Specification Sheet in ten degree increments; however, the NTC may be calculated at any temperature point using a 1°C R-T table.

$$NTC = \left(\frac{1}{R} \cdot \frac{dR}{dT} \cdot 100 \right)$$

Example: What is the NTC of 10,000 ohm (R25) of a Curve 1 thermistor at 44°C?

$$100 \left(\frac{1}{4543\Omega @ 44^\circ C} \times \frac{4368\Omega @ 45^\circ C - 4725\Omega @ 43^\circ C}{2} \right) = 3.9\%$$

To determine the resistance tolerance at any given temperature point, simply multiply the specified temperature tolerance by the NTC at the given temperature.

Example: What are the resistance tolerances at 0°C, 25°C and 70°C for a Curve 1 thermistor with a ± 0.5°C temperature tolerance over the range of 0°C to 70°C?

R₀ = ± 0.5°C x - 5.1% = ± 2.55% resistance tolerance

R₂₅ = ± 0.5°C x - 4.4% = ± 2.2% resistance tolerance

R₇₀ = ± 0.5°C x - 3.4% = ± 1.7% resistance tolerance

It may now be clear why a single resistance tolerance over a temperature range may not be practical for a particular temperature measurement application.

If a single temperature point is the only design specification, NTC and Manufacturing Tolerances are useful in determining temperature tolerances at other temperature points. Manufacturing Tolerance is given on the Dale Specification Sheet in a ± % resistance tolerance. Point-matched specifications must have the difference in deviation between the specified temperature point and any other temperature point of interest added to the resistance tolerance at the specified temperature.

Example: What are the resistance tolerances at 0°C and 50°C for a standard 1M1002?

R₀ = ± 10% + ± 1.1% = ± 11.1% resistance tolerance

R₂₅ = ± 10% + ± 0.0% = ± 10% resistance tolerance

R₅₀ = ± 10% + ± 1.1% = ± 11.1% resistance tolerance

To determine the temperature tolerance at any temperature point, divide the resistance tolerance by the NTC at that point.

Example: What is the temperature tolerance at 0°C for a 1M1002?

± 11.1% ÷ - 5.1% = ± 2.2°C temperature tolerances

It should be noted that the Manufacturing Tolerances listed on the Dale Specification Sheet are all referenced at 25°C. If the thermistor is referenced at a temperature other than 25°C, then the total difference in deviation between the two points, if the 25°C is between them, is the sum of the maximum deviations listed at each point.

Example: What is the maximum resistance tolerance of a Curve 1 thermistor at 0°C if the specified tolerance is ± 5% at 70°C?

(± 5% resistance tolerance at 70°C) + (MT ± 1.8% at 70°C)
+ (MT ± 1.1% at 0°C) = ± 7.9% resistance tolerance at 0°C.

6. Tolerance Availability vs. R-T Curve

Not all temperature/resistance tolerances are available in all R-T Curves. If a temperature tolerance over an extended temperature range is required, then at present, Curves 1, 2, 4, 8 or 9 may be selected. All other curves may be specified to a resistance or temperature tolerance at a single temperature point. Curves 12 and 13 may only have ± 5% or ± 10% resistance tolerances specified. Contact the factory for further information.

7. Tolerance Availability vs. Configuration

Not all temperature/resistance tolerances are available in all configurations. Basically, Hybrids, uncoated NTC thermistors without leads and uncoated NTC thermistors with leads are only available in ± 5% or ± 10% point-matched resistance tolerances.

8. Thermistor resistance measurements must be made at precisely controlled temperature while applying essentially zero-power to assure measurement accuracy.

RESISTANCE-TEMPERATURE RELATIONSHIP

Many empirical equations have been developed over the years in an attempt to accurately describe the non-linear resistance-temperature dependence of NTC thermistors. An early equation called the "Beta" formula proved to be useful over narrow temperature ranges for broad tolerances. The Beta formula may be written using a single material dependent constant B as:

$$R(T) = R(T_0) \exp \left[B \left(\frac{1}{T} - \frac{1}{T_0} \right) \right]$$

where R (T) is the resistance at the temperature T in Kelvin and R (T₀) is a reference point at temperature T₀. The Beta formula requires a two-point calibration, but under the best of conditions is not accurate to ± 1°C over the range of 0°C to 100°C and typically not to ± 5°C over our published temperature ranges.

The best empirical expression published to date is the Steinhart-Hart equation written explicitly in temperature T as:

$$\frac{1}{T} = A + B (\ln R) + C (\ln R)^3$$

where ln R is the natural logarithm of the resistance R at temperature T and the A, B and C's are derived coefficients from actual measurement. This form of the Steinhart-Hart equation requires a minimum of three calibration points to determine the derived coefficients. Typical accuracies would be less than ± 0.15°C over the range of - 50°C to + 150°C.

If the temperature points selected from the R-T tables to calculate A, B, C lie within a 100°C range, the accuracy is better than ± 0.01°C, assuming measurement accuracy to at least four significant figures and preferably five.

The Steinhart-Hart equation is an approximation. If a tighter tolerance than guaranteed is desired, then each thermistor must be individually calibrated.

CONVERSION TABLES

NTC Thermistors

Resistance/Temperature Conversion



CURVE 1 R/T CONVERSION TABLE R _t /R ₂₅							
TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅
-60	141.18	-7	4.708	46	.4201	99	.07000
-59	130.76	-6	4.464	47	.4041	100	.06798
-58	121.18	-5	4.234	48	.3888	101	.06602
-57	112.36	-4	4.017	49	.3742	102	.06413
-56	104.24	-3	3.812	50	.3602	103	.06231
-55	96.77	-2	3.620	51	.3468	104	.06054
-54	89.87	-1	3.438	52	.3340	105	.05884
-53	83.52	0	3.266	53	.3217	106	.05719
-52	77.65	1	3.104	54	.3099	107	.05559
-51	72.24	2	2.951	55	.2987	108	.05404
-50	67.23	3	2.806	56	.2878	109	.05255
-49	62.61	4	2.669	57	.2775	110	.05110
-48	58.33	5	2.540	58	.2675	111	.04970
-47	54.38	6	2.418	59	.2580	112	.04835
-46	50.71	7	2.302	60	.2489	113	.04704
-45	47.32	8	2.192	61	.2401	114	.04577
-44	44.18	9	2.089	62	.2317	115	.04454
-43	41.26	10	1.990	63	.2236	116	.04335
-42	38.56	11	1.897	64	.2158	117	.04219
-41	36.05	12	1.809	65	.2084	118	.04108
-40	33.72	13	1.726	66	.2012	119	.03999
-39	31.55	14	1.647	67	.1944	120	.03894
-38	29.54	15	1.571	68	.1878	121	.03793
-37	27.67	16	1.500	69	.1814	122	.03694
-36	25.93	17	1.432	70	.1753	123	.03598
-35	24.31	18	1.368	71	.1695	124	.03506
-34	22.80	19	1.307	72	.1638	125	.03416
-33	21.39	20	1.249	73	.1584	126	.03329
-32	20.08	21	1.194	74	.1532	127	.03244
-31	18.86	22	1.142	75	.1482	128	.03162
-30	17.72	23	1.092	76	.1433	129	.03083
-29	16.65	24	1.045	77	.1387	130	.03005
-28	15.66	25	1.000	78	.1342	131	.02930
-27	14.73	26	.9572	79	.1299	132	.02858
-26	13.86	27	.9165	80	.1258	133	.02787
-25	13.05	28	.8777	81	.1218	134	.02718
-24	12.29	29	.8408	82	.1179	135	.02652
-23	11.58	30	.8056	83	.1142	136	.02587
-22	10.92	31	.7721	84	.1106	137	.02524
-21	10.30	32	.7402	85	.1072	138	.02464
-20	9.713	33	.7098	86	.1039	139	.02404
-19	9.166	34	.6808	87	.1007	140	.02347
-18	8.654	35	.6531	88	.09759	141	.02291
-17	8.173	36	.6267	89	.09461	142	.02236
-16	7.722	37	.6015	90	.09174	143	.02184
-15	7.298	38	.5774	91	.08897	144	.02132
-14	6.900	39	.5545	92	.08630	145	.02082
-13	6.526	40	.5326	93	.08372	146	.02034
-12	6.175	41	.5116	94	.08123	147	.01987
-11	5.845	42	.4916	95	.07882	148	.01941
-10	5.534	43	.4725	96	.07650	149	.01896
-9	5.242	44	.4543	97	.07426	150	.01853
-8	4.967	45	.4368	98	.07209		

CURVE 2 R/T CONVERSION TABLE R _t /R ₂₅							
TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅
-55	53.40	-3	3.222	49	.4225	101	.0921
-54	50.10	-2	3.079	50	.4086	102	.0898
-53	47.02	-1	2.944	51	.3953	103	.0875
-52	44.16	0	2.815	52	.3824	104	.0853
-51	41.48	1	2.692	53	.3700	105	.0832
-50	38.99	2	2.576	54	.3581	106	.0811
-49	36.66	3	2.465	55	.3467	107	.0792
-48	34.48	4	2.360	56	.3356	108	.0772
-47	32.45	5	2.260	57	.3250	109	.0753
-46	30.55	6	2.164	58	.3147	110	.0735
-45	28.77	7	2.074	59	.3049	111	.0717
-44	27.11	8	1.987	60	.2954	112	.0700
-43	25.55	9	1.905	61	.2862	113	.0683
-42	24.09	10	1.826	62	.2774	114	.0667
-41	22.73	11	1.751	63	.2689	115	.0651
-40	21.45	12	1.680	64	.2607	116	.0636
-39	20.25	13	1.612	65	.2528	117	.0621
-38	19.13	14	1.547	66	.2451	118	.0607
-37	18.07	15	1.485	67	.2378	119	.0593
-36	17.08	16	1.426	68	.2306	120	.0579
-35	16.15	17	1.370	69	.2238	121	.0566
-34	15.28	18	1.316	70	.2172	122	.0553
-33	14.46	19	1.264	71	.2108	123	.0540
-32	13.68	20	1.215	72	.2046	124	.0528
-31	12.96	21	1.168	73	.1986	125	.0516
-30	12.27	22	1.123	74	.1929	126	.0504
-29	11.63	23	1.080	75	.1873	127	.0493
-28	11.03	24	1.039	76	.1820	128	.0482
-27	10.46	25	1.000	77	.1768	129	.0471
-26	9.918	26	.9624	78	.1717	130	.0461
-25	9.411	27	.9265	79	.1669	131	.0451
-24	8.934	28	.8921	80	.1622	132	.0441
-23	8.483	29	.8591	81	.1577	133	.0431
-22	8.058	30	.8276	82	.1533	134	.0422
-21	7.657	31	.7973	83	.1490	135	.0413
-20	7.278	32	.7684	84	.1449	136	.0404
-19	6.920	33	.7406	85	.1410	137	.0395
-18	6.582	34	.7140	86	.1371	138	.0387
-17	6.263	35	.6885	87	.1334	139	.0379
-16	5.960	36	.6641	88	.1298	140	.0371
-15	5.675	37	.6406	89	.1263	141	.0363
-14	5.404	38	.6181	90	.1229	142	.0355
-13	5.148	39	.5965	91	.1197	143	.0348
-12	4.906	40	.5758	92	.1165	144	.0341
-11	4.676	41	.5559	93	.1134	145	.0334
-10	4.459	42	.5368	94	.1105	146	.0327
-9	4.253	43	.5185	95	.1076	147	.0320
-8	4.058	44	.5008	96	.1048	148	.0314
-7	3.872	45	.4839	97	.1021	149	.0307
-6	3.697	46	.4676	98	.0995	150	.0301
-5	3.530	47	.4520	99	.0969		
-4	3.372	48	.4370	100	.0945		

NTC THERMISTOR CONVERSION TABLES

CURVE 3 R/T CONVERSION TABLE R ₁ /R ₂₅							
TEMP. °C	R ₁ /R ₂₅	TEMP. °C	R ₁ /R ₂₅	TEMP. °C	R ₁ /R ₂₅	TEMP. °C	R ₁ /R ₂₅
-60	49.1	-8	3.57	44	.532	96	.127
-59	46.3	-7	3.43	45	.515	97	.124
-58	43.6	-6	3.29	46	.500	98	.121
-57	41.1	-5	3.15	47	.484	99	.118
-56	38.8	-4	3.02	48	.470	100	.115
-55	36.6	-3	2.90	49	.455	101	.113
-54	34.5	-2	2.79	50	.442	102	.110
-53	32.6	-1	2.67	51	.428	103	.107
-52	30.8	0	2.57	52	.416	104	.105
-51	29.1	1	2.47	53	.403	105	.103
-50	27.5	2	2.37	54	.391	106	.100
-49	26.1	3	2.28	55	.380	107	.0980
-48	24.7	4	2.19	56	.369	108	.0957
-47	23.3	5	2.10	57	.358	109	.0937
-46	22.1	6	2.02	58	.348	110	.0917
-45	20.9	7	1.94	59	.338	111	.0893
-44	19.8	8	1.87	60	.328	112	.0873
-43	18.8	9	1.80	61	.319	113	.0857
-42	17.8	10	1.72	62	.310	114	.0837
-41	16.9	11	1.67	63	.301	115	.0820
-40	16.1	12	1.60	64	.293	116	.0800
-39	15.2	13	1.55	65	.285	117	.0783
-38	14.5	14	1.49	66	.277	118	.0767
-37	13.8	15	1.43	67	.269	119	.0750
-36	13.1	16	1.38	68	.262	120	.0733
-35	12.4	17	1.33	69	.255	121	.0720
-34	11.8	18	1.28	70	.248	122	.0703
-33	11.2	19	1.24	71	.241	123	.0687
-32	10.7	20	1.19	72	.234	124	.0673
-31	10.2	21	1.15	73	.228	125	.0660
-30	9.70	22	1.11	74	.222	126	.0647
-29	9.24	23	1.07	75	.216	127	.0633
-28	8.81	24	1.04	76	.211	128	.0620
-27	8.40	25	1.00	77	.205	129	.0607
-26	8.01	26	.966	78	.200	130	.0593
-25	7.64	27	.933	79	.195	131	.0583
-24	7.28	28	.901	80	.189	132	.0570
-23	6.95	29	.870	81	.185	133	.0560
-22	6.64	30	.841	82	.180	134	.0547
-21	6.34	31	.813	83	.175	135	.0537
-20	6.05	32	.786	84	.171	136	.0527
-19	5.79	33	.760	85	.167	137	.0517
-18	5.53	34	.735	86	.162	138	.0507
-17	5.29	35	.711	87	.158	139	.0497
-16	5.06	36	.688	88	.154	140	.0487
-15	4.84	37	.666	89	.151		
-14	4.63	38	.645	90	.147		
-13	4.43	39	.624	91	.143		
-12	4.24	40	.604	92	.140		
-11	4.06	41	.585	93	.136		
-10	3.89	42	.567	94	.133		
-9	3.73	43	.549	95	.130		

CURVE 4 R/T CONVERSION TABLE R ₁ /R ₂₅							
TEMP. °C	R ₁ /R ₂₅	TEMP. °C	R ₁ /R ₂₅	TEMP. °C	R ₁ /R ₂₅	TEMP. °C	R ₁ /R ₂₅
-40	40.16	9	2.19	58	.2442	107	.0448
-39	37.50	10	2.078	59	.2348	108	.0434
-38	35.04	11	1.976	60	.2259	109	.0421
-37	32.75	12	1.878	61	.2174	110	.0408
-36	30.62	13	1.787	62	.2092	111	.0396
-35	28.64	14	1.700	63	.2014	112	.0384
-34	26.80	15	1.617	64	.1939	113	.0373
-33	25.09	16	1.540	65	.1867	114	.0362
-32	23.50	17	1.466	66	.1798	115	.0351
-31	22.02	18	1.396	67	.1732	116	.0341
-30	20.64	19	1.330	68	.1669	117	.0331
-29	19.35	20	1.267	69	.1608	118	.0322
-28	18.16	21	1.208	70	.1550	119	.0312
-27	17.04	22	1.152	71	.1495	120	.0303
-26	15.99	23	1.099	72	.1441	121	.0295
-25	15.02	24	1.048	73	.1390	122	.0286
-24	14.11	25	1.000	74	.1341	123	.0278
-23	13.26	26	.9545	75	.1293	124	.0270
-22	12.47	27	.9113	76	.1248	125	.0263
-21	11.73	28	.8702	77	.1204	126	.0255
-20	11.03	29	.8313	78	.1163	127	.0248
-19	10.39	30	.7942	79	.1122	128	.0241
-18	9.78	31	.7590	80	.1084	129	.0235
-17	9.21	32	.7256	81	.1047	130	.0228
-16	8.68	33	.6938	82	.1011	131	.0222
-15	8.18	34	.6636	83	.0977	132	.0216
-14	7.71	35	.6348	84	.0944	133	.0210
-13	7.28	36	.6074	85	.0912	134	.0204
-12	6.87	37	.5814	86	.0882	135	.0199
-11	6.48	38	.5566	87	.0852	136	.0193
-10	6.12	39	.5330	88	.0824	137	.0188
-9	5.78	40	.5105	89	.0797	138	.0183
-8	5.46	41	.4891	90	.0771	139	.0178
-7	5.16	42	.4686	91	.0746	140	.0173
-6	4.88	43	.4492	92	.0721	141	.0169
-5	4.62	44	.4306	93	.0698	142	.0164
-4	4.37	45	.4129	94	.0676	143	.0160
-3	4.13	46	.3961	95	.0654	144	.0156
-2	3.91	47	.3800	96	.0633	145	.0152
-1	3.71	48	.3646	97	.0613	146	.0148
0	3.51	49	.3499	98	.0594	147	.0144
1	3.33	50	.3359	99	.0575	148	.0140
2	3.15	51	.3225	100	.0557	149	.0137
3	2.99	52	.3098	101	.0540	150	.0133
4	2.84	53	.2976	102	.0523		
5	2.69	54	.2859	103	.0507		
6	2.55	55	.2748	104	.0491		
7	2.43	56	.2641	105	.0476		
8	2.30	57	.2539	106	.0462		

NTC THERMISTOR CONVERSION TABLES

CURVE 7 R/T CONVERSION TABLE R _t /R ₂₅					
TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅
-60	185.1	-7	5.372	46	.3823
-59	171.3	-6	5.074	47	.3661
-58	158.5	-5	4.794	48	.3506
-57	146.8	-4	4.531	49	.3359
-56	136.0	-3	4.284	50	.3219
-55	126.1	-2	4.052	51	.3085
-54	116.9	-1	3.833	52	.2957
-53	108.5	0	3.627	53	.2835
-52	100.7	1	3.434	54	.2719
-51	93.55	2	3.251	55	.2608
-50	86.92	3	3.079	56	.2502
-49	80.80	4	2.918	57	.2401
-48	75.14	5	2.765	58	.2304
-47	69.91	6	2.621	59	.2212
-46	65.07	7	2.485	60	.2124
-45	60.59	8	2.357	61	.2040
-44	56.44	9	2.237	62	.1959
-43	52.60	10	2.123	63	.1882
-42	49.05	11	2.015	64	.1808
-41	45.75	12	1.913	65	.1738
-40	42.69	13	1.817	66	.1671
-39	39.85	14	1.727	67	.1606
-38	37.22	15	1.641	68	.1544
-37	34.77	16	1.560	69	.1485
-36	32.50	17	1.483	70	.1429
-35	30.39	18	1.411	71	.1375
-34	28.42	19	1.342	72	.1323
-33	26.60	20	1.277	73	.1273
-32	24.90	21	1.215	74	.1226
-31	23.32	22	1.157	75	.1180
-30	21.84	23	1.102	76	.1136
-29	20.47	24	1.050	77	.1095
-28	19.19	25	1.000	78	.1054
-27	18.00	26	.9530	79	.1016
-26	16.89	27	.9084	80	.09790
-25	15.85	28	.8662	81	.09436
-24	14.88	29	.8261	82	.09096
-23	13.98	30	.7880	83	.08770
-22	13.13	31	.7519	84	.08457
-21	12.34	32	.7176	85	.08156
-20	11.61	33	.6850	86	.07868
-19	10.92	34	.6541	87	.07591
-18	10.27	35	.6247	88	.07325
-17	9.668	36	.5967	89	.07069
-16	9.103	37	.5702	90	.06823
-15	8.573	38	.5449	91	.06587
-14	8.077	39	.5209	92	.06360
-13	7.613	40	.4981	93	.06142
-12	7.177	41	.4763	94	.05933
-11	6.769	42	.4556	95	.05731
-10	6.385	43	.4359	96	.05537
-9	6.026	44	.4172	97	.05351
-8	5.688	45	.3993	98	.05171

CURVE 8 R/T CONVERSION TABLE R _t /R ₂₅					
TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅
-40	29.49	8	2.151	56	.2927
-39	27.70	9	2.052	57	.2822
-38	26.03	10	1.958	58	.2722
-37	24.46	11	1.869	59	.2625
-36	23.01	12	1.785	60	.2533
-35	21.64	13	1.704	61	.2444
-34	20.37	14	1.628	62	.2359
-33	19.17	15	1.556	63	.2277
-32	18.06	16	1.487	64	.2198
-31	17.01	17	1.421	65	.2122
-30	16.03	18	1.359	66	.2050
-29	15.12	19	1.300	67	.1980
-28	14.26	20	1.243	68	.1913
-27	13.45	21	1.190	69	.1848
-26	12.70	22	1.139	70	.1786
-25	11.99	23	1.090	71	.1727
-24	11.32	24	1.044	72	.1669
-23	10.70	25	1.000	73	.1614
-22	10.11	26	.9580	74	.1561
-21	9.557	27	.9180	75	.1510
-20	9.040	28	.8800	76	.1460
-19	8.550	29	.8437	77	.1413
-18	8.093	30	.8090	78	.1367
-17	7.660	31	.7760	79	.1323
-16	7.253	32	.7443	80	.1281
-15	6.873	33	.7143	81	.1240
-14	6.513	34	.6857	82	.1201
-13	6.173	35	.6580	83	.1163
-12	5.853	36	.6320	84	.1126
-11	5.553	37	.6070	85	.1091
-10	5.267	38	.5830	86	.1057
-9	5.000	39	.5600	87	.1024
-8	4.747	40	.5383	88	.09930
-7	4.507	41	.5173	89	.09623
-6	4.283	42	.4973	90	.09330
-5	4.070	43	.4783	91	.09047
-4	3.867	44	.4600	92	.08773
-3	3.677	45	.4427	93	.08507
-2	3.497	46	.4257	94	.08253
-1	3.327	47	.4097	95	.08007
0	3.166	48	.3943	96	.07770
1	3.014	49	.3797	97	.07540
2	2.870	50	.3657	98	.07317
3	2.733	51	.3523	99	.07103
4	2.604	52	.3393	100	.06897
5	2.481	53	.3269	101	.06697
6	2.365	54	.3150	102	.06500
7	2.255	55	.3036	103	.06313
8				104	.06133
9				105	.05960
10				106	.05790
11				107	.05627
12				108	.05467
13				109	.05313
14				110	.05167
15				111	.05023
16				112	.04883
17				113	.04750
18				114	.04620
19				115	.04493
20				116	.04370
21				117	.04253
22				118	.04137
23				119	.04027
24				120	.03920
25				121	.03817
26				122	.03713
27				123	.03617
28				124	.03523
29				125	.03430
30				126	.03340
31				127	.03254
32				128	.03170
33				129	.03089
34				130	.03010
35				131	.02933
36				132	.02859
37				133	.02787
38				134	.02717
39				135	.02649
40				136	.02583
41				137	.02519
42				138	.02456
43				139	.02396
44				140	.02337
45				141	.02280
46				142	.02225
47				143	.02171
48				144	.02119
49				145	.02068
50				146	.02018
51				147	.01970
52				148	.01924
53				149	.01878
54				150	.01834

NTC THERMISTOR CONVERSION TABLES

CURVE 9 R/T CONVERSION TABLE R _t /R ₂₅							
TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅
-50	44.13	2	2.689	54	.3385	106	.06936
-49	41.45	3	2.569	55	.3270	107	.06753
-48	38.94	4	2.455	56	.3160	108	.06575
-47	36.60	5	2.346	57	.3054	109	.06403
-46	34.41	6	2.243	58	.2952	110	.06235
-45	32.37	7	2.145	59	.2854	111	.06073
-44	30.46	8	2.052	60	.2760	112	.05916
-43	28.67	9	1.963	61	.2669	113	.05764
-42	27.00	10	1.879	62	.2582	114	.05616
-41	25.44	11	1.798	63	.2497	115	.05473
-40	23.98	12	1.722	64	.2417	116	.05334
-39	22.60	13	1.649	65	.2339	117	.05199
-38	21.32	14	1.579	66	.2264	118	.05068
-37	20.11	15	1.513	67	.2191	119	.04941
-36	18.98	16	1.450	68	.2122	120	.04818
-35	17.92	17	1.390	69	.2055	121	.04698
-34	16.93	18	1.333	70	.1990	122	.04582
-33	16.00	19	1.279	71	.1928	123	.04469
-32	15.12	20	1.226	72	.1868	124	.04359
-31	14.30	21	1.177	73	.1810	125	.04253
-30	13.52	22	1.129	74	.1754	126	.04149
-29	12.79	23	1.084	75	.1700	127	.04049
-28	12.11	24	1.041	76	.1648	128	.03951
-27	11.46	25	1.000	77	.1598	129	.03856
-26	10.86	26	.9605	78	.1549	130	.03764
-25	10.29	27	.9227	79	.1503	131	.03674
-24	9.749	28	.8867	80	.1458	132	.03587
-23	9.243	29	.8523	81	.1414	133	.03503
-22	8.766	30	.8194	82	.1372	134	.03420
-21	8.316	31	.7880	83	.1332	135	.03340
-20	7.891	32	.7579	84	.1293	136	.03263
-19	7.491	33	.7291	85	.1255	137	.03187
-18	7.113	34	.7016	86	.1218	138	.03113
-17	6.757	35	.6752	87	.1183	139	.03042
-16	6.420	36	.6500	88	.1149	140	.02972
-15	6.102	37	.6258	89	.1116	141	.02904
-14	5.801	38	.6026	90	.1084	142	.02838
-13	5.517	39	.5805	91	.1053	143	.02774
-12	5.248	40	.5592	92	.1023	144	.02712
-11	4.994	41	.5389	93	.09942	145	.02651
-10	4.754	42	.5193	94	.09663	146	.02592
-9	4.527	43	.5006	95	.09393	147	.02534
-8	4.311	44	.4827	96	.09132	148	.02478
-7	4.107	45	.4655	97	.08879	149	.02423
-6	3.914	46	.4489	98	.08634	150	.02370
-5	3.731	47	.4331	99	.08397		
-4	3.557	48	.4179	100	.08168		
-3	3.393	49	.4033	101	.07946		
-2	3.237	50	.3893	102	.07731		
-1	3.089	51	.3758	103	.07523		
0	2.949	52	.3629	104	.07321		
1	2.815	53	.3504	105	.07126		

CURVE 12 R/T CONVERSION TABLE R _t /R ₂₅							
TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅
-60	265.0	-7	6.126	46	.3516	99	.03762
-59	244.0	-6	5.763	47	.3354	100	.03624
-58	225.0	-5	5.423	48	.3199	101	.03492
-57	207.0	-4	5.104	49	.3053	102	.03364
-56	191.0	-3	4.806	50	.2914	103	.03242
-55	176.4	-2	4.526	51	.2782	104	.03125
-54	162.9	-1	4.264	52	.2656	105	.03013
-53	150.5	0	4.018	53	.2537	106	.02905
-52	139.1	1	3.788	54	.2423	107	.02801
-51	128.6	2	3.572	55	.2316	108	.02702
-50	119.0	3	3.369	56	.2213	109	.02606
-49	110.1	4	3.179	57	.2115	110	.02514
-48	102.0	5	3.000	58	.2022	111	.02426
-47	94.46	6	2.833	59	.1934	112	.02341
-46	87.54	7	2.675	60	.1849	113	.02259
-45	81.17	8	2.527	61	.1769	114	.02181
-44	75.29	9	2.387	62	.1693	115	.02106
-43	69.87	10	2.256	63	.1620	116	.02033
-42	64.87	11	2.133	64	.1551	117	.01964
-41	60.24	12	2.017	65	.1485	118	.01897
-40	55.98	13	1.908	66	.1422	119	.01832
-39	52.03	14	1.806	67	.1362	120	.01770
-38	48.39	15	1.709	68	.1304	121	.01710
-37	45.01	16	1.618	69	.1250	122	.01653
-36	41.89	17	1.532	70	.1198	123	.01598
-35	39.00	18	1.451	71	.1148	124	.01544
-34	36.33	19	1.375	72	.1100	125	.01493
-33	33.85	20	1.303	73	.1055	126	.01444
-32	31.55	21	1.235	74	.1012	127	.01396
-31	29.42	22	1.171	75	.09706	128	.01351
-30	27.45	23	1.111	76	.09311	129	.01306
-29	25.61	24	1.054	77	.08935	130	.01264
-28	23.91	25	1.000	78	.08575	131	.01223
-27	22.33	26	.9492	79	.08231	132	.01183
-26	20.86	27	.9011	80	.07902	133	.01145
-25	19.50	28	.8558	81	.07588	134	.01109
-24	18.23	29	.8129	82	.07287	135	.01073
-23	17.05	30	.7723	83	.07000	136	.01039
-22	15.95	31	.7339	84	.06725	137	.01006
-21	14.93	32	.6977	85	.06462	138	.00975
-20	13.98	33	.6633	86	.06210	139	.00944
-19	13.09	34	.6308	87	.05969	140	.00915
-18	12.27	35	.6001	88	.05739	141	.00886
-17	11.50	36	.5710	89	.05518	142	.00859
-16	10.78	37	.5434	90	.05307	143	.00832
-15	10.11	38	.5173	91	.05105	144	.00806
-14	9.486	39	.4925	92	.04911	145	.00782
-13	8.903	40	.4690	93	.04725	146	.00758
-12	8.359	41	.4468	94	.04547	147	.00735
-11	7.850	42	.4257	95	.04377	148	.00712
-10	7.375	43	.4057	96	.04213	149	.00691
-9	6.930	44	.3867	97	.04057	150	.00670
-8	6.515	45	.3687	98	.03906	151	.00650

NTC THERMISTOR CONVERSION TABLES

CURVE 13 R/T CONVERSION TABLE R_t/R₂₅

TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅				
-60	824.0	-40	125.0	-20	23.43	0	5.250	20	1.370	40	.4075	60	.1358	80	.05000	100	.02009	120	.008715	140	.004048
-59	745.0	-39	114.0	-19	21.65	1	4.892	21	1.285	41	.3847	61	.1289	81	.04768	101	.01923	121	.008374	141	.003902
-58	675.0	-38	105.0	-18	20.02	2	4.560	22	1.207	42	.3633	62	.1224	82	.04548	102	.01842	122	.008048	142	.003762
-57	612.0	-37	96.0	-17	18.52	3	4.253	23	1.133	43	.3432	63	.1162	83	.04338	103	.01764	123	.007736	143	.003628
-56	554.0	-36	88.0	-16	17.14	4	3.967	24	1.064	44	.3243	64	.1104	84	.04139	104	.01690	124	.007437	144	.003499
-55	503.0	-35	81.0	-15	15.87	5	3.702	25	1.000	45	.3065	65	.1049	85	.03950	105	.01619	125	.007151	145	.003375
-54	457.0	-34	74.0	-14	14.70	6	3.456	26	.9399	46	.2898	66	.09966	86	.03771	106	.01552	126	.006877	146	.003256
-53	415.0	-33	68.0	-13	13.62	7	3.228	27	.8837	47	.2741	67	.09473	87	.03600	107	.01487	127	.006615	147	.003141
-52	377.0	-32	63.0	-12	12.63	8	3.016	28	.8311	48	.2592	68	.09006	88	.03438	108	.01426	128	.006364	148	.003031
-51	343.0	-31	57.0	-11	11.71	9	2.818	29	.7819	49	.2453	69	.08564	89	.03284	109	.01367	129	.006123	149	.002925
-50	312.0	-30	53.0	-10	10.87	10	2.635	30	.7358	50	.2322	70	.08146	90	.03137	110	.01311	130	.005892	150	.002824
-49	284.0	-29	49.0	-9	10.08	11	2.464	31	.6927	51	.2198	71	.07750	91	.02998	111	.01258	131	.005671		
-48	259.0	-28	45.0	-8	9.364	12	2.305	32	.6522	52	.2081	72	.07375	92	.02865	112	.01207	132	.005459		
-47	236.0	-27	41.0	-7	8.699	13	2.158	33	.6144	53	.1971	73	.07020	93	.02739	113	.01158	133	.005256		
-46	215.0	-26	38.0	-6	8.084	14	2.020	34	.5789	54	.1868	74	.06683	94	.02619	114	.01111	134	.005061		
-45	196.0	-25	35.0	-5	7.515	15	1.892	35	.5456	55	.1770	75	.06364	95	.02504	115	.01067	135	.004874		
-44	179.0	-24	32.0	-4	6.990	16	1.772	36	.5143	56	.1678	76	.06062	96	.02395	116	.01024	136	.004695		
-43	163.0	-23	30.0	-3	6.503	17	1.661	37	.4850	57	.1591	77	.05775	97	.02291	117	.009833	137	.004523		
-42	149.0	-22	27.0	-2	6.053	18	1.557	38	.4575	58	.1509	78	.05503	98	.02193	118	.009444	138	.004358		
-41	137.0	-21	25.0	-1	5.636	19	1.460	39	.4317	59	.1431	79	.05245	99	.02098	119	.009072	139	.004200		

CURVE 14 R/T CONVERSION TABLE R_t/R₂₅

TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅				
-60	43.0	-40	14.4	-20	5.69	0	2.45	20	1.18	40	.628	60	.350	80	.208	100	.130	120	.085	140	.058
-59	40.4	-39	13.7	-19	5.43	1	2.36	21	1.14	41	.608	61	.342	81	.203	101	.127	121	.084	141	.057
-58	38.0	-38	13.1	-18	5.20	2	2.27	22	1.11	42	.589	62	.332	82	.198	102	.124	122	.082	142	.056
-57	35.8	-37	12.5	-17	4.98	3	2.18	23	1.07	43	.571	63	.323	83	.193	103	.122	123	.080	143	.055
-56	33.8	-36	11.8	-16	4.75	4	2.10	24	1.03	44	.554	64	.313	84	.188	104	.119	124	.079	144	.054
-55	31.9	-35	11.3	-15	4.56	5	2.02	25	1.00	45	.537	65	.305	85	.183	105	.117	125	.077	145	.053
-54	30.2	-34	10.8	-14	4.37	6	1.95	26	.970	46	.522	66	.297	86	.179	106	.114	126	.076	146	.052
-53	28.6	-33	10.3	-13	4.18	7	1.88	27	.939	47	.507	67	.289	87	.175	107	.112	127	.074	147	.051
-52	27.1	-32	9.79	-12	4.01	8	1.81	28	.910	48	.492	68	.282	88	.171	108	.109	128	.073	148	.050
-51	25.7	-31	9.32	-11	3.84	9	1.74	29	.881	49	.477	69	.274	89	.167	109	.107	129	.071	149	.049
-50	24.3	-30	8.93	-10	3.68	10	1.68	30	.854	50	.464	70	.267	90	.163	110	.105	130	.070	150	.048
-49	23.0	-29	8.51	-9	3.52	11	1.62	31	.828	51	.452	71	.261	91	.159	111	.103	131	.069		
-48	21.8	-28	8.12	-8	3.39	12	1.57	32	.802	52	.438	72	.254	92	.156	112	.101	132	.067		
-47	20.7	-27	7.78	-7	3.25	13	1.52	33	.779	53	.426	73	.248	93	.152	113	.098	133	.066		
-46	19.6	-26	7.41	-6	3.12	14	1.47	34	.756	54	.414	74	.242	94	.148	114	.096	134	.065		
-45	18.6	-25	7.10	-5	2.99	15	1.42	35	.732	55	.403	75	.236	95	.145	115	.094	135	.064		
-44	17.6	-24	6.80	-4	2.87	16	1.37	36	.710	56	.393	76	.229	96	.142	116	.092	136	.062		
-43	16.7	-23	6.49	-3	2.76	17	1.32	37	.689	57	.382	77	.224	97	.139	117	.091	137	.061		
-42	15.9	-22	6.21	-2	2.65	18	1.27	38	.668	58	.372	78	.218	98	.136	118	.089	138	.060		
-41	15.1	-21	5.93	-1	2.55	19	1.22	39	.647	59	.361	79	.213	99	.133	119	.087	139	.059		

CURVE 17 R/T CONVERSION TABLE R_t/R₂₅

TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅	TEMP. °C	R _t /R ₂₅				
-50	72.50	-31	20.24	-12	6.519	7	2.369	26	.9603	45	.4276	64	.2081	83	.1086	102	.06021	121	.03520	140	.02158
-49	68.17	-30	18.82	-11	6.143	8	2.254	27	.9205	46	.4122	65	.2001	84	.1050	103	.05846	122	.03430	141	.02109
-48	63.84	-29	17.82	-10	5.767	9	2.139	28	.8808	47	.3968	66	.1936	85	.1014	104	.05672	123	.03340	142	.02060
-47	59.50	-28	16.81	-9	5.491	10	2.024	29	.8410	48	.3815	67	.1871	86	.09842	105	.05497	124	.03250	143	.02010
-46	55.17	-27	15.81	-8	5.215	11	1.937	30	.8013	49	.3661	68	.1807	87	.09545	106	.05350	125	.03160	144	.01961
-45	50.84	-26	14.80	-7	4.940	12	1.850	31	.7703	50	.3507	69	.1742	88	.09247	107	.05203	126	.03083	145	.01912
-44	47.89	-25	13.80	-6	4.664	13	1.763	32	.7392	51	.3384	70	.1677	89	.08950	108	.05055	127	.03006	146	.01869
-43	44.94	-24	13.09	-5	4.388	14	1.676	33	.7082	52	.3261	71	.1624	90	.08652	109	.04908	128	.02929	147	.01826
-42	41.99	-23	12.37	-4	4.183	15	1.589	34	.6771	53	.3138	72	.1571	91	.08404	110	.04761	129	.02851	148	.01784
-41	39.04	-22	11.66	-3	3.978	16	1.522	35	.6461	54	.3017	73	.1518	92	.08155	111	.04637	130	.02774	149	.01741
-40	36.09	-21	10.94	-2	3.773	17	1.456	36	.6217	55	.2894	74	.1465	93	.07907	112	.04512	131	.02708	150	.01698
-39	34.06	-20	10.23	-1	3.568	18	1.389	37	.5973	56	.2794	75	.1412	94	.07658	113	.04388	132	.02642		
-38	32.02	-19	9.713	0	3.363	19	1.323	38	.5729	57	.2696	76	.1368	95	.07410	114	.04263	133	.02575		
-37	29.99	-18	9.196	1	3.210	20	1.256	39	.5484	58	.2598	77	.1325	96	.07202	115	.04139	134	.02509		
-36	27.95	-17	8.680	2	3.057	21	1.205	40	.5241	59	.2499	78	.1281	97	.06994	116	.04033	135	.02443		
-35	25.92	-16	8.163	3	2.905	22	1.154	41	.5048	60	.2400	79	.1238	98	.06786	117	.03929	136	.02386		
-34	24.50	-15	7.646	4	2.752	23	1.102	42	.4855	61	.2320	80	.1194	99	.06578	118	.03822	137	.02329		
-33	23.08	-14	7.270	5	2.599	24	1.051	43	.4662	62	.2240	81	.1158	100	.06370	119	.03716	138	.02272		
-32	21.66	-13	6.894	6	2.484	25	1.000	44	.4469	63	.2161	82	.1122	101	.06195	120	.03610	139	.02215		

PACKAGING [Numbers in brackets indicate millimeters]

CODE	TYPE	DESCRIPTION
PO6	Bulk	Coated, leaded thermistors in a 4" x 6" [101.60 x 152.40] antistatic plastic bag.
P20	Bulk	Disc style thermistors in a 4" x 6" [101.60 x 152.40] or 6.5" x 10" [165.10 x 254] antistatic plastic bag.
R58	Tape and Reel	Chip style thermistors in 8mm embossed plastic tape.
R85	Tape and Reel	Chip style thermistors in 12mm embossed plastic tape.
TO6	Tray	Chip style thermistors in molded waffle style trays.

Ceramic Power Capacitors



PART NUMBERS AND ORDERING INFORMATION						
	MODEL	CAPACITANCE RANGE (pF)	TOLERANCES (%)	RATED VOLTAGE (kVp)	RATED POWER (kVA)	RATED CURRENT (Arms)
	WATER COOLED POWER CAPACITORS					
	TWXF95 x 162	100-2500	20-10	14	1000...1500	150
	TWXF95 x 187	1000	20-10	14	1500	150
	TWXF95 x 220	5000	20-10	12	1275	150
	TWXF110 x 250	5000	20-10	14	2000	200
	TWXF135 x 218	4000	20-10	16	2500	250
	TWXF135 x 250	5000	20-10	16	2830	250
	TWXF135 x 272	6000	20-10	16	2830	250
	TWXF135 x 285	5000	20-10	20	3000	250
	TWXF165 x 270	7600	20-10	16	3000	300
	TWXF165 x 420	10000	20-10	18	2500	250
	PLATE CAPACITORS WITH SMALL RIM					
	FP .20		0.5 pF			
	to FP .200	4.7-6000	to 20%	2...8	3...60	5...20
	PLATE CAPACITORS WITH CONTOURED RIM					
	P .20		0.5 pF			
	to P .200	5.6-10000	to 20%	5...15	5...140	5...100
	FEED-THROUGH CAPACITORS					
	D. 16 x 30					
	to D. 50 x 180	15-2500	20-10-5	3...20	1.5...60	5...50

High Voltage Applications for ceramic power capacitors include: RF generators for induction heating and dielectric heating • HF transmitters • RF suppression (feed-throughs) • X-Ray equipment • Electrostatic powder spraying • Special design capabilities available.

Ceramic Power Capacitors



PART NUMBERS AND ORDERING INFORMATION						
	MODEL	CAPACITANCE RANGE (pF)	TOLERANCES (%)	RATED VOLTAGE (kVp)	RATED POWER (kVA)	RATED CURRENT (Arms)
TUBULAR RIMMED CAPACITORS						
	R. 12 x 8.5					
	to	3-2500	0.5 pF to 20%	2...11	0.5...60	4...50
	R. 45 x 120					
POT CAPACITORS WITH CONTOURED RIM						
	T. 20 x 30					
	to	10-4000	20-10-5	6...15	2.5...50	6...15
	T. 85 x 120					
BARREL CAPACITORS						
	TO. 16 x 10					
	to	1.5-100	0.5 pF to 20%	5-9	0.8...2.5	5-10
	TO. 25 x 16					

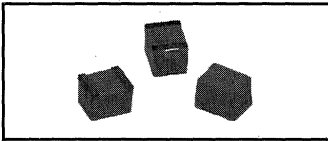
High Voltage Ceramic Capacitors



PART NUMBERS AND ORDERING INFORMATION						
	MODEL	CAPACITANCE RANGE (pF)	TOLERANCES (%)	RATED VOLTAGE (kV)	RATED POWER (kVA)	RATED CURRENT (Arms)
HIGH VOLTAGE						
	HPA/HPD	350-5000	20	20	—	6
	HPB/HPC	350-5000	20	20	—	6
	HR	750-1500	20	2.8	—	—
		2000-5000	+50-20			

MODEL IMC-1210 Inductors

Surface Mount, Molded



FEATURES

- Molded construction provides superior strength and moisture resistance
- Printed marking
- Tape and reel packaging for automatic handling, 2000/reel, EIA 481
- Compatible with vapor phase and infra-red reflow soldering

STANDARD ELECTRICAL SPECIFICATIONS

IND. (μH)	TOL.	Q MIN.	TEST FREQ. L & Q (MHz)	SELF-RESONANT FREQ. MIN. (MHz)	DCR MAX. (Ohms)	RATED DC CURRENT (mA)
.010	±20%	30	50.0	1000.0	.13	450
.012	±20%	30	50.0	1000.0	.14	450
.015	±20%	30	50.0	1000.0	.16	450
.018	±20%	30	50.0	1000.0	.18	450
.022	±20%	30	50.0	1000.0	.20	450
.027	±20%	30	50.0	1000.0	.22	450
.033	±20%	30	50.0	1000.0	.24	450
.039	±20%	30	50.0	1000.0	.27	450
.047	±20%	30	50.0	1000.0	.30	450
.056	±20%	30	50.0	1000.0	.33	450
.068	±20%	30	50.0	1000.0	.36	450
.082	±20%	30	50.0	900.0	.40	450
.100	±20%	30	50.0	700.0	.44	450
.12	±20%	30	25.2	500.0	.22	450
.15	±20%	30	25.2	450.0	.25	450
.18	±20%	30	25.2	400.0	.28	450
.22	±20%	30	25.2	350.0	.32	450
.27	±20%	30	25.2	320.0	.36	450
.33	±20%	30	25.2	300.0	.40	450
.39	±20%	30	25.2	250.0	.45	450
.47	±20%	30	25.2	220.0	.50	450
.56	±20%	30	25.2	180.0	.55	450
.68	±20%	30	25.2	160.0	.60	450
.82	±20%	30	25.2	140.0	.67	450
1.0	±10%	30	7.96	120.0	.70	400
1.2	±10%	30	7.96	100.0	.75	390
1.5	±10%	30	7.96	85.0	.85	370
1.8	±10%	30	7.96	80.0	.90	350
2.2	±10%	30	7.96	75.0	1.0	320
2.7	±10%	30	7.96	70.0	1.1	290
3.3	±10%	30	7.96	60.0	1.2	260
3.9	±10%	30	7.96	55.0	1.3	250
4.7	±10%	30	7.96	50.0	1.5	220
5.6	±10%	30	7.96	45.0	1.6	200
6.8	±10%	30	7.96	40.0	1.8	180
8.2	±10%	30	7.96	38.0	2.0	170
10.0	±10%	30	2.52	33.0	2.1	150
12.0	±10%	30	2.52	30.0	2.5	140
15.0	±10%	30	2.52	21.0	2.8	130
18.0	±10%	30	2.52	20.0	3.3	120
22.0	±10%	30	2.52	19.0	3.7	110
27.0	±10%	30	2.52	18.0	5.0	80
33.0	±10%	30	2.52	16.0	6.0	70
39.0	±10%	30	2.52	15.0	7.0	65
47.0	±10%	30	2.52	14.0	9.0	60
56.0	±10%	30	2.52	12.0	10.0	55
68.0	±10%	30	2.52	11.0	11.0	50
82.0	±10%	30	2.52	10.0	12.0	45
100.0	±10%	20	.796	9.0	14.0	40

ELECTRICAL SPECIFICATIONS

Inductance Range: .01μH to 100μH.

Inductance Tolerance: ±20% for .01μH to .82μH. ±10% for 1.0μH to 100μH standard. Special tolerances available.

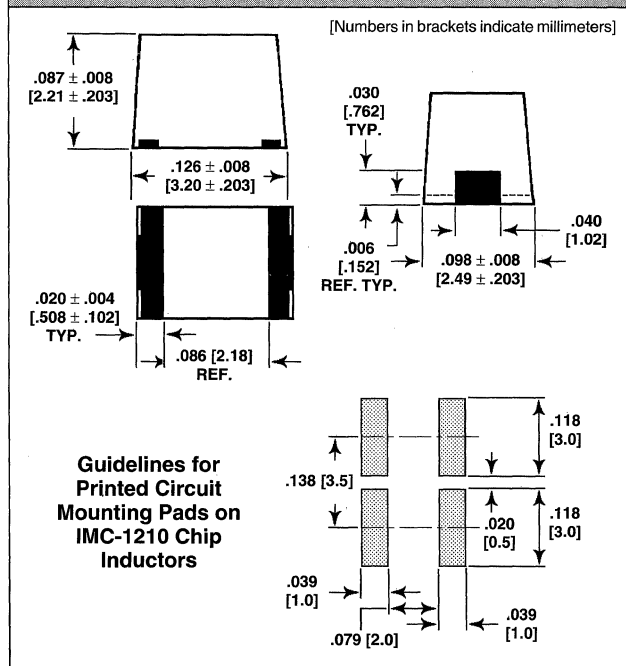
Temperature Range: -40°C to +105°C.

Coilform Material: Non-magnetic for .01μH to .10μH. Powdered Iron for .12μH to 100μH.

TEST EQUIPMENT

- H/P 4342A Q meter with Dale® test fixture or equivalent.
- H/P 4191A RF Impedance Analyzer (for SRF measurements).
- Wheatstone Bridge.

DIMENSIONAL CONFIGURATIONS



PART MARKING

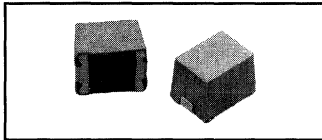
- Dale
- Inductance value

HOW TO ORDER

IMC-1210	10μH	±10%
MODEL	INDUCTANCE VALUE	INDUCTANCE TOLERANCE

MODEL IMC-1812 Inductors

Surface Mount, Molded



FEATURES

- Molded construction provides superior strength and moisture resistance
- Printed marking
- Tape and reel packaging for automatic handling, 2000/reel, EIA 481
- Compatible with vapor phase and infra-red reflow soldering

STANDARD ELECTRICAL SPECIFICATIONS

IND. (μH)	TOL.	Q MIN.	TEST FREQ. L & Q (MHz)	SELF-RESONANT FREQ. MIN. (MHz)	DCR MAX. (Ohms)	RATED DC CURRENT (mA)
.010	±20%	50	50.0	1000.0	.20	450
.012	±20%	50	50.0	1000.0	.20	450
.018	±20%	50	50.0	1000.0	.20	450
.022	±20%	50	50.0	1000.0	.20	450
.027	±20%	50	50.0	1000.0	.20	450
.033	±20%	50	50.0	1000.0	.30	450
.039	±20%	50	50.0	1000.0	.30	450
.047	±20%	50	50.0	1000.0	.30	450
.056	±20%	40	50.0	900.0	.35	450
.068	±20%	40	50.0	800.0	.35	450
.082	±20%	40	50.0	700.0	.40	450
.10	±20%	30	25.2	650.0	.32	450
.12	±20%	30	25.2	600.0	.30	450
.15	±20%	30	25.2	500.0	.30	450
.18	±20%	30	25.2	400.0	.35	450
.22	±20%	30	25.2	350.0	.40	450
.27	±20%	30	25.2	300.0	.45	450
.33	±20%	30	25.2	250.0	.55	430
.39	±20%	30	25.2	220.0	.70	380
.47	±10%	30	25.2	190.0	.80	355
.56	±10%	30	25.2	170.0	1.20	285
.68	±10%	30	25.2	150.0	1.40	270
.82	±10%	30	25.2	140.0	1.60	250
1.0	±10%	50	7.96	100.0	.50	450
1.2	±10%	50	7.96	80.0	.55	430
1.5	±10%	50	7.96	70.0	.60	410
1.8	±10%	50	7.96	60.0	.65	390
2.2	±10%	50	7.96	55.0	.70	380
2.7	±10%	50	7.96	50.0	.75	370
3.3	±10%	50	7.96	45.0	.80	355
3.9	±10%	50	7.96	40.0	.90	330
4.7	±10%	50	7.96	35.0	1.00	315
5.6	±10%	50	7.96	33.0	1.10	300
6.8	±10%	50	7.96	27.0	1.20	285
8.2	±10%	50	7.96	25.0	1.40	270
10.0	±10%	50	2.52	20.0	1.60	250
12.0	±10%	50	2.52	18.0	2.00	225
15.0	±10%	50	2.52	17.0	2.50	200
18.0	±10%	50	2.52	15.0	2.80	190
22.0	±10%	50	2.52	13.0	3.20	180
27.0	±10%	50	2.52	12.0	3.60	170
33.0	±10%	50	2.52	11.0	4.00	160
39.0	±10%	50	2.52	11.0	4.50	150
47.0	±10%	50	2.52	10.0	5.00	140
56.0	±10%	50	2.52	9.0	5.50	135
68.0	±10%	50	2.52	9.0	6.00	130
82.0	±10%	50	2.52	8.0	7.00	120
100.0	±10%	50	.79	8.0	8.00	110
120.0	±10%	40	.79	6.0	8.00	110
150.0	±10%	40	.79	5.0	9.00	105
180.0	±10%	40	.79	5.0	9.50	102
220.0	±10%	40	.79	4.0	10.0	100
270.0	±10%	40	.79	4.0	12.0	92
330.0	±10%	40	.79	3.5	14.0	85
390.0	±10%	40	.79	3.0	16.0	80
470.0	±10%	40	.79	3.0	26.0	62
560.0	±10%	30	.79	3.0	30.0	50
680.0	±10%	30	.79	3.0	30.0	50
820.0	±10%	30	.79	2.5	35.0	30
1000.0	±10%	30	.25	2.5	40.0	30

ELECTRICAL SPECIFICATIONS

Inductance Range: .01μH to 1000μH.

Inductance Tolerance: ±20% for .01μH to .39μH.
±10% for .47μH to 1000μH standard.
±10%, ±5%, ±3% available.

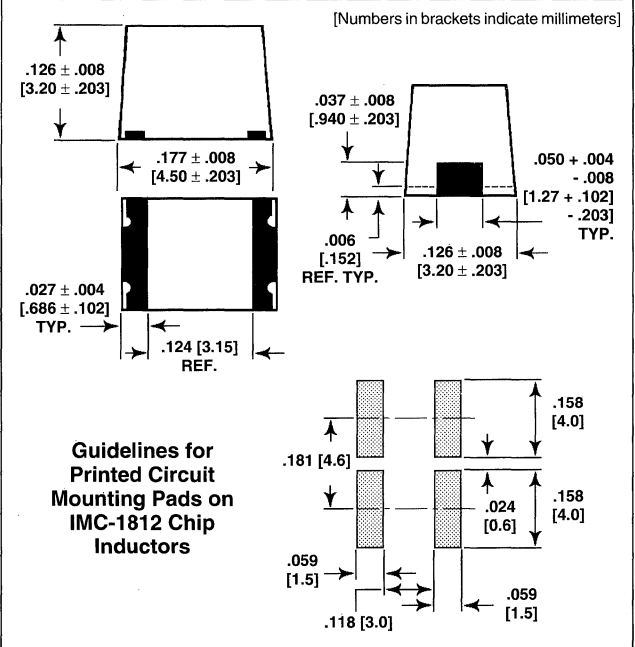
Temperature Range: -40°C to +105°C.

Coilform Material: Ceramic for .01μH to .82μH. Powdered Iron for 1.0μH to 120μH. Ferrite for 150μH to 1000μH.

TEST EQUIPMENT

- H/P 4342A Q meter with Dale® test fixture or equivalent.
- H/P 4191A RF Impedance Analyzer (for SRF measurements).
- Wheatstone Bridge.

DIMENSIONAL CONFIGURATIONS



PART MARKING

- Dale
- Inductance value
- Date code

HOW TO ORDER

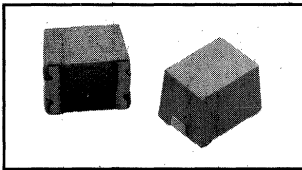
IMC-1812
MODEL

10μH
INDUCTANCE
VALUE

±10%
INDUCTANCE
TOLERANCE

MODEL ISC-1812 Inductors

Surface Mount, Molded, Shielded



FEATURES

- Molded construction provides superior strength and moisture resistance
- Compatible with vapor phase and infra-red reflow soldering
- Tape and reel packaging for automatic handling, 2000/reel, EIA 481
- Shielded construction minimizes coupling to other components

STANDARD ELECTRICAL SPECIFICATIONS

IND. (μ H)	TOL.	Q MIN.	TEST FREQ. L & Q (MHz)	SELF- RESONANT FREQ. MIN. (MHz)	DCR MAX. (Ohms)	RATED DC CURRENT (mA)
.10	$\pm 20\%$	30	25.2	460.0	.23	450
.12	$\pm 20\%$	30	25.2	400.0	.26	450
.15	$\pm 20\%$	30	25.2	390.0	.29	450
.18	$\pm 20\%$	30	25.2	350.0	.32	450
.22	$\pm 20\%$	30	25.2	310.0	.36	450
.27	$\pm 20\%$	30	25.2	280.0	.40	450
.33	$\pm 20\%$	30	25.2	240.0	.45	450
.39	$\pm 20\%$	30	25.2	215.0	.60	410
.47	$\pm 20\%$	30	25.2	205.0	.75	370
.56	$\pm 20\%$	30	25.2	195.0	.80	355
.68	$\pm 20\%$	30	25.2	165.0	.95	310
.82	$\pm 20\%$	30	25.2	155.0	1.20	285
1.0	$\pm 20\%$	30	7.96	140.0	.35	150
1.2	$\pm 20\%$	30	7.96	120.0	.38	145
1.5	$\pm 20\%$	30	7.96	100.0	.40	140
1.8	$\pm 20\%$	30	7.96	90.0	.43	130
2.2	$\pm 20\%$	30	7.96	80.0	.46	120
2.7	$\pm 20\%$	30	7.96	67.0	.49	110
3.3	$\pm 20\%$	30	7.96	61.0	.55	105
3.9	$\pm 20\%$	30	7.96	56.0	.59	100
4.7	$\pm 20\%$	30	7.96	50.0	.62	92
5.6	$\pm 20\%$	30	7.96	40.0	.63	86
6.8	$\pm 20\%$	30	7.96	32.0	.75	80
8.2	$\pm 20\%$	30	7.96	30.0	.82	75
10.0	$\pm 10\%$	50	2.52	25.0	.90	70
12.0	$\pm 10\%$	50	2.52	22.0	1.0	65
15.0	$\pm 10\%$	50	2.52	18.0	1.10	60
18.0	$\pm 10\%$	50	2.52	15.0	1.24	57
22.0	$\pm 10\%$	50	2.52	14.0	1.36	54
27.0	$\pm 10\%$	50	2.52	13.0	1.56	50
33.0	$\pm 10\%$	50	2.52	12.0	1.72	47
39.0	$\pm 10\%$	50	2.52	11.0	1.89	44
47.0	$\pm 10\%$	50	2.52	9.0	2.10	41
56.0	$\pm 10\%$	50	2.52	8.0	2.34	39
68.0	$\pm 10\%$	50	2.52	7.6	2.60	36
82.0	$\pm 10\%$	50	2.52	7.2	2.86	34
100.0	$\pm 10\%$	50	.796	7.0	3.25	32
120.0	$\pm 10\%$	50	.796	6.0	3.64	30
150.0	$\pm 10\%$	50	.796	5.0	4.16	28
180.0	$\pm 10\%$	40	.796	4.5	5.72	26
220.0	$\pm 10\%$	40	.796	4.2	6.30	24
270.0	$\pm 10\%$	40	.796	4.0	6.90	23
330.0	$\pm 10\%$	40	.796	3.7	7.54	22
390.0	$\pm 10\%$	40	.796	3.5	8.20	21
470.0	$\pm 10\%$	40	.796	3.3	9.20	19
560.0	$\pm 10\%$	40	.796	2.8	10.50	18
680.0	$\pm 10\%$	40	.796	2.6	12.0	17
820.0	$\pm 10\%$	40	.796	2.2	13.50	16
1000.0	$\pm 10\%$	40	.252	2.0	16.0	15

ELECTRICAL SPECIFICATIONS

Inductance Range: .01 μ H to 1000 μ H.

Inductance Tolerance: $\pm 20\%$ for .01 μ H to .82 μ H.
 $\pm 10\%$ for 1.0 μ H to 1000 μ H standard.
 $\pm 10\%$, $\pm 5\%$, $\pm 3\%$ available.

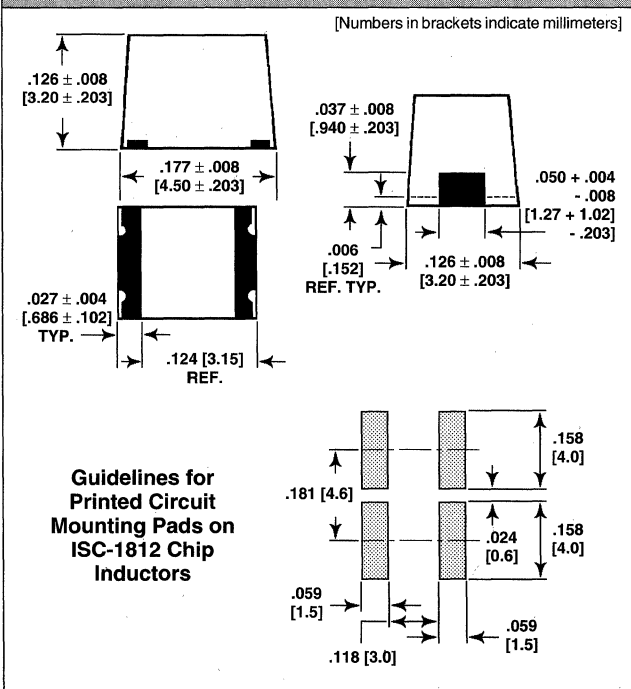
Temperature Range: -40°C to +105°C.

Coilform Material: Ceramic for .10 μ H to .82 μ H. Powdered Iron for 1.0 μ H to 22 μ H. Ferrite for 27 μ H to 1000 μ H.

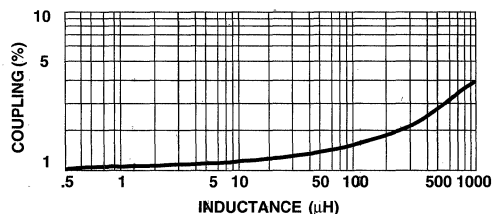
TEST EQUIPMENT

- H/P 4342A Q meter with Dale® test fixture or equivalent.
- H/P 4191A RF Impedance Analyzer (for SRF measurements).
- Wheatstone Bridge.

DIMENSIONAL CONFIGURATIONS



COUPLING SPECIFICATIONS (MAXIMUM)



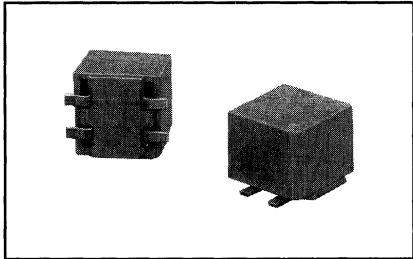
PART MARKING

- Dale
- Inductance value
- Date code

HOW TO ORDER

ISC-1812	10 μ H	$\pm 10\%$
MODEL	INDUCTANCE VALUE	INDUCTANCE TOLERANCE

MODEL IS Inductors Surface Mount



FEATURES

- High Q
- Low EMI
- Compatible with autoplacement equipment
- Wide inductance range with low copper losses
- Compatible with wave, vapor phase reflow and infrared reflow soldering
- EIA PDP-100 standard package outline No. SOPM-6464
- 16mm tape and reel package available per EIA 481 standard

TOROID								POT CORE							
MODEL	IND. (μH)	TOL.	Q MIN.	TEST FREQ. L & Q (kHz)	SELF-RESONANT FREQ. MIN. (kHz)	DCR MAX. (Ohms)	INCRE.* MENTAL CURRENT (mA)	MODEL	IND. (μH)	TOL.	Q MIN.	TEST FREQ. L & Q (kHz)	SELF-RESONANT FREQ. MIN. (kHz)	DCR MAX. (Ohms)	INCRE.* MENTAL CURRENT (mA)
IS-21	40000 ± 10%		30	10	80	6.0	1	IS-22	25000 ± 40%		70	50	400	8.0	7
	2500 ± 10%		13	50	400	8.0	75		10000 ± 40%		80	50	750	5.0	10
	2000 ± 10%		15	50	800	5.0	100		1000 ± 40%		50	50	2000	.5	25
	1000 ± 10%		18	50	1200	3.0	140		200 ± 40%		50	50	10000	.2	60
	100 ± 10%		5	50	5000	1.8	160								

* Incremental Current: The DC current required to cause a 50% reduction in the nominal inductance value.

ELECTRICAL SPECIFICATIONS

Inductance Range: 100μH to 40,000μH.

Inductance Tolerance: IS-21 = ± 10%. IS-22 = ± 40%.

Temperature Range: - 20°C to + 105°C.

Incremental Current: The DC current required to cause a 50% reduction in the nominal inductance value.

TEST EQUIPMENT

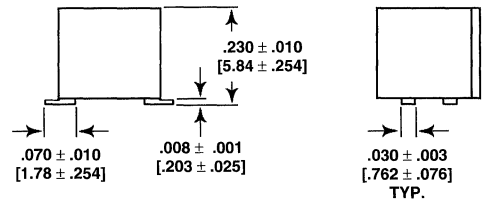
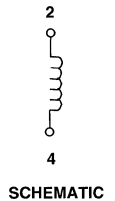
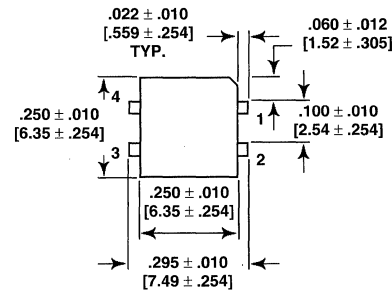
- H/P 4192A Impedance Analyzer (for Inductance and Q measurements).
Test Frequency per Table, Test Voltage = 100 mV RMS.
- H/P 654A Audio Oscillator (for SRF measurements).
- ESI Model Number 1700 (for DCR measurements).

PART MARKING

- Model
- Value
- Date code

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



HOW TO ORDER

IS-21
MODEL

1000μH
INDUCTANCE VALUE

± 10%
INDUCTANCE TOLERANCE

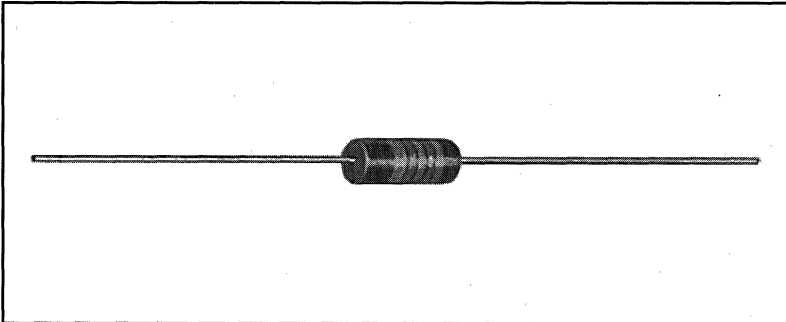
MODEL IMS-5 Inductors

**Military, MIL-C-15305 Qualified, Type LT
and Commercial, Molded, Shielded**



FEATURES

- Wide inductance range in small package
- Flame retardant coating
- Electromagnetic shield-finest shield available
- Epoxy molded construction provides superior moisture protection
- Precision performance, excellent reliability, sturdy construction



ELECTRICAL SPECIFICATIONS

Inductance Tolerance: $\pm 10\%$ standard. $\pm 5\%$ available.

Insulation Resistance: 1000 Megohm minimum per MIL-STD-202, Method 302, Test Condition B.

Dielectric Withstanding Voltage: 1000 VAC per MIL-STD-202, Method 301 (sea level).

Percent Coupling: 3% maximum per MIL-C-15305.

Operating Temperature Range: -55°C to $+105^{\circ}\text{C}$.

MECHANICAL SPECIFICATIONS

Terminal Strength: 5 pounds pull per MIL-STD-202, Method 211, Test Condition A.

Weight: IMS-5 = .85 grams maximum.

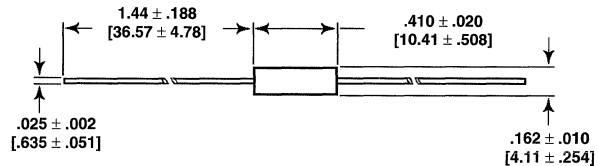
MATERIAL SPECIFICATIONS

Encapsulant: Epoxy.

Standard Terminal: #22 AWG tinned copper.

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



ENVIRONMENTAL PERFORMANCE

TEST	CONDITIONS	SPECIFICATIONS
Barometric Pressure	Test Condition C	MIL-STD-202, Method 105
Thermal Shock	Test Condition A-1	MIL-STD-202, Method 107
Flammability	—	MIL-STD-202, Method 111
Overload	—	MIL-C-15305
Low Temperature Storage	—	MIL-C-15305
Resistance to Soldering Heat	Test Condition A	MIL-STD-202, Method 210
Resistance to Solvents	—	MIL-STD-202, Method 215

INDUCTANCE RANGE AND MILITARY STANDARD

INDUCTANCE RANGE		CLASSIFICATION		MATERIAL		MILITARY STANDARD
FROM	TO	GRADE	CLASS	CORE	SHIELD	
.10 μH	.82 μH	1	A	Phenolic	Powd. Iron	MS75087
1.0 μH	12.0 μH	1	A	Powd. Iron	Powd. Iron	MS75088
15.0 μH	100,000 μH	1	A	Ferrite	Ferrite	MS75089*

* Not QPL'd.

MODEL IMS-5

STANDARD ELECTRICAL SPECIFICATIONS									
IND. (μH)	TOL.	MILITARY STANDARD	MILITARY TYPE	Q MIN.	TEST FREQ. L & Q (MHz)	SELF-RESONANT * FREQ. MIN. (MHz)	DCR @ 25°C MAX. (Ohms)	RATED DC ** CURRENT (mA)	INCREMENTAL*** CURRENT (mA)
		MS75087	LT10K						
.10	± 10%	-1	191	50	25.0	250.0	.025	1790	—
.12	± 10%	-2	192	51	25.0	250.0	.034	1530	—
.15	± 10%	-3	193	51	25.0	250.0	.037	1470	—
.18	± 10%	-4	194	50	25.0	250.0	.047	1300	—
.22	± 10%	-5	195	49	25.0	250.0	.067	1100	—
.27	± 10%	-6	196	47	25.0	250.0	.11	855	—
.33	± 10%	-7	197	46	25.0	250.0	.13	780	—
.39	± 10%	-8	198	44	25.0	250.0	.18	670	—
.47	± 10%	-9	199	44	25.0	235.0	.25	565	—
.56	± 10%	-10	200	43	25.0	210.0	.33	490	—
.68	± 10%	-11	201	42	25.0	190.0	.45	420	—
.82	± 10%	-12	202	40	25.0	180.0	.59	370	—
		MS75088	LT10K						
1.0	± 10%	-1	203	44	25.0	140.0	.07	1070	—
1.2	± 10%	-2	204	44	7.9	130.0	.10	895	—
1.5	± 10%	-3	205	44	7.9	115.0	.12	815	—
1.8	± 10%	-4	206	44	7.9	105.0	.14	775	—
2.2	± 10%	-5	207	44	7.9	100.0	.19	650	—
2.7	± 10%	-6	208	44	7.9	92.0	.28	535	—
3.3	± 10%	-7	209	44	7.9	85.0	.35	480	—
3.9	± 10%	-8	210	44	7.9	75.0	.40	450	—
4.7	± 10%	-9	211	44	7.9	70.0	.55	380	—
5.6	± 10%	-10	212	44	7.9	65.0	.72	335	—
6.8	± 10%	-11	213	50	7.9	55.0	1.02	280	—
8.2	± 10%	-12	214	50	7.9	50.0	1.32	250	—
10.0	± 10%	-13	215	50	7.9	46.0	1.62	220	—
12.0	± 10%	-14	216	55	2.5	44.0	2.0	200	—
		MS75089 (Not QPL'd)	LT10K						
15.0	± 10%	-1	217	45	2.5	49.0	.80	315	250.0
18.0	± 10%	-2	218	45	2.5	45.0	.89	300	235.0
22.0	± 10%	-3	219	45	2.5	41.0	.96	290	220.0
27.0	± 10%	-4	220	45	2.5	38.0	1.19	260	200.0
33.0	± 10%	-5	221	45	2.5	34.0	1.37	240	190.0
39.0	± 10%	-6	222	50	2.5	29.0	1.93	205	180.0
47.0	± 10%	-7	223	50	2.5	27.0	2.11	195	175.0
56.0	± 10%	-8	224	50	2.5	25.0	2.23	190	160.0
68.0	± 10%	-9	225	50	2.5	21.0	2.70	170	150.0
82.0	± 10%	-10	226	50	2.5	10.5	2.44	180	140.0
100.0	± 10%	-11	227	50	2.5	10.0	3.12	160	120.0
120.0	± 10%	-12	228	55	.79	9.7	3.6	150	95.0
150.0	± 10%	-13	229	55	.79	8.5	4.1	140	90.0
180.0	± 10%	-14	230	55	.79	8.0	4.4	135	85.0
220.0	± 10%	-15	231	55	.79	7.5	5.0	125	80.0
270.0	± 10%	-16	232	55	.79	7.0	5.8	115	70.0
330.0	± 10%	-17	233	55	.79	6.5	6.4	110	65.0
390.0	± 10%	-18	234	60	.79	6.2	7.4	105	60.0
470.0	± 10%	-19	235	60	.79	5.7	9.5	92	58.0
560.0	± 10%	-20	236	60	.79	4.7	10.5	90	55.0
680.0	± 10%	-21	237	60	.79	4.5	11.8	80	50.0
820.0	± 10%	-22	238	60	.79	4.2	13.0	80	45.0
1000.0	± 10%	-23	239	60	.25	3.8	17.5	70	40.0
1200.0	± 10%	-24	240	45	.25	1.5	22.1	60	35.0
1500.0	± 10%	-25	241	45	.25	1.2	26.5	55	33.0
1800.0	± 10%	-26	242	45	.25	1.0	29.9	50	30.0
2200.0	± 10%	-27	243	45	.25	.97	33.8	50	27.0
2700.0	± 10%	-28	244	45	.25	.92	47.3	40	25.0
3300.0	± 10%	-29	245	45	.25	.84	53.0	40	22.0
3900.0	± 10%	-30	246	45	.25	.80	73.8	35	20.0
4700.0	± 10%	-31	247	45	.25	.74	81.6	31	19.0
5600.0	± 10%	-32	248	44	.25	.73	98.9	28	17.0
6800.0	± 10%	-33	249	40	.25	.66	111.0	27	16.0
8200.0	± 10%	-34	250	40	.25	.54	119.0	26	15.0
10000.0	± 10%	-35	251	40	.079	.47	137.0	24	14.0
12000.0	± 10%	-36	252	30	.079	.33	143.0	23	13.0
15000.0	± 10%	-37	253	30	.079	.29	157.0	22	12.0
18000.0	± 10%	-38	254	30	.079	.28	175.0	21	10.0
22000.0	± 10%	-39	255	27	.079	.25	274.0	17	9.0
27000.0	± 10%	-40	256	27	.079	.21	308.0	16	8.0
33000.0	± 10%	-41	257	27	.079	.19	343.0	15	7.5
39000.0	± 10%	-42	258	27	.079	.17	376.0	15	6.0
47000.0	± 10%	-43	259	23	.079	.16	473.0	13	5.5
56000.0	± 10%	-44	260	23	.079	.14	512.0	13	5.0
68000.0	± 10%	-45	261	23	.079	.13	580.0	12	4.0
82000.0	± 10%	-46	262	21	.079	.12	618.0	11	3.5
100000.0	± 10%	-47	263	18	.079	.11	678.0	11	3.0

* Measured with full length lead. ** Rated DC current based on maximum temperature rise not to exceed 15°C at 90°C ambient.

*** Incremental Current: The minimum typical current at which the inductance will be decreased by 5% from its initial zero DC value.

NOTE: Listing of Military Standard does not imply qualification. Contact factory for latest government QPL information.

HOW TO ORDER			HOW TO ORDER - MILITARY PART NUMBER						
IMS-5	10μH	± 10%	MS75088	-13	OR	LT	10	K	215
MODEL	IND. VALUE	IND. TOLERANCE	MILITARY STANDARD	IND. VALUE		TYPE	GRADE AND CLASS	FAMILY	ID NUMBER

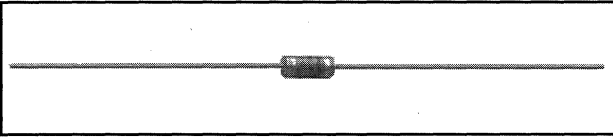
MODEL IMS-2 Inductors

Military, MIL-C-15305 Qualified, Type LT and Commercial, Molded, Shielded, Miniature



FEATURES

- Flame retardant coating
- Electromagnetic shield
- Small package for a shielded inductor
- Epoxy molded construction provides superior moisture protection
- Precision performance, excellent reliability, sturdy construction



STANDARD ELECTRICAL SPECIFICATIONS

IND. (μH)	TOL.	MIL. STD.	MIL. TYPE	Q	TEST FREQ. L & Q (MHz)	SELF-RESONANT FREQ. (MHz)	DCR MAX. (Ohms)	RATED** DC CURRENT (mA)	INCRE-*** MENTAL CURRENT
MS21426 LT10K									
.10	± 10%	-1	518	54	25.0	490.0	.10	670	—
.12	± 10%	-2	519	52	25.0	430.0	.11	635	—
.15	± 10%	-3	520	50	25.0	415.0	.12	610	—
.18	± 10%	-4	521	49	25.0	375.0	.13	585	—
.22	± 10%	-5	522	47	25.0	330.0	.15	545	—
.27	± 10%	-6	523	46	25.0	300.0	.16	530	—
.33	± 10%	-7	524	44	25.0	260.0	.18	495	—
.39	± 10%	-8	525	42	25.0	230.0	.19	485	—
.47	± 10%	-9	526	41	25.0	220.0	.21	460	—
.56	± 10%	-10	527	41	25.0	210.0	.23	440	—
.68	± 10%	-11	528	39	25.0	180.0	.24	430	—
.82	± 10%	-12	529	38	25.0	165.0	.27	405	—
1.0	± 10%	-13	530	37	25.0	150.0	.30	385	—
1.2	± 10%	-14	531	40	7.9	130.0	.73	247	—
1.5	± 10%	-15	532	41	7.9	115.0	.86	228	—
1.8	± 10%	-16	533	43	7.9	105.0	.95	217	—
2.2	± 10%	-17	534	45	7.9	95.0	1.1	202	—
2.7	± 10%	-18	535	48	7.9	90.0	1.2	193	—
3.3	± 10%	-19	536	49	7.9	80.0	1.3	185	—
3.9	± 10%	-20	537	50	7.9	75.0	1.5	173	—
4.7	± 10%	-21	538	53	7.9	70.0	2.4	136	—
5.6	± 10%	-22	539	54	7.9	60.0	2.9	124	—
6.8	± 10%	-23	540	55	7.9	55.0	3.2	118	—
8.2	± 10%	-24	541	55	7.9	53.0	3.6	111	—
10.0	± 10%	-25	542	57	7.9	50.0	4.0	106	—
12.0	± 10%	-26	543	36	2.5	35.0	3.0	122	—
15.0	± 10%	-27	544	38	2.5	30.0	3.4	115	—
18.0	± 10%	-28	545	40	2.5	26.0	3.8	108	—
22.0	± 10%	-29	546	40	2.5	24.0	4.9	96	—
27.0	± 10%	-30	547	40	2.5	21.0	5.8	88	—
33.0	± 10%	-31	548	41	2.5	20.0	6.5	83	—
39.0	± 10%	-32	549	42	2.5	19.0	7.9	75	—
47.0	± 10%	-33	550	44	2.5	16.0	9.3	69	—
56.0	± 10%	-34	551	44	2.5	15.0	11.0	64	—
68.0	± 10%	-35	552	45	2.5	13.0	12.0	61	—
82.0	± 10%	-36	553	45	2.5	11.0	13.0	59	—
100.0	± 10%	-37	554	40	2.5	10.5	16.8	51	—
MS21427									
120.0	± 10%	-1	555	31	.79	13.0	5.8	88	27
150.0	± 10%	-2	556	33	.79	12.0	7.9	75	24
180.0	± 10%	-3	557	33	.79	11.0	9.4	69	22
220.0	± 10%	-4	558	35	.79	10.0	11.0	64	20
270.0	± 10%	-5	559	37	.79	9.0	12.0	61	18
330.0	± 10%	-6	560	40	.79	8.0	16.0	53	16
390.0	± 10%	-7	561	38	.79	7.8	21.0	46	14
470.0	± 10%	-8	562	36	.79	7.5	24.0	43	13
560.0	± 10%	-9	563	36	.79	7.0	28.0	40	12

* Measured with full length lead.

** Rated DC current based on the maximum temperature rise not to exceed 15°C at 90°C ambient.

*** Incremental Current: The minimum typical current at which the inductance will be decreased by 5% from its initial zero DC value.

INDUCTANCE RANGE AND MILITARY STANDARD

INDUCTANCE RANGE		CLASSIFICATION		MATERIAL		MILITARY STANDARD
FROM	TO	GRADE	CLASS	CORE	SHIELD	
.10μH	100μH	1	A	Powd. Iron	Powd. Iron	MS21426
120μH	560μH	1	A	Ferrite	Ferrite	MS21427

NOTE: Listing of Military Standard does not imply qualification. Contact factory for latest government QPL information.

HOW TO ORDER

IMS-2	10μH	± 10%
MODEL	IND. VALUE	IND. TOLERANCE

HOW TO ORDER - MILITARY PART NUMBER

MS21426	-14	OR	LT	10	K	531
MILITARY STANDARD	IND. VALUE		TYPE	GRADE AND CLASS	FAMILY	ID NUMBER

ELECTRICAL SPECIFICATIONS

Inductance Tolerance: ± 10% standard. ± 5% available.

Insulation Resistance: 1000 Megohm minimum per MIL-STD-202, Method 302, Test Condition B.

Dielectric Withstanding Voltage: 200 VAC per MIL-STD-202, Method 301 (sea level).

Percent Coupling: 3% maximum per MIL-C-15305.

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

MECHANICAL SPECIFICATIONS

Terminal Strength: 3 pounds pull per MIL-STD-202, Method 211, Test Condition A except 180° rotation for a total of 540°.

Weight: IMS-2 = .30 grams maximum.

MATERIAL SPECIFICATIONS

Encapsulant: Epoxy.

Standard Terminal: #24 AWG tinned copper.

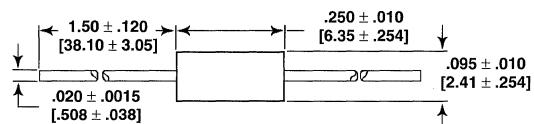
TEST EQUIPMENT*

- H/P 4342A Q-Meter.
- Measurements Corporation Megacycle Meter, Model 59.
- Wheatstone Bridge.

* Test procedures per MIL-C-15305.

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



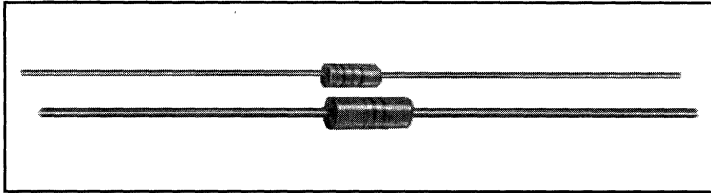
ENVIRONMENTAL PERFORMANCE

TEST	CONDITIONS	SPECIFICATIONS
Barometric Pressure	Test Condition C	MIL-STD-202, Method 105
Thermal Shock	Test Condition A-1	MIL-STD-202, Method 107
Flammability	—	MIL-STD-202, Method 111
Overload	—	MIL-C-15305
Low Temperature Storage	—	MIL-C-15305
Resistance to Soldering Heat	Test Condition A	MIL-STD-202, Method 210
Resistance to Solvents	—	MIL-STD-202, Method 215



MODEL IM Inductors

Military, MIL-C-15305 Qualified, Type LT and Commercial, Molded



FEATURES

- Wide inductance range in small package
- Flame retardant coating
- Precision performance, excellent reliability, sturdy construction
- Epoxy molded construction provides superior moisture protection

INDUCTANCE RANGE AND MILITARY STANDARD

MODEL	INDUCTANCE RANGE Mil. Range in bold face		CLASSIFICATION		MILITARY STANDARD
	FROM	TO	GRADE	CLASS	
IM-1	.10μH	1000μH	—	—	—
IM-2	.022μH	.082μH	—	—	—
	.10μH	1μH	1	B	MS75083
	1.2μH	27μH	1	A	MS75084
	33μH	1000μH	1	A	MS75085
IM-4	.15μH	4.7μH	1	B	MS18130
	5.6μH	33μH	1	A	MS14046
	36μH	240μH	1	A	MS90538
	270μH	1800μH	—	—	—
IM-6	.10μH	2.7μH	1	B	MS75008 Not QPL'd
	3.3μH	27μH	1	A	MS75101 Not QPL'd
	33μH	220μH	—	—	—
	270μH	1000μH	1	A	MS90539 Not QPL'd
IM-8	1100μH	3600μH	1	A	MS90540 Not QPL'd
IM-9	68μH	150μH	1	A	MS14047 Not QPL'd
IM-10	3900μH	10,000μH	1	A	MS90541 Not QPL'd

ELECTRICAL SPECIFICATIONS

Inductance Tolerance: ± 1%, ± 3%, ± 5%, ± 10%, ± 20%. Other tolerances available on request.

Insulation Resistance: 1000 Megohm minimum per MIL-STD-202, Method 302, Test Condition B.

Dielectric Strength: Per MIL-STD-202, Method 301: 1000 VAC for IM-2, -4, -6, -8, -9 and -10. 200 VAC for IM-1.

MECHANICAL SPECIFICATIONS

Terminal Strength: Per MIL-STD-202, Method 211, Test Condition A: For IM-1, 3 pounds pull.

For IM-2, -4, -6, -8, -9 and -10, 5 pounds pull and twist.

Weight: IM-1 = .25 gram maximum,

IM-2 = .30 gram maximum,

IM-4 = .65 gram maximum,

IM-6 = .95 gram maximum,

IM-8 = 1.5 gram maximum,

IM-9 = 2.0 gram maximum,

IM-10 = 2.5 gram maximum.

MATERIAL SPECIFICATIONS

Encapsulant: Epoxy.

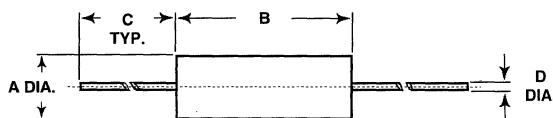
Standard Terminals: IM-1 and IM-2, 24 AWG; IM-4, IM-6 and IM-9, 22 AWG; IM-8, 21 AWG; and IM-10, 20 AWG, Tinned Copper.

TEST EQUIPMENT*

- H/P 4342A Q-Meter.
- Measurements Corporation Megacycle Meter, Model 59.
- Wheatstone Bridge.

* Test procedures per MIL-C-15305.

DIMENSIONAL CONFIGURATIONS



[Numbers in brackets indicate millimeters]

MODEL		A (Dia.)	B	C (Typ.)	D (Dia.)
IM-1	Maximum	.086 [2.18]	.210 [5.33]	1.62 [41.15]	.0215 [.546]
	Minimum	.070 [1.78]	.190 [4.83]	1.38 [35.05]	.0185 [.470]
IM-2	Maximum	.105 [2.67]	.260 [6.60]	1.63 [41.40]	.0215 [.546]
	Minimum	.085 [2.16]	.240 [6.10]	1.25 [31.75]	.0185 [.470]
IM-4	Maximum	.165 [4.19]	.385 [9.78]	1.63 [41.40]	.027 [.686]
	Minimum	.145 [3.68]	.365 [9.27]	1.25 [31.75]	.023 [.584]
IM-6	Maximum	.200 [5.08]	.450 [11.43]	1.63 [41.40]	.027 [.686]
	Minimum	.180 [4.57]	.430 [10.92]	1.25 [31.75]	.023 [.584]
IM-8	Maximum	.225 [5.72]	.570 [14.48]	1.63 [41.40]	.030 [.762]
	Minimum	.205 [5.21]	.550 [13.97]	1.25 [31.75]	.026 [.660]
IM-9	Maximum	.260 [6.60]	.570 [14.48]	1.63 [41.40]	.027 [.686]
	Minimum	.240 [6.10]	.550 [13.97]	1.25 [31.75]	.023 [.580]
IM-10	Maximum	.250 [6.35]	.750 [19.05]	1.63 [41.40]	.034 [.864]
	Minimum	.230 [5.84]	.730 [18.54]	1.25 [31.75]	.030 [.762]

ENVIRONMENTAL PERFORMANCE

TEST	CONDITIONS	SPECIFICATIONS
Barometric Pressure	Test Condition C	MIL-STD-202, Method 105
Thermal Shock	Test Condition A-1	MIL-STD-202, Method 107
Flammability	—	MIL-STD-202, Method 111
Overload	—	MIL-C-15305
Low Temperature Storage	—	MIL-C-15305
Resistance to Soldering Heat	Test Condition A	MIL-STD-202, Method 210
Resistance to Solvents	—	MIL-STD-202, Method 215

MODEL IM

STANDARD ELECTRICAL SPECIFICATIONS															
MODEL IM-1					TEST					MODEL IM-1					
IND.	MIL.	MIL.	Q	TEST	SELF-*	DCR	RATED**	IND.	MIL.	MIL.	Q	TEST	SELF-*	DCR	RATED**
(μH)	TOL.	STD.	MIN.	FREQ.	RESONANT	MAX.	DC	(μH)	TOL.	STD.	MIN.	FREQ.	RESONANT	MAX.	DC
				L & Q	FREQ. MIN.	(Ohms)	CURRENT					L & Q	FREQ. MIN.	(Ohms)	CURRENT
				(MHz)	(MHz)		(mA)					(MHz)	(MHz)		(mA)
.10 ± 10%	—	—	35	25.0	680.0	.13	895	3.9 ± 10%	—	—	50	7.9	95.0	1.5	178
.12 ± 10%	—	—	35	25.0	650.0	.15	835	4.7 ± 10%	—	—	55	7.9	88.0	2.1	150
.15 ± 10%	—	—	35	25.0	560.0	.18	760	5.6 ± 10%	—	—	55	7.9	78.0	2.8	130
.18 ± 10%	—	—	35	25.0	540.0	.21	705	6.8 ± 10%	—	—	55	7.9	69.0	3.2	122
.22 ± 10%	—	—	30	25.0	500.0	.25	645	8.2 ± 10%	—	—	45	7.9	52.0	4.4	104
.27 ± 10%	—	—	30	25.0	440.0	.38	525	10.0 ± 10%	—	—	45	7.9	47.0	5.2	95
.33 ± 10%	—	—	25	25.0	410.0	.49	460	12.0 ± 10%	—	—	40	2.5	31.0	3.0	126
.39 ± 10%	—	—	25	25.0	380.0	.59	420	15.0 ± 10%	—	—	40	2.5	26.0	3.4	118
.47 ± 10%	—	—	25	25.0	340.0	.62	410	18.0 ± 10%	—	—	40	2.5	23.0	3.8	112
.56 ± 10%	—	—	40	25.0	250.0	.18	510	22.0 ± 10%	—	—	45	2.5	20.0	4.3	105
.68 ± 10%	—	—	40	25.0	215.0	.20	485	27.0 ± 10%	—	—	45	2.5	17.0	4.7	100
.82 ± 10%	—	—	40	25.0	200.0	.22	465	33.0 ± 10%	—	—	45	2.5	15.0	5.2	95
1.0 ± 10%	—	—	40	25.0	190.0	.25	435	39.0 ± 10%	—	—	45	2.5	13.5	6.8	83.5
1.2 ± 10%	—	—	35	7.9	170.0	.28	410	47.0 ± 10%	—	—	45	2.5	12.5	8.2	76
1.5 ± 10%	—	—	40	7.9	150.0	.49	310	56.0 ± 10%	—	—	45	2.5	11.5	10.0	69
1.8 ± 10%	—	—	40	7.9	135.0	.56	290	68.0 ± 10%	—	—	45	2.5	10.5	11.5	64
2.2 ± 10%	—	—	45	7.9	130.0	.72	257	82.0 ± 10%	—	—	45	2.5	10.0	16.0	54.5
2.7 ± 10%	—	—	45	7.9	110.0	.85	236	100.0 ± 10%	—	—	45	2.5	9.5	17.5	52
3.3 ± 10%	—	—	45	7.9	100.0	1.2	198								
MODEL IM-2															
					PHENOLIC CORE										
.022 ± 20%	—	—	50	50.0	900.0	.025	2400	5.6 ± 10%	—09	069	50	7.9	65.0	1.8	185
.027 ± 10%	—	—	40	25.0	875.0	.03	2200	6.8 ± 10%	-10	070	50	7.9	60.0	2.0	175
.033 ± 10%	—	—	40	25.0	850.0	.035	2000	8.2 ± 10%	-11	071	55	7.9	55.0	2.7	155
.039 ± 10%	—	—	40	25.0	825.0	.04	1900	10.0 ± 10%	-12	072	55	7.9	50.0	3.7	130
.047 ± 10%	—	—	40	25.0	800.0	.045	1800	12.0 ± 10%	-13	073	45	2.5	40.0	2.7	155
.056 ± 10%	—	—	40	25.0	775.0	.05	1700	15.0 ± 10%	-14	074	40	2.5	35.0	2.8	150
.068 ± 10%	—	—	40	25.0	750.0	.06	1500	18.0 ± 10%	-15	075	50	2.5	30.0	3.1	145
.082 ± 10%	—	—	40	25.0	725.0	.07	1400	22.0 ± 10%	-16	076	50	2.5	25.0	3.3	140
								27.0 ± 10%	-17	077	50	2.5	20.0	3.5	135
MS75083 LT4K					PHENOLIC CORE					MS75084 LT10K					
.10 ± 10%	-1	339	40	25.0	680.0	.08	1350	33.0 ± 10%	-1	078	45	2.5	24.0	3.4	130
.12 ± 10%	-2	340	40	25.0	640.0	.09	1270	39.0 ± 10%	-2	079	45	2.5	22.0	3.6	125
.15 ± 10%	-3	341	38	25.0	600.0	.10	1200	47.0 ± 10%	-3	080	45	2.5	20.0	4.5	110
.18 ± 10%	-4	342	35	25.0	550.0	.12	1105	56.0 ± 10%	-4	081	45	2.5	18.0	5.7	100
.22 ± 10%	-5	343	33	25.0	510.0	.14	1025	68.0 ± 10%	-5	082	50	2.5	15.0	6.7	92
.27 ± 10%	-6	344	33	25.0	430.0	.16	960	82.0 ± 10%	-6	083	50	2.5	14.0	7.3	88
.33 ± 10%	-7	345	30	25.0	410.0	.22	815	100.0 ± 10%	-7	084	50	2.5	13.0	8.0	84
.39 ± 10%	-8	346	30	25.0	365.0	.30	700	120.0 ± 10%	-8	085	30	.79	12.0	13.0	66
.47 ± 10%	-9	347	30	25.0	330.0	.35	650	150.0 ± 10%	-9	086	30	.79	11.0	15.0	61
.56 ± 10%	-10	348	30	25.0	300.0	.50	545	180.0 ± 10%	-10	087	30	.79	10.0	17.0	57
.68 ± 10%	-11	349	28	25.0	275.0	.60	495	220.0 ± 10%	-11	088	30	.79	9.0	21.0	52
.82 ± 10%	-12	350	28	25.0	250.0	.85	415	270.0 ± 10%	-12	089	30	.79	8.0	25.0	47
1.0 ± 10%	-13	351	25	25.0	230.0	1.0	385	330.0 ± 10%	-13	090	30	.79	7.0	28.0	45
MS75084 LT10K					PHENOLIC CORE					MS75085 LT10K					
1.2 ± 10%	-01	061	25	7.9	150.0	.18	590	390.0 ± 10%	-14	091	30	.79	6.5	35.0	40
1.5 ± 10%	-02	062	28	7.9	140.0	.22	535	470.0 ± 10%	-15	092	30	.79	6.0	42.0	36
1.8 ± 10%	-03	063	30	7.9	125.0	.30	455	560.0 ± 10%	-16	093	30	.79	5.0	46.0	35
2.2 ± 10%	-04	064	30	7.9	115.0	.40	395	680.0 ± 10%	-17	094	30	.79	4.0	60.0	30
2.7 ± 10%	-05	065	37	7.9	100.0	.55	355	820.0 ± 10%	-18	095	30	.79	3.8	65.0	29
3.3 ± 10%	-06	066	45	7.9	90.0	.85	270	1000.0 ± 10%	-19	096	30	.79	3.4	72.0	28
3.9 ± 10%	-07	067	45	7.9	80.0	1.0	250								
4.7 ± 10%	-08	068	45	7.9	75.0	1.2	230								
MODEL IM-4															
MS18130 LT4K					PHENOLIC CORE					MS90538 LT10K					
.15 ± 20%	-1	074	50	25.0	525.0	.03	2450	36.0 ± 5%	-1	001	60	2.5	15.5	2.50	180
.22 ± 20%	-2	075	50	25.0	450.0	.055	1810	39.0 ± 5%	-2	002	60	2.5	14.5	2.60	176
.33 ± 20%	-3	076	45	25.0	360.0	.09	1400	43.0 ± 5%	-3	003	60	2.5	13.7	2.70	172
.47 ± 20%	-4	077	45	25.0	310.0	.12	1225	47.0 ± 5%	-4	004	55	2.5	13.0	2.75	170
.56 ± 20%	-5	078	50	25.0	280.0	.135	1150	51.0 ± 5%	-5	005	55	2.5	12.7	2.85	167
.68 ± 10%	-6	079	50	25.0	250.0	.15	1100	56.0 ± 5%	-6	006	55	2.5	12.0	3.0	164
.82 ± 10%	-7	080	50	25.0	220.0	.22	900	62.0 ± 5%	-7	007	55	2.5	11.5	3.15	160
1.0 ± 10%	-8	081	50	25.0	200.0	.29	785	68.0 ± 5%	-8	008	55	2.5	11.0	3.30	156
1.2 ± 10%	-9	082	33	7.9	180.0	.42	650	75.0 ± 5%	-9	009	55	2.5	10.5	3.70	147
1.5 ± 10%	-10	083	33	7.9	160.0	.50	600	82.0 ± 5%	-10	010	50	2.5	10.3	3.90	143
1.8 ± 10%	-11	084	33	7.9	150.0	.65	525	91.0 ± 5%	-11	011	50	2.5	10.0	4.30	136
2.2 ± 10%	-12	085	33	7.9	135.0	.95	435	100.0 ± 5%	-12	012	50	2.5	9.5	4.50	133
2.7 ± 10%	-13	086	33	7.9	120.0	1.20	385	110.0 ± 5%	-13	013	60	.79	8.9	4.90	128
3.3 ± 10%	-14	087	33	7.9	110.0	2.0	300	120.0 ± 5%	-14	014	65	.79	8.7	5.20	124
3.9 ± 10%	-15	088	33	7.9	100.0	2.30	280	130.0 ± 5%	-15	015	65	.79	8.5	5.45	121
4.7 ± 10%	-16	089	33	7.9	90.0	2.60	260	150.0 ± 5%	-16	016	65	.79	8.0	6.05	114
MS14046 LT10K					PHENOLIC CORE					IRON CORE					
5.6 ± 10%	-1	128	45	7.9	60.0	.32	495	160.0 ± 5%	-17	017	65	.79	7.5	6.40	111
6.8 ± 10%	-2	129	50	7.9	55.0	.50	395	180.0 ± 5%	-18	018	65	.79	7.0	6.75	108
8.2 ± 10%	-3	130	50	7.9	50.0	.60	360	200.0 ± 5%	-19	019	65	.79	6.5	7.10	106
10.0 ± 10%	-4	131	55	7.9	45.0	.90	290	220.0 ± 5%	-20	020	65	.79	6.2	7.45	103
12.0 ± 10%	-5	132	65	2.5	42.0	1.10	265	240.0 ± 5%	-21	021	65	.79	5.9	7.80	101
15.0 ± 10%	-6	133	65	2.5	40.0	1.40	240	270.0 ± 5%	—	—	65	.79	5.7	11.0	129
18.0 ± 10%	-7	134	75	2.5	34.0	2.25	185	300.0 ± 5%	—	—	65	.79	5.4	11.5	125
22.0 ± 10%	-8	135	75	2.5	30.0	2.50	175								
27.0 ± 10%	-9	136	60	2.5	25.0	2.60	170								
33.0 ± 10%	-10	137	65	2.5	19.0	3.0	165								

NOTE: Listing of Military Standard does not imply qualification. Contact factory for latest government QPL information.

MODEL IM

STANDARD ELECTRICAL SPECIFICATIONS																	
MODEL IM-4								MODEL IM-4									
IND. (μH)	TOL.	MIL. STD.	MIL. TYPE	Q MIN.	TEST FREQ. L & Q (MHz)	SELF-RESONANT FREQ. (MHz)	DCR MAX. (Ohms)	RATED** DC CURRENT (mA)	IND. (μH)	TOL.	MIL. STD.	MIL. TYPE	Q MIN.	TEST FREQ. L & Q (MHz)	SELF-RESONANT FREQ. (MHz)	DCR MAX. (Ohms)	RATED** DC CURRENT (mA)
330.0 ± 5%	—	—	—	65	.79	5.1	12.0	123	820.0 ± 5%	—	—	—	55	.79	2.7	30.0	77
360.0 ± 5%	—	—	—	65	.79	4.8	15.5	108	910.0 ± 5%	—	—	—	55	.79	2.5	31.5	76
390.0 ± 5%	—	—	—	65	.79	4.5	16.3	105	1000.0 ± 5%	—	—	—	55	.79	2.3	33.1	74
430.0 ± 5%	—	—	—	65	.79	4.2	17.1	102	1100.0 ± 5%	—	—	—	30	.25	2.1	43.5	64
470.0 ± 5%	—	—	—	65	.79	3.9	17.9	100	1200.0 ± 5%	—	—	—	30	.25	2.0	45.7	63
510.0 ± 5%	—	—	—	65	.79	3.7	18.8	98	1300.0 ± 5%	—	—	—	30	.25	1.9	49.0	61
560.0 ± 5%	—	—	—	65	.79	3.5	24.7	85	1500.0 ± 5%	—	—	—	30	.25	1.8	52.5	59
620.0 ± 5%	—	—	—	65	.79	3.3	25.9	83	1600.0 ± 5%	—	—	—	30	.25	1.7	54.0	58
680.0 ± 5%	—	—	—	55	.79	3.1	27.2	81	1800.0 ± 5%	—	—	—	30	.25	1.6	56.7	56
750.0 ± 5%	—	—	—	55	.79	2.9	28.6	79									
MODEL IM-6								MODEL IM-6									
MS75008 LT4K (Not QPL'd)								MS90539 LT0K (Not QPL'd)									
.10 ± 10%	—	—	—	55	25.0	510.0	.020	3600	33.0 ± 10%	—	—	—	75	2.5	20.0	3.5	185
.12 ± 10%	—	—	—	55	25.0	510.0	.025	3300	39.0 ± 10%	—	—	—	75	2.5	18.0	3.8	176
.15 ± 10%	-21	027	55	25.0	510.0	.030	3000	47.0 ± 10%	—	—	—	75	2.5	16.0	4.0	170	
.18 ± 10%	—	—	—	55	25.0	450.0	.030	2900	56.0 ± 10%	—	—	—	75	2.5	15.0	4.4	164
.22 ± 10%	-22	028	50	25.0	415.0	.035	2800	68.0 ± 10%	—	—	—	75	2.5	12.0	4.7	156	
.27 ± 10%	—	—	—	50	25.0	380.0	.050	2400	82.0 ± 10%	—	—	—	75	2.5	10.0	5.3	143
.33 ± 10%	-23	029	50	25.0	350.0	.065	2000	100.0 ± 10%	—	—	—	65	2.5	8.0	6.0	133	
.39 ± 10%	—	—	—	50	25.0	320.0	.080	1800	120.0 ± 10%	—	—	—	65	.79	6.0	5.0	124
.47 ± 10%	-24	030	50	25.0	300.0	.085	1700	150.0 ± 10%	—	—	—	65	.79	5.4	5.8	118	
.56 ± 10%	-25	031	50	25.0	270.0	.125	1450	180.0 ± 10%	—	—	—	65	.79	5.0	6.6	114	
.68 ± 10%	-26	032	45	25.0	250.0	.150	1300	220.0 ± 10%	—	—	—	65	.79	4.7	7.4	112	
.82 ± 10%	-27	033	40	25.0	210.0	.205	1100	MS90547 LT10K (Not QPL'd)									
1.0 ± 10%	-28	034	40	25.0	200.0	.290	930	270.0 ± 5%	-01	022	65	.79	5.6	8.2	110		
1.2 ± 10%	-29	035	30	7.9	180.0	.400	785	300.0 ± 5%	-02	023	65	.79	5.3	8.7	107		
1.5 ± 10%	-30	036	30	7.9	170.0	.485	700	330.0 ± 5%	-03	024	65	.79	5.0	9.1	105		
1.8 ± 10%	-31	037	30	7.9	150.0	.740	580	360.0 ± 5%	-04	025	65	.79	4.7	9.6	102		
2.2 ± 10%	-32	038	30	7.9	140.0	.970	505	390.0 ± 5%	-05	026	65	.79	4.5	10.0	100		
2.7 ± 10%	-33	039	30	7.9	120.0	1.20	460	430.0 ± 5%	-06	027	65	.79	4.3	10.6	97		
MS75101 LT10K (Not QPL'd)								MS90541 LT10K (Not QPL'd)									
3.3 ± 10%	-01	169	30	7.9	70.0	.140	990	470.0 ± 5%	-07	028	65	.79	4.0	11.1	95		
3.9 ± 10%	-02	170	30	7.9	65.0	.155	870	510.0 ± 5%	-08	029	65	.79	3.8	11.6	93		
4.7 ± 10%	-03	171	30	7.9	60.0	.210	745	560.0 ± 5%	-09	030	65	.79	3.6	12.3	91		
5.6 ± 10%	-04	172	30	7.9	50.0	.280	645	620.0 ± 5%	-10	031	60	.79	3.5	13.0	88		
6.8 ± 10%	-05	173	30	7.9	50.0	.375	560	680.0 ± 5%	-11	032	60	.79	3.4	13.7	85		
8.2 ± 10%	-06	174	30	7.9	48.0	.440	540	750.0 ± 5%	-12	033	60	.79	3.3	14.4	83		
10.0 ± 10%	-07	175	30	7.9	42.0	.605	440	820.0 ± 5%	-13	034	60	.79	3.1	15.1	81		
12.0 ± 10%	-08	176	50	2.5	36.0	1.05	370	910.0 ± 5%	-14	035	60	.79	2.9	15.8	79		
15.0 ± 10%	-09	177	55	2.5	30.0	1.20	310	1000.0 ± 5%	-15	036	60	.79	2.8	16.5	78		
18.0 ± 10%	-10	178	60	2.5	30.0	1.95	255	MODEL IM-9									
22.0 ± 10%	-11	179	60	2.5	24.0	2.20	240	MS14047 LT10K (Not QPL'd)									
27.0 ± 10%	-12	180	65	2.5	22.0	2.75	205	68.0 ± 10%	-01	138	70	2.5	13.0	3.3	168		
MODEL IM-8								MODEL IM-10									
MS90540 LT10K (Not QPL'd)								MS90541 LT10K (Not QPL'd)									
1100.0 ± 5%	-01	037	60	.25	2.8	21.0	78	3900.0 ± 5%	-01	050	80	.25	1.45	44.0	61		
1200.0 ± 5%	-02	038	60	.25	2.7	22.0	76	4300.0 ± 5%	-02	051	80	.25	1.40	46.0	59		
1300.0 ± 5%	-03	039	60	.25	2.6	23.0	75	4700.0 ± 5%	-03	052	80	.25	1.35	48.0	58		
1500.0 ± 5%	-04	040	65	.25	2.4	25.0	72	5000.0 ± 5%	-04	053	80	.25	1.30	50.0	57		
1600.0 ± 5%	-05	041	65	.25	2.3	26.0	70	5600.0 ± 5%	-05	054	80	.25	1.25	53.0	56		
1800.0 ± 5%	-06	042	65	.25	2.2	28.0	68	6200.0 ± 5%	-06	055	80	.25	1.20	56.0	54		
2000.0 ± 5%	-07	043	65	.25	2.1	29.0	67	6800.0 ± 5%	-07	056	80	.25	1.15	59.0	52		
2200.0 ± 5%	-08	044	70	.25	2.0	30.0	66	7500.0 ± 5%	-08	057	80	.25	1.10	62.0	51		
2400.0 ± 5%	-09	045	70	.25	1.9	31.0	64	8200.0 ± 5%	-09	058	80	.25	1.05	65.0	50		
2700.0 ± 5%	-10	046	70	.25	1.8	33.0	62	9100.0 ± 5%	-10	059	80	.25	1.0	68.0	49		
3000.0 ± 5%	-11	047	70	.25	1.7	35.0	61	10000.0 ± 5%	-11	060	80	.25	.95	72.0	47		
3300.0 ± 5%	-12	048	70	.25	1.6	38.0	58										
3600.0 ± 5%	-13	049	70	.25	1.5	40.0	57										

* Measured with full length lead.

** Rated DC current based on maximum temperature rise as shown in table:

MAXIMUM TEMPERATURE RISE		
		OPERATING TEMP. RANGE
IM-1	.10 to .47μH = 35°C at 90°C ambient.	-55°C to +125°C
	.56 to 1000μH = 15°C at 90°C ambient.	-55°C to +105°C
IM-2	.1 to 1.0μH = 35°C at 90°C ambient.	-55°C to +125°C
	1.2 to 27μH = 15°C at 90°C ambient.	-55°C to +105°C
IM-4	33 to 1000μH = 15°C at 90°C ambient.	-55°C to +105°C
	.15 to 4.7μH = 35°C at 90°C ambient.	-55°C to +125°C
IM-6	5.6 to 33μH = 15°C at 90°C ambient.	-55°C to +105°C
	36 to 240μH = 15°C at 90°C ambient.	-55°C to +105°C
IM-8, IM-9, IM-10	270 to 1800μH = 35°C at 90°C ambient.	-55°C to +125°C
	.1 to 2.7μH = 35°C at 90°C ambient.	-55°C to +125°C
	3.3 to 1000μH = 15°C at 90°C ambient.	-55°C to +105°C
		-55°C to +105°C

NOTE: Listing of Military Standard does not imply qualification. Contact factory for latest government QPL information.

NOTE: Products with dashes instead of Military Standard value and type designations are not qualified.

HOW TO ORDER

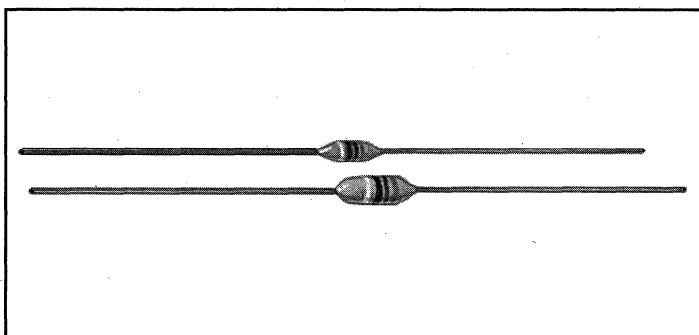
IM-2	10μH	± 10%
MODEL	INDUCTANCE VALUE	INDUCTANCE TOLERANCE

HOW TO ORDER - MILITARY PART NUMBER

MS75084	-12	OR	LT	10	K	072
MILITARY STANDARD	INDUCTANCE VALUE		TYPE	GRADE AND CLASS	FAMILY ID NUMBER	

MODEL IR Inductors

Epoxy Conformal Coated Uniform Roll Coated



FEATURES

- Flame-retardant coating
- Color band identification
- Excellent environmental characteristics
- Uniform coating is excellent for automatic insertion
- Comparable in quality to molded chokes at a lower price
- Epoxy coating is more durable than lacquer coated models, yet is priced comparably

ELECTRICAL SPECIFICATIONS

Inductance Tolerance: $\pm 1\%$, $\pm 3\%$, $\pm 5\%$, $\pm 10\%$, $\pm 20\%$.
Other tolerances available on request.

Insulation Resistance: 1000 Megohm minimum per MIL-STD-202, Method 302, Test Condition B.

Dielectric Strength: 1000 VAC per MIL-STD-202, Method 301.

MATERIAL SPECIFICATIONS

Coating: Epoxy-uniform roll coated.

Lead: Tinned Copper.

MECHANICAL SPECIFICATIONS

Terminal Strength: 5 pounds pull per MIL-STD-202, Method 211, Test Condition A.

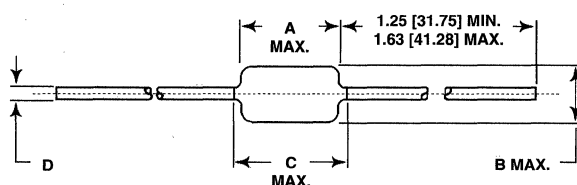
Weight: IR-2 = .30 gram maximum.
IR-4 = .65 gram maximum.

TEST EQUIPMENT*

- H/P 4342A Q-Meter.
- Measurements Corporation Megacycle Meter, Model 59.
- Wheatstone Bridge.

* Test procedures per MIL-C-15305.

DIMENSIONAL CONFIGURATIONS



[Numbers in brackets indicate millimeters]

MODEL	A (Max.)	B (Max.)	C (Max.)	D
IR-2	.260 [6.60]	.120 [3.05]	.330 [8.38]	.0200 \pm .0015 [.508 \pm .038]
IR-4	.385 [9.78]	.180 [4.57]	.440 [11.18]	.025 \pm .002 [.635 \pm .051]

ENVIRONMENTAL PERFORMANCE

TEST	CONDITIONS	SPECIFICATIONS
Barometric Pressure	Test Condition C	MIL-STD-202, Method 105
Thermal Shock	Test Condition A-1	MIL-STD-202, Method 107
Flammability	—	MIL-STD-202, Method 111
Overload	—	MIL-C-15305
Low Temperature Storage	—	MIL-C-15305
Resistance to Soldering Heat	Test Condition A	MIL-STD-202, Method 210
Resistance to Solvents	—	MIL-STD-202, Method 215

MAXIMUM TEMPERATURE RISE

	OPERATING TEMP. RANGE	OPERATING TEMP. RANGE
IR-2	.1 to 1.0 μ H = 35°C at 90°C ambient.	- 55°C to + 125°C
	1.2 to 27 μ H = 15°C at 90°C ambient.	- 55°C to + 105°C
	33 to 1000 μ H = 15°C at 90°C ambient.	- 55°C to + 105°C
IR-4	.15 to 4.7 μ H = 35°C at 90°C ambient.	- 55°C to + 125°C
	5.6 to 33 μ H = 15°C at 90°C ambient.	- 55°C to + 105°C
	36 to 240 μ H = 15°C at 90°C ambient.	- 55°C to + 105°C
	270 to 1800 μ H = 35°C at 90°C ambient.	- 55°C to + 125°C

MODEL IR

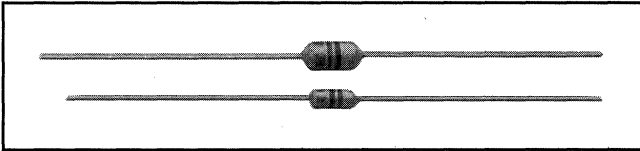
STANDARD ELECTRICAL SPECIFICATIONS														
MODEL IR-2			TEST FREQ. L & Q (MHz)	SELF- [*] RESONANT FREQ. MIN. (MHz)	DCR MAX. (Ohms)	RATED ^{**} DC CURRENT (mA)	MODEL IR-2			TEST FREQ. L & Q (MHz)	SELF- [*] RESONANT FREQ. MIN. (MHz)	DCR MAX. (Ohms)	RATED ^{**} DC CURRENT (mA)	
IND. (μH)	TOL.	Q MIN.					IND. (μH)	TOL.	Q MIN.					
.10	± 10%	40	25.0	680.0	.08	1350	12.0	± 10%	45	2.5	40.0	2.7	155	IRON CORE
.12	± 10%	40	25.0	640.0	.09	1270	15.0	± 10%	40	2.5	35.0	2.8	150	
.15	± 10%	38	25.0	600.0	.10	1200	18.0	± 10%	50	2.5	30.0	3.1	145	
.18	± 10%	35	25.0	550.0	.12	1105	22.0	± 10%	50	2.5	25.0	3.3	140	
.22	± 10%	33	25.0	510.0	.14	1025	27.0	± 10%	50	2.5	20.0	3.5	135	
.27	± 10%	33	25.0	430.0	.16	960								
.33	± 10%	30	25.0	410.0	.22	815	33.0	± 10%	45	2.5	24.0	3.4	130	
.39	± 10%	30	25.0	365.0	.30	700	39.0	± 10%	45	2.5	22.0	3.6	125	
.47	± 10%	30	25.0	330.0	.35	650	47.0	± 10%	45	2.5	20.0	4.5	110	
.56	± 10%	30	25.0	300.0	.50	545	56.0	± 10%	45	2.5	18.0	5.7	100	
.68	± 10%	28	25.0	275.0	.60	495	68.0	± 10%	50	2.5	15.0	6.7	92	
.82	± 10%	28	25.0	250.0	.85	415	82.0	± 10%	50	2.5	14.0	7.3	88	
1.0	± 10%	25	25.0	230.0	1.0	385	100.0	± 10%	50	2.5	13.0	8.0	84	
							120.0	± 10%	30	.79	12.0	13.0	66	
1.2	± 10%	25	7.9	150.0	.18	590	150.0	± 10%	30	.79	11.0	15.0	61	
1.5	± 10%	28	7.9	140.0	.22	535	180.0	± 10%	30	.79	10.0	17.0	57	
1.8	± 10%	30	7.9	125.0	.30	455	220.0	± 10%	30	.79	9.0	21.0	52	
2.2	± 10%	30	7.9	115.0	.40	395	270.0	± 10%	30	.79	8.0	25.0	47	
2.7	± 10%	37	7.9	100.0	.55	355	330.0	± 10%	30	.79	7.0	28.0	45	
3.3	± 10%	45	7.9	90.0	.85	270	390.0	± 10%	30	.79	6.5	35.0	40	
3.9	± 10%	45	7.9	80.0	1.0	250	470.0	± 10%	30	.79	6.0	42.0	36	
4.7	± 10%	45	7.9	75.0	1.2	230	560.0	± 10%	30	.79	5.0	46.0	35	
5.6	± 10%	50	7.9	65.0	1.8	185	680.0	± 10%	30	.79	4.0	60.0	30	
6.8	± 10%	50	7.9	60.0	2.0	175	820.0	± 10%	30	.79	3.8	65.0	29	
8.2	± 10%	55	7.9	55.0	2.7	155	1000.0	± 10%	30	.79	3.4	72.0	28	
10.0	± 10%	55	7.9	50.0	3.7	130								
MODEL IR-4							MODEL IR-4							
.15	± 20%	50	25.0	525.0	.03	2450	75.0	± 5%	55	2.5	10.5	3.70	147	IRON CORE
.22	± 20%	50	25.0	450.0	.055	1810	82.0	± 5%	50	2.5	10.3	3.90	143	
.33	± 20%	45	25.0	360.0	.09	1400	91.0	± 5%	50	2.5	10.0	4.30	136	
.47	± 20%	45	25.0	310.0	.12	1225	100.0	± 5%	50	2.5	9.5	4.50	133	
.56	± 10%	50	25.0	280.0	.135	1150	110.0	± 5%	60	.79	8.9	4.90	128	
.68	± 10%	50	25.0	250.0	.15	1100	120.0	± 5%	65	.79	8.7	5.20	124	
.82	± 10%	50	25.0	220.0	.22	900	130.0	± 5%	65	.79	8.5	5.45	121	
1.0	± 10%	50	25.0	200.0	.29	785	150.0	± 5%	65	.79	8.0	6.05	114	
1.2	± 10%	33	7.9	180.0	.42	650	160.0	± 5%	65	.79	7.5	6.40	111	
1.5	± 10%	33	7.9	160.0	.50	600	180.0	± 5%	65	.79	7.0	6.75	108	
1.8	± 10%	33	7.9	150.0	.65	525	200.0	± 5%	65	.79	6.5	7.10	106	
2.2	± 10%	33	7.9	135.0	.95	435	220.0	± 5%	65	.79	6.2	7.45	103	
2.7	± 10%	33	7.9	120.0	1.20	385	240.0	± 5%	65	.79	5.9	7.80	101	
3.3	± 10%	33	7.9	110.0	2.0	300	270.0	± 5%	65	.79	5.7	11.0	129	
3.9	± 10%	33	7.9	100.0	2.30	280	300.0	± 5%	65	.79	5.4	11.5	125	
4.7	± 10%	33	7.9	90.0	2.60	260	330.0	± 5%	65	.79	5.1	12.0	123	
5.6	± 10%	45	7.9	60.0	.32	495	360.0	± 5%	65	.79	4.8	15.5	108	
6.8	± 10%	50	7.9	55.0	.50	395	390.0	± 5%	65	.79	4.5	16.3	105	
8.2	± 10%	50	7.9	50.0	.60	360	430.0	± 5%	65	.79	4.2	17.1	102	
10.0	± 10%	55	7.9	45.0	.90	290	470.0	± 5%	65	.79	3.9	17.9	100	
12.0	± 10%	65	2.5	42.0	1.10	265	510.0	± 5%	65	.79	3.7	18.8	98	
15.0	± 10%	65	2.5	40.0	1.40	240	560.0	± 5%	65	.79	3.5	24.7	85	
18.0	± 10%	75	2.5	34.0	2.25	185	620.0	± 5%	65	.79	3.3	25.9	83	
22.0	± 10%	75	2.5	30.0	2.50	175	680.0	± 5%	55	.79	3.1	27.2	81	
27.0	± 10%	60	2.5	25.0	2.60	170	750.0	± 5%	55	.79	2.9	28.6	79	
33.0	± 10%	65	2.5	19.0	3.0	165	820.0	± 5%	55	.79	2.7	30.0	77	
36.0	± 5%	60	2.5	15.5	2.50	180	910.0	± 5%	55	.79	2.5	31.5	76	
39.0	± 5%	60	2.5	14.5	2.60	176	1000.0	± 5%	55	.79	2.3	33.1	74	
43.0	± 5%	60	2.5	13.7	2.70	172	1100.0	± 5%	30	.25	2.1	43.5	64	
47.0	± 5%	55	2.5	13.0	2.75	170	1200.0	± 5%	30	.25	2.0	45.7	63	
51.0	± 5%	55	2.5	12.7	2.85	167	1300.0	± 5%	30	.25	1.9	49.0	61	
56.0	± 5%	55	2.5	12.0	3.0	164	1500.0	± 5%	30	.25	1.8	52.5	59	
62.0	± 5%	55	2.5	11.5	3.15	160	1600.0	± 5%	30	.25	1.7	54.0	58	
68.0	± 5%	55	2.5	11.0	3.30	156	1800.0	± 5%	30	.25	1.6	56.7	56	

* Measured with full length lead. ** Rated DC current based on maximum temperature rise as shown in table.

HOW TO ORDER		
IR-2	10μH	± 10%
MODEL	INDUCTANCE VALUE	INDUCTANCE TOLERANCE

MODEL IRF Inductors

Epoxy Conformal Coated Uniform Roll Coated



FEATURES

- Flame-retardant coating and color band identification
- Uniform coating is excellent for automatic insertion
- Available in bulk, ammo and reel pack per EIA RS-296
- Superior electrical specifications High Q and Self Resonant Frequency, Low DC resistance, High rated DC current

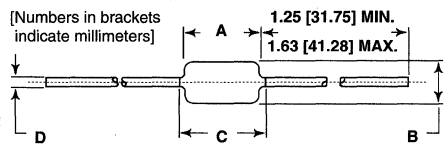
STANDARD ELECTRICAL SPECIFICATIONS

MODEL IRF-1							MODEL IRF-3						
IND. (μH)	TOL.	Q MIN.	TEST FREQ. L & Q (MHz)	SRF MIN.* (MHz)	DCR MAX. (Ohms)	RATED DC** CURRENT (mA)	IND. (μH)	TOL.	Q MIN.	TEST FREQ. L & Q (MHz)	SRF MIN.* (MHz)	DCR MAX. (Ohms)	RATED DC** CURRENT (mA)
.10	±20%	40	25.0	400.0	.06	1350	.22	±20%	55	25.0	380.0	.10	1400
.12	±20%	40	25.0	400.0	.06	1270	.27	±20%	55	25.0	340.0	.11	1320
.15	±20%	40	25.0	400.0	.07	1200	.33	±20%	55	25.0	300.0	.12	1280
.18	±20%	40	25.0	400.0	.075	1155	.39	±20%	55	25.0	280.0	.13	1200
.22	±20%	40	25.0	380.0	.075	1150	.47	±20%	55	25.0	250.0	.14	1150
.27	±20%	40	25.0	360.0	.08	1110	.56	±20%	55	25.0	230.0	.15	1100
.33	±20%	40	25.0	350.0	.08	1110	.68	±20%	55	25.0	210.0	.16	1030
.39	±20%	40	25.0	320.0	.09	1000	.82	±20%	55	25.0	172.0	.17	980
.47	±20%	40	25.0	300.0	.10	1000	1.0	±10%	55	25.0	157.0	.19	920
.56	±20%	40	25.0	280.0	.11	950	1.2	±10%	50	7.9	144.0	.21	880
.68	±20%	40	25.0	250.0	.12	900	1.5	±10%	50	7.9	131.0	.23	830
.82	±20%	40	25.0	200.0	.12	900	1.8	±10%	55	7.9	121.0	.25	790
1.0	±10%	50	25.0	180.0	.15	815	2.2	±10%	55	7.9	110.0	.28	750
1.2	±10%	50	7.9	165.0	.18	740	2.7	±10%	60	7.9	100.0	.30	720
1.5	±10%	50	7.9	150.0	.20	700	3.3	±10%	65	7.9	94.0	.34	670
1.8	±10%	50	7.9	125.0	.23	655	3.9	±10%	65	7.9	86.0	.37	640
2.2	±10%	50	7.9	115.0	.25	630	4.7	±10%	70	7.9	80.0	.39	620
2.7	±10%	50	7.9	100.0	.28	595	5.6	±10%	70	7.9	74.0	.43	590
3.3	±10%	50	7.9	90.0	.30	575	6.8	±10%	75	7.9	68.0	.48	550
3.9	±10%	50	7.9	80.0	.32	555	8.2	±10%	80	7.9	53.0	.52	530
4.7	±10%	50	7.9	75.0	.35	530	10.0	±10%	85	7.9	45.0	.58	500
5.6	±10%	50	7.9	65.0	.40	500	12.0	±10%	75	2.5	42.0	.63	480
6.8	±10%	50	7.9	60.0	.45	470	15.0	±10%	70	2.5	40.0	.72	460
8.2	±10%	50	7.9	55.0	.55	425	18.0	±10%	65	2.5	34.0	.77	430
10.0	±10%	50	7.9	50.0	.72	370	22.0	±10%	60	2.5	30.0	.84	410
12.0	±10%	50	2.5	40.0	.80	350	27.0	±10%	55	2.5	25.0	.94	390
15.0	±10%	50	2.5	35.0	.88	335	33.0	±10%	55	2.5	19.0	1.03	370
18.0	±10%	50	2.5	30.0	1.0	315	39.0	±10%	50	2.5	14.5	1.12	350
22.0	±10%	50	2.5	25.0	1.2	285	47.0	±10%	45	2.5	13.0	1.22	340
27.0	±10%	50	2.5	20.0	1.35	270	56.0	±10%	40	2.5	12.0	1.34	320
33.0	±10%	50	2.5	24.0	1.5	255	68.0	±10%	40	2.5	11.0	1.47	305
39.0	±10%	50	2.5	22.0	1.7	240	82.0	±10%	35	2.5	10.3	1.62	290
47.0	±10%	60	2.5	20.0	2.3	205	100.0	±10%	30	2.5	9.5	1.8	275
56.0	±10%	60	2.5	18.0	2.6	195	120.0	±10%	70	.79	3.8	3.7	185
68.0	±10%	60	2.5	15.0	2.9	185	150.0	±10%	70	.79	3.5	4.2	175
82.0	±10%	60	2.5	14.0	3.2	175	180.0	±10%	70	.79	3.3	4.6	165
100.0	±10%	60	2.5	13.0	3.5	165	220.0	±10%	70	.79	3.0	5.1	155
120.0	±10%	60	.79	5.40	3.8	160	270.0	±10%	70	.79	2.8	5.8	145
150.0	±10%	60	.79	4.75	4.4	150	330.0	±10%	70	.79	2.6	6.4	137
180.0	±10%	60	.79	4.35	5.0	140	390.0	±10%	65	.79	2.4	7.0	133
220.0	±10%	60	.79	4.0	5.7	130	470.0	±10%	65	.79	2.25	7.7	126
270.0	±10%	60	.79	3.70	6.5	120	560.0	±10%	65	.79	2.1	8.5	120
330.0	±10%	60	.79	3.40	9.5	100	680.0	±10%	65	.79	1.95	9.4	113
390.0	±10%	60	.79	2.80	10.5	95	820.0	±10%	65	.79	1.85	10.5	105
470.0	±10%	60	.79	2.55	11.6	90	1000.0	±10%	65	.79	1.4	14.0	100
560.0	±10%	60	.79	2.35	13.0	85							
680.0	±10%	60	.79	2.0	18.0	75							
820.0	±10%	60	.79	1.85	23.0	65							
1000.0	±10%	60	.79	1.40	26.0	60							

* Measured with full length lead.

** Rated DC current based on a temperature rise of 15°C at 90°C ambient.

DIMENSIONAL CONFIGURATIONS



MODEL	A (Max.)	B (Max.)	C (Max.)	D
IRF-1	.260 [6.60]	.120 [3.05]	.330 [8.38]	.0200 ± .0015 [.508 ± .038]
IRF-3	.385 [9.78]	.165 [4.19]	.410 [10.41]	.025 ± .002 [.635 ± .051]

ELECTRICAL SPECIFICATIONS

Inductance Tolerance: ± 5%, ± 10%, ± 20%. Other tolerances available on request.

Insulation Resistance: 1000 MΩ min. per MIL-STD-202, Method 302, Test Condition B.

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

MECHANICAL and ENVIRONMENTAL SPECIFICATIONS (Per MIL-STD-202)

Terminal Strength: 5 lbs. pull, Method 211, Test Condition A.

Flammability: Method 111.

Resistance to Soldering Heat: Method 210, Test Condition A.

Resistance to Solvents: Method 215.

MATERIAL SPECIFICATIONS

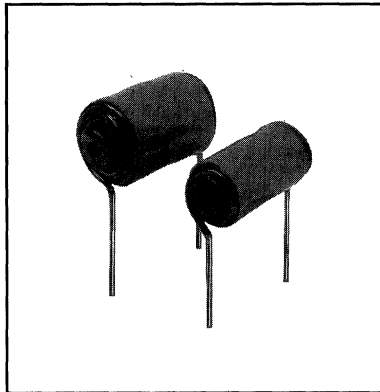
Coating: Epoxy-uniform roll coated. **Lead:** Tinned Copper. **Core:** Ferrite.

Weight: IRF-1 = .3 gram maximum. IRF-3 = .6 gram maximum.

ENVIRONMENTAL SPECIFICATIONS - Overload: Per MIL-C-15305.

How to Order & Test Equipment: Same as IR.

MODEL IH Filter Inductors High Current



FEATURES

- Printed circuit mounting
- Pre-tinned leads
- Protected by polyolefin tubing - flame retardant UL type VW-1 per MIL-I-23053/5, Class 3 requirements

APPLICATIONS

Noise filtering for switching regulators, power amplifiers, power supplies and SCR or Triac control circuits.

ELECTRICAL SPECIFICATIONS

Inductance: Measured at 1.0 volt with zero DC current.

Incremental Current: The typical current at which the inductance will be decreased by 5% from its initial zero DC value.

Operating Temperature: - 55°C to + 125°C (no load).
- 55°C to 75°C (at full rated current).

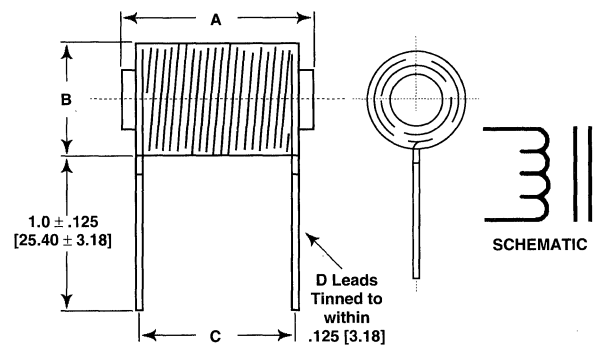
STANDARD ELECTRICAL SPECIFICATIONS

MODEL	IND. @ 1 kHz (μ H)	TOL.	DCR MAX. (Ohms)	RATED CURRENT (Max. Amps)	INCRE- MENTAL CURRENT (Amps)
IH-3	5	$\pm 10\%$	.015	10.0	25
IH-3	10	$\pm 10\%$	.018	9.0	19
IH-3	27	$\pm 10\%$.035	7.0	12
IH-3	50	$\pm 10\%$.050	5.6	8
IH-3	100	$\pm 10\%$.065	5.2	6
IH-3	150	$\pm 10\%$.075	5.0	5
IH-3	250	$\pm 10\%$.090	5.0	4
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IH-5	5	$\pm 10\%$.012	14.0	25
IH-5	10	$\pm 10\%$.015	12.0	19
IH-5	27	$\pm 10\%$.025	9.0	13
IH-5	50	$\pm 10\%$.030	8.0	10
IH-5	68	$\pm 10\%$.035	7.5	9
IH-5	100	$\pm 10\%$.050	7.5	7
IH-5	150	$\pm 10\%$.060	7.0	5
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IH-10	5	$\pm 10\%$.010	19.0	25
IH-10	10	$\pm 10\%$.012	16.0	19
IH-10	27	$\pm 10\%$.018	12.5	12
IH-10	50	$\pm 10\%$.025	11.0	10
IH-10	68	$\pm 10\%$.027	10.0	8
IH-10	100	$\pm 10\%$.030	10.0	7
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IH-15	5	$\pm 10\%$.008	24.0	25
IH-15	10	$\pm 10\%$.010	20.0	19
IH-15	27	$\pm 10\%$.015	16.0	14
IH-15	50	$\pm 10\%$.020	15.0	10

HOW TO ORDER

MODEL	INDUCTANCE VALUE	INDUCTANCE TOLERANCE
IH-5	10 μ H	$\pm 10\%$

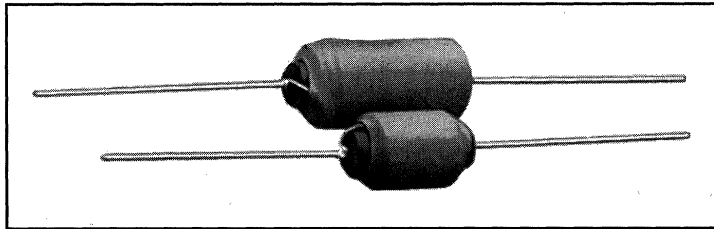
DIMENSIONAL CONFIGURATIONS



[Numbers in brackets indicate millimeters]

MODEL	A (Max.)	B (Max.)	C $\pm .062$ [1.59]	D $\pm .005$ [.130]
IH-3	.875 [22.23]	.600 [15.24]	.500 [12.70]	.042 [1.067]
IH-3	1.125 [28.58]	.625 [15.88]	.687 [17.45]	.042 [1.067]
IH-3	.875 [22.23]	.800 [20.32]	.437 [11.10]	.042 [1.067]
IH-3	.875 [22.23]	.800 [20.32]	.750 [19.05]	.042 [1.067]
IH-3	1.125 [28.58]	.800 [20.32]	.937 [23.80]	.042 [1.067]
IH-3	1.375 [34.93]	.800 [20.32]	1.062 [26.97]	.042 [1.067]
IH-3	1.625 [41.28]	.800 [20.32]	1.312 [33.32]	.042 [1.067]
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IH-5	.875 [22.23]	.625 [15.88]	.750 [19.05]	.053 [1.35]
IH-5	1.125 [28.58]	.625 [15.88]	1.0 [25.40]	.053 [1.35]
IH-5	.875 [22.23]	.840 [21.34]	.562 [14.27]	.053 [1.35]
IH-5	1.125 [28.58]	.840 [21.34]	.750 [19.05]	.053 [1.35]
IH-5	1.125 [28.58]	.860 [21.84]	.875 [22.23]	.053 [1.35]
IH-5	1.375 [34.93]	.860 [21.84]	1.0 [25.40]	.053 [1.35]
IH-5	1.625 [41.28]	.860 [21.84]	1.250 [31.75]	.053 [1.35]
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IH-10	1.125 [28.58]	.635 [16.13]	.812 [20.62]	.065 [1.65]
IH-10	1.375 [34.93]	.635 [16.13]	1.218 [30.94]	.065 [1.65]
IH-10	1.125 [28.58]	.935 [23.75]	.687 [17.45]	.065 [1.65]
IH-10	1.375 [34.93]	.935 [23.75]	.937 [23.80]	.065 [1.65]
IH-10	1.375 [34.93]	.935 [23.75]	1.125 [28.58]	.065 [1.65]
IH-10	1.625 [41.28]	.935 [23.75]	1.312 [33.32]	.065 [1.65]
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IH-15	1.375 [34.93]	.700 [17.78]	.937 [23.80]	.082 [2.08]
IH-15	1.687 [42.85]	.700 [17.78]	1.50 [38.10]	.082 [2.08]
IH-15	1.375 [34.93]	1.0 [25.40]	.937 [23.80]	.082 [2.08]
IH-15	1.625 [41.28]	1.0 [25.40]	1.125 [28.58]	.082 [2.08]

MODEL IHA Filter Inductors High Current



FEATURES

- Printed circuit mounting (axial leads)
- Pre-tinned leads
- Low cost construction
- Designed for use with switching power supplies
- Protected by polyolefin sleeve - flame retardant UL type VW-1 per MIL-I-23053/5, Class 3 requirements

STANDARD ELECTRICAL SPECIFICATIONS				
MODEL	IND. @ 1 kHz (μ H)	TOL.	DCR MAX. (Ohms)	RATED CURRENT (Max. Amps)
IHA-101	50	$\pm 10\%$	.12	2.5
IHA-102	100	$\pm 10\%$	.16	2.1
IHA-103	250	$\pm 10\%$	.28	1.8
IHA-104	500	$\pm 10\%$	.42	1.6
IHA-105	1000	$\pm 10\%$	.60	1.4
IHA-201	27	$\pm 10\%$	.060	3.7
IHA-202	50	$\pm 10\%$	.085	3.1
IHA-203	100	$\pm 10\%$	.12	2.7
IHA-204	250	$\pm 10\%$	.20	2.4
IHA-205	500	$\pm 10\%$	.32	2.3
IHA-301	5	$\pm 10\%$	.015	6.8
IHA-302	10	$\pm 10\%$	.021	6.1
IHA-303	27	$\pm 10\%$	.040	4.8
IHA-304	50	$\pm 10\%$	.050	4.3
IHA-305	100	$\pm 10\%$	.070	4.2
IHA-501	5	$\pm 10\%$	.010	9.3
IHA-502	10	$\pm 10\%$	.015	8.3
IHA-503	27	$\pm 10\%$	.030	6.5
IHA-504	50	$\pm 10\%$	.040	6.1
IHA-505	100	$\pm 10\%$	.060	5.9

DIMENSIONAL CONFIGURATIONS			
[Numbers in brackets indicate millimeters]			
MODEL	A (Max.)	B (Max.)	C $\pm .002$ [.050]
IHA-101	.475 [12.07]	.800 [20.32]	.032 [.813]
IHA-102	.475 [12.07]	.800 [20.32]	.032 [.813]
IHA-103	.475 [12.07]	1.05 [26.67]	.032 [.813]
IHA-104	.550 [13.97]	1.05 [26.67]	.032 [.813]
IHA-105	.550 [13.97]	.175 [29.85]	.032 [.813]
IHA-201	.500 [12.70]	.800 [20.32]	.032 [.813]
IHA-202	.500 [12.70]	.800 [20.32]	.032 [.813]
IHA-203	.500 [12.70]	.920 [23.37]	.032 [.813]
IHA-204	.600 [15.24]	.920 [23.37]	.032 [.813]
IHA-205	.750 [19.05]	1.05 [26.67]	.032 [.813]
IHA-301	.475 [12.07]	.800 [20.32]	.032 [.813]
IHA-302	.475 [12.07]	.920 [23.37]	.032 [.813]
IHA-303	.550 [13.97]	.800 [20.32]	.032 [.813]
IHA-304	.550 [13.97]	.920 [23.37]	.032 [.813]
IHA-305	.550 [13.97]	1.175 [29.85]	.032 [.813]
IHA-501	.475 [12.07]	1.05 [26.67]	.040 [1.02]
IHA-502	.475 [12.07]	1.05 [26.67]	.040 [1.02]
IHA-503	.700 [17.78]	1.05 [26.67]	.040 [1.02]
IHA-504	.700 [17.78]	1.05 [26.67]	.040 [1.02]
IHA-505	.700 [17.78]	1.30 [33.02]	.040 [1.02]

ELECTRICAL SPECIFICATIONS

Inductance: Measured at 1 V with no DC current.

Current Rating: Maximum continuous operating current (DC or RMS) based on 50°C temperature rise.

Dielectric Rating: 2500 V RMS, 60 Hz, applied for one minute between winding and outer circumference to within .250" [6.35] of the insulation sleeve edge.

Operating Temperature: - 55°C to + 125°C (no load).
- 55°C to + 75°C (at full rated current).

MECHANICAL SPECIFICATIONS

Winding: Layered solenoid type with magnetic core.

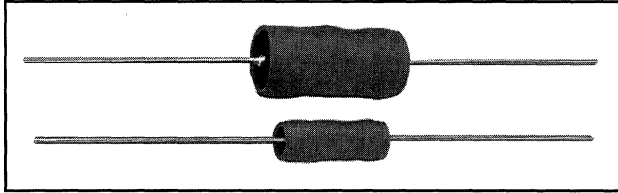
Wire: Solid soft copper.

Terminals: Tinned copper leads.

Coating: Polyolefin tubing.

HOW TO ORDER		
MODEL	INDUCTANCE VALUE	INDUCTANCE TOLERANCE
IHA-101	50 μ H	$\pm 10\%$

MODEL IHD Filter Inductors High Current



FEATURES

- Printed circuit mounting (axial leads)
- Protected by polyolefin sleeve
- High saturation bobbin used allowing high inductance with low DC resistance
- Pre-tinned leads
- High resistivity core offers very high parallel resistance, resulting in maximum coil performance

STANDARD ELECTRICAL SPECIFICATIONS									
MODEL IHD-1				MODEL IHD-3					
IND. @ 1 kHz (μH)	TOL.	DCR MAX. (Ohms)	RATED CURRENT (Max. Amps)	INCREMENTAL CURRENT (Amps Approx.)	IND. @ 1 kHz (μH)	TOL.	DCR MAX. (Ohms)	RATED CURRENT (Max. Amps)	INCREMENTAL CURRENT (Amps Approx.)
1.0	± 15%	.009	5.3	7.0	3.9	± 15%	.007	4.0	8.2
1.2	± 15%	.010	5.0	6.4	4.7	± 15%	.008	4.0	7.5
1.5	± 15%	.011	4.8	5.7	5.6	± 15%	.011	4.0	6.9
1.8	± 15%	.012	4.6	5.2	6.8	± 15%	.011	4.0	6.3
2.2	± 15%	.013	4.4	4.7	8.2	± 15%	.013	4.0	5.7
2.7	± 15%	.014	4.2	4.3	10.0	± 15%	.016	4.0	5.2
3.3	± 15%	.016	4.0	3.9	12.0	± 15%	.018	4.0	4.7
3.9	± 15%	.017	3.8	3.6	15.0	± 15%	.020	4.0	4.3
4.7	± 15%	.022	3.4	3.3	18.0	± 15%	.022	4.0	3.9
5.6	± 15%	.024	3.2	3.0	22.0	± 15%	.024	4.0	3.5
6.8	± 15%	.026	3.1	2.7	27.0	± 15%	.025	4.0	3.2
8.2	± 15%	.028	3.0	2.5	33.0	± 15%	.028	4.0	2.9
10.0	± 15%	.033	2.8	2.3	39.0	± 15%	.031	4.0	2.7
12.0	± 15%	.037	2.6	2.1	47.0	± 15%	.034	4.0	2.5
15.0	± 15%	.040	2.5	1.9	56.0	± 15%	.043	3.2	2.3
18.0	± 15%	.044	2.4	1.7	68.0	± 15%	.059	2.5	2.1
22.0	± 15%	.050	2.2	1.5	82.0	± 15%	.066	2.0	1.9
27.0	± 15%	.070	1.9	1.4	100.0	± 15%	.084	1.6	1.7
33.0	± 15%	.075	1.8	1.3	120.0	± 15%	.113	1.6	1.6
39.0	± 15%	.084	1.7	1.2	150.0	± 15%	.129	1.6	1.4
47.0	± 15%	.104	1.6	1.1	180.0	± 15%	.150	1.6	1.3
56.0	± 15%	.130	1.4	.97	220.0	± 15%	.162	1.6	1.2
68.0	± 15%	.145	1.3	.88	270.0	± 15%	.226	1.6	1.1
82.0	± 15%	.152	1.3	.80	330.0	± 15%	.257	1.6	.95
100.0	± 15%	.208	1.1	.73	390.0	± 15%	.288	1.6	.88
120.0	± 15%	.283	.94	.66	470.0	± 15%	.393	1.2	.80
150.0	± 15%	.330	.87	.60	560.0	± 15%	.504	1.0	.74
180.0	± 15%	.362	.83	.54	680.0	± 15%	.570	1.0	.67
220.0	± 15%	.505	.70	.49	820.0	± 15%	.643	.80	.61
270.0	± 15%	.557	.67	.45	1000.0	± 15%	.844	.80	.56
330.0	± 15%	.650	.62	.40	1200.0	± 15%	.977	.60	.51
390.0	± 15%	.770	.57	.37	1500.0	± 15%	1.18	.60	.46
470.0	± 15%	1.03	.49	.34	1800.0	± 15%	1.50	.60	.42
560.0	± 15%	1.14	.47	.31	2200.0	± 15%	1.76	.50	.38
680.0	± 15%	1.50	.41	.28	2700.0	± 15%	2.13	.40	.34
820.0	± 15%	1.98	.36	.26	3300.0	± 15%	2.53	.40	.31
1000.0	± 15%	2.30	.33	.23	3900.0	± 15%	2.84	.40	.29
1200.0	± 15%	2.55	.31	.21	4700.0	± 15%	3.79	.40	.26
1500.0	± 15%	3.0	.29	.19	5600.0	± 15%	4.24	.32	.24
1800.0	± 15%	4.0	.25	.18	6800.0	± 15%	5.75	.25	.22
2200.0	± 15%	4.40	.24	.16	8200.0	± 15%	6.44	.25	.20
2700.0	± 15%	5.80	.21	.14	10000.0	± 15%	7.30	.25	.18
3300.0	± 15%	6.56	.20	.13	12000.0	± 15%	9.34	.20	.17
3900.0	± 15%	8.63	.17	.12	15000.0	± 15%	10.7	.20	.15
4700.0	± 15%	10.1	.16	.11	18000.0	± 15%	14.8	.16	.14
5600.0	± 15%	11.2	.15	.10	22000.0	± 15%	18.0	.13	.12
6800.0	± 15%	15.0	.13	.09	27000.0	± 15%	22.7	.13	.11
8200.0	± 15%	20.8	.11	.08	33000.0	± 15%	25.7	.13	.10
10000.0	± 15%	23.4	.10	.08	39000.0	± 15%	29.7	.10	.09
12000.0	± 15%	26.0	.10	.07	47000.0	± 15%	33.7	.10	.09
15000.0	± 15%	36.0	.08	.06	56000.0	± 15%	38.0	.10	.08
18000.0	± 15%	40.0	.08	.06	68000.0	± 15%	52.8	.08	.07
					82000.0	± 15%	67.3	.07	.07
					100000.0	± 15%	76.0	.07	.06

ELECTRICAL SPECIFICATIONS

Inductance: Measured at 1 V with no DC current.

Incremental Current: The typical current at which the inductance will be decreased by 5% from its initial zero DC value.

Dielectric Rating: 2500 V RMS between winding and outer circumference to within .250" [6.35] of the insulating sleeve edge.

Operating Temperature:
 - 55°C to + 125°C (no load).
 - 55°C to + 85°C (at full rated current).

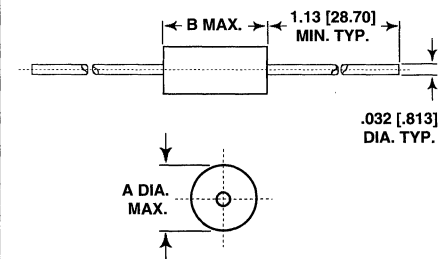
MECHANICAL SPECIFICATIONS

Wire: Solid soft copper.

Terminals: 20 AWG tinned copper leads.

Coating: Polyolefin tubing - flame retardant UL type VW-1 per MIL-I-23053/5, Class 3 requirements.

DIMENSIONAL CONFIGURATIONS



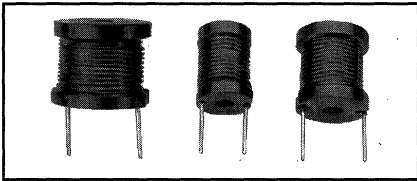
[Numbers in brackets indicate millimeters]

MODEL	A (Max.)	B (Max.)
IHD-1	.270 [6.85]	.700 [17.78]
IHD-3	.460 [11.68]	.900 [22.86]

HOW TO ORDER

IHD-1	3.9μH	± 15%
MODEL	INDUCTANCE	INDUCTANCE
	VALUE	TOLERANCE

MODEL IHB Filter Inductors High Current



FEATURES

- Printed circuit mounting
- Wide range of inductance and current ratings
- Pre-tinned leads
- Optional insulating covering and printing available at additional cost

ELECTRICAL SPECIFICATIONS

Inductance: Measured at 1 V with no DC current.

Dielectric: 2500 V RMS between winding and .250" [6.35] of insulating covering edge (with optional insulating covering).

Operating Temperature: - 55°C to + 130°C (no load).
- 55°C to + 80°C (at full rated current).

MECHANICAL SPECIFICATIONS

Terminals: Extensions of winding wire, solder coated to within .063" [1.60] of body.

Mounting: Center hole for mechanical mounting.

DIMENSIONAL CONFIGURATIONS					
	MODEL	A (Max.)	B (Max.)	C (Min.)	D (Min.)
	IHB-1	.660 [16.76]	.840 [21.34]	.162 [4.11]	.115 [2.92]
	IHB-2	.825 [20.96]	.840 [21.34]	.162 [4.11]	.115 [2.92]
	IHB-3	1.10 [27.94]	.840 [21.34]	.162 [4.11]	.115 [2.92]
	IHB-4	1.60 [40.64]	1.03 [26.16]	.250 [6.35]	.175 [4.45]
	IHB-5	1.60 [40.64]	1.45 [36.83]	.250 [6.35]	.175 [4.45]
	IHB-6	2.0 [50.80]	1.50 [38.10]	.330 [8.38]	.160 [4.06]

[Numbers in brackets indicate millimeters]

*E varies between components. See individual model specifications for details.

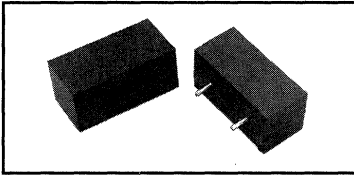
STANDARD ELECTRICAL SPECIFICATIONS and DIMENSION E														
MODEL IHB-1														
IND. @ 1 kHz (μH)	TOL.	DCR MAX. (Ohms)	RATED CURRENT (Amps)	APPROX. LEAD "E" SPACING	IND. @ 1 kHz (μH)	TOL.	DCR MAX. (Ohms)	RATED CURRENT (Amps)	APPROX. LEAD "E" SPACING	IND. @ 1 kHz (μH)	TOL.	DCR MAX. (Ohms)	RATED CURRENT (Amps)	APPROX. LEAD "E" SPACING
1.0	20%	.003	9.0	.550 [13.97]	10.0	10%	.010	9.0	.550 [13.97]	100.0	10%	.095	2.8	.500 [12.70]
1.2	20%	.003	9.0	.550 [13.97]	12.0	10%	.011	9.0	.550 [13.97]	120.0	10%	.127	2.0	.500 [12.70]
1.5	20%	.004	9.0	.550 [13.97]	15.0	10%	.015	7.2	.500 [12.70]	150.0	10%	.181	1.6	.500 [12.70]
1.8	20%	.004	9.0	.550 [13.97]	18.0	10%	.016	7.2	.500 [12.70]	180.0	10%	.217	1.6	.500 [12.70]
2.2	20%	.005	9.0	.550 [13.97]	22.0	10%	.020	5.5	.500 [12.70]	220.0	10%	.240	1.6	.500 [12.70]
2.7	20%	.005	9.0	.550 [13.97]	27.0	10%	.030	4.5	.500 [12.70]	270.0	10%	.300	1.6	.480 [12.19]
3.3	20%	.005	9.0	.550 [13.97]	33.0	10%	.040	4.0	.475 [12.07]	330.0	10%	.336	1.3	.480 [12.19]
3.9	20%	.006	9.0	.550 [13.97]	39.0	10%	.046	4.0	.475 [12.07]	390.0	10%	.460	1.0	.480 [12.19]
4.7	20%	.007	9.0	.550 [13.97]	47.0	10%	.062	2.8	.470 [11.94]	470.0	10%	.636	.8	.475 [12.07]
5.6	20%	.007	9.0	.550 [13.97]	56.0	10%	.069	2.8	.470 [11.94]	560.0	10%	.696	.8	.475 [12.07]
6.8	20%	.008	9.0	.550 [13.97]	68.0	10%	.077	2.8	.500 [12.70]					
8.2	20%	.009	9.0	.550 [13.97]	82.0	10%	.083	2.8	.500 [12.70]					
MODEL IHB-2														
1.0	20%	.003	11.4	.620 [15.75]	15.0	10%	.013	9.0	.620 [15.75]	220.0	10%	.150	2.8	.600 [15.24]
1.2	20%	.003	11.4	.620 [15.75]	18.0	10%	.018	7.2	.615 [15.62]	270.0	10%	.213	2.0	.600 [15.24]
1.5	20%	.003	11.4	.620 [15.75]	22.0	10%	.019	7.2	.615 [15.62]	330.0	10%	.305	1.6	.600 [15.24]
1.8	20%	.003	11.4	.620 [15.75]	27.0	10%	.026	5.5	.575 [14.61]	390.0	10%	.320	1.6	.600 [15.24]
2.2	20%	.004	11.4	.620 [15.75]	33.0	10%	.029	5.5	.575 [14.61]	470.0	10%	.355	1.6	.590 [14.99]
2.7	20%	.005	11.4	.620 [15.75]	39.0	10%	.030	5.5	.600 [15.24]	560.0	10%	.388	1.6	.590 [14.99]
3.3	20%	.005	11.4	.620 [15.75]	47.0	10%	.035	5.5	.600 [15.24]	680.0	10%	.430	1.6	.590 [14.99]
3.9	20%	.005	11.4	.620 [15.75]	56.0	10%	.039	5.5	.600 [15.24]	820.0	10%	.590	1.3	.590 [14.99]
4.7	20%	.005	11.4	.620 [15.75]	68.0	10%	.053	4.8	.600 [15.24]	1000.0	10%	.818	1.0	.590 [14.99]
5.6	20%	.006	11.4	.620 [15.75]	82.0	10%	.060	4.8	.600 [15.24]	1200.0	10%	1.14	.8	.590 [14.99]
6.8	20%	.007	11.4	.620 [15.75]	100.0	10%	.080	4.0	.600 [15.24]	1500.0	10%	1.26	.8	.590 [14.99]
8.2	20%	.007	11.4	.620 [15.75]	120.0	10%	.090	4.0	.600 [15.24]	1800.0	10%	1.39	.8	.590 [14.99]
10.0	10%	.009	11.4	.620 [15.75]	150.0	10%	.098	4.0	.600 [15.24]	2200.0	10%	1.54	.8	.590 [14.99]
12.0	10%	.009	11.4	.620 [15.75]	180.0	10%	.110	4.0	.600 [15.24]					

MODEL IHB

STANDARD ELECTRICAL SPECIFICATIONS and DIMENSION E [Numbers in brackets indicate millimeters]														
MODEL IHB-3														
IND. @ 1 kHz (μH)	TOL.	DCR MAX. (Ohms)	RATED CURRENT (Amps)	APPROX. LEAD "E" SPACING	IND. @ 1 kHz (μH)	TOL.	DCR MAX. (Ohms)	RATED CURRENT (Amps)	APPROX. LEAD "E" SPACING	IND. @ 1 kHz (μH)	TOL.	DCR MAX. (Ohms)	RATED CURRENT (Amps)	APPROX. LEAD "E" SPACING
1.0	20%	.003	21.0	.790 [20.07]	18.0	10%	.010	13.5	.750 [19.05]	330.0	10%	.122	4.5	.770 [19.56]
1.2	20%	.003	21.0	.790 [20.07]	22.0	10%	.011	13.5	.750 [19.05]	390.0	10%	.169	4.0	.740 [18.80]
1.5	20%	.003	21.0	.790 [20.07]	27.0	10%	.012	13.5	.800 [20.32]	470.0	10%	.187	4.0	.740 [18.80]
1.8	20%	.003	21.0	.790 [20.07]	33.0	10%	.017	13.5	.780 [19.81]	560.0	10%	.205	4.0	.740 [18.80]
2.2	20%	.003	21.0	.790 [20.07]	39.0	10%	.022	11.4	.780 [19.81]	680.0	10%	.256	2.8	.725 [18.42]
2.7	20%	.003	21.0	.790 [20.07]	47.0	10%	.024	9.0	.760 [19.30]	820.0	10%	.288	2.8	.725 [18.42]
3.3	20%	.003	21.0	.790 [20.07]	56.0	10%	.026	9.0	.760 [19.30]	1000.0	10%	.426	2.0	.715 [18.16]
3.9	20%	.003	21.0	.790 [20.07]	68.0	10%	.029	9.0	.760 [19.30]	1200.0	10%	.462	2.0	.760 [19.30]
4.7	20%	.003	21.0	.790 [20.07]	82.0	10%	.032	9.0	.760 [19.30]	1500.0	10%	.518	2.0	.760 [19.30]
5.6	20%	.003	21.0	.790 [20.07]	100.0	10%	.034	9.0	.760 [19.30]	1800.0	10%	.705	1.6	.740 [18.80]
6.8	20%	.004	21.0	.790 [20.07]	120.0	10%	.046	7.2	.740 [18.80]	2200.0	10%	1.02	1.3	.720 [18.29]
8.2	20%	.004	21.0	.790 [20.07]	150.0	10%	.064	5.5	.720 [18.29]	2700.0	10%	1.14	1.3	.720 [18.29]
10.0	10%	.006	17.0	.770 [19.56]	180.0	10%	.072	5.5	.720 [18.29]	3300.0	10%	1.27	1.3	.720 [18.29]
12.0	10%	.008	13.5	.750 [19.05]	220.0	10%	.080	5.5	.790 [20.07]	3900.0	10%	1.67	1.0	.700 [17.78]
15.0	10%	.009	13.5	.750 [19.05]	270.0	10%	.110	4.5	.770 [19.56]	4700.0	10%	1.86	1.0	.730 [18.54]
MODEL IHB-4														
1.8	20%	.002	27.0	1.10 [27.94]	39.0	10%	.012	21.0	1.10 [27.94]	820.0	10%	.154	7.2	1.13 [28.70]
2.2	20%	.002	27.0	1.10 [27.94]	47.0	10%	.018	14.4	1.10 [27.94]	1000.0	10%	.216	5.5	1.10 [27.94]
2.7	20%	.003	27.0	1.10 [27.94]	56.0	10%	.019	14.4	1.11 [28.19]	1200.0	10%	.232	5.5	1.10 [27.94]
3.3	20%	.003	27.0	1.10 [27.94]	68.0	10%	.021	14.4	1.11 [28.19]	1500.0	10%	.324	4.5	1.14 [28.96]
3.9	20%	.003	27.0	1.10 [27.94]	82.0	10%	.023	14.4	1.11 [28.19]	1800.0	10%	.360	4.5	1.14 [28.96]
4.7	20%	.003	27.0	1.10 [27.94]	100.0	10%	.025	14.4	1.11 [28.19]	2200.0	10%	.494	4.0	1.11 [28.19]
5.6	20%	.004	27.0	1.10 [27.94]	120.0	10%	.028	14.4	1.11 [28.19]	2700.0	10%	.555	4.0	1.11 [28.19]
6.8	20%	.004	27.0	1.10 [27.94]	150.0	10%	.040	11.4	1.10 [27.94]	3300.0	10%	.773	2.8	1.09 [27.69]
8.2	20%	.004	27.0	1.10 [27.94]	180.0	10%	.045	11.4	1.10 [27.94]	3900.0	10%	.845	2.8	1.09 [27.69]
10.0	10%	.005	27.0	1.10 [27.94]	220.0	10%	.050	11.4	1.10 [27.94]	4700.0	10%	1.14	2.0	1.07 [27.18]
12.0	10%	.005	27.0	1.10 [27.94]	270.0	10%	.056	11.4	1.10 [27.94]	5600.0	10%	1.60	2.0	1.05 [26.67]
15.0	10%	.006	27.0	1.10 [27.94]	330.0	10%	.074	11.4	1.16 [29.46]	6800.0	10%	1.76	1.6	1.05 [26.67]
18.0	10%	.008	27.0	1.10 [27.94]	390.0	10%	.082	9.0	1.13 [28.70]	8200.0	10%	1.95	1.6	1.09 [27.69]
22.0	10%	.009	21.0	1.10 [27.94]	470.0	10%	.114	7.2	1.13 [28.70]	10000.0	10%	2.76	1.3	1.07 [27.18]
27.0	10%	.010	21.0	1.10 [27.94]	560.0	10%	.125	7.2	1.13 [28.70]	12000.0	10%	3.04	1.3	1.07 [27.18]
33.0	10%	.011	21.0	1.10 [27.94]	680.0	10%	.139	7.2	1.13 [28.70]	15000.0	10%	3.39	1.3	1.07 [27.18]
MODEL IHB-5														
1.8	20%	.002	35.0	1.13 [28.70]	39.0	10%	.010	27.0	1.10 [27.94]	820.0	10%	.127	9.0	1.07 [27.18]
2.2	20%	.002	35.0	1.13 [28.70]	47.0	10%	.011	27.0	1.10 [27.94]	1000.0	10%	.176	7.2	1.05 [26.67]
2.7	20%	.002	35.0	1.13 [28.70]	56.0	10%	.013	21.0	1.10 [27.94]	1200.0	10%	.195	7.2	1.05 [26.67]
3.3	20%	.002	35.0	1.13 [28.70]	68.0	10%	.015	21.0	1.10 [27.94]	1500.0	10%	.274	5.5	1.03 [26.16]
3.9	20%	.003	35.0	1.13 [28.70]	82.0	10%	.017	21.0	1.10 [27.94]	1800.0	10%	.302	5.5	1.10 [27.94]
4.7	20%	.003	35.0	1.13 [28.70]	100.0	10%	.018	21.0	1.10 [27.94]	2200.0	10%	.338	5.5	1.10 [27.94]
5.6	20%	.003	35.0	1.13 [28.70]	120.0	10%	.022	17.0	1.08 [27.43]	2700.0	10%	.459	4.5	1.08 [27.43]
6.8	20%	.003	35.0	1.13 [28.70]	150.0	10%	.025	17.0	1.08 [27.43]	3300.0	10%	.642	4.0	1.06 [26.92]
8.2	20%	.003	35.0	1.13 [28.70]	180.0	10%	.035	13.5	1.12 [28.45]	3900.0	10%	.699	4.0	1.06 [26.92]
10.0	10%	.004	35.0	1.13 [28.70]	220.0	10%	.040	13.5	1.12 [28.45]	4700.0	10%	.775	4.0	1.06 [26.92]
12.0	10%	.004	35.0	1.13 [28.70]	270.0	10%	.044	13.5	1.12 [28.45]	5600.0	10%	.843	4.0	1.06 [26.92]
15.0	10%	.005	35.0	1.13 [28.70]	330.0	10%	.049	13.5	1.12 [28.45]	6800.0	10%	1.15	2.8	1.04 [26.42]
18.0	10%	.007	27.0	1.10 [27.94]	390.0	10%	.070	11.4	1.09 [27.69]	8200.0	10%	1.26	2.8	1.09 [27.69]
22.0	10%	.007	27.0	1.10 [27.94]	470.0	10%	.078	11.4	1.09 [27.69]	10000.0	10%	1.74	2.0	1.07 [27.18]
27.0	10%	.008	27.0	1.10 [27.94]	560.0	10%	.105	9.0	1.07 [27.18]	12000.0	10%	1.92	2.0	1.07 [27.18]
33.0	10%	.009	27.0	1.10 [27.94]	680.0	10%	.115	9.0	1.07 [27.18]	15000.0	10%	2.17	2.0	1.07 [27.18]
MODEL IHB-6														
4.7	20%	.002	35.0	1.43 [36.32]	120.0	10%	.015	27.0	1.45 [36.83]	3300.0	10%	.498	4.5	1.32 [33.53]
5.6	20%	.002	35.0	1.43 [36.32]	150.0	10%	.023	21.0	1.41 [35.81]	3900.0	10%	.548	4.5	1.32 [33.53]
6.8	20%	.003	35.0	1.43 [36.32]	180.0	10%	.025	21.0	1.41 [35.81]	4700.0	10%	.608	4.5	1.32 [33.53]
8.2	20%	.003	35.0	1.43 [36.32]	220.0	10%	.028	21.0	1.41 [35.81]	5600.0	10%	.671	4.5	1.38 [35.05]
10.0	10%	.003	35.0	1.43 [36.32]	270.0	10%	.030	21.0	1.41 [35.81]	6800.0	10%	.750	4.5	1.38 [35.05]
12.0	10%	.004	35.0	1.43 [36.32]	330.0	10%	.040	17.0	1.38 [35.05]	8200.0	10%	1.03	4.0	1.35 [34.29]
15.0	10%	.004	35.0	1.43 [36.32]	390.0	10%	.055	13.5	1.35 [34.29]	10000.0	10%	1.16	4.0	1.35 [34.29]
18.0	10%	.005	35.0	1.43 [36.32]	470.0	10%	.061	13.5	1.35 [34.29]	12000.0	10%	1.54	2.8	1.33 [33.78]
22.0	10%	.005	35.0	1.43 [36.32]	560.0	10%	.068	13.5	1.35 [34.29]	15000.0	10%	1.75	2.8	1.33 [33.78]
27.0	10%	.006	35.0	1.43 [36.32]	680.0	10%	.094	11.4	1.33 [33.78]	18000.0	10%	1.94	2.8	1.38 [35.05]
33.0	10%	.006	35.0	1.43 [36.32]	820.0	10%	.104	11.4	1.33 [33.78]	22000.0	10%	2.74	2.0	1.36 [34.56]
39.0	10%	.006	35.0	1.43 [36.32]	1000.0	10%	.143	9.0	1.31 [33.27]	27000.0	10%	3.71	1.7	1.33 [33.78]
47.0	10%	.008	35.0	1.53 [38.86]	1200.0	10%	.156	9.0	1.40 [35.56]	33000.0	10%	4.16	1.7	1.33 [33.78]
56.0	10%	.009	35.0	1.53 [38.86]	1500.0	10%	.219	7.2	1.37 [34.80]	39000.0	10%	5.55	1.4	1.31 [33.27]
68.0	10%	.009	35.0	1.53 [38.86]	1800.0	10%	.241	7.2	1.37 [34.80]	47000.0	10%	6.19	1.4	1.34 [34.04]
82.0	10%	.010	35.0	1.53 [38.86]	2200.0	10%	.270	7.2	1.37 [34.80]					
100.0	10%	.014	27.0	1.45 [36.83]	2700.0	10%	.364	5.5	1.34 [34.04]					

HOW TO ORDER		
IHB-1	10μH	± 10%
MODEL	INDUCTANCE VALUE	INDUCTANCE TOLERANCE

MODEL IHM-2 Filter Inductors High Current



FEATURES

- Totally encapsulated using a potted flame-resistant shell
- Pre-tinned leads
- Printed circuit mounting

STANDARD ELECTRICAL SPECIFICATIONS

IND. @ 1 kHz (μ H)	TOL.	DCR MAX. (Ohms)	RATED CURRENT (Max. Amps)
1.0	$\pm 10\%$	.005	17.8
1.2	$\pm 10\%$	.005	17.0
1.5	$\pm 10\%$	.006	16.2
1.8	$\pm 10\%$	.006	15.6
2.2	$\pm 10\%$	.007	15.0
2.7	$\pm 10\%$	.008	14.5
3.3	$\pm 10\%$	.008	14.0
3.9	$\pm 10\%$	.009	13.5
4.7	$\pm 10\%$	.010	13.0
5.6	$\pm 10\%$	.011	12.75
6.8	$\pm 10\%$	.012	12.50
8.2	$\pm 10\%$	.013	11.25
10.0	$\pm 10\%$	.014	10.0
12.0	$\pm 10\%$	.016	9.25
15.0	$\pm 10\%$	.022	8.50
18.0	$\pm 10\%$	.024	7.50
22.0	$\pm 10\%$	.033	6.50
27.0	$\pm 10\%$	.037	6.0
33.0	$\pm 10\%$	.051	5.50
39.0	$\pm 10\%$	.056	5.0
47.0	$\pm 10\%$	.076	4.50
56.0	$\pm 10\%$	.084	4.25
68.0	$\pm 10\%$	.093	4.0
82.0	$\pm 10\%$	.103	3.65
100.0	$\pm 10\%$	.140	3.30
120.0	$\pm 10\%$	.175	3.0
150.0	$\pm 10\%$	.210	2.70
180.0	$\pm 10\%$	.241	2.45
220.0	$\pm 10\%$	.330	2.20
270.0	$\pm 10\%$	.420	1.95
330.0	$\pm 10\%$	.510	1.70
390.0	$\pm 10\%$	.561	1.65
470.0	$\pm 10\%$	.610	1.60
560.0	$\pm 10\%$	.687	1.45
680.0	$\pm 10\%$	.910	1.30
820.0	$\pm 10\%$	1.03	1.15
1000.0	$\pm 10\%$	1.40	1.0
1200.0	$\pm 10\%$	1.57	.92
1500.0	$\pm 10\%$	2.20	.84
1800.0	$\pm 10\%$	2.42	.77
2200.0	$\pm 10\%$	3.30	.69
2700.0	$\pm 10\%$	3.72	.62
3300.0	$\pm 10\%$	5.10	.55
3900.0	$\pm 10\%$	5.58	.50
4700.0	$\pm 10\%$	7.70	.45
5600.0	$\pm 10\%$	8.32	.41
6800.0	$\pm 10\%$	11.70	.36
8200.0	$\pm 10\%$	12.80	.35
10000.0	$\pm 10\%$	14.20	.33
12000.0	$\pm 10\%$	15.70	.30
15000.0	$\pm 10\%$	21.90	.26

ELECTRICAL SPECIFICATIONS

Inductance: Measured at 1 V with no DC current.

Current Rating: Maximum continuous operating current based on 50°C temperature rise.

Dielectric Rating: 1500 V RMS between windings and top of component.

Operating Temperature: - 55°C to + 125°C (no load).
- 55°C to + 75°C (at full rated current).

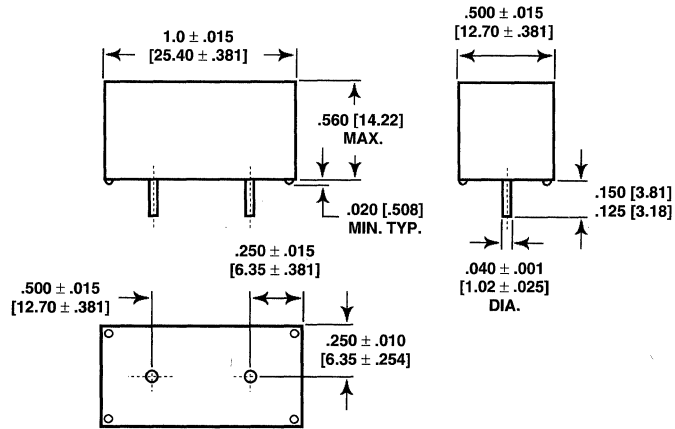
MECHANICAL SPECIFICATIONS

Terminals: 18 AWG tinned copper.

Encapsulant: Flame-resistant shell potted with epoxy.

DIMENSIONAL CONFIGURATIONS

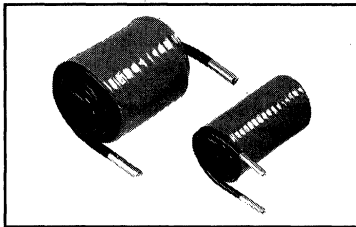
[Numbers in brackets indicate millimeters]



HOW TO ORDER

IHM-2 10 μ H $\pm 10\%$
MODEL INDUCTANCE VALUE INDUCTANCE TOLERANCE

MODEL IHV Filter Inductors High Current



FEATURES

- Printed circuit mounting
- Low cost construction
- Designed for use with switching power supplies
- Pre-tinned leads
- Epoxy coated for durability and reliability

STANDARD ELECTRICAL SPECIFICATIONS					
MODEL	IND.* @ 1 kHz (μ H)	TOL.	SELF- RESONANT FREQ. MIN. (kHz)	DCR MAX. (Ohms)	RATED CURRENT (Max. Amps)
IHV-15-500	500	$\pm 10\%$	.8	.0500	15
IHV-20-200	200	$\pm 10\%$	1.2	.0210	20
IHV-28-60	60	$\pm 10\%$	1.9	.0085	28
IHV-30-150	150	$\pm 10\%$	2.1	.0130	30
IHV-40-39	39	$\pm 10\%$	2.5	.0048	40
IHV-45-92	92	$\pm 10\%$	2.9	.0075	45
IHV-50-50	50	$\pm 10\%$	3.1	.0045	50
IHV-60-24	24	$\pm 10\%$	5.7	.0025	60

* Will not decrease more than 10% at rated current.

ELECTRICAL SPECIFICATIONS

Inductance: Measured at 1 V with no DC current.

Dielectric: 2500 V RMS between winding and outer circumference to within .250" [6.35] of the insulation sleeve edge.

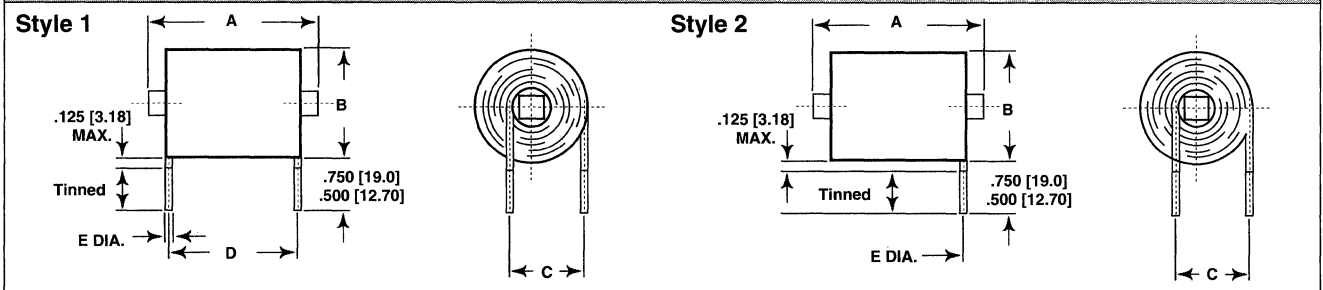
Operating Temperature: - 55°C to + 125°C (no load).
Storage: - 55°C to + 75°C (at full rated current).

MECHANICAL SPECIFICATIONS

Terminals: Extensions of winding wire, solder coated.

Coating: Epoxy conformal coated.

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



MODEL	STYLE	A (Maximum)	B $\pm .050$ [1.27]	C $\pm .062$ [1.57]	D $\pm .062$ [1.57]	E (Diameter)	TYPICAL WEIGHT (Grams)
IHV-15-500	1	2.45 [62.23]	1.45 [36.83]	.980 [24.89]	1.95 [49.53]	.082 [2.08]	305
IHV-20-200	2	2.45 [62.23]	1.45 [36.83]	.980 [24.89]	—	.102 [2.59]	310
IHV-28-60	2	2.45 [62.23]	1.02 [25.91]	.770 [19.56]	—	.102 [2.59]	160
IHV-30-150	2	2.45 [62.23]	1.65 [41.91]	1.08 [27.43]	—	.129 [3.28]	470
IHV-40-39	2	2.45 [62.23]	1.15 [29.21]	.820 [20.83]	—	.129 [3.28]	210
IHV-45-92	2	2.55 [64.77]	1.92 [48.77]	1.21 [30.73]	—	.162 [4.11]	650
IHV-50-50	1	2.55 [64.77]	1.57 [39.88]	1.05 [26.67]	2.10 [53.34]	.162 [4.11]	420
IHV-60-24	2	2.45 [62.23]	1.27 [32.26]	.890 [22.61]	—	.162 [4.11]	270

HOW TO ORDER

IHV-15 MODEL	500 μ H INDUCTANCE VALUE	$\pm 10\%$ INDUCTANCE TOLERANCE
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CUSTOM PRODUCTS

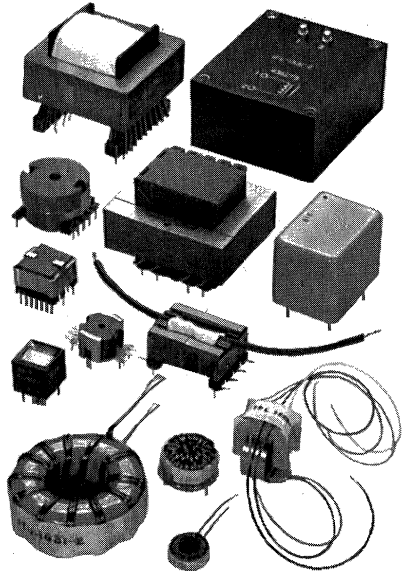
Magnetic Components

A COMPANY OF

VISHAY

DALE

Switch Mode Magnetics



CUSTOM DESIGN AND PRODUCTION

Dale® has extensive facilities for custom design and production of custom magnetics used in switching power supplies including:

- Inductors
- Switching Converters
- Current Sense Transformers
- Power Transformers

PACKAGE DESIGN AND MATERIALS

If you have your own electrical design we can add value by assisting you with selection of the most economical materials and efficient packaging design.

Dale can provide designs to meet UL, CSA, IEEE and VDE requirements.

Air Core Inductors



Produced to your specifications for a wide range of high frequency applications including: Television, Radio (2-way, scanners, AM/FM), Satellite Communication, Cable TV Systems, Microwave, Test Equipment.

ELECTRICAL SPECIFICATIONS

Frequency: To 500 MHz.

Current: 10 amp maximum.

Temperature: To 130°C.

MECHANICAL SPECIFICATIONS

Winding: 1 to 32 turns, clockwise or counter-clockwise with variable pitch.

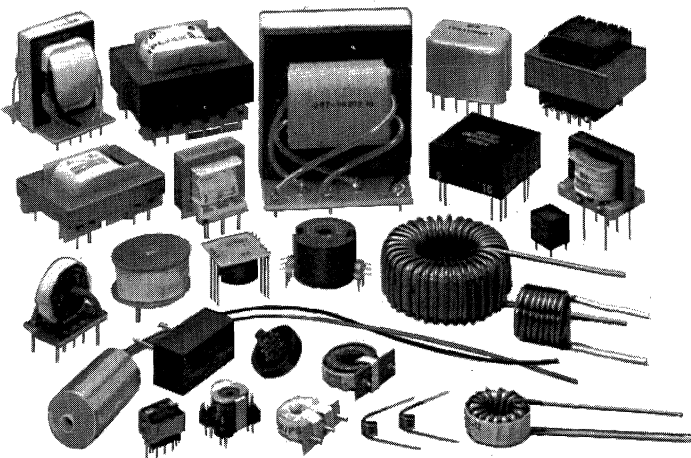
Wire Gauge: #18 to #32.

Leads: Automatically tinned. Various configurations available.

Coil Inside Diameter: .079" to .354" [2.01 to 8.99].

Coil Length: Up to 1.26" [32.0].

Inductive Products



Can't find it in the catalog? Dale has the custom capability to design and produce a wide range of magnetic components to your requirements.

POWER TRANSFORMERS:

50 to 400 Hz, VA ratings to 100 VA. Specialty models in Low Profile and PC Mount.

INDUCTORS:

Inductance values to 20 H, current ratings to 60 amps. Capability of many styles including: Toroidal, Laminated, E Core, Pot Core, Slug Core, Air Core.

AUDIO TRANSFORMERS:

Coupling Transformers and Hybrid Transformers available in PC Mount, Leadset and Low Profile.


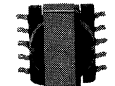




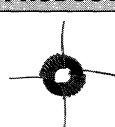





TRANSFORMERS:

Switching Magnetics, Converter Transformers, Pulse Transformers, High Voltage Transformer.

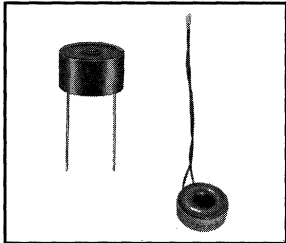
SURFACE MOUNT Inductive Components

Quick Reference Guide



STANDARD PRODUCTS		
1. 	MODELS IS-21 and IS-22 Inductors Toroidal or Pot Core 100μH to 40,000μH	Molded shell design. High Q. Low EMI. EIA PDP-100 P/N SOPM6464 package. Pick and place compatible.
2. 	MODEL PT-100-09 Transformers ISDN S/T and U Interfaces	CCITT I.430 pulse wave form. Digital communications. Pulse coupling. Pick and place compatible.
3. 	MODEL IMC-1812 Inductors Molded Chips 0.01μH to 1,000μH	RF circuits. Rugged construction. Size is .177" [4.50] L x .126" [3.20] W x .126" [3.20] H. Pick and place compatible.
4. 	MODEL ISC-1812 Inductors Shielded Molded Chips 0.1μH to 1,000μH	RF circuits. Rugged construction. Size is .177" [4.50] L x .126" [3.20] W x .126" [3.20] H. Pick and place compatible.
5. 	MODEL IMC-1210 Inductors Molded Chips 0.01μH to 100μH	RF circuits. Rugged construction. Size is .126" [3.20] L x .098" [2.49] W x .087" [2.21] H. Pick and place compatible.
CUSTOM VARIATIONS OF STANDARD PRODUCTS		
6. 	Toroid or Pot Core Inductors and Transformers, Slug Core Inductors	Modification of IS-21 and IS-22. Ferrite, molypermalloy, and powdered iron cores. Pick and place compatible.
CUSTOM PRODUCTS		
7. 	Toroidal Type Inductors or Transformers	Low Cost. Low EMI. Sizes down to 0.10" [2.54] OD.
8. 	Slug Core Style Inductors	Low Cost. Large D-C current capability.
9. 	LP Series Inductors or Transformers	Multiple sizes. On-board power supplies. Industry interchangeable. Pick and place compatible.
PRODUCTS UNDER DEVELOPMENT		
10. 	Toroidal Type Inductors or Transformers Molded Construction	Modified C style solder pads. Switching regulators. Common mode chokes. Rugged construction. Pick and place compatible.
11. 	Ferrite Core Inductors Metalized Solder Pads	Ultra low profile. Very high inductance. Shielded. Low EMI. Pick and place compatible.
12. 	Ferrite Cup Core Inductors or Transformers	Shielded. Low EMI. Large D-C current capability. Low cost. Pick and place compatible.

MODELS TE and TD Filter Inductors Toroid



FEATURES

- Choice of encapsulated (TE) or dipped (TD) styles
- TD style combines low cost with excellent performance in commercial applications
- High Q and wide selection of Q versus frequency ranges in one small package. Large number of standard inductance values.

STANDARD ELECTRICAL SPECIFICATIONS (Applies to Core Only)

MODEL	TE-2 TD-2	TE-3 TD-3	TE-4 TD-4	TE-5 TD-5	T. C. CODE	TEMPERATURE COEFFICIENT	TEMPERATURE RANGE	T. C. AVAILABILITY		
								Q0	Q3	Q4
X	X	X	X	X	TA	0 ± 1%	- 55°C to + 125°C	X	X	
			X	X	TB	0 ± 0.1%	+ 13°C to + 35°C	X	X	
X	X	X	X	X	TD	0 ± 0.1%	0°C to + 55°C	X	X	
			X	X	TE	0 ± 0.15%	0°C to + 55°C			X
	X	X	X	X	TL*	+ 40 to + 110 PPM/°C + 85 to + 185 PPM/°C	- 55°C to + 25°C + 25°C to + 85°C			X
X	X	X	X	X	TM	0 ± 0.25%	- 65°C to + 125°C		X	X
X	X	X	X	X	TR	50 PPM/°C (Typical)	- 65°C to + 125°C	X		
X	X	X	X	X	TW	0 ± 0.25%	- 55°C to + 85°C		X	X

* Inverse of typical Temperature Coefficient of polystyrene capacitor.

INDUCTANCE RANGES

T. C. CODE	TE-2 TD-2	TE-3 TD-3	TE-4 TD-4	TE-5 TD-5
Q0	40µH to 15mH	50µH to 15mH	150µH to 20mH	1mH to 100mH
Q3	475µH to 120mH	500µH to 1H	1mH to 2H	5mH to 2H
Q4	1mH to 250mH	1mH to 4H	2mH to 5H	10mH to 5H

ELECTRICAL SPECIFICATIONS

Tolerance:

- TE-2, TD-2 = ± 1% > 2mH, ± 2% = .05mH to 2mH.
- TE-3, TD-3 = ± 1% > 2mH, ± 2% 154µH to 2mH, ± 5% < 150µH.
- TE-4, TD-4 = ± 1% > 2mH, ± 2% < 2mH.
- TE-5, TD-5 = ± 1% > 2mH, ± 2% < 2mH.

Insulation Resistance: 1000 Megohm minimum.

Dielectric Strength: 1000 V minimum (TE). 500 V minimum (TD).

MECHANICAL SPECIFICATIONS

Terminal Strength: 2 pounds pull test (TE).

Vibration: Per MIL-T-27 (TE).

Shock: Per MIL-T-27 (TE).

Weight: TE-2 = 2 grams, TD-2 = 1.6 grams typical.
TE-3 = 5.1 grams, TD-3 = 4.9 grams typical.
TE-4 = 20 grams, TD-4 = 17 grams typical.
TE-5 = 53 grams, TD-5 = 52 grams typical.

MATERIAL SPECIFICATIONS

Coating: Vinyl (TD), non-flammable, abrasion and moisture resistant. Resists most cleaning agents.
(Consult factory for chemicals which may be used.)

Standard Terminals: Tinned copper (TE);
Stranded, tinned copper, Teflon insulated (TD).

Encapsulant: Epoxy (TE).

Gauge: TE-2 = 24 AWG, TD-2 = 30 AWG.
TE-3 = 22 AWG, TD-3 = 26 AWG.
TE-4 = 20 AWG, TD-4 = 24 AWG.
TE-5 = 20 AWG, TD-5 = 24 AWG.

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

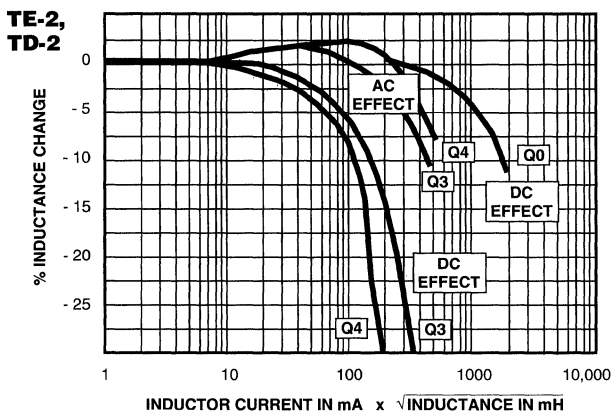
MODEL	A	B	C	D	E	F	G
TE-2	.437 [11.10]	.270 [6.86]	1.0 [25.40]	.020 [.508]	.300 [7.62]	—	—
TD-2	.437 [11.10]	.250 [6.35]	2.0 [50.80]	—	—	—	—
TE-3	.685 [17.40]	.385 [9.78]	1.0 [25.40]	.025 [.635]	.500 [12.70]	.093 [2.36]	.250 [6.35]
TD-3	.685 [17.40]	.320 [8.13]	3.0 [76.20]	—	—	.125 [3.18]	—
TE-4	1.06 [26.92]	.500 [12.70]	1.0 [25.40]	.032 [.813]	.900 [22.86]	.120 [3.05]	.450 [11.43]
TD-4	1.06 [26.92]	.437 [11.10]	4.0 [101.60]	—	—	.220 [5.59]	—
TE-5	1.32 [33.53]	.725 [18.42]	1.0 [25.40]	.032 [.813]	1.0 [25.40]	.144 [3.66]	.500 [12.70]
TD-5	1.32 [33.53]	.688 [17.48]	6.0 [152.40]	—	—	.220 [5.59]	—

MODELS TE and TD

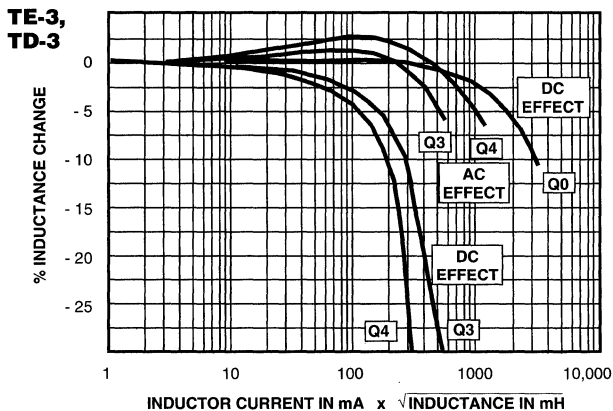
DC RESISTANCE AND SELF-RESONANT FREQUENCIES (Typical Values)

MODEL TE-2, TD-2	DCR (Ohms)			SELF-RESONANT FREQ. (MHz)			
	IND.	Q0	Q3	Q4	Q0	Q3	Q4
.05mH	1.9	—	—	10.0	—	—	
.10mH	2.7	—	—	7.0	—	—	
.332mH	7.7	—	—	3.1	—	—	
.475mH	9.3	2.3	—	2.5	2.4	—	
1.0mH	26.0	4.2	2.3	1.4	1.2	2.0	
3.32mH	79.0	9.7	5.4	.70	.79	.95	
10.0mH	251.0	31.0	18.0	.34	.40	.43	
33.2mH	—	118.0	54.0	—	.18	.21	
100.0mH	—	408.0	227.0	—	.06	.10	
250.0mH	—	—	450.0	—	—	.05	

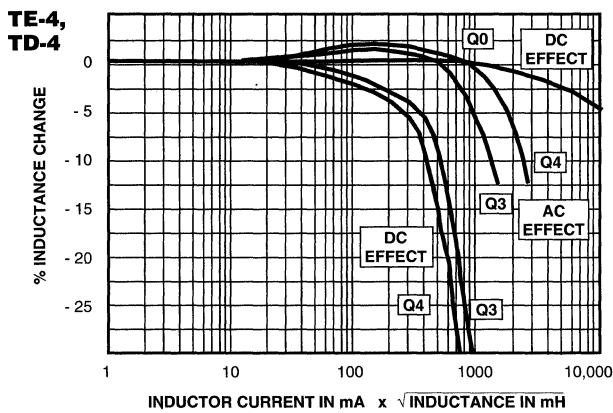
Inductance vs DC Bias, Inductance vs AC Excitation



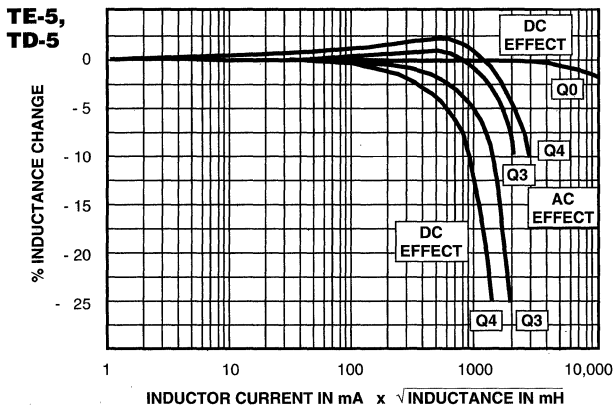
MODEL TE-3, TD-3	IND.	Q0	Q3	Q4	Q0	Q3	Q4
50.0μH	.68	—	—	7.6	—	—	
100.0μH	1.0	—	—	5.1	—	—	
332.0μH	3.3	—	—	2.9	—	—	
1.0mH	6.9	1.5	.82	1.4	1.1	1.0	
3.32mH	24.0	4.1	2.3	.79	.57	.55	
10.0mH	84.0	14.0	5.9	.40	.29	.25	
15.0mH	106.0	17.0	9.1	.34	.24	.21	
33.2mH	—	40.0	18.0	—	.14	.12	
100.0mH	—	138.0	58.0	—	.08	.077	
332.0mH	—	555.0	220.0	—	.04	.038	
1.0H	—	1500.0	670.0	—	.021	.019	
4.0H	—	—	2700.0	—	—	.009	



MODEL TE-4, TD-4	IND.	Q0	Q3	Q4	Q0	Q3	Q4
150.0μH	.54	—	—	2.6	—	—	
1.0mH	2.8	.7	—	1.0	.75	—	
2.0mH	5.5	1.4	.78	.64	.54	.45	
10.0mH	27.0	4.9	2.5	.24	.21	.18	
20.0mH	54.0	9.6	5.0	.18	.15	.13	
100.0mH	—	56.0	23.0	—	.059	.051	
1.0H	—	570.0	260.0	—	.016	.014	
2.0H	—	1200.0	520.0	—	.013	.011	
7.5H	—	—	2000.0	—	—	.004	

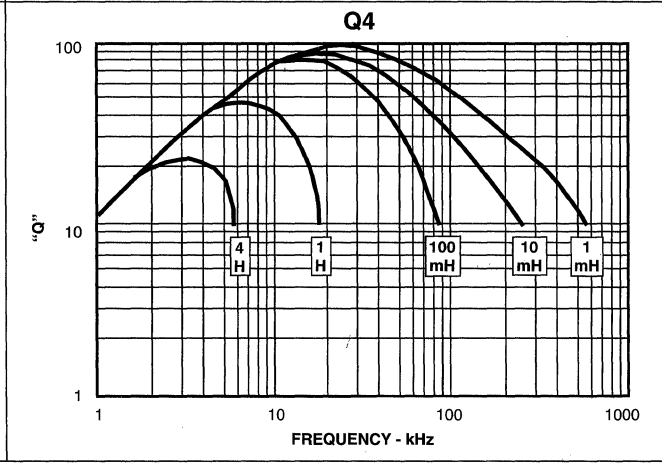
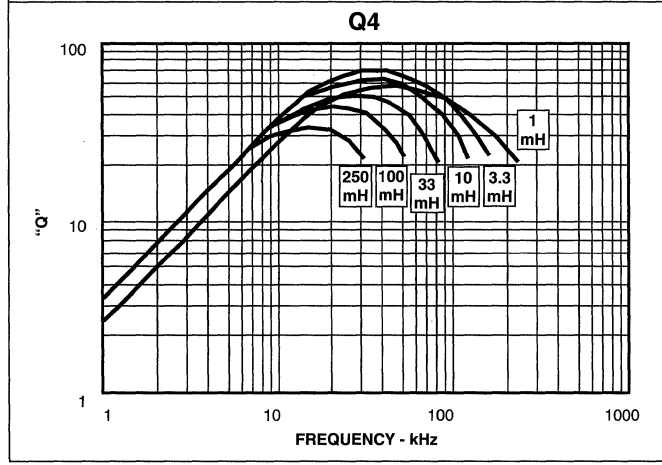
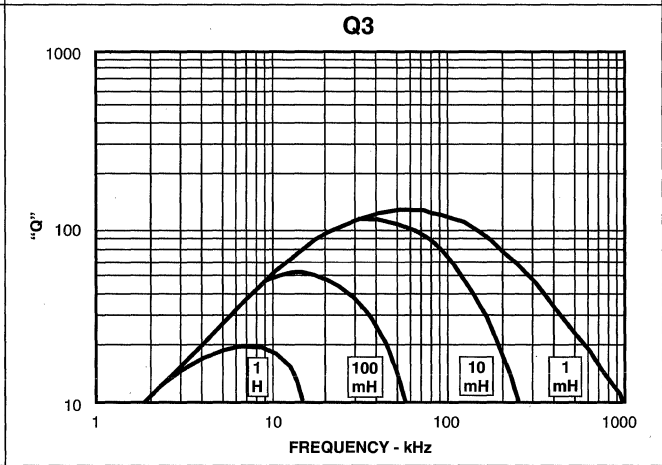
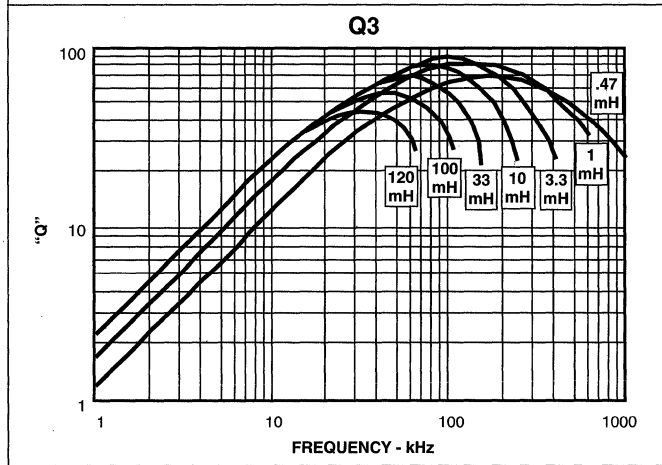
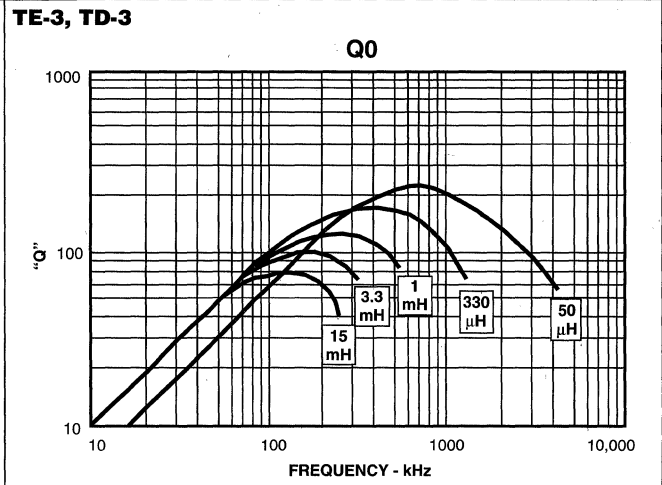
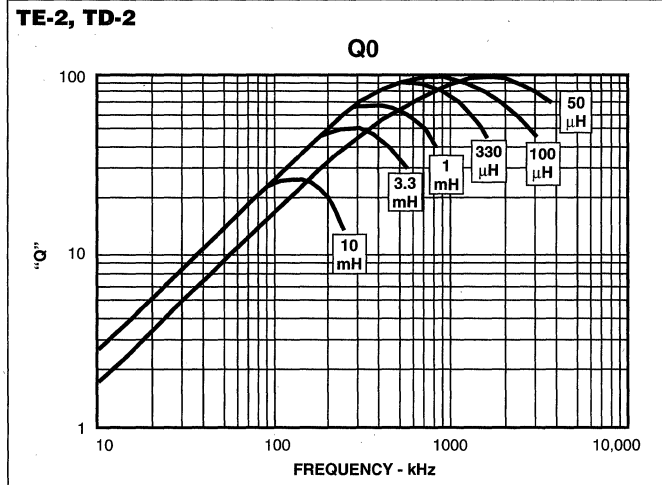


MODEL TE-5, TD-5	IND.	Q0	Q3	Q4	Q0	Q3	Q4
1.0mH	1.8	—	—	.80	—	—	
3.32mH	5.2	—	—	.44	—	—	
5.0mH	6.5	1.8	—	.33	.32	—	
10.0mH	13.0	2.4	1.7	.21	.20	.15	
33.2mH	49.0	8.8	3.9	.12	.11	.086	
100.0mH	133.0	27.0	11.0	.061	.057	.044	
332.0mH	—	80.0	44.0	—	.032	.024	
1.0H	—	222.0	121.0	—	.016	.012	
2.0H	—	475.0	217.0	—	.012	.008	
10.0H	—	—	1300.0	—	—	.003	
20.0H	—	—	2400.0	—	—	.002	



MODELS TE and TD

PERFORMANCE GRAPHS: TYPICAL Q vs FREQUENCY



STANDARD INDUCTANCE VALUE

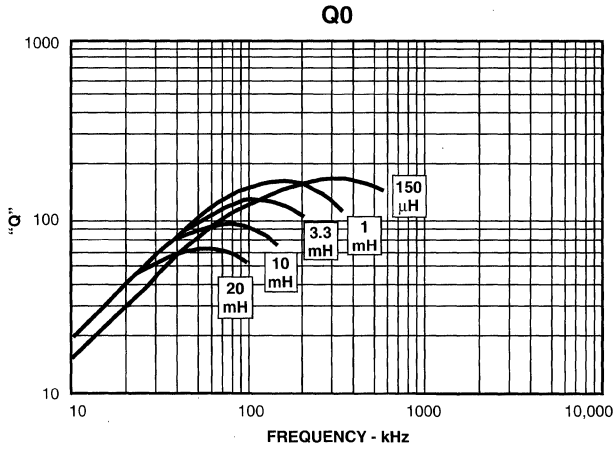
The following standardization chart is offered for your design and ordering convenience. Each value listed is within one percent of the preceding and succeeding values shown. All decade multiples of these values, within the range shown for each model in the chart, are Dale® standard values. (Example: For a TE-2 200μH, 20mH and 200mH are all decade multiples of 2.00 and are all standard values.)

1.00	1.21	1.47	1.78	2.15	2.61	3.09	3.74	4.42	5.23	6.19	7.32	8.66
1.02	1.24	1.50	1.82	2.21	2.67	3.16	3.83	4.53	5.36	6.34	7.50	8.87
1.05	1.27	1.54	1.87	2.26	2.74	3.24	3.92	4.64	5.49	6.49	7.68	9.00
1.07	1.30	1.58	1.91	2.32	2.80	3.32	4.00	4.75	5.62	6.65	7.87	9.09
1.10	1.33	1.62	1.96	2.37	2.87	3.40	4.02	4.87	5.76	6.81	8.00	9.31
1.13	1.37	1.65	2.00	2.43	2.94	3.48	4.12	4.99	5.90	6.98	8.06	9.53
1.15	1.40	1.69	2.05	2.49	3.00	3.57	4.22	5.00	6.00	7.00	8.25	9.76
1.18	1.43	1.74	2.10	2.55	3.01	3.65	4.32	5.11	6.04	7.15	8.45	

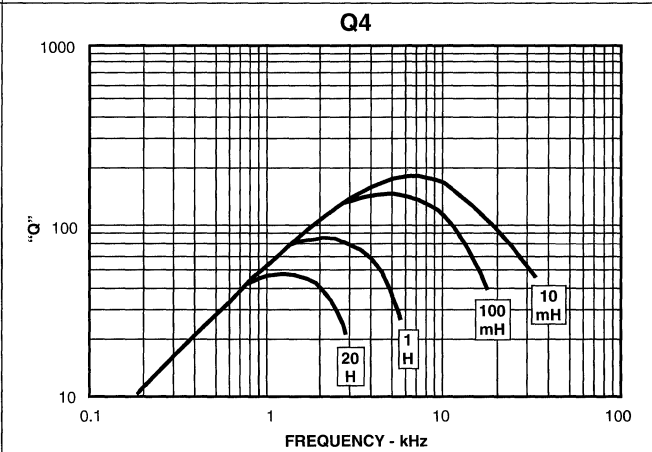
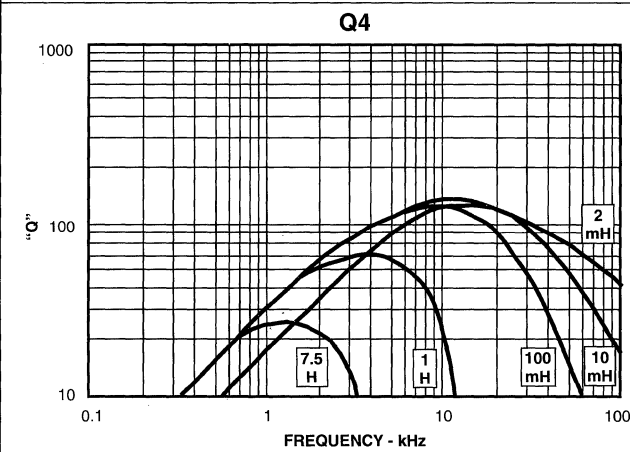
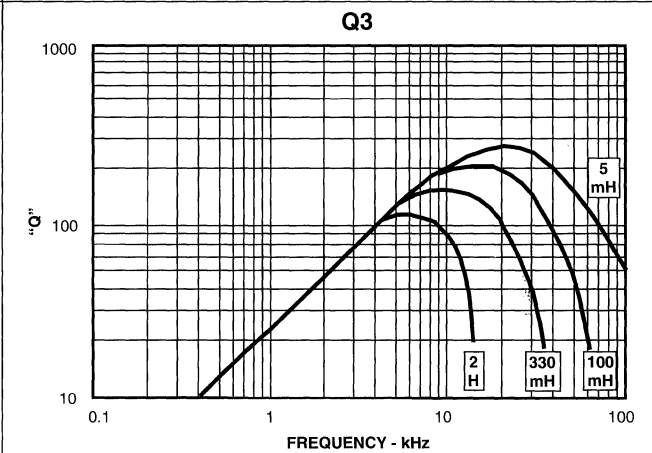
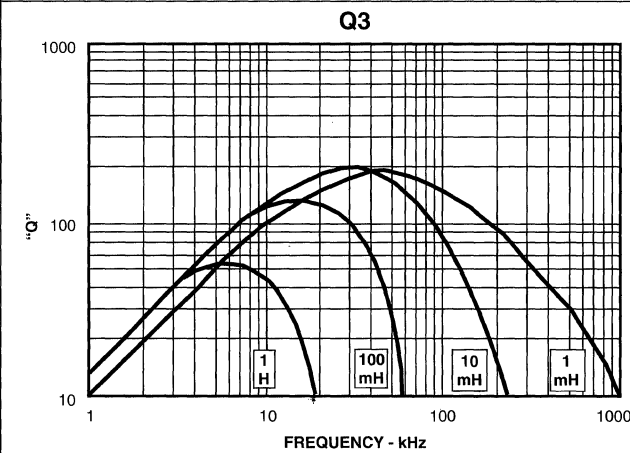
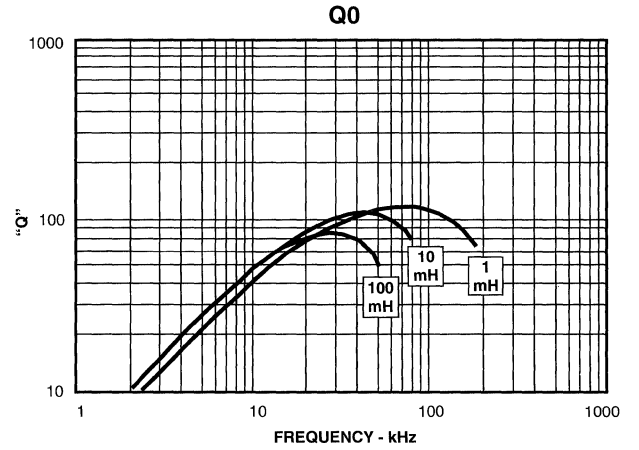
MODELS TE and TD

PERFORMANCE GRAPHS: TYPICAL Q vs FREQUENCY

TE-4, TD-4



TE-5, TD-5



PART MARKING

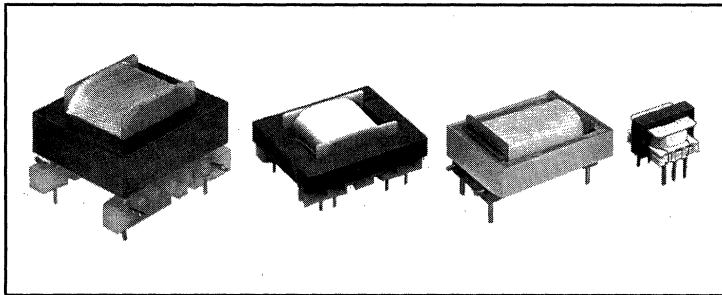
- Dale
- Model
- Q Type
- T.C. code
- Inductance value
- Inductance tolerance
- Date code

HOW TO ORDER

<u>TE-2</u>	<u>Q0</u>	<u>TR</u>	<u>5mH</u>	<u>1%</u>
MODEL	Q TYPE	T. C. CODE	INDUCTANCE VALUE	INDUCTANCE TOLERANCE

MODEL TA Transformers

Audio, Telephone Coupling



FEATURES

- Designed to meet FCC Part 68
- Provide line isolation, impedance matching and line balance
- Designed and built to meet telephone company requirements for data and voice access on leased private telephone lines or through dial-up switched telephone networks

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	IMPEDANCE (Ohms)		COUPLING APPLICATION	UNBALANCED DC CURRENT (mA)	RETURN LOSS MIN. (dB)	INSERTION LOSSES @ 1 kHz (dB)	FREQUENCY RESPONSE REF. @ 1 kHz (dB)	IMPEDANCE MATCHING	DISTORTION	SCHEMATIC STYLE	NUMBER
	PRI	SEC									
TA-10-08	600	600	DATA/VOICE	0	26	1.0	± .5	± 10%	.5%	C	5
TA-10-07	600	600	DATA/VOICE	0	26	1.0	± .5	± 10%	.5%	J	5
TA-30-06	600	600	DATA/VOICE	0-5	14	1.5	± 1.5	± 25%	5.0%	J	5
TA-10-05	600	600	DATA/VOICE	0	26	.6	± .5	± 10%	.5%	B	5
TA-30-02	600	600	DATA/VOICE	0-5	15	1.4	± 1.5	± 25%	5.0%	B	5
TA-30-03	600	600	DATA	0-90	8	2.4	± 1.0	± 25%	5.0%	G	5
TA-32-02	600	600	DATA/VOICE	0-80	11	1.2	± 1.5	± 25%	5.0%	M	13
TA-40-01*	600	600	DATA/VOICE	0-90	14	1.7	± 2.0	± 20%	.5%	N	13
TA-33-02	600	600	DATA/VOICE	0-100	8	1.6	± 1.5	± 25%	5.0%	E	15
TA-30-04	600	600 CT	DATA	0-90	8	2.4	± 1.0	± 25%	5.0%	H	9
TA-10-04	600 CT	600 CT	DATA/VOICE	0	26	.6	± .5	± 10%	.5%	A	4
TA-30-01	600 CT	600 CT	DATA/VOICE	0-5	15	1.4	± 1.5	± 25%	5.0%	A	4
TA-31-01	600 SPLIT	600	DATA/VOICE	0-50	8	1.4	± 1.5	± 25%	5.0%	K	11
TA-32-03	600 SPLIT	600	DATA/VOICE	0-80	11	1.2	± 1.5	± 25%	5.0%	L	14
TA-13-01	600	600 SPLIT	DATA/VOICE	0-75	13	1.2	± .5	± 10%	.5%	E	7
TA-33-01	600	600 SPLIT	DATA/VOICE	0-100	8	1.6	± 1.5	± 25%	5.0%	E	7
TA-10-01	600	600/600	DATA/VOICE HYBRID	0	26	.8	± .5	± 10%	.5%	A	1
TA-30-05	600	600/600	DATA/VOICE HYBRID	0-5	14	1.4	± 1.5	± 25%	5.0%	A	10
TA-11-01	600	600/600	DATA/VOICE HYBRID	0	26	.8	± .5	± 10%	.5%	D	1
TA-30-07	600	900	DATA/VOICE	0-5	14	1.5	± 1.5	± 25%	5.0%	J	2
TA-10-02	600	900	DATA/VOICE	0	26	.7	± .5	± 10%	.5%	B	2
TA-32-01	600/900	600	DATA/VOICE	0-100/0-120	8	1.4	± 1.5	± 25%	5.0%	L	12
TA-14-01	600	600/900	DATA/VOICE	0-100/0-120	14	.5	± .5	± 10%	.5%	F	8
TA-10-06	900	900	DATA/VOICE	0	26	.7	± .5	± 10%	.5%	A	6
TA-10-03	4k	600	DATA/VOICE	0	22	.7	± .5	± 10%	.5%	B	3
TA-23-01	600	600 SPLIT	DATA/VOICE	0-75	13	1.2	± .5	± 10%	.5%	E	16

* Reference for TA-40-01 is 1.8 kHz. Model TA-3 is the low-cost alternative to Model TA-1. For HOLDING COIL information, refer to MODEL TE/TD.

ELECTRICAL SPECIFICATIONS

Power Level: - 45 dBm to + 7 dBm except TA-40-01 (- 45 dBm to + 10 dBm).

Longitudinal Balance: Per FCC 68.310
60 dB minimum = 200 - 1000 Hz.
45 dB minimum = 1000 - 4000 Hz.

Dielectric Strength: Per FCC 68.304 1500 V peak.

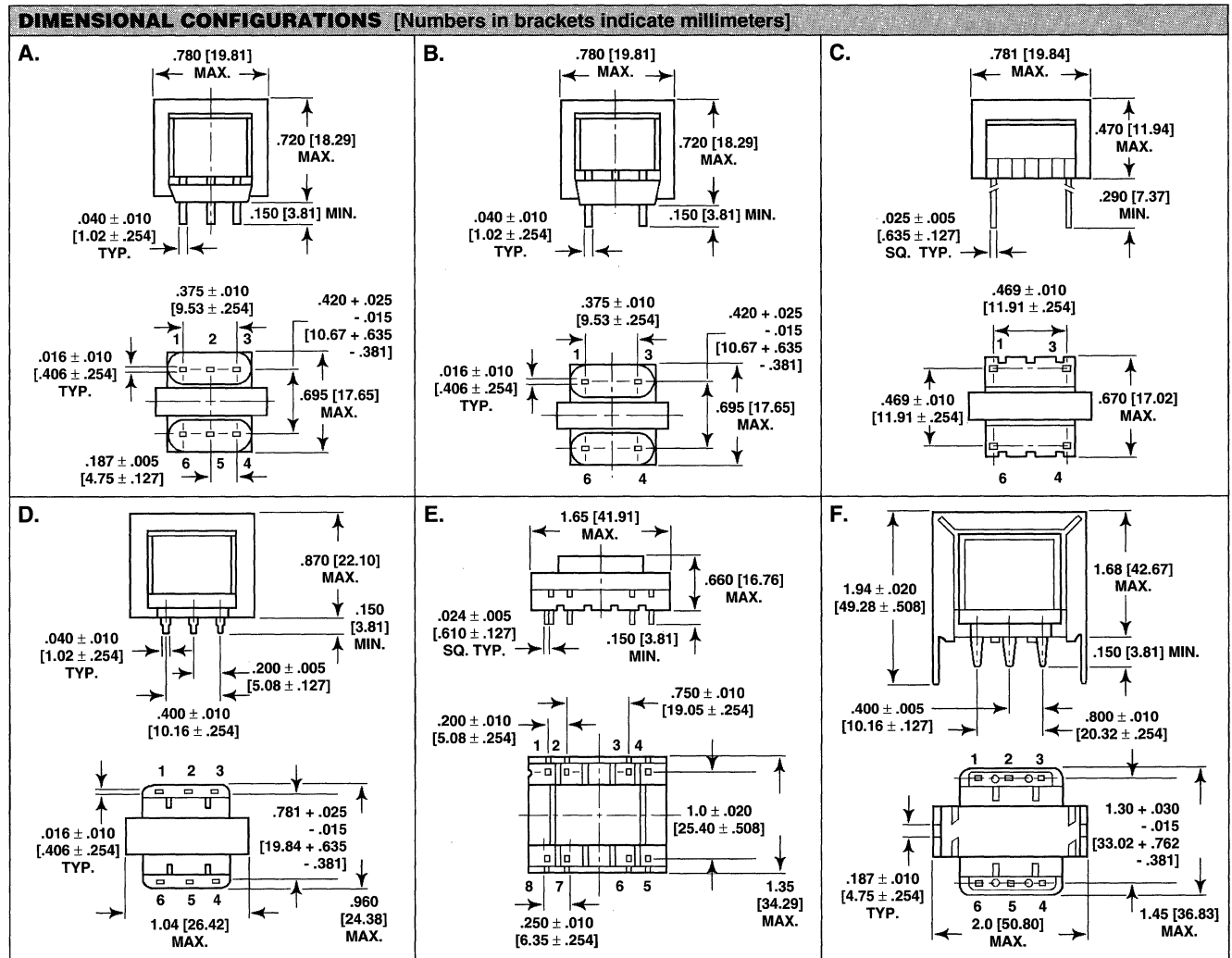
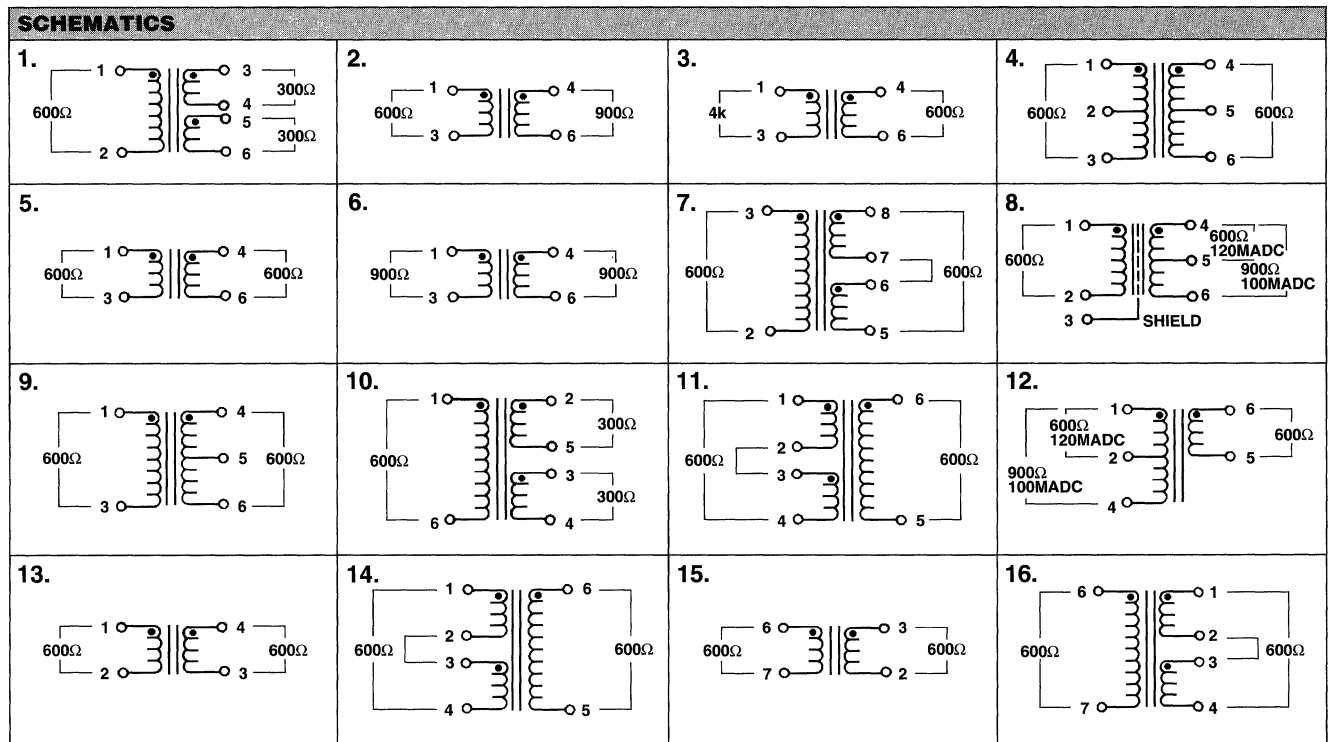
Frequency Range: Data/Voice = 300 to 3500 Hz.
Data = 800 to 3500 Hz.

MECHANICAL SPECIFICATIONS

Coating: Impregnated with polyester varnish.

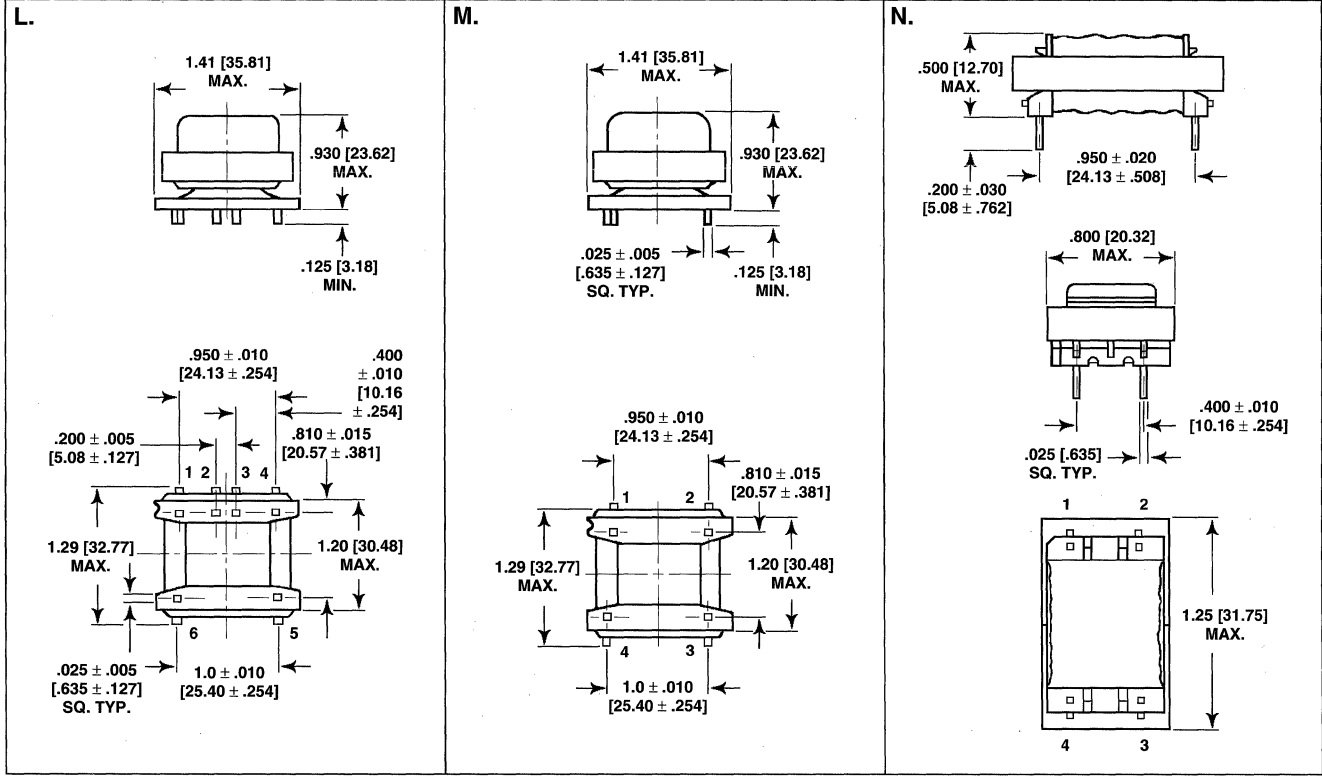
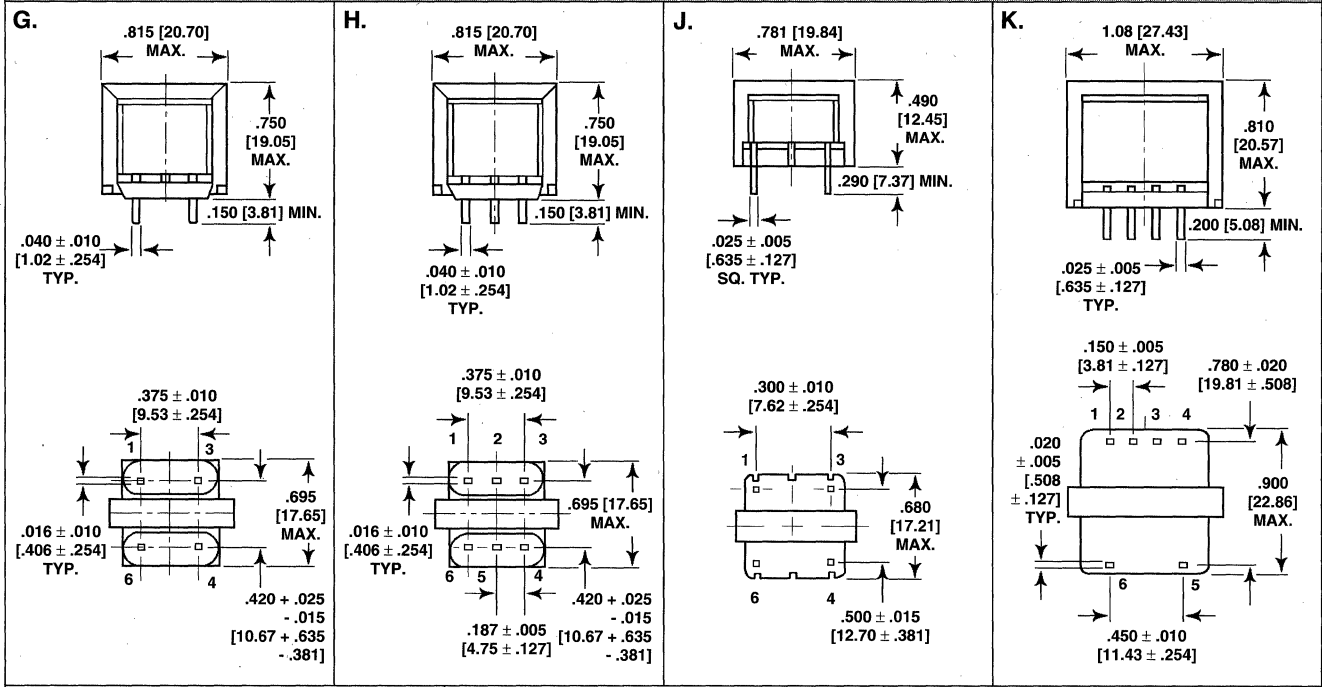
Terminals: Precision spaced PC type plug-in terminals.

MODEL TA



MODEL TA

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



PART MARKING

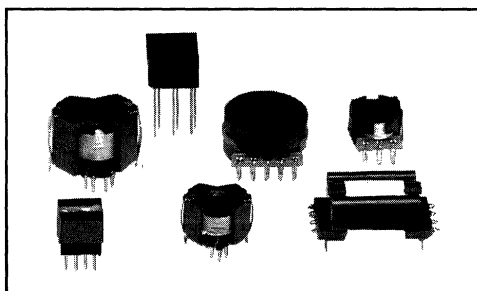
- Dale
- Date code
- Model

HOW TO ORDER

TA	-	10	-	01
MODEL		SIZE		DASH NUMBER

Special designs not listed are available on request.

MODEL PT ISDN Transformers



FEATURES

- Integrated Services Digital Network transformers that provide isolation for the line card and terminal in conjunction with both "S/T" and "U" interfaces
- Designed to meet the CCITT I.430 pulse wave form template requirements
- Isolation voltage levels available for US and international applications
- Printed circuit board mountable in both through-hole and surface mount packages
- Standard and custom configurations available

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	TURNS RATIO	PRIMARY INDUCTANCE MIN. (mH)	PRIMARY DCR MAX. (Ohms)	SECONDARY DCR MAX. (Ohms)	LEAKAGE INDUCTANCE MAX. (μH)	PRIMARY/SECONDARY HIPOT (V RMS)	STYLE NUMBER	SCHEMATIC NUMBER
PT-100-01	1 CT : 2 CT	20	1.2	11.0	30	1500	1	1
PT-100-02	1 CT : 2 CT	20	1.2	11.0	30	1500	2	2
PT-100-04	1 CT : 2 CT	20	3.0	4.5	15	1500	4	4
PT-100-05	1 CT : 2.5 CT	22	2.8	6.5	20	1500	1	1
PT-100-06	1 CT : 1 CT	22	2.8	2.8	10	1500	5	6
PT-100-08	1 CT : 1.8 CT	22	2.8	5.5	20	1500	1	1
PT-100-09	1 CT : 2 CT	22	8.0	15.0	30	1500	7	5
PT-100-11	1 CT : 2 CT	22	2.8	5.5	10	2000	9	4
PT-200-01	2.5 : 1 : 1	72	8.5	1.0	160	1100	3	3
PT-200-02	1 : 1 : 1 CT	25	5.5	3.5	20	1100	6	7
PT-200-03	4 : 1 : 1	30	2.3	1.0	200	1100	8	8
PT-200-04	1 : 1.32	7	0.9	1.5	17	1100	3	5
PT-200-05	1 : 1 : 1 CT	25	4.3	3.8	20	2000	10	9

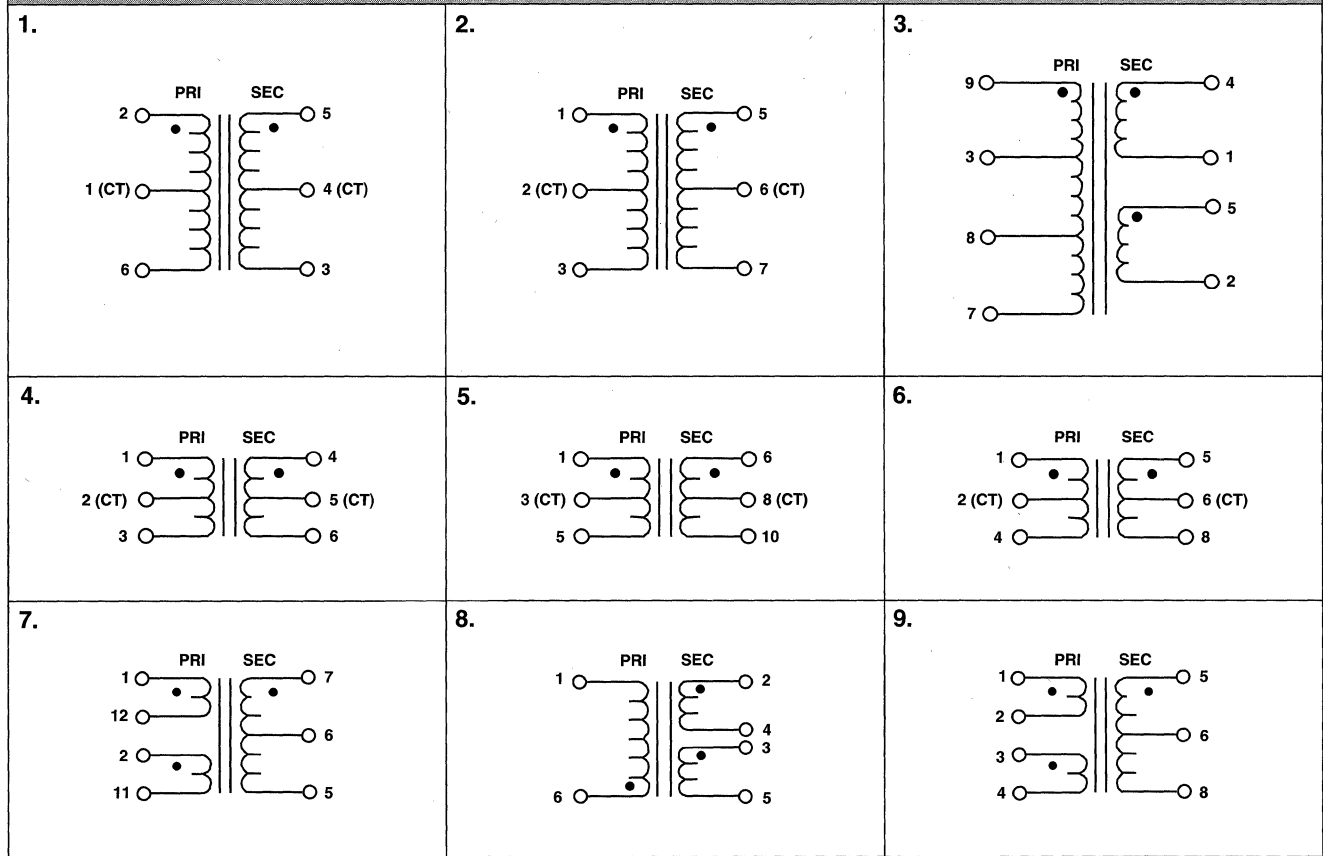
TRANSFORMER CROSS REFERENCE FOR TRANSCEIVER CHIPS

MODEL	TURNS RATIO	IC MANUFACTURER	IC PART NUMBER
PT-100-01	1 CT : 2 CT	SIEMENS	PEB2080/2085
PT-100-02	1 CT : 2 CT	SIEMENS	PEB2080/2085
PT-100-04	1 CT : 2 CT	AMD	79C30A
		MITEL	MT8930
		NATIONAL	TP3420
PT-100-05	1 CT : 2.5 CT	INTEL	29C53
		AT&T	T7250/T7252
PT-100-06	1 CT : 1 CT	MOTOROLA	MC145474
			MC145475
PT-100-08	1 CT : 1.8 CT	INTEL	29C53
PT-100-09	1 CT : 2 CT	SIEMENS	PEB2080/2085
		AMD	79C30A
		MITEL	MT8930
		NATIONAL	TP3420
PT-100-11*	1 CT : 2 CT	SIEMENS	PEB2080/2085
		AMD	79C30A
		MITEL	MT8930
		NATIONAL	TP3420
PT-200-01	2.5 : 1 : 1	AT&T	T7262/T7263
PT-200-02	1 : 1 : 1 CT	MOTOROLA	MC145472
PT-200-03	4 : 1 : 1	MITEL	MT8972
PT-200-04	1 : 1.32	SIEMENS	PEB2091
PT-200-05*	1 : 1 : 1 CT**	MOTOROLA	MC145472

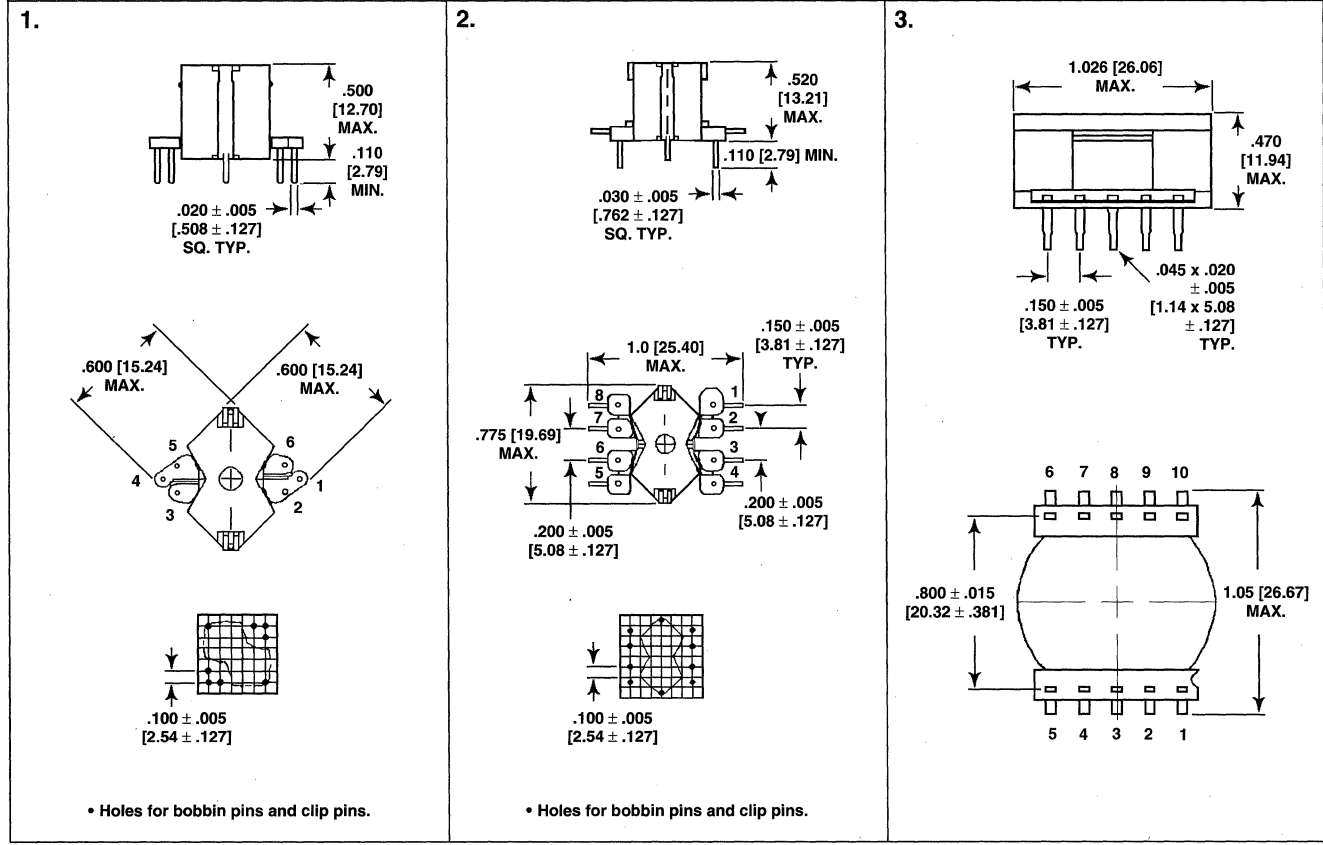
* Hipot voltage will meet International Safety Standards. ** Low Profile.

MODEL PT

SCHEMATICS

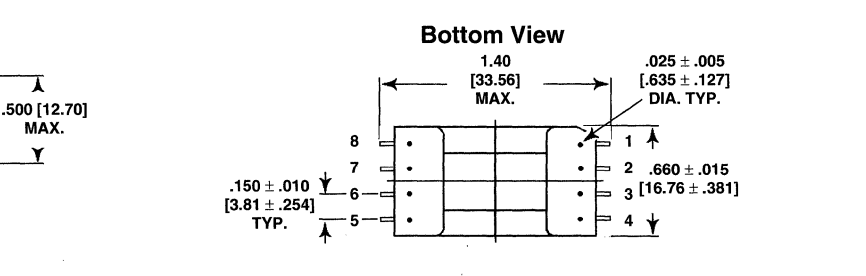
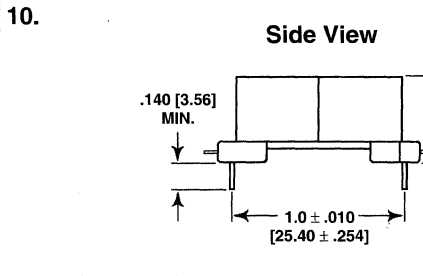
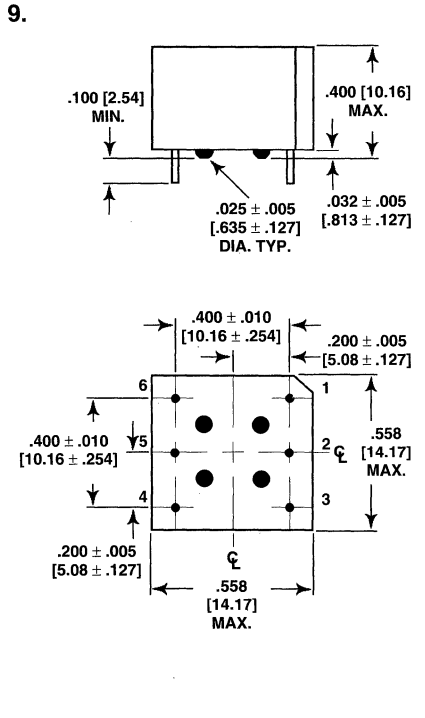
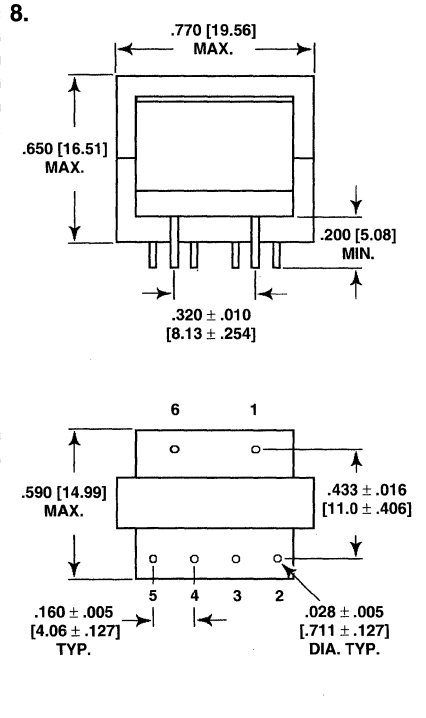
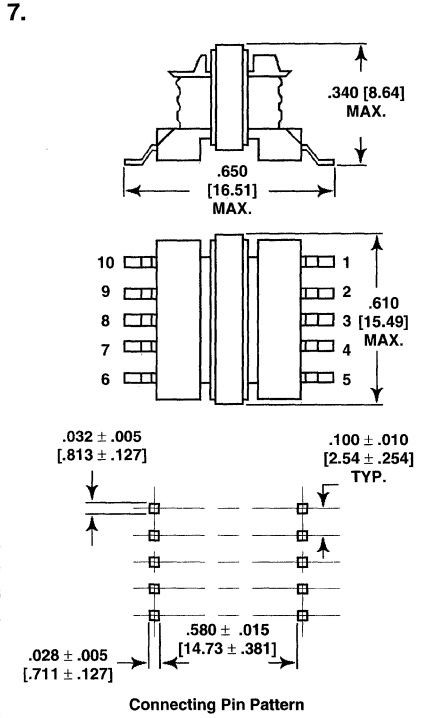
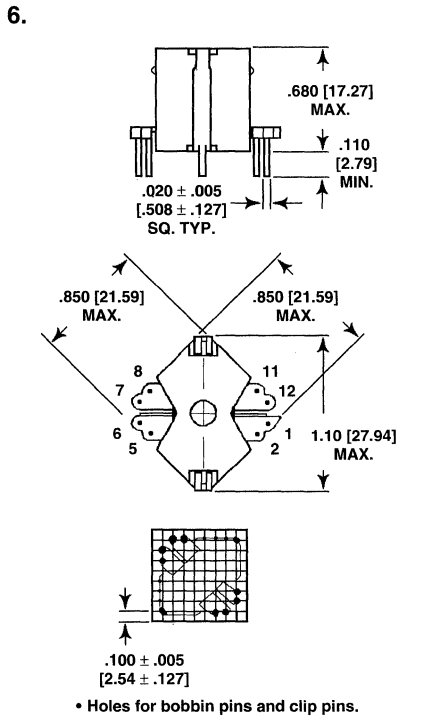
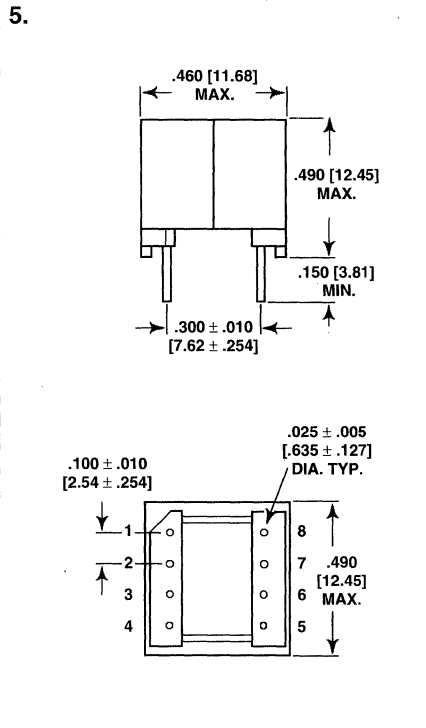
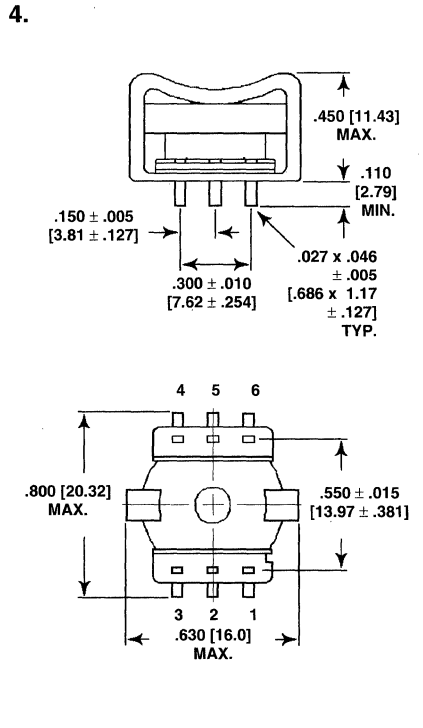


DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



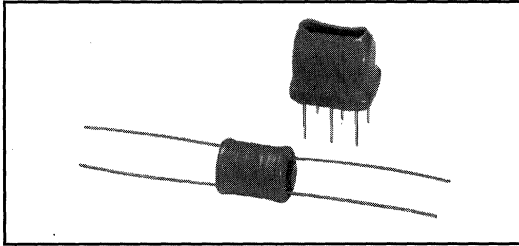
MODEL PT

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



MODELS PT-10 and PT-20 Transformers

Pulse, Trigger Type



FEATURES

- Choice of printed circuit or bobbin-type configurations
- Designed to transfer high amplitude or long duration pulses without saturation
- Designed for low-cost trigger source isolation in half and full wave SCR power control circuits, including motor speed controls, heater controls and incandescent lighting controls

STANDARD ELECTRICAL SPECIFICATIONS

DASH NUMBER	TURNS RATIO	FIGURE	PRIMARY INDUCTANCE MIN. (μ H)	LEAKAGE INDUCTANCE MAX. (μ H)	INTERWINDING CAPACITY MAX. (pF)	DCR MAX. (Ohms)
101*	1:1 \pm 10%	1/3	200	3	800	1.5-1.5
102*	1:1 \pm 10%	1/3	500	6	1500	4.5-4.5
103*	1:1 \pm 10%	1/3	1000	12	2000	8-8
104	1:1 \pm 10%	1/3	2000	13	2800	12-12
105	1:1 \pm 10%	1/3	5000	15	3500	18-18
106*	1:1:1 \pm 10%	2/4	200	3	800	2-2-2
107	1:1:1 \pm 10%	2/4	500	6	1500	6-6-6
108	1:1:1 \pm 10%	2/4	1000	12	2000	10-10-10
109	1:1:1 \pm 10%	2/4	2000*	13	2800	15-15-15
110	1:1:1 \pm 10%	2/4	5000	15	3500	27-27-27
111*	2:1 \pm 10%	1/3	500	6	1000	4-2
112*	2:1 \pm 10%	1/3	1000	10	1300	10-2
113	2:1 \pm 10%	1/3	2000	12	1800	10-5
114	2:1 \pm 10%	1/3	5000	15	2400	18-10
115*	2:1:1 \pm 10%	2/4	200	8	700	4-2-2
116*	2:1:1 \pm 10%	2/4	500	11	1000	6-2-2
117*	2:1:1 \pm 10%	2/4	1000	15	1300	10-2-2
118	2:1:1 \pm 10%	2/4	2000	60	2000	10-5-5
119	2:1:1 \pm 10%	2/4	5000	75	2100	20-10-10
120*	5:1 \pm 10%	1/3	5000	1500	400	19-3
121	5:1:1 \pm 10%	2/4	5000	1500	400	20-4-4

* Standard items in PT-10 Model. Other dash numbers available on request.
All dash numbers standard in PT-20 Model.

ELECTRICAL SPECIFICATIONS

Primary Inductance Values: From 200 μ H to 5000 μ H.

Turns Ratio: 1:1, 1:1:1, 2:1, 2:1:1 and 5:1.

Temperature Range: - 10°C to + 70°C.

Dielectric Test @ 60 Hz: 1600 V RMS (Windings to case).

AC Line Voltage @ 60 Hz: 240 V RMS maximum in test circuits shown.

MATERIAL SPECIFICATIONS

Bobbin: Nylon.

Leads: Tinned, solderable.

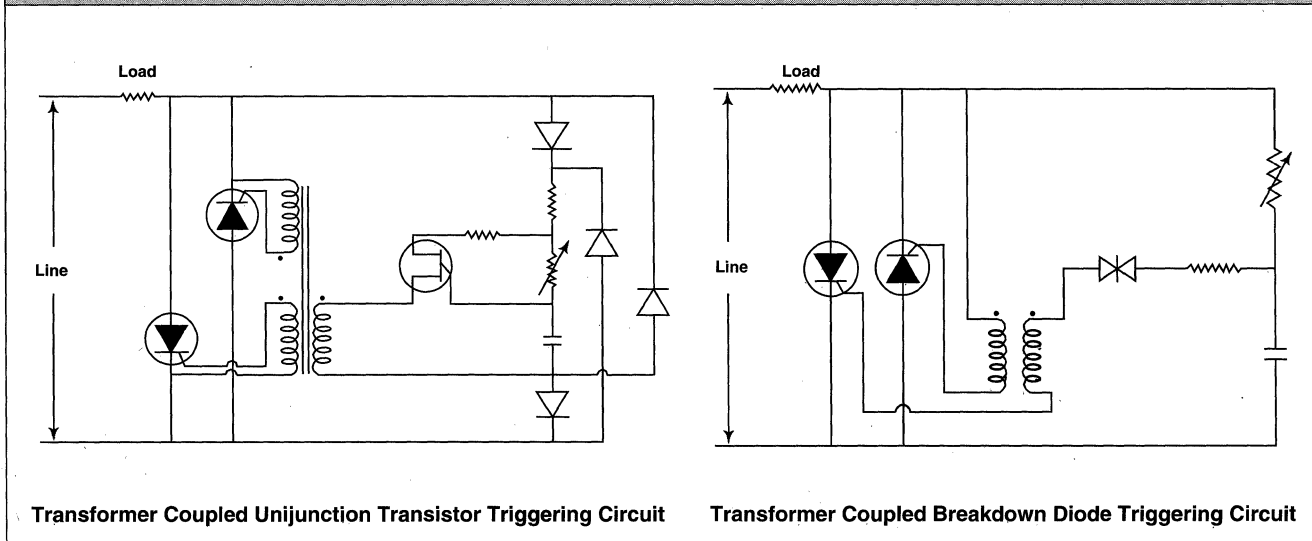
PT-10 = Polyurethane insulated magnet wire for clip or bracket mounting.

PT-20 = Tinned copper #20 AWG for printed circuit mounting.

Header: Thermoset plastic.

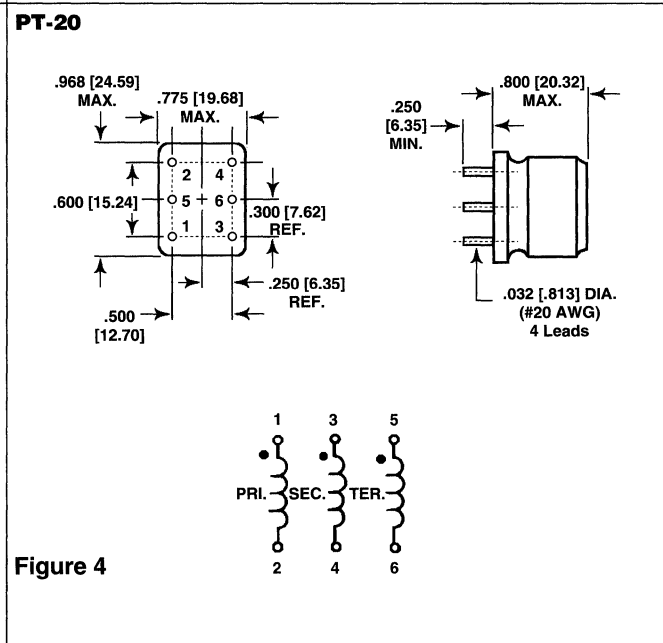
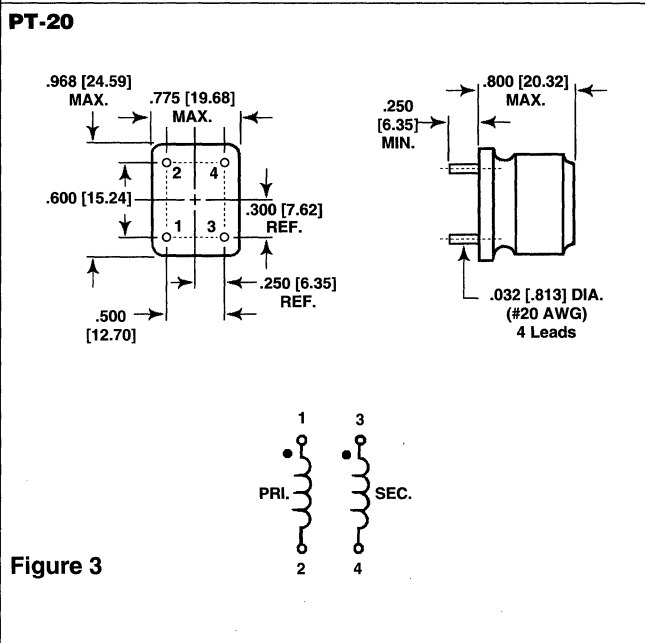
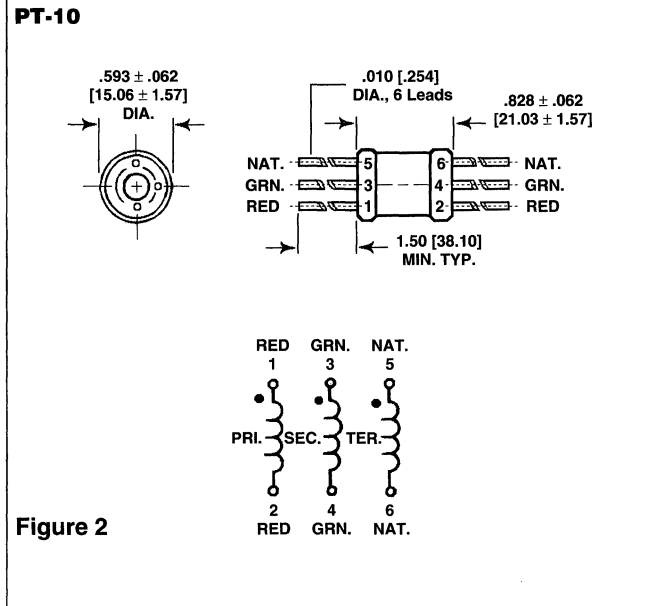
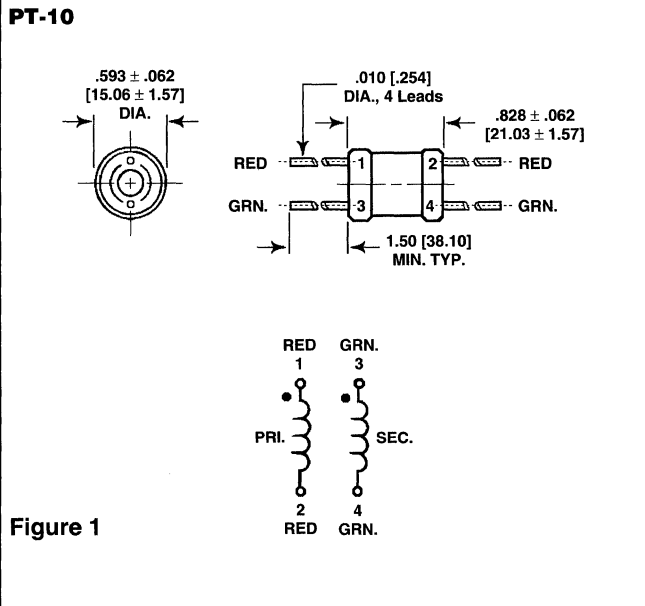
Covering: Thermoplastic.

CIRCUIT DIAGRAMS



MODELS PT-10 and PT-20

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



PART MARKING

— Dale
— Model
— Style
— Dash number

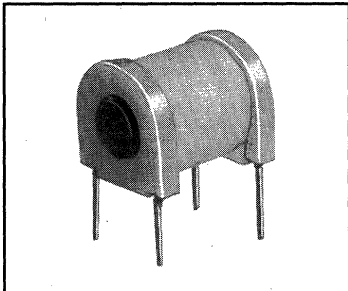
HOW TO ORDER

PT	-	10	-	101
MODEL		STYLE		DASH NUMBER

Contact factory for special designs not listed.

MODEL PT-50 Transformers

Trigger, SCR Isolation



FEATURES

- Designed for low-cost trigger source isolation in SCR Power Control Circuits
- Small physical size and low profile provide packaging advantages
- Designed to transfer high amplitude or long duration pulses without saturation
- Industrial and commercial applications include motor speed controls, lighting controls and heater controls
- Interchangeable. Designed for circuit board mounting using same mounting dimensions as 11Z and PT-20 models.

STANDARD ELECTRICAL SPECIFICATIONS					
DASH NUMBER	TURNS RATIO	PRIMARY INDUCTANCE MIN. (μ H)	LEAKAGE INDUCTANCE MAX. (μ H)	INTERWINDING CAPACITY MAX. (pF)	DCR MAX. (Ohms)
101	1:1 \pm 10%	200	3	800	1.5-1.5
102	1:1 \pm 10%	500	6	1500	4.5-4.5
103	1:1 \pm 10%	1000	12	2000	8.0-8.0
104	1:1 \pm 10%	2000	13	2800	12-12
105	1:1 \pm 10%	5000	15	3500	18-18
106	2:1 \pm 10%	500	6	1000	4-2
107	2:1 \pm 10%	1000	10	1300	10-2
108	2:1 \pm 10%	2000	12	1800	10-5
109	2:1 \pm 10%	5000	15	2400	18-10
110	5:1 \pm 10%	5000	1500	400	19-3

ELECTRICAL SPECIFICATIONS

Primary Inductance Values: From 200 μ H to 5000 μ H.

Turns Ratio: 1:1, 2:1 and 5:1.

Temperature Range: - 55°C to + 105°C.

Dielectric Test @ 60 Hz: 1600 V RMS.
(Windings to core).

AC Line Voltage @ 60 Hz: 240 V RMS maximum
in test circuits shown.

MATERIAL SPECIFICATIONS

Bobbin: Glass-filled nylon.

Terminals: .025" [.635] Square tinned copper.

Material Rating: 105°C Class A.

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

Dot identifies #1 terminal

Sq. Terminals TYP.

Terminal Numbers For Ref. Only

SCHEMATIC

CIRCUIT DIAGRAM

Transformer Coupled Breakdown Diode Triggering Circuit

PART MARKING

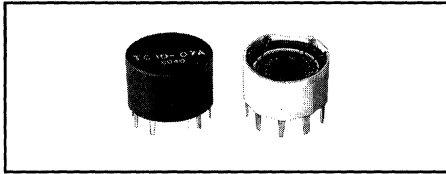
— Dale
— Model
— Dash number

HOW TO ORDER

PT - 50 - 101
TYPE MODEL DASH NUMBER

Contact factory for special designs not listed.

MODEL TC Transformers Converter



FEATURES

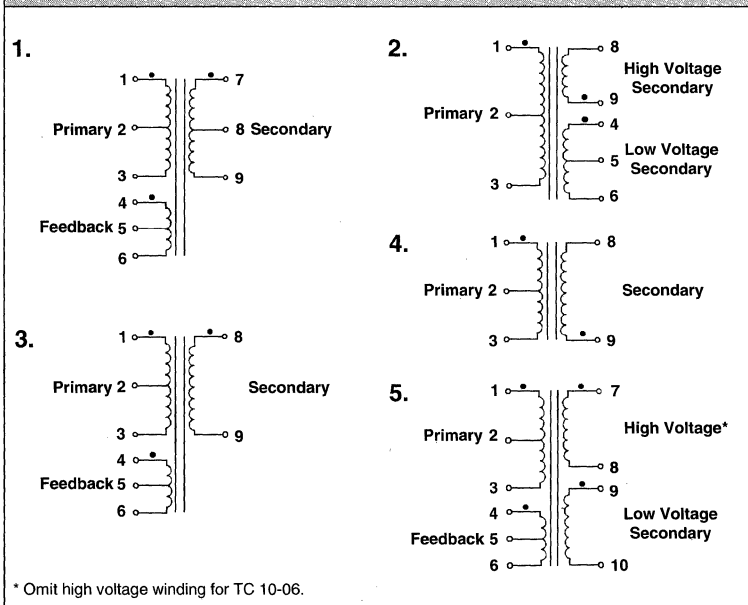
- Designed especially for low-power solid state circuits
- Designed for mounting on printed circuit boards
- Miniature size for minimum space
- Choice of encapsulated or open (impregnated) styles
- High conversion efficiency from DC input to filtered DC output

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	INPUT	OUTPUT	FREQ. REF. (kHz)	CIRCUIT EFF.	SCHEMATIC NUMBER
TC 10-01	3.6 VDC	+7.2 ± .2 VDC at 150 MW -7.2 ± .2 VDC at 150 MW	7.5	50%	1
TC 10-02	5 VDC	200 ± 10 VDC at 250 MW	11	64%	4
TC 10-03	5 VDC	200 ± 10 VDC at 250 MW + 15 ± .4 VDC at 125 MW - 15 ± .4 VDC at 125 MW	11	60%	2
TC 10-04	5 VDC	+ 15 ± .4 VDC at 500 MW - 15 ± .4 VDC at 500 MW	8	75%	1
TC 10-05	5 VDC	+ 170 ± 5.1 VDC at 850 MW + 32 ± 1.0 VDC at 510 MW	11	75%	5
TC 10-06	5 VDC	+ 35 ± 1.0 VDC at 610 MW	11	70%	5*
TC 10-07	7.5 VDC	+ 16.3 ± .4 VDC at 330 MW - 16.3 ± .4 VDC at 330 MW	7	65%	1
TC 10-08	12 VDC	+ 15 ± .4 VDC at 1 W - 15 ± .4 VDC at 1 W	7.5	72%	1
TC 10-09	12 VDC	160 ± 5 VDC at 1.5 W	10	75%	3
TC 10-10	12 VDC	14.2 ± .7 VDC at 3 W	10	70%	1
TC 10-11	12 VDC	+ 24 ± .5 VDC at 2 W	10	80%	1
TC 10-12	24 VDC	170 ± 5.1 VDC at 850 MW 32 ± 1.0 VDC at 510 MW	11	70%	5

* Specifications relate to transformer when operated in applicable test circuit and at specified load power.

SCHEMATICS



APPLICATIONS

Power supply for gas discharge display, battery-operated portable instruments, operational amplifier power supplies.

ELECTRICAL SPECIFICATIONS

Transformer Power Rating: 3 watt.

Isolation, Primary-Secondary: 500 V 60 Hz.
Operating characteristics may be varied to suit specific applications by appropriate selection of circuit components.

Operating Temperature Range: - 20°C to + 80°C.

Intended for use in enclosed commercial and industrial applications.

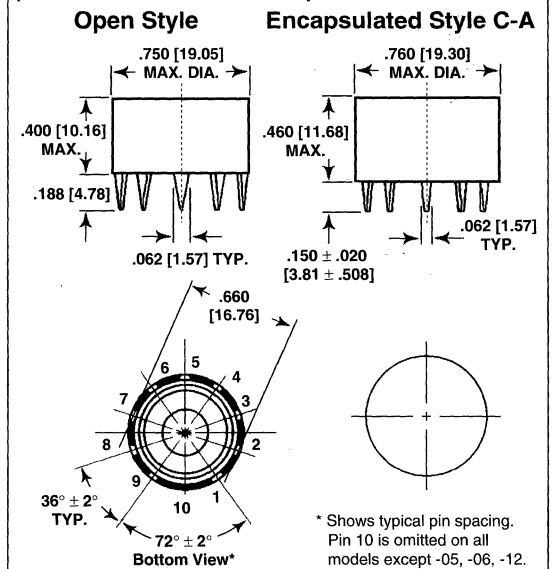
MECHANICAL SPECIFICATIONS

Coating: Varnish dip coat or epoxy encapsulated.

Terminals: .015" [.381] thick, solder plated, varnish-free. Intended for PC board mounting.

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



PART MARKING

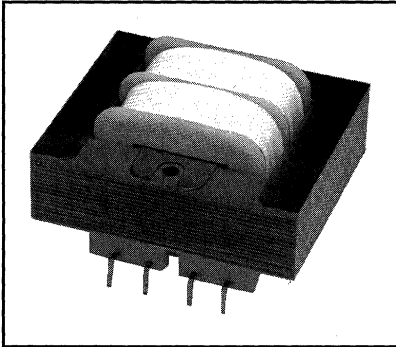
- Model
- Date code

HOW TO ORDER

TC-10 - 01 A
MODEL DASH NUMBER ENCAPSULATED STYLE Leave blank for open style.

MODELS PLS and PLD Power Transformers

Single Primary - Dual Secondary, 6 Pin, 115 Volts
Dual Primary - Dual Secondary, 8 Pin 115/230 Volts



FEATURES

- PC pin mounting
- Provides isolation from power line
- **PLD:** Dual Primary for operational 115 V or 230 V, 50/60 Hz
- Modification to these standard items are available as specialty products
- Laminated construction for low-cost industrial applications, including power supplies, controls and instrumentation
- Designed to meet UL and CSA requirements
- Dual Secondary for **series connection** obtains twice winding voltage with center tap or for **parallel connection** obtains twice winding current rating
- Split-section winding for increased dielectric strength between primary and secondary windings, plus reduced interwinding capacitance

ELECTRICAL SPECIFICATIONS

Input Voltage:

PLS = 115 V 50-60 Hz.

PLD = 115 V 60 Hz or 230 V 50-60 Hz.

Output Power Rating:

PLS-52, PLD-52 = 1.1 VA.

PLS-53, PLD-53 = 2.4 VA.

PLS-54, PLD-54 = 6.0 VA.

PLS-55, PLD-55 = 12.0 VA.

PLS-56, PLD-56 = 20.0 VA.

PLS-57, PLD-57 = 36.0 VA.

Dielectric Strength: Primary to secondary windings and all windings to core:

All Units = 2500 V.

Between secondary windings:

All Units = 1000 V.

Between primary windings: PLD = 500 V.

MECHANICAL SPECIFICATIONS

Temperature Class: All materials rated 130°C minimum. A UL approved Class B Insulation System can be furnished upon request.

Bobbin: Split section, reinforced nylon.

Terminals: Brass, solder coated.

Weight: (reference)

PLS-52, PLD-52 = 73 grams.

PLS-53, PLD-53 = 114 grams.

PLS-54, PLD-54 = 182 grams.

PLS-55, PLD-55 = 295 grams.

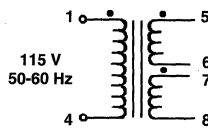
PLS-56, PLD-56 = 386 grams.

PLS-57, PLD-57 = 500 grams.

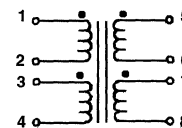
SCHEMATICS

Basic Styles

PLS

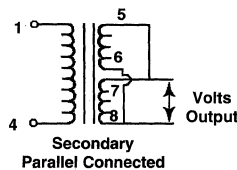
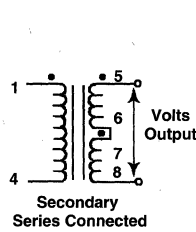


PLD

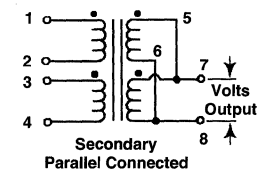
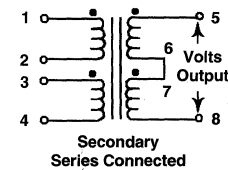
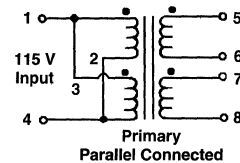
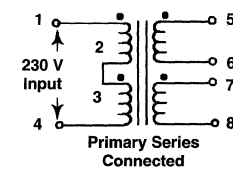


Options

PLS



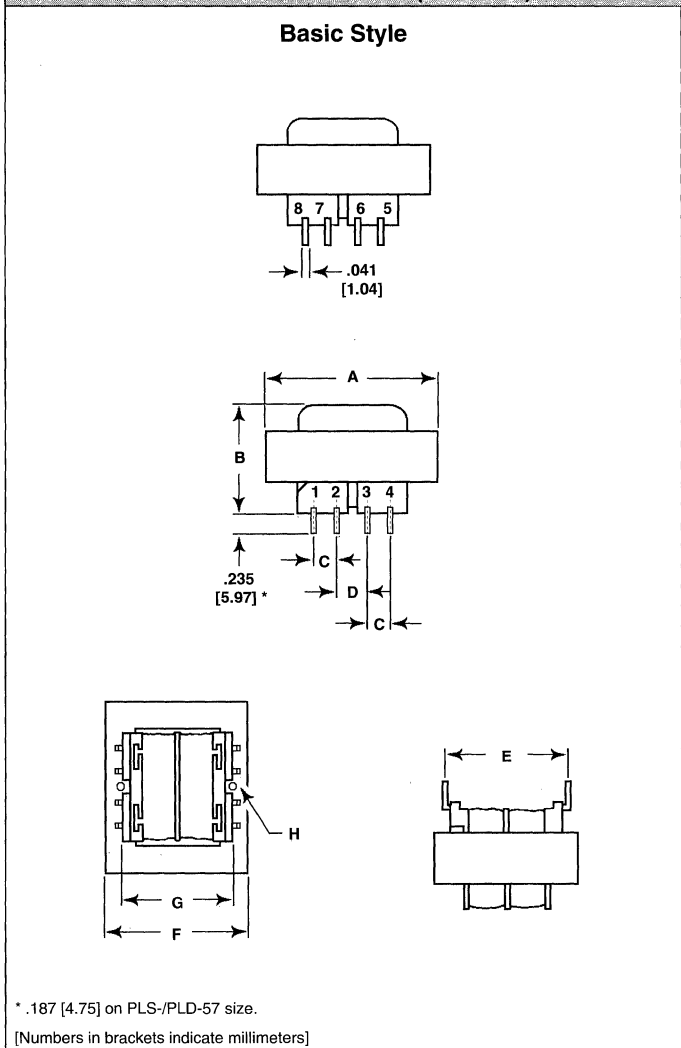
PLD



MODELS PLS and PLD

OUTPUT VOLTAGE TABLE					
MODEL	MODEL	OUTPUT VOLTAGE		OUTPUT CURRENT (A)	
		SERIES	PARALLEL	SERIES	PARALLEL
PLS-52-10	PLD-52-10	10 VCT	5 V	.11	.22
PLS-53-10	PLD-53-10			.25	.50
PLS-54-10	PLD-54-10			.60	1.2
PLS-55-10	PLD-55-10			1.2	2.4
PLS-56-10	PLD-56-10			2.0	4.0
PLS-57-10	PLD-57-10			3.6	7.2
PLS-52-12	PLD-52-12	12.6 VCT	6.3 V	.09	.18
PLS-53-12	PLD-53-12			.20	.40
PLS-54-12	PLD-54-12			.50	1.0
PLS-55-12	PLD-55-12			1.0	2.0
PLS-56-12	PLD-56-12			1.6	3.2
PLS-57-12	PLD-57-12			2.85	5.7
PLS-52-16	PLD-52-16	16 VCT	8 V	.07	.14
PLS-53-16	PLD-53-16			.15	.30
PLS-54-16	PLD-54-16			.40	.80
PLS-55-16	PLD-55-16			.80	1.6
PLS-56-16	PLD-56-16			1.25	2.5
PLS-57-16	PLD-57-16			2.25	4.5
PLS-52-20	PLD-52-20	20 VCT	10 V	.055	.11
PLS-53-20	PLD-53-20			.12	.24
PLS-54-20	PLD-54-20			.30	.60
PLS-55-20	PLD-55-20			.60	1.2
PLS-56-20	PLD-56-20			1.0	2.0
PLS-57-20	PLD-57-20			1.8	3.6
PLS-52-24	PLD-52-24	24 VCT	12 V	.045	.09
PLS-53-24	PLD-53-24			.10	.20
PLS-54-24	PLD-54-24			.25	.50
PLS-55-24	PLD-55-24			.50	1.0
PLS-56-24	PLD-56-24			.80	1.6
PLS-57-24	PLD-57-24			1.5	3.0
PLS-52-28	PLD-52-28	28 VCT	14 V	.04	.08
PLS-53-28	PLD-53-28			.085	.17
PLS-54-28	PLD-54-28			.20	.40
PLS-55-28	PLD-55-28			.42	.84
PLS-56-28	PLD-56-28			.70	1.4
PLS-57-28	PLD-57-28			1.3	2.6
PLS-52-36	PLD-52-36	36 VCT	18 V	.03	.06
PLS-53-36	PLD-53-36			.065	.13
PLS-54-36	PLD-54-36			.17	.34
PLS-55-36	PLD-55-36			.35	.70
PLS-56-36	PLD-56-36			.55	1.1
PLS-57-36	PLD-57-36			1.0	2.0
PLS-52-48	PLD-52-48	48 VCT	24 V	.023	.046
PLS-53-48	PLD-53-48			.05	.10
PLS-54-48	PLD-54-48			.125	.25
PLS-55-48	PLD-55-48			.25	.50
PLS-56-48	PLD-56-48			.40	.80
PLS-57-48	PLD-57-48			.75	1.5
PLS-52-56	PLD-52-56	56 VCT	28 V	.02	.04
PLS-53-56	PLD-53-56			.045	.09
PLS-54-56	PLD-54-56			.11	.22
PLS-55-56	PLD-55-56			.22	.44
PLS-56-56	PLD-56-56			.35	.70
PLS-57-56	PLD-57-56			.65	1.3
PLS-52-120	PLD-52-120	120 VCT	60 V	.01	.02
PLS-53-120	PLD-53-120			.02	.04
PLS-54-120	PLD-54-120			.05	.10
PLS-55-120	PLD-55-120			.10	.20
PLS-56-120	PLD-56-120			.16	.32
PLS-57-120	PLD-57-120			.30	.60

DIMENSIONAL CONFIGURATIONS (Reference)



MODEL	A	B	C	D	E	F	G	MOUNTING HOLE DIA. H
PLS-52	1.39	.940	.250	.250	1.22	1.15	—	NONE
PLD-52	[35.31]	[23.88]	[6.35]	[6.35]	[30.99]	[29.21]		
PLS-53	1.39	1.19	.250	.250	1.22	1.15	—	NONE
PLD-53	[35.31]	[30.23]	[6.35]	[6.35]	[30.99]	[29.21]		
PLS-54	1.64	1.32	.250	.350	1.28	1.33	1.06	.125
PLD-54	[41.66]	[33.53]	[6.35]	[8.89]	[32.51]	[33.78]	[26.92]	[3.18]
PLS-55	1.89	1.44	.300	.400	1.40	1.58	1.25	.125
PLD-55	[48.01]	[36.58]	[7.62]	[10.16]	[35.56]	[40.13]	[31.75]	[3.18]
PLS-56	2.27	1.44	.300	.400	1.59	1.89	1.50	.132
PLD-56	[57.66]	[36.58]	[7.62]	[10.16]	[40.39]	[48.01]	[38.10]	[3.35]
PLS-57	2.64	1.57	.400	.400	1.84	2.21	*	.156
PLD-57	[67.06]	[39.88]	[10.16]	[10.16]	[46.74]	[56.13]		[3.96]

* Size #57 has four mounting holes on 2.19 x 1.75 [55.63 x 44.45] centers.

PART MARKING

- Date
- Model
- Date code

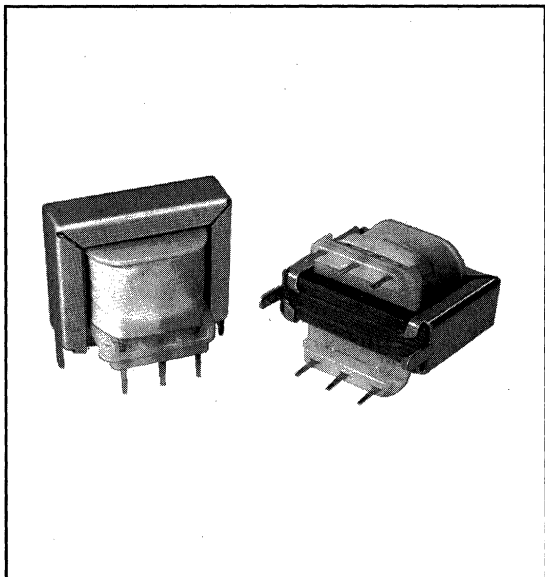
HOW TO ORDER

PL	S	52	-10
MODEL	PRIMARY	SIZE	OUTPUT VOLTAGE AND CURRENT
	S = Single D = Dual		

Special design not listed, available on request.

MODELS PL-11,-12,-13,-14,-32,-33,-34 Low Power Transformers

**Single Primary, Input 115 Volts, Dual Secondary:
PL-11 thru -14, Single Secondary: PL-32 thru -34**



FEATURES

- PC pin mounting
- Provides isolation from power line
- Mounting frames and bobbin standoff are available
- Modification to these standard items are available as specialty products
- Laminated construction for low-cost industrial applications, including power supplies, controls and instrumentation
- **PL-11, PL-12, PL-13, PL-14:** Dual secondaries for **series connection** to obtain twice voltage with center tap or **parallel connection** for twice current rating
- **PL-32, PL-33, PL-34:** Single secondary and lower cost construction
- Recognized under the Component Program of Underwriters Laboratories, Inc., U.L. File E71961. For general purpose transformers (U.L. Standard 506).

ELECTRICAL SPECIFICATIONS

Input Voltage: 115 V 60 Hz.

Output Power Rating:

- PL-11 = .75 VA.
- PL-12, PL-32 = 1.50 VA.
- PL-13, PL-33 = 4.50 VA.
- PL-14, PL-34 = 10.0 VA.

Dielectric Strength: All models are 1500 V 60 Hz from primary to secondary winding and all windings to core.

Temperature Class: Insulation Class A, 105°C.

MECHANICAL SPECIFICATIONS

Terminals: Brass, solder coated.

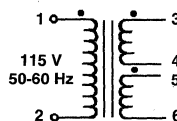
Weight: (reference)

- PL-11 = 35 grams.
- PL-12, PL-32 = 100 grams.
- PL-13, PL-33 = 160 grams.
- PL-14, PL-34 = 240 grams.

SCHEMATICS

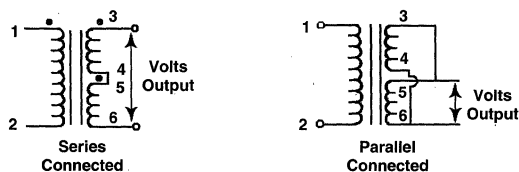
Basic Style

PL-11, PL-12, PL-13, PL-14

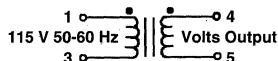


Options

PL-11, PL-12, PL-13, PL-14



PL-32, PL-33, PL-34



MODELS PL-11, -12, -13, -14, -32, -33, -34

OUTPUT VOLTAGE TABLE							
DUAL SECONDARY				SINGLE SECONDARY			
MODEL	OUTPUT VOLTAGE		OUTPUT CURRENT (mA)		MODEL	OUTPUT VOLTAGE	OUTPUT CURRENT (mA)
	SERIES	PARALLEL	SERIES	PARALLEL			
					PL-32-01	6.4 V	200
					PL-33-01		700
					PL-34-01		1300
PL-11-01	8	4 V	94	188			
PL-12-01	VCT		188	376			
PL-13-01			562	1124			
PL-14-01			940	1880			
PL-11-02	10	5 V	75	150	PL-32-02	10 V	120
PL-12-02	VCT		120	240	PL-33-02		450
PL-13-02			440	880	PL-34-02		800
PL-14-02			1000	2000			
PL-11-03	12.6	6.3 V	60	120	PL-32-03	12.6 V	100
PL-12-03	VCT		100	200	PL-33-03		350
PL-13-03			350	700	PL-34-03		650
PL-14-03			800	1600			
PL-11-04	15	7.5 V	50	100	PL-32-04	15 V	80
PL-12-04	VCT		100	200	PL-33-04		300
PL-13-04			300	600	PL-34-04		550
PL-14-04			500	1000			
PL-11-05	16	8 V	47	94			
PL-12-05	VCT		75	150			
PL-13-05			260	520			
PL-14-05			640	1280			
PL-11-06	20	10 V	38	76	PL-32-05	20 V	60
PL-12-06	VCT		60	120	PL-33-05		225
PL-13-06			220	440	PL-34-05		400
PL-14-06			500	1000			
PL-11-07	24	12 V	31	62	PL-32-06	24 V	50
PL-12-07	VCT		50	100	PL-33-06		185
PL-13-07			180	360	PL-34-06		330
PL-14-07			450	900			
PL-11-08	30	15 V	25	50	PL-32-07	30 V	40
PL-12-08	VCT		50	100	PL-33-07		150
PL-13-08			150	300	PL-34-07		270
PL-14-08			250	500			
PL-11-09	34	17 V	22	44			
PL-12-09	VCT		35	70			
PL-13-09			125	250			
PL-14-09			300	600			
PL-11-10	40	20 V	19	38			
PL-12-10	VCT		30	60			
PL-13-10			110	220			
PL-14-10			250	500			
PL-12-11	54	27 V	28	56	PL-32-08	54 V	22
PL-13-11	VCT		84	168	PL-33-08		80
PL-14-11			140	280	PL-34-08		150
PL-12-12	56	28 V	20	40			
PL-13-12	VCT		80	160			
PL-14-12			180	360			
PL-12-13	76	38 V	20	40	PL-32-09	76 V	16
PL-13-13	VCT		60	120	PL-33-09		60
PL-14-13			100	200	PL-34-09		110
PL-12-14	88	44 V	15	30	PL-32-10	88 V	14
PL-13-14	VCT		50	100	PL-33-10		50
PL-14-14			120	240	PL-34-10		90
					PL-32-11	115 V	10
					PL-33-11		40
					PL-34-11		70
PL-12-15	120	60 V	10	20			
PL-13-15	VCT		35	70			
PL-14-15			85	170			
PL-12-16	180	90 V	6	12	PL-32-12	180 V	7
PL-13-16	VCT		24	48	PL-33-12		25
PL-14-16			55	110	PL-34-12		45
PL-12-17	230	115 V	5	10	PL-32-13	230 V	5
PL-13-17	VCT		20	40	PL-33-13		20
PL-14-17			40	80	PL-34-13		35

DIMENSIONAL CONFIGURATIONS (Reference)

Basic Style

PL-11, PL-12, PL-13, PL-14 **PL-32, PL-33, PL-34**

"A" Type of Mounting Frame

"B" Type of Mounting Frame

[Numbers in brackets indicate millimeters]

MODEL	A	B	C	D	E	F	G	H	I	J	K
PL-11	1.04 [26.42]	.860 [21.84]	.250 [6.35]	.920 [23.37]	.720 [18.29]	1.07 [27.18]	1.38 [35.05]	1.69 [42.93]	.018 [4.57]	.125 [3.18]	.125 [3.18]
PL-12	1.43 [36.32]	1.20 [30.48]	.312 [7.92]	1.19 [30.23]	1.0 [25.40]	1.50 [38.10]	1.75 [44.45]	2.12 [53.85]	.031 [7.87]	.125 [3.18]	.188 [4.78]
PL-13	1.68 [42.67]	1.38 [35.05]	.400 [10.16]	1.30 [33.02]	1.10 [27.94]	1.75 [44.45]	2.0 [50.80]	2.44 [61.98]	.031 [7.87]	.125 [3.18]	.188 [4.78]
PL-14	1.93 [49.02]	1.64 [41.66]	.400 [10.16]	1.48 [37.59]	1.30 [33.02]	2.0 [50.80]	2.38 [60.45]	2.88 [73.15]	.031 [7.87]	.188 [4.78]	.188 [4.78]

PART MARKING

- Dale
- Model
- Date code

HOW TO ORDER

PL-11 **-01** **A** **S***

MODEL OUTPUT VOLTAGE AND CURRENT MOUNTING FRAME (If not required, leave blank.) FOR BOBBIN STANDOFF (If not required, leave blank.)

.063 [1.60] Bobbin Standoff

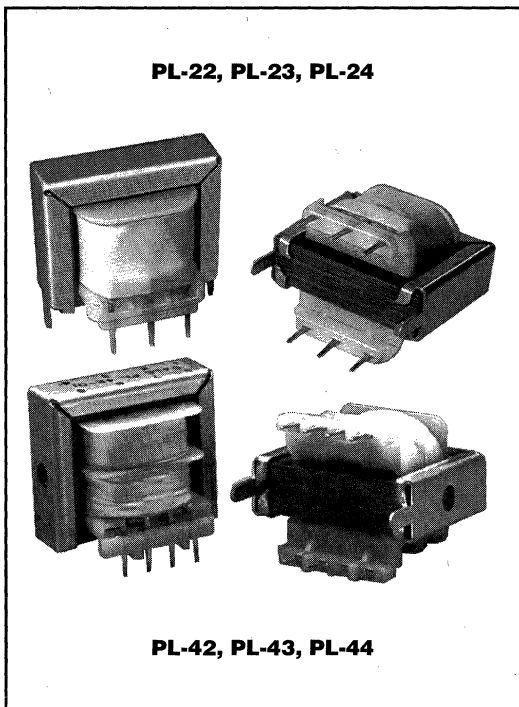
Special design not listed, available on request. * Standoff option not available on PL-11 size.

MODELS PL-22, -23, -24, -42, -43, -44

Low Power Transformers

Dual Primary - Dual Secondary

115/230 Volts



FEATURES

- PC pin mounting
- Provides isolation from power line
- Dual Primary for operation at 115 V or 230 V, 50/60 Hz
- Designed to meet UL requirements
- Dual Secondary for **series connection** obtains twice winding voltage with center tap or for **parallel connection** obtains twice winding current rating
- Modification to these standard items are available as specialty products
- Laminated construction for low-cost industrial applications, including power supplies, controls and instrumentation
- Mounting brackets and bobbin standoff are available
- **PL-22, PL-23, PL-24:** Concentric windings for increased coupling, decreased leakage reactance and improved regulation. Recognized under the Component Program of Underwriters Laboratories, Inc. (U.L. File E71961). For General Purpose Transformers (U.L. Standard 506).
- **PL-42, PL-43, PL-44:** Split-section winding for increased dielectric strength between primary and secondary windings plus reduced interwinding capacitance

ELECTRICAL SPECIFICATIONS

Input Voltage: 115 V 60 Hz or 230 V 50-60 Hz.

Output Power Rating:

PL-22, PL-42 = 1.5 VA.
 PL-23, PL-43 = 4.5 VA.
 PL-24, PL-44 = 10.0 VA.

Dielectric Strength: Between primary windings and secondary windings and core:

PL-22, PL-23, PL-24 = 1500 V.
 PL-42, PL-43, PL-44 = 2500 V.

Between secondary windings to core:

All units = 1000 V.

From primary to primary windings:

All units = 500 V.

From secondary to secondary windings:

All Units = 500 V.

MECHANICAL SPECIFICATIONS

Temperature Class:

PL-22, PL-23, PL-24: Insulation Class A, 105°C.
 PL-42, PL-43, PL-44: Insulation Class B, 130°C;
 A UL approved Class B Insulation System can be furnished on request.

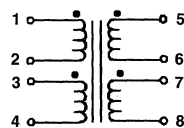
Terminals: Brass, solder coated.

Weight: (reference)

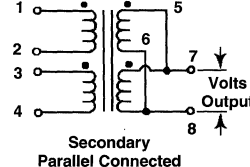
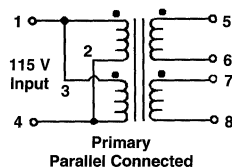
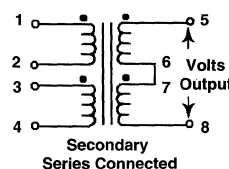
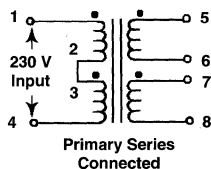
PL-22, PL-42 = 100 grams.
 PL-23, PL-43 = 160 grams.
 PL-24, PL-44 = 240 grams.

SCHEMATICS

Basic Style



Options



MODELS PL-22, -23, -24, -42, -43, -44

OUTPUT VOLTAGE TABLE						
MODEL	SPLIT- CONCENTRIC SECTION WINDINGS	OUTPUT VOLTAGE		OUTPUT CURRENT (mA)		
		SERIES	PARALLEL	SERIES	PARALLEL	
PL-22-01	PL-42-01	8 VCT	4 V	188	376	
PL-23-01	PL-43-01		562	1124		
PL-24-01	PL-44-01		940	1880		
PL-22-02	PL-42-02	10 VCT	5 V	120	240	
PL-23-02	PL-43-02		440	880		
PL-24-02	PL-44-02		1000	2000		
PL-22-03	PL-42-03	12.6 VCT	6.3 V	100	200	
PL-23-03	PL-43-03		350	700		
PL-24-03	PL-44-03		800	1600		
PL-22-04	PL-42-04	15 VCT	7.5 V	100	200	
PL-23-04	PL-43-04		300	600		
PL-24-04	PL-44-04		500	1000		
PL-22-05	PL-42-05	16 VCT	8 V	75	150	
PL-23-05	PL-43-05		260	520		
PL-24-05	PL-44-05		640	1280		
PL-22-06	PL-42-06	20 VCT	10 V	60	120	
PL-23-06	PL-43-06		220	440		
PL-24-06	PL-44-06		500	1000		
PL-22-07	PL-42-07	24 VCT	12 V	50	100	
PL-23-07	PL-43-07		180	360		
PL-24-07	PL-44-07		450	900		
PL-22-08	PL-42-08	30 VCT	15 V	50	100	
PL-23-08	PL-43-08		150	300		
PL-24-08	PL-44-08		250	500		
PL-22-09	PL-42-09	34 VCT	17 V	35	70	
PL-23-09	PL-43-09		125	250		
PL-24-09	PL-44-09		300	600		
PL-22-10	PL-42-10	40 VCT	20 V	30	60	
PL-23-10	PL-43-10		110	220		
PL-24-10	PL-44-10		250	500		
PL-22-11	PL-42-11	54 VCT	27 V	28	56	
PL-23-11	PL-43-11		84	168		
PL-24-11	PL-44-11		140	280		
PL-22-12	PL-42-12	56 VCT	28 V	20	40	
PL-23-12	PL-43-12		80	160		
PL-24-12	PL-44-12		180	360		
PL-22-13	PL-42-13	76 VCT	38 V	20	40	
PL-23-13	PL-43-13		60	120		
PL-24-13	PL-44-13		100	200		
PL-22-14	PL-42-14	88 VCT	44 V	15	30	
PL-23-14	PL-43-14		50	100		
PL-24-14	PL-44-14		120	240		
PL-22-15	PL-42-15	120 VCT	60 V	10	20	
PL-23-15	PL-43-15		35	70		
PL-24-15	PL-44-15		85	170		
PL-22-16	PL-42-16	180 VCT	90 V	6	12	
PL-23-16	PL-43-16		24	48		
PL-24-16	PL-44-16		55	110		
PL-22-17	PL-42-17	230 VCT	115 V	5	10	
PL-23-17	PL-43-17		20	40		
PL-24-17	PL-44-17		40	80		

DIMENSIONAL CONFIGURATIONS (Reference)

Basic Style

"A" Type of Mounting Frame

"B" Type of Mounting Frame

[Numbers in brackets indicate millimeters]

MODEL	A	B	C	D	E	F	G	H
PL-22	1.43	1.20	.200	1.19	1.0	.125	1.75	2.12
PL-42	[36.32]	[30.48]	[5.08]	[30.23]	[25.40]	[3.18]	[44.45]	[53.85]
PL-23	1.68	1.38	.250	1.30	1.10	.125	2.0	2.44
PL-43	[42.67]	[35.05]	[6.35]	[33.02]	[27.94]	[3.18]	[50.80]	[61.98]
PL-24	1.93	1.64	.250	1.48	1.30	.188	2.38	2.88
PL-44	[49.02]	[41.66]	[6.35]	[37.59]	[33.02]	[4.78]	[60.45]	[73.15]

PART MARKING

— Dale
 — Model
 — Date code

HOW TO ORDER

PL-22 **-01** **A** **B**
 MODEL OUTPUT VOLTAGE MOUNTING FRAME FOR BOBBIN STANDOFF
 AND CURRENT (If not required, leave blank.) (If not required, leave blank.)

.063 [1.60]
Bobbin Standoff

Special design not listed, available on request.

MODELS EB4, EB6, EB7, EB8 Edgeboard Connectors

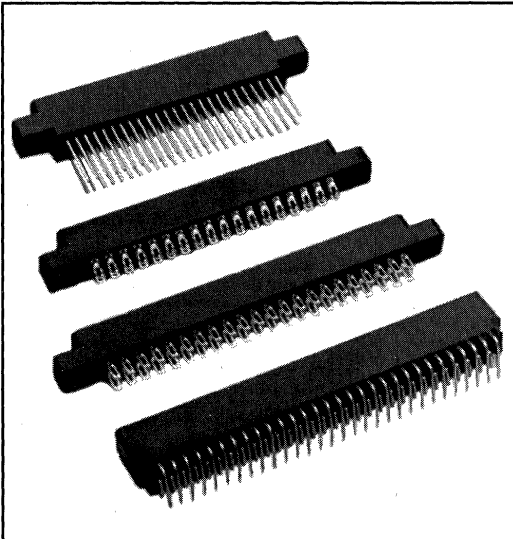
150°C and 200°C Burn-In Connectors

Dual Readout

A COMPANY OF

VISHAY

DALE®



APPLICATIONS

High temperature, long life connectors specifically designed for burn-in oven and automatic temperature testing applications.

Available in a wide range of sizes. Priced affordably and competitively.

SPECIAL NOTE:

When operating units at elevated temperatures, solder having a melting point 50 degrees Centigrade above the operating temperature should be used. Contact factory for specific solder information.

FEATURES

- EB4, .100" [2.54] C-C. EB6, .125" [3.17]. EB7 and EB8, .156" [3.96] C-C.
- Right angle styles included for all models
- High temperature, glass reinforced phenolic connector bodies - 150°C
- High temperature, glass reinforced PPS connector bodies - 200°C
- High reliability copper-nickel-tin alloy contacts
- Accepts P.C. board thickness of .054" to .071" [1.37 to 1.80]
- High reliability bifurcated bellows contacts
- Gold-plated contacts
- Card extender style terminals standard
- Variety of mounting styles available
- **Recognized under the Component Program of Underwriters Laboratories, Inc. Listed under File E65524.**

ELECTRICAL SPECIFICATIONS

Current Rating: 5 amps.

Test Voltage Between Contacts: At sea level: 1800 V RMS.
At 70,000 feet: 450 V RMS.

Insulation Resistance: 5,000 Megohm minimum at 500 VDC potential.

Contact Resistance: 30 millivolts maximum at rated current.

Humidity: 48 hours at 95% relative humidity at 90°C, insulation resistance 5,000 Megohm.

Shock: 3-50G shocks in each of 3 mutually perpendicular planes with no loss of continuity.

MATERIAL SPECIFICATIONS

Body Material:

150°C Connectors: Fiberglass reinforced phenolic, 150°C operating temperature, flame-retardant (UL94V-O).

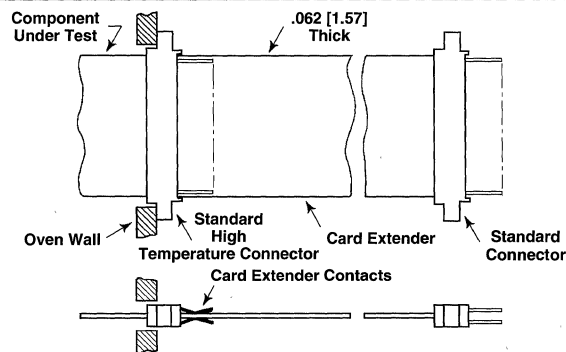
200°C Connectors: Fiberglass reinforced polyphenylene sulfide, 200°C operating temperature, flame-retardant (UL94V-O).

Contacts: Copper-nickel-tin alloy per ASTM B 740.

Plating: Gold plating (.00003" [.000762] thick), over .00005" [.00127] minimum nickel underplate.

MOUNTING STYLES [Numbers in brackets indicate millimeters]

Card Extender Mounting For Fast Change of Test Setups



- .100" [2.54] C-C (EB4)
- .125" [3.17] C-C (EB6)
- .156" [3.96] C-C (EB7)
- .156" [3.96] C-C (EB8)

150°C CARD EXTENDER MODEL NUMBERS

EB44-PE10GX	EB44-PE43GX	EB64-PE22GX	EB64-PE49GX
EB44-PE12GX	EB44-PE44GX	EB64-PE24GX	EB64-PE50GX
EB44-PE15GX	EB44-PE48GX	EB64-PE25GX	EB74D-PE36GX
EB44-PE18GX	EB44-PE49GX	EB64-PE28GX	EB74D-PE43GX
EB44-PE20GX	EB44-PE50GX	EB64-PE30GX	EB84-PE6GX
EB44-PE22GX	EB44-PE60GX	EB64-PE31GX	EB84-PE10GX
EB44-PE25GX	EB44-PE65GX	EB64-PE32GX	EB84-PE12GX
EB44-PE28GX	EB64-PE6GX	EB64-PE35GX	EB84-PE15GX
EB44-PE30GX	EB64-PE10GX	EB64-PE36GX	EB84-PE18GX
EB44-PE31GX	EB64-PE14GX	EB64-PE40GX	EB84-PE22GX
EB44-PE35GX	EB64-PE15GX	EB64-PE43GX	EB84-PE24GX
EB44-PE36GX	EB64-PE18GX	EB64-PE44GX	EB84-PE25GX
EB44-PE40GX			

200°C CARD EXTENDER MODEL NUMBERS

EB45-PE10GX	EB45-PE43GX	EB65-PE22GX	EB65-PE49GX
EB45-PE12GX	EB45-PE44GX	EB65-PE24GX	EB65-PE50GX
EB45-PE15GX	EB45-PE48GX	EB65-PE25GX	EB75D-PE36GX
EB45-PE18GX	EB45-PE49GX	EB65-PE28GX	EB75D-PE43GX
EB45-PE20GX	EB45-PE50GX	EB65-PE30GX	EB85-PE6GX
EB45-PE22GX	EB45-PE60GX	EB65-PE31GX	EB85-PE10GX
EB45-PE25GX	EB45-PE65GX	EB65-PE32GX	EB85-PE12GX
EB45-PE28GX	EB65-PE6GX	EB65-PE35GX	EB85-PE15GX
EB45-PE30GX	EB65-PE10GX	EB65-PE36GX	EB85-PE18GX
EB45-PE31GX	EB65-PE14GX	EB65-PE40GX	EB85-PE22GX
EB45-PE35GX	EB65-PE15GX	EB65-PE43GX	EB85-PE24GX
EB45-PE36GX	EB65-PE18GX	EB65-PE44GX	EB85-PE25GX
EB45-PE40GX			

MODELS EB4, EB6, EB7, EB8 - 150°C and 200°C Burn-In Connectors

MOUNTING STYLES [Numbers in brackets indicate millimeters]							
Wire Wrap™ Permanent Mounting						.100" [2.54] C-C (EB4) .125" [3.17] C-C (EB6)	
150°C WIRE WRAP™ MODEL NUMBERS				200°C WIRE WRAP™ MODEL NUMBERS			
EB44-PK10GX	EB44-PK35GX	EB64-PK6GX	EB64-PK31GX	EB45-PK10GX	EB45-PK35GX	EB65-PK6GX	EB65-PK31GX
EB44-PK12GX	EB44-PK36GX	EB64-PK10GX	EB64-PK32GX	EB45-PK12GX	EB45-PK36GX	EB65-PK10GX	EB65-PK32GX
EB44-PK15GX	EB44-PK40GX	EB64-PK14GX	EB64-PK35GX	EB45-PK15GX	EB45-PK40GX	EB65-PK14GX	EB65-PK35GX
EB44-PK18GX	EB44-PK43GX	EB64-PK15GX	EB64-PK36GX	EB45-PK18GX	EB45-PK43GX	EB65-PK15GX	EB65-PK36GX
EB44-PK20GX	EB44-PK44GX	EB64-PK18GX	EB64-PK40GX	EB45-PK20GX	EB45-PK44GX	EB65-PK18GX	EB65-PK40GX
EB44-PK22GX	EB44-PK48GX	EB64-PK22GX	EB64-PK43GX	EB45-PK22GX	EB45-PK48GX	EB65-PK22GX	EB65-PK43GX
EB44-PK25GX	EB44-PK49GX	EB64-PK24GX	EB64-PK44GX	EB45-PK25GX	EB45-PK49GX	EB65-PK24GX	EB65-PK44GX
EB44-PK28GX	EB44-PK50GX	EB64-PK25GX	EB64-PK49GX	EB45-PK28GX	EB45-PK50GX	EB65-PK25GX	EB65-PK49GX
EB44-PK30GX	EB44-PK60GX	EB64-PK28GX	EB64-PK50GX	EB45-PK30GX	EB45-PK60GX	EB65-PK28GX	EB65-PK50GX
EB44-PK31GX	EB44-PK65GX	EB64-PK30GX		EB45-PK31GX	EB45-PK65GX	EB65-PK30GX	
Right Angle P. C. Board Mounting						.100" [2.54] C-C (EB4) .125" [3.17] C-C (EB6) .156" [3.96] C-C (EB7)	
150°C RIGHT ANGLE MODEL NUMBERS				200°C RIGHT ANGLE MODEL NUMBERS			
EB44-P3R10GXS	EB44-P3R40GXS	EB64-P3R18GX	EB64-P3R44GX	EB45-P3R10GXS	EB45-P3R40GXS	EB65-P3R18GX	EB65-P3R44GX
EB44-P3R12GXS	EB44-P3R43GXS	EB64-P3R22GX	EB64-P3R49GX	EB45-P3R12GXS	EB45-P3R43GXS	EB65-P3R22GX	EB65-P3R49GX
EB44-P3R15GXS	EB44-P3R44GXS	EB64-P3R24GX	EB64-P3R50GX	EB45-P3R15GXS	EB45-P3R44GXS	EB65-P3R24GX	EB65-P3R50GX
EB44-P3R18GXS	EB44-P3R48GXS	EB64-P3R25GX	EB74D-PR6GXS	EB45-P3R18GXS	EB45-P3R48GXS	EB65-P3R25GX	EB75D-PR6GXS
EB44-P3R20GXS	EB44-P3R49GXS	EB64-P3R28GX	EB74D-PR10GXS	EB45-P3R20GXS	EB45-P3R49GXS	EB65-P3R28GX	EB75D-PR10GXS
EB44-P3R22GXS	EB44-P3R50GXS	EB64-P3R30GX	EB74D-PR12GXS	EB45-P3R22GXS	EB45-P3R50GXS	EB65-P3R30GX	EB75D-PR12GXS
EB44-P3R25GXS*	EB44-P3R60GXS	EB64-P3R31GX	EB74D-PR15GXS	EB45-P3R25GXS*	EB45-P3R60GXS	EB65-P3R31GX	EB75D-PR15GXS
EB44-P3R28GXS	EB44-P3R65GXS	EB64-P3R32GX	EB74D-PR18GXS	EB45-P3R28GXS	EB45-P3R65GXS	EB65-P3R32GX	EB75D-PR18GXS
EB44-P3R30GXS	EB64-P3R6GX	EB64-P3R35GX	EB74D-PR22GXS	EB45-P3R30GXS	EB65-P3R6GX	EB65-P3R35GX	EB75D-PR22GXS
EB44-P3R31GXS	EB64-P3R10GX	EB64-P3R36GX	EB74D-PR36GXS	EB45-P3R31GXS	EB65-P3R10GX	EB65-P3R36GX	EB75D-PR36GXS
EB44-P3R35GXS	EB64-P3R14GX	EB64-P3R40GX	EB74D-PR43GXS	EB45-P3R35GXS	EB65-P3R14GX	EB65-P3R40GX	EB75D-PR43GXS
EB44-P3R36GXS	EB64-P3R15GX	EB64-P3R43GX		EB45-P3R36GXS	EB65-P3R15GX	EB65-P3R43GX	
Hard Wire Permanent Mounting						.156" [3.96] C-C (EB7) .156" [3.96] C-C (EB8)	
150°C HARD WIRE MODEL NUMBERS				200°C HARD WIRE MODEL NUMBERS			
EB84-PA6GX	EB84-PA15GX	EB84-PA24GX	EB74D-PA43GX	EB85-PA6GX	EB85-PA15GX	EB85-PA24GX	EB75D-PA43GX
EB84-PA10GX	EB84-PA18GX	EB84-PA25GX		EB85-PA10GX	EB85-PA18GX	EB85-PA25GX	
EB84-PA12GX	EB84-PA22GX	EB74D-PA36GX		EB85-PA12GX	EB85-PA22GX	EB75D-PA36GX	

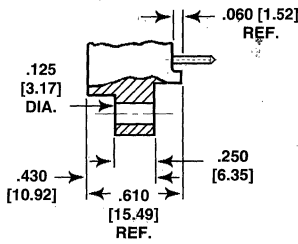
MODELS EB4, EB6, EB7, EB8 - 150°C and 200°C Burn-In Connectors

MOUNTING VARIATIONS FOR 150°C AND 200°C BURN-IN CONNECTORS

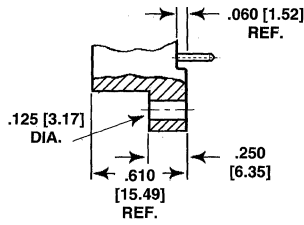
.100" [2.54] C-C (EB4)

.125" [3.17] C-C (EB6)

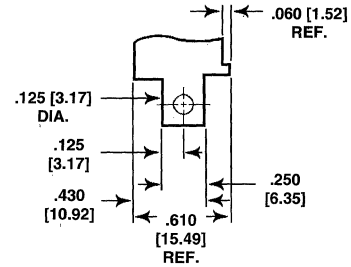
TYPE "X"
CLEARANCE HOLE
RAISED MOUNTING FLANGE



TYPE "XF"
CLEARANCE HOLE
FLUSH MOUNTING FLANGE



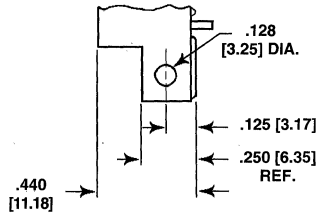
TYPE "XS"
RIGHT ANGLE
MOUNTING FLANGE



.156" [3.96] C-C (EB7 and EB8)

Side Mounting

TYPE "XS"

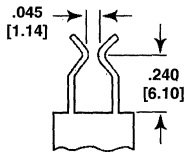


[Numbers in brackets indicate millimeters]

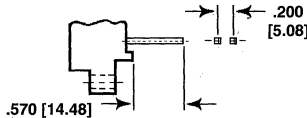
TERMINAL VARIATIONS FOR 150°C AND 200°C BURN-IN CONNECTORS

.100" [2.54] C-C (EB4)

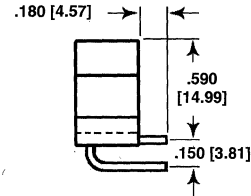
TYPE "E"
CARD EXTENDER



TYPE "K"
WIRE WRAP™
.025 [6.30] Square Terminals



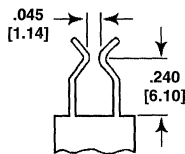
TYPE "3R"
RIGHT ANGLE
.025 [6.30] Square Terminals



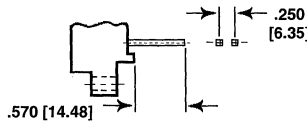
[Numbers in brackets indicate millimeters]

.125" [3.17] C-C (EB6)

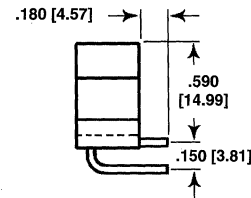
TYPE "E"
CARD EXTENDER



TYPE "K"
WIRE WRAP™
.025 [6.30] Square Terminals

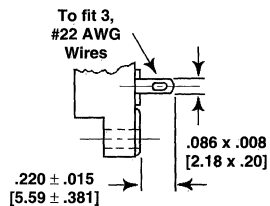


TYPE "3R"
RIGHT ANGLE
.025 [6.30] Square Terminals

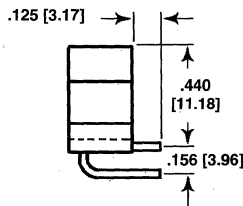


.156" [3.96] C-C (EB7 and EB8)

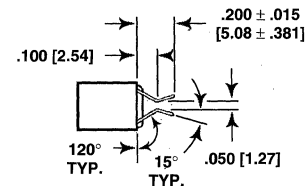
TYPE "A"
SOLDER EYELET



TYPE "R"
RIGHT ANGLE



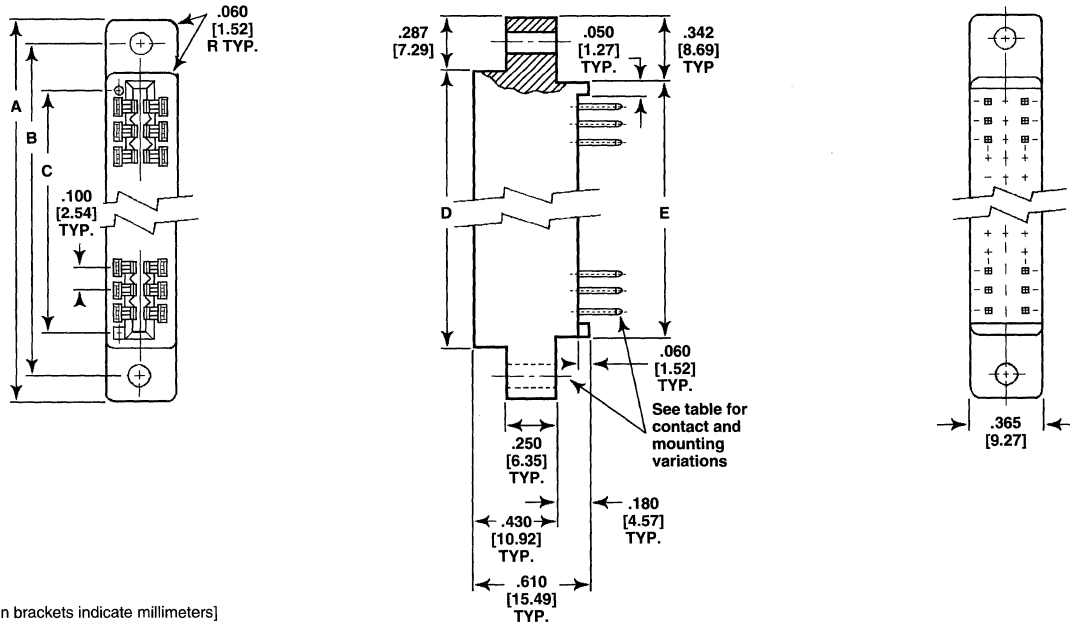
TYPE "E"
CARD EXTENDER (Made from Type "A")



MODELS EB4, EB6, EB7, EB8 - 150°C and 200°C Burn-In Connectors

DIMENSIONAL CONFIGURATIONS FOR 150°C AND 200°C BURN-IN CONNECTORS

.100" [2.54] C-C (EB4)



[Numbers in brackets indicate millimeters]

MODEL - PART NUMBER	# OF CONTACT POSITIONS PER SIDE	A	B	C	D	E	CARD SLOT DEPTH
EB4*-P□10GΔ	10	1.835 [46.61]	1.575 [40.00]	1.100 [27.94]	1.260 [32.00]	1.150 [29.21]	.300 [7.62]
EB4*-P□12GΔ	12	2.035 [51.69]	1.775 [45.08]	1.300 [33.02]	1.460 [37.08]	1.350 [34.29]	.300 [7.62]
EB4*-P□15GΔ	15	2.335 [59.31]	2.075 [52.70]	1.600 [40.64]	1.760 [44.70]	1.650 [41.91]	.300 [7.62]
EB4*-P□18GΔ	18	2.635 [66.93]	2.375 [60.32]	1.900 [48.26]	2.060 [52.32]	1.950 [49.53]	.300 [7.62]
EB4*-P□20GΔ	20	2.835 [72.01]	2.575 [65.40]	2.100 [53.34]	2.260 [57.40]	2.150 [54.61]	.300 [7.62]
EB4*-P□22GΔ	22	3.035 [77.09]	2.775 [70.48]	2.300 [58.42]	2.460 [62.48]	2.350 [59.69]	.300 [7.62]
EB4*-P□25GΔ	25	3.335 [84.71]	3.075 [78.10]	2.600 [66.04]	2.760 [70.10]	2.650 [67.31]	.300 [7.62]
EB4*-P□28GΔ	28	3.635 [92.33]	3.375 [85.72]	2.900 [73.66]	3.060 [77.72]	2.950 [74.93]	.300 [7.62]
EB4*-P□30GΔ	30	3.835 [97.41]	3.575 [90.80]	3.100 [78.74]	3.260 [82.80]	3.150 [80.01]	.300 [7.62]
EB4*-P□31GΔ	31	3.935 [99.95]	3.675 [93.34]	3.200 [81.28]	3.360 [85.34]	3.250 [82.55]	.300 [7.62]
EB4*-P□35GΔ	35	4.335 [110.11]	4.075 [103.50]	3.600 [91.44]	3.760 [95.50]	3.650 [92.71]	.300 [7.62]
EB4*-P□36GΔ	36	4.435 [112.65]	4.175 [106.04]	3.700 [93.98]	3.860 [98.04]	3.750 [95.25]	.300 [7.62]
EB4*-P□40GΔ	40	4.835 [122.81]	4.575 [116.20]	4.100 [104.14]	4.260 [108.20]	4.150 [105.41]	.300 [7.62]
EB4*-P□43GΔ	43	5.135 [130.43]	4.875 [123.82]	4.400 [111.76]	4.560 [115.82]	4.450 [113.03]	.300 [7.62]
EB4*-P□44GΔ	44	5.235 [132.97]	4.975 [126.36]	4.500 [114.30]	4.660 [118.36]	4.550 [115.57]	.300 [7.62]
EB4*-P□48GΔ	48	5.635 [143.13]	5.375 [136.52]	4.900 [124.46]	5.060 [128.52]	4.950 [125.73]	.300 [7.62]
EB4*-P□49GΔ	49	5.735 [145.67]	5.475 [139.06]	5.000 [127.00]	5.160 [131.06]	5.050 [128.27]	.300 [7.62]
EB4*-P□50GΔ	50	5.835 [148.21]	5.575 [141.60]	5.100 [129.54]	5.260 [133.60]	5.150 [130.81]	.300 [7.62]
EB4*-P□60GΔ	60	6.835 [173.61]	6.575 [167.00]	6.100 [154.94]	6.260 [159.00]	6.150 [156.21]	.300 [7.62]
EB4*-P□65GΔ	65	7.335 [186.31]	7.075 [179.70]	6.600 [167.64]	6.760 [171.70]	6.650 [168.91]	.300 [7.62]

ORDERING INFORMATION

When ordering connectors using the above part numbers:

* = Indicate "4" for 150°C Burn-In Connectors, or "5" for 200°C Burn-In Connectors.

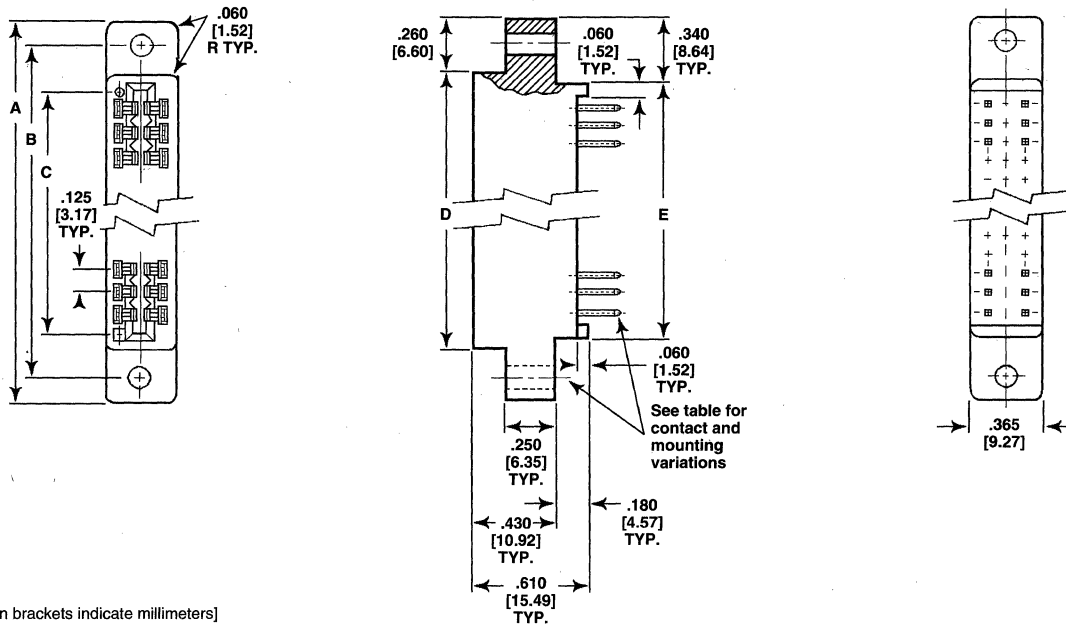
□ = Indicate "E" for Card Extender, "K" for Wire Wrap™, or "3R" for Right Angle Terminals.

Δ = Indicate "X" for Standard Mounting, "XF" for Flush Mounting, or "XS" for Side Mounting.

MODELS EB4, EB6, EB7, EB8 - 150°C and 200°C Burn-In Connectors

DIMENSIONAL CONFIGURATIONS FOR 150°C AND 200°C BURN-IN CONNECTORS

.125" [3.17] C-C (EB6)



[Numbers in brackets indicate millimeters]

MODEL - PART NUMBER	# OF CONTACT POSITIONS PER SIDE	A	B	C	D	E	CARD SLOT DEPTH
EB6*-P□6GΔ	6	1.555 [39.50]	1.295 [33.89]	.875 [22.22]	1.035 [26.29]	.875 [22.22]	.300 [7.62]
EB6*-P□10GΔ	10	2.055 [52.20]	1.795 [45.59]	1.375 [34.92]	1.535 [38.99]	1.375 [34.92]	.300 [7.62]
EB6*-P□14GΔ	14	2.555 [64.90]	2.295 [58.29]	1.875 [47.62]	2.035 [51.69]	1.875 [47.62]	.300 [7.62]
EB6*-P□15GΔ	15	2.680 [68.07]	2.420 [61.47]	2.000 [50.80]	2.160 [54.86]	2.000 [50.80]	.300 [7.62]
EB6*-P□18GΔ	18	3.055 [77.60]	2.795 [70.99]	2.375 [60.32]	2.535 [64.39]	2.375 [60.32]	.300 [7.62]
EB6*-P□22GΔ	22	3.555 [90.30]	3.295 [83.69]	2.875 [73.02]	3.035 [77.09]	2.875 [73.02]	.300 [7.62]
EB6*-P□24GΔ	24	3.805 [96.65]	3.545 [90.04]	3.125 [79.38]	3.285 [83.44]	3.125 [79.38]	.300 [7.62]
EB6*-P□25GΔ	25	3.930 [99.82]	3.670 [93.22]	3.250 [82.55]	3.410 [86.61]	3.250 [82.55]	.300 [7.62]
EB6*-P□28GΔ	28	4.305 [109.35]	4.045 [102.74]	3.625 [92.08]	3.785 [96.14]	3.625 [92.08]	.300 [7.62]
EB6*-P□30GΔ	30	4.555 [115.70]	4.295 [109.09]	3.875 [98.42]	4.035 [102.49]	3.875 [98.42]	.300 [7.62]
EB6*-P□31GΔ	31	4.680 [118.87]	4.420 [112.27]	4.000 [101.60]	4.160 [105.66]	4.000 [101.60]	.300 [7.62]
EB6*-P□32GΔ	32	4.805 [122.05]	4.545 [115.44]	4.125 [104.78]	4.285 [108.84]	4.125 [104.78]	.300 [7.62]
EB6*-P□35GΔ	35	5.180 [131.57]	4.920 [124.97]	4.500 [114.30]	4.660 [118.36]	4.500 [114.30]	.300 [7.62]
EB6*-P□36GΔ	36	5.305 [134.75]	5.045 [128.14]	4.625 [117.48]	4.785 [121.54]	4.625 [117.48]	.300 [7.62]
EB6*-P□40GΔ	40	5.805 [147.45]	5.545 [140.84]	5.125 [130.18]	5.285 [134.24]	5.125 [130.18]	.300 [7.62]
EB6*-P□43GΔ	43	6.180 [156.97]	5.920 [150.37]	5.500 [139.70]	5.660 [143.76]	5.500 [139.70]	.300 [7.62]
EB6*-P□44GΔ	44	6.305 [160.15]	6.045 [153.54]	5.625 [142.88]	5.785 [146.94]	5.625 [142.88]	.300 [7.62]
EB6*-P□49GΔ	49	6.930 [176.02]	6.670 [169.42]	6.250 [158.75]	6.410 [162.81]	6.250 [158.75]	.300 [7.62]
EB6*-P□50GΔ	50	7.055 [179.20]	6.795 [172.59]	6.375 [161.92]	6.535 [165.99]	6.375 [161.92]	.300 [7.62]

ORDERING INFORMATION

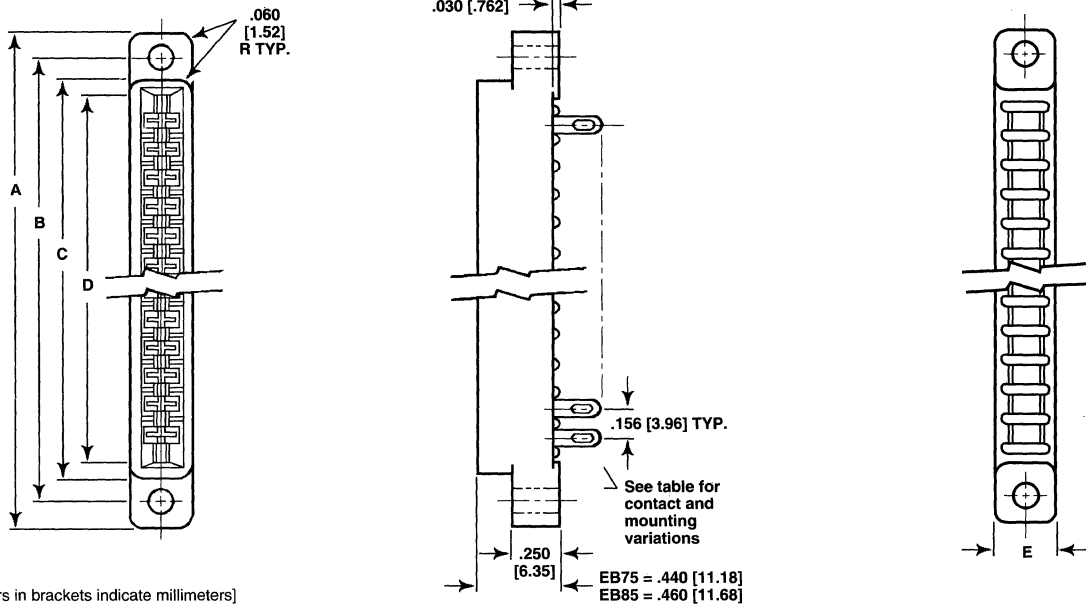
When ordering connectors using the above part numbers:

- * = Indicate "4" for 150°C Burn-In Connectors, or "5" for 200°C Burn-In Connectors.
- = Indicate "E" for Card Extender, "K" for Wire Wrap™, or "3R" for Right Angle Terminals.
- Δ = Indicate "X" for Standard Mounting, "XF" for Flush Mounting, or "XS" for Side Mounting.

MODELS EB4, EB6, EB7, EB8 - 150°C and 200°C Burn-In Connectors

DIMENSIONAL CONFIGURATIONS FOR 150°C AND 200°C BURN-IN CONNECTORS

.156" [3.96] C-C (EB7 and EB8)



MODEL - PART NUMBER	# OF CONTACT POSITIONS PER SIDE	A	B	C	D	E	CARD SLOT DEPTH
EB8* X -P□6GΔ	6	1.780 [45.21]	1.531 [38.89]	1.240 [31.50]	1.100 [27.94]	.340 [8.64]	.330 [8.38]
EB8* X -P□10GΔ	10	2.410 [61.21]	2.156 [54.76]	1.864 [47.35]	1.724 [43.79]	.340 [8.64]	.330 [8.38]
EB8* X -P□12GΔ	12	2.720 [69.09]	2.469 [62.71]	2.176 [55.27]	2.036 [51.71]	.340 [8.64]	.330 [8.38]
EB8* X -P□15GΔ	15	3.190 [81.03]	2.937 [74.60]	2.644 [67.16]	2.504 [63.60]	.340 [8.64]	.330 [8.38]
EB8* X -P□18GΔ	18	3.660 [92.96]	3.406 [86.51]	3.112 [79.04]	2.972 [75.49]	.340 [8.64]	.330 [8.38]
EB8* X -P□22GΔ	22	4.280 [108.71]	4.031 [102.39]	3.736 [94.89]	3.596 [91.34]	.340 [8.64]	.330 [8.38]
EB8* X -P□24GΔ	24	4.590 [116.59]	4.344 [110.34]	4.051 [102.90]	3.911 [99.34]	.340 [8.64]	.330 [8.38]
EB8* X -P□25GΔ	25	4.750 [120.65]	4.500 [114.30]	4.207 [106.86]	4.067 [103.30]	.340 [8.64]	.330 [8.38]
EB7* D -P□36GΔ	36	6.530 [165.86]	6.219 [157.96]	5.906 [150.01]	5.778 [146.76]	.438 [11.13]	.260 [6.60]
EB7* D -P□43GΔ	43	7.615 [193.42]	7.302 [185.47]	7.000 [177.80]	6.802 [172.77]	.500 [12.70]	.260 [6.60]
RIGHT ANGLE DIMENSIONS							
EB7* D -PR6GΔ	6	1.780 [45.21]	1.531 [38.89]	1.218 [30.94]	1.100 [27.94]	.328 [8.33]	.260 [6.60]
EB7* D -PR10GΔ	10	2.410 [61.21]	2.156 [54.76]	1.843 [46.81]	1.724 [43.79]	.328 [8.33]	.260 [6.60]
EB7* D -PR12GΔ	12	2.720 [69.09]	2.468 [62.69]	2.156 [54.76]	2.036 [51.71]	.328 [8.33]	.260 [6.60]
EB7* D -PR15GΔ	15	3.190 [81.03]	2.937 [74.60]	2.624 [66.65]	2.504 [63.60]	.328 [8.33]	.260 [6.60]
EB7* D -PR18GΔ	18	3.660 [92.96]	3.406 [86.51]	3.093 [78.56]	2.972 [75.49]	.328 [8.33]	.260 [6.60]
EB7* D -PR22GΔ	22	4.280 [108.71]	4.031 [102.39]	3.717 [94.41]	3.596 [91.34]	.328 [8.33]	.260 [6.60]
EB7* D -PR 36GΔ	36	6.530 [165.86]	6.219 [157.96]	5.906 [150.01]	5.778 [146.76]	.438 [11.13]	.260 [6.60]
EB7* D -PR 43GΔ	43	7.615 [193.42]	7.302 [185.47]	7.000 [177.80]	6.802 [172.77]	.500 [12.70]	.260 [6.60]

ORDERING INFORMATION

When ordering connectors using the above part numbers:

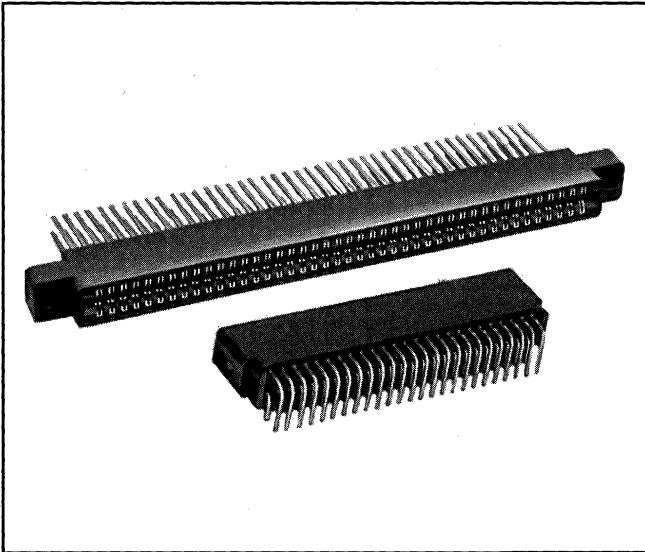
X = Indicate "4" for 150°C Burn-In Connectors, or "5" for 200°C Burn-In Connectors.

□ = Indicate "A" for Solder Eyelet, or "E" for Card Extender. Note dimensions are the same for "A" or "E" styles.

Δ = Indicate "X" for Standard Mounting, or "XS" for Side Mounting.

MODEL EB4 Edgeboard Connectors

Dual Readout, .100" [2.54] C-C Standard and Right Angle Terminals



FEATURES

- Grid Patterns: .100" C-C x .150" [2.54 x 3.81] and .100" C-C x .200" [2.54 x 5.08]
- Standard and right angle terminals
- Greater design latitude
 - 3 body materials: Diallyl phthalate, phenolic and glass-filled polyester
 - 7 contact termination styles - 3 Standard, 4 Right Angle
 - 20 body sizes and 6 mounting styles
- Selective gold plating
- Accepts P. C. board thickness of .054" - .071" [1.37 - 1.80]
- Polarization between contact positions in all sizes. Between contact polarization permits polarizing without loss of contact position.
- Recognized under the Component Program of Underwriters Laboratories Inc. Listed under File E65524, Project 77CH3889.

APPLICATIONS

For use with .0625" [1.59] printed circuit boards requiring an edgeboard type connector on .100" [2.54] centers.

PHYSICAL SPECIFICATIONS

Contact Type: Bifurcated Cantilever Beam.

Number of Contacts: 10, 12, 15, 18, 20, 22, 25, 28, 30, 31, 35, 36, 40, 43, 44, 48, 49, 50, 60 and 65 per side.

Contact Terminal Variation: Standard Terminals.

Type "C" - Dip Solder, .025" [.635] square terminals, .175" [4.44] nominal terminal length below standoffs.

Type "D" - Dip Solder, .025" [.635] square terminals, .115" [2.92] nominal terminal length below standoffs.

Type "K" - Wire Wrap™, .025" [.635] square terminals, .570" [14.48] nominal terminal length below standoffs.

Contact Terminal Variation: Right Angle Terminals.

Type "1R" - Dip Solder, .025" [.635] square terminals, .120" [3.05] nominal terminal length x .150" [3.81] nominal terminal row spacing.

Type "2R" - Dip Solder, .025" [.635] square terminals, .120" [3.05] nominal terminal length x .200" [5.08] nominal terminal row spacing.

Type "3R" - Dip Solder, .025" [.635] square terminals, .180" [4.57] nominal terminal length x .150" [3.81] nominal terminal row spacing.

Type "4R" - Dip Solder, .025" [.635] square terminals, .180" [4.57] nominal terminal length x .200" [5.08] nominal terminal row spacing.

Contact Spacing: .100" [2.54] center to center.

Contact Terminal Row Spacing:

Standard - .200" [5.08] nominal.

Right Angle - .200" [5.08] nominal and .150" [3.81] nominal.

Card Thickness: .054" to .071" [1.37 to 1.80].

Card Slot Depth: .300" [7.62].

Connector Polarization: Between contact polarization key(s) are located to the right of the contact position(s) designated.

High temperature burn-in, edgeboard connectors, with .100" [2.54] center to center are on page 272 of this catalog.

[Numbers in brackets indicate millimeters]

ELECTRICAL SPECIFICATIONS

Current Rating: 3 amps.

Test Voltage between Contacts:

At sea level: 650 V RMS.

At 70,000 feet [21,336 meters]: 275 V RMS.

Insulation Resistance: 5000 Megohm minimum at 500 VDC potential.

Contact Resistance: 30 millivolts maximum at rated current (with gold plating).

Operating Temperature: - 65°C to + 125°C.

Humidity: 96 hours at 90% relative humidity at 40°C, dried at room temperature for 3 hours minimum, insulation resistance was greater than 5000 Megohm.

Durability: After 500 cycles of insertion and withdrawal of a .070" [1.78] thick steel test board, contact resistance less than .030V at 3 amps on gold plated contacts and individual contact pair separation force when measured with a .054" [1.37] thick steel test blade was greater than 1/2 ounce.

Shock: Three 50G shocks in each of 3 mutually perpendicular planes with no loss of continuity.

Vibration: 2 hours in each of 3 mutually perpendicular planes, frequency sweep 10 to 55 cps at .06 double amplitude with no loss of continuity.

MATERIAL SPECIFICATIONS

Body Material:

"1" glass-filled diallyl phthalate per MIL-M-14, Type SDG-F green, flame retardant (UL 94V-0).

"2" glass-filled phenolic per MIL-M-14, Type MFH dark green, flame retardant (UL 94V-0).

"3" thermoplastic polyester, glass-filled, black, flame retardant (UL 94V-0).

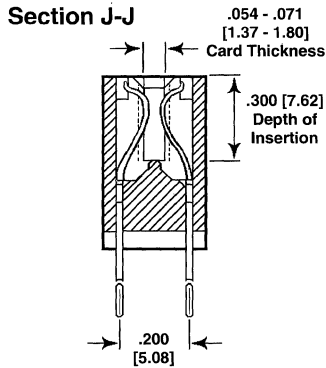
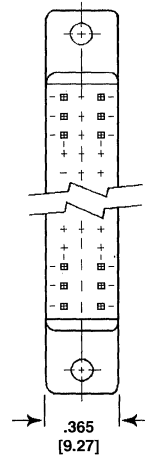
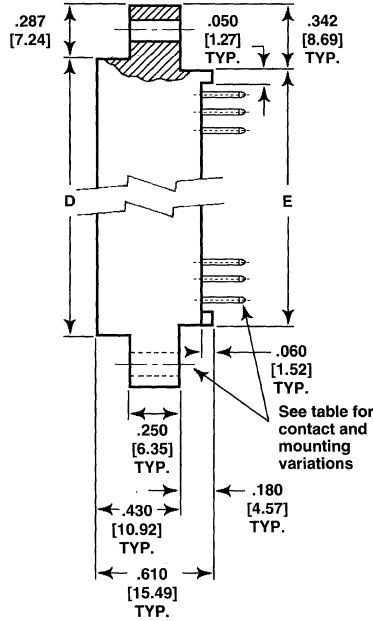
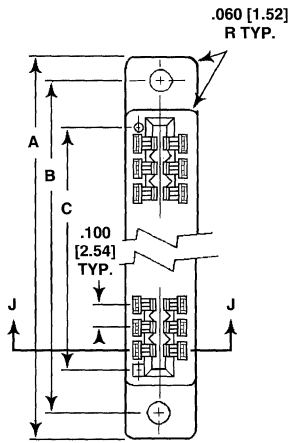
Contacts: Phosphor bronze. (See How to Order.)

Polarizing Key: Glass reinforced nylon, flame retardant (UL 94H-B).

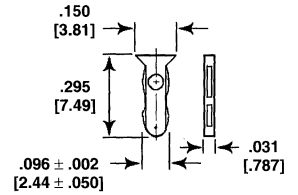
Plating: Gold. (See How to Order.)

MODEL EB4

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



Polarizing Key:
 When ordering polarizing keys individually, specify by the Model Number: PK-4 between contacts. Hand insertion tool, TPK-4, provided upon request.

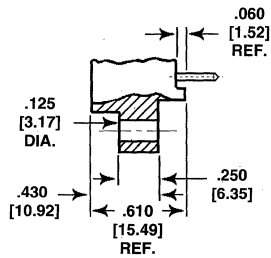


# OF CONTACT POSITIONS PER SIDE	A	B	C	D	E
10	1.835 [46.61]	1.575 [40.00]	1.100 [27.94]	1.260 [32.00]	1.150 [29.21]
12	2.035 [51.69]	1.775 [45.08]	1.300 [33.02]	1.460 [37.08]	1.350 [34.29]
15	2.335 [59.31]	2.075 [52.70]	1.600 [40.64]	1.760 [44.70]	1.650 [41.91]
18	2.635 [66.93]	2.375 [60.32]	1.900 [48.26]	2.060 [52.32]	1.950 [49.53]
20	2.835 [72.01]	2.575 [65.40]	2.100 [53.34]	2.260 [57.40]	2.150 [54.61]
22	3.035 [77.09]	2.775 [70.48]	2.300 [58.42]	2.460 [62.48]	2.350 [59.69]
25	3.335 [84.71]	3.075 [78.10]	2.600 [66.04]	2.760 [70.10]	2.650 [67.31]
28	3.635 [92.33]	3.375 [85.72]	2.900 [73.66]	3.060 [77.72]	2.950 [74.93]
30	3.835 [97.41]	3.575 [90.80]	3.100 [78.74]	3.260 [82.80]	3.150 [80.01]
31	3.935 [99.95]	3.675 [93.34]	3.200 [81.28]	3.360 [85.34]	3.250 [82.55]
35	4.335 [110.11]	4.075 [103.50]	3.600 [91.44]	3.760 [95.50]	3.650 [92.71]
36	4.435 [112.65]	4.175 [106.04]	3.700 [93.98]	3.860 [98.04]	3.750 [95.25]
40	4.835 [122.81]	4.575 [116.20]	4.100 [104.14]	4.260 [108.20]	4.150 [105.41]
43	5.135 [130.43]	4.875 [123.82]	4.400 [111.76]	4.560 [115.82]	4.450 [113.03]
44	5.235 [132.97]	4.975 [126.36]	4.500 [114.30]	4.660 [118.36]	4.550 [115.57]
48	5.635 [143.13]	5.375 [136.52]	4.900 [124.46]	5.060 [128.52]	4.950 [125.73]
49	5.735 [145.67]	5.475 [139.06]	5.000 [127.00]	5.160 [131.06]	5.050 [128.27]
50	5.835 [148.21]	5.575 [141.60]	5.100 [129.54]	5.260 [133.60]	5.150 [130.81]
60	6.835 [173.61]	6.575 [167.00]	6.100 [154.94]	6.260 [159.00]	6.150 [156.21]
65	7.335 [186.31]	7.075 [179.70]	6.600 [167.64]	6.760 [171.70]	6.650 [168.91]

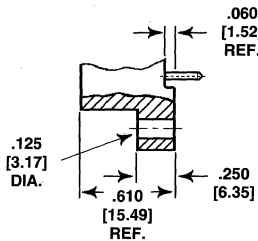
MODEL EB4

MOUNTING VARIATIONS [Numbers in brackets indicate millimeters]

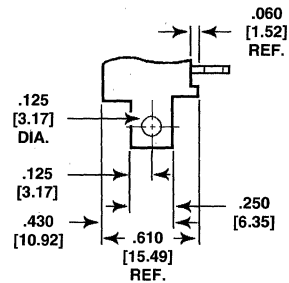
TYPE "X"
CLEARANCE HOLE
RAISED MOUNTING FLANGE



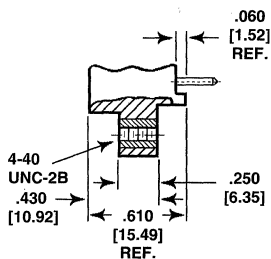
TYPE "XF"
CLEARANCE HOLE
FLUSH MOUNTING FLANGE



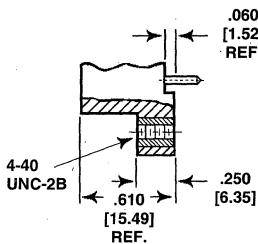
TYPE "XS"
RIGHT ANGLE
MOUNTING FLANGE



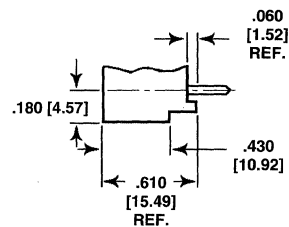
TYPE "Y"
THREADED INSERT
RAISED MOUNTING FLANGE



TYPE "YF"
THREADED INSERT
FLUSH MOUNTING FLANGE

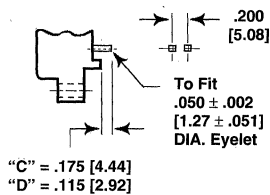


TYPE "W"
NO MOUNTING FLANGE

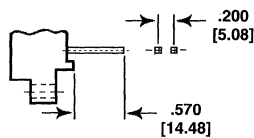


TERMINAL VARIATIONS [Numbers in brackets indicate millimeters]

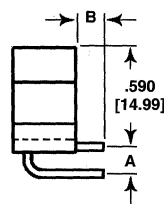
TYPE "C" and "D"
SOLDER DIP, STANDARD
.025 [.635] SQUARE TERMINALS



TYPE "K"
WIRE WRAP™, STANDARD
.025 [.635] SQUARE TERMINALS



TYPE "1R", "2R", "3R" and "4R"
RIGHT ANGLE
.025 [.635] SQUARE TERMINALS



TYPE	A	B
1R	.150 [3.81]	.120 ± .030 [3.05 ± .762]
2R	.200 [5.08]	.120 ± .030 [3.05 ± .762]
3R	.150 [3.81]	.180 ± .030 [4.57 ± .762]
4R	.200 [5.08]	.180 ± .030 [4.57 ± .762]

HOW TO ORDER

EB4
MODEL

3
BODY
MATERIAL

- 1 = Diallyl Phthalate
- 2 = Phenolic
- 3 = Glass-filled Polyester

K
STANDARD
TERMINAL
VARIATIONS

- C, D, K, 1R,
- 2R, 3R, 4R

20
CONTACTS

- 10, 12, 15,
- 18, 20, 22,
- 25, 28, 30,
- 31, 35, 36,
- 40, 43, 44,
- 48, 49, 50,
- 60 and 65
per side.

SG
CONTACT
PLATING

SG = Selective Gold Plating (.00003" [.000762] minimum thick) on contact area with Gold Flash on terminal.
SGF = Selective Gold Plating (.000010" [.000254] minimum thick) on contact area with Gold Flash on terminal.
All Gold Plating over .00005" [.00127] minimum Nickel Underplate.
Contact factory for additional plating options.

X
MOUNTING
VARIATIONS

15
POLARIZING
KEY
POSITIONS

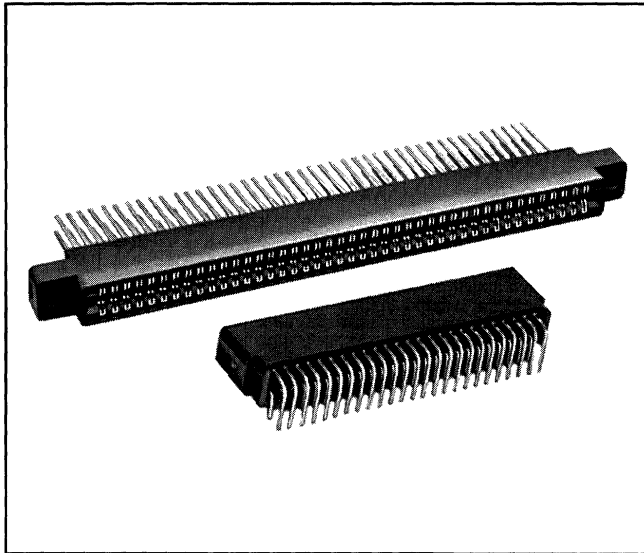
Key(s) are located to right of position(s) designated. Use odd-numbered contact for ordering: -1, -3, -5, etc. Required only when polarizing keys are to be factory installed. **NOTE:** To order polarizing keys individually, specify model PK-4.

MODEL EB6

Edgeboard Connectors

Dual Readout, .125" [3.17] C-C

Standard and Right Angle Terminals



FEATURES

- Grid Patterns: .125" C-C x .150" [3.17 x 3.81], .125" C-C x .200" [3.17 x 5.08] and .125" C-C x .250" [3.17 x 6.35]
- Standard and right angle terminals
- Greater design latitude
 - 3 body materials: Diallyl phthalate, phenolic and glass-filled polyester
 - 7 contact termination styles - 3 Standard, 4 Right Angle
 - 19 body sizes and 6 mounting styles
- Selective gold plating
- Accepts P. C. board thickness of .054" - .071" [1.37 - 1.80]
- Polarization between contact positions in all sizes. Between contact polarization permits polarizing without loss of contact position.
- **Recognized under the Component Program of Underwriters Laboratories Inc. Listed under File E65524, Project 77CH3889.**

APPLICATIONS

For use with .0625" [1.59] printed circuit boards requiring an edgeboard type connector on .125" [3.17] centers.

ELECTRICAL SPECIFICATIONS

Current Rating: 3 amps.

Test Voltage between Contacts:

At sea level: 1500 V RMS.

At 70,000 feet [21,336 meters]: 325 V RMS.

Insulation Resistance: 5000 Megohm minimum at 500 VDC potential.

Contact Resistance: 30 millivolts maximum at rated current (with gold plating).

Operating Temperature: - 65°C to + 125°C.

Humidity: 96 hours at 90% relative humidity at 40°C, dried at room temperature for 3 hours minimum, insulation resistance was greater than 5000 Megohm.

Durability: After 500 cycles of insertion and withdrawal of a .070" [1.78] thick steel test board, contact resistance less than .030V at 3 amps on gold plated contacts and individual contact pair separation force when measured with a .054" [1.37] thick steel test blade was greater than 1/2 ounce.

Shock: Three 50G shocks in each of 3 mutually perpendicular planes with no loss of continuity.

Vibration: 2 hours in each of 3 mutually perpendicular planes, frequency sweep 10 to 55 cps at .06 double amplitude with no loss of continuity.

MATERIAL SPECIFICATIONS

Body Material:

"1" glass-filled diallyl phthalate per MIL-M-14, Type SDG-F green, flame retardant (UL 94V-0).

"2" glass-filled phenolic per MIL-M-14, Type MFH dark green, flame retardant (UL 94V-0).

"3" thermoplastic polyester, glass-filled, black, flame retardant (UL 94V-0).

Contacts: Phosphor bronze. (See How to Order.)

Polarizing Key: Glass reinforced nylon, flame retardant (UL 94H-B).

Plating: Gold. (See How to Order.)

PHYSICAL SPECIFICATIONS

Contact Type: Bifurcated Cantilever Beam.

Number of Contacts: 6, 10, 14, 15, 18, 22, 24, 25, 28, 30, 31, 32, 35, 36, 40, 43, 44, 49 and 50 per side.

Contact Terminal Variation: Standard Terminals.

Type "C" - Dip Solder, .025" [.635] square terminals, .175" [4.44] nominal terminal length below standoffs.

Type "D" - Dip Solder, .025" [.635] square terminals, .115" [2.92] nominal terminal length below standoffs.

Type "K" - Wire Wrap™, .025" [.635] square terminals, .570" [14.48] nominal terminal length below standoffs.

Contact Terminal Variation: Right Angle Terminals.

Type "1R" - Dip Solder, .025" [.635] square terminals, .120" [3.05] nominal terminal length x .150" [3.81] nominal terminal row spacing.

Type "2R" - Dip Solder, .025" [.635] square terminals, .120" [3.05] nominal terminal length x .200" [5.08] nominal terminal row spacing.

Type "3R" - Dip Solder, .025" [.635] square terminals, .180" [4.57] nominal terminal length x .150" [3.81] nominal terminal row spacing.

Type "4R" - Dip Solder, .025" [.635] square terminals, .180" [4.57] nominal terminal length x .200" [5.08] nominal terminal row spacing.

Contact Spacing: .125" [3.17] center to center.

Contact Terminal Row Spacing:

Standard - .250" [6.35] nominal.

Right Angle - .200" [5.08] nominal and .150" [3.81] nominal.

Card Thickness: .054" to .071" [1.37 to 1.80].

Card Slot Depth: .300" [7.62].

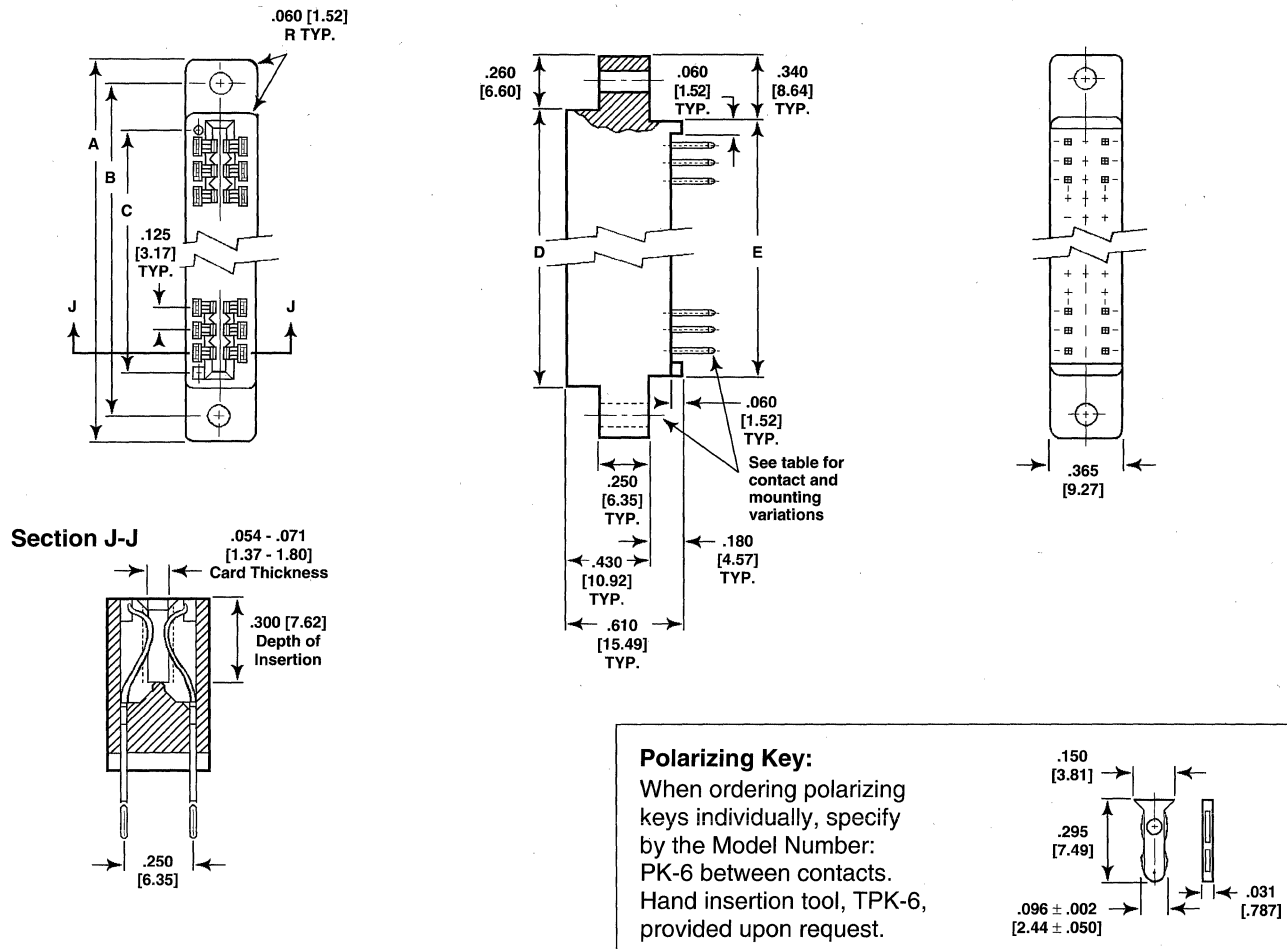
Connector Polarization: Between contact polarization key(s) are located to the right of the contact position(s) designated.

High temperature burn-in, edgeboard connectors, with .125" [3.17] center to center are on page 272 of this catalog.

[Numbers in brackets indicate millimeters]

MODEL EB6

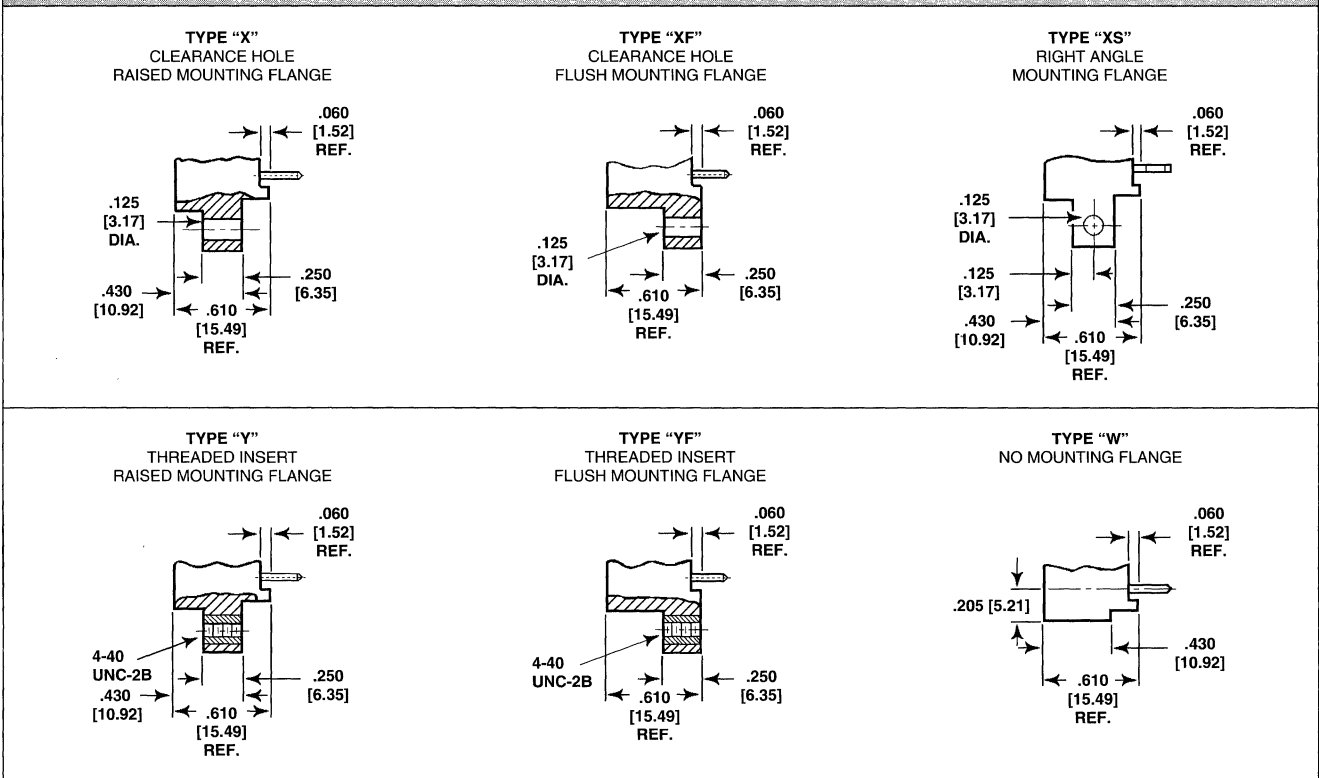
DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



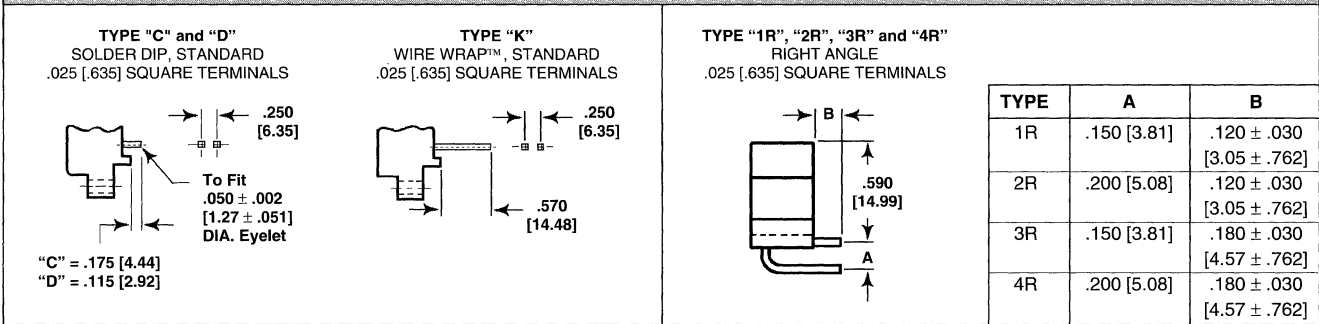
# OF CONTACT POSITIONS PER SIDE	A	B	C	D	E
6	1.555 [39.50]	1.295 [32.89]	.875 [22.22]	1.035 [26.29]	.875 [22.22]
10	2.055 [52.20]	1.795 [45.59]	1.375 [34.92]	1.535 [38.99]	1.375 [34.92]
14	2.555 [64.90]	2.295 [58.29]	1.875 [47.62]	2.035 [51.69]	1.875 [47.62]
15	2.680 [68.07]	2.420 [61.47]	2.000 [50.80]	2.160 [54.86]	2.000 [50.80]
18	3.055 [77.60]	2.795 [70.99]	2.375 [60.32]	2.535 [64.39]	2.375 [60.32]
22	3.555 [90.30]	3.295 [83.69]	2.875 [73.02]	3.035 [77.09]	2.875 [73.02]
24	3.805 [96.65]	3.545 [90.04]	3.125 [79.38]	3.285 [83.44]	3.125 [79.38]
25	3.930 [99.82]	3.670 [93.22]	3.250 [82.55]	3.410 [86.61]	3.250 [82.55]
28	4.305 [109.35]	4.045 [102.74]	3.625 [92.08]	3.785 [96.14]	3.625 [92.08]
30	4.555 [115.70]	4.295 [109.09]	3.875 [98.42]	4.035 [102.49]	3.875 [98.42]
31	4.680 [118.87]	4.420 [112.27]	4.000 [101.60]	4.160 [105.66]	4.000 [101.60]
32	4.805 [122.05]	4.545 [115.44]	4.125 [104.78]	4.285 [108.84]	4.125 [104.78]
35	5.180 [131.57]	4.920 [124.97]	4.500 [114.30]	4.660 [118.36]	4.500 [114.30]
36	5.305 [134.75]	5.045 [128.14]	4.625 [117.48]	4.785 [121.54]	4.625 [117.48]
40	5.805 [147.45]	5.545 [140.84]	5.125 [130.18]	5.285 [134.24]	5.125 [130.18]
43	6.180 [156.97]	5.920 [150.37]	5.500 [139.70]	5.660 [143.76]	5.500 [139.70]
44	6.305 [160.15]	6.045 [153.54]	5.625 [142.88]	5.785 [146.94]	5.625 [142.88]
49	6.930 [176.02]	6.670 [169.42]	6.250 [158.75]	6.410 [162.81]	6.250 [158.75]
50	7.055 [179.20]	6.795 [172.59]	6.375 [161.92]	6.535 [165.99]	6.375 [161.92]

MODEL EB6

MOUNTING VARIATIONS [Numbers in brackets indicate millimeters]



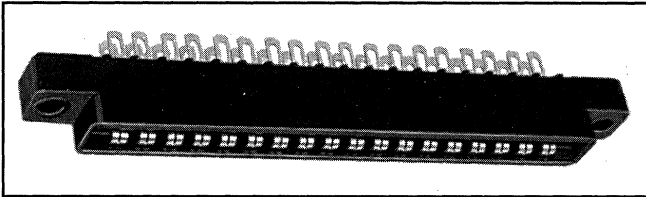
TERMINAL VARIATIONS [Numbers in brackets indicate millimeters]



HOW TO ORDER

EB6 MODEL	3 BODY MATERIAL	K STANDARD TERMINAL VARIATIONS	40 CONTACTS	SG CONTACT PLATING	X MOUNTING VARIATIONS	15 POLARIZING KEY POSITIONS
	1 = Diallyl Phthalate 2 = Phenolic 3 = Glass-filled Polyester	C, D, K, 1R, 2R, 3R, 4R.	6, 10, 14, 15, 18, 22, 24, 25, 28, 30, 31, 32, 35, 36, 40, 43, 44, 49 and 50 per side.	SG = Selective Gold Plating (.00003" [.000762] minimum thick) on contact area with Gold Flash on terminal. SGF = Selective Gold Plating (.000010" [.000254] minimum thick) on contact area with Gold Flash on terminal. All Gold Plating over .00005" [.00127] minimum Nickel Underplate. Contact factory for additional plating options.	Key(s) are located to right of position(s) designated. Use odd-numbered contact for ordering: -1, -3, -5, etc. Required only when polarizing keys are to be factory installed. NOTE: To order polarizing keys individually, specify model PK-6.	

MODEL EB7D Edgeboard Connectors Dual Readout



ELECTRICAL SPECIFICATIONS

Current Rating: 5 amps.

Test Voltage between Contacts:

At sea level: 1800 V RMS.

At 70,000 feet [21,336 meters]: 450 V RMS.

Insulation Resistance: 5000 Megohm minimum at 500 VDC potential.

Contact Resistance: 30 millivolts maximum at rated current (with gold plating).

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

Humidity: 96 hours at 90% relative humidity at 40°C, dried at room temperature for 3 hours minimum, insulation resistance 5000 Megohm.

Durability: (With gold plating.) After 500 cycles of insertion and withdrawal of .070" [1.78] thick steel test gauge, contact resistance less than .030 V at 5 amps and individual contact retention force when measured with a .054" [1.37] thick steel test slug greater than 1/2 ounce.

Shock: Three 50G shocks in each of 3 mutually perpendicular planes with no loss of continuity.

Vibration: 2 hours in each of 3 mutually perpendicular planes, frequency sweep 10 to 55 cps at .06 double amplitude with no loss of continuity.

PHYSICAL SPECIFICATIONS

Contact Type: Bifurcated bellows.

Number of Contacts: 6, 10, 12, 15, 18, 22, 36, 43 per side.

Contact Spacing: .156" [3.96] center to center.

Card Thickness: .054" to .071" [1.37 to 1.80].

Card Slot Depth: Dual Readout = .260" [6.60].

FEATURES

- .156" C-C x .140" Grid [3.96 x 3.56]
- Bifurcated bellows contacts provide 2 flexing contact surfaces to assure positive contact under adverse conditions such as vibration or P.C. board irregularities
- Accepts P.C. board thickness of .054" - .071" [1.37 - 1.80]
- Polarization between contact positions in all sizes. Between contact polarization permits polarizing without loss of a contact position.
- Selective gold plating
- Polarizing key is reinforced nylon, may be inserted by hand, requires no adhesive
- Protected entry, provided by recessed leading edge of contact, permits the card slot to straighten and align the board before electrical contact is made. Prevents damage to contact which might be caused by warped or out of tolerance boards.
- **Recognized under the Component Program of Underwriters Laboratories Inc. Listed under File E65524, Project 77CH3889.**

APPLICATIONS

For use with .062" [1.57] printed circuit boards requiring an edgeboard type connector on .156" [3.96] centers.

MATERIAL SPECIFICATIONS

Body: (Standard) Glass-filled phenolic per MIL-M-14, dark green, flame retardant (UL 94V-0).

(Optional - See How to Order):

"1" glass-filled diallyl phthalate per MIL-M-14, Type SDG-F green, flame retardant (UL 94V-0).

"3" thermoplastic polyester, glass filled, black, flame retardant (UL 94V-0).

Contacts: Phosphor bronze.

Polarizing Key: Glass reinforced nylon, flame retardant (UL 94H-B).

Contact Plating: Gold (See How to Order).

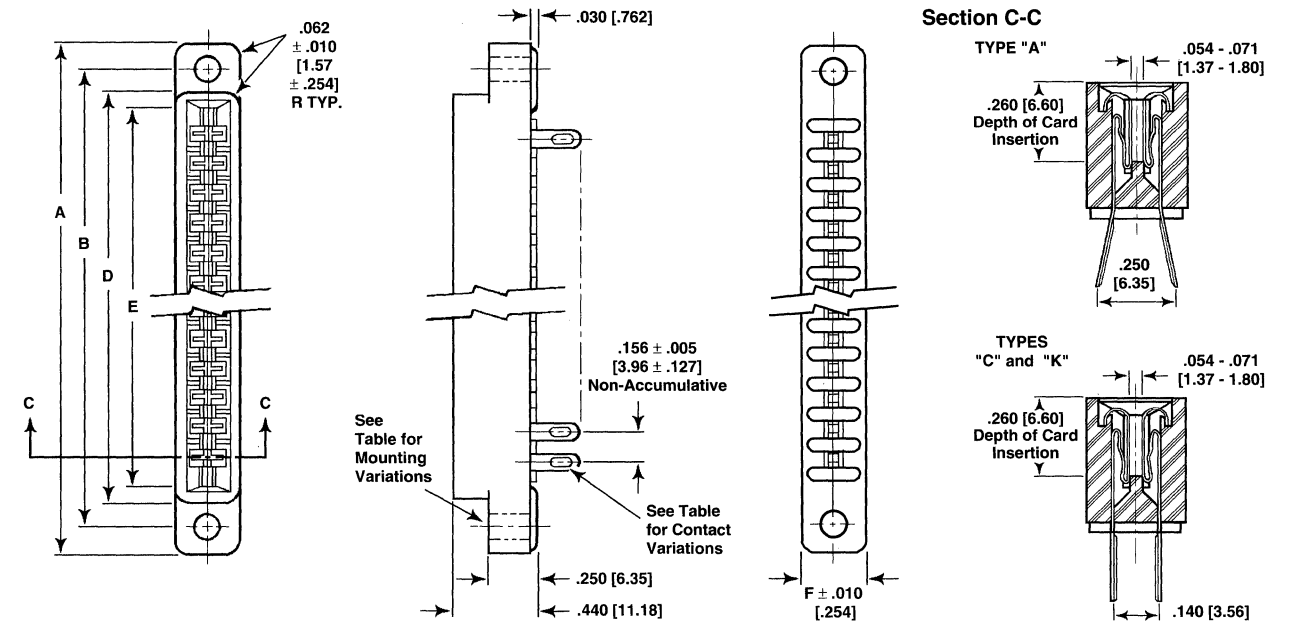
NOTE: High temperature burn-in, edgeboard connectors, .156" [3.96] center to center are on page 272 of this catalog.

Mounting Variations [Numbers in brackets indicate millimeters]

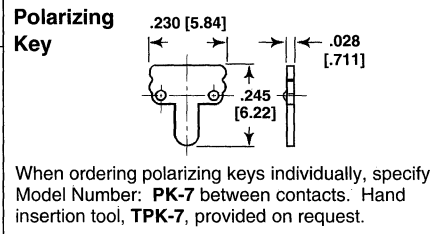
<p>TYPE "V" CLEARANCE HOLE</p> <p>.250 [6.35] REF. .142 [3.61] DIA.</p>	<p>TYPE "VI" CLEARANCE HOLE NO MOUNTING PAD</p> <p>.250 [6.35] REF. .142 [3.61] DIA. .220 [5.59] REF.</p>	<p>TYPE "W" NO MOUNTING FLANGE</p> <p>.010 [254] .000 [0.000]</p>	<p>TYPE "X" CLEARANCE HOLE</p> <p>.250 [6.35] REF. .128 [3.25] DIA.</p>
<p>TYPE "XI" CLEARANCE HOLE NO MOUNTING PAD</p> <p>.250 [6.35] REF. .128 [3.25] DIA. .220 [5.59] REF.</p>	<p>TYPE "Y" THREADED INSERT</p> <p>.250 [6.35] REF. 4-40 UNC-2B .218 [5.54] REF.</p>	<p>TYPE "Z" FLOATING BUSHING RADIAL FLOAT .047 [1.19]</p> <p>.250 [6.35] REF. .116 [2.95] DIA. .250 [6.35] DIA. .270 [6.86]</p> <p>NOTE: Overall body length increased by .060" [1.52].</p>	

MODEL EB7D

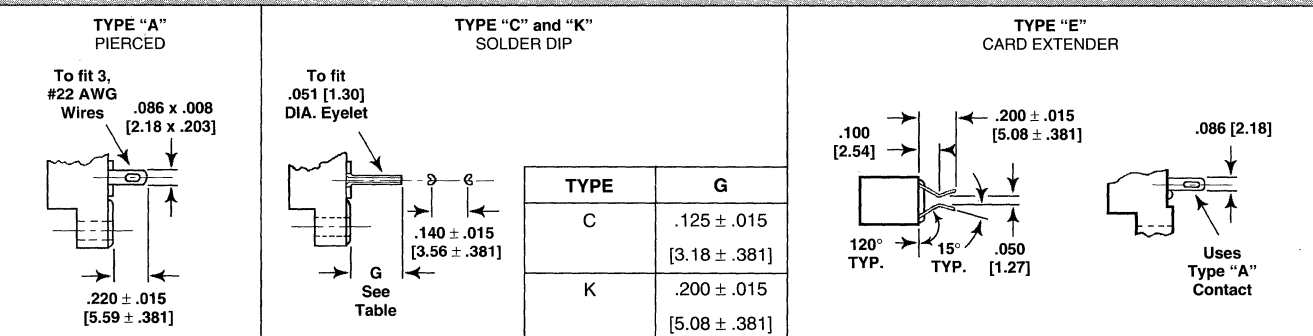
DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



# OF CONTACT POSITIONS	A	B	D	E	F
6	1.78 [45.21]	1.53 [38.86]	1.22 [30.99]	1.10 [27.94]	.328 [8.33]
10	2.41 [61.21]	2.16 [54.86]	1.84 [46.74]	1.72 [43.69]	.328 [8.33]
12	2.72 [69.09]	2.47 [62.74]	2.16 [54.86]	2.04 [51.82]	.328 [8.33]
15	3.19 [81.03]	2.94 [74.68]	2.62 [66.55]	2.50 [63.50]	.328 [8.33]
18	3.66 [92.96]	3.41 [86.61]	3.09 [78.49]	2.97 [75.44]	.328 [8.33]
22	4.28 [108.71]	4.03 [102.36]	3.72 [94.49]	3.60 [91.44]	.328 [8.33]
36	6.53 [165.86]	6.22 [157.99]	5.91 [150.11]	5.78 [146.81]	.438 [11.13]
43	7.62 [193.55]	7.30 [185.42]	7.00 [177.66]	6.80 [172.72]	.500 [12.70]



TERMINAL VARIATIONS [Numbers in brackets indicate millimeters]



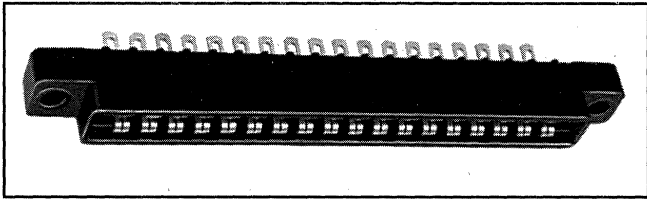
HOW TO ORDER

EB7	1	D	B	A	22	G	X	A	
MODEL	BODY MATERIAL	DUAL READOUT	OPTIONAL CONTACTS	STANDARD TERMINAL VARIATIONS	CONTACTS	CONTACT PLATING	MOUNTING VARIATIONS	POLARIZING KEY POSITIONS	
	Optional Body Material "1" = Diallyl Phthalate "3" = Glass-filled Polyester Omit for standard phenolic.		Beryllium Copper contacts optional. Available in "A" and "E" contact styles only. (Omit for standard.)	A, E, C or K	6, 10, 12, 15, 18, 22, 36 or 43			Key(s) are located to right of position(s) designated. Required only when polarizing keys are to be factory installed.	
					SG = Selective Gold Plating (.00003 [.000762] minimum thick) on contact area with Gold Flash on terminal. SGF = Selective Gold Plating (.00001 [.000254] minimum thick) on contact area with Gold Flash on terminal. All Gold Plating over .00005 [.00127] minimum Nickel Underplate. Contact factory for additional plating options.				

MODEL EB7S

Edgeboard Connectors

Single Readout



ELECTRICAL SPECIFICATIONS

Current Rating: 5 amps.

Test Voltage between Contacts:

At sea level: 1800 V RMS.

At 70,000 feet [21,336 meters]: 450 V RMS.

Insulation Resistance: 5000 Megohm minimum at 500 VDC potential.

Contact Resistance: 30 millivolts maximum at rated current (with gold plating).

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

Humidity: 96 hours at 90% relative humidity at 40°C, dried at room temperature for 3 hours minimum, insulation resistance 5000 Megohm.

Durability: (With gold plating.) After 500 cycles of insertion and withdrawal of .070" [1.78] thick steel test gauge, contact resistance less than .030 V at 5 amps and individual contact retention force when measured with a .054" [1.37] thick steel test slug greater than 1/2 ounce.

Shock: Three 50G shocks in each of 3 mutually perpendicular planes with no loss of continuity.

Vibration: 2 hours in each of 3 mutually perpendicular planes, frequency sweep 10 to 55 cps at .06 double amplitude with no loss of continuity.

PHYSICAL SPECIFICATIONS

Contact Type: Bifurcated bellows.

Number of Contacts: 6, 10, 12, 15, 18 and 22 per side.

Contact Spacing: .156" [3.96] center to center.

Card Thickness: .054" to .071" [1.37 to 1.80].

Card Slot Depth: Single Readout = .300" [7.62].

FEATURES

- .156" [3.96] C-C
- Bifurcated bellows contacts provide 2 flexing contact surfaces to assure positive contact under adverse conditions such as vibration or P.C. board irregularities
- Accepts P.C. board thickness of .054" - .071" [1.37 - 1.80]
- Polarization between contact positions in all sizes. Between contact polarization permits polarizing without loss of a contact position.
- Selective gold plating
- Polarizing key is reinforced nylon, may be inserted by hand, requires no adhesive
- Protected entry, provided by recessed leading edge of contact, permits the card slot to straighten and align the board before electrical contact is made. Prevents damage to contact which might be caused by warped or out of tolerance boards.
- **Recognized under the Component Program of Underwriters Laboratories Inc. Listed under File E65524, Project 77CH3889.**

APPLICATIONS

For use with .062" [1.57] printed circuit boards requiring an edgeboard type connector on .156" [3.96] centers.

MATERIAL SPECIFICATIONS

Body: (Standard) Glass-filled phenolic per MIL-M-14, dark green, flame retardant (UL 94V-0).

(Optional - See How to Order):

"1" glass-filled diallyl phthalate per MIL-M-14, Type SDG-F green, flame retardant (UL 94V-0).

"3" thermoplastic polyester, glass filled, black, flame retardant (UL 94V-0).

Contacts: Phosphor bronze.

Polarizing Key: Glass reinforced nylon, flame retardant (UL 94H-B).

Contact Plating: Gold (See How to Order).

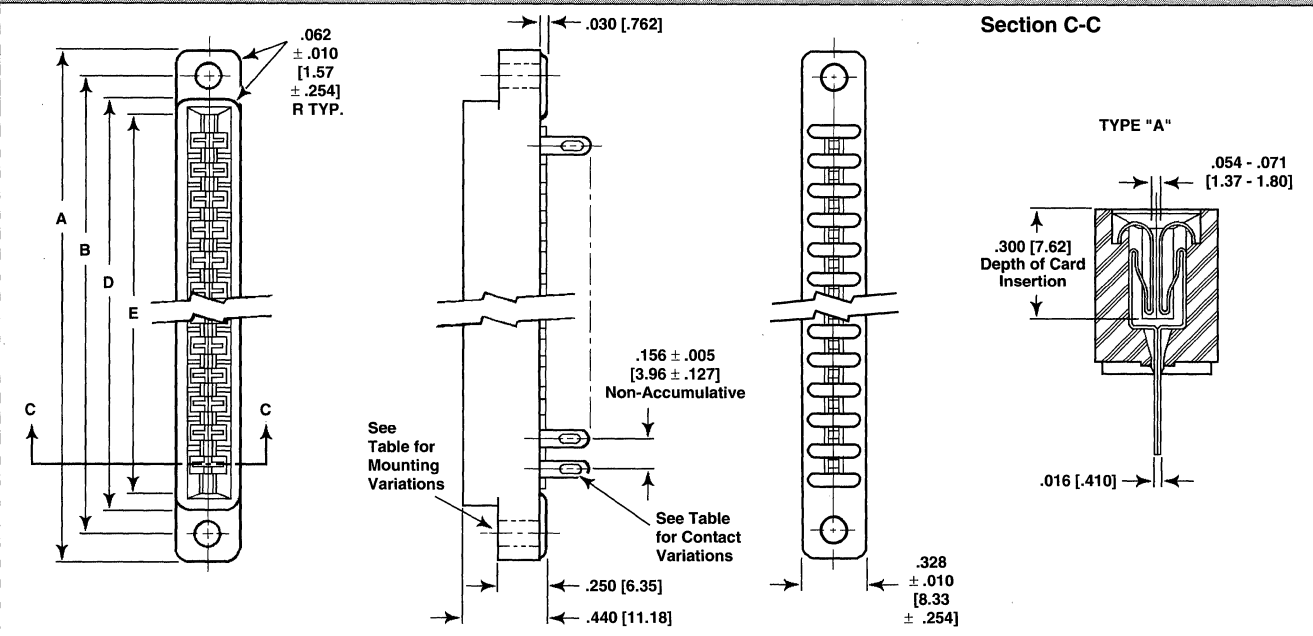
NOTE: High temperature burn-in, edgeboard connectors, .156" [3.96] center to center are on page 272 of this catalog.

MOUNTING VARIATIONS [Numbers in brackets indicate millimeters]

<p>TYPE "V" CLEARANCE HOLE</p> <p>.250 [6.35] REF. .142 [3.61] DIA.</p>	<p>TYPE "VI" CLEARANCE HOLE NO MOUNTING PAD</p> <p>.250 [6.35] REF. .142 [3.61] DIA. .220 [5.59] REF.</p>	<p>TYPE "W" NO MOUNTING FLANGE</p> <p>.010 [.254] .000 [.000]</p>	<p>TYPE "X" CLEARANCE HOLE</p> <p>.250 [6.35] REF. .128 [3.25] DIA.</p>
<p>TYPE "XI" CLEARANCE HOLE NO MOUNTING PAD</p> <p>.250 [6.35] REF. .128 [3.25] DIA. .220 [5.59] REF.</p>	<p>TYPE "Y" THREADED INSERT</p> <p>.250 [6.35] REF. 4-40 UNC-2B .218 [5.54] REF.</p>	<p>TYPE "Z" FLOATING BUSHING RADIAL FLOAT .047 [1.19]</p> <p>.250 [6.35] REF. .116 [2.95] DIA. .250 [6.35] DIA. .270 [6.86]</p> <p>NOTE: Overall body length increased by .060" [1.52].</p>	

MODEL EB7S

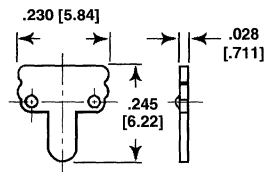
DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



NUMBER OF CONTACT POSITIONS	A	B	D	E
6	1.78 [45.21]	1.531 [38.89]	1.218 [30.94]	1.100 [27.94]
10	2.41 [61.21]	2.156 [54.76]	1.843 [46.81]	1.724 [43.79]
12	2.72 [69.09]	2.468 [62.69]	2.156 [54.76]	2.036 [51.71]
15	3.19 [81.03]	2.937 [74.60]	2.624 [66.65]	2.504 [63.60]
18	3.66 [92.96]	3.406 [86.51]	3.093 [78.56]	2.972 [75.49]
22	4.28 [108.71]	4.031 [102.39]	3.717 [94.41]	3.596 [91.34]

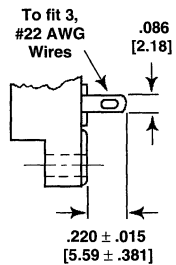
POLARIZING KEY

When ordering polarizing keys individually, specify Model Number: **PK-7** between contacts. Hand insertion tool, **TPK-7**, provided on request.

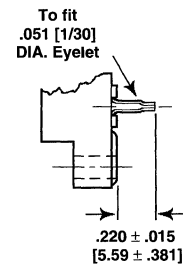


TERMINAL VARIATIONS [Numbers in brackets indicate millimeters]

TYPE "A" PIERCED



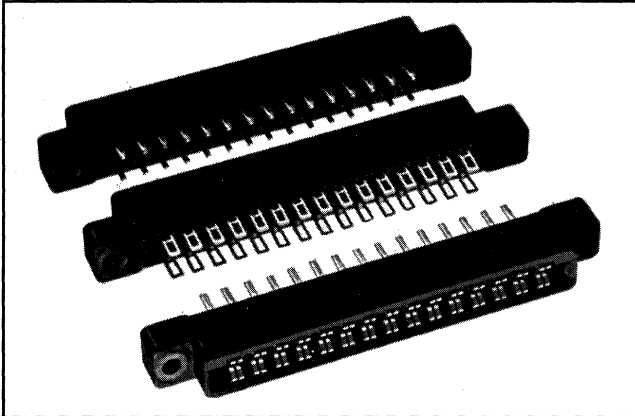
TYPE "B" SOLDER DIP



HOW TO ORDER

EB7 MODEL	1 BODY MATERIAL	S SINGLE READOUT	A STANDARD TERMINAL VARIATIONS	22 CONTACTS	G CONTACT PLATING	X MOUNTING VARIATIONS	A POLARIZING KEY POSITIONS
	Optional Body Material "1" = Diallyl Phthalate "3" = Glass-filled Polyester Omit for standard phenolic.		A or B	6, 10, 12, 15, 18 or 22			Key(s) are located to right of position(s) designated. Required only when polarizing keys are to be factory installed.
				SG = Selective Gold Plating (.00003 [.000762] minimum thick) on contact area with Gold Flash on terminal. SGF = Selective Gold Plating (.00001 [.000254] minimum thick) on contact area with Gold Flash on terminal. All Gold Plating over .00005 [.00127] minimum Nickel Underplate. Contact factory for additional plating options.			

MODEL EB8 Edgeboard Connectors Dual Readout



FEATURES

- .156" C-C x .200" Grid [3.96 x 5.08]
- Greater design latitude
 - 3 body materials: Diallyl phthalate, phenolic and glass-filled polyester
 - 6 contact termination styles
 - 8 body sizes
 - 7 mounting styles
- Bifurcated bellows contacts provide 2 flexing contact surfaces to assure positive contact
- Accepts P.C. board thickness of .054" - .071" [1.37 - 1.80]
- Polarization between contact positions in all sizes
- Selective gold plating
- **Recognized under the Component Program of Underwriters Laboratories Inc. Listed under File E65524, Project 77CH3889.**

ELECTRICAL SPECIFICATIONS

Current Rating: 5 amps.

Test Voltage between Contacts:

At sea level: 1800 V RMS.

At 70,000 feet [21,336 meters]: 450 V RMS.

Insulation Resistance: 5000 Megohm minimum at 500 VDC potential.

Contact Resistance: 30 millivolts maximum at rated current (with gold plating).

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

Humidity: 96 hours at 90% relative humidity at 40°C, dried at room temperature for 3 hours minimum, insulation resistance 5000 Megohm.

Durability: (With gold plating.) After 500 cycles of insertion and withdrawal of .070" [1.78] thick steel test gauge, contact resistance less than .030 V at 5 amps and individual contact retention force when measured with a .054" [1.37] thick steel test pin greater than 1/2 ounce.

Shock: Three 50G shocks in each of 3 mutually perpendicular planes with no loss of continuity.

Vibration: 2 hours in each of 3 mutually perpendicular planes, frequency sweep 10 to 55 cps at .06 double amplitude with no loss of continuity.

APPLICATIONS

For use with .062" [1.57] printed circuit boards requiring an edgeboard type connector on .156" [3.96] centers.

PHYSICAL SPECIFICATIONS

Contact Type: Bifurcated bellows.

Number of Contacts: 6, 10, 12, 15, 18, 22, 24, 25 per side.

Contact Spacing: .156" [3.96] center to center.

Card Thickness: .054" to .071" [1.37 to 1.80].

Card Slot Depth: .330" [8.38], dual readout.

MATERIAL SPECIFICATIONS

Body:

"1" glass-filled diallyl phthalate per MIL-M-14, Type SDG-F green, flame retardant (UL 94V-0).

"2" glass-filled phenolic per MIL-M-14, Type MFH dark green, flame retardant (UL 94V-0).

"3" thermoplastic polyester, glass filled, black, flame retardant (UL 94V-0).

Contacts: Phosphor bronze.

Polarizing Key: Glass reinforced nylon, flame retardant (UL 94V-0).

Contact Plating: Gold (See How to Order).

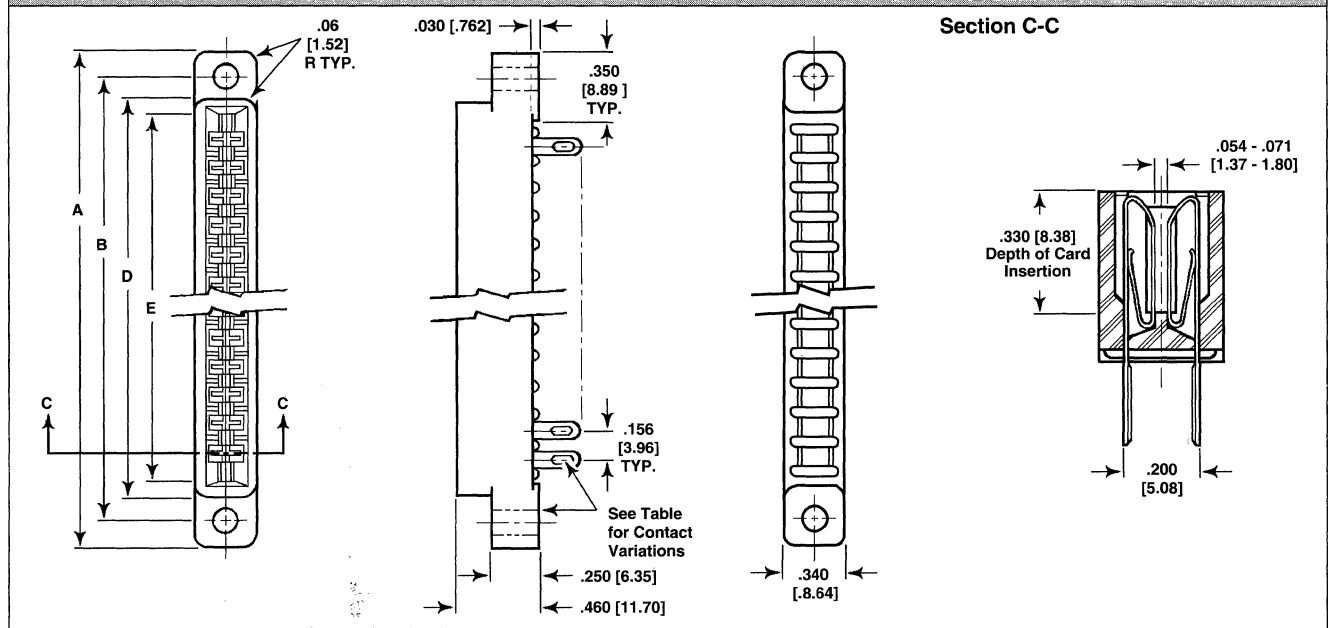
NOTE: High temperature burn-in, edgeboard connectors, .156" [3.96] center to center are on page 272 of this catalog.

MOUNTING VARIATIONS [Numbers in brackets indicate millimeters]

<p>TYPE "V" CLEARANCE HOLE</p>	<p>TYPE "VI" CLEARANCE HOLE NO MOUNTING PAD</p>	<p>TYPE "W" NO MOUNTING FLANGE</p>	<p>TYPE "X" CLEARANCE HOLE</p>
<p>TYPE "XI" CLEARANCE HOLE NO MOUNTING PAD</p>	<p>TYPE "Y" THREADED INSERT</p>	<p>TYPE "Z" FLOATING BUSHING RADIAL FLOAT .047 [1.19]</p> <p>NOTE: Overall body length increased by .060" [1.52].</p>	

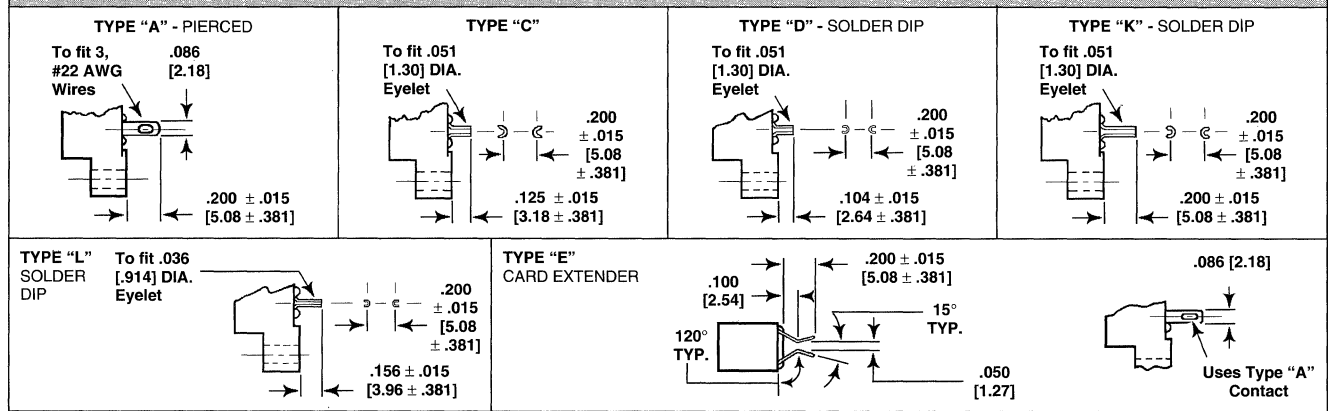
MODEL EBB

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



# OF CONTACT POSITIONS	A	B	D	E	Polarizing Key
6	1.78 [45.21]	1.531 [38.89]	1.240 [31.50]	1.100 [27.94]	When ordering polarizing keys individually, specify Model Number: PK-8 between contacts. Hand insertion tool, TPK-8, provided on request.
10	2.41 [61.21]	2.156 [54.76]	1.864 [47.35]	1.724 [43.79]	
12	2.72 [69.09]	2.469 [62.71]	2.176 [55.27]	2.036 [51.71]	
15	3.19 [81.03]	2.937 [74.60]	2.644 [67.16]	2.504 [63.60]	
18	3.66 [92.96]	3.406 [86.51]	3.112 [79.05]	2.972 [75.49]	
22	4.28 [108.71]	4.031 [102.39]	3.736 [94.89]	3.596 [91.34]	
24	4.59 [116.68]	4.344 [110.33]	4.051 [102.89]	3.911 [99.34]	
25	4.75 [120.65]	4.500 [114.30]	4.207 [106.86]	4.067 [103.30]	

TERMINAL VARIATIONS [Numbers in brackets indicate millimeters]



HOW TO ORDER

EBB MODEL	2 BODY MATERIAL	B OPTIONAL CONTACTS	A STANDARD TERMINAL VARIATIONS	22 CONTACTS	G CONTACT PLATING	X MOUNTING VARIATIONS	A POLARIZING KEY POSITIONS
	Optional Body Material "1" = Diallyl Phthalate "2" = Phenolic "3" = Glass-filled Polyester	Beryllium Copper contacts optional. Available in "A" and "E" contact styles only. (Omit for standard.)	A, C, D, K, L or E	6, 10, 12, 15, 18, 22, 24 or 25		V, VI, W, X, XI, Y, or Z	Key(s) are located to right of position(s) designated. Required only when polarizing keys are to be factory installed.
<p>SG = Selective Gold Plating (.00003" [.000762] minimum thick) on contact area with Gold Flash on terminal. SGF = Selective Gold Plating (.00001" [.000254] minimum thick) on contact area with Gold Flash on terminal. All Gold Plating over .00005" [.00127] minimum Nickel Underplate. Contact factory for additional plating options.</p>							

MODEL EBT156 Edgeboard Connector

Single Readout

Dip Solder, Eyelet and Wire Wrap™ Termination



FEATURES

- .156" [3.96] C-C
- Modified tuning fork contacts have chamfered lead-in to reduce wear on printed circuit board contacts without sacrificing contact pressure and wiping action.
- Accepts P.C. board thickness of .054" to .070" [1.37 to 1.78]
- Polarization on or between contact position in all sizes. Between contact polarization permits polarizing without loss of a contact position.
- Polarizing key is reinforced nylon, may be inserted by hand, requires no adhesive
- Protected entry, provided by recessed leading edge of contact, permits the card slot to straighten and align the board before electrical contact is made. Prevents damage to contacts which might be caused by warped or out of tolerance boards.
- Optional terminal configurations, including eyelet (Type A), dip-solder (Types B, C, D, R), Wire Wrap™ (Types E, F).
- **Connectors with Type A, B, C, D or R contacts are recognized under the Component Program of Underwriters Laboratories Inc. Listed under File 65524, Project 77CH3889.**

ELECTRICAL SPECIFICATIONS

Current Rating: 5 amps.

Test Voltage between Contacts:

At Sea Level: 1800 V RMS.

At 70,000 feet [21,336 meters]: 450 V RMS.

Insulation Resistance: 5000 Megohm minimum.

Contact Resistance: (Voltage Drop) 30 millivolts maximum at rated current with gold flash.

PHYSICAL SPECIFICATIONS

Number of Contacts: 6, 10, 12, 15, 18 or 22.

Contact Spacing: .156" [3.96].

Card Thickness: .054" to .070" [1.37 to 1.78].

Card Slot Depth: .330" [8.38].

APPLICATIONS

For use with .062" [1.57] printed circuit boards requiring an edgeboard type connector on .156" [3.96] centers.

MATERIAL SPECIFICATIONS

Body: Glass-filled phenolic per MIL-M-14, Type MFH, black, flame retardant (UL 94V-0).

Contacts: Copper Alloy.

Finish: 1 = Electro Tin Plated. 2 = Gold Flash.

Polarizing Key: Glass-filled nylon.

Optional Threaded Mounting Insert: Nickel plated brass (Type Y).

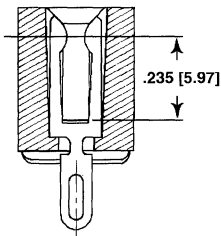
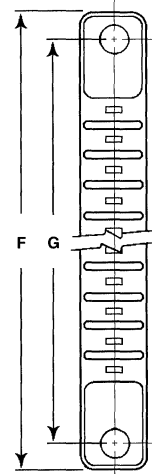
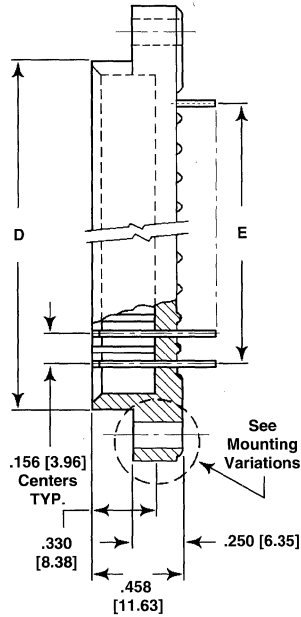
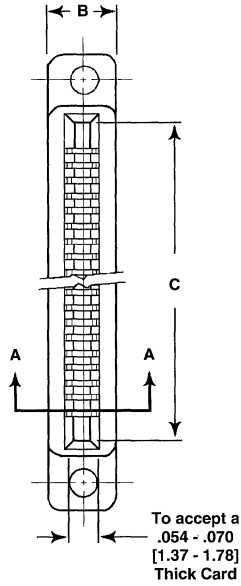
Optional Floating Mounting Bushing: Cadmium plated brass (Type Z).

MOUNTING VARIATIONS [Numbers in brackets indicate millimeters]

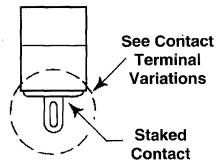
TYPE "W" NO MOUNTING FLANGE	TYPE "X" CLEARANCE HOLE	TYPE "Y" THREADED INSERT	TYPE "Z" FLOATING BUSHING
<p>+ .010 [.254] - .000 [.000]</p>	<p>.140 [3.56] DIA.</p>	<p>4-40 UNC-2B</p>	<p>.250 [6.35] DIA. .116 ± .003 [2.95 ± .076] DIA. .010 [.254] MIN. Radial Float .040 [1.02] MIN. Wall .010 [.254] .005 [.127] Axial Float</p>

MODEL EBT156

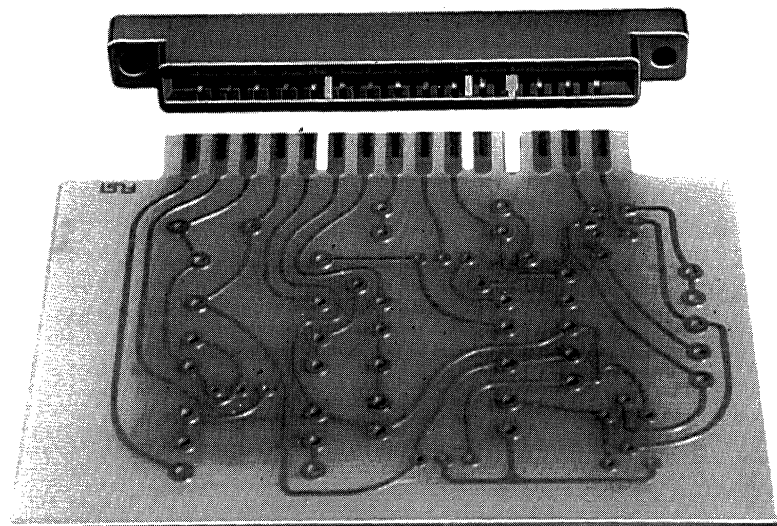
DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



SECTION A-A
Rotated 90° CW



# OF CONTACT POSITIONS	B	C	D	E	F	G
6	.340 [8.64]	1.10 [27.94]	1.24 [31.50]	.781 [19.84]	1.80 [45.72]	1.53 [38.86]
10	.340 [8.64]	1.72 [43.69]	1.86 [47.24]	1.41 [35.81]	2.43 [61.72]	2.16 [54.86]
12	.340 [8.64]	2.04 [51.82]	2.18 [55.37]	1.72 [43.69]	2.74 [69.60]	2.47 [62.74]
15	.340 [8.64]	2.50 [63.50]	2.65 [67.31]	2.19 [55.63]	3.21 [81.53]	2.94 [74.67]
18	.340 [8.64]	2.97 [75.44]	3.11 [78.99]	2.66 [67.56]	3.68 [93.22]	3.41 [86.61]
22	.340 [8.64]	3.60 [91.44]	3.74 [95.0]	3.28 [83.31]	4.30 [109.22]	4.03 [102.36]



Between contact or on contact polarization available in all sizes for factory or field insertion.

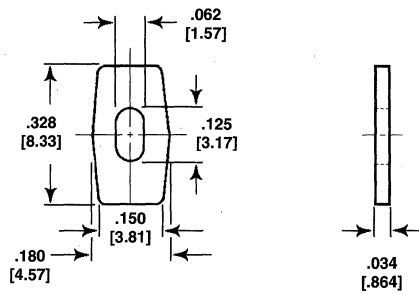
MODEL EBT156

POLARIZING KEYS [Numbers in brackets indicate millimeters]

When ordering polarizing keys individually, specify by Model Number **PK156** or **PKC156**.

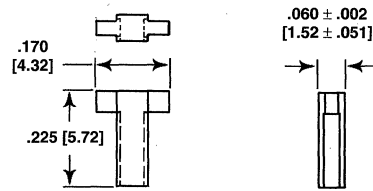
Between Contact Polarizing Key

PK156



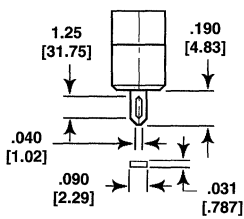
On Contact Polarizing Key (Field insertable)

PKC156

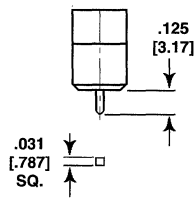


TERMINAL VARIATIONS [Numbers in brackets indicate millimeters]

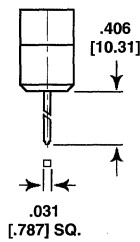
TYPE "A"



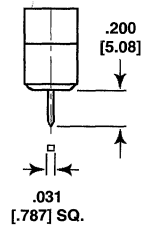
TYPE "B"



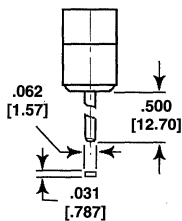
TYPE "C"



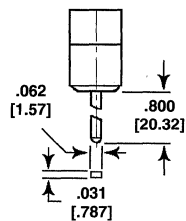
TYPE "D"



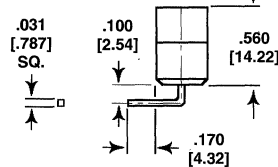
TYPE "E"



TYPE "F"



TYPE "R"



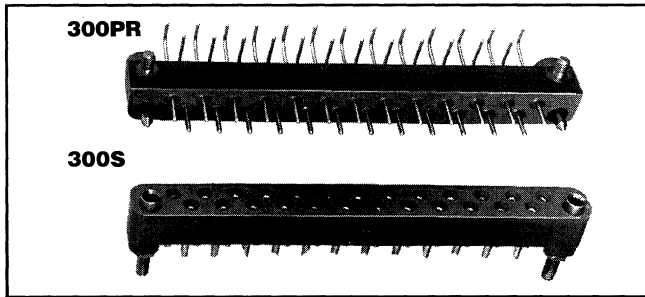
HOW TO ORDER

EBT156 -	10	A	1	X	A, J	A9, J9
MODEL	CONTACTS	CONTACT TERMINAL VARIATIONS	CONTACT FINISH	MOUNTING VARIATIONS	BETWEEN CONTACT POLARIZATION	ON CONTACT POLARIZATION
	6, 10, 12, 15, 18, 22	A, B, C, D, E, F, R	1 = Electro Tin Plated 2 = Gold Flash	W, X, Y, Z	Required only when polarizing key(s) are to be factory installed .	Required only when polarizing key(s) are to be factory installed .

Polarization key positions: Between contact polarization key(s) are located to the right of the contact position(s) desired. Example: **A, J** means keys between **A and B**, and **J and K**.

Polarization key replaces contact(s), indicate by adding suffix "9" to contact position(s) desired. Example: **A9, J9** means keys replace terminals **A and J**.

MODEL 300 Printed Circuit Board Connectors Dip Solder



FEATURES

- Right angle or straight through dip solder terminals
- Threaded mounting studs
- Male contacts molded in
- Mating connector has solder cup or dip solder terminals
- Permanent mounting provides greater reliability
- Female contacts float to aid in alignment and resist vibration
- Polarization provided by contact arrangement and guide pin location

APPLICATIONS

Where permanent mounting of male connector to printed circuit board is required with mating female connector available.

PHYSICAL SPECIFICATIONS

- Number of Contacts:** 7, 15, 19 and 25.
- Contact Spacing:** .250" [6.35] staggered rows provide a .125" [3.18] grid.
- Contact Gauge:** #20 AWG.
- Minimum Creepage Path Between Contacts:** .160" [4.06].
- Minimum Air Space Between Contacts:** .110" [2.79].

ELECTRICAL SPECIFICATIONS

- Current Rating:** 7.5 amps.
- Breakdown Voltage:** At Sea Level: 3600 V RMS.
At 70,000 feet: 975 V RMS.

MATERIAL SPECIFICATIONS

- Contact Pin:** Phosphor Bronze.
- Contact Socket:** Phosphor Bronze.
- Contact Plating:** Gold Plated.
- Guide Pins:** Stainless steel, passivated.
- Body:** (Standard) Glass-filled diallyl phthalate per MIL-M-14, Type GDI-30F, green. Other body material available.

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

300S Typical Side View

300SE Typical Side View

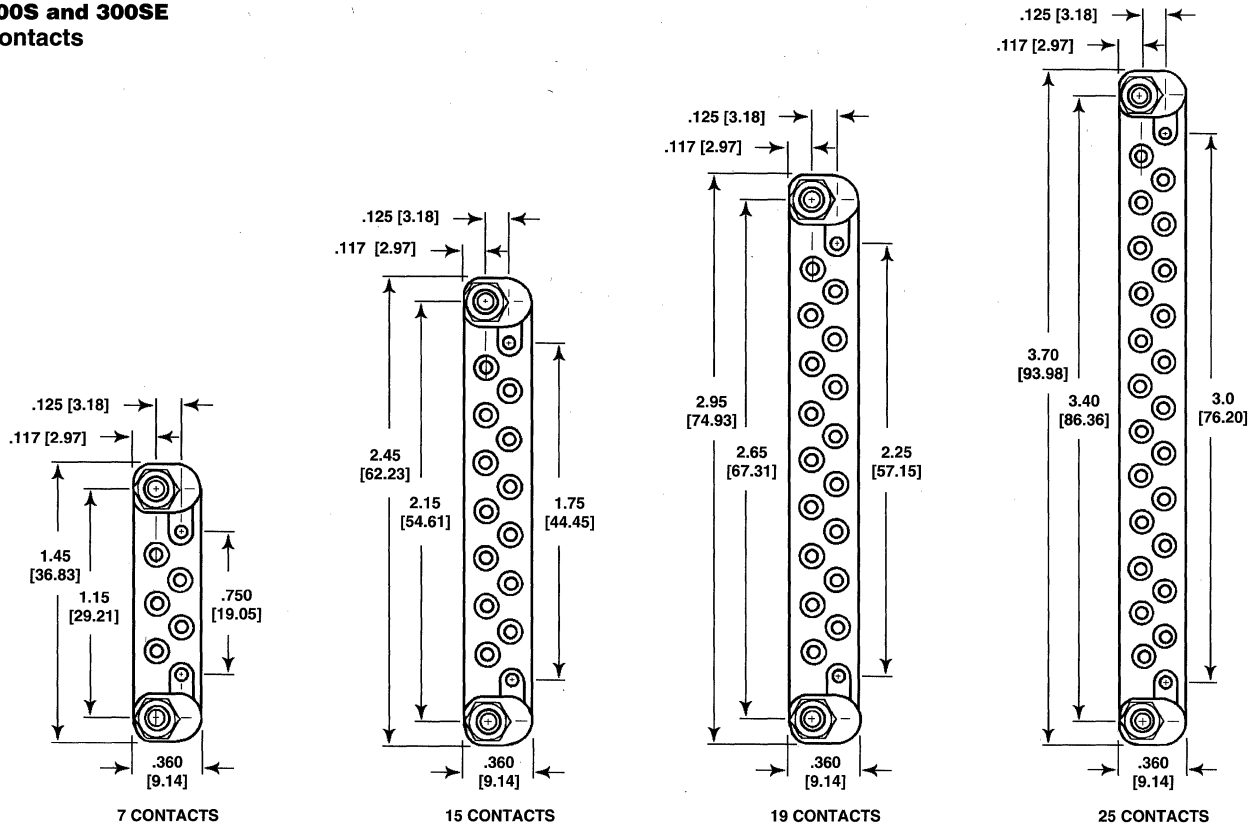
300S and 300SE Panel Cutout

NUMBER OF CONTACT POSITIONS	A	B	C
7	1.0 [25.40]	1.15 [29.21]	1.28 [32.51]
15	2.0 [50.80]	2.15 [54.61]	2.28 [57.91]
19	2.50 [63.50]	2.65 [67.31]	2.78 [70.61]
25	3.25 [82.55]	3.40 [86.36]	3.53 [89.66]

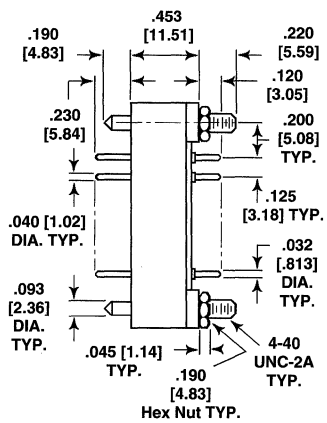
MODEL 300

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

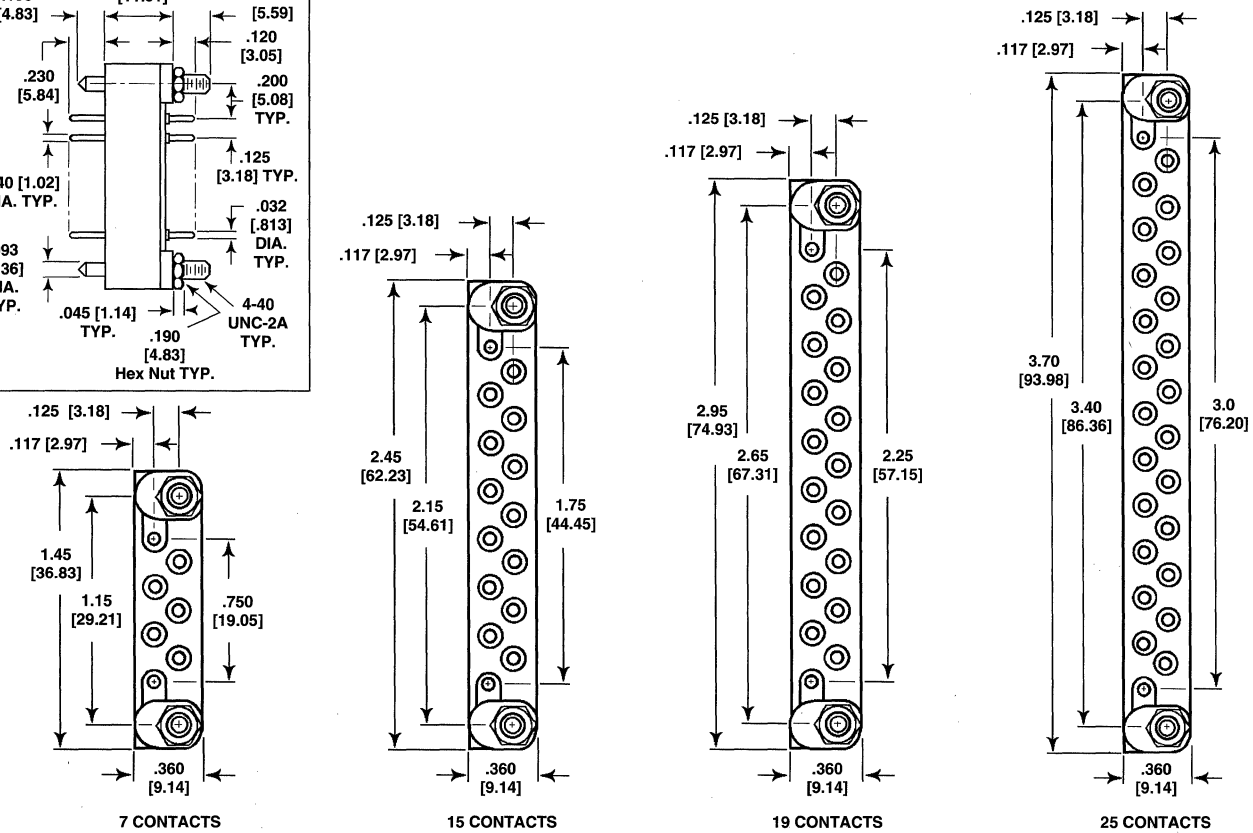
300S and 300SE Contacts



300PE - Typical Side View



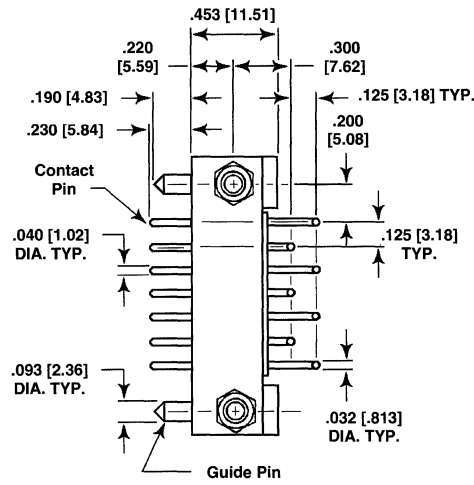
300PE Contacts



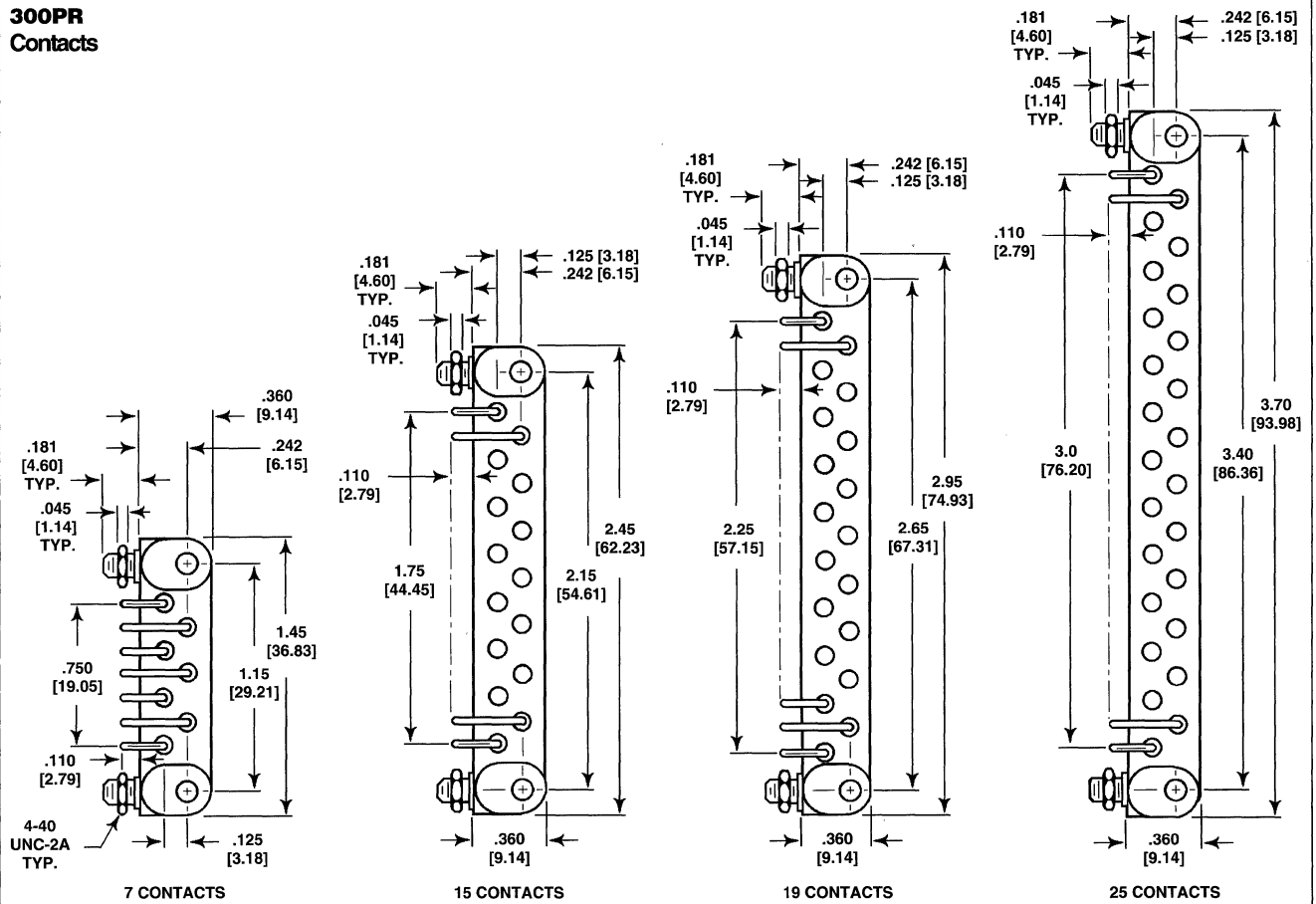
MODEL 300

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

300PR
Typical
Side
View



300PR
Contacts



HOW TO ORDER

300
MODEL

S
SOCKET OR PIN CONNECTOR

7
CONTACTS

W
WITHOUT GUIDES

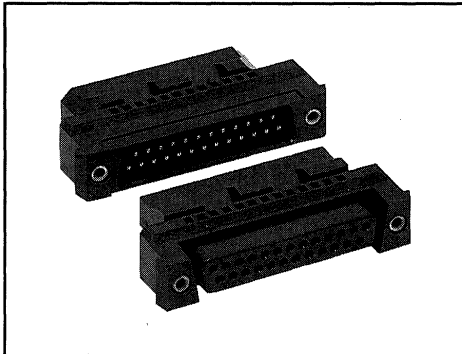
- S = Socket with solder cup
- PE = Pin with dip solder terminals
- SE = Socket with dip solder terminals
- PR = Pin with right angle dip solder terminals

7, 15, 19 or 25

"W" indicates no hardware. Available as an option only on S, PE and SE models.

MODEL DSEB Connectors

D-Subminiature/Edgeboard Hybrid



FEATURES

- Combined technology of D-Subminiature and edgeboard into one connector
- Excellent alternative to surface mount technology
- Precision molded housing for accurate alignment during mating
- Selective gold plating in contact areas only to minimize costs
- Built-in locking features to hold in position in back panel of device
- Available with D-Subminiature pin or socket mating option

APPLICATIONS

For use with any printed circuit board requiring a D-Subminiature Connector. Allows the elimination of soldering the D-Subminiature connector to the printed circuit board by mounting the connector directly to the chassis.

ELECTRICAL SPECIFICATIONS

Current Rating: 5 amps.

Dielectric Withstanding Voltage: At Sea Level: 1000 V RMS.

Contact Resistance: 15 Milliohm maximum.

Insulation Resistance: 5000 Megohm minimum at 500 VDC.

MATERIAL SPECIFICATIONS

Body: Black, glass-filled PPO with flammability rating of VL94V-1.

Contacts: Phosphor Bronze.

Inserts: Brass.

Contact Plating: .00002" [.000508] thick gold in contact areas. .00005" [.00127] minimum nickel underplate all over.

PHYSICAL SPECIFICATIONS

Contact Type: Stamped and formed. Selectively plated.

Card Thickness: .054" to .071" [1.37 to 1.80].

Engagement/Separation Forces:

D-Subminiature: Individual engagement to be 5 to 12 ounces on a .040" [1.02] diameter test pin.

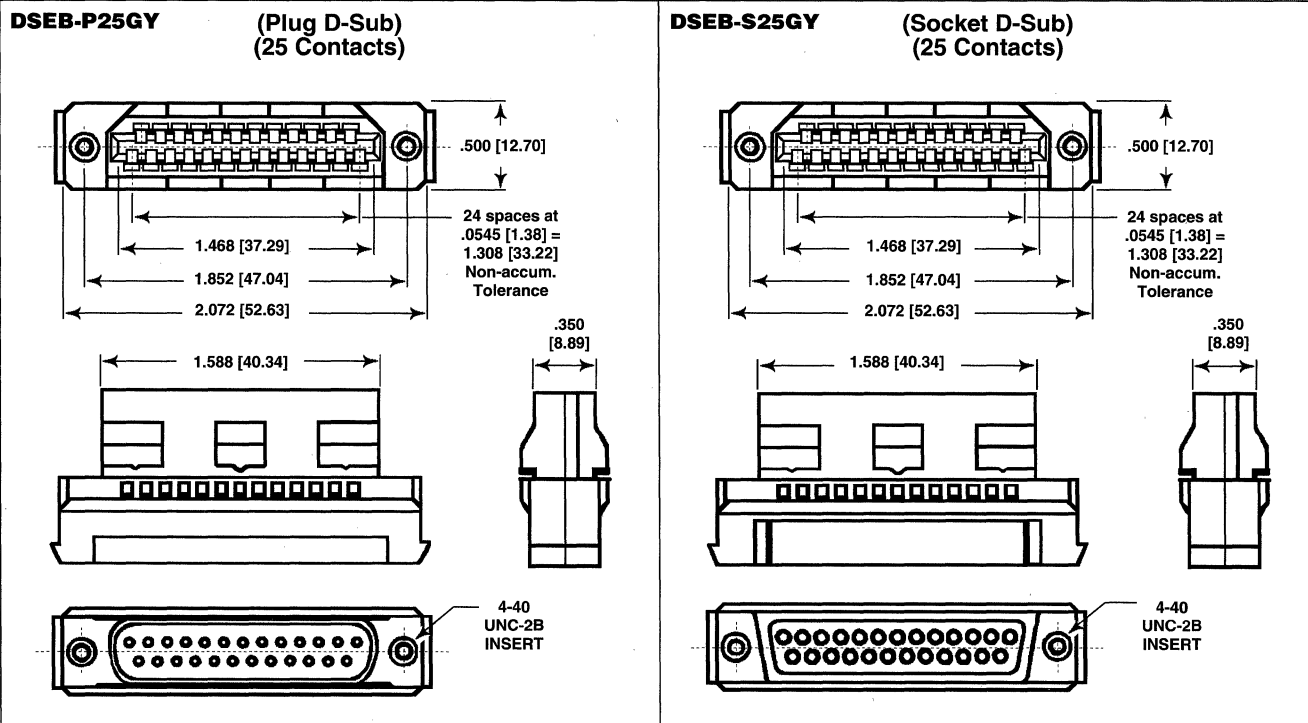
Edgeboard: Individual engagement to be 16 ounces maximum on a .071" [1.80] thick test blade. Individual separation to be .5 ounces minimum on a .054" [1.37] thick test blade.

Individual Contact Retention: 2 pounds minimum.

Operation Temperature: - 55°C to + 105°C.

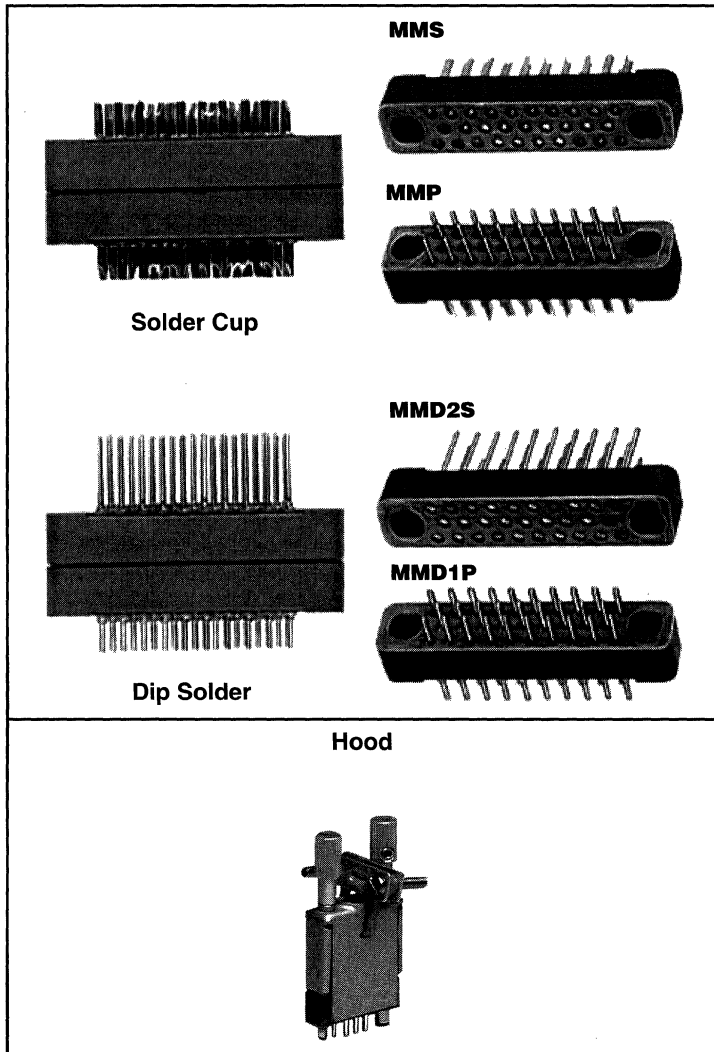
Pull-out Force of Mounting Inserts: 50 pounds minimum.

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



MODELS MM22 and MM24 Rack and Panel Connectors

Military, MIL-C-28748/7,/8 Qualified and Commercial
Microminiature Rectangular with Optional Hoods



FEATURES

- Qualified to MIL-C-28748/7,/8
- Solder cup contacts
- Dip solder contacts
- Fixed and turnable screwlocks
- Optional closed entry socket contacts

APPLICATIONS

Especially suited for use in airborne, instrumentation and portable equipment applications or wherever the following requirements must be met: Minimum space and weight without sacrifice of performance, high quality materials, long service life, high vibration and shock resistance and positive locking.

ELECTRICAL SPECIFICATIONS

Current Rating: Model MM22 = 5 amps.
Model MM24 = 3 amps.

Breakdown Voltage: At Sea Level: 2000 V RMS.
At 70,000 feet: 500 V RMS.

MATERIAL SPECIFICATIONS

Contact Pin: Phosphor Bronze.

Contact Socket: Phosphor Bronze.
(Beryllium Copper available on request.)

Contact Plating: Gold.

Screwlocks: Stainless steel, passivated.

Guides: Brass, gold plated or stainless steel, passivated.

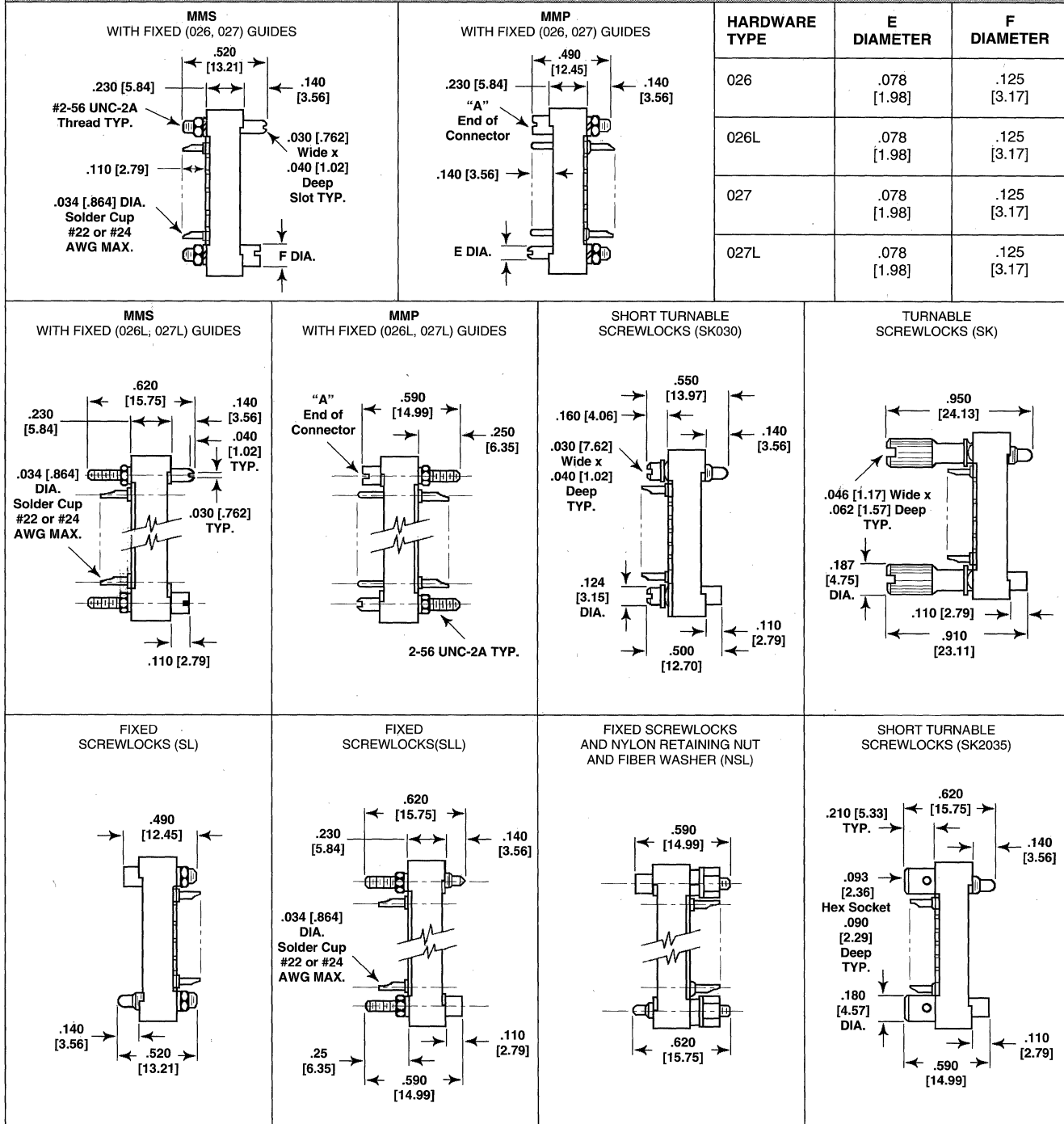
Standard Body: Glass-filled diallyl phthalate per MIL-M-14, Type SDG-F, green.

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

MMS WITH SOLDER CUP CONTACTS		MMP WITH SOLDER CUP CONTACTS		MMD2S WITH DIP SOLDER CONTACTS		MMD1P WITH DIP SOLDER CONTACTS	
CONTACT GAUGE	B DIAMETER	CONTACT GAUGE	C DIP TAIL LENGTH	CONTACT GAUGE	D DIAMETER	CONTACT GAUGE	D DIAMETER
22 AWG	.030 ± .001 [.762 ± .025]	22 AWG	.160 or .350 [4.06 or 8.89] NOM.	22 AWG	.025 [.635]	22 AWG	.025 [.635]
24 AWG	.025 ± .001 [.635 ± .025]	24 AWG	.160 or .350 [4.06 or 8.89] NOM.	24 AWG	.025 [.635]	24 AWG	.025 [.635]

MODELS MM22 and MM24

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



HARDWARE MATING CHART

HARDWARE TYPE	MATES WITH HARDWARE TYPE
026	026, 026L
027	027, 027L
SK	SL, NSL or SLL
SK030	SL, NSL or SLL
SK2	SL2, NSL2 or SL2L
SK2030	SL2, NSL2 or SL2L
SK2035	SL2, NSL2 or SL2L

NOTE: Either MMP or MMS Connectors may be ordered with any type of hardware shown.

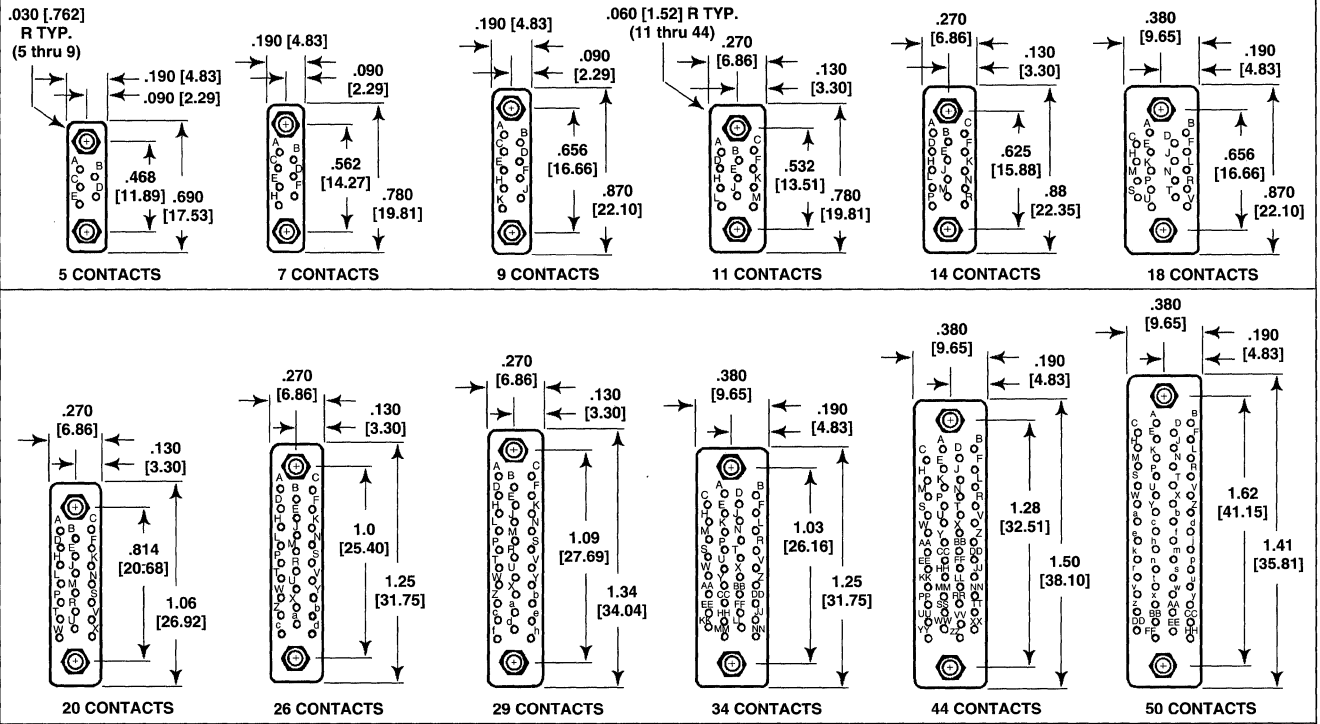
EXAMPLES:

1. MMP with 026 Hardware would mate with an MMS with 026 Hardware.
2. MMS with SK Hardware would mate with an MMP with SL or NSL Hardware.
3. MMS with SL2 Hardware would mate with an MMP with SK2 or SK2030 Hardware.

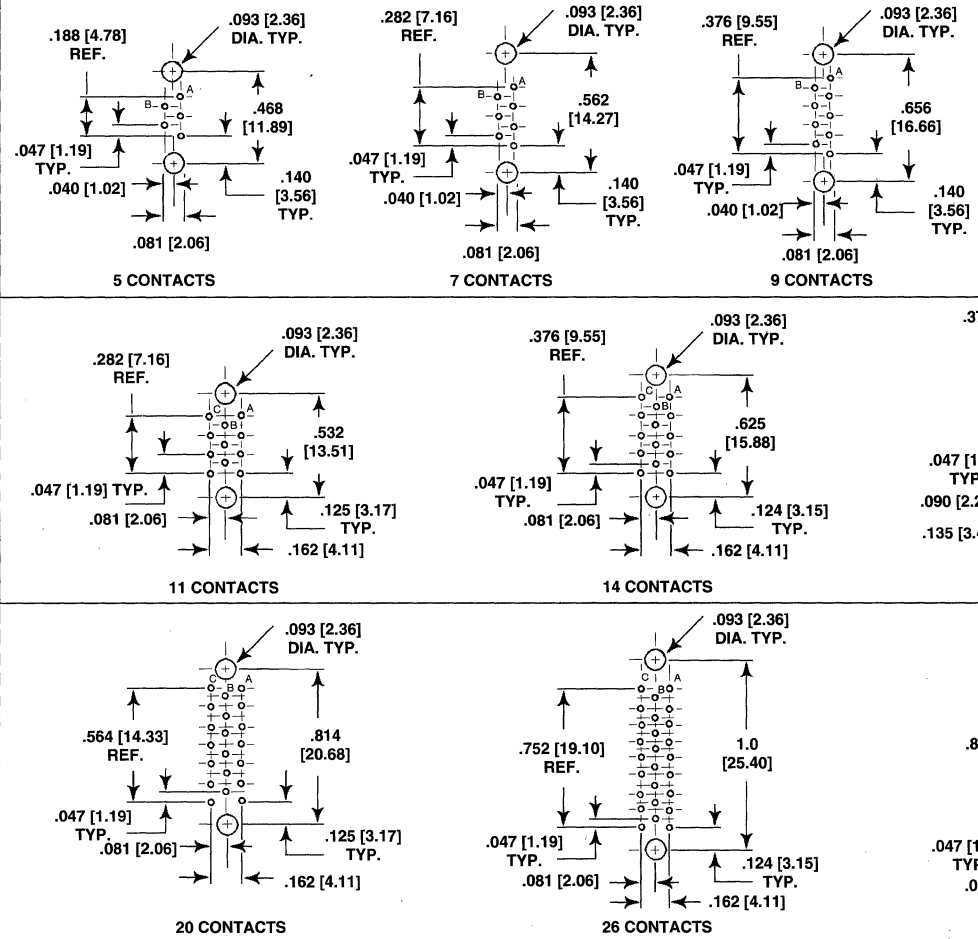
MODELS MM22 and MM24

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

NOTE: The views below show the wiring side of a pin type connector (female is opposite). Socket hardware assembled at "A" contact end of a pin type connector.



MOUNTING VARIATIONS [Numbers in brackets indicate millimeters]

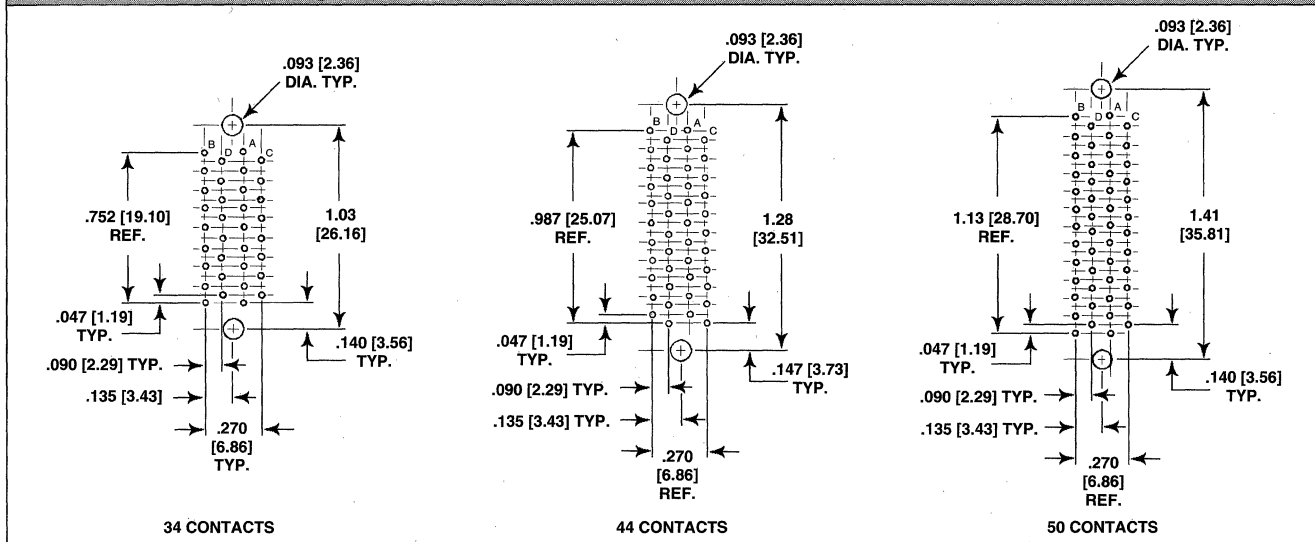


DIP SOLDER PC BOARD MOUNTING PATTERNS

Male (MMP) Connector Shown - Female is Opposite.
Contact, Contact Row and Mating Hole C to C Dimensions also Applies to Solder Cup Style Connectors.

MODELS MM22 AND MM24

MOUNTING VARIATIONS [Numbers in brackets indicate millimeters]

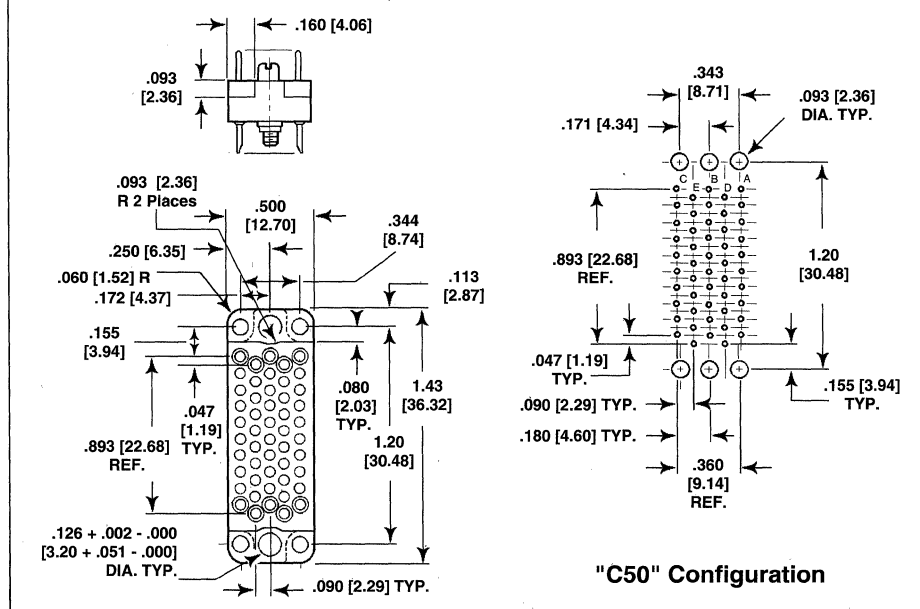


PANEL CUTOUT [Numbers in brackets indicate millimeters]

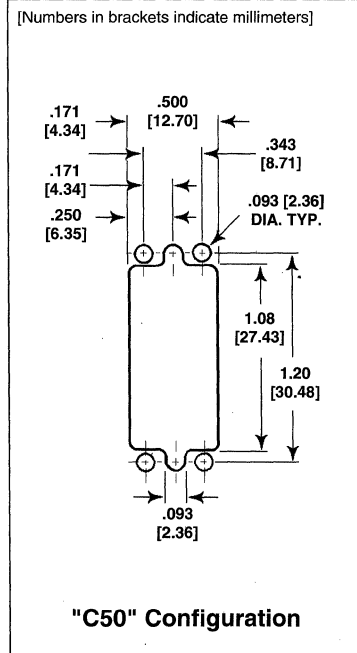
NUMBER OF CONTACTS	A B C			NUMBER OF CONTACTS	A B C		
	A	B	C		A	B	C
5	.190 [4.83]	.468 [11.89]	.340 [8.64]	20	.270 [6.86]	.814 [20.68]	.690 [17.53]
7	.190 [4.83]	.562 [14.27]	.440 [11.18]	26	.270 [6.86]	1.0 [25.40]	.870 [22.10]
9	.190 [4.83]	.656 [16.66]	.530 [13.46]	29	.270 [6.86]	1.09 [27.69]	.970 [24.64]
11	.270 [6.86]	.532 [13.51]	.410 [10.41]	34	.380 [9.65]	1.03 [26.16]	.910 [23.11]
14	.270 [6.86]	.625 [15.88]	.500 [12.70]	44	.380 [9.65]	1.28 [32.51]	1.16 [29.46]
18	.380 [9.65]	.656 [16.66]	.530 [13.46]	50	.380 [9.65]	1.41 [35.81]	1.28 [32.51]

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

NOTE: The views below show the wiring side of a pin type connector (Socket style is opposite). Socket hardware is assembled at "A" contact end of pin connector.



PANEL CUTOUT [Numbers in brackets indicate millimeters]



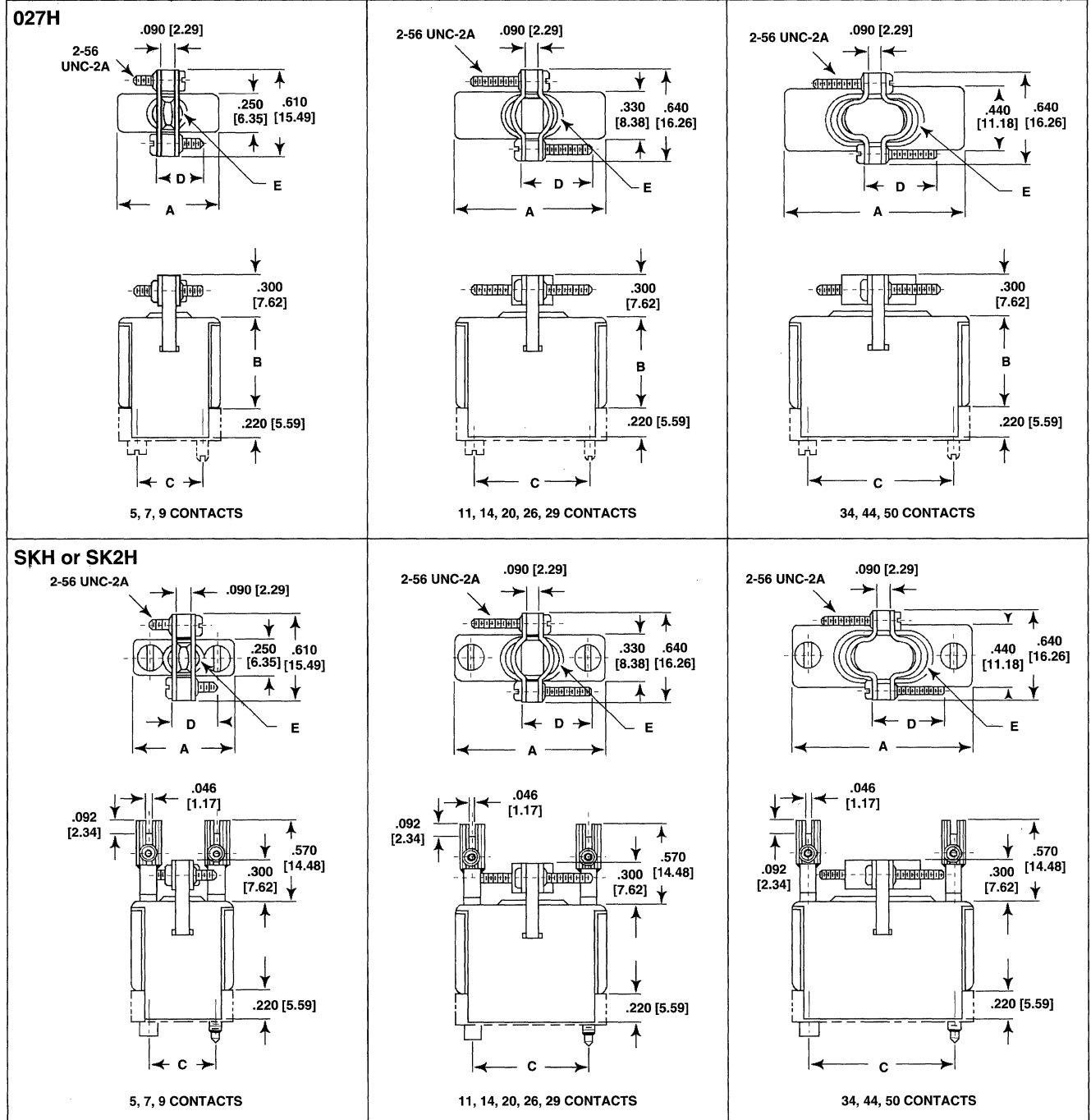
DIP SOLDER PC BOARD MOUNTING PATTERNS

Male (MMP) Connector Shown - Female is Opposite.

Contact, Contact Row and Mating Hole ϕ to ϕ Dimensions also Applies to Solder Cup Style Connectors.

MODELS MM22 and MM24

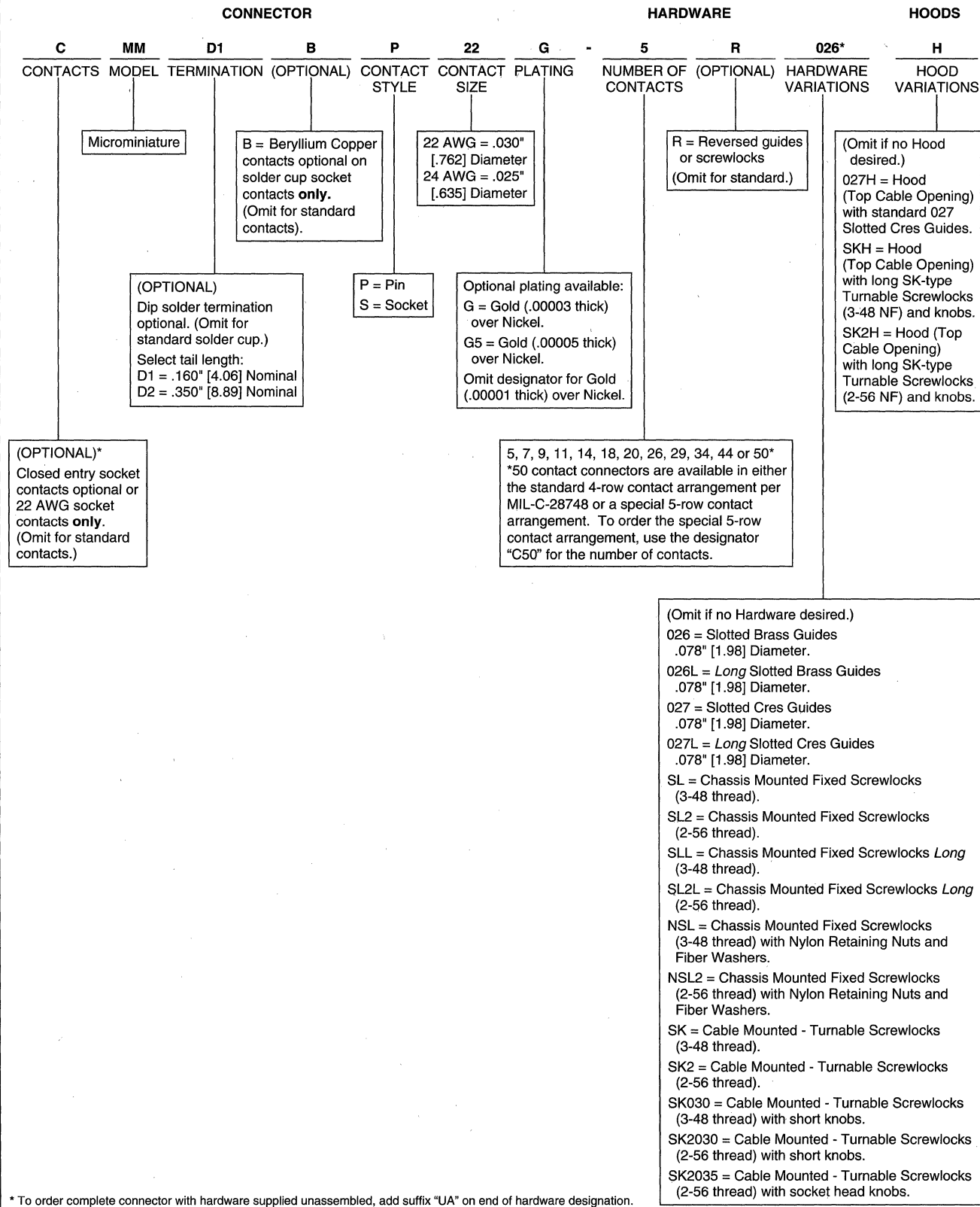
HOOD VARIATIONS [Numbers in brackets indicate millimeters]



NUMBER OF CONTACTS	A	B	C	D	"E" CABLE OPENING SQ. IN. [SQ. MM]
5	.690 [17.53]	.630 [16.0]	.468 [11.89]	.310 [7.87]	.028 [7.11]
7	.780 [19.81]	.630 [16.0]	.562 [14.27]	.440 [11.18]	.037 [9.40]
9	.870 [22.10]	.630 [16.0]	.656 [16.66]	.500 [12.70]	.052 [1.321]
11	.780 [19.81]	.630 [16.0]	.532 [13.51]	.440 [11.18]	.054 [1.372]
14	.870 [22.10]	.630 [16.0]	.625 [15.88]	.500 [12.70]	.076 [1.930]
20	1.06 [26.92]	.630 [16.0]	.814 [20.68]	.620 [15.75]	.105 [2.667]
26	1.25 [31.75]	.630 [16.0]	1.0 [25.40]	.620 [15.75]	.105 [2.667]
29	1.34 [34.04]	.630 [16.0]	1.09 [27.67]	.620 [15.75]	.105 [2.667]
34	1.25 [31.75]	.630 [16.0]	1.03 [26.16]	.500 [12.70]	.160 [4.064]
44	1.50 [38.10]	1.19 [30.23]	1.28 [32.51]	.500 [12.70]	.190 [4.826]
50	1.62 [41.15]	1.19 [30.23]	1.41 [35.81]	.620 [15.75]	.202 [5.131]

MODELS MM22 and MM24

HOW TO ORDER

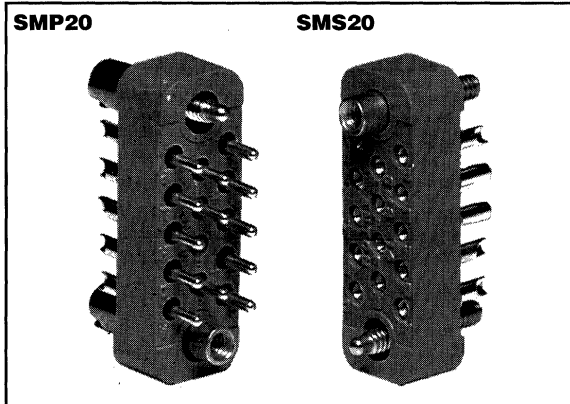


* To order complete connector with hardware supplied unassembled, add suffix "UA" on end of hardware designation.

MODEL SM20

Rack and Panel Connectors

Subminiature Rectangular



FEATURES

- Lightweight
- Polarized by guides or screwlocks
- Screwlocks lock connectors together to withstand vibration and accidental disconnect
- Overall height kept to a minimum
- Floating contacts aid in alignment and in withstanding vibration
- Contacts, precision machined and individually gauged, provide high reliability
- Insertion and withdrawal forces kept low without increasing contact resistance
- Contact plating provides protection against corrosion, assures low contact resistance and ease of soldering

APPLICATIONS

For use wherever space is at a premium and a high quality connector is required in avionics, automation, communications, controls, instrumentation, missiles, computers and guidance systems.

MATERIAL SPECIFICATIONS

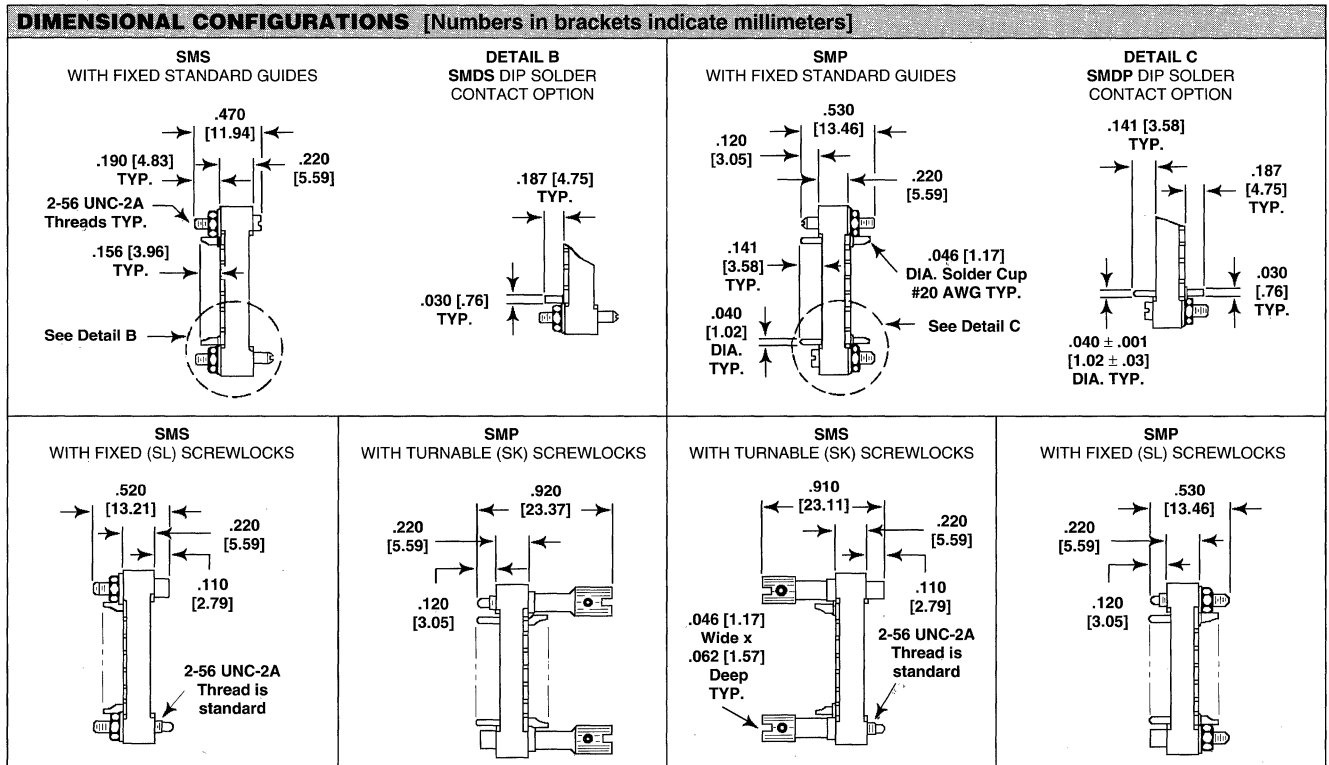
- Contact Pin:** Brass, gold plated.
- Contact Socket:** Phosphor Bronze, gold plated. (Beryllium Copper available on request.)
- Guides:** Stainless steel, passivated.
- Screwlocks:** Stainless steel, passivated.
- Standard Body:** DG glass-filled diallyl phthalate per MIL-M-14, Type GDI-30F, green.

ELECTRICAL SPECIFICATIONS

- Current Rating:** 7.5 amps.
- Breakdown Voltage:**
At Sea Level: 2000 V RMS.
At 70,000 feet [21,336 meters]: 500 V RMS.

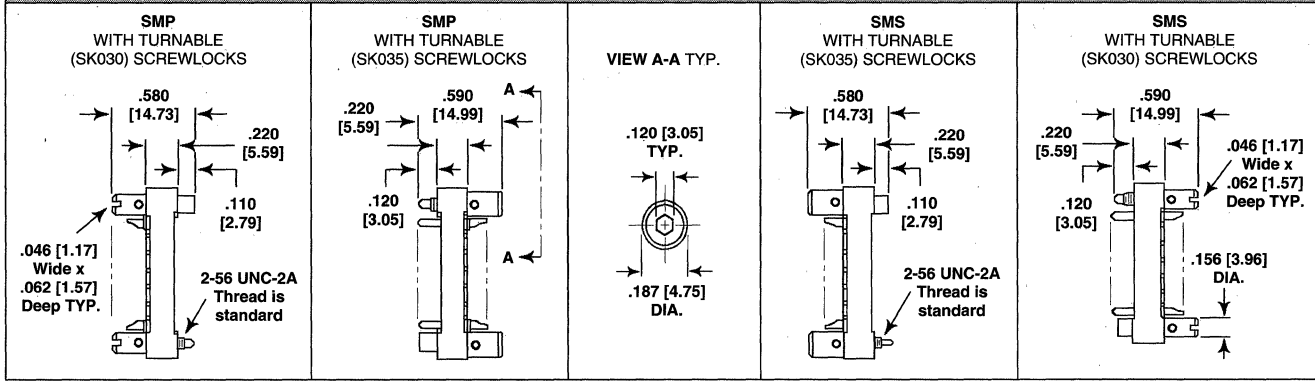
PHYSICAL SPECIFICATIONS

- Number of Contacts:** 5, 7, 11, 14, 20, 26, 34, 42, 50, 75.
- Contact Spacing:** .120" [3.05].
- Contact Gauge:** #20 AWG.
- Minimum Creepage Path Between Contacts:** .080" [2.03].
- Minimum Air Space Between Contacts:** .050" [1.27].



MODEL SM20

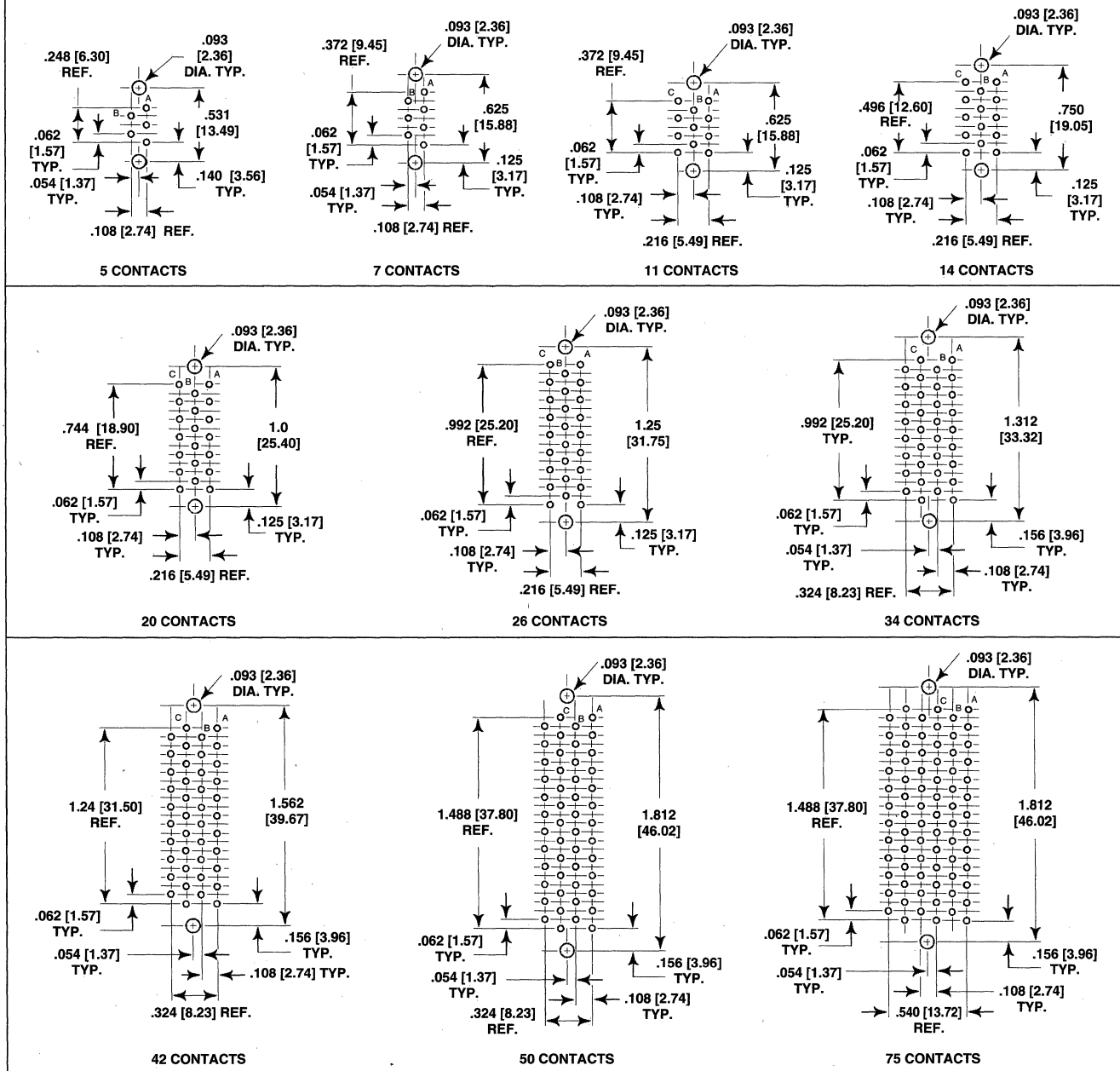
DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



TERMINAL VARIATIONS [Numbers in brackets indicate millimeters]

DIP SOLDER PC BOARD MOUNTING PATTERNS

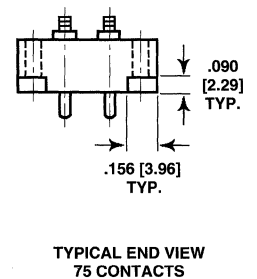
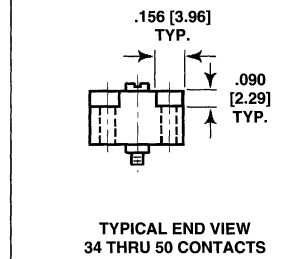
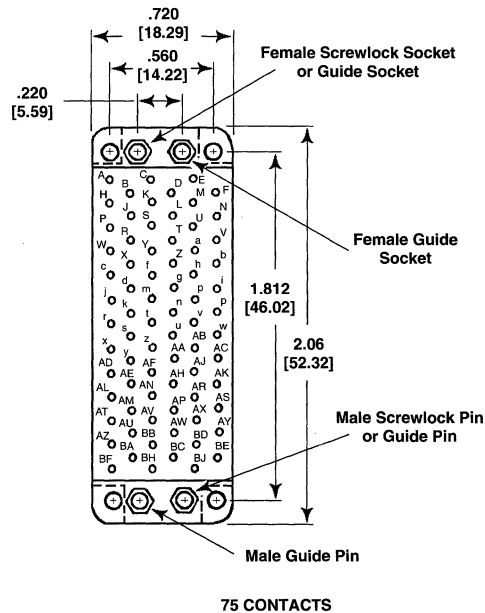
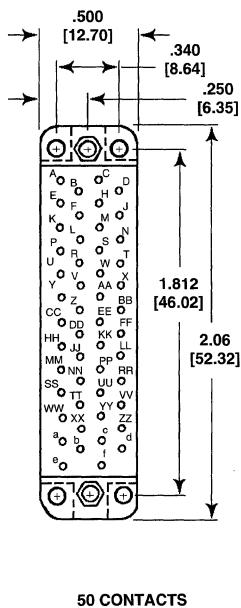
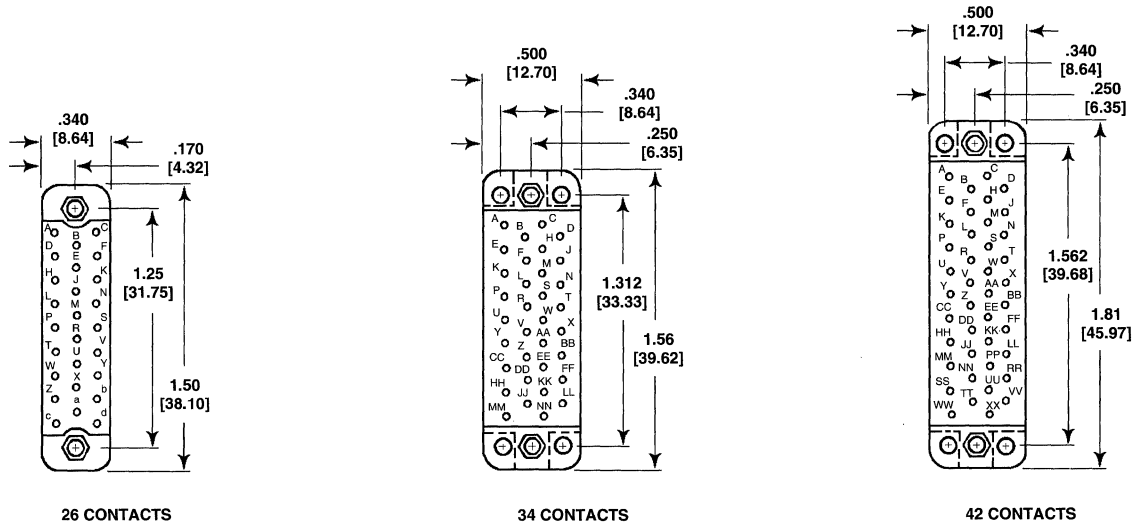
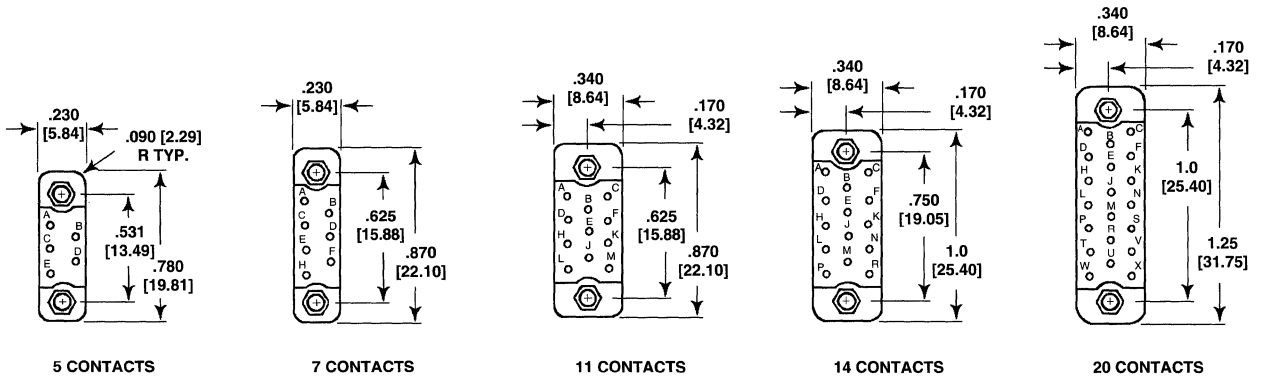
Male (SMP) Connector is Shown - Female is Opposite. Contact Row and Mating Hole \varnothing to \varnothing Dimensions also Applies to Solder Cup Connectors.



MODEL SM20

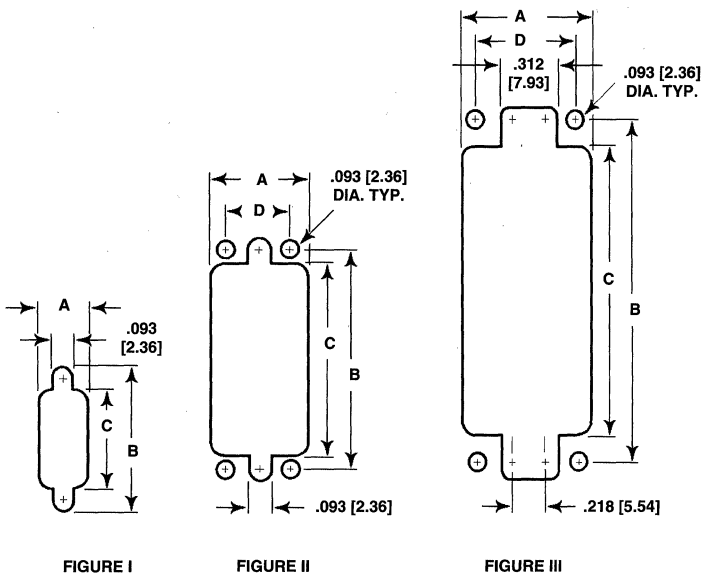
DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

NOTE: The views below show the wiring side of a pin type connector (female is opposite). Socket hardware is assembled at "A" contact end of a pin type connector.



MODEL SM20

PANEL CUTOUT [Numbers in brackets indicate millimeters]



NUMBER OF CONTACTS	A	B	C	D	FIGURE
5	.230 [5.84]	.531 [13.49]	.410 [10.41]	—	I
7	.230 [5.84]	.625 [15.88]	.500 [12.70]	—	
11	.340 [8.64]	.625 [15.88]	.530 [13.46]	—	
14	.340 [8.64]	.750 [19.05]	.620 [15.75]	—	
20	.340 [8.64]	1.0 [25.40]	.910 [23.11]	—	
26	.340 [8.64]	1.25 [31.75]	1.16 [29.46]	—	
34	.500 [12.70]	1.312 [33.33]	1.16 [29.46]	.343 [8.71]	II
42	.500 [12.70]	1.562 [39.68]	1.41 [35.81]	.343 [8.71]	
50	.500 [12.70]	1.812 [46.02]	1.66 [42.16]	.343 [8.71]	
75	.720 [18.29]	1.812 [46.02]	1.66 [42.16]	.562 [14.28]	III

HOW TO ORDER

<p>C</p> <p>CONTACTS</p> <p>(OPTIONAL) Closed entry socket contacts only. Omit for Standard Contacts.</p>	<p>SM</p> <p>MODEL</p> <p>Subminiature</p>	<p>B</p> <p>CONTACT TYPE</p> <p>(OPTIONAL)* B = Beryllium Copper, Socket Contacts (Solder Cup). D = Dip Solder Contacts.</p>	<p>S</p> <p>CONTACT STYLE</p> <p>P = Pin S = Socket</p>	<p>20</p> <p>CONTACT SIZE</p> <p>(#20 AWG)</p>	<p>G</p> <p>PLATING</p> <p>Optional plating available: G = Gold (.00003 thick) over nickel. G5 = Gold (.00005 thick) over nickel. Omit Designator for Gold (.00001 thick) over Nickel.</p>	<p>26</p> <p>NUMBER OF CONTACTS</p> <p>5, 7, 11, 14, 20, 26, 34, 42, 50, 75</p>	<p>R</p> <p>(OPTIONAL)</p> <p>R = Reversed Guides or Screwlocks. Omit for Standard.</p>	<p>027*</p> <p>HARDWARE OPTIONS</p> <p>(Omit if no Hardware desired) 027 = Slotted Cres Guides .090" [2.29] Diameter. SK = Turnable Screwlocks with 2-56 threads. SK3 = Turnable Screwlocks with 3-48 threads. SL = Fixed Screwlocks with 2-56 threads. SL3 = Fixed Screwlocks with 3-48 threads. SK030 = Turnable Screwlocks with short knobs. SK035 = Turnable Screwlocks with socket head knobs. SK3030 = Turnable Screwlocks with short knobs. SK035 = Turnable Screwlocks with socket head knobs.</p>
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EXAMPLES:
 SMBS20-26SK035 = Female, 26 Beryllium Copper Socket Contacts with Socket Head Knobs on Turnable Screwlocks for #20 AWG Wiring.
 SMP20-14SL3 = Male, 14 Contact Pins, Fixed Screwlocks with 3-48 Threads for #20 AWG Wiring.

* To order complete connector with hardware supplied unassembled, add suffix "UA" on end of hardware designation.

SPECIAL APPLICATIONS Connectors



Dale® can provide engineering assistance to meet your special connector requirements. Some of these special models are:

	<p>MODELS ES1 and ES5 Digital Display Connectors</p>	<p>Single readout digital display connectors. Permit custom variations in substrate length, width and number of contacts without tooling charge. Substrate lengths from 1" [25.40] to 6" [152.40] in .050" [1.27] increments. These accept .047" [1.19], .062" [1.59] and .125" [3.18] substrates. From 10 through 60 contacts can be provided on .100" [2.54] centers.</p>
	<p>MODELS ED1 and ED5 Edgeboard Connectors</p>	<p>Dual readout edgeboard connectors. Permit custom variations in substrate length, width and number of contacts without tooling charge. Substrate lengths from 1.20" [30.48] to 4.50" [114.30] in .050" [1.27] increments. These accept .031" [.794] and .062" [1.59] substrates. From 20 through 87 contacts can be provided on .050" [1.27] centers.</p>
	<p>MODEL 303 Dip Solder Connectors</p>	<p>Right angle or straight-through terminals. Series 303 has 45 staggered contacts in a compact 3-row design (.050" x .200" [1.27 x 5.08] pattern).</p>
	<p>MODEL 315 Dip Solder Connectors</p>	<p>50 contacts with .200" [5.08] spacing. Staggered rows provide a .100" [2.54] grid. Right angle or straight-through terminations. Interchangeable polarization guides can be oriented to provide 144 keying variations.</p>
	<p>MODELS PJ and 500SR5 Test Point Connectors</p>	<p>Right angle or straight-through dip solder pins for permanent mounting. Models with 1 and 5 contacts, and .150" [3.81] spacing, accept .080" [2.03] diameter probes.</p>
	<p>MODELS A20 and WA20 Side Mount Connectors</p> <p>MODELS G20 and G16 Side Mount Connectors</p>	<p>Body components available with any desired pin and socket combination. Floating contacts. Hole through body permits flat or building block type mounting.</p>
	<p>MODEL S20 Housed Connectors</p>	<p>Lightweight connectors. Protective housing and hood. For RF and power interconnect applications. Floating contacts withstand vibration and aid in alignment. Shell design provides polarization.</p>
	<p>MODEL QX32 Umbilical Connectors</p>	<p>Umbilical types. QX styles designed for use in missile firing systems.</p>

Plasma Flat Panel Displays

INTRODUCTION

Dale[®] displays are screened image DC plasma (gas discharge) displays. The neon-orange color and screened image construction combine to produce a man-machine interface that has superior ergonomics, with wide viewing angles, and high contrast over a broad range of lighting conditions.

Dale displays have a versatile range of applications including point-of-sale devices, avionics, gasoline pumps, industrial controls and measurement systems, audio equipment, medical instrumentation and programmable controllers.

To meet these needs, Dale provides a variety of models including numeric and alphanumeric segmented displays, linear bar graphs, and segmented and dot matrix modules.

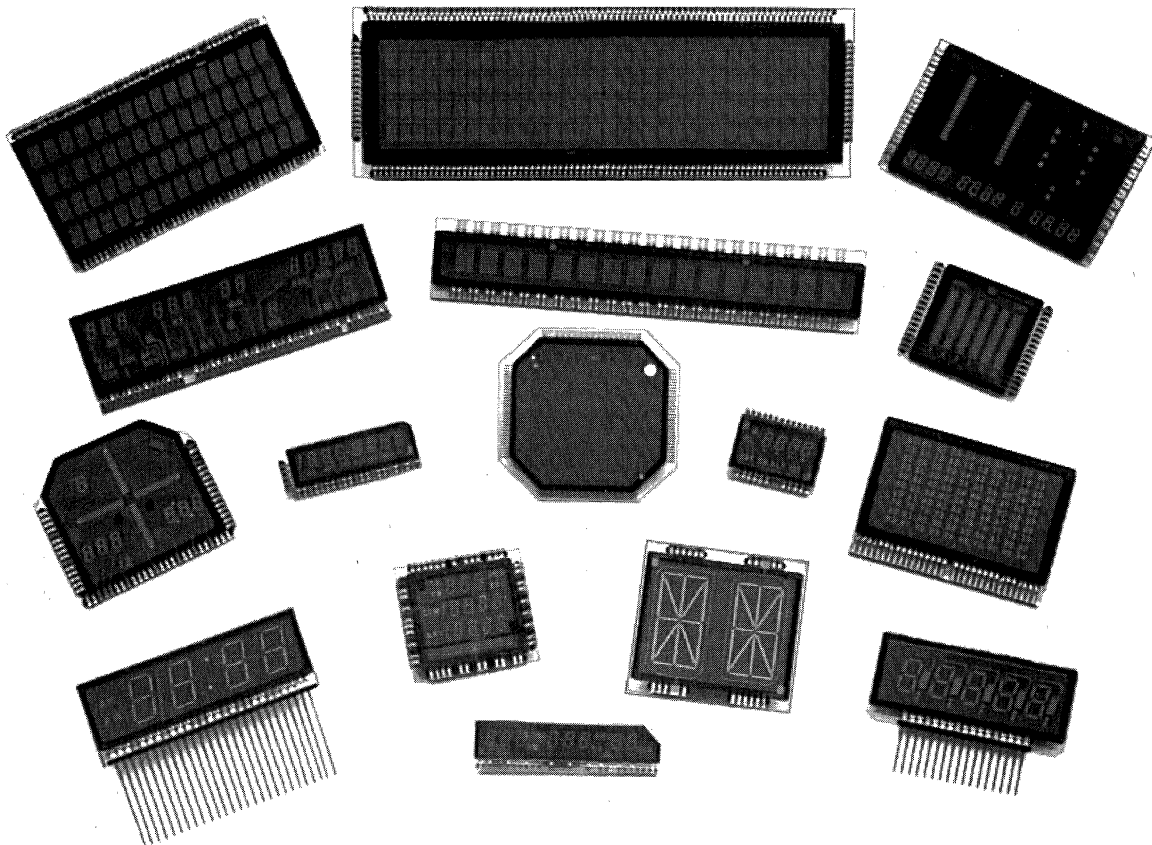
We continue to add new products and enhancements to existing models, so please contact us if your needs are not met by any of the products in this brochure.

ENGINEERING ASSISTANCE

If you would like to discuss the various design parameters and display technologies in order to choose the right display for your application, call our engineering department. They will give you an objective analysis of your options. Consideration will be given to the amount and type of information to be displayed, viewing distance, ambient lighting conditions, operating environment, power, mounting dimensions and cost. Our goal is to help you select the best display - the first time.

CUSTOM DISPLAYS

We "cut our teeth" on custom displays and continue to design and build displays that enable our customers to personalize their products. Our screened image technology allows maximum freedom to display symbols, messages and characters unique to your application - at a price you can afford. Just send us a sketch of your idea, and we'll prepare a counter drawing and a budgetary quotation.

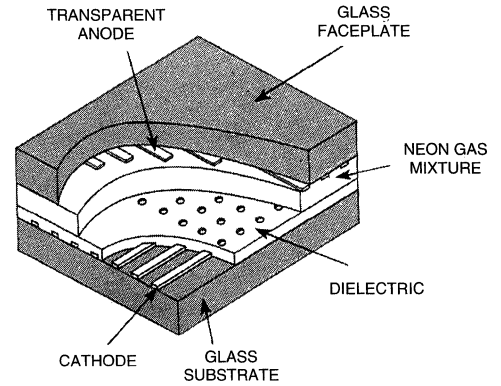


PLASMA FLAT PANEL DISPLAYS

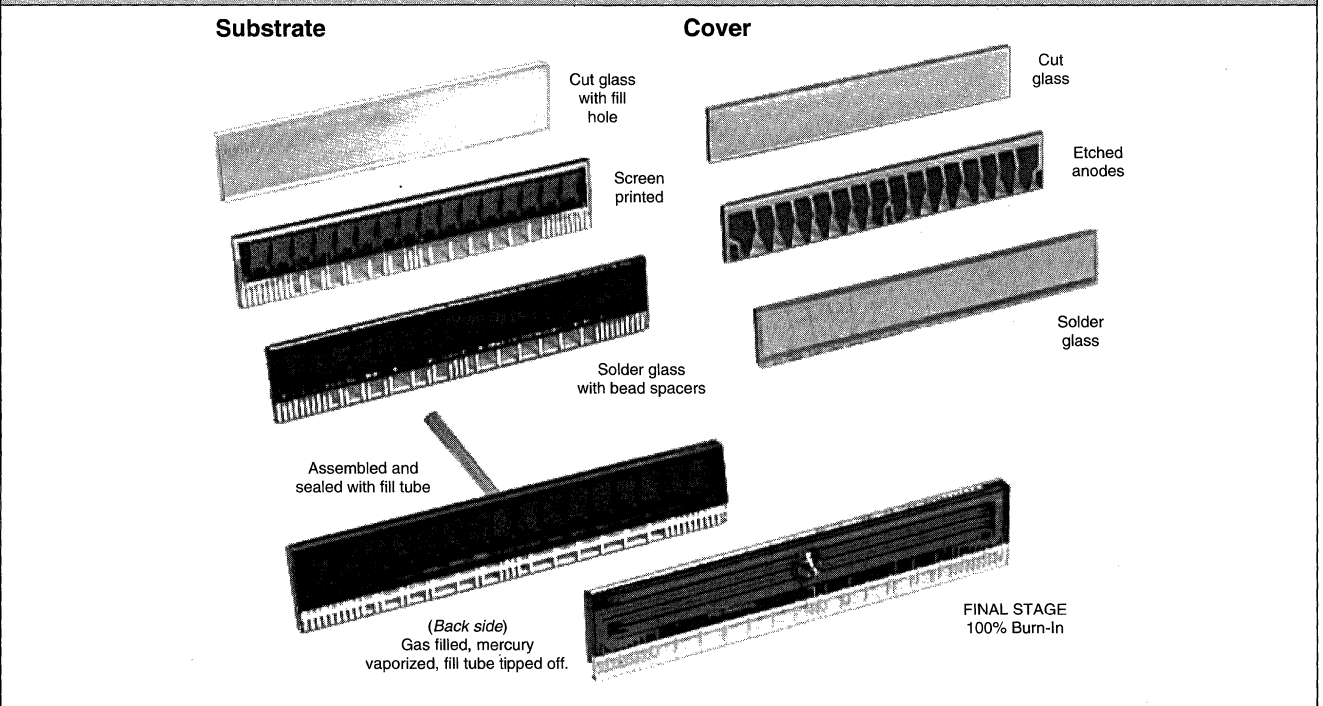
CONSTRUCTION AND OPERATION

Dale® plasma displays share a common construction method. Cathodes are screen printed and fired on a glass substrate and then outlined with a dielectric to precisely determine the geometry of the display element. Some models have an additional circuit underneath the cathodes to allow for crossovers. The transparent tin oxide anodes on the front substrate are defined by a screen printing and etching process. The two glass substrates are placed together, but separated by a small gap, sealed and filled with a neon-based gas mixture. When an appropriate voltage and current is applied between the anode and cathode electrodes, the gas will ionize, creating an image of the cathode. All Dale displays are designed to be multiplexed to reduce the number of display connections and drivers. Several "keep-alives" are used to supply a low level ion source to ensure rapid ionization and to provide stable operation under a variety of operating conditions. Integrated circuit drivers and DC-DC high voltage converter modules are readily available to facilitate your circuit design.

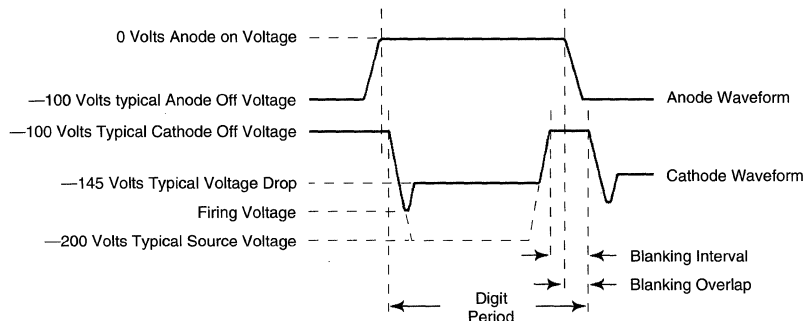
DOT MATRIX INTERNAL CONSTRUCTION



SEGMENTED DISPLAY CONSTRUCTION STAGES



TYPICAL ANODE AND CATHODE WAVE FORMS



DOT MATRIX PLASMA DISPLAY MODULES

Quick Reference Guide



MODEL	APD-064M033	APD-064M033-1	APD-016M040	APD-222G007	APD-080M025-1	APD-128G128	APD-192G096
No. of Characters	64	64	16	32	80	192	256
Configuration	4 x 16	4 x 16	1 x 16	222 x 7	4 x 20	128 x 128	192 x 96
Display Format	Character	Character	Character	Graphic	Character	Graphics	Graphics
Character Height	0.33	0.33	0.40	0.20	0.25	0.17	0.17
Pixel Size (W x H)	0.030 (Dia.)	0.030 (Dia.)	0.036 (Dia.)	0.019 x 0.017	0.018 x 0.018	0.015 (Dia.)	0.017 (Dia.)
Pixel Pitch (W x H)	0.050 x 0.050	0.050 x 0.050	0.061 x 0.061	0.030 x 0.030	0.034 x 0.038	0.025 x 0.025	0.026 x 0.026
Display Area (W x H)	4.76 x 2.00	4.76 x 2.00	7.15 x 0.40	7.15 x 0.20	4.03 x 1.46	3.24 x 3.24	4.96 x 2.47
Outline Dim. (W x H x D)	8.00 x 3.48 x 2.33	8.00 x 3.48 x 2.33	8.50 x 2.25 x 1.96	8.50 x 2.25 x 0.98	6.25 x 3.00 x 1.75	4.62 x 4.72 x 3.75	6.0 x 4.5 x 1.95
Luminance (fL)	80	80	80	60	80	80	70
Interface *	ASCII (P)	ASCII (S)	ASCII (P&S)	Special	ASCII (S)	ASCII (S)	ASCII (S)
Supply Voltage	+ 5, + 185	+ 5	5.0	+ 5, + 250	+ 5	+ 5, + 12	+ 5
Power Consumption (Max)	6.45	7.50	6.25	9.90	5.00	8.5	12
Viewing Angle (Degrees)	150°	150°	150°	150°	150°	120°	120°
Operating Temperature	0°C to + 55°C	0°C to + 55°C	0°C to + 55°C	0°C to + 55°C	0°C to + 55°C	- 15°C to + 55°C	0°C to + 55°C
Storage Temperature	- 55°C to + 85°C	- 55°C to + 85°C	- 55°C to + 85°C	- 55°C to + 85°C	- 55°C to + 85°C	- 55°C to + 85°C	- 55°C to + 85°C

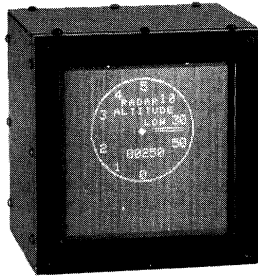
MODEL	APD-240M026A	APD-240M026A-1	APD-240M019	APD-240M021	APD-256M026	APD-256M026-1	APD-256M025A
No. of Characters	240	240	240	240	256	256	256
Configuration	6 x 40	6 x 40	6 x 40	6 x 40	8 x 32	8 x 32	8 x 32
Display Format	Character	Character	Character	Character	Character	Character	Character
Character Height	0.26	0.26	0.196	0.21	0.26	0.26	0.25
Pixel Size (W x H)	0.020 (Dia.)	0.020 (Dia.)	0.019 x 0.019	0.018 (Dia.)	0.020 (Dia.)	0.020 (Dia.)	0.018 x 0.018
Pixel Pitch (W x H)	0.030 x 0.040	0.030 x 0.040	0.030 x 0.030	0.032 x 0.032	0.040 x 0.040	0.040 x 0.040	0.032 x 0.039
Display Area (W x H)	8.33 x 2.26	8.33 x 2.26	7.43 x 1.83	7.52 x 2.15	7.62 x 3.30	7.62 x 3.30	7.00 x 3.05
Outline Dim. (W x H x D)	11.0 x 4.3 x 1.21	11.0 x 4.3 x 1.91	10.63 x 4.33 x 1.85	10.00 x 4.30 x 1.7	9.15 x 6.10	11.0 x 6.10 x 2.2	9.45 x 4.72 x 2.28
Luminance (fL)	100	100	100	100	100	100	70
Interface *	CRT	ASCII (P&S)	ASCII (S)	ASCII (P)	CRT	ASCII (P&S)	ASCII (P)
Supply Voltage	+ 5, + 12, + 65, - 115	+ 5, + 12	+ 5	+ 5, + 12 to + 30	+ 5, + 12, + 95, - 90	+ 5, + 12	+ 5, + 185
Power Consumption (Max)	14.00	15.50	12.50	11.10	14.00	15.50	12.00
Viewing Angle (Degrees)	150°	150°	150°	150°	150°	150°	150°
Operating Temperature	0°C to + 55°C	0°C to + 55°C	0°C to + 55°C	0°C to + 55°C	0°C to + 55°C	0°C to + 55°C	- 5°C to + 55°C
Storage Temperature	- 55°C to + 85°C	- 55°C to + 85°C	- 55°C to + 85°C	- 55°C to + 85°C	- 55°C to + 85°C	- 55°C to + 85°C	- 55°C to + 85°C

MODEL	APD-480M021	APD-480M021-1	APD-480M021-2	APD-336M019	APD-336M019-2	APD-192G088	APD-240G120
No. of Characters	480	480	480	336	336	352	480
Configuration	12 x 40	12 x 40	12 x 40	14 x 24	14 x 24	192 x 88	240 x 120
Display Format	Character	Character	Character	Character	Character	Graphics	Graphics
Character Height	0.21	0.21	0.21	0.19	0.19	0.26	0.21
Pixel Size (W x H)	0.018 x 0.018	0.018 x 0.018	0.018 x 0.018	0.013 (Dia.)	0.013 (Dia.)	0.020 (Dia.)	0.018 x 0.018
Pixel Pitch (W x H)	0.032 x 0.032	0.032 x 0.032	0.032 x 0.032	0.023 x 0.030	0.023 x 0.030	0.040 x 0.040	0.032 x 0.031
Display Area (W x H)	7.56 x 3.74	7.56 x 3.74	7.56 x 3.74	3.27 x 3.30	3.27 x 3.30	7.66 x 3.50	7.55 x 3.74
Outline Dim. (W x H x D)	10.87 x 5.91 x 1.77	10.87 x 5.91 x 1.77	10.87 x 5.91 x 1.77	4.40 x 4.60 x 3.0	4.40 x 4.60 x 3.0	10.87 x 6.00 x 2.25	10.87 x 5.91 x 1.77
Luminance (fL)	60	60	60	80	80	80	40
Interface *	ASCII (P)	ASCII (S)	ASCII (P)	ASCII (P)	ASCII (P)	ASCII (P & S)	ASCII (P & S)
Supply Voltage	+ 5, + 185	+ 5, + 12	+ 5, + 12	+ 5, + 15	+ 5, + 15	+ 5, + 12	+ 5, + 12
Power Consumption (Max)	10.00	12.20	12.40	10.00	10.00	15.50	13.50
Viewing Angle (Degrees)	150°	150°	150°	120°	120°	150°	150°
Operating Temperature	0°C to + 55°C	0°C to + 55°C	0°C to + 55°C	0°C to + 55°C	- 15°C to + 70°C	0°C to + 55°C	0°C to + 55°C
Storage Temperature	- 55°C to + 85°C	- 55°C to + 85°C	- 55°C to + 85°C	- 55°C to + 85°C	- 55°C to + 85°C	- 55°C to + 85°C	- 55°C to + 85°C

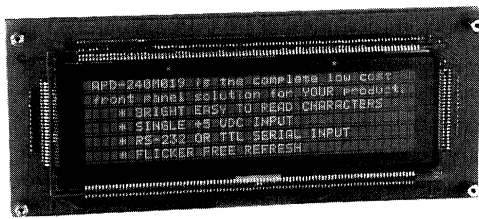
* (P) = Parallel Interface. (S) = Serial (RS-232) Interface.

DC Plasma Display Modules

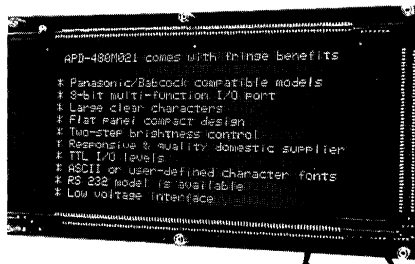
APD-128G128



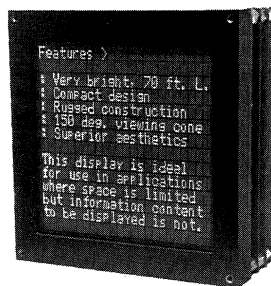
APD-240M019



APD-480M021-1



APD-336M019



FEATURES

- **Viewing Angle:** Dale's® patented "open" construction method provides superior viewing angles that are unsurpassed by any display technology.
- **Brightness:** Dale displays are designed to exploit the inherent high brightness capability of DC Plasma displays to make them excellent choices for practically any application, whether it is in sunlight, brightly lit factories, or total darkness. The nature of the plasma glow make the display characters or graphics appear much larger than they actually are. The brightness is also extremely uniform since there are no internal filaments or grids that affect the light output.
- **Compact Size:** State-of-the-art design using the latest SMT components and DC/DC converters result in modules that provide minimum front panel space and depth.
- **Flexibility:** Dale excels in building display modules that allow the user to personalize their products at affordable prices. Our screened image display technology allows maximum freedom to design a display module that is application specific with interface circuitry that is synergistic to the end system.
- **High Speed Data Input:** Dale's creative interfaces allow high speed data input without display flickering or difficult handshaking schemes.
- **Rugged Design:** Shock and Vibration (non operating and operating) are no problem, as there are no fragile filaments or grids that may break.
- **Made in USA:** Dale Plasma display modules are completely manufactured in the USA by Dale which insures total control over all aspects of design and manufacturing to provide the utmost in customer service and support.

THE SELECTION PROCESS

- **Call Dale:** We have designed hundreds of application specific displays which enable us to give you an objective analysis of your needs and options.
- **Type and Amount of Information to be Displayed:** This will define whether a graphics or character format is required, and the minimum size of the format.
- **Viewing Distance Range:** This will determine the size of the characters from which the pixel pitch and size will be derived.
- **Ambient Lighting Conditions:** The lighting conditions will dictate the display luminance, whether or not dimming is required, and the type of contrast enhancement filter.
- **Power and Voltage Available:** Through the use of efficient DC/DC converters, Dale can design modules compatible with practically any power and voltage source. Dale Plasma display power requirements are competitive with any light emissive display technology.
- **Overall Size:** Dale is adept at designing packages to fit your space budget.
- **Interface:** Three basic interface levels are available: (1) ASCII - Parallel or serial (RS-232), (2) CRT controller (user supplies sync, pixel data, and clock signals) or (3) Display glass only (Dale will gladly provide application assistance).
- **Operating Environment:** The operating conditions may affect the component selection and whether special packaging is required for hostile environments.

DALE'S GOAL

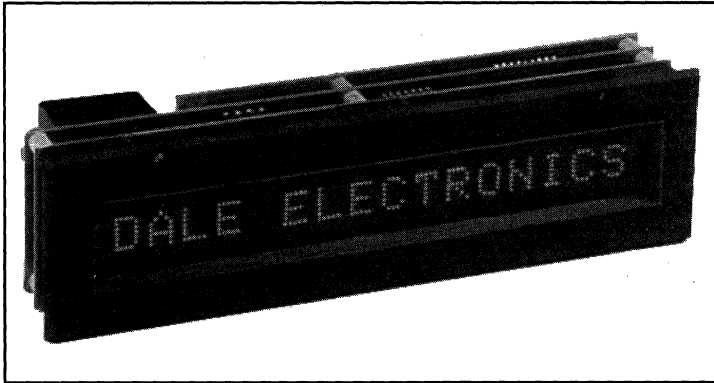
- To help you select the best display for your application - the first time.

MODEL APD-016M040

Plasma Panel Display Modules

16 Character Display

with Drive Electronics and Controller



The APD-16M040 display module is a 1 line by 16 character 5 x 7 dot matrix display. It includes drive electronics, a microprocessor-based controller consisting of a character generator, control logic and a 32 character refresh memory. The controller can be programmed for either parallel or serial interface. An on board DC-DC converter develops the necessary panel voltages from a single 5 V input.

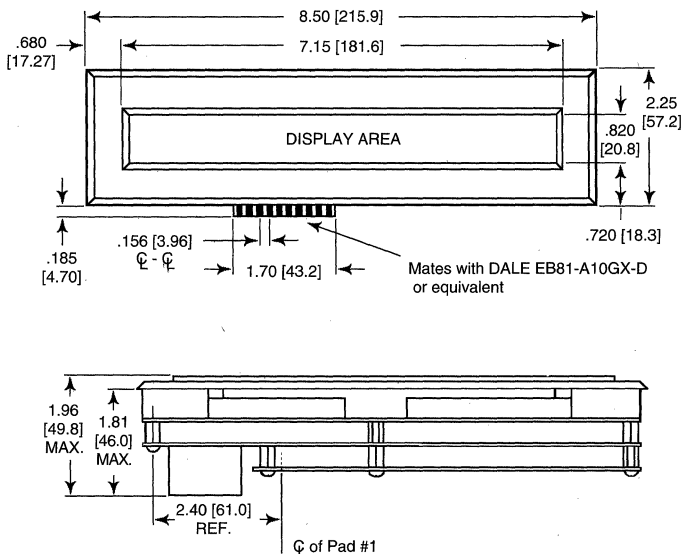
STANDARD ELECTRICAL SPECIFICATIONS

	SYMBOL	MIN.	TYP.	MAX.	UNITS
Supply Voltage	V _{CC}	4.75	5.0	5.25	V
Supply Current ⁽¹⁾	I _{CC}	—	1.25	1.75	A
Logic One Voltage	V _{IH}	2.0	—	—	V
Logic 0 Voltage	V _{IL}	—	—	.8	V

(1) V_{CC} is the input to a DC-DC Converter. There may be peak in rush currents higher than shown.

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



FEATURES

- 16 (1 x 16) alphanumeric characters (5 x 7 dot matrix)
- Bezel and filter included
- Parallel and serial interfaces
- High brightness
- Wide viewing angle (150°)
- Low input voltage
- Compact size
- Enhanced replacement for Burroughs SSD1000-0061 (optionally-0041)

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature: 0°C to + 55°C.
Storage Temperature: - 55°C to + 85°C.
Relative Humidity: 10-90% non-condensing.
Mechanical Shock: 50G 1/2 Sine Wave, 11 ms duration, 5 shocks in each of 6 directions.
Vibration: .018" displacement amplitude from 10 to 50 Hz, 2G acceleration from 50 to 2000 Hz logarithmic sweep rate. 30 minutes duration along each side of the 3 major axes.

OPTICAL SPECIFICATIONS

Viewing Area: .40" [10.2] W x 6.69" [169.9] L.
Number of Characters: 16.
Character Size: .28" [7.1] W x .40" [10.2] H.
Pixel Size: .036" [.914] diameter.
Pixel Pitch: .061" [1.55].
Character Spacing: 2 blank columns between successive characters - .147" [3.73].
Luminance: 80 foot lamberts.
Color: Neon orange.
Viewing Angle: 150° cone.

MODEL APD-016M040

GENERAL DESCRIPTION

The APD-016M040 has two modes of operation, parallel or serial input. The parallel interface consists of a 6 bit data bus plus 3 hand-shaking and 3 control lines. New characters are entered from right to left by presenting the appropriate 6 bit code to the data bus and latching it into memory with a DATA PRESENT pulse. A WRITE CYCLE output signal is provided during the time in which data can be written to the display, and a DATA TAKEN pulse occurs after data has been accepted, or when BACK SPACE occurs. BACK SPACE allows the displayed message to be shifted to the right, recalling the last character shifted off the left end of the display. Up to 16 characters may be recalled, after which blanks are entered in the left position of the display. The display may be cleared at any time by bringing the CLEAR line low. A BLANK DISABLE line is provided to blank the display without altering the refresh memory contents.

The serial interface is RS-232-C compatible and has 3 selectable baud rates (300, 1200, 9600). This mode assumes 1 start bit, 8 data bits, 1 stop bit, no parity and half duplex. No handshaking is provided. Mode settings and baud rates are selected as follows. (Both lines are internally pulled to Vcc with 6.8 kilohm pull-up resistors.)

SS0	SS1	BAUD RATE
0	0	300
0	1	1200
1	0	9600
1	1	Parallel

PIN DESCRIPTION			
PIN	DESCRIPTION	PIN	DESCRIPTION
1	DATA BIT 5	A	DATA BIT 4
2	DATA BIT 3	B	DATA BIT 2
3	DATA BIT 1	C	DATA BIT 0
4	N/C	D	DATA PRESENT
5	CLEAR	E	BACK SPACE
6	SPEED SELECT 1	F	DATA TAKEN
7	WRITE CYCLE	H	RECEIVED DATA
8	BLANK DISABLE	J	+ 5 V
9	SPEED SELECT 0	K	N/C
10	N/C	L	GND

Keyway between pins 4 (D) and 5 (E).

MODIFIED USASCII CHARACTER SET

(Serial Mode)

Bits															
b7	b6	b5	b4	b3	b2	b1	Col.	0	1	2	3	4	5	6	7
							Row	0	1	2	3	4	5	6	7
0	0	0	0	0	0	0	0			SP	0	@	P	\	p
0	0	0	0	1	1	1	1			!	1	A	Q	a	q
0	0	1	0	0	0	0	2			"	2	B	R	b	r
0	0	1	1	1	1	1	3	BON		#	3	C	S	c	s
0	1	0	0	0	0	0	4	BOFF		\$	4	D	T	d	t
0	1	0	1	1	1	1	5	RST		%	5	E	U	e	u
0	1	1	0	0	0	0	6			&	6	F	V	f	v
0	1	1	1	1	1	1	7			/	7	G	W	g	w
1	0	0	0	0	0	0	8	BS		(	8	H	X	h	x
1	0	0	1	1	1	1	9			)	9	I	Y	i	y
1	0	1	0	0	0	0	10			*	:	J	Z	j	z
1	0	1	1	1	1	1	11			+	;	K	[	k	{
1	1	0	0	0	0	0	12	CLR		'	<	L	\	l	!
1	1	0	1	1	1	1	13			-	=	M	]	m	}
1	1	1	0	0	0	0	14			.	>	N	^	n	~
1	1	1	1	1	1	1	15			/	?	O	_	o	DEL

(Parallel Mode)

Bits												
b6	b5	b4	b3	b2	b1	Col.	0	1	2	3		
						Row	0	1	2	3		
0	0	0	0	0	0	0	@	P	SP	0		
0	0	0	0	1	1	1	A	Q	!	1		
0	0	1	0	0	0	2	B	R	"	2		
0	0	1	1	1	1	3	C	S	#	3		
0	1	0	0	0	0	4	D	T	\$	4		
0	1	0	1	1	1	5	E	U	%	5		
0	1	1	0	0	0	6	F	V	&	6		
0	1	1	1	1	1	7	G	W	/	7		
1	0	0	0	0	0	8	H	X	(	8	
1	0	0	1	1	1	9	I	Y	)	9	
1	0	1	0	0	0	10	J	Z	*	:		
1	0	1	1	1	1	11	K	[+	;		
1	1	0	0	0	0	12	L	~	'	<		
1	1	0	1	1	1	13	M]	-	=		
1	1	1	0	0	0	14	N	{	.	>		
1	1	1	1	1	1	15	O	}	/	?		

ORDERING INFORMATION

DESCRIPTION

Display and Electronics (includes Bezel) (Equivalent to Burroughs SSD1000-0061) APD-016M040

Display and Electronics (includes Bezel) Data Entry is Left to Right (Equivalent to Burroughs SSD1000-0041) APD-016M040-1

Mating Connector 280498-01

PART NO.

MODEL APD-064M033

Plasma Panel Display Modules

64 Character Display with Drive Electronics and Controller, Serial and Parallel Versions

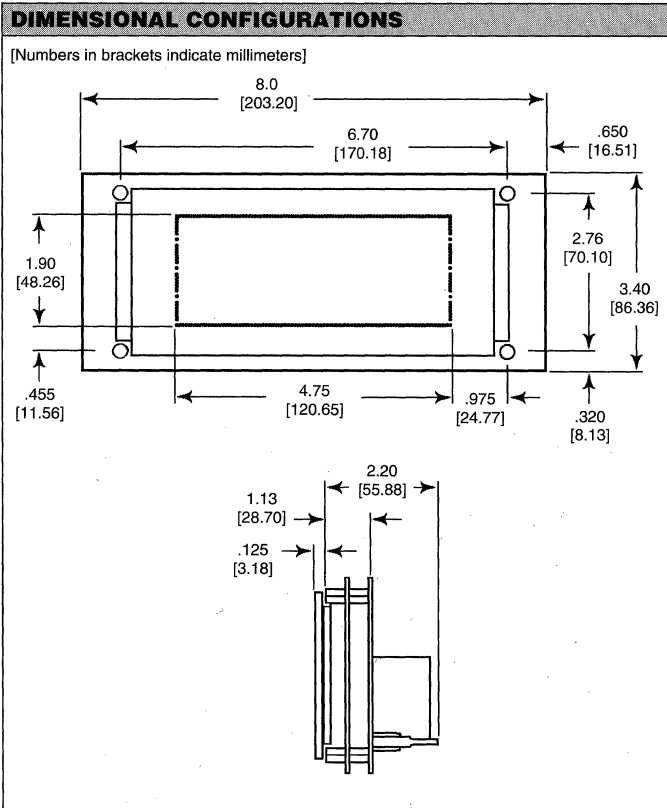


The APD-064M033 display module displays up to 64 alphanumeric 5 x 7 dot matrix characters arranged in 4 lines of 16 characters each. The module includes drive electronics, a controller consisting of refresh memory, character generator and control logic with ASCII input. Interfacing is very simple and requires minimum handshake to enable the module to serve as a cost effective direct readout device for many applications including POS terminals, industrial controls, computer peripherals, measurement instruments and office machines. Serial and parallel versions are available as well as single + 5 VDC power input.

STANDARD ELECTRICAL SPECIFICATIONS				
	MIN.	TYP.	MAX.	UNITS
Logic Supply Voltage	+ 4.75	+ 5.0	+ 5.25	V
Logic Supply Current	—	—	750	mA
Panel Supply Voltage	+175	+ 185	+195	V
Panel Supply Current	—	—	30	mA
(+ 5 VDC only option)				
Supply Voltage	+ 4.75	+ 5.0	+ 5.25	V
Supply Current	—	—	1.0	A

FEATURES

- 64 (4 x 16) alpha numeric characters (5 x 7 dot matrix)
- Only + 5 and + 185 VDC required (+ 5 volt only available)
- ASCII character set (optional character sets available)
- Parallel or serial interface
- Wide viewing angle (150°)
- Rugged design/slim profile
- Flicker free refresh, high speed data input
- High brightness
- Compatible with Babcock DP-0416-C1



ENVIRONMENTAL SPECIFICATIONS

Operating Temperature: 0°C to + 55°C.
Storage Temperature: - 55°C to + 85°C.
Relative Humidity: 10-90% R.H. non-condensing.
Mechanical Shock: 50G 1/2 sine wave, 11 msec duration, 5 shocks in each of 6 directions.
Vibration: .018" [.457] displacement amplitude from 10 to 50 Hz, 2G acceleration from 50 to 2000 Hz logarithmic sweep rate, along each side of the 3 major axes.

OPTICAL SPECIFICATIONS.

Viewing Area: 4.76" [120.90] W x 2.0" [50.80] H.
Number of Characters: 64.
Character Size: .330" [8.38] W x .230" [5.84] H.
Luminance: 80 foot lamberts.
Color: Neon orange.
Viewing Angle: 150° cone.

MODEL APD-064M033

GENERAL DESCRIPTION

The APD-064M033 plasma display module consists of a multiplexed DC plasma display, driver circuitry and a microprocessor-based controller board. The interface is a basic 8 bit parallel ASCII interface with handshaking and some dedicated control lines or a serial data interface which requires no handshaking. The EPROM based character generator is programmed with an ASCII character set but is easily configured for any character set. Dale's patented open construction display technology assures a stable, flicker free screen.

Parallel ASCII and cursor data are presented to the unit in negative logic convention and a separate strobe line for each determines which is entered. A single busy signal indicates to the host system when the display is busy. The logic input is one 74LS type input with a 4.75 kilohm to + 5 VDC and a 1000 pF capacitor to ground. The output is driven from a 74LS06 open collector gate and is not internally pulled up.

The serial interface is RS-232 compatible. Baud rate is 9600 (other baud rates can be supplied) and the data byte format is 8 data bits, 1 stop bit and no parity. The serial interface supports Reset, Backspace, Line Feed and Carriage Return in addition to Cursor Position selection.

INTERFACE SIGNAL DESCRIPTION

DB0-DB7 (Data bus) - Data bus to enter character and cursor data.

CUR-LD (Cursor Load) - The cursor is moved to the address given by DB0-DB7 where:
 00H = home position.
 0FH = last character position, 1st line.
 3FH = last character position, 4th line.

WR (Write) - The ASCII character, as defined by the code given by DB0-DB7, is displayed at the selected address. The display auto-increments from a given address.

BUSY (Busy Signal) - I/O is inhibited when busy is high.

PIN DESCRIPTION		
CONNECTOR	PIN	SIGNAL
J1	1, 3, 5, 7, 9, 11, 13, 15	DB0-DB7
	2	BUSY
	4	SERIAL DATA
	6, 8, 10, 12	GROUND (Data)
	14	WR
	16	CUR-LD
J2	1	+ 185 VDC
	2	GROUND (H)
	3	GROUND (L)
	4	+ 5 VDC
TB1	1	+ 185 VDC
	2	GROUND (L)
	3	SERIAL DATA
	4	GROUND (Data)
	5	+ 5 VDC
	6	GROUND (H)

WARNING: Wrong connections may cause permanent damage to the display and host system. When using APD-064M033-1 (+ 5 VDC only version), no connections must be made to pins 1, 2 of J2 and 1, 6 of TB1.

PARALLEL INPUT FUNCTION TABLE		
CUR-LD	WR	FUNCTION
L	H	Select a cursor address with DB0-DB7
H	L	DB0-DB7 ASCII character loaded at cursor address, increment address

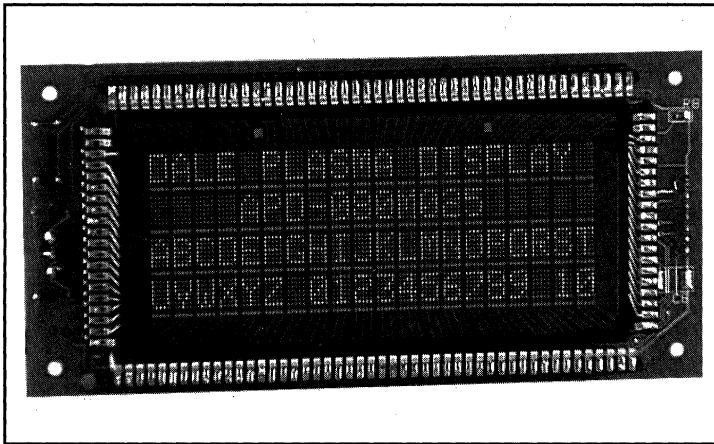
SERIAL DATA CONTROL CODES	
Reset	01H
Backspace	08H
Line Feed	0AH
Carriage Return	0DH
Load Cursor Position	1BH, XX (XX = cursor address)

ORDERING INFORMATION	
DESCRIPTION	PART NUMBER
PARALLEL VERSION, + 5, + 185 VDC INPUT	
Display, Drive Electronics and Controller	APD-064M033
SERIAL VERSION, + 5 VDC INPUT, 9600 BAUD	
Display, Drive Electronics and Controller	APD-064M033-1
J1 Data Connector Kit	280105-02
J2 Power Connector Kit	280108-06
Non-Glare Filter (amber circular polarized) - other filters available, contact factory	280109-15

MODEL APD-080M025-1

Plasma Panel Display Modules

80 Character Display with Drive Electronics, Controller and Serial Interface



The APD-080M025-1 display module displays up to 80 alphanumeric 5 x 7 dot matrix characters arranged in 4 lines of 20 characters each. The module includes drive electronics, a controller consisting of refresh memory, character generator and control logic with an RS-232 compatible ASCII input. Interface is through a single 3 pin power connector. Baud rate is selectable from 300 to 9600. Handshaking is not required as a 20 byte FIFO buffer is used to capture data when the display is busy. Applications include POS terminals, industrial controls, computer peripherals, measurement instruments and office machines.

STANDARD ELECTRICAL SPECIFICATIONS				
	MIN.	TYP.	MAX.	UNITS
Panel Supply Voltage	+ 4.75	+ 5.0	+ 5.25	V
Panel Supply Current	—	0.3	1.0	A

FEATURES

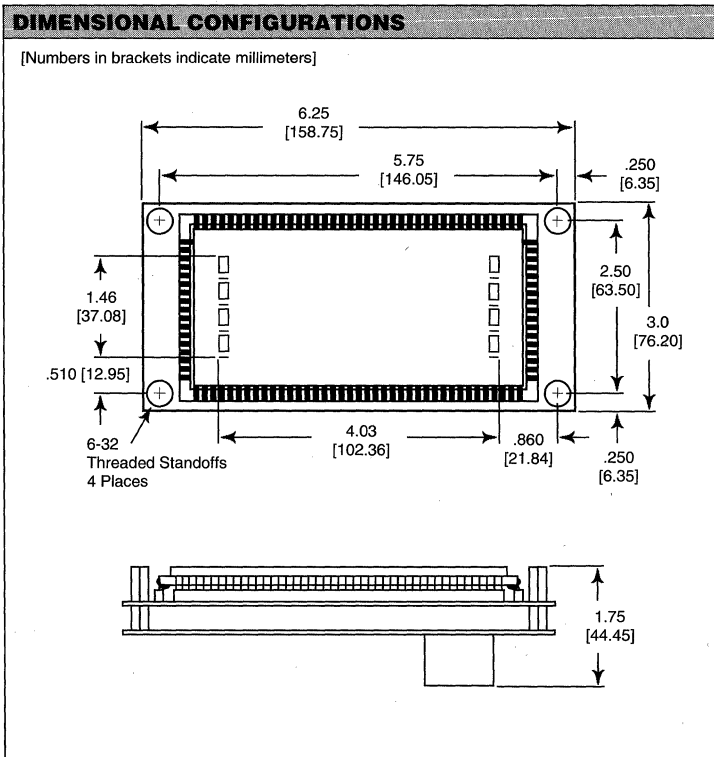
- 80 (4 x 20) alphanumeric characters (5 x 7 dot matrix) plus underbar
- Only + 5 VDC required
- ASCII character set (optional character sets available)
- Efficient serial interface (RS-232)
- Wide viewing angle (150°)
- Rugged design/slim profile
- Flicker free refresh, high speed data input
- High brightness

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature: 0°C to + 55°C.
Storage Temperature: - 55°C to + 85°C.
Relative Humidity: 10-90% R.H. non-condensing.
Mechanical Shock: 50G 1/2 sine wave, 11 msec duration, 5 shocks in each of 6 directions.
Vibration: .018" [.457] displacement amplitude from 10 to 50 Hz, 2G acceleration from 50 to 2000 Hz logarithmic sweep rate, along each side of the 3 major axes.

OPTICAL SPECIFICATIONS

Viewing Area: 4.03" [102.36] W x 1.46" [37.08] H.
Number of Characters: 80.
Character Size: .150" [3.81] W x .250" [6.35] H.
Luminance: 80 foot lamberts.
Color: Neon orange.
Viewing Angle: 150° cone.



MODEL APD-080M025-1

GENERAL DESCRIPTION

The APD-080M025-1 plasma display module consists of a multiplexed DC plasma display, drive circuitry and switching voltage converter mated with an intelligent, microprocessor-based controller board. The resulting assembly interfaces easily to microprocessor based systems and only requires readily available low voltages for power. Dale's patented open construction display technology assures a stable flicker free screen even at highest communication rates.

Interfacing is very simple (and requires no handshaking as a 20 byte FIFO buffer captures data when the display is busy) through a single 3 pin connector that has + 5 VDC, SERIAL (RS-232) DATA and GROUND connections.

An EPROM based character generator is factory programmed with 96 ASCII characters. Alternate character sets can be user or factory programmed.

Serial data protocol is 1 start bit, 8 data bits and no stop bit. Baud rate (300, 1200 or 9600) is selected with a control board jumper. A simplified command set allows quick and efficient code generation.

PIN DESCRIPTION	
PIN	SIGNAL
1	+ 5 VDC
2	SERIAL DATA
3	GROUND
WARNING: Wrong connections may cause permanent damage to the display and host system.	

COMMAND SET		
COMMAND	FUNCTION	CODE (HEX)
Backspace	Moves cursor left	08
Horizontal Tab	Moves cursor right	09
Vertical Tab	Moves cursor up one line	0B
Line Feed	Moves cursor down one line	0A
Carriage Return	Moves cursor to start of line	0D
Clear Screen	Screen cleared, cursor homed	0C
Cursor Home	Moves cursor to home position	0E
Position Cursor	Moves cursor to X-Y coord.	0F
Cursor Address		##
Cursor On	Cursor visible	06
Cursor Off	Cursor invisible	07
NOTE: All codes are in hexadecimal.		

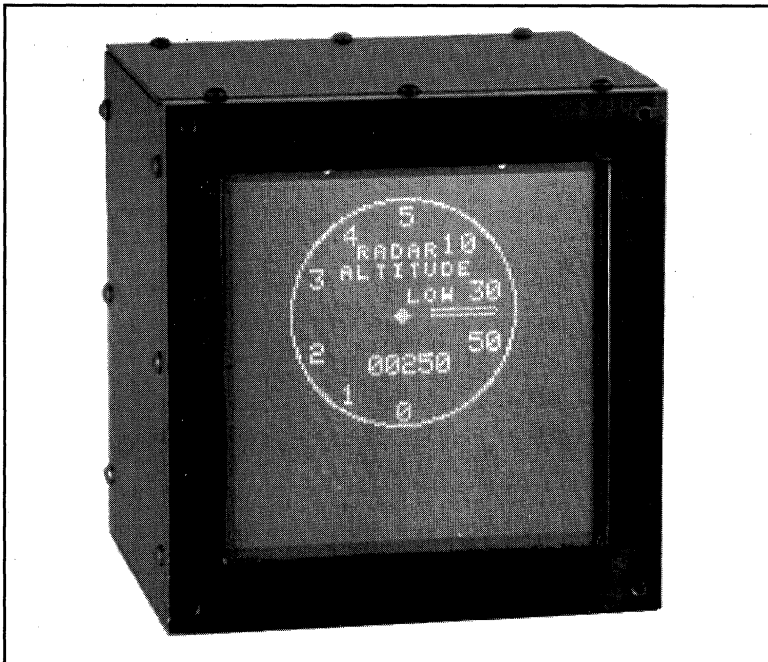
ASCII CHARACTER SET						
	32	48	64	80	96	112
0	SP	0	@	P	'	p
1	!	1	A	Q	a	q
2	"	2	B	R	b	r
3	#	3	C	S	c	s
4	\$	4	D	T	d	t
5	%	5	E	U	e	u
6	&	6	F	V	f	v
7	'	7	G	W	g	w
8	(	8	H	X	h	x
9	)	9	I	Y	i	y
10	*	:	J	Z	j	z
11	+	;	K	[	k	{
12	,	<	L	\	l	|
13	-	=	M	]	m	}
14	.	>	N	^	n	~
15	/	?	O	_	o	

ORDERING INFORMATION	
DESCRIPTION	PART NUMBER
Display, Drive Electronics and Controller	APD-080M025-1
Mating Connector Kit	280108-01
Non-Glare Filter (amber circular polarized) - other filters available - contact factory	280109-10

MODEL APD-128G128

Plasma Panel Display Modules

128 x 128 Graphics Display with Drive Electronics, Controller and Serial Interface



The APD-128G128 is a full field dot matrix display with 128 columns and 128 rows. It includes drive electronics, microprocessor based controller and enclosure. The controller maintains all the refresh memory, character generation and control logic to enable the module to serve as a direct readout device for many applications including communications terminals, computer readouts and microprocessor instruments. The controller interfaces via RS-232 at 9600 baud (other baud rates are available). A DC/DC converter is also included to develop the necessary panel voltage from + 12 VDC.

FEATURES

- 128 x 128 Full field dot matrix
- Text or graphics modes (12 rows of 16 characters in text mode)
- Flexible operating modes
- Serial (RS-232) interface
- All functions software accessible
- High brightness
- Wide viewing angle
- Low input voltage
- On-board diagnostics
- Software dimming
- Minimal footprint
- Highly ruggedized

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature: - 15°C to + 55°C
(Life may be shortened when subjected to extended operation below 0°C).

Storage Temperature: - 55°C to + 85°C.

Relative Humidity: 10-90% R.H. non-condensing.

Mechanical Shock: 50G 1/2 sine wave, 11 msec duration, 5 shocks in each of 6 directions.

Vibration: .018 [.46] displacement amplitude from 10 to 50 Hz, 2G acceleration from 50 to 2000 Hz logarithmic sweep rate, along each side of the 3 major axes.

OPTICAL SPECIFICATIONS

Viewing Area: 3.24" [82.30] W x 3.24" [82.30] H.

Pixel Size: .015" [0.30] diameter.

Pixel Pitch: .025" [0.64].

Luminance: 60-80 foot lamberts.

Color: Neon orange.

Viewing Angle: 120° vertical, 60° horizontal.

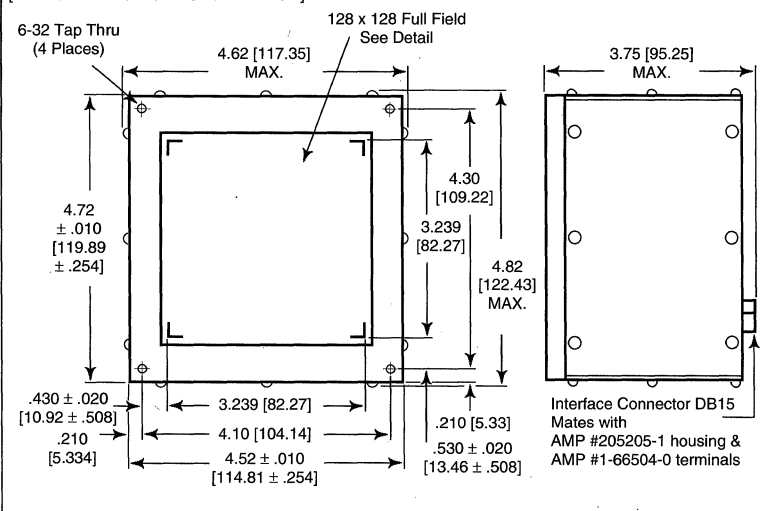
STANDARD ELECTRICAL SPECIFICATIONS

	MIN.	TYP.	MAX.	UNITS
Logic Supply Voltage	+ 4.75	+ 5.0	+ 5.25	V
Logic Supply Current	—	250	—	mA
Panel Supply Voltage	+ 11.4	+ 12.0	12.6	V
Panel Supply Current ⁽¹⁾	—	0.6	1.2	A

(1) This is the input to a DC/DC converter. There may be peak in-rush currents higher than shown.

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



MODEL APD-128G128

GENERAL DESCRIPTION

The APD-128G128 consists of a graphics DC plasma display panel, controller, DC/DC converter and enclosure.

The controller maintains all the refresh memory, character generation and control logic to enable the module to serve as a direct readout device for many applications including communications terminals, computer readouts and microprocessor instruments. It interfaces via RS-232 at 9600 baud.

Single byte and two byte commands allow simplified code generation, yet accomplish complex display tasking such as scrolling or inserting lines and characters. The character generator is a 8K x 8 bit EPROM with 256 characters consisting of 128 ASCII characters (including control codes) and 128 block graphics characters. Alternate character sets can be factory or user programmed. The dot pattern in text mode is 7 x 9 pixels in an 8 x 12 block. Two means of using graphics are supported.

The first is character graphics, in which the user sends the proper ASCII code to select the desired graphics character. The character graphics mode allows easy mixing of text and graphics images.

The second is the bit plot mode (using set and reset commands) which allows any graphic pattern to be drawn a bit at a time.

Character entry in bit mode allows for 5 x 7 ASCII characters to be placed at any given pixel location within the pixel map.

INTERFACING

SERIAL INTERFACE

(See pin descriptions.) The controller is considered to be a DTE type device and will operate with a host that is either a DTE or DCE device. The serial input and output lines meet RS-232C specifications. Serial data is entered asynchronously with a 9600 baud. The byte format is 1 start bit, 8 data bits and 1 stop bit.

ASCII CHARACTER SET						
	32	48	64	80	96	112
0	SP	0	@	P	'	p
1	!	1	A	Q	a	q
2	"	2	B	R	b	r
3	#	3	C	S	c	s
4	\$	4	D	T	d	t
5	%	5	E	U	e	u
6	&	6	F	V	f	v
7	'	7	G	W	g	w
8	(	8	H	X	h	x
9	)	9	I	Y	i	y
10	*	:	J	Z	j	z
11	+	;	K	[	k	{
12	,	<	L	\	l	|
13	-	=	M	]	m	}
14	.	>	N	^	n	~
15	/	?	O	_	o	

(Control codes not shown)

PIN DESCRIPTION	
PIN	SIGNAL
1	NC
2	TRANSMIT DATA
3	RECEIVE DATA
4	READY TO SEND
5	CLEAR TO SEND
6, 7	NC
8	+ 12 VDC
9, 10	+ 5 VDC
11, 12, 13	GND
14, 15	+ 12 VDC

(Interface connector mates with AMP #205205-1 housing and #1-66504-0 terminals.)

ABRIDGED FUNCTION SUMMARY		
CONTROL CODES	HEX	ASCII
Cursor Home	0E	CNTRL N
Carriage Return	0D	CNTRL M
Cursor Down (Line Feed)	0A	CNTRL J
Cursor Up	0B	CNTRL K
Cursor Right	09	CNTRL I
Cursor Left	08	CNTRL H
Alter Cursor Character Position	11	CNTRL Q
Cursor Character Address (0-1F)	##	
Alter Cursor Row Position	13	CNTRL S
Cursor Row Address (0-A)	##	
Cursor On	12	CNTRL R
Cursor Off	14	CNTRL T
Alter Cursor Format	15	CNTRL U
Cursor Format Code	##	
Full Block, no blink =	00	
Blinking underbar =	01	
Underbar, no blink =	03	
No Operation	00	CNTRL @
Clear Screen	0C	CNTRL L
Character Insert	0F	CNTRL O
Character Delete	10	CNTRL P
Line Insert	16	CNTRL V
Line Delete	17	CNTRL W

ESCAPE CONTROL CODES		
Erase to End of Line	1B, 0D	ESC CNTRL M
Erase to End of Screen	1B, 18	ESC CNTRL X
Erase Line	1B, 13	ESC CNTRL S
Erase Line and Carriage Return	1B, 25	ESC CNTRL %
Alter Brightness	1B, 0C	ESC CNTRL L
0 = Brightest	##	
7 = Dimmest		
Scroll	1B, 1A	ESC CNTRL Z
* End Scroll	1B, 20	ESC SPACE
Blank Display (saves screen data)	1B, 11	ESC CNTRL Q
Unblank Display (restores screen)	1B, 12	ESC CNTRL R
Enter Bit Plot Mode	1B, 16	ESC CNTRL V
* Exit Bit Plot Mode	1B, 17	ESC CNTRL W
Start Confidence Test	1B, 1F	ESC, CNTRL _
* Disable Confidence Test (any code)	##	
Character Blink	1B, 21	
Disable Character Blink	1B, 22	
Reset Controller (to initial state)	1B, 19	ESC CNTRL Y

* Indicates power-up condition

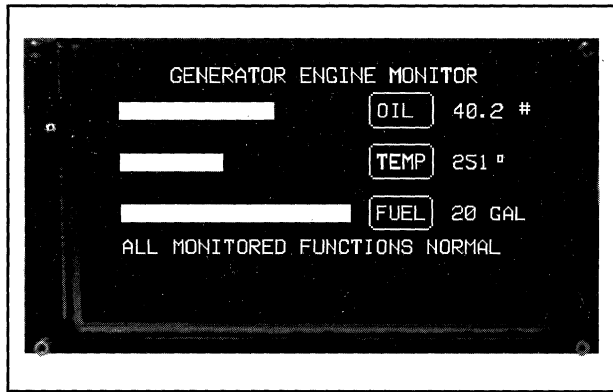
ORDERING INFORMATION	
DESCRIPTION	PART NUMBER
Display, Drive Electronics and Controller (Includes DC/DC converter)	APD-128G128
Non-Glare Filter (amber circular polarized) - other filters available - contact factory	280109-08

MODEL APD-192G088

Plasma Panel Display Modules

192 by 88 Graphics Display

with Drive Electronics and Controller



The APD-192G088 is a full field dot matrix display with 192 columns and 88 rows. It includes drive electronics and a microprocessor based controller. The controller maintains all the refresh memory, character generation and control logic with parallel or serial interface and a DC to DC converter to generate the necessary panel voltage. A touch panel version is also available (APD-192G088-5).

FEATURES

- 192 x 88 full field dot matrix
- Parallel and serial interfaces
- All functions software accessible
- Character and bit plot graphics
- Wide viewing angle
- High brightness
- Software dimming
- Low input voltage
- Compact size

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature: 0°C to +55°C.

Storage Temperature: -55°C to +85°C.

Relative Humidity: 10-90% R.H. non-condensing.

Mechanical Shock: 50G 1/2 sine wave, 11 msec duration, 5 shocks in each of 6 directions.

Vibration: .018" [.457] displacement amplitude from 10 to 50 Hz, 2G acceleration from 50 to 2000 Hz logarithmic sweep rate, along each side of the 3 major axes.

OPTICAL SPECIFICATIONS

Viewing Area: 7.66" [194.56] x 3.50" [88.90].

Pixel Size: .020" [.508].

Pixel Pitch: .040" [1.02].

Luminance: 80 foot lamberts.

Color: Neon orange.

Viewing Angle: 150° cone.

GENERAL DESCRIPTION

The APD-192G088 consists of a DC plasma graphics display panel, drive circuitry and controller.

The controller maintains all the refresh memory, character generation and control logic to enable the module to serve as a direct readout device for communications terminals, computer readouts, microprocessor instruments, or any other system requiring a self-contained readout. It is programmable to operate in a parallel or serial mode.

The parallel interface is a basic 8 bit parallel interface with handshaking and some dedicated control lines. The serial interface is RS-232C compatible with 8 selectable baud rates (from 150 - 19,200).

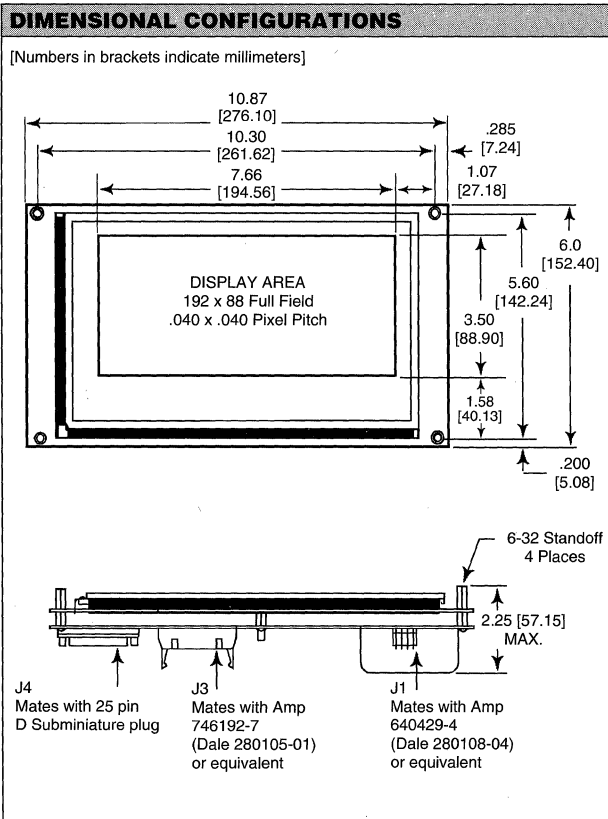
Single byte and two byte commands allow simplified code generation, yet accomplish complex display tasking such as scrolling or inserting lines and characters. The character generator is a 4K x 8 bit EPROM with 256 characters consisting of 128 ASCII characters (including control codes) and 128 block graphics characters. The character set can be factory or user modified.

Two means of using graphics are supported - character graphics, in which the user sends the proper ASCII code to select the desired graphics character, or the bit plot mode. The character graphics mode allows easy mixing of text and graphics images and the bit plot mode (using set and reset commands) allows any graphic pattern to be drawn a bit at a time.

A DC/DC converter generates the required display voltages from +12 VDC and all input lines are LSTTL compatible with 4.7 kilohm pull-up resistors to Vcc.

STANDARD ELECTRICAL SPECIFICATIONS				
	MIN.	TYP.	MAX.	UNITS
Logic Supply Voltage	+ 4.75	+ 5.0	+ 5.25	V
Logic Supply Current	—	700.0	—	mA
Panel Supply Voltage	+ 11.4	+ 12.0	+ 12.6	V
Panel Supply Current *	—	1.0	2.2	A
Logic One Voltage	2.0	—	—	V
Logic Zero Voltage	—	—	0.8	V
Logic Zero Input Current	—	—	- 0.4	mA

* This is the input to a DC/DC converter. There may be peak in-rush currents higher than shown.



MODEL APD-192G088

INTERFACING

PARALLEL INTERFACE

The parallel interface offers two forms of hand-shaking called Ready and Data Taken. Each 8 bit word appearing on the data bus is latched with the falling edge of the Data Strobe pulse.

This same negative transition notifies the on-board processor that data has been entered. The Ready signal then goes low and the Data Taken signal goes low momentarily. The Ready signal remains low until the command is completed or the data has been entered. The Data Taken pulse is normally 800 nanoseconds long and indicates when the on-board processor has read the input latch. Data may be entered into the input latch after the rising edge of Data Taken.

SERIAL RS-232C INTERFACE

(See J4 pin descriptions.) The controller is considered to be a DTE type device and will operate with a host that is either a DTE or DCE type device. The serial input and output lines meet RS-232C specifications. Serial data is entered asynchronously with selectable baud rates. The byte format is 1 start bit, 8 data bits and 1 stop bit.

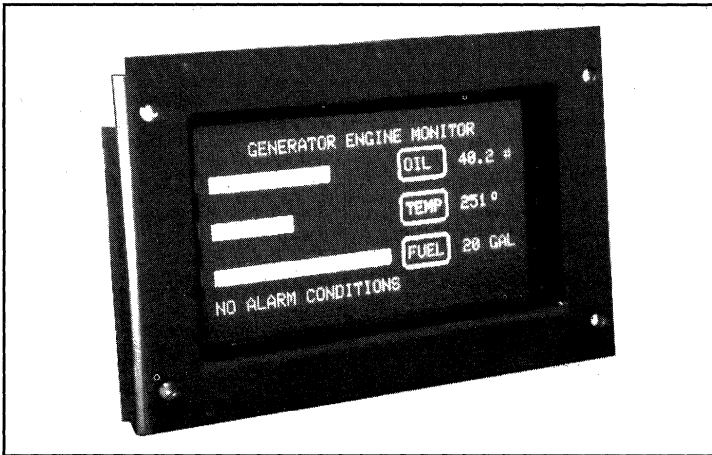
ABRIDGED FUNCTION SUMMARY		
CONTROL CODES	HEX	ASCII
Cursor Home	0E	CNTRL N
Carriage Return	0D	CNTRL M
Cursor Down (Line Feed)	0A	CNTRL J
Cursor Up	0B	CNTRL K
Cursor Right	09	CNTRL I
Cursor Left	08	CNTRL H
Alter Cursor Character Position	11	CNTRL Q
Cursor Character Address (0-1F)	##	
Alter Cursor Row Position	13	CNTRL S
Cursor Row Address (0-A)	##	
Cursor On	12	CNTRL R
Cursor Off	14	CNTRL T
Clear Screen	0C	CNTRL L
Character Insert	0F	CNTRL O
Character Delete	10	CNTRL P
Line Insert	16	CNTRL V
Line Delete	17	CNTRL W
ESCAPE CONTROL CODES		
Erase to End of Line	1B,0D	ESC CNTRL M
Erase to End of Screen	1B,18	ESC CNTRL X
Erase Line	1B,13	ESC CNTRL S
Erase Line and Carriage Return	1B,25	ESC SHIFT %
Alter Brightness	1B,0C	ESC CNTRL L
0 = Brightest	##	
7 = Dimmest		
Scroll	1B,1A	ESC CNTRL Z
* End Scroll	1B,20	ESC SPACE
Blank Display (on/off alternately)	1B,11	ESC CNTRL Q
Enter Bit Plot Mode	1B,16	ESC CNTRL V
* Exit Bit Plot Mode	1B,17	ESC CNTRL W
Reset Controller (to initial state)	1B,19	ESC CNTRL Y
* Indicates power up condition.		

PIN DESCRIPTION			
CONNECTOR	PIN	SIGNAL	DESCRIPTION
J1	1	+ 12 VDC	Panel supply voltage.
	2	+ 5 VDC	Logic supply voltage.
	3	GND	Ground.
	4	NC	No Connection.
J3	1,2,4,5,7,6,3,9	DB7-DB0	Data bus lines used to transfer data and commands to display.
	13	READY	Used to monitor the display's activity. A logic 0 indicates that the display is busy and cannot respond to new data.
	15	DATA STROBE	Used to notify the display that valid data is present on the data bus. The data byte is loaded with the falling edge of DATA STROBE.
	17	DATA TAKEN	This output goes to logic 0 for approximately 800 nsec when the display has accepted the input data byte after DATA STROBE goes low. New data may be presented coincident with the leading edge of this signal.
	22	SYSTEM SELECT	Used as a unique unit select input. A logic 0 on this line disables the DATA STROBE input.
	10	CURSOR DISABLE	A logic 1 will disable the visual cursor. (This can also be accomplished with a data bus command.)
	16	INITIALIZE	Serves as a display reset. A logic 0 will initialize the controller to its power up state.
	12	RESERVED	This pin is to be left unconnected.
	25,26	+ 5 VDC	Logic supply voltage.
	19,20	GND	Ground.
J4	3	RECEIVE DATA	The display receives data on this pin. (The signal originates at the DCE device transmit pin 2.)
	2	TRANSMIT DATA	The display transmits received data on this pin. (The signal originates at the DCE device receive pin 3.)
	4	READY TO SEND	This pin will be low when the display is busy and cannot accept new data. (This pin is connected to pin 5 of the DCE device.)
	7	GND	Signal ground (required).
	(Pins 6, 8, and 20 of J4 are connected together internally.)		
NOTE: Unidentified pins are not connected.			
WARNING: Wrong connections or reversing J3 may cause permanent damage to the display and host interface.			

ORDERING INFORMATION	
DESCRIPTION	PART NUMBER
Display, Drive Electronics, Controller Board (Includes DC/DC converter)	APD-192G088
Parallel Data Connector Kit.....	280105-01
Power Connector Kit	280108-04
Non-Glare Filter (amber circular polarized) - other filters available - contact factory	280109-06

MODEL APD-192G088-5 Plasma Panel Display Modules

192 by 88 Graphics Display, Drive Electronics Controller, and Infrared Touch Screen



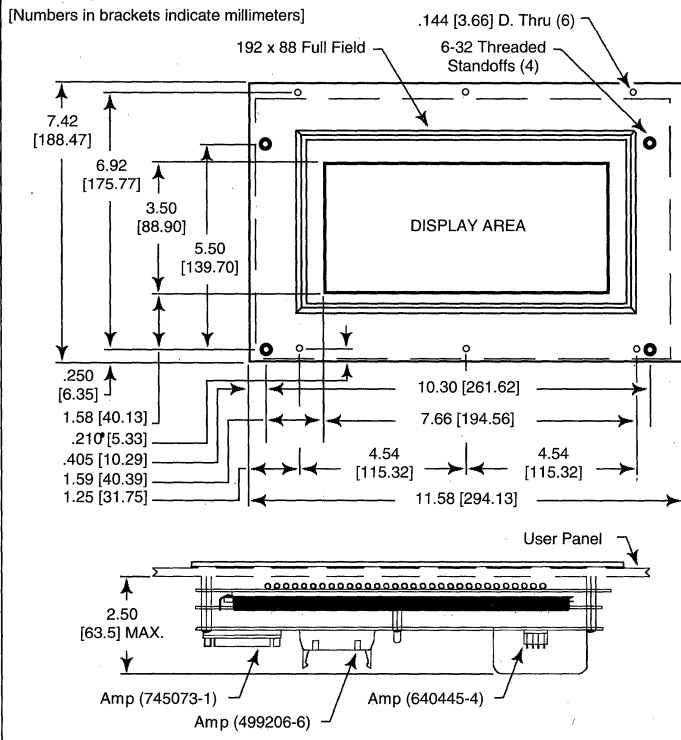
The APD-192G088-5 is a full field dot matrix display with 192 columns and 88 rows. It includes drive electronics, microprocessor based controller, IR touch panel and bezel. The controller maintains all the refresh memory, character generation, touch input and control logic to enable the module to serve as a direct input/output device for communications terminals, computer readouts, microprocessor instruments or any other system requiring a self-contained input/output terminal. It also controls the report of touch point coordinates from the touch panel to the host computer.

STANDARD ELECTRICAL SPECIFICATIONS

	MIN.	TYP.	MAX.	UNITS
Logic Supply Voltage	+ 4.75	+ 5.0	+ 5.25	V
Logic Supply Current	—	700	—	mA
Panel Supply Voltage	+ 11.4	+12.0	12.6	V
Panel Supply Current*	—	1.0	2.2	A
Logic One Voltage	2.0	—	—	V
Logic Zero Voltage	—	—	0.8	V
Logic Zero Input Current	—	—	- 0.4	mA

* This is the input to a DC/DC converter. There may be peak in-rush currents higher than shown.

DIMENSIONAL CONFIGURATIONS



FEATURES

- 192 x 88 full field dot matrix
- Text or graphics modes
(11 rows of 32 characters in text mode)
- Infrared touch panel
- 63 x 31 touch point format
- Flexible operating modes
- All functions software accessible
- High brightness
- Wide viewing angle
- Low input voltage
- Parallel and serial interfaces

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature: 0°C to + 55°C.

Storage Temperature: - 55°C to + 85°C.

Relative Humidity: 10-90% R.H. non-condensing.

Mechanical Shock: 50G 1/2 sine wave, 11 msec duration, 5 shocks in each of 6 directions.

Vibration: .018" [.457] displacement amplitude from 10 to 50 Hz, 2G acceleration from 50 to 2000 Hz logarithmic sweep rate, along each side of the 3 major axes.

OPTICAL SPECIFICATIONS

Viewing Area: 7.66" [194.56] W x 3.50" [88.90] H.

Pixel Size: .020" [.508].

Pixel Pitch: .040" [1.02].

Luminance: 80 foot lamberts.

Color: Neon orange.

Viewing Angle: 120° cone.

IR Beams: 32 on X axis, 16 on Y axis.

MODEL APD-192G088-5

GENERAL DESCRIPTION

The APD-192G088-5 consists of a graphics DC plasma display panel, IR touch screen, controller and bezel.

The controller maintains all the refresh memory, character generation, touch panel operation and control logic to enable the module to serve as a direct I/O device for communications terminals, computer readouts, microprocessor instruments or any other system requiring a self-contained terminal. It is programmable to operate in a parallel or RS-232C compatible serial mode with 7 selectable baud rates from 300 to 19,200.

Single byte and two byte commands allow simplified code generation, yet accomplish complex display tasking such as scrolling or inserting lines and characters. The character generator is a 4K x 8 bit EPROM with 256 characters consisting of 128 ASCII characters (including control codes) and 128 block graphics characters. The character set can be factory or user modified.

Two means of using graphics are supported - character graphics, in which the user sends the proper ASCII code to select the desired graphics character or the bit plot mode. The character graphics mode allows easy mixing of text and graphic images and the bit plot mode (using set and reset commands) allows any graphic pattern to be drawn a bit at a time.

The infrared touch screen consists of IR LEDs and detectors arranged to provide a grid of infrared light beams across the face of the display. If an object is present, then an intersecting pair of beams will be blocked and the controller will determine the coordinates of that point and report it to the host computer. Using simple input commands, the touch screen can be configured to report coordinates when a stylus is entered into the touch panel, when it is removed or continuously. Other commands are provided to allow control over the flow of touch point coordinates between the touch panel and the host computer.

A DC/DC converter generates the required display voltage from + 12 VDC and all input lines are LSTTL compatible with 4.7 kilohm pull-up resistors to Vcc.

INTERFACING

PARALLEL INTERFACE

The parallel interface offers two forms of handshaking called READY and DATA TAKEN. Each 8 bit word appearing on the data bus is latched with the falling edge of the DATA STROBE pulse.

This same negative transition notifies the on-board processor that data has been entered. The READY signal then goes low and the DATA TAKEN signal goes low momentarily. The READY signal remains low until the command is completed or the data has been entered. The DATA TAKEN pulse indicates when the on-board processor has read the input latch. Data may be entered into the input latch after the rising edge of DATA TAKEN.

SERIAL RS-232C INTERFACE

(See J4 pin descriptions.) The controller is considered to be a DTE type device and will operate with a host that is either a DTE or DCE device. The serial input and output lines meet RS-232C specifications. Serial data is entered asynchronously with selectable baud rates. The byte format is 1 start bit, 8 data bits and 1 stop bit.

TOUCH SCREEN COMMANDS	
COMMAND	CODE (HEX)
Enable Exit Point Mode	20
* Disable Exit Point Mode	21
Enable Enter Point Mode	22
* Disable Enter Point Mode	23
Enable Continuous Mode	24
* Disable Continuous Mode	25
Enable Touch Screen	27
Request Failed Beam Report	28
Enable Report Transfer	29
* Disable Report Transfer	2A
Request Report	2B
* Indicates default condition.	
NOTE: All touch screen commands are preceded by 18.	

ABRIDGED FUNCTION SUMMARY		
CONTROL CODES	HEX	ASCII
Cursor Home	0E	CNTRL N
Carriage Return	0D	CNTRL M
Cursor Down (Line Feed)	0A	CNTRL J
Cursor Up	0B	CNTRL K
Cursor Right	09	CNTRL I
Cursor Left	08	CNTRL H
Alter Cursor Character Position	11	CNTRL Q
Cursor Character Address (0-1F)	##	
Alter Cursor Row Position	13	CNTRL S
Cursor Row Address (0-A)	##	
Cursor On	12	CNTRL R
Cursor Off	14	CNTRL T
Clear Screen	0C	CNTRL L
Character Insert	0F	CNTRL O
Character Delete	10	CNTRL P
Line Insert	16	CNTRL V
Line Delete	17	CNTRL W
ESCAPE CONTROL CODES		
Erase to End of Line	1B,0D	ESC CNTRL M
Erase to End of Screen	1B,18	ESC CNTRL X
Erase Line	1B,13	ESC CNTRL S
Erase Line and Carriage Return	1B,25	ESC CNTRL %
Alter Brightness	1B,0C	ESC CNTRL L
0 = Brightest	##	
7 = Dimmest		
Scroll	1B,1A	ESC CNTRL Z
* End Scroll	1B,20	ESC SPACE
Blank Display (on/off alternately)	1B,11	ESC CNTRL Q
Enter Bit Plot Mode	1B,16	ESC CNTRL V
* Exit Bit Plot Controller	1B,17	ESC CNTRL W
Reset Controller (to initial state)	1B,19	ESC CNTRL Y

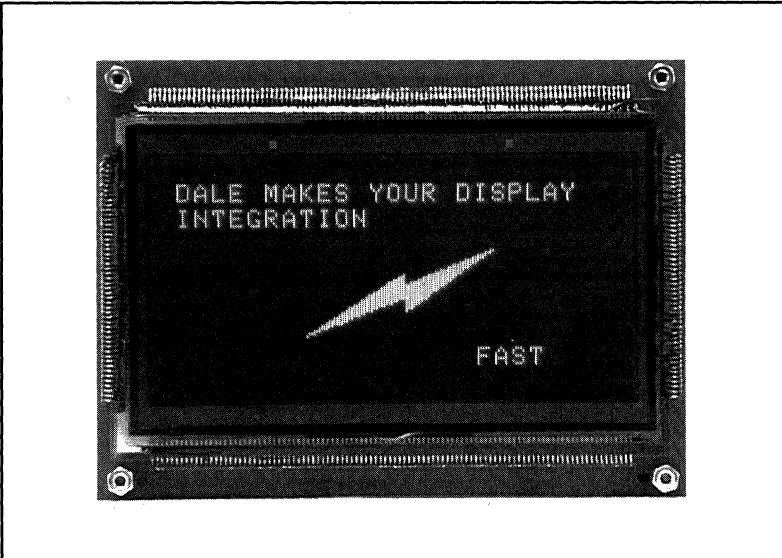
PIN DESCRIPTION		
CONNECTOR	PIN	SIGNAL
J1	1	+ 12 VDC
	2	+ 5 VDC
	3	GND
	4	NC
J3	1, 2, 4, 5, 7, 6, 3, 9	DB7-DB0
	13	READY
	15	DATA STROBE
	17	DATA TAKEN
	22	SYSTEM SELECT
	10	CURSOR DISABLE
	16	INITIALIZE
	12	RESERVED
	25, 26	+ 5 VDC
	19, 20	GND
J4	3	RECEIVE DATA
	2	TRANSMIT DATA
	4	READY TO SEND
	5	CLEAR TO SEND
	7	GND
(Pins 6, 8 and 20 of J4 are connected together internally.)		
NOTE: Unidentified pins are not connected.		
WARNING: Wrong connections or reversing J3 may cause permanent damage to the display.		

ORDERING INFORMATION	
DESCRIPTION	PART NUMBER
Display, Drive Electronics, plus Controller, Touch Screen and Bezel (Includes DC/DC Converter)	APD-192G088-5
Parallel Data Connector Kit	280105-01
Power Connector Kit	280108-04

MODEL APD-192G096

Plasma Panel Display Modules

192 x 96 Graphics Display with Drive Electronics, Controller and Serial Interface



The APD-192G096 is a full field dot matrix display with 192 columns and 96 rows. It includes drive electronics and a micro-processor based controller consisting of refresh memory, character generator and control logic. Interface is via RS-232 that allows for efficient handshaking and data protocol for bi-directional data interface with selectable baud rates from 150 to 19,200. A DC/DC converter is also included to develop the necessary panel voltage. Applications include POS terminals, industrial controls, computer peripherals, measurement instruments and office machines.

STANDARD ELECTRICAL SPECIFICATIONS

	MIN.	TYP.	MAX.	UNITS
Supply Voltage	4.75	5.0	5.25	V
Supply Current	—	1.0	2.5	A

FEATURES

- 192 x 96 full field dot matrix
- Text or graphics modes (8 rows of 32 characters in text mode)
- Only + 5 VDC required
- Very compact size
- Wide Viewing angle (150°)
- Flicker free refresh
- Editing functions
- High brightness

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature: 0°C to + 55°C.

Storage Temperature: - 55°C to + 85°C.

Relative Humidity: 10-90% R.H. non-condensing.

Mechanical Shock: 50G 1/2 sine wave, 11 msec duration, 5 shocks in each of 6 directions.

Vibration: .018 [.46] displacement amplitude from 10 to 50 Hz, 2G acceleration from 50 to 2000 Hz logarithmic sweep rate, along each side of the 3 major axes.

OPTICAL SPECIFICATIONS

Viewing Area: 4.966" [126.14] W x 2.470" [62.74] H.

Pixel Size: 0.017 [0.43] square.

Pixel Pitch: 0.026 [0.66].

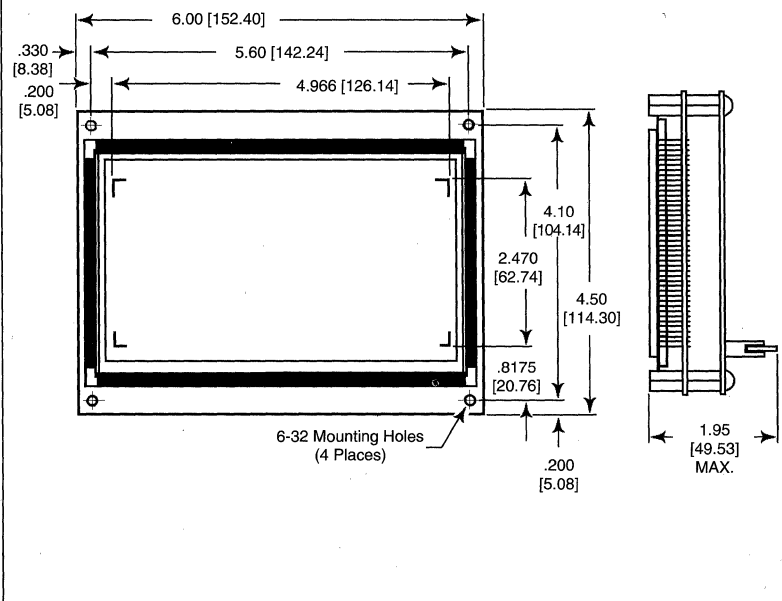
Luminance: 70 foot lamberts.

Color: Neon orange.

Viewing Angle: 150° cone.

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



MODEL APD-192G096

GENERAL DESCRIPTION

The APD-192G096 consists of a graphics DC plasma display panel, controller and DC/DC converter.

The controller maintains all the refresh memory, character generation and control logic to enable the module to serve as a direct readout device for many applications including POS terminals, industrial controls and microprocessor instruments. Single byte, two and three byte commands allow simplified code generation, yet accomplish complex display tasking such as scrolling or inserting lines and characters. An EPROM based character generator is easily configured for any character set, but comes standard with three variations of international fonts (Standard International, International plus Kata-kana and International plus Russian) and 128 block graphics characters. Alternate character sets can be factory or user programmed. The pixel pattern in text mode is 5 x 7 pixels in an 6 x 12 block. Two means of using graphics are supported. The first is character graphics, in which the user sends the proper ASCII code to select the desired graphics character. The character graphics mode allows easy mixing of text and graphics images. The second is the bit plot mode (using set and reset commands) which allows any graphic pattern to be drawn a bit at a time. Character entry in bit mode allows for 5 x 7 ASCII characters to be placed at any given pixel location within the pixel map.

A FIFO buffer is used to capture incoming data in the event the display's microprocessor is busy with a length command. Handshaking is suggested when operating in the graphics mode. The data format is 1 start bit, 8 data bits and 1 stop bit.

OPERATING MODE DESCRIPTION

DC1 - (Overwrite Mode) The cursor advances automatically when character data is written. If it is at the last column in a row, it shifts to the first column of the next row.

DC2 - (Vertical Scroll Mode) The cursor advances automatically when character data is written. If it is at the last column of the last row, all screen characters shift upwards one row, pushing the top row off the screen. The bottom row is cleared and the cursor is placed at the first column of the last row.

PIN DESCRIPTION	
PIN	SIGNAL
1, 2	+ 5 VDC
7	BELL
3, 4	GROUND
8	N/C
5, 6	+ 5 VDC
11	TXD
12	CTS
13, 14	N/C
15, 16	GROUND
9	RXD
10	RTS

COMMAND SUMMARY		
CONTROL COMMANDS	CODE (HEX)	TIMING
No Operation	00	40 µS
* Clear Screen	01	6.0 mS
* Fill Screen with Following Data	02	6.0 mS
* Graphics Character Write	03	600 µS
* Pixel Set	04	280 µS
* Pixel Reset	05	280 µS
No Operation	06	40 µS
No Operation	07	40 µS
Cursor Left	08	210 µS
Cursor Right	09	210 µS
Cursor Down	0A	210 µS
Cursor Up	0B	210 µS
Clear Screen, Home Cursor	0C	6.4 mS
Carriage Return	0D	210 µS
Home Cursor	0E	210 µS
Insert Character	0F	1.2 mS
Delete Character	10	1.2 mS
Re-position Cursor Column	11	190 µS
Cursor Select, Data Byte	12	190 µS
Re-position Cursor Row	13	190 µS
Character Generator Select	14	190 µS
Erase Line/Carriage Return	15	650 µS
Insert Line	16	2.2 mS
Delete Line	17	2.2 mS
Select Text Mode	18	110 µS
Select Graphics Mode	19	110 µS
No Operation	1A	40 µS
No Operation	1B	40 µS
Set to DC1 (Overwrite) Mode	1C	90 µS
Set to DC2 (Vertical Scroll) Mode	1D	90 µS
Blank Display (Data Saved)	1E	120 µS
Unblank Display (Restores Screen)	1F	120 µS

* These commands are only valid if the graphics mode has been selected. When graphics mode is selected, text commands are invalid.

ORDERING INFORMATION

DESCRIPTION	PART NUMBER
Display, Drive Electronics and Controller	APD-192G096
Mating Connector	280105-02
Non-Glare Filter (amber circular polarized) - other filters available, contact factory	280109-16

MODEL APD-222G007

Plasma Panel Display Modules

222 x 7 Graphics Display with Drive Electronics

Up to 37 Characters in Text Mode



The APD-222G007 is a full field dot matrix display with 222 columns and 7 rows of pixels. It can display 1 row of 32 characters (with 2 blank columns between characters) or 1 row of 37 characters with 1 blank column between characters. It includes the display, drive electronics, bezel and contrast enhancement filter. The superior esthetics of a plasma display combined with a package that conserves front panel area enables this module to serve as an output device for many applications including automatic teller machines, point of sale systems and microprocessor instruments.

STANDARD ELECTRICAL SPECIFICATIONS				
	MIN.	TYP.	MAX.	UNITS
Logic Supply Voltage	+ 4.75	+ 5.0	+ 5.25	V
Logic Supply Current	—	—	230	mA
Panel Supply Voltage	237.5	250.0	262.5	V
Panel Supply Current	—	—	35	mA
Logic One Voltage	2.0	—	—	V
Logic Zero Voltage	—	—	0.8	V
Logic Zero Input Current	—	—	- 17.2	mA

FEATURES

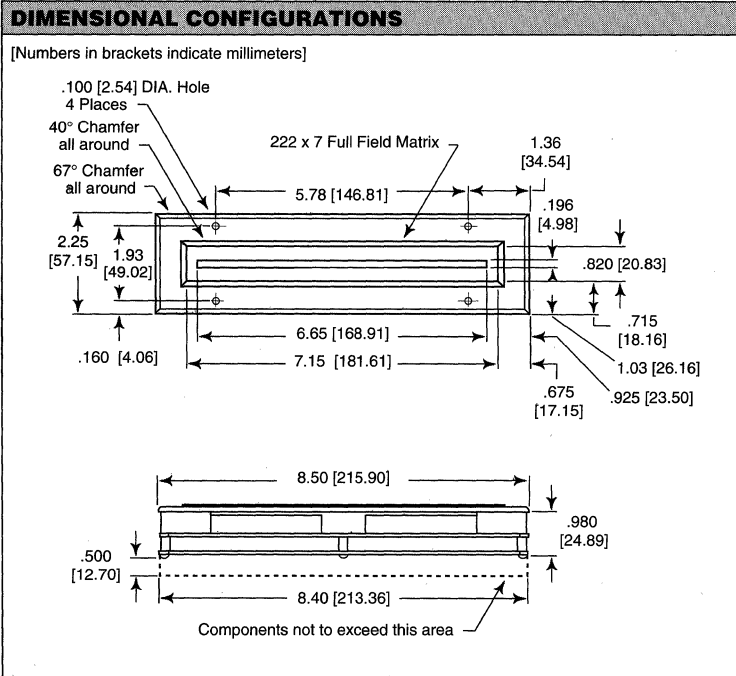
- 32 or 37 alphanumeric characters (5 x 7 dot matrix) or 222 x 7 graphics format
- Bezel and filter included
- Wide viewing angle (150°)
- Compact size
- Replacement for Burroughs SSD0132-0039

OPTICAL SPECIFICATIONS

- Viewing Area:** 6.65" [168.91] W x .196" [4.98] H.
- Pixel Size:** .019" [.483] W x .016" [.406] H.
- Pixel Pitch:** .030" [.762].
- Luminance:** 60 foot lamberts.
- Color:** Neon orange.
- Viewing Angle:** 150° cone.

ENVIRONMENTAL SPECIFICATIONS

- Operating Temperature:** 0°C to + 55°C.
- Storage Temperature:** - 55°C to + 85°C.
- Relative Humidity:** 10-90% R.H. non-condensing.
- Mechanical Shock:** 50G 1/2 sine wave, 11 msec duration, 5 shocks in each of 6 directions.
- Vibration:** .018" [.457] displacement amplitude from 10 to 50 Hz, 2G acceleration from 50 to 2000 Hz logarithmic sweep rate, along each side of the 3 major axes.



MODEL APD-222G007

GENERAL DESCRIPTION

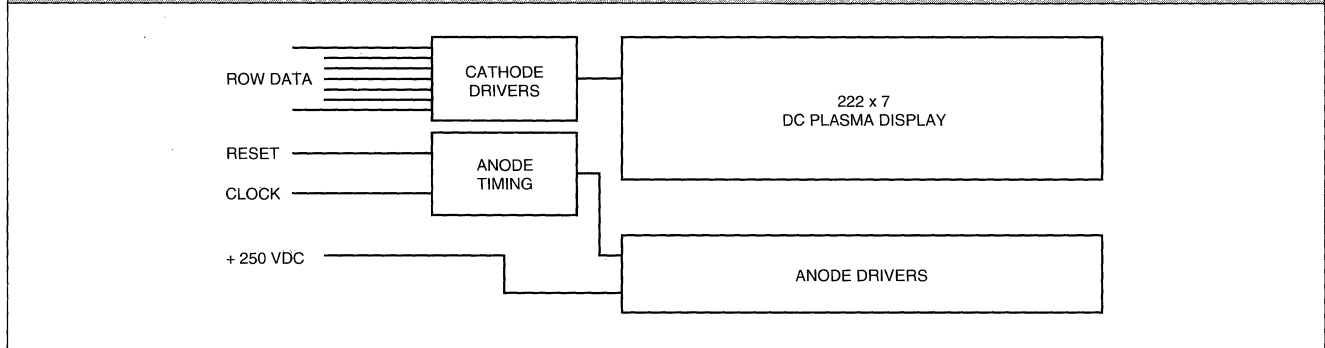
The APD-222G007 consists of a DC plasma display panel, drive electronics and bezel and is designed for a direct replacement of Burroughs type SSD0132-0039 display modules.

The display tube has 222 columns and 7 rows, which allows display of any dot matrix information presentable in 222 columns by 7 rows of dots. The display operates by scanning one column at a time (for each clock pulse input). At the end of the 222nd clock period, a reset pulse must be applied to reset the display and start a new scan at column 1. The scanning is done at 70-80 Hz so the display characters do not flicker. Dot matrix information is presented to the 7 data input lines column by column. To display information in any specified column, clock pulses must be counted starting with the first clock pulse after reset. Each clock pulse equals one column "on" time; thus, the number of clock pulses equals the column which is being scanned. A logical 0 at any data input lights a pixel. The data inputs must be held in the logic 1 state for 15 microseconds after each negative clock transition and during the entire reset period. Input data must be present for the entire "on" time of the displayed column.

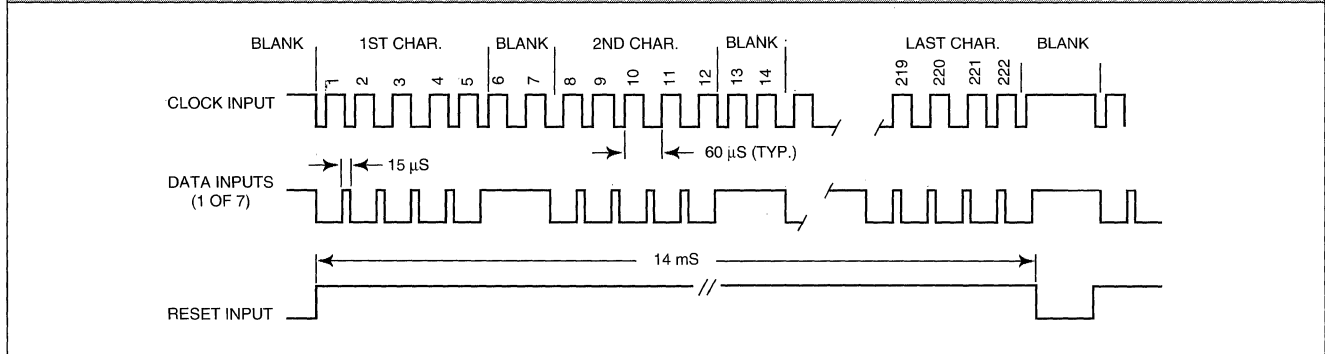
PIN DESCRIPTION	
PIN	SIGNAL
1	N/C
2	N/C
3	N/C
4	ROW 1 DATA
5	ROW 3 DATA
6	ROW 5 DATA
7	ROW 6 DATA
8	N/C
10	N/C
11	N/C
12	+ 250 VDC
A	N/C
B	N/C
C	N/C
D	N/C
E	ROW 2 DATA
F	ROW 4 DATA
H	ROW 7 DATA
J	N/C
K	CLOCK
L	+ 5 VDC
M	RESET
N	GROUND

Polarizing key between pins 7 and 8.

BLOCK DIAGRAM



TIMING DIAGRAM (32 CHARACTER)



ORDERING INFORMATION

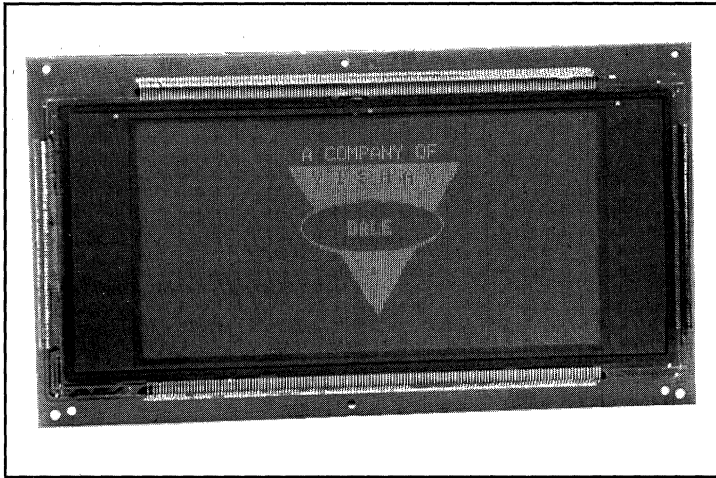
DESCRIPTION	PART NUMBER
Display, Drive Electronics and Bezel	APD-222G007
Mating Connector	280498-01

MODEL APD-240G120

Plasma Panel Display Modules

240 x 120 Graphics Display

with Drive Electronics and Controller



The APD-240G120 is a full field dot matrix display with 240 columns and 120 rows. It includes drive electronics, and a microprocessor based ASCII and VT-100 compatible controller consisting of refresh memory, character generator and control logic with parallel or serial interface and a DC to DC converter to generate the necessary panel voltage. When used in the text mode the module will display 12 lines by 40 characters. Applications include POS terminals, industrial controls, computer peripherals, measurement instruments and office machines.

A touch panel version is also available (APD-240G120-5).

STANDARD ELECTRICAL SPECIFICATIONS

	MIN.	TYP.	MAX.	UNITS
Logic Supply Voltage	4.75	5.0	5.25	V
Logic Supply Current	—	0.4	—	A
Panel Supply Voltage	9.5	12.0	28.5	V
Panel Supply Current *	—	0.8	3.0	A

* At 12.0 volt input.

FEATURES

- 240 x 120 full field dot matrix
- Text or graphics modes (12 rows of 40 characters in text mode)
- Only +5 and +12 VDC required
- Parallel or RS-232/422 serial interface
- VT-100 compatible
- Powerful software commands
- International character sets
- ISA graphics line drawing character set
- Wide viewing angle (150°)
- Flicker free refresh
- Editing functions
- High brightness

ENVIRONMENTAL SPECIFICATIONS

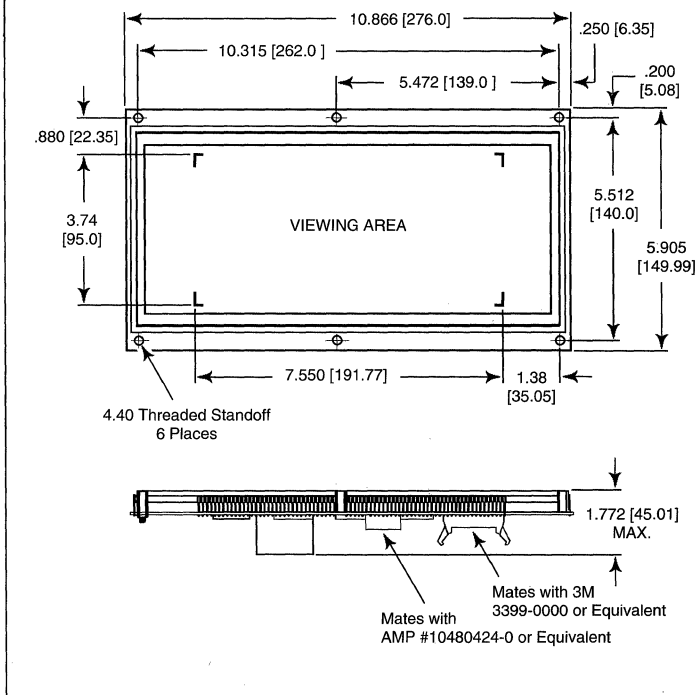
Operating Temperature: 0°C to +55°C.
Storage Temperature: -55°C to +85°C.
Relative Humidity: 10-90% R.H. non-condensing.
Mechanical Shock: 50G 1/2 sine wave, 11 msec duration, 5 shocks in each of 6 directions.
Vibration: .018 [.46] displacement amplitude from 10 to 50 Hz, 2G acceleration from 50 to 2000 Hz logarithmic sweep rate, along each side of the 3 major axes.

OPTICAL SPECIFICATIONS

Viewing Area: 7.550" [191.77] W x 3.740" [95.00] H.
Pixel Size: 0.020 [0.508] diameter.
Pixel Pitch: 0.031 [0.787].
Luminance: 60 foot lamberts.
Color: Neon orange.
Viewing Angle: 150° cone.

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



MODEL APD-240G120

GENERAL DESCRIPTION

The APD-240G120 consists of a graphics DC plasma display panel, controller and DC/DC converter. Dale's® patented open construction display technology assures a stable flicker free screen.

Interface is through either a parallel or RS-232/422 serial interface. The parallel interface allows for efficient handshaking and data protocol for bi-directional data interface. The serial interface is very flexible allowing for many selectable baud rates (150 to 19,200) and data formats. A second serial port allows for communication with the optional IR touch panel and software is available that allows for simple integration.

An EPROM based character generator is easily configured for any character set, but comes standard with three variations of international fonts (Standard International, International plus Kata-kana and International plus Russian) and the standard ISA 96 character graphics line drawing character set. Alternate character sets can be factory or user programmed. The pixel pattern in text mode is 5 x 7 pixels in a 6 x 10 block. The characters are adjusted for one pixel space above, one space to the right and 2 spaces on the bottom of each character.

Various editing functions are available such as scrolling, inserting and deleting characters.

A FIFO buffer is used to capture incoming serial data in the event the display's microprocessor is busy with a lengthy command. Handshaking is suggested when operating in the graphics mode. The data format is programmable.

The touch panel version (APD-240G120-5) includes a Dale® TIP-3216 infrared touch panel that consists of IR LEDs and detectors arranged to provide a grid of infrared light beams across the face of the display. When a pair of intersecting beams are blocked by a finger or stylus, the module will report the coordinates to the host computer. Various reporting modes are supported such as ENTER, EXIT, TRACKING and CONTINUOUS. All of the touch panel functions are controlled through the display controller so the user doesn't have to provide an additional serial port. The touch panel includes an attractive sealed bezel and contrast enhancement filter, providing an elegant solution for menu driven applications.

OPERATING MODE DESCRIPTION

DC1 - (Overwrite Mode) The cursor advances automatically when character data is written. If it is at the last column in a row, it shifts to the first column of the next row.

DC2 - (Vertical Scroll Mode) The cursor advances automatically when character data is written. If it is at the last column of the last row, all screen characters shift upwards one row, pushing the top row off the screen. The bottom row is cleared and the cursor is placed at the first column of the last row.

DC3 - Cursor is turned on.

DC4 - Cursor is turned off.

DC5 - Cursor is turned on and blinks at 4 Hz.

PIN DESCRIPTION		
CONNECTOR	PIN	SIGNAL
J1	1	+ 12 VDC
	2	GROUND
	3	N/C
	4	+ 5 VDC
J2	1	GROUND
	2	TXD
	3	RXD
	4	RTS
	5	CTS
	6	N/C
	7	GROUND
	8, 9	N/C
	J3	1, 3, 5, 7, 9, 11, 13, 15	DB0-DB7
17		WR (Write)
19		US (Unit Select)
21		RD (Read)
23		CLR (Clear Display)
25		BL (Blank Display)
6		A0 (Register Select)
12		CHK (Self Test)
24		BUSY OUTPUT
2, 4, 8, 10, 14, 16, 18, 20, 22, 26		GROUND
WARNING: Wrong connections may cause permanent damage to the display and host system.		

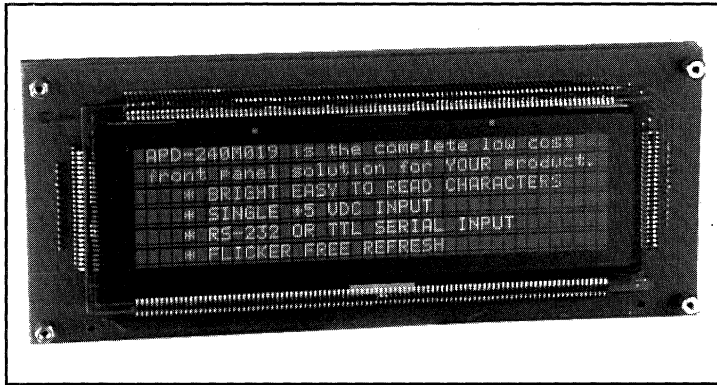
ABRIDGED TEXT FUNCTION SUMMARY	
Cursor Left (Back Space)	Erase to End of Line
Cursor Right (Horizontal Tab)	Erase to End of Screen
Cursor Down (Line Feed)	Scroll
Cursor Up (Vertical Tab)	Alter Cursor Column
Clear Screen	Alter Cursor Row
Clear Screen, Home Cursor	Insert Line
Carriage Return	Delete Line
Cursor Home	Set Operating Mode
Cursor On	Read Cursor Position
Cursor Off	Read Data at Cursor
Insert Character	Reset
Delete Character	

ORDERING INFORMATION	
DESCRIPTION	PART NUMBER
Display, Drive Electronics and Controller	APD-240G120
Parallel Connector Kit	280105-01
Power Connector Kit	280108-05
Non-Glare Filter (amber circular polarized) - other filters available, contact factory	280109-11

MODEL APD-240M019

Plasma Panel Display Modules

240 Character Display with Drive Electronics, Controller and Serial Interface



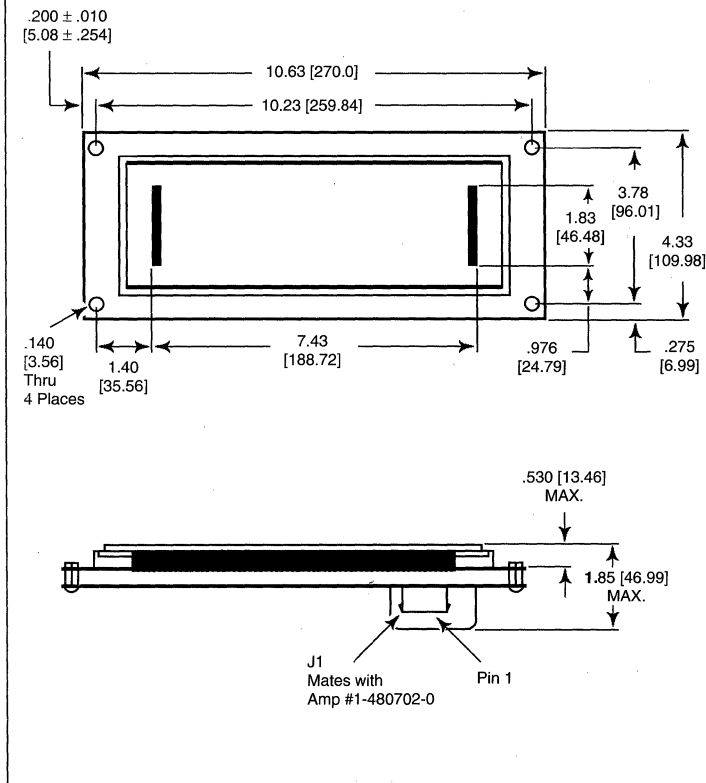
The APD-240M019 display module displays up to 240 alphanumeric 5 x 7 dot matrix characters arranged in 6 lines of 40 characters each. The module includes drive electronics, a controller consisting of refresh memory, character generator and control logic with an RS-232 compatible ASCII input. Interface is through a single 4 pin power connector. Handshaking is not required as a 20 byte FIFO buffer is used to capture data when the display is busy. Applications include POS terminals, industrial controls, computer peripherals, measurement instruments and office machines.

STANDARD ELECTRICAL SPECIFICATIONS

	MIN.	TYP.	MAX.	UNITS
Panel Supply Voltage	4.75	5.0	5.25	V
Panel Supply Current	1.0	1.5	2.5	A

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



FEATURES

- 240 (6 x 40) alphanumeric characters (5 x 7 dot matrix)
- Compatible with Noritake CU40066MCPB-S31A
- Only + 5 VDC required
- Three international character sets (other character sets available)
- Efficient serial interface (TTL or RS-232)
- Four step brightness control
- Wide viewing angle (150°)
- Rugged design/slim profile
- Flicker free refresh
- Editing functions
- High brightness

ENVIRONMENTAL SPECIFICATIONS

- Operating Temperature:** 0°C to + 55°C.
- Storage Temperature:** - 55°C to + 85°C.
- Relative Humidity:** 10-90% R. H. non-condensing.
- Mechanical Shock:** 50G 1/2 sine wave, 11 msec duration, 5 shocks in each of 6 directions.
- Vibration:** .018" [.457] displacement amplitude from 10 to 50 Hz, 2G acceleration from 50 to 2000 Hz logarithmic sweep rate, along each side of the 3 major axes.

OPTICAL SPECIFICATIONS

- Viewing Area:** 7.43" [188.72] W x 1.83" [46.48] H.
- Number of Characters:** 240.
- Character Size:** .137" [3.48] W x .196" [4.98] H.
- Luminance:** 100 foot lamberts.
- Color:** Neon orange.
- Viewing Angle:** 150° cone.

MODEL APD-240M019

GENERAL DESCRIPTION

The APD-240M019 plasma display module consists of a multiplexed DC plasma display, drive circuitry and switching voltage converter mated with an intelligent, microprocessor-based controller board. The resulting assembly interfaces easily to microprocessor-based systems and only requires readily available low voltages for power. Dale's patented open construction display technology assures a stable flicker free screen. Interfacing is very simple (and requires no handshaking as a 20 byte FIFO buffer captures data when the display is busy) through a single 4 pin connector that has + 5 VDC, RESET, GROUND and SERIAL DATA connections. The serial data interface can be either RS-232 or TTL level, selectable on the controller.

An EPROM based character generator is easily configured for any character set, but comes standard with three variations of international fonts (Standard International, International plus Kata-kana and International plus Russian) which are software selectable.

Serial data protocol is 8 data bits, no parity, 1 start bit and 1 stop bit. Baud rate (300, 1200, 9600 or 19,200) is selected with a control board jumper.

Various editing functions are available such as scrolling, inserting and deleting characters. The display can also be dimmed or blanked for screen highlighting.

OPERATING MODE DESCRIPTION

DC1 - (Overwrite Mode) The cursor advances automatically when character data is written. If it is at the last column in a row, it shifts to the first column of the next row.

DC2 - (Vertical Scroll Mode) The cursor advances automatically when character data is written. If it is at the last column of the last row, all screen characters shift upwards one row, pushing the top row off the screen. The bottom row is cleared and the cursor is placed at the first column of the last row.

DC3 - The cursor is visible as a non-blinking underbar.

DC4 - The cursor is invisible.

DC5 - The cursor is visible as a blinking character block.

DC6 - The cursor is visible as a blinking underbar.

COMMAND SUMMARY		
CONTROL COMMANDS	CODE (HEX)	TIMING
Back Space	08	190 µS
Horizontal Tab	09	190 µS
Line Feed	0A	190 µS
Vertical Tab	0B	190 µS
Cursor Home*	0C	130 µS
Carriage Return	0D	210 µS
Clear Screen (cursor remains)*	0E	3.0 mS
Select DC1, Overwrite Mode*	11	130 µS
Select DC2, Vertical Scroll Mode	12	130 µS
Select DC3, Cursor On, Underline*	13	130 µS
Select DC4, Cursor Off	14	130 µS
Select DC5, Cursor On, Blinking Block	15	130 µS
Select DC6, Cursor On, Blinking Underbar	16	130 µS
Character Set 0 (International)*	17	110 µS
Character Set 1 (Intl. + Kata-kana)	18	110 µS
Character Set 2 (Intl. + Russian)	19	110 µS
ESCAPE COMMANDS		
Position Cursor	1B, 48	150 µS
Cursor Address	##	
Luminance Control	1B, 4C, ##	310 µS
Initialize (Software Reset)	1B, 49	500 mS
Character Blink Start	1B, 42	130 µS
Character Blink Stop	1B, 41	130 µS
EXTENDED CONTROL COMMANDS		
Position Cursor	1B, 58	150 µS
Cursor Address	##	
Insert Character	1B, 58, F3	500 µS
Delete Character	1B, 58, F4	500 µS
Line Insert	1B, 58, F5	2.0 mS
Line Delete	1B, 58, F6	2.0 mS
Reset (to power up status)	1B, 58, FF	500 µS
* Power up default condition.		

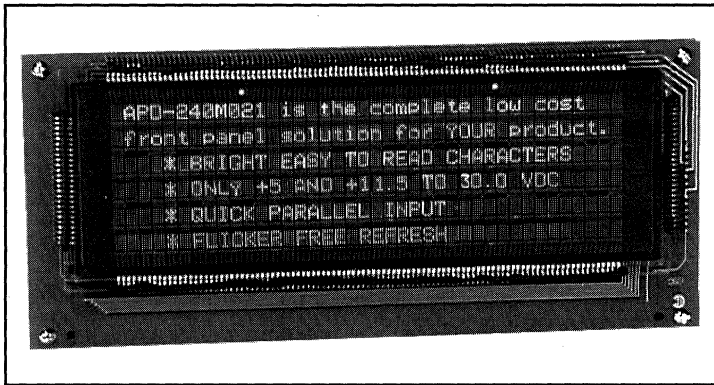
PIN DESCRIPTION	
PIN	SIGNAL
1	+ 5 VDC
2	SERIAL DATA
3	GROUND
4	RESET (hardware)

ORDERING INFORMATION	
DESCRIPTION	PART NUMBER
Display, Drive Electronics, Controller	APD-240M019
Mating Controller	280108-06
Non-Flare Filter (amber circular polarized) - other filters available - contact factory	280109-12

MODEL APD-240M021

Plasma Panel Display Modules

240 Character Display with Drive Electronics, Controller and Parallel Interface



The APD-240M021 display module displays up to 240 alphanumeric 5 x 7 dot matrix characters arranged in 6 lines of 40 characters each. The module includes drive electronics, a controller consisting of refresh memory, character generator and control logic with ASCII input. Interfacing is very simple (over an 8 bit data bus) and requires minimum handshake to enable the module to serve as a cost effective direct readout device for many applications including POS terminals, industrial controls, computer peripherals, measurement instruments and office machines.

STANDARD ELECTRICAL SPECIFICATIONS

	MIN.	TYP.	MAX.	UNITS
Logic Supply Voltage	+ 4.75	+ 5.0	+ 5.25	V
Logic Supply Current	—	300.0	—	mA
Panel Supply Voltage	11.5	12.0	30.0	V
Panel Supply Current*	—	600.0	1000.0	mA
Logic One Voltage	2.4	—	—	V
Logic Zero Voltage	—	—	.8	V
Logic Zero Input Current	—	—	-.4	mA

* At 12 volt input.

FEATURES

- 240 (6 x 40) alphanumeric characters (5 x 7 dot matrix)
- Compatible with IEE 3402-08-240N
- Only + 5 and + 11.5 to 30.0 VDC required
- ASCII character set (optional character sets available)
- Efficient parallel interface
- Wide viewing angle (150°)
- Rugged design/slim profile
- Flicker free refresh
- Editing functions
- High brightness

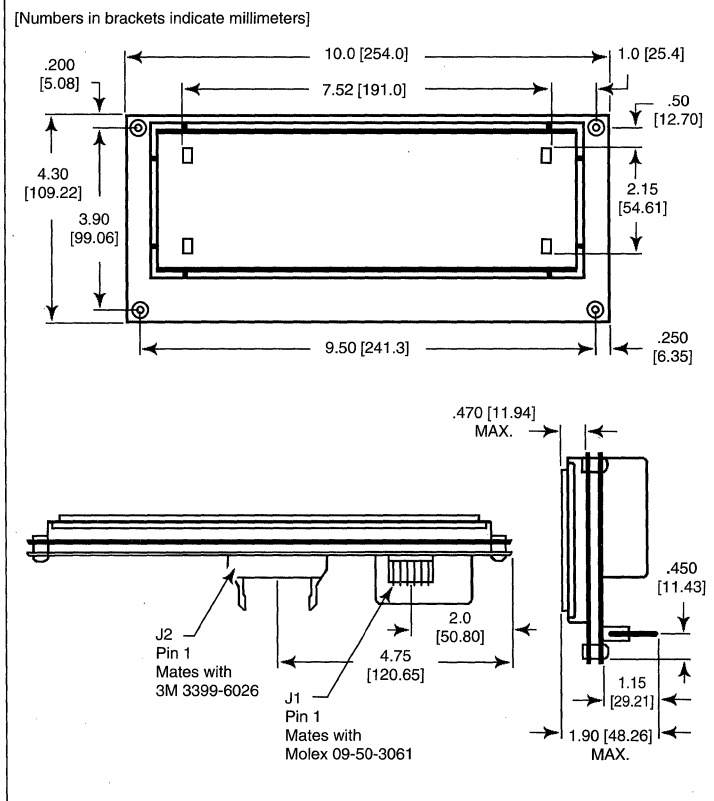
ENVIRONMENTAL SPECIFICATIONS

- Operating Temperature:** 0°C to + 55°C.
Storage Temperature: - 55°C to + 85°C.
Relative Humidity: 10-90% R. H. non-condensing.
Mechanical Shock: 50G 1/2 sine wave, 11 msec duration, 5 shocks in each of 6 directions.
Vibration: .018" [.457] displacement amplitude from 10 to 50 Hz, 2G acceleration from 50 to 2000 Hz logarithmic sweep rate, along each side of the 3 major axes.

OPTICAL SPECIFICATIONS

- Viewing Area:** 7.52" [191.01] W x 2.15" [54.61] H.
Number of Characters: 240.
Character Size: 0.15" [3.81] W x .021" [5.33] H.
Luminance: 100 foot lamberts.
Color: Neon orange.
Viewing Angle: 150° cone.

DIMENSIONAL CONFIGURATIONS



MODEL APD-240M021

GENERAL DESCRIPTION

The APD-240M021 plasma display module consists of a multiplexed DC plasma display, drive circuitry and switching voltage converter mated with an intelligent, microprocessor-based controller board. The resulting assembly interfaces easily to microprocessor-based systems and requires only readily available low voltages for power. Dale's® patented open construction display technology assures a stable flicker free screen.

Interfacing is a basic 8 bit parallel ASCII interface with some dedicated control lines and requires minimum handshaking. DEVICE SELECT (CS), ADDRESS (A₀), WRITE and READ lines are enabled in accordance with the Function Summary Chart and allow the host system to write or read data from the display. Data bus signals are formatted in accordance with the standard ASCII which allow control functions to be included in the character code matrix table. Functions such as advancing the cursor position or selecting the end-of-line mode are implemented with a single 8 bit control word.

Characters sent on the data bus are entered at the cursor position addressed and latched by the display module when it receives a WRITE pulse. The cursor then automatically advances to the next character position. Characters may be randomly entered at any position on the display field by first sending the module a command to set the cursor at the desired character location and then entering a character as described. When the last display line is filled, the end-of-line mode selected determines the location of the "overflow" characters.

A self test can be activated by maintaining a logic low at J2-1 (T₀) for a period longer than 4 seconds. RESET can be accomplished with a data bus command or bringing the RESET input low for 20 msec minimum. The display may be blanked (without losing display contents) by applying a logic 0 to J1-2 (SHUTDOWN).

When a byte of data is placed on the bus and a WRITE pulse is applied to WR, the data is entered into an input buffer in the microprocessor. The data is examined to determine its nature (control code, ASCII character, etc.) and if it is a character, it is stored in the display refresh memory. The time required to execute this process and prepare for a new character determines the display's character loading rate. Most commands and character entry are executed within 80 µsec.

Maximum loading rate is obtained by first writing the character to the display and then reading the input buffer status to determine when the next character can be sent. Data should be written to the display only when the input buffer is empty, indicating that it is ready to accept another byte of data.

PIN DESCRIPTION		
CONNECTOR	PIN	SIGNAL
J1	1	+ 5 VDC
	2	SHUT DOWN
	3	+ 11.5 to + 30.0 VDC
	4	GND (Logic)
	5	GNO (Power)
	6	RESET
J2	1	T ₀
	3	CS
	5	READ
	7	A ₀
	9	WRITE
	2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26	GND
	11, 13, 15, 17, 19, 21, 23, 25	DB0-DB7

WARNING: Wrong connections or reversing J2 may cause permanent damage to the display and host.

ABRIDGED FUNCTION SUMMARY						
FUNCTION	BUS CODE	A ₀	CS	WR	RD	
Write ASCII Data to Display	ASCII DATA	0	0	pl	1	
Prepare to Read Data at Present Cursor Location	04	0	0	pl	1	
Backspace	08	0	0	pl	1	
Horizontal Tab	09	0	0	pl	1	
Line Feed	0A	0	0	pl	1	
Vertical Tab	0B	0	0	pl	1	
Clear Screen	0C	0	0	pl	1	
Carriage Return	0D	0	0	pl	1	
Cursor Home	0E	0	0	pl	1	
Character Insert	0F	0	0	pl	1	
Character Delete	10	0	0	pl	1	
Alter Cursor Column Position (2 byte command)	11	0	0	pl	1	
Cursor Column Address	##	0	0	pl	1	
Cursor on	12	0	0	pl	1	
Alter Cursor Row Position (2 byte command)	13	0	0	pl	1	
Cursor Row Address	##	0	0	pl	1	
Cursor Off	14	0	0	pl	1	
Line Insert	16	0	0	pl	1	
Line Delete	17	0	0	pl	1	
Start Underbar/Blinking Character Field	18	0	0	pl	1	
End Underbar/Blinking Character Field	19	0	0	pl	1	
Prepare to Read Data at Present Cursor Location and Increment Cursor	43	1	0	pl	1	
Prepare to Read Cursor Column Position	54	1	0	pl	1	
Prepare to Read Cursor Row Position	55	1	0	pl	1	
Read Data From Data Bus		0	0	1	pl	
Read Input/Output Buffer Status		1	0	1	pl	
Disable Display Data Input	x	1	1	x	x	

NOTES: Data bus code shown in hexadecimal.
pl = Pulse Low.
x = Don't Care.

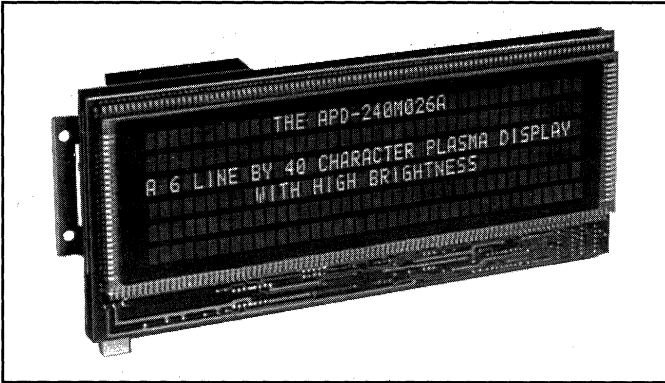
ORDERING INFORMATION

DESCRIPTION	PART NUMBER
Display, Drive Electronics, Controller	APD-240M021
Parallel Data Connector Kit	280105-01
Power Connector Kit	280108-07
Non-Glare Filter (amber circular polarized) - other filters available - contact factory	280109-13

MODEL APD-240M026A

Plasma Panel Display Modules

240 Character Display with Drive Electronics



The APD-240M026A display module displays up to 240 alphanumeric 5 x 7 dot matrix characters arranged in 6 lines of 40 characters each. The module includes drive electronics and is easily interfaced to CRT controllers.

FEATURES

- 240 (6 x 40) alphanumeric characters (5 x 7 dot matrix)
- .14 W x .26 H character size
- High brightness (100 foot lamberts typical)
- Controller Board available with parallel and RS232 inputs
- Wide viewing angle (150°)
- Easily interfaced
- Compact size

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature: 0°C to + 55°C.

Storage Temperature: - 55°C to + 85°C.

Relative Humidity: 10-90% non-condensing.

Mechanical Shock: 50G 1/2 Sine Wave, 11 ms duration, 5 shocks in each of 6 directions.

Vibration: .018" displacement amplitude from 10 to 50 Hz, 2G acceleration from 50 to 2000 Hz logarithmic sweep rate. 30 minute duration along each side of the 3 major axes.

OPTICAL SPECIFICATIONS

Viewing Area: 2.26" [57.40] W x 8.33" [211.58] L.

Number of Characters: 240.

Character Size: .14" [3.56] W x .26" [6.60] H.

Dot Size: .020" [.508] diameter.

Dot Pitch, Vertical: .040" [1.016].

Dot Pitch, Horizontal: .030" [.762].

Character Spacing: 2 blank columns of dots between successive characters.

Brightness: 100 foot lamberts.

Color: Neon orange.

Viewing Angle: 150° cone.

GENERAL DESCRIPTION

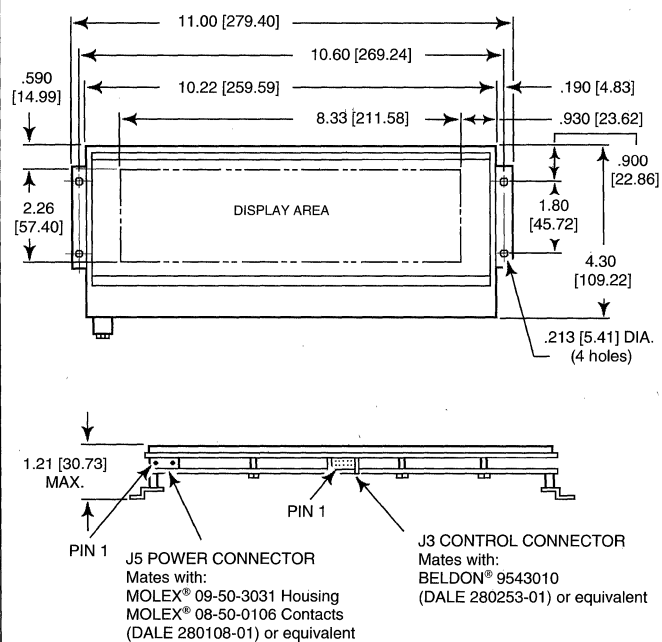
The APD-240M026A consists of a DC plasma panel display and drive circuitry to accept serially entered row data and generate the required cathode and anode signals to display the desired information. The module displays information in a row scanning mode; that is, row by row beginning at the top, with each character being 5 dots wide, and with 40 characters per row, 200 bits of dot information per row is supplied to the module as serial data. When all 200 bits of row information have been loaded, the data will be displayed. This process is repeated until all 42 rows have been scanned in succession. All inputs are TTL compatible.

STANDARD ELECTRICAL SPECIFICATIONS

	MIN.	TYP.	MAX.	UNITS
Logic Supply 1 Voltage	4.75	5.0	5.25	V
Logic Supply 2 Voltage	11.40	12.0	12.60	V
Logic Supply 1 Current	—	50.0	60.0	mA
Logic Supply 2 Current	—	60.0	75.0	mA
Panel Supply 1 Voltage	60.0	65.0	70.0	V
Panel Supply 2 Voltage	- 110.0	- 115.0	- 120.0	V
Panel Supply 1 Current	—	60.0	128.0	mA
Panel Supply 2 Current	—	80.0	135.0	mA

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



MODEL APD-240M026A

INTERFACE SIGNAL DESCRIPTION

Serial Data - The 200 bits of data that represent one row of character data is serially entered on this input. The information is entered at the 200th dot position (right side of display) and is advanced one column with each Data Shift pulse.

Data Shift - A negative going edge on this input enters the row data bit present at the Serial Data input. This input requires 200 pulses to enter the 200 bits of row data.

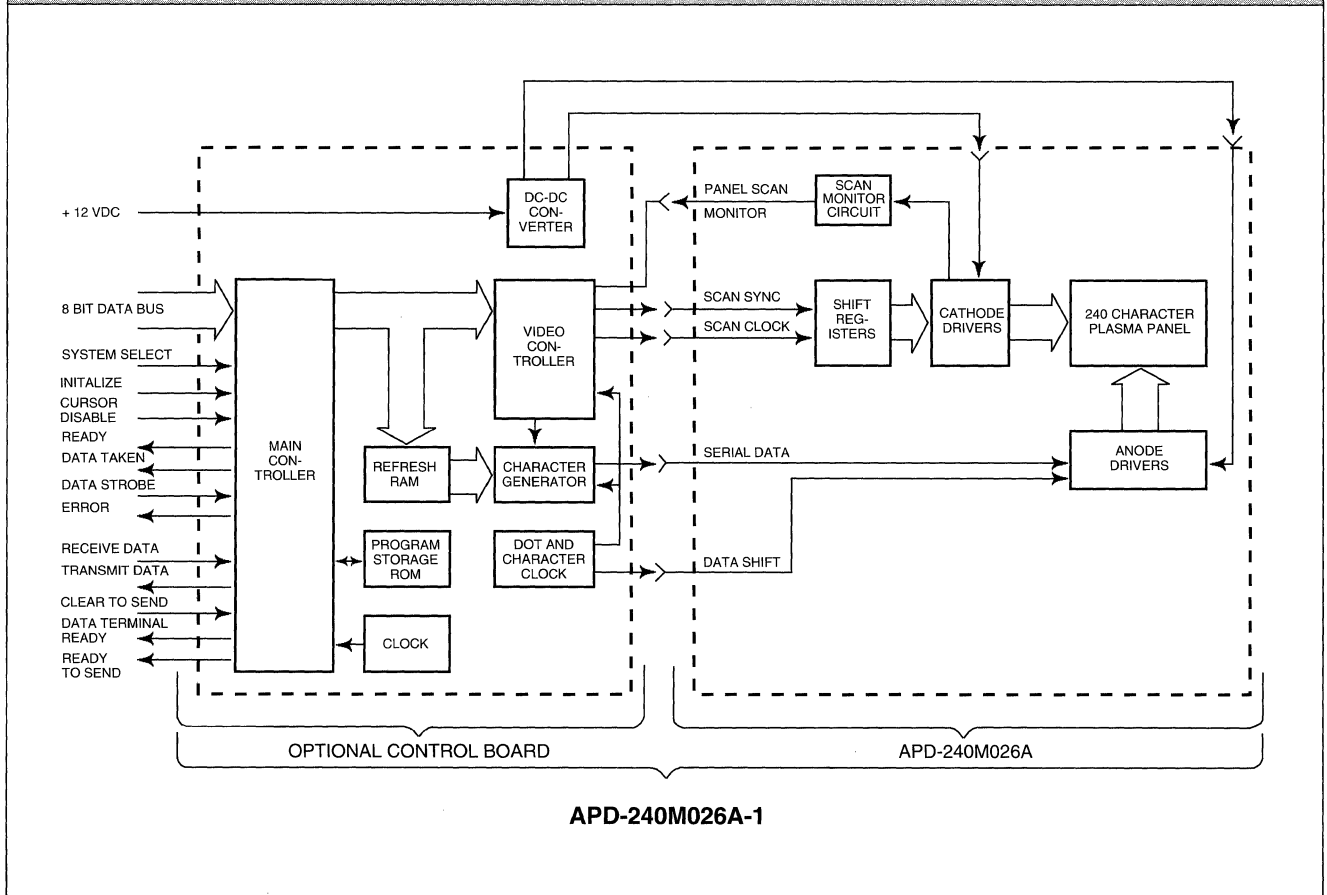
Scan Clock - Much like horizontal sync on a CRT, this signal is used to advanced the the row pointer vertically down the display, one row at a time. This input must be continually pulsed whenever the display is on to prevent damage to the panel.

Scan Sync - This pulse is applied after each complete scan to begin a new scan at the top row of the panel, similar to vertical sync on a CRT.

PIN DESCRIPTION

CONNECTOR	PIN	SIGNAL
J3	1	DATA SHIFT
	2	GROUND
	3	N/C
	4	+ 12 VDC
	5	SCAN SYNC
	6	SCAN CLOCK
	7	+ 5 VDC
	8	SCAN MONITOR
	9	GROUND
	10	SERIAL DATA
J5	A	- 115 VDC
	B	GROUND
	C	+ 65 VDC

SYSTEM BLOCK DIAGRAM



ORDERING INFORMATION

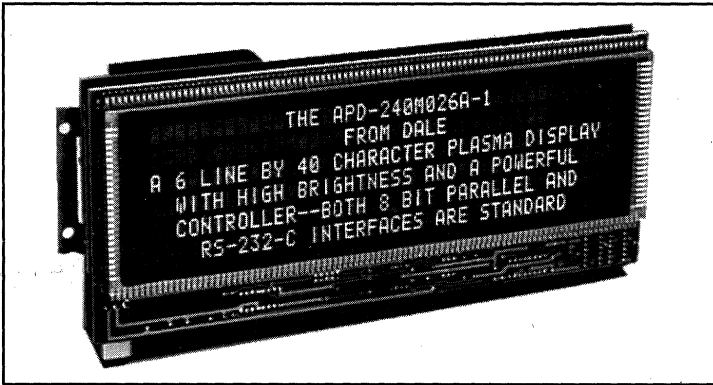
DESCRIPTION	PART NO.
Display and Drive Electronics	APD-240M026A
Display and Drive Electronics plus Controller Board (includes DC-DC high voltage converter)	APD-240M026A-1
DC-DC High Voltage Converter	PDS-400
Data Connector Kit	280253-01
Power Connector Kit	280108-01
Non-Glare Filter (amber circularly polarized) - other filters available - contact factory	280109-03

MODEL APD-240M026A-1

Plasma Panel Display Modules

240 Character Display

with Drive Electronics and Controller



The APD-240M026A-1 display module displays up to 240 alphanumeric 5 x 7 dot matrix characters arranged in 6 lines of 40 characters each. The module includes drive electronics, a micro-processor-based controller consisting of refresh memory, character generator and control logic with parallel or serial interface and a DC to DC converter to develop the necessary panel voltage.

FEATURES

- 240 (6 x 40) alphanumeric characters (5 x 7 dot matrix)
- 128 USASCII character set + 128 user programmable character set
- High brightness
- Wide viewing angle (150°)
- Low input voltage
- Compact size
- Software dimming
- Parallel and Serial Interfaces

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature: 0°C to +55°C.
Storage Temperature: -55°C to +85°C.
Relative Humidity: 10-90% non-condensing.
Mechanical Shock: 50G 1/2 Sine Wave, 11 ms duration, 5 shocks in each of 6 directions.
Vibration: .018" displacement amplitude from 10 to 50 Hz, 2G acceleration from 50 to 2000 Hz logarithmic sweep rate. 30 minute duration along each side of the 3 major axes.

OPTICAL SPECIFICATIONS

Viewing Area: 2.26" [57.40] W x 8.33" [211.58] L.
Number of Characters: 240.
Character Size: .14" [3.56] W x .26" [6.60] H.
Dot Size: .020" [.508] diameter.
Dot Pitch, Vertical: .040" [1.016].
Dot Pitch, Horizontal: .030" [.762].
Character Spacing: 2 blank columns of dots between successive characters.
Brightness: 100 foot lamberts.
Color: Neon orange.
Viewing Angle: 150° cone.

GENERAL DESCRIPTION

The APD-240M026A-1 consists of a DC plasma panel display, drive circuitry and controller. The controller is programmable to operate in a parallel or serial mode. The parallel interface is a basic 8 bit parallel interface with handshaking and some dedicated control lines. The serial interface is RS-232-C compatible with 8 selectable baud rates and 2 bit formats. Single byte and two byte commands allow simplified code generation, yet accomplish complex display tasking such as scrolling, or inserting lines and characters.

The character generator is a 4K x 8 bit EPROM and is capable of storing two 128 character sets. The standard set consists of 128 USASCII characters (including control codes). An alternate set of 128 characters can be user programmed.

A DC-DC converter generates the required display voltage from +12 VDC, and all input lines are LSTTL compatible with 6.8 kilohm pull-up resistors to Vcc.

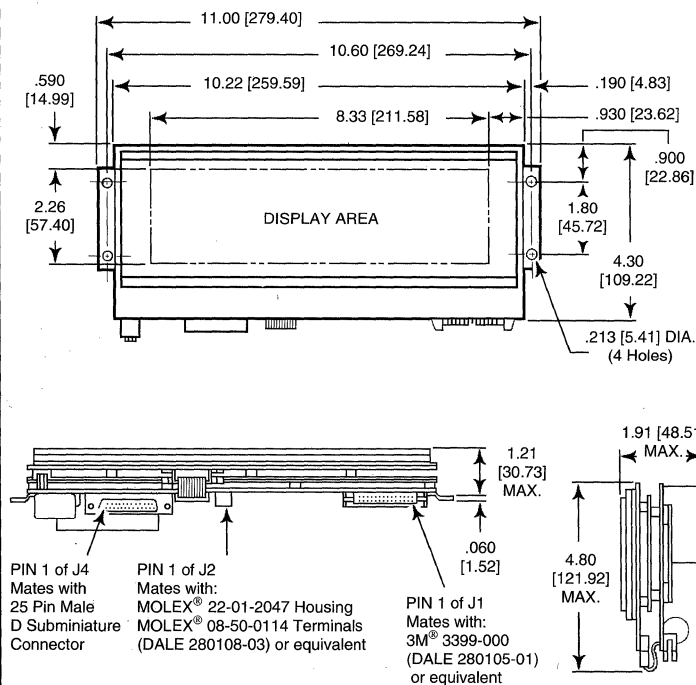
STANDARD ELECTRICAL SPECIFICATIONS

	MIN.	TYP.	MAX.	UNITS
Logic Supply Voltage	+ 4.75	5.0	+ 5.25	V
Logic Supply Current	—	700.0	—	mA
Panel Supply Voltage	11.4	12.0	12.6	V
Panel Supply Current ⁽¹⁾	—	1.0	2.2	A
Negative Supply Voltage ⁽²⁾	11.4	- 12.0	- 12.6	V
Negative Supply Current	—	60.0	—	mA

(1) This is the input to a DC-DC converter. There may be peak in rush currents higher than shown.
 (2) Required only if RS-232-C serial interface is used.

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



MODEL APD-240M026A-1

FUNCTION SUMMARY					
CONTROL CODES	HEX	ASCII	CONTROL CODES	HEX	ASCII
CURSOR HOME	0E	CNTRL-N	ERASE TO END OF LINE	1B,0D	ESC, CNTRL-M
CARRIAGE RETURN	0D	CNTRL-M	ERASE TO END OF SCREEN	1B, 18	ESC, CNTRL-X
LINE FEED	0A	CNTRL-J	ERASE LINE	1B, 13	ESC, CNTRL-S
CURSOR UP	0B	CNTRL-K	ERASE LINE & CARRIAGE RETURN	1B, 25	ESC, CNTRL-%
CURSOR DOWN	0A	CNTRL-J	ALTER BRIGHTNESS	1B, 0C	ESC, CNTRL-L
CURSOR RIGHT	09	CNTRL-I	BRIGHTNESS CONTROL CODES:		
CURSOR LEFT	08	CNTRL-H	(0 = BRIGHTEST, 7 = LEAST BRIGHT)	##	
ALTER CURSOR CHARACTER POSITION	11	CNTRL-Q	SCROLL	1B, 1A	ESC, CNTRL-Z
CURSOR POSITION ADDRESS	##		* END SCROLL	1B, 20	ESC, SPACE BAR
ALTER CURSOR ROW POSITION	13	CNTRL-S	BLANK DISPLAY (ON/OFF ALTERNATELY)	1B, 11	ESC, CNTRL-Q
CURSOR ROW ADDRESS	##		SCAN DISABLE (ON/OFF ALTERNATELY)	1B, 12	ESC, CNTRL-R
CURSOR ON	12	CNTRL-R	SELECT ALTERNATE CHARACTER SET	1B, 0F	ESC, CNTRL-O
CURSOR OFF	14	CNTRL-T	* SELECT STANDARD CHARACTER SET	1B, 0E	ESC, CNTRL-N
ALTER CURSOR FORMAT	15	CNTRL-U	ENABLE SCAN DISABLE TIMER	1B, 23	ESC, SHIFT-#
CURSOR FORMAT CODE:			* DISABLE SCAN DISABLE TIMER	1B, 24	ESC, SHIFT-\$
FULL BLOCK, NO BLINK	00		DISPLAY CONTROL CHARACTERS	1B, 1E	ESC, CNTRL-^
NO OPERATION	00	CNTRL-@	* DISABLE DISPLAY CONTROL CHARACTERS	1B, 26	ESC, SHIFT-&
CLEAR SCREEN	0C	CNTRL-L	CHARACTER BLINK	1B, 21	ESC, SHIFT-!
CHARACTER INSERT	0F	CNTRL-O	* DISABLE CHARACTER BLINK	1B, 22	ESC, SHIFT-"
CHARACTER DELETE	10	CNTRL-P	START CONFIDENCE TEST	1B, 1F	ESC, SHIFT-_
LINE INSERT	16	CNTRL-V	* DISABLE CONFIDENCE TEST (ANY CODE)	##	
LINE DELETE	17	CNTRL-W	RESET CONTROLLER (TO INITIAL STATE)	1B, 19	ESC, CNTRL-Y

* Power up condition.

PIN DESCRIPTION		
CONNECTOR	PIN	SIGNAL
J1	9	DATA BIT 1 (LSB)
	3	DATA BIT 2
	6	DATA BIT 3
	7	DATA BIT 4
	5	DATA BIT 5
	4	DATA BIT 6
	2	DATA BIT 7
	1	DATA BIT 8 (MSB)
	10	CURSOR DISABLE
	12	ERROR
	13	READY
	15	DATA STROBE
	16	INITIALIZE
	17	DATA TAKEN
	22	SYSTEM SELECT
	25	+ 5 V
	26	+ 5 V
	24	- 12 V (RS-232-C ONLY)
	21	+ 12 V
	19	GROUND
20	GROUND	
J2	1	+ 12 V (DISPLAY POWER)
	2	+ 5 V
	3	GROUND
	4	- 12 (RS-232-C ONLY)
J4	3	RECEIVED DATA
	2	TRANSMIT DATA
	7	SIGNAL GROUND
	4	READY TO SEND
	5	CLEAR TO SEND
	20	DATA TERMINAL READY

NOTE: Unidentified pins are not connected.
WARNING: Wrong connections in any connectors or reversing J1 may cause permanent damage to the display and host interface.

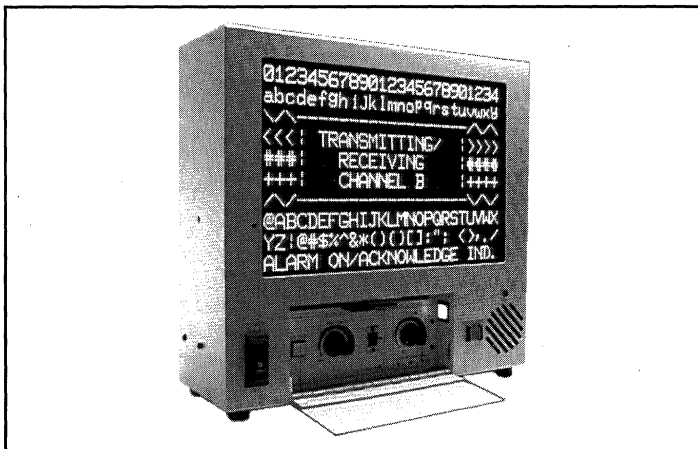
MODIFIED USASCII CHARACTER SET												
Bits				0	0	0	0	1	1	1	1	
b7	_____			0	0	1	1	0	0	1	1	
b6	_____			0	1	0	1	0	1	0	1	
b5	_____											
b4	b3	b2	b1	Col.	0	1	2	3	4	5	6	7
Row				0	NUL	DLE	SP	0	@	P	'	p
0 0 0 0 0				1	SOH	DC1	!	1	A	Q	a	q
0 0 1 0 2				2	STX	DC2	"	2	B	R	b	r
0 0 1 1 3				3	ETX	DC3	#	3	C	S	c	s
0 1 0 0 4				4	EOT	DC4	\$	4	D	T	d	t
0 1 0 1 5				5	ENQ	NAK	%	5	E	U	e	u
0 1 1 0 6				6	ACK	SYN	&	6	F	V	f	v
0 1 1 1 7				7	BEL	ETB	'	7	G	W	g	w
1 0 0 0 8				8	BS	CAN	(	8	H	X	h	x
1 0 0 1 9				9	HT	EM	)	9	I	Y	i	y
1 0 1 0 10				10	LF	SUB	*	:	J	Z	j	z
1 0 1 1 11				11	VT	ESC	+	;	K	[	k	{
1 1 0 0 12				12	FF	FS	,	<	L	\	l	!
1 1 0 1 13				13	CR	GS	-	=	M	]	m	}
1 1 1 0 14				14	SO	RS	.	>	N	^	n	~
1 1 1 1 15				15	SI	US	/	?	O	_	o	DEL

ORDERING INFORMATION	
DESCRIPTION	PART NO.
Display, Drive Electronics plus Controller Board (includes DC-DC converter)	APD-240M026A-1
Display and Drive Electronics Only	APD-240M026A
Parallel Data Connector Kit	280105-01
Power Connector Kit	280108-03
Non-Glare Filter (amber circular polarized) - other filters available - contact factory	280109-03

MODEL APD-250M060

Plasma Panel Display Monitors

250 Character Display/Drive Electronics/Controller/ Audio Alarm/Enclosure/Illuminated Control Panel



The APD-250M060 monitor displays up to 250 alphanumeric 7 x 9 dot matrix characters arranged in 10 lines of 250 characters each. Its large characters and high brightness and viewing angle makes it ideal for long distance viewing. Up to 8 monitors can be daisy chained with messages sent to all or specific units. Interfacing is via RS-232D with no handshaking. User controls are power, self test, auto/manual brightness, I/O bypass, alarm volume control and alarm acknowledge. It can serve as a status indicator and/or alarm for security systems building management, factory floor annunciation, machine control or any other system requiring a self-contained monitor with provisions for acknowledgment of alarm conditions by the operator.

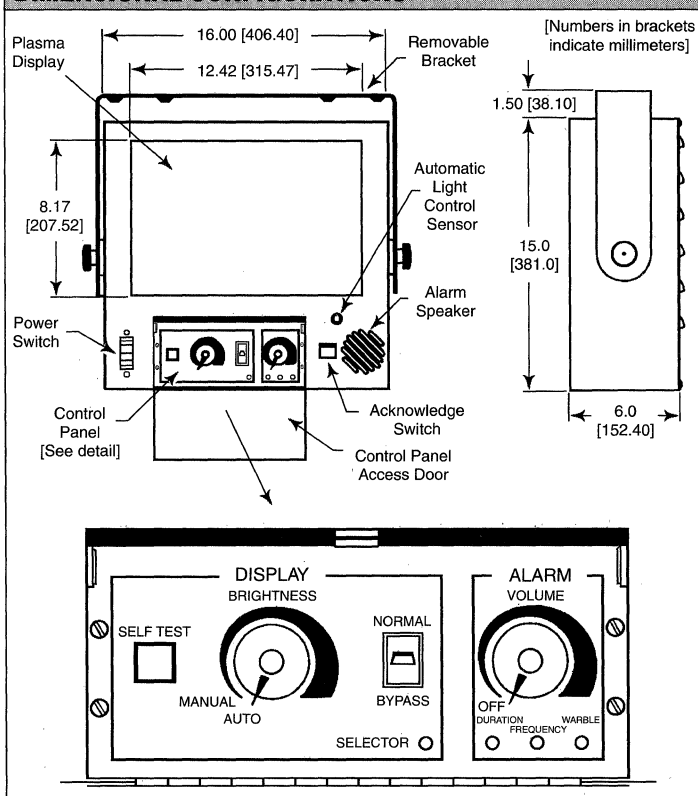
STANDARD ELECTRICAL SPECIFICATIONS

	MIN.	TYP.	MAX.	UNITS
Voltage	102	120	138	VAC
Current	—	—	0.75	A
Frequency	57	60	63	Hz
Interface	Per RS-232D			
Logic One	3	—	12	VDC
Logic Zero	-3	—	-12	VDC

FEATURES

- High brightness - Sunlight readable
- Auto/Manual brightness control
- Wide viewing angle
- Large character size
- Fully self contained
- Can be daisy chained
- Audible alarm
- Simple RS-232D interface
- Compact size

DIMENSIONAL CONFIGURATIONS



MECHANICAL SPECIFICATIONS

Dimensions: 16" [406.40] W x 15" [381.0] H x 6" [152.40] D.

Weight: 30 pounds [13.61 kilogram].

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature: 0°C to + 55°C.

Storage Temperature: - 55°C to + 85°C.

Relative Humidity: 10-80% R.H. non-condensing.

OPTICAL SPECIFICATIONS

Viewing Area: 12.42" [315.47] W x 8.17" [207.52] H.

Number of Characters: 250.

Character Size: .420" [10.67] W x .610" [15.49] H.

Luminance: 50 foot lamberts maximum (through the filter).

Contrast Ratio: 3:1 minimum at 2000 fc ambient.

Color: Neon orange.

Viewing Angle: 120° cone.

AUDIO SPECIFICATIONS

Sound Pressure: 60 to 85 dbA at 3 feet (1 meter).

Warble: Two alternating tones.

MODEL APD-250M060

GENERAL DESCRIPTION

The APD-250M060 monitor consists of 250 character DC plasma display panel, drive circuitry, display controller, audible alarm, enclosure and illuminated control panel. The enclosure may be mounted on a flat surface or in a suspended configuration. Its large characters, wide viewing angle and high brightness (with an auto or manual brightness control) provides excellent visibility in a wide range of ambient light conditions from total darkness to bright sunlight.

Interfacing is via RS-232D at 9600 baud with no handshaking (a FIFO buffer is used to capture data when the display is busy). The byte format is 1 start bit, 8 data bits and 1 stop bit. As each monitor receives a data byte, it automatically sends it to the next unit in the daisy (up to 8 monitors maximum) chain. Returning data from the monitors are handled in the same way. A front panel bypass switch is provided to allow the operator to instantly route the input channel to the output channel in the event of a monitor failure.

Single byte and two byte commands allow simplified code generation, yet accomplish complex display tasking such as scrolling or inserting lines and characters. The character generator is an 8K x 8 bit EPROM which has capacity for two 256 character sets. It is preprogrammed with two ASCII character sets (128 characters each including control codes). Other character sets may be factory programmed per the user's special requirements.

The audio alarm operation is under the complete control of the host system. The alarm is a warble of two tones which can be user adjusted. The volume may be adjusted by the operator from 65 to 85 dbA by a front panel control.

User controls are power, self test, auto/manual brightness adjustment, I/O bypass, alarm volume control and alarm acknowledge.

The APD-250M060 monitor is a DTE device and will operate with a host that is either a DTE or DCE type device. Interface is through standard DB25, RS-232D connectors.

PIN DESCRIPTION		
CONNECTOR	PIN	SIGNAL
J1	1	Ground (Shield)
	2	Transmit Data
	3	Receive Data
	7	Ground
	4, 5, 6, 8-25	No connection
J2	1	Ground (Shield)
	2	Receive Data
	3	Transmit Data
	7	Ground
	4, 5, 6, 8-25	No Connection

WARNING: Wrong connections may cause permanent damage to the monitor and host system.

MONITOR FUNCTION SUMMARY	
CONTROL CODES	DATA
NO OPERATION	00
BELL	07
CURSOR LEFT	08
CURSOR RIGHT	09
CURSOR DOWN/LINE FEED	0A
CURSOR UP	0B
CLEAR SCREEN AND CURSOR HOME	0C
CARRIAGE RETURN	0D
CURSOR HOME	0E
CHARACTER INSERT	0F
CHARACTER DELETE	10
ALTER CURSOR COLUMN POSITION	11
CURSOR COLUMN ADDRESS (0-18)	##
CURSOR ON	12
ALTER CURSOR ROW POSITION	13
CURSOR ROW ADDRESS (0-9)	##
CURSOR OFF	14
START OF BLINK FIELD	15
LINE INSERT	16
LINE DELETE	17
END OF BLINK FIELD	18
ENABLE ALARM	19
DISABLE ALARM	1A
POLL	1C
BROADCAST TO ALL MONITORS	1D
MONITOR SELECT	1E
ID NUMBER (0-7)	nn
DESELECT ALL MONITORS	1F

ESCAPE CONTROL CODES	
ERASE TO END OF LINE	1B,0D
ERASE TO END OF SCREEN	1B,18
ERASE LINE	1B,13
ERASE LINE AND CARRIAGE RETURN	1B,25
SCROLL MODE	1B,1A
OVERWRITE OF LAST SCREEN CHARACTER	1B,1C
AUTO WRAP	1B,20
BLANK MONITOR/SCREEN SAVER	1B,11
UNBLANK MONITOR	1B,12
SELECT ALTERNATE CHARACTER SET	1B,0F
*SELECT STANDARD CHARACTER SET	1B,0E
DISPLAY CONTROL CHARACTERS	1B,1E
*DISABLE CONTROL CHARACTERS DISPLAY	1B,26
START CONFIDENCE TEST	1B,1F
*DISABLE CONFIDENCE TEST (ANY CODE)	00
RESET	1B,19

* Indicates power up condition.
All codes are hexadecimal format.

ORDERING INFORMATION	
DESCRIPTION	PART NUMBER
Complete Display Monitor and Alarm System	APD-250M060

MODEL APD-256M025A

Plasma Panel Display Modules

256 Character Display with Drive Electronics and Controller, Parallel Interface



The APD-256M025A display module displays up to 256 alphanumeric 5 x 7 dot matrix characters arranged in 8 lines of 32 characters each. The module includes drive electronics, a controller consisting of refresh memory, character generator and control logic with ASCII input. Interfacing is very simple (over an 8 data bus) and requires minimum handshake to enable the module to serve as a cost effective direct readout device for many applications including POS terminals, industrial controls, computer peripherals, measurement instruments and office machines.

STANDARD ELECTRICAL SPECIFICATIONS

	MIN.	TYP.	MAX.	UNITS
Logic Supply Voltage	+ 4.75	+ 5.0	+ 5.25	V
Logic Supply Current	—	.85	—	A
Panel Supply Voltage	+ 180	+ 185	+ 190	V
Panel Supply Current	—	—	0.1	A
Logic One Voltage	2.4	—	5.5	V
Logic Zero Voltage	—	—	0.8	V
Logic Zero Input Current	—	—	- 0.4	mA

FEATURES

- 256 (8 x 32) alpha numeric characters (5 x 7 dot matrix)
- Only + 5 and + 185 VDC required
- 256 International character set (includes ASCII characters). Optional character sets available.
- Efficient parallel interface
- Wide viewing angle (150°)
- Rugged design/slim profile
- Flicker free refresh, high speed data input
- High brightness
- Compatible with Babcock DP-0832-C1

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature: 0°C to + 55°C.
Storage Temperature: - 55°C to + 85°C.
Relative Humidity: 10-90% R.H. non-condensing.

Mechanical Shock: 50G 1/2 sine wave, 11 msec duration, 5 shocks in each of 6 directions.

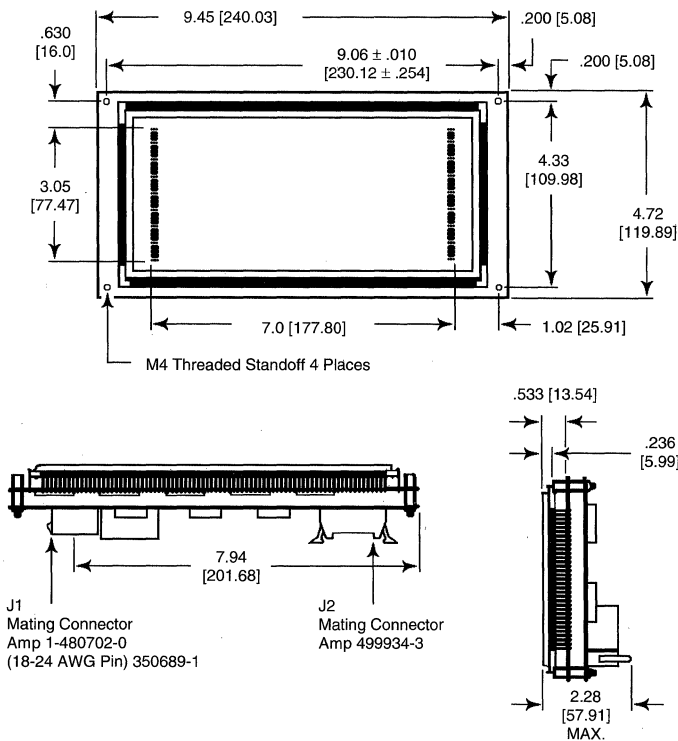
Vibration: .018" [.457] displacement amplitude from 10 to 50 Hz, 2G acceleration from 50 to 2000 Hz logarithmic sweep rate, along each side of the 3 major axes.

OPTICAL SPECIFICATIONS

Viewing Area: 7.0" [177.80] W x 3.05" [77.47] H.
Number of Characters: 256.
Character Size: .146" [3.71] W x .252" [6.40] H.
Luminance: 70 foot lamberts.
Color: Neon orange.
Viewing Angle: 150° cone.

DIMENSIONAL CONFIGURATION

[Numbers in brackets indicate millimeters]



MODEL APD-256M025A

GENERAL DESCRIPTION

The APD-256M025A plasma display module consists of a multiplexed DC plasma display, driver circuitry and a microprocessor-based controller board. The interface is a basic 8 bit parallel ASCII interface with handshaking and some dedicated control lines. The system microprocessor handles input data rates up to 10 kHz. Dale's patented open construction display technology assures a stable, flicker free screen.

The ASCII data and cursor data are presented to the unit in negative logic convention and a separate strobe line for each determines which is entered. A single busy signal indicates to the host system when the display is busy.

The EPROM based character generator is programmed with an international character set which includes the standard ASCII characters. It can be factory or user programmed for other character sets.

The logic input is one 74LS type input with a 4.75 kilohm to + 5 VDC and a 1000 pF capacitor to ground. The output is driven from a 74LS06 open collector gate and is not internally pulled up.

INTERFACE SIGNAL DESCRIPTION

DB0-DB7 (Data bus) - Data bus to enter character and cursor data.

CUR-LD (Cursor Load) - The cursor is moved to the address given by DB0-DB7 where:
 00 = home position.
 1F = last character, 1st line.
 E0 = first character, 8th line.
 FF = last character, 8th line.

WR (Write) - The character as defined by the code given by DB0-DB7 is displayed at the selected address. The display auto-increments from a given address.

CLR (Clear Command) - Display memory is cleared and the cursor goes to the HOME position (upper left corner of the screen).

CUR ON/OFF (Cursor on or off) - A logic low will display the cursor and a logic high will turn the cursor off.

BUSY (Busy Signal) - I/O is inhibited when busy is high.

PIN DESCRIPTION		
CONNECTOR	PIN	SIGNAL
J1	1	+ 185 VDC
	2	GROUND (H)
	3	GROUND(L)
	4	+ 5 VDC
J2	1, 3, 5, 7, 9, 11, 13, 15	DB0-DB7
	2,4,6	NO CONNECTION
	8	BUSY
	10	CUR ON/OFF
	12	CLR
	14	WR
	16	CUR-LD

WARNING: Wrong connections or reversing J2 may cause permanent damage to the display and host system.

CURSOR ADDRESS MAP	
0	31
32	63
64	95
96	127
128	159
160	191
192	223
224	255

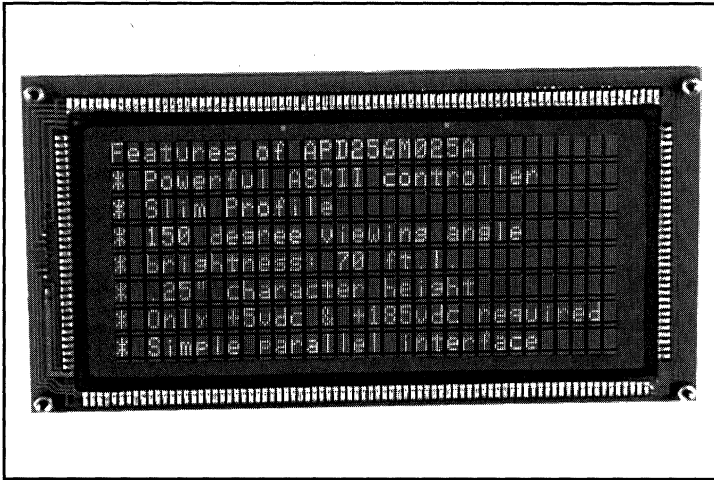
0 = HOME = 0000. 0000 = All "HIGH".
 The cursor address is given by the 8 bit binary equivalent of the numbers shown.

INPUT FUNCTION TABLE			
CUR-LD	WR	CLEAR	FUNCTION
L	H	H	Select a cursor address with DB0-DB7
H	L	H	DB0-DB7 ASCII character loaded at cursor address, increment address
H	H	L	Erase display and go to the home position

ORDERING INFORMATION	
DESCRIPTION	PART NUMBER
Display, Drive Electronics and Controller	APD-256M025A
Parallel Data Connector Kit	280105-02
Power Connector Kit	280108-06
Non-Glare Filter (amber circular polarized) - other filters available - contact factory	280109-14

MODEL APD-256M025A-1 Plasma Panel Display Modules

256 Character Display with Drive Electronics, Controller, Parallel and Serial Interface



The APD-256M025A-1 display module displays up to 256 alphanumeric 5 x 7 dot matrix characters arranged in 8 lines of 32 characters each.

The module includes drive electronics, a controller consisting of refresh memory, character generator and control logic with ASCII input. Interfacing is very simple (parallel or serial) and requires minimum handshake to enable the module to serve as a cost effective direct readout device for many applications including POS terminals, industrial controls, computer peripherals, measurement instruments and office machines.

STANDARD ELECTRICAL SPECIFICATIONS

	MIN.	TYP.	MAX.	UNITS
Logic Supply Voltage	+ 4.75	+ 5.0	+ 5.25	V
Logic Supply Current	—	0.45	—	A
Panel Supply Voltage	+ 11.4	12.0	12.6	V
Panel Supply Current	—	0.6	1.0	A
Logic One Voltage	2.4	—	5.5	V
Logic Zero Voltage	—	—	0.8	V
Logic Zero Input Current	—	—	- 0.4	mA

FEATURES

- 256 (8 x 32) alphanumeric characters (5 x 7 dot matrix)
- Only + 5 and + 12 VDC required
- 256 International character set (includes ASCII characters). (Optional character sets available.)
- Parallel interface
- Serial interface (RS-232 or TTL)
- Wide viewing angle (150°)
- Rugged design/slim profile
- Flicker free refresh, high speed data input
- High brightness

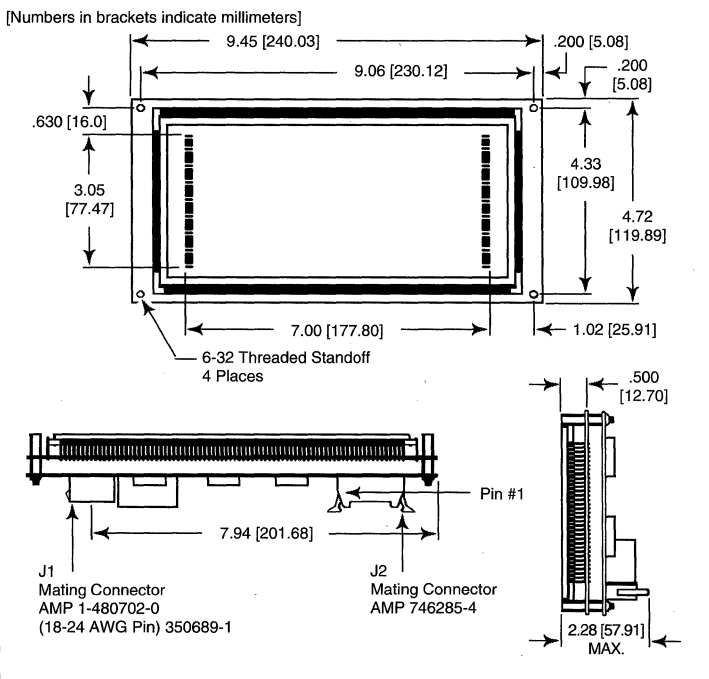
ENVIRONMENTAL SPECIFICATIONS

- Operating Temperature:** 0°C to + 55°C.
- Storage Temperature:** - 55°C to + 85°C.
- Relative Humidity:** 10-90% R.H. non-condensing.
- Mechanical Shock:** 50G 1/2 sine wave, 11 msec duration, 5 shocks in each of 6 directions.
- Vibration:** 0.018 [0.46] displacement amplitude from 10 to 50 Hz, 2G acceleration from 50 to 2000 Hz logarithmic sweep rate, along each side of the 3 major axes.

OPTICAL SPECIFICATIONS

- Viewing Area:** 7.00" [177.80] W x 3.05" [77.47] H.
- Number of Characters:** 256.
- Character Size:** 0.146" [3.71] W x 0.252" [6.40] H.
- Luminance:** 70 foot lamberts.
- Color:** Neon orange.
- Viewing Angle:** 150° cone.

DIMENSIONAL CONFIGURATIONS



MODEL APD-256M025A-1

GENERAL DESCRIPTION

The APD-256M025A-1 plasma display module consists of a multiplexed DC plasma display, driver circuitry and a microprocessor-based controller board. Dale's[®] patented open construction display technology assures a stable, flicker free screen.

The parallel interface is a basic 8 bit parallel ASCII interface with handshaking and some dedicated control lines. The ASCII data and command data are presented to the unit in positive logic convention. Data is entered by first placing the data to be strobed into the display on the data bus. A negative going strobe of 200 nS on the WRITE pin will notify the controller that data is available. The controller will respond with a positive going BUSY signal that will remain a logic one until the controller is ready. The system microprocessor handles input data rates up to 10 kHz.

Data format for serial interface is 1 start bit, 8 data bits and 1 stop bit. Baud rates from 150 to 19,200 can be selected. The serial interface can be programmed for RS-232 or TTL voltage levels. The display can operate with no handshaking at the highest baud rate, as it has a 20 character buffer to capture data while doing long commands. However, it is important to note instruction execution times to prevent loss of data in the event that several long commands are placed in sequence.

The EPROM based character generator is programmed with an international character set which includes the standard ASCII characters. It can be factory or user programmed for other character sets.

The logic input is one HCT type input with a 4.75 kilohm to + 5 VDC. The output is driven from a 74LS06 open collector gate and is not internally pulled up.

INTERFACE SIGNAL DESCRIPTION

DB0-DB7 (Data Bus) - Data bus to enter character and cursor data.

WRITE - A negative going strobe of 20 nS (minimum) notifies the display that data is present on the data bus.

BUSY (Busy Signal) - I/O is inhibited when busy is high.

SERIAL DATA - Input for serial data (RS-232 or TTL voltage levels). Note - Voltage levels must be jumper selected. Application of RS-232 voltages with the jumper set for TTL levels will damage the display.

OPERATING MODE DESCRIPTION

DC1 - (Overwrite Mode) The cursor advances automatically when character data is written. If it is at the last column in a row, it shifts to the first column of the next row.

DC2 - (Vertical Scroll Mode) The cursor advances automatically when character data is written. If it is at the last column of the last row, all screen characters shift upwards one row, pushing the top row off the screen. The bottom row is cleared and the cursor is placed at the first column of the last row.

PIN DESCRIPTION		
CONNECTOR	PIN	SIGNAL
J1	1	+ 12 VDC
	2	GROUND
	3	SERIAL DATA
	4	+ 5 VDC
J2	1, 3, 5, 7, 9, 11, 13, 15	DB0-DB7
	17	BUSY
	19	WRITE
	2, 4, 6, 8, 10, 12, 14, 16, 18, 20	GROUND
	WARNING: Wrong connections may cause permanent damage to the display and host system.	

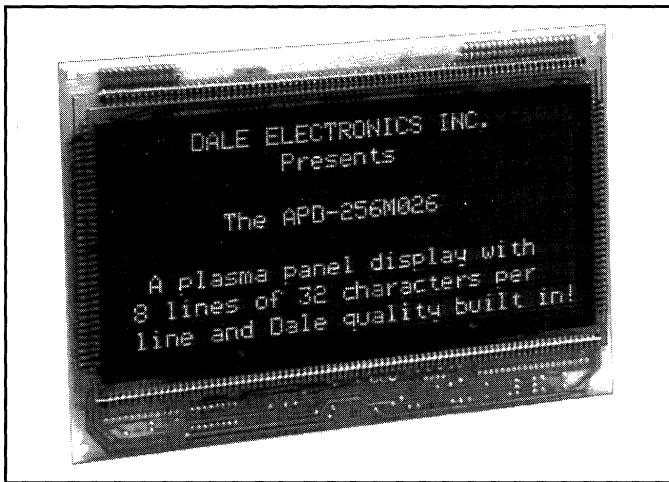
COMMAND SUMMARY		
CONTROL COMMANDS	CODE (HEX)	TIMING
Cursor Left	08	210 μS
Cursor Right	09	210 μS
Cursor Down	0A	210 μS
Cursor Up	0B	210 μS
Clear Screen, Home Cursor	0C	6.4 mS
Carriage Return	0D	210 μS
Home Cursor	0E	210 μS
Insert Character	0F	1.2 mS
Delete Character	10	1.2 mS
Alter Cursor Column (2 Byte)	11	190 μS
Cursor On (Blinking Underbar)	12	190 μS
Alter Cursor Row (2 Byte)	13	190 μS
Cursor Invisible	14	190 μS
Insert Line	16	2.2 mS
Delete Line	17	2.2 mS
Set Display to DC2 Mode	18	190 μS
Set Display to DC1 Mode	19	190 μS

ORDERING INFORMATION	
DESCRIPTION	PART NUMBER
Display, Drive Electronics and Controller	APD-256M025A-1
Parallel Data Connector Kit	280105-04
Power/Serial Data Connector Kit	280108-06
Non-Glare Filter (amber circular polarized) - other filters available, contact factory	280109-14

MODEL APD-256M026

Plasma Panel Display Modules

256 Character Display with Drive Electronics



The APD-256M026 display module displays up to 256 alphanumeric 5 x 7 dot matrix characters arranged in 8 lines of 32 characters each. The module includes drive electronics and is easily interfaced to CRT controllers.

FEATURES

- 256 (8 x 32) alphanumeric characters (5 x 7 dot matrix plus underbar)
- .18 W x .26 H character size
- High brightness (100 foot/lamberts typical)
- Controller Board available with parallel and RS232 inputs
- Wide viewing angle (150°)
- Easily interfaced
- Compact size

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature: 0°C to + 55°C.

Storage Temperature: - 55°C to + 85°C.

Relative Humidity: 10-90% non-condensing.

Mechanical Shock: 50G 1/2 sine wave, 11 ms duration, 5 shocks in each of 6 directions.

Vibration: .018" displacement amplitude from 10 to 50 Hz, 2G acceleration from 50 to 2000 Hz logarithmic sweep rate. 30 minutes duration along each side of the 3 major axes.

OPTICAL SPECIFICATIONS

Viewing Area: 3.30" [83.82] W x 7.62" [193.55] L.

Number of Characters: 256.

Character Size: .18" [4.57] W x .26" [6.60] H.

Dot Size: .020" [.508] diameter.

Dot Pitch: .040" [1.016].

Character Spacing: .060" [1.52].

Scanning Rate: 70-80 Hz.

Brightness: 100 foot lamberts.

Color: Neon orange.

Viewing Angle: 150° cone.

GENERAL DESCRIPTION

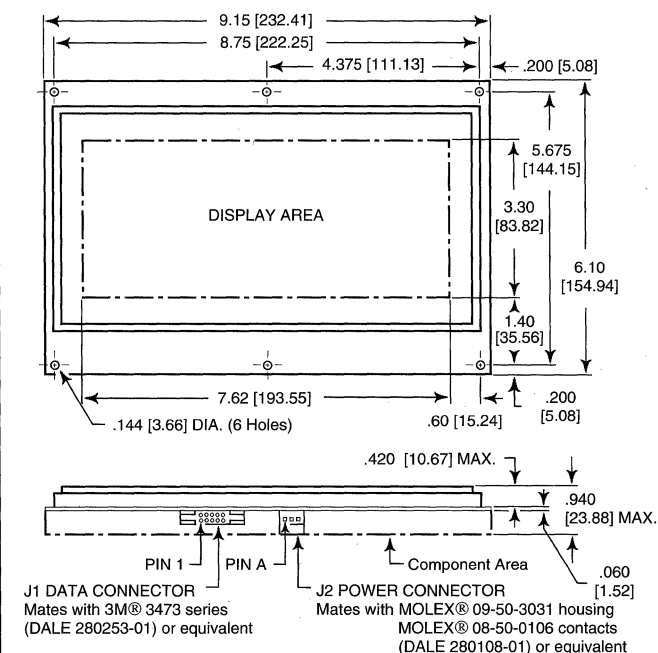
The APD-256M026 consists of a DC plasma panel display and drive circuitry to accept serially entered row data and generate the required cathode and anode signals to display the desired information. The module displays information in a row scanning mode; that is, row by row beginning at the top, with each character being 5 dots wide and with 32 characters per row, 160 bits of dot information per row is supplied to the module as serial data. When all 160 bits of row information have been loaded, the data will be displayed. This process is repeated until all 64 rows (each character being 7 dots high plus underbar) have been scanned in succession. All inputs are TTL compatible.

STANDARD ELECTRICAL SPECIFICATIONS

	MIN.	TYP.	MAX.	UNITS
Logic Supply 1 Voltage	4.75	5.0	5.25	V
Logic Supply 2 Voltage	11.40	12.0	12.60	V
Logic Supply 1 Current	—	50.0	60.0	mA
Logic Supply 2 Current	—	60.0	75.0	mA
Panel Supply 1 Voltage	91.25	95.0	99.75	V
Panel Supply 2 Voltage	- 85.50	- 90.0	- 94.50	V
Panel Supply 1 Current	—	60.0	128.0	mA
Panel Supply 2 Current	—	80.0	135.0	mA

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



MODEL APD-256M026

INTERFACE SIGNAL DESCRIPTION

Serial Data - The 160 bits of data that represent one row of character data is serially entered on this input. The information is entered at the 160th dot position (right side of display) and is advanced one column with each **Data Shift** pulse.

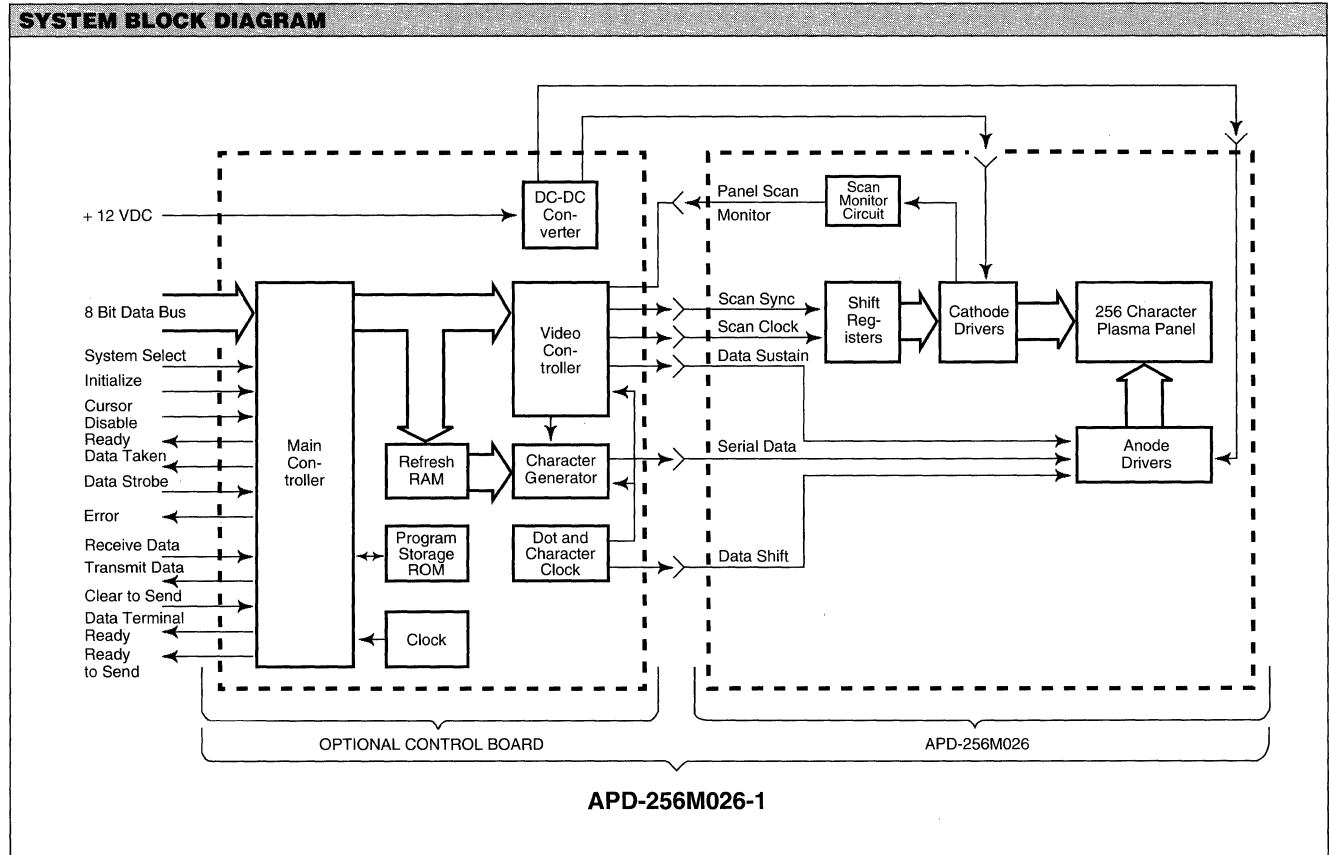
Data Shift - A negative going edge on this input enters the row data bit present at the **Serial Data** input. This input requires 160 pulses to enter the 160 bits of row data.

Data Sustain - This input blanks the display during data entry. When all 160 bits of dot data are entered, a logic low on this input displays the data.

Scan Clock - Much like horizontal sync on a CRT, this signal is used to advance the row pointer vertically down the display, one row at a time. This input must be continually pulsed whenever the display is on to prevent damage to the panel.

Scan Sync - This pulse is applied after each complete scan to begin a new scan at the top row of the panel, similar to vertical sync on a CRT.

PIN DESCRIPTION		
CONNECTOR	PIN	FUNCTION
J1	1	DATA SHIFT
	2	GROUND
	3	DATA SUSTAIN
	4	+ 12 VDC
	5	SCAN SYNC
	6	SCAN CLOCK
	7	+ 5 VDC
	8	SCAN MONITOR
	9	GROUND
	10	SERIAL DATA
J2	A	- 90 VDC
	B	GROUND
	C	+ 95 VDC



ORDERING INFORMATION

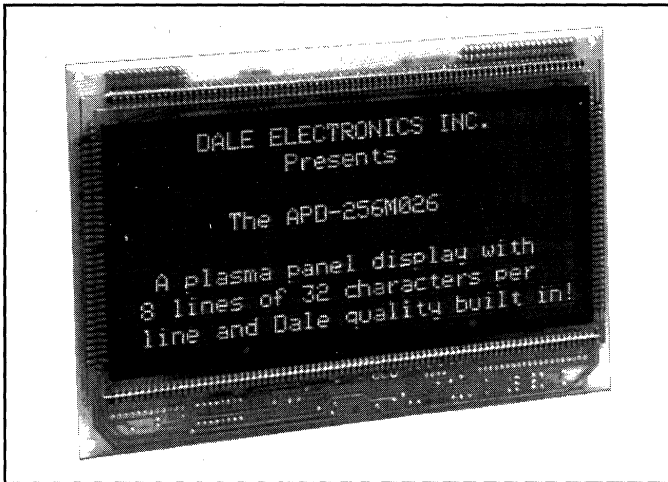
DESCRIPTION	PART NUMBER
Display and Drive Electronics	APD-256M026
Display and Drive Electronics plus Controller Board (includes DC-DC high voltage converter)	APD-256M026-1
DC-DC High Voltage Converter	PDS-300
Data Connector Kit	280253-01
Power Connector Kit	280108-01
Non-Glare Filter (amber circularly polarized) - other filters available - contact factory	280109-04

MODEL APD-256M026-1

Plasma Panel Display Modules

256 Character Display

with Drive Electronics and Controller



The APD-256M026-1 display module displays up to 256 alphanumeric 5 x 7 dot matrix characters arranged in 8 lines of 32 characters each. The module includes drive electronics, a microprocessor-based controller consisting of refresh memory, character generator and control logic with parallel or serial interface and a DC to DC converter to develop the necessary panel voltage.

FEATURES

- 256 (8 x 32) alphanumeric characters (5 x 7 dot matrix plus underbar)
- 128 USASCII character set + 128 user programmable character set
- High brightness
- Wide viewing angle (150°)
- Low input voltage
- Compact size
- Software dimming
- Parallel and serial interfaces

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature: 0°C to + 55°C.

Storage Temperature: - 55°C to + 85°C.

Relative Humidity: 10-90% non-condensing.

Mechanical Shock: 50G 1/2 sine wave, 11 ms duration, 5 shocks in each of 6 directions.

Vibration: .018" displacement amplitude from 10 to 50 Hz, 2G acceleration from 50 to 2000 Hz logarithmic sweep rate. 30 minutes duration along each side of the 3 major axes.

OPTICAL SPECIFICATIONS

Viewing Area: 3.30" [83.82] W x 7.62" [193.55] L.

Number of Characters: 256.

Character Size: .18" [4.57] W x .26" [6.60] H.

Dot Size: .020" [.508] diameter.

Dot Pitch: .040" [1.016].

Character Spacing: .060" [1.52].

Brightness: 100 foot lamberts.

Color: Neon orange.

Viewing Angle: 150° cone.

GENERAL DESCRIPTION

The APD-256M026-1 consists of a DC plasma panel display, drive circuitry and controller. The controller is programmable to operate in a parallel or serial mode. The parallel interface is a basic 8 bit parallel interface with hand-shaking and some dedicated control lines. The serial interface is RS-232-C compatible with 8 selectable baud rates and 2 bit formats. Single byte and two byte commands allow simplified code generation, yet accomplish complex display tasking such as scrolling, or inserting lines and characters.

The character generator is a 4K x 8 bit EPROM and is capable of storing two 128 character sets. The standard set consists of 128 USASCII characters (including control codes). An alternate set of 128 characters can be user programmed.

A DC-DC converter generates the required display voltage from + 12 VDC, and all input lines are LSTTL compatible with 6.8 kilohm pull-up resistors to Vcc.

ELECTRICAL SPECIFICATIONS

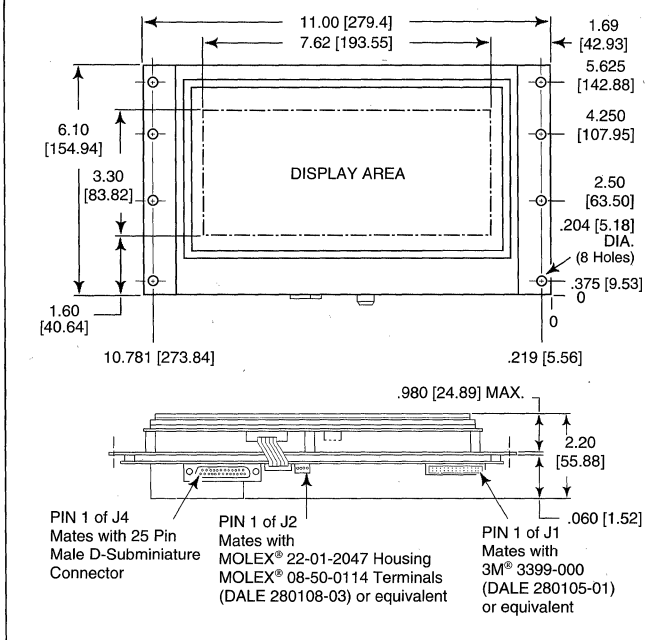
	MIN.	TYP.	MAX.	UNITS
Logic Supply Voltage	+ 4.75	5.0	+ 5.25	V
Logic Supply Current	—	700	—	mA
Panel Supply Voltage	11.40	12.0	12.60	V
Panel Supply Current (1)	—	1.0	2.20	A
Negative Supply Voltage(2)	- 11.40	- 12.0	- 12.60	V
Negative Supply Current	—	60.0	—	mA

(1) This is the input to a DC-DC converter. There may be peak in rush currents higher than shown.

(2) Required only if RS-232-C serial interface is used.

DIMENSIONAL CONFIGURATION

[Numbers in brackets indicate millimeters]



MODEL APD-256M026-1

FUNCTION SUMMARY					
CONTROL CODES	HEX	ASCII	CONTROL CODES	HEX	ASCII
CURSOR HOME	0E	CNTRL-N	ERASE TO END OF LINE	1B,0D	ESC, CNTRL-M
CARRIAGE RETURN	0D	CNTRL-M	ERASE TO END OF SCREEN	1B, 18	ESC, CNTRL-X
LINE FEED	0A	CNTRL-J	ERASE LINE	1B, 13	ESC, CNTRL-S
CURSOR UP	0B	CNTRL-K	ERASE LINE & CARRIAGE RETURN	1B, 25	ESC, CNTRL-%
CURSOR DOWN	0A	CNTRL-J	ALTER BRIGHTNESS	1B, 0C	ESC, CNTRL-L
CURSOR RIGHT	09	CNTRL-I	BRIGHTNESS CONTROL CODES: (0 = BRIGHTEST, 7 = LEAST BRIGHT)	##	
CURSOR LEFT	08	CNTRL-H	SCROLL	1B, 1A	ESC, CNTRL-Z
ALTER CURSOR CHARACTER POSITION	11	CNTRL-Q	* END SCROLL	1B, 20	ESC, SPACE BAR
CURSOR POSITION ADDRESS	##		BLANK DISPLAY (ON/OFF ALTERNATELY)	1B, 11	ESC, CNTRL-Q
ALTER CURSOR ROW POSITION	13	CNTRL-S	SCAN DISABLE (ON/OFF ALTERNATELY)	1B, 12	ESC, CNTRL-R
CURSOR ROW ADDRESS	##		SELECT ALTERNATE CHARACTER SET	1B, 0F	ESC, CNTRL-O
CURSOR ON	12	CNTRL-R	* SELECT STANDARD CHARACTER SET	1B, 0E	ESC, CNTRL-N
CURSOR OFF	14	CNTRL-T	ENABLE SCAN DISABLE TIMER	1B, 23	ESC, SHIFT-#
ALTER CURSOR FORMAT	15	CNTRL-U	* DISABLE SCAN DISABLE TIMER	1B, 24	ESC, SHIFT-\$
CURSOR FORMAT CODE:			DISPLAY CONTROL CHARACTERS	1B, 1E	ESC, CNTRL-^
FULL BLOCK, NO BLINK	00		* DISABLE DISPLAY CONTROL CHARACTERS	1B, 26	ESC, SHIFT-&
NO OPERATION	00	CNTRL-@	CHARACTER BLINK	1B, 21	ESC, SHIFT-!
CLEAR SCREEN	0C	CNTRL-L	* DISABLE CHARACTER BLINK	1B, 22	ESC, SHIFT-"
CHARACTER INSERT	0F	CNTRL-O	START CONFIDENCE TEST	1B, 1F	ESC, SHIFT-_
CHARACTER DELETE	10	CNTRL-P	* DISABLE CONFIDENCE TEST (ANY CODE)	##	
LINE INSERT	16	CNTRL-V	RESET CONTROLLER (TO INITIAL STATE)	1B, 19	ESC, CNTRL-Y
LINE DELETE	17	CNTRL-W			

* Power up condition.

PIN DESCRIPTION		
CONNECTOR	PIN	SIGNAL
J1	9	DATA BIT 1 (LSB)
	3	DATA BIT 2
	6	DATA BIT 3
	7	DATA BIT 4
	5	DATA BIT 5
	4	DATA BIT 6
	2	DATA BIT 7
	1	DATA BIT 8 (MSB)
	10	CURSOR DISABLE
	12	ERROR
	13	READY
	15	DATA STROBE
	16	INITIALIZE
	17	DATA TAKEN
	22	SYSTEM SELECT
	25	+ 5 V
	26	+ 5 V
	24	- 12 V (RS-232-C ONLY)
	21	+ 12 V
	19	GROUND
20	GROUND	
J2	1	+ 12 V (DISPLAY POWER)
	2	+ 5 V
	3	GROUND
	4	- 12 V (RS-232-C ONLY)
J4	3	RECEIVED DATA
	2	TRANSMIT DATA
	7	SIGNAL GROUND
	4	READY TO SEND
	5	CLEAR TO SEND
20	DATA TERMINAL READY	

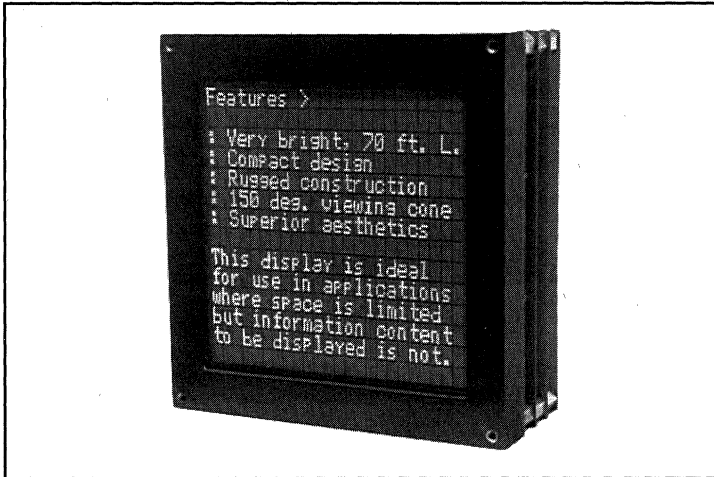
NOTE: Unidentified pins are not connected.
WARNING: Wrong connections in any connectors or reversing J1 may cause permanent damage to the display and host interface.

MODIFIED USASCII CHARACTER SET															
Bits					Col.	0	1	2	3	4	5	6	7		
b7	b6	b5	b4	b3	b2	b1	Row	0	1	2	3	4	5	6	7
0	0	0	0	0	0	0	0	NUL	DLE	SP	0	@	P	'	p
0	0	0	1	1	1	1	0	SOH	DC1	!	1	A	Q	a	q
0	0	1	0	2	2	2	0	STX	DC2	"	2	B	R	b	r
0	0	1	1	3	3	3	0	ETX	DC3	#	3	C	S	c	s
0	1	0	0	4	4	4	0	EOT	DC4	\$	4	D	T	d	t
0	1	0	1	5	5	5	0	ENQ	NAK	%	5	E	U	e	u
0	1	1	0	6	6	6	0	ACK	SYN	&	6	F	V	f	v
0	1	1	1	7	7	7	0	BEL	ETB	'	7	G	W	g	w
1	0	0	0	8	8	8	0	BS	CAN	(	8	H	X	h	x
1	0	0	1	9	9	9	0	HT	EM	)	9	I	Y	i	y
1	0	1	0	10	10	10	0	LF	SUB	*	:	J	Z	j	z
1	0	1	1	11	11	11	0	VT	ESC	+	;	K	[	k	{
1	1	0	0	12	12	12	0	FF	FS	,	<	L	\	l	|
1	1	0	1	13	13	13	0	CR	GS	_	=	M	]	m	}
1	1	1	0	14	14	14	0	SO	RS	.	>	N	^	n	~
1	1	1	1	15	15	15	0	SI	US	/	?	O	_	o	DEL

ORDERING INFORMATION	
DESCRIPTION	PART NO.
Display, Drive Electronics plus Controller Board (includes DC-DC converter)	APD-256M026-1
Display and Drive Electronics Only	APD-256M026
Parallel Data Connector Kit	280105-01
Power Connector Kit	280108-03
Non Glare Filter (amber circular polarized) - other filters available - contact factory	280109-04

MODEL APD-336M019/-2 Plasma Panel Display Modules

336 Character Display with Drive Electronics and Controller



The APD-336M019 display module displays up to 336 alphanumeric 5 x 7 dot matrix characters arranged in 14 lines of 24 characters each. The module includes drive electronics, a controller consisting of refresh memory, character generation and control logic to enable the module to serve as a direct readout device for many applications. A DC/DC converter is also included to develop the necessary panel voltage from + 15 VDC (other input voltages available).

FEATURES

- 336 (14 x 24) alphanumeric characters (5 x 7 dot matrix)
- 128 USASCII character set plus 128 user programmable character set
- Parallel interface
- High brightness
- Wide viewing angle (120°)
- Low input voltage
- Minimal footprint

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature: 0°C to + 55°C.

APD-336M019-2: - 15°C to + 70°C.

(Life may be shortened when subjected to operation below 0°C.)

Storage Temperature: - 55°C to + 85°C.

Relative Humidity: 10-90% non-condensing.

Mechanical Shock: 50G 1/2 sine wave, 11 msec duration. Five shocks in each of six directions.

Vibration: 0.018" displacement amplitude from 10 to 50 Hz, 2G acceleration from 50 to 2000 Hz logarithmic sweep rate, along each side of the 3 major axes.

OPTICAL SPECIFICATIONS

Viewing Area: 3.28" [83.31] W x 3.31" [84.07] L.

Number of Characters: 336.

Character Size: 0.105" [2.67] W x .193" [4.90] H.

Pixel Pitch:
0.023" [.584] horizontal.
0.030" [.762] vertical.

Luminance: 80 foot lamberts maximum.

Color: Neon orange.

Viewing Angle: 120°C cone.

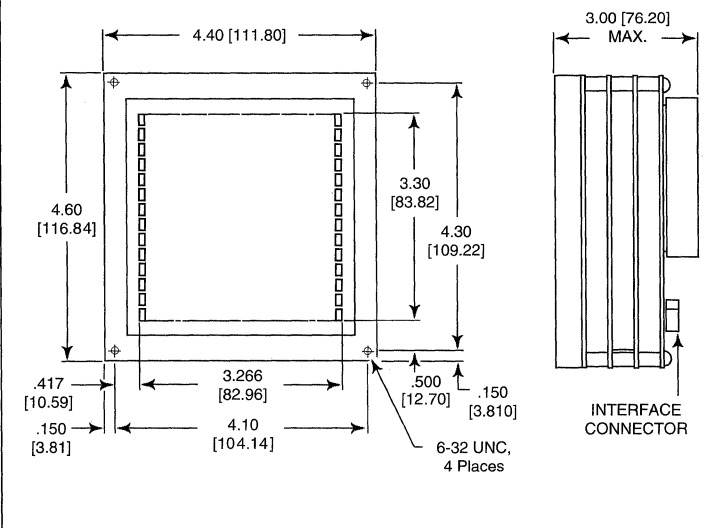
STANDARD ELECTRICAL SPECIFICATIONS

	MIN.	TYP.	MAX.	UNITS
Logic Supply Voltage	4.75	5.0	5.25	V
Logic Supply Current	—	0.5	—	A
Panel Supply Voltage	14.25	15.00	15.75	V
Panel Supply Current *	—	0.5	—	A
Logic One Voltage	2.0	—	—	V
Logic Zero Voltage	—	—	0.8	V
Logic Zero Input Current	—	—	- 0.4	mA

* This is the input to a DC/DC converter. There may be peak in-rush currents higher than shown.

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



MODEL APD-336M019-2

GENERAL DESCRIPTION

The APD-336M019 consists of a DC plasma panel display, drive circuitry, and refresh controller. The interface is a basic 8 bit parallel interface.

The refresh controller maintains all the refresh memory, character generation and control logic. The controller automatically shuts off the display on power up, prior to set up. The host processor must then initialize the refresh controller by setting up its internal registers, then bringing the BLS line low and back high. This feature is designed to protect the display from misscan damage on power-up. The character generator is a 2732A EPROM that is preprogrammed with a 128 ASCII character set. Character highlighting (4 Hz blink) is accomplished by setting DB7 high when entering any given character.

Industrial temperature range IC's are used in the APD-336M019-2 to extend the operating temperature range to - 15°C to + 70°C.

INTERFACE SIGNAL DESCRIPTION

E (Enable) - Triggers all data transfers between the system microprocessor and the display.

R/W (Read/Write) - Controls the direction of data transfers.

RS0 (Register Select 0) - Accesses the displays internal control registers.

RS1 (Register Select 1) - Accesses the data input/output latches.

US (Unit Select) - Display selected when US signal is low.

CDIS (Cursor Disable) - Cursor disabled when CDIS is low.

BLS (Blank Screen) - Screen blanked when BLS signal is low.

DB0-DB7 (Data Bus) - Tri-state Bi-directional data bus to exchange data between display and host processor.

PIN DESCRIPTION	
PIN	DESCRIPTION
1, 2, 3, 4	UNUSED
5	DATA BIT 0
6	DATA BIT 1
7	DATA BIT 2
8	DATA BIT 3
9	DATA BIT 4
10	DATA BIT 5
11	DATA BIT 6
12	DATA BIT 7
13	CURSOR DISABLE
14	BLS
15	RS0
16	RS1
17	E
18	US
19	R/W
20	+ 5 VDC
21, 23, 25	GND (all inputs must be connected)
22, 24, 26	+ 15 VDC (all inputs must be connected)
WARNING: Wrong connections or reversal of the connector may cause permanent damage to the display and host interface.	

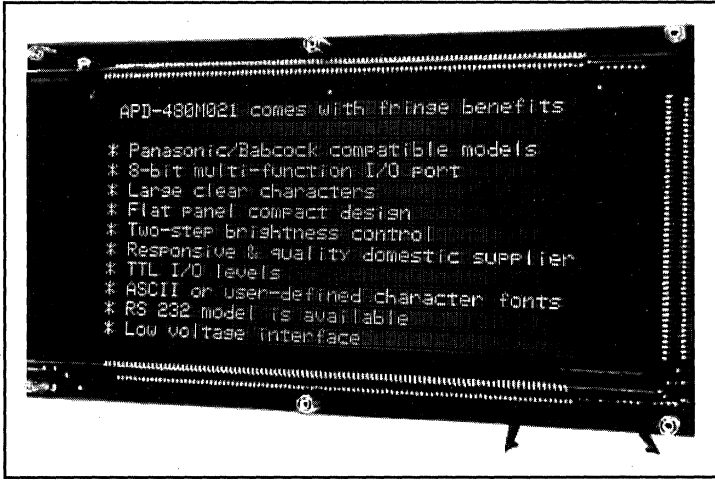
MODIFIED USASCII CHARACTER SET															
Bits															
					0	0	0	0	1	1	1	1			
					0	0	1	1	0	0	1	1			
					0	1	0	1	0	1	0	1			
b6	b5	b4	b3	b2	b1	b0	Col.	0	1	2	3	4	5	6	7
							Row	0	1	2	3	4	5	6	7
						0		NUL	DLE	SP	0	@	P	'	p
						0	1	SOH	DC1	!	1	A	Q	a	q
						0	0	1	0	2	STX	DC2	"	2	B R b r
						0	0	1	1	3	ETX	DC3	#	3	C S c s
						0	1	0	0	4	EOT	DC4	\$	4	D T d t
						0	1	0	1	5	ENQ	NAK	%	5	E U e u
						0	1	1	0	6	ACK	SYN	&	6	F V f v
						0	1	1	1	7	BEL	ETB	'	7	G W g w
						1	0	0	0	8	BS	CAN	(	8	H X h x
						1	0	0	1	9	HT	EM	)	9	I Y i y
						1	0	1	0	10	LF	SUB	*	:	J Z j z
						1	0	1	1	11	VT	ESC	+	;	K [k {
						1	1	0	0	12	FF	FS	,	<	L \ l !
						1	1	0	1	13	CR	GS	_	=	M] m }
						1	1	1	0	14	SO	RS	.	>	N ^ n ~
						1	1	1	1	15	SI	US	/	?	O _ o DEL

ORDERING INFORMATION	
DESCRIPTION	PART NUMBER
Display, Driver Electronics, Controller, with DC/DC Converter	APD-336M019
Display, Drive Electronics, Controller, with DC/DC Converter and Extended Operating Temperature Range	APD-336M019-2
Interface Connector Kit	280105-01
Non-Glare Filter (amber circular polarized) - other filters available - contact factory	280109-08

MODEL APD-480M021-1

Plasma Panel Display Modules

480 Character Display with Drive Electronics, Controller and Serial Interface

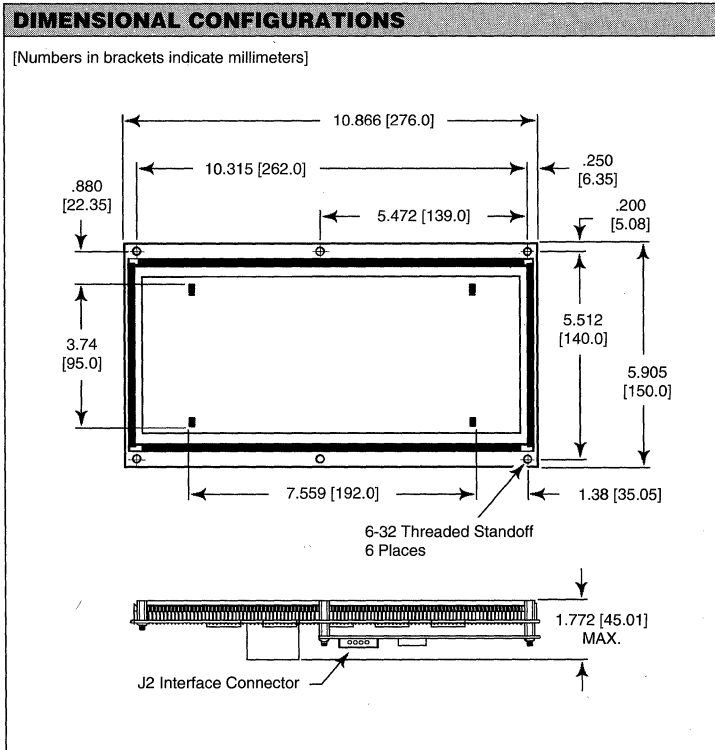


The APD-480M021-1 display module displays up to 480 alphanumeric 5 x 7 dot matrix characters arranged in 12 lines of 40 characters each. The module includes drive electronics, a controller consisting of refresh memory, character generator and control logic with an ASCII one line RS-232 compatible interface to enable the module to serve as a direct readout device for many applications including POS terminals, industrial controls, computer peripherals, measurement instruments, and office machines. (A Parallel Interface version is available - APD-480M021-2).

STANDARD ELECTRICAL SPECIFICATIONS				
	MIN.	TYP.	MAX.	UNITS
Logic Supply Voltage	+ 4.75	+ 5.0	+ 5.25	V
Logic Supply Current	—	—	750	mA
Panel Supply Voltage	11.4	12.0	12.6	V
Panel Supply Current	—	.7	2.5	A

FEATURES

- 480 (12 x 40) alphanumeric characters (5 x 7 dot matrix)
- Only + 5 and + 12 VDC required
- ASCII character set (optional character sets available)
- Efficient serial interface
- Two step brightness control
- Wide viewing angle (150°)
- Rugged design/slim profile
- Flicker free refresh
- Editing functions



ENVIRONMENTAL SPECIFICATIONS

Operating Temperature: 0°C to + 55°C.
Storage Temperature: - 55°C to + 85°C.
Relative Humidity: 10-90% R.H. non-condensing.
Mechanical Shock: 50G sine wave, 11 msec duration, 5 shocks in each of 6 directions.
Vibration: .018" displacement amplitude from 10 to 50 Hz, 2 G acceleration from 50 to 2000 Hz logarithmic sweep rate, along each side of the 3 major axes.

OPTICAL SPECIFICATIONS

Viewing Area: 7.56" [192.02] W x 3.74" [95.00] H.
Number of Characters: 480.
Character Size: 0.146" [3.708] W x .209" [5.309] H.
Luminance: 60 foot lamberts.
Color: Neon orange.
Viewing Angle: 150° cone.

MODEL APD-480M021-1

GENERAL DESCRIPTION

The APD-480M021-1 consists of a DC plasma panel display, drive circuitry and controller. The interface is through a single 4 pin power connector that only requires + 5 VDC, + 12 VDC, Ground and Serial Data inputs. Handshaking is not required as a 20 byte FIFO buffer is used to capture data when the display is busy. Dale's® patented open construction display technology assures a stable, flicker free screen. The controller maintains all the refresh memory, character generation and control logic. Various editing functions are available such as scrolling, inserting and deleting characters. The module can also be dimmed or blanked for screen highlighting. Serial data protocol is 8 data bits, no parity, 1 start bit and 1 stop bit. Baud rate (300, 1200 or 9600) is selected with a control board jumper. A self test can be manually performed by removing a jumper. The EPROM based character generator is programmed with an ASCII character set, but is easily configured for any character set.

PIN DESCRIPTION		
CONNECTOR	PIN	SIGNAL
J2	1	+ 5 V
	2	SERIAL DATA
	3	GND
	4	+ 12 VDC
WARNING: Wrong connections or reversing J2 may cause permanent damage to the display and host interface.		

COMMAND DESCRIPTION

- 04H:** Set display to full brightness.
- 05H:** Set display to half brightness.
- 06H:** Unblank Display - Restores screen information previously blanked with Blank Display command.
- 07H:** Blank Display - Blanks screen without losing data.
- 08H:** Cursor Left (Back Space).
- 09H:** Cursor Right (Horizontal Tab).
- 0AH:** Cursor Down (Line Feed).
- 0BH:** Cursor Up (Vertical Tab).
- 0CH:** Clear Screen, Home Cursor.
- 0DH:** Carriage Return.
- 0EH:** Cursor Home.
- 0FH:** Insert Character.
- 10H:** Delete Character.
- 11H:** DC1 MODE (Default Display Mode) - Cursor shifts one character to the right automatically when character data is written. If the cursor is at the right end of a row, it shifts to the leftmost end of the next row.
- 12H:** DC2 MODE (Vertical Scroll Mode) - When the Cursor reaches the right end of the bottom row, all screen characters shift upwards one row, pushing the top row off the screen. The bottom row is cleared and the cursor is placed at the left end of the bottom row.
- 13H:** DC3 MODE (Default Cursor Mode) - Cursor is turned on.
- 14H:** DC4 MODE - Cursor is turned off.
- 15H:** DC5 MODE - Cursor is turned on and blinks at 4 Hz.
- 16H:** Line Insert.
- 17H:** Line Delete.
- 18H:** Cursor position - The cursor position may be defined by 2 bytes of data after the Cursor Position command. The first byte defines the row, and the second byte the column.

COMMAND EXECUTION TIMING		
CODE	DESCRIPTION	TIMING
04H	Set Full Brightness	190 µS
05H	Set Half Brightness	190 µS
06H	Unblank	190 µS
07H	Blank Display	190 µS
08H	Cursor Left	210 µS
09H	Cursor Right	210 µS
0AH	Cursor Down	210 µS
0BH	Cursor Up	210 µS
0CH	Clear Screen, Cursor Home	6.4 µS
0DH	Carriage Return	210 µS
0EH	Cursor Home	210 µS
0FH	Insert Character	1.2 mS
10H	Delete Character	1.2 mS
11H	DC1 Mode	190 µS
12H	DC2 Mode	190 µS
13H	DC3 Mode	190 µS
14H	DC4 Mode	190 µS
15H	DC5 Mode	190 µS
16H	Line Insert	2.2 mS
17H	Line Delete	2.2 mS
18H	Cursor Position	190 µS
	Y Position	120 µS
	X Position	120 µS

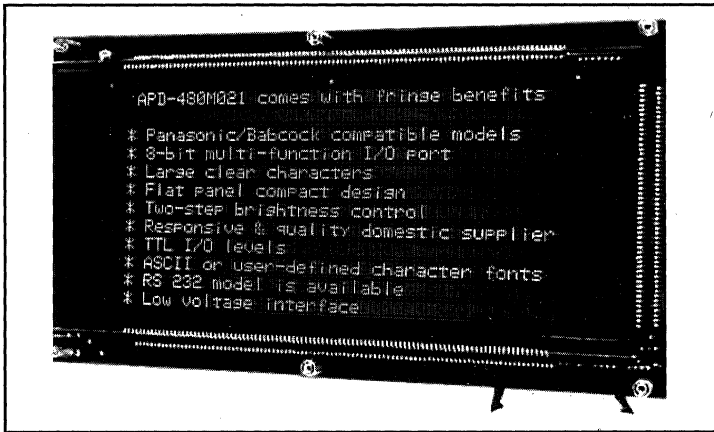
ORDERING INFORMATION

DESCRIPTION	PART NUMBER
Display, Drive Electronics, Controller	APD-480M021-1
Interface Connector Kit	280108-05
Non-Glare Filter (amber circular polarized) - other filters available, contact factory	280109-11

MODEL APD-480M021/-2

Plasma Panel Display Modules

480 Character Display with Drive Electronics, Controller and Parallel Interface



The APD-480M021 display module displays up to 480 alphanumeric 5 x 7 dot matrix characters arranged in 12 lines of 40 characters each. The module includes drive electronics, a controller consisting of refresh memory, character generator and control logic with ASCII input to enable the module to serve as a direct readout device for many applications including POS terminals, industrial controls, computer peripherals, measurement instruments, and office machines.

(A serial interface version is available - APD-480M021-1.)

STANDARD ELECTRICAL SPECIFICATIONS

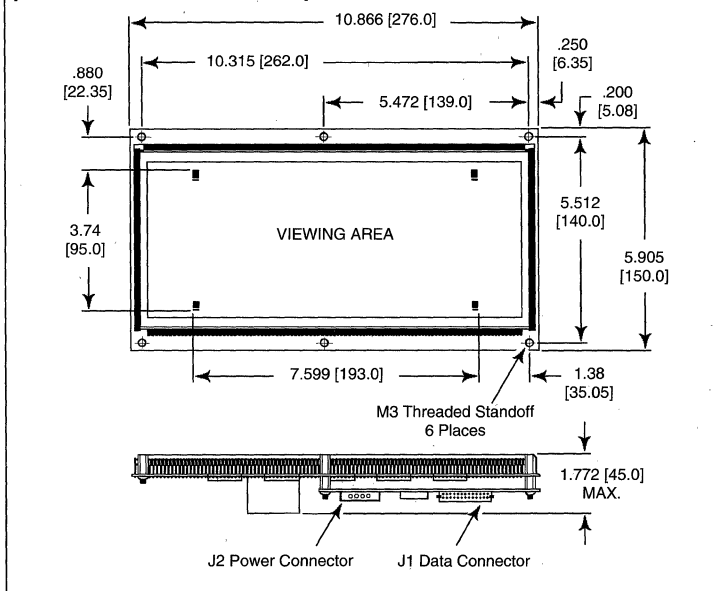
	MIN.	TYP.	MAX.	UNITS
Logic Supply Voltage	4.75	5.0	5.25	V
Logic Supply Current	—	800	—	mA
Panel Supply Voltage	180.0	185.0	190.0	V
Panel Supply Current	—	—	105.0	mA
Logic One Voltage	2.2	—	5.0	V
Logic Zero Voltage	—	—	0.8	V
Logic Zero Input Current	—	—	-0.4	mA
(APD-480M021-2)				
Panel Supply Voltage	11.4	12.0	12.6	V
Panel Supply Current	—	0.7	2.5	A

FEATURES

- 480 (12 x 40) alphanumeric characters (5 x 7 dot matrix)
- Only + 5 and + 12 VDC required (- 2 option)
- ASCII character set (optional character sets available)
- Efficient Parallel Interface
- Two Step Brightness Control
- Wide viewing angle (150°)
- Rugged design/slim profile
- Flicker free refresh
- Editing functions
- Panasonic/NEC/Babcock Compatible

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



ENVIRONMENTAL SPECIFICATIONS

- Operating Temperature:** 0°C to + 55°C.
- Storage Temperature:** - 55°C to + 85°C.
- Relative Humidity:** 10-90% non-condensing.
- Mechanical Shock:** 50G 1/2 sine wave, 11 msec duration. 5 shocks in each of six directions.
- Vibration:** 0.018" [.46] displacement amplitude from 10 to 50 Hz acceleration from 50 to 2000 Hz logarithmic sweep rate, along each side of the 3 major axes.

OPTICAL SPECIFICATIONS

- Viewing Area:** 7.56" [192.02] W x 3.74" [95.0] H.
- Number of Characters:** 480.
- Character Size:** 0.146" [3.708] W x .209" [5.309] H.
- Luminance:** 60 foot lamberts.
- Color:** Neon orange.
- Viewing Angle:** 150° cone.

MODEL APD-480M021/-2

GENERAL DESCRIPTION

The APD-480M021 consists of a DC plasma panel display, drive circuitry, and controller. The interface is a basic 8 bit parallel ASCII interface with handshaking and some dedicated control lines.

Dale's® patented open construction display technology assures a stable, flicker free screen.

The controller maintains all the refresh memory, character generation and control logic. It supports back space, horizontal tab, line feed, vertical tab, clear, carriage return and escape through software instructions. Control commands available include reading cursor position and data, horizontal tab after reading data at cursor position, character insert, character delete, line insert, line delete and screen clear. Operating modes are "normal" (wrap-around) or vertical scroll. The cursor may be turned on, or off, or on with a 4 Hz blink rate.

The EPROM based character generator is programmed with an ASCII character set, but is easily configured for any character set.

The logic input is one 74LS type input with 4.75 kilohm to + 5 VDC. All input lines also have a 1000 µF capacitor to ground.

INTERFACE SIGNAL DESCRIPTION

DB0-DB7 (Data Bus) - Tri-state bi-directional data bus to exchange data between display and host processor.

CHK (Check Command) - If CHK is low, any character written will fill all positions on the screen. After CHK is low, momentarily pulling CLR low will start a self-test where all the characters in the character set are scrolled from right to left.

WR (Write) - Enter data while WR is low.

RD (Read) - Read data while RD is low.

A0 (Address Bus) - Selects character control codes or control command. A0 = low enables writing data.

US (Unit Select) - Read and Write commands will only influence display while US is low

B/D (Brightness/Dim) - Brightness is reduced 50% when B/D is low.

BL (Blank Screen) - Screen blanked when BL is low, but the data and cursor are maintained.

CLR (Clear Display) - Display memory is cleared and the cursor goes to the HOME position when CLR is low.

BUSY (Busy Signal) - I/O is inhibited while BUSY is high. This output is driven from a 74LS06 open collector output and is not pulled up.

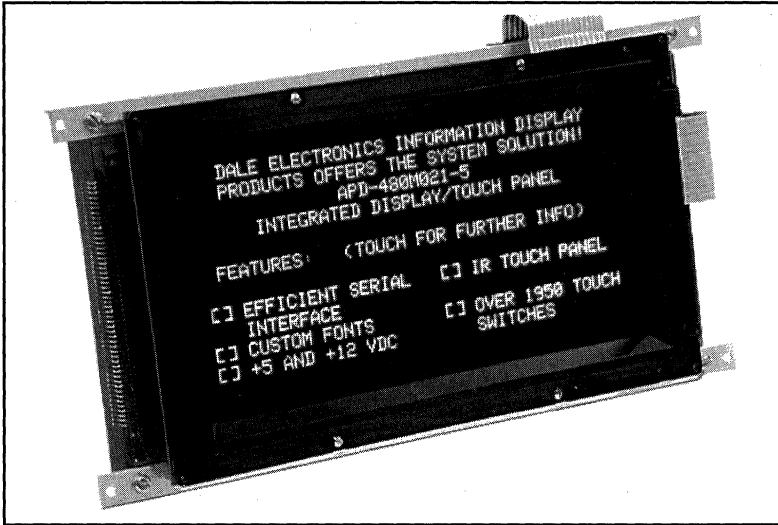
PIN DESCRIPTION	
PIN	DESCRIPTION
J1 DATA CONNECTOR	
1	DATA BIT 0
3	DATA BIT 1
5	DATA BIT 2
7	DATA BIT 3
9	DATA BIT 4
11	DATA BIT 5
13	DATA BIT 6
15	DATA BIT 7
17	WR
19	US
21	RD
23	CLR
2, 26	GND
4	B/D
6	A0
12	CHK
24	BUSY
25	BL
8, 10, 14, 16, 18, 20, 22	Unused
J2 POWER CONNECTOR	
1	+ 185 V (+ 12 with - 2 option)
2	GND (Power)
3	GND (Logic)
4	+ 5 V
WARNING: Wrong connections or reversal of the connector may cause permanent damage to the display and host interface.	

FUNCTION SUMMARY	
CONTROL CODES	HEX
Back Space	08
Horizontal Tab	09
Line Feed	0A
Vertical Tab	0B
Clear	0C
Carriage Return	0D
Read Cursor Position	F0
Read Data at Cursor Position	F1
Read Cursor Position Data, then Perform Horizontal Tab	F2
Character Insert	F3
Character Delete	F4
Line Insert	F5
Line Delete	F6
Screen Clear	FF
ESCAPE CONTROL CODES	
Alter Cursor Position	1B
Row Position	##
Column Position	##

ORDERING INFORMATION	
DESCRIPTION	PART NUMBER
Display, Driver Electronics and Controller	APD-480M021
Display, Driver Electronics, Controller with Built-in DC/DC Converter	APD-480M021-2
Parallel Data Connector Kit	280105-01
Power Connector Kit	280108-05
Non-Glare Filter (amber circular polarized) - other filters available, contact factory	280109-11

MODEL APD-480M021-5 Plasma Panel Display Modules

480 Character Display with Drive Electronics, Controller and Infrared Touch Screen



The APD-480M021-5 display module displays up to 480 alphanumeric 5 x 7 dot matrix characters arranged in 12 lines of 40 characters each. It includes drive electronics, a microprocessor based controller, plus an IR touch panel and bezel. The controller maintains all the refresh memory, character generation, touch input and control logic to enable the module to serve as a direct input/output device for many applications including POS terminals, industrial controls, computer peripherals, measurement instruments or any other system requiring a self contained input/output terminal.

It also controls the report of touch point coordinates from the touch panel to the host computer.

FEATURES

- 480 (12 x 40) alphanumeric characters (5 x 7 dot matrix)
- Infrared touch panel
- 63 x 31 touch point format
- All functions software accessible
- High brightness
- Wide viewing angle
- Low input voltage
- Efficient serial interface

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature: 0°C to + 55°C.

Storage Temperature: - 55°C to + 85°C.

Relative Humidity: 10-90% R.H. non-condensing.

Mechanical Shock: 50G 1/2 sine wave, 11 msec duration, 5 shocks in each of 6 directions.

Vibration: .018 [.46] displacement amplitude from 10 to 50 Hz, 2G acceleration from 50 to 2000 Hz logarithmic sweep rate, along each side of the 3 major axes.

OPTICAL SPECIFICATIONS

Viewing Area: 7.56" [192.02] W x 3.74" [95.00] H.

Number of Characters: 480.

Character Size: 0.146" [3.708] W x 0.209" [5.309] H.

Luminance: 40 foot lamberts (filtered).

Color: Neon orange.

Viewing Angle: 150° cone.

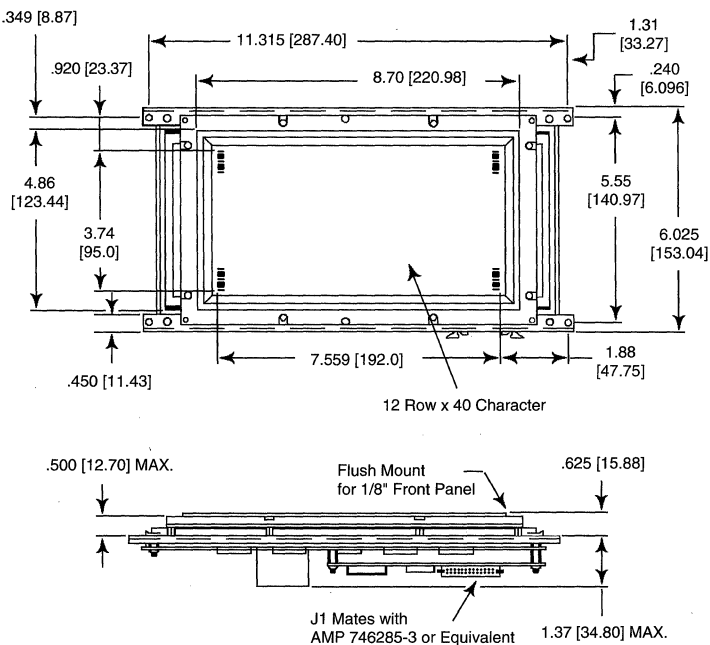
IR Beams: 32 on X axis, 16 on Y axis.

STANDARD ELECTRICAL SPECIFICATIONS

	MIN.	TYP.	MAX.	UNITS
Logic Supply Voltage	+ 4.75	+ 5.0	+ 5.25	V
Logic Supply Current	—	750	—	mA
Panel Supply Voltage	11.4	12.0	12.6	V
Panel Supply Current	—	.7	2.5	A

DIMENSIONAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



MODEL APD-480M021-5

GENERAL DESCRIPTION

The APD-480M021-5 consists of a 480 character DC plasma display, drive electronics, RS-232 compatible serial ASCII input controller integrated with an IR touch panel and bezel to form a rugged, slim profile display I/O sub-system. Interface is through a single 15 pin D subminiature connector that has + 5, + 12 VDC, ground and serial data connections. (A DC/DC converter generates the required display voltage from + 12 VDC.)

An EPROM based character generator is easily configured for any character set. Various editing functions are available on the controller such as scrolling, inserting and deleting characters. The display module can also be dimmed or blanked for screen highlighting. DALE'S® patented open construction display technology assures a stable, flicker free screen.

The infrared touch screen consists of IR LEDs and detectors arranged to provide a grid of infrared light beams across the face of the display. If an object is present, then an intersecting pair of beams will be blocked, and the controller will determine the coordinates of that point and report it to the host computer. Using simple input commands, the touch screen can be configured to report coordinates when a stylus is entered into the touch panel, when it is removed, or continuously. Other commands are provided to allow control over the flow of touch point coordinates between the touch panel and the host computer.

INTERFACING

(See pin descriptions.) The controller is considered to be a DTE type device and will operate with a host that is either a DTE or DCE device. The serial input and output lines meet RS-232C specifications. Serial data is entered asynchronously with 3 (300, 1200 or 9600) selectable baud rates. The byte format is 1 start bit, 8 data bits and 1 stop bit.

TOUCH SCREEN COMMANDS	
COMMAND	CODE
Enable Exit Point Mode	20H
* Disable Exit Point Mode	21H
Enable Enter Point Mode	22H
* Disable Enter Point Mode	23H
Enable Continuous Mode	24H
* Disable Continuous Mode	25H
Enable Touch Screen	27H
Request Failed Beam Report	28H
Enable Report Transfer	29H
* Disable Report Transfer	2AH
Request Report	2BH
NOTE: All touch screen commands are preceded by 18H.	
* Indicates default condition.	

PIN DESCRIPTION		
CONNECTOR	PIN	SIGNAL
J1	1	GROUND
	2	TRANSMIT DATA
	3	RECEIVE DATA
	4	READY TO SEND
	5	CLEAR TO SEND
	6	GROUND
	7	GROUND
	8	+ 5 VDC
	9	+ 5 VDC
	10	GROUND
	11	GROUND
	12	GROUND
	13	+ 12 VDC
	14	+ 12 VDC
	15	+ 12 VDC
	16	NC

COMMAND DESCRIPTION	
04H	Set display to full brightness.
05H	Set display to half brightness.
06H	Unblank display - Restores screen information previously blanked with blank display command.
07H	Blank display - Blanks screen without losing data.
08H	Cursor left (Back space).
09H	Cursor right (Horizontal tab).
0AH	Cursor down (Line feed).
0BH	Cursor up (Vertical tab).
0CH	Clear screen, home cursor.
0DH	Carriage return.
0EH	Cursor home.
0FH	Insert character.
10H	Delete character.
11H	DC1 MODE (Default display mode) - Cursor shifts one character to the right automatically when character data is written. If the cursor is at the right end of a row, it shifts to the leftmost end of the next row.
12H	DC2 MODE (Vertical scroll mode) - When the cursor reaches the right end of the bottom row, all screen characters shift upwards one row, pushing the top row off the screen. The bottom row is cleared and the cursor is placed at the left end of the bottom row.
13H	DC3 MODE (Default cursor mode) - Cursor is turned on.
14H	DC4 MODE - Cursor is turned off.
15H	DC5 MODE - Cursor is turned on and blinks at 4 Hz.
16H	Line insert.
17H	Line delete.
18H	Touch Panel Command to follow.
19H	Begin character blink.
1AH	End character blink.
1BH	Cursor position - The cursor position may be defined by 2 bytes of data after the cursor position command. The first byte defines the row, and the second byte the column.
1CH	Font select (followed by data byte).

ORDERING INFORMATION	
DESCRIPTION	PART NUMBER
Display, Drive Electronics, plus Controller, Touch Screen and Bezel (Includes DC/DC converter)	APD-480M021-5
Mating Connector Kit	280105-02
An amber colored non circular polarized contrast filter is standard. Contact factory for other filter options.	

ezTouch[®] Touch Panel Software (Dale[®] Version)



ezTouch is a stand-alone all-in-one programming tool for software designers and programmers of touch-sensitive hardware systems integrated with the IBM PC/XT/AT and compatible computers.

ezTouch enables users to control touch frames with programs written in any language without having to create software "drivers", procedures or functions. ezTouch is a memory-resident program - once loaded by the user ezTouch is always available to control and read the touch frame, regardless of what application the computer is running. Using simple commands, programmable in any language (even issued from DOS), the user can activate ezTouch and acquire touch frame data. ezTouch places data received from the touch frame into the PC keyboard buffer. ezTouch is invoked by simply typing (at the prompt) ezTouch [/COM2], (COM1 is the default). Thus, touch choices are communicated to your program as though they were typed at the keyboard.

ezTouch provides a fast, easy method of creating touch-active areas (targets), specifying plain text strings that are put into the keyboard buffer when the target is touched. Targets therefore return simple descriptive strings (of the user's choice) instead of numerical coordinates. For example: Touched targets could return "ON", "OFF", "CLOSE VALVE" AND "BEGIN VIDEO", to a program. ezTouch therefore makes any code much more writable, readable and maintainable than ordinary touch software methods.

ezTouch comes with additional commands to control screen displays, and to display screens and windows created with the SAYWHAT?![®] LIS screen storage standard. ezTouch includes a completely compatible superset of the commands available in VIDPOP.COM[®], SAYWHAT'S[®] resident language enhancer. ezTouch can be used in place of VIDPOP whenever using SAYWHAT?! screens (although ezTouch and VIDPOP should not be resident at the same time).

SYSTEM REQUIREMENTS

- ezTouch runs on the PC-DOS[®] and MS-DOS[®] operating systems installed on IBM PC family and PC compatible computers. What you specifically need is:
- IBM PC/XT/AT, Hewlett-Packard VECTRA[®], COMPAQ[®] or compatible computer
- 256K bytes minimum memory. ezTouch requires approximately 73K of RAM on systems with a color card (CGA or EGA) and 85K of RAM on systems with a monochrome card
- Any compatible monochrome, CGA or EGA video card
- Serial communication port for the Dale TIP touch panel
- PC-DOS or MS-DOS version 2.0 or greater
- One disk drive
- A Dale Electronics, Inc. TIP infrared touch panel

ezTouch COMMANDS

```
ARE YOU THERE
CLEAR
DEFINE TARGETS
DIAGNOSTICS
DISPLAY PAGE n
DO CALIBRATION
EMPTY
FILL PAGE n
MOVE LINES
PRINT SCREEN
RESET
SET BEEP <ON/OFF>
SET BLINK <ON/OFF>
SET CARET <ON/OFF>
SET CARRIAGE RETURN <ON/OFF>
SET COM PORT TO [<n>]
SET DIAGNOSTIC TIMEOUT TO <n>
SET FLASH TO <duration>
SET FLASH <ON/OFF>
SET KEYBOARD <ON/OFF>
SET MESSAGE <ON/OFF>
SET MODE TO CONTINUOUS
SET MODE TO ENTRY POINT
SET MODE TO EXIT POINT
SET MODE TO INTERRUPT
SET MODE TO ON EXIT
SET MODE TO TRACKING
SET TARGETS TO <filename>
SET XY TO <coordinate system>
SWAP XY
TERMINATE
TOUCH SCREEN <screen number>, <timeout>
The following commands allows SAYWHAT?! screens to be displayed
or stored:
<filename> (to display SAYWHAT?! image file)
FILL PAGE n filename (moves SAYWHAT?! file from disk to
"pigeon hole".)
```

SAYWHAT?![®] Screen Generator Software



SAYWHAT?! is a stand-alone all-in-one tool for computer users that gives them the ability to quickly create fantastic screens for menus, data entry screens, data display and help panels. SAYWHAT?! screens can be displayed by any programming language with just a single line of code. SAYWHAT?! also creates screens just as quickly and easily for use by non-programmers to be displayed directly from the keyboard or through batch file "scripts". Even slide shows are easily prepared with SAYWHAT?!

SAYWHAT?! lets you work with lined and unlined boxes, horizontal and vertical lines, special characters and attributes and of course colors. You quickly create visually balanced and aesthetic screens that are a pleasure to read and work with when they become part of your applications.

SAYWHAT?! lets you visually enter the location of all your dBASE GET statements, (or Turbo ReadLn, or BASIC INPUT statements) and lets you enter variable names and picture clauses. SAYWHAT?! will even come up with variable names if you decide not to specify them. SAYWHAT?! also lets you specify the location of data you want to display rather than input, such as the system date (or other variable).

SAYWHAT?! lets you create pop-up windows of any size anywhere on the screen that your application can overlay on top of other screens to give your programs that state of the art "sidekick" feel.

SAYWHAT?! generates the minimum code segment in any version of dBASE, Turbo Pascal and BASIC that you can include in your application program to bring up gorgeous screens complete with data input statements.

SAYWHAT?! can combine up to 100 screens into a single library file, and you can have as many screen libraries as you like.

SAYWHAT?! lets you make moving bar menus in seconds, and manage them at run time with a single line of code in any language.

SAYWHAT?! IS FAST! You create screens quickly because SAYWHAT's?! feel is easy and natural. Even more impressive the startling speed with which screens appear when called by your application program. Screens typically appear in 0.15 seconds, and as quickly as a single video frame time! Rather than paint from left to right and top to bottom, SAYWHAT?! screens "pop" onto your monitor whenever you want them. In some cases, SAYWHAT?! gives you the opportunity to create dazzling screen animation effects.

SAYWHAT? comes loaded with free utilities so you can IMPORT screens from running programs, install SAYWHAT?! to come up just the way you like, send screens to the printer from an application, "roll" screens from the bottom or top of your monitor and much more.

SAYWHAT?! is NOT menu-driven. You don't need a Ph.D. in "menulology" to work SAYWHAT?! Screens are created by you visually right on the monitor, using simple commands.

SAYWHAT?! and ezTouch are not copy protected but backup copies shall be made for archival purposes only. A Run Time module is available for ezTouch under a simple licensing agreement at a nominal price to allow end-users to run ezTouch programs without the obligation of purchasing the complete program.

ezTouch[®], SAYWHAT?![®], VIDPOP[®] are trademarks of Software Science, Inc. MS-DOS[®] is a trademark of Microsoft. PC-DOS[®] and IBM PC/XT/AT[®] are trademarks of IBM. VECTRA[®] is a trademark of Hewlett Packard. COMPAC[®] is a trademark of Compaq Computer Corporation.

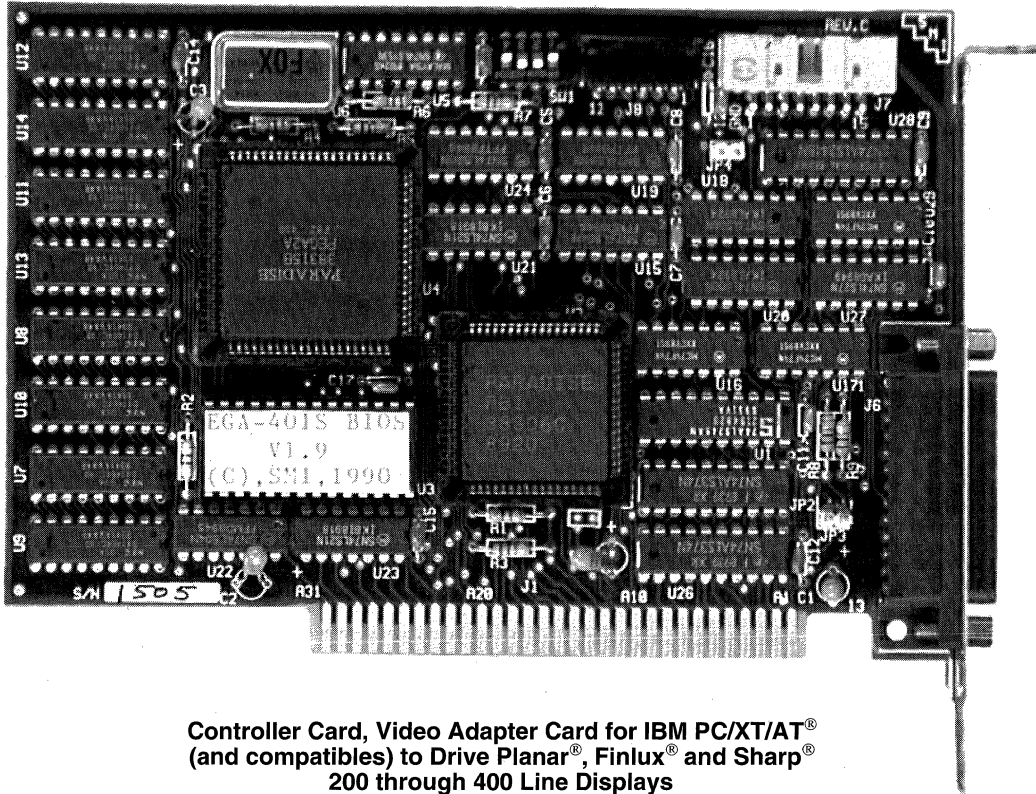
ORDERING INFORMATION

DESCRIPTION	PART NUMBER
SAYWHAT?! [®] Software	280879-01
ezTouch [®] Software (Developers Version)	280879-02
ezTouch [®] Software (Run Time Version)	280879-03

MODEL PDS-30/1/2

Flat Panel Display Controller

EGA/CGA, Controller Card



Controller Card, Video Adapter Card for IBM PC/XT/AT®
(and compatibles) to Drive Planar®, Finlux® and Sharp®
200 through 400 Line Displays

The PDS-30 video adapter card is a compact 4" x 5" [101.6 x 127.0] XT/AT® half-card which supports all IBM EGA modes and AT&T® mode 40H on 400 line panels. In addition, all CGA modes are supported on 200 line panels. Gray scale circuitry automatically converts RGB color information to gray scale and hatching patterns. This greatly improves the display of existing color software, as well as enhancing the impact of new applications. Two character fonts are active in the 40 and 80 column text modes. The fonts are normal and bold and are selected by the intensity bit of the text attribute.

An external DB-25 connector is provided for use with all panels. Internally, a 16 pin header connector is supplied for connection to the Planar EL8358HR® or Finlux MD640.400-52® EL panel. A 12 pin ZIF connector is provided for internal connection to the Planar EL8358MS. Versions are available for Planar, Finlux and Sharp electroluminescent displays. Card for other displays can be obtained by special order.

This product is available integrated with the display of your choice and with or without a companion infrared touch panel. Dale Electronics, Inc. has a broad line of information display products and manufactures DC Plasma Displays in dot matrix (graphics and character), segmented and bar graph formats (standard and custom). We welcome the opportunity to help you engineer the optimum man-machine interface for your application.

FEATURES

- IBM/AT/386® Compatible Interface
- Supports all IBM EGA modes on 350/400 line ELD panels
- Supports all IBM CGA modes on 200 line ELD panels
- Converts color software to gray scale and hatching patterns
- Normal and bold character fonts

ELECTRICAL SPECIFICATIONS

Compatibility: IBM XT/AT/386.

Bus: ISA.

Power: 5 VDC @ 1.4A (Card only).

ENVIRONMENTAL SPECIFICATIONS

Storage Temperature: - 40°C to + 100°C.

Operating Temperature: 0°C to + 70°C.

Relative Humidity: 0-90% non-condensing.

MODEL PDS-30/1/2

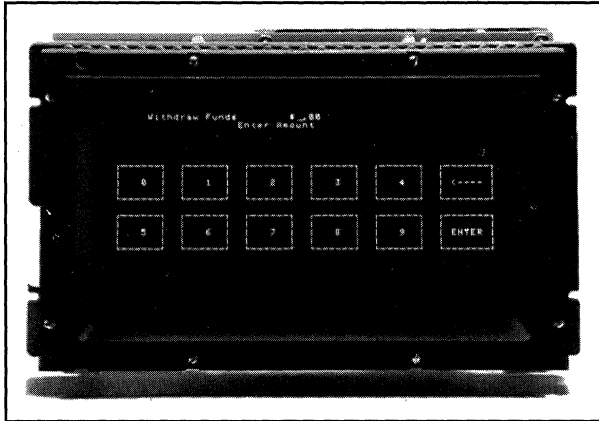
PIN DESCRIPTION			
J6 - EXTERNAL 25 PIN PANEL CONNECTOR		J7 - INTERNAL 16 PIN HEADER CONNECTOR	
Connector Type: DB-25S, Female. Mating Connector: DB-25P, Male.		Connector Type: T&B Ansley 609-1627 or equivalent. Mating Connector: T&B Ansley 609-1630 or equivalent.	
PIN	SIGNAL	PIN	SIGNAL
1	+12 VDC	2	+12 VDC
2	+5 VDC	4	+5 VDC
3	SMODE1	6	SMODE2
4	GND	8	GND
5	VSYNC	10	GND
6	HSYNC	12	GND
7	CLOCK	14	GND
8	DATA	16	GND
9	N.C.		
10	N.C.		
11	N.C.		
12	N.C.		
13	N.C.		
14	+12 VDC		
15	+5 VDC		
16	SMODE2		
17	GND		
18	GND		
19	GND		
20	GND		
21	GND		
22	N.C.		
23	N.C.		
24	N.C.		
25	N.C.		
		J8 - INTERNAL 12 PIN ZIF CONNECTORS	
		Connector Type: Burndy SLEM12R-2 or equivalent. Mating Connector: Gore BMS-829-1-12-X or equivalent.	
		PIN	SIGNAL
		1	DATASEL
		2	VIDPOL
		3	VCLKPOL
		4	GND
		5	CLOCK
		6	GND
		7	DATA
		8	GND
		9	N.C.
		10	GND
		11	HSYNC
		12	VSYNC
		JP4-12 VDC CONNECTOR FOR EXTERNAL POWER	
		Connector Type: .250" [6.35] square pins on .100" [2.54] centers.	
		PIN	SIGNAL
		1	+12 VDC
		2	GND

COMPATIBLE DISPLAYS	
PLANAR	EL8348HR EL8358MS
FINLUX	MD640.400-52
SHARP	LJ640U27

CONFIGURATION	
JP2 - Panel Select ON = 350/400 Line Panel OFF = 200 Line Panel	SW1 - EGA/CGA Select 1 2 3 4 ON OFF OFF ON EGA Modes Enabled ON ON ON OFF CGA Modes Enabled
JP3 - Gray Scale Enable ON = Gray Scale Disabled OFF = Gray Scale Enabled	

ORDERING INFORMATION	
DESCRIPTION	PART NUMBER
Adapter Card for Planar 200, 350, 400 Line ELD Panels	PDS-30
Adapter Card for Finlux 400 Line ELD Panels	PDS-31
Adapter Card for Sharp 400 Line ELD Panels	PDS-32

MODEL TIP Infrared Touch Panels With Controller



TIP products are infrared touch panels designed to fit most flat panel display technologies. The touch panels are a matrix of infrared diodes and detectors, scanning electronics, micro-processor controller, bezel/optical filter assembly and hardware to mount the touch panel and controller to the flat panel display. These touch panels are ideal for many applications including medical instrumentation, machine or process controls, point of sale devices, public information displays, banking and military.

Optional PC based ezTouch[®] software provides simple touch panel integration, facilitating the creation of user keypads. ezTouch is a resident program and is language independent. Commands are executed by writing to the screen and touch information is read from the keyboard buffer.

ezTouch is a trademark of Software Science, Inc.

FEATURES

- Fast response time
- Flexible operating modes
- User transparent
- Rugged construction
- Sealed for environmental resistance
- Immune to high or changing ambient light
- RS-232C interface
- Pre-assembled - no assembly or disassembly required to mount display

ELECTRICAL SPECIFICATIONS

Voltage: + 12 VDC \pm 5%.

Current: 400 mA typical.

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature: 0°C to + 55°C.

Storage Temperature: - 55°C to + 85°C.

Relative Humidity: 10-90% non-condensing.

INTERFACE SPECIFICATIONS

Type: RS-232C.

Data Rate: 300, 1200, 9600 baud and auto baud.

Word Format: 8 bits, no parity, 1 start bit, 1 stop bit.

HOW TO ORDER

TIP MODEL		3216 MATRIX		FA DISPLAY DESIGNATOR		A FILTER * DESIGNATOR		## DASH NUMBER (If Required)	
TOUCH PANEL		DISPLAY						A = Non polarized, gray B = Polarized, gray C = Non polarized, amber D = Polarized, amber S = Special - Contact factory	
MATRIX	TOUCH POINTS	PIXELS	TECHNOLOGY	MANUFACTURER	PART NUMBER	DESIGNATOR			
3216	63 x 31	512 x 256	ELD	Finlux Planar	MD512.256 EL6648MSS	FA PA			
3220	63 x 39	640 x 400	ELD	Finlux Planar Sharp	MD640.400 EL8358HR LJ640U27	FB PB SA			
3224	63 x 47	640 x 480	ELD	Sharp	LJ64ZU49	SB			
3526	69 x 51	640 x 480	ELD	Planar	EL7768MS	PC			
5648	111 x 95	1024 x 864	ELD	Planar	EL751214MS	PD			

NOTE: Contact factory for other touch panel and display combinations.

* Other user specified filters will be designated as "S". Contact factory for availability. Any "S" filter designation will require a factory assigned dash number suffix.

Filters A-D are plastic. Glass filters may be available on selected models.

MODEL TIP

GENERAL DESCRIPTION

Each Dale® touch panel has infrared LED emitters and detectors along the X— and Y— axis, forming a grid of infrared light beams across the face of the display. The first two numbers of the TIP "matrix" number specify the number of vertical beams and the last two numbers specify the number of horizontal beams. The controller scans the emitter/detector pairs one at a time and determines whether both X and Y beams are blocked, indicating that a finger or stylus is present. (When beams are blocked on only one axis, they are ignored and not reported to the host.) The controller determines the coordinates of the touch point and reports them to the host computer. By interpolating a "virtual" beam between two physical beams, the number of touch points on each axis is effectively doubled. When an odd number of beams along either axis is blocked, the coordinate of the center physical beam is reported. When an even number of beams is blocked, the coordinate of the virtual beam in the center of the blocked beams is calculated and reported. The touch controller supports ENTER, EXIT, CONTINUOUS and TRACKING report modes or combinations of these modes. The controller also has a beeper output. Hardware handshaking, software handshaking, baud rates and auto-baud features are jumper selected. The user initializes the desired report modes and requests reports when needed.

Several optical filters are standard to provide the most cost effective filter for each application. "Non-standard" filters may be specified as well. The filter increases the contrast ratio of the display and protects the display face and electronics. Dale can assist in recommending the optimum filter based on years of experience as a display manufacturer. The perimeter of the filter is bonded to the bezel and a bezel to front panel gasket is included to provide a splash proof seal.

MATING CONNECTORS		
	DALE	OTHER
J1	280105-02	AMP 746288-1
J5, J6	280108-07	MOLEX 22-01-3027 housing, 08-50-0114 terminals
J4	280108-06	MOLEX 22-01-3037 housing , 08-50-0114 terminals

PIN DESCRIPTION			
J1 DATA CONNECTOR			
PIN	SIGNAL	PIN	SIGNAL
1	RD (to touch panel)	2	Ground
3	+ 12 (optional)	4	+ 12 (optional)
5	CTS	6	Reserved
7	RTS	8	Reserved
9	Ground	10	TD (from touch panel)
J5, J6 POWER CONNECTOR			
PIN	SIGNAL		
1	+ 12 VDC		
2	GND		
J4 AUDIO FEED BACK CONNECTOR			
PIN	SIGNAL		
1	GND		
2	Beeper Signal (active low)		
3	+ 5 VDC		

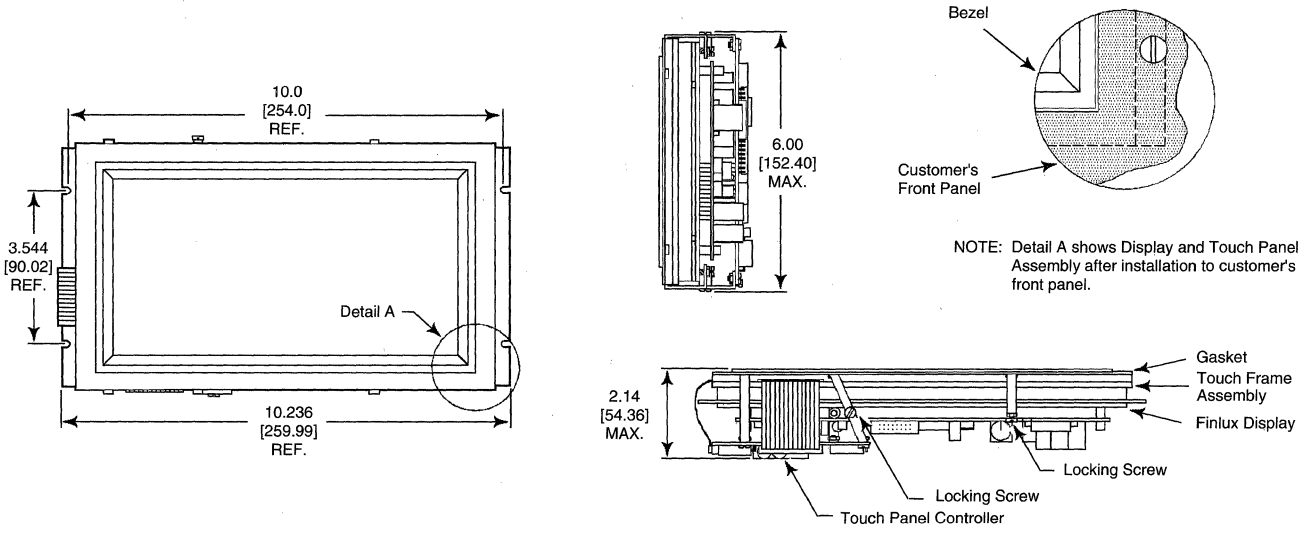
COMMAND SET (Abridged)	
11H	DC1, Ctl Q, XON Software handshaking
13H	DC3, Ctl S, XOFF, Software handshaking
20H	Enable EXIT point mode
21H	Disable EXIT point mode (default)
22H	Enable ENTER point mode
23H	Disable ENTER point mode (default)
24H	Enable CONTINUOUS mode/disable TRACKING
25H	Disable CONTINUOUS mode (default) and TRACKING
26H	Enable touch panel
27H	Disable touch panel (default)
28H	Request Failed beam report
29H	Enable automatic report transfer
2AH	Disable automatic report transfer (default)
2BH	Request one coordinate report
2CH	Reset touch panel
2EH	Disable beeper (default)
2FxxH	Sound beep, xx = duration (00H to FFH)
34H	Enable TRACKING mode/disable CONTINUOUS

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]						
Touch Frame	MODEL	A	B	C	D	VIEWING AREA
	3220	9.006 [228.75]	9.748 [247.60]	6.238 [158.45]	6.950 [176.53]	8.0 x 5.2 [203.20 x 132.08]
	3224	8.576 [217.83]	9.685 [246.0]	6.687 [169.85]	7.086 [179.98]	7.8 x 5.9 [198.12 x 149.86]
	3526	9.490 [241.04]	10.404 [264.26]	7.311 [185.70]	7.532 [191.31]	8.6 x 6.4 [218.44 x 162.56]
	5648	14.501 [368.33]	15.435 [392.05]	12.406 [315.11]	13.250 [336.55]	13.8 x 11.7 [350.52 x 297.18]

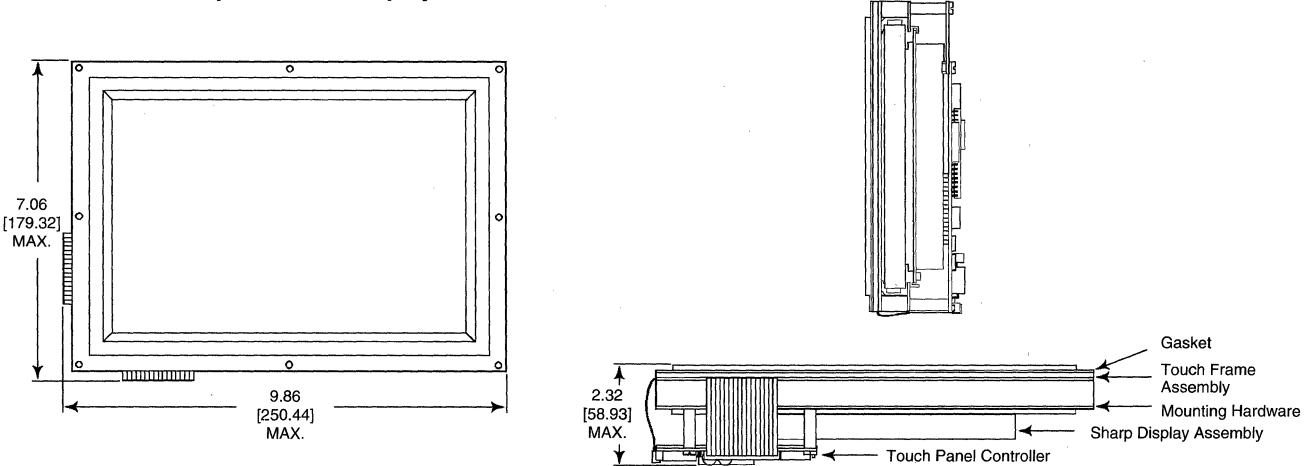
MODEL TIP

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

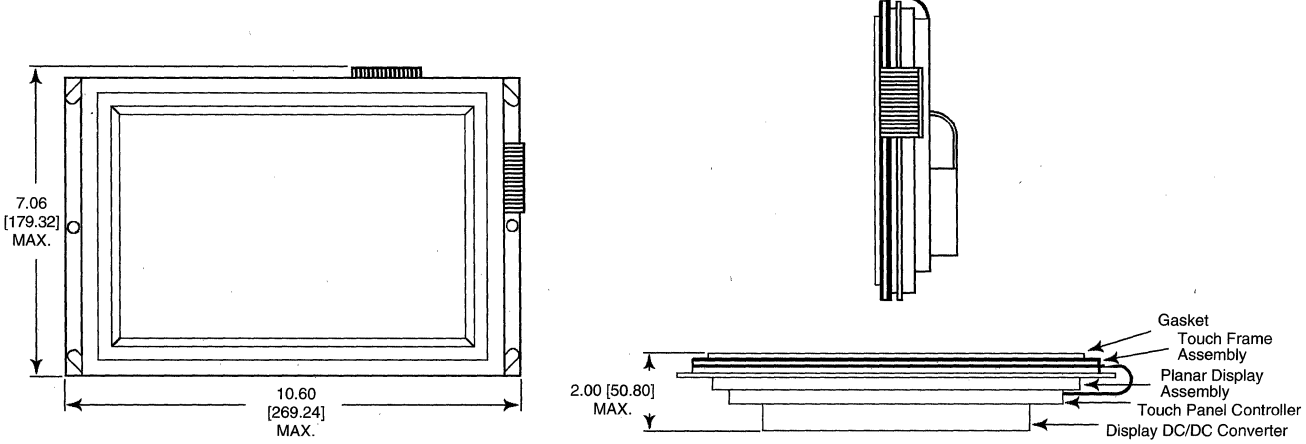
TIP 3216 with Finlux 512 x 256 Display



TIP 3220 with Sharp 640 x 400 Display

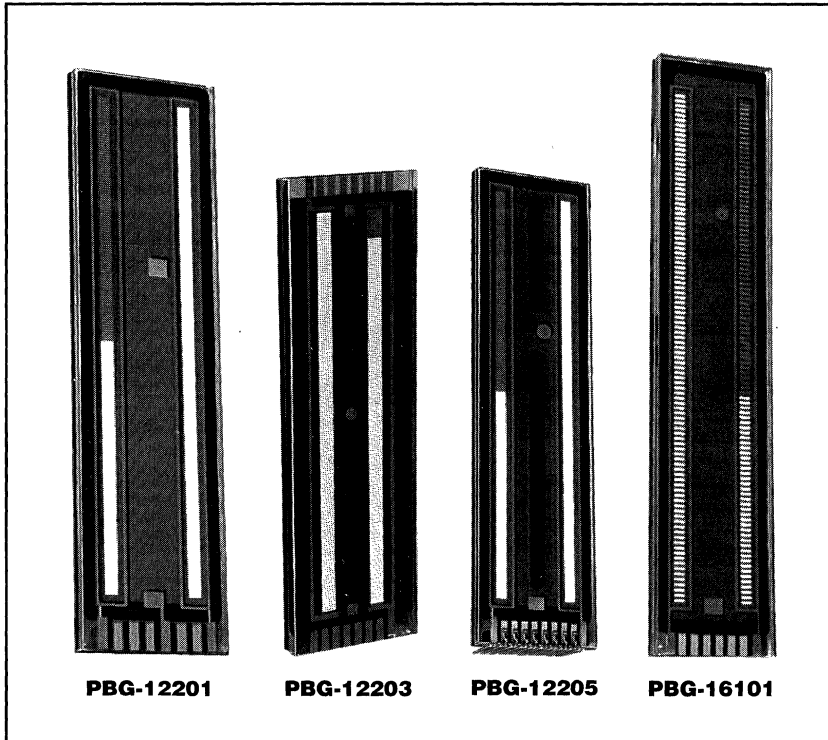


TIP 3220 with Planar 640 x 400 Display



Contact Factory for Models not Shown.

MODEL PBG Plasma Panel Displays Dual Linear Bar Graph



FEATURES

- Two separate bar graphs, each including reset for 1/2% or 1% resolution (see chart)
- At normal viewing distances glow blends into continuous, but precisely controlled bar length
- Unique scanning technique minimizes the number of drivers required
- PBG-12203 bars may be scanned from either direction or both both directions simultaneously
- PBG-12203 can display four separate columns of information, providing combined total of information does not exceed 201 clock counts per bar

ENVIRONMENTAL SPECIFICATIONS

Altitude: 0 to 70,000 feet.

Operating Temperature: 0°C to + 55°C.

Storage Temperature: - 55°C to + 85°C.

Relative Humidity (No Condensation): 85% maximum.

Vibration: .018 inches DA, 10 to 50 Hz, 2G, 50 to 2000 Hz.

Shock: 50G, 1/2 sine wave, 11 mS duration.

ELECTRICAL SPECIFICATIONS

OPERATING PARAMETERS	PBG-12201				PBG-12203				PBG-12205				PBG-16101			
	Min.	Max.	Rec.	Units	Min.	Max.	Rec.	Units	Min.	Max.	Rec.	Units	Min.	Max.	Rec.	Units
Anode Supply Voltage	235	265	250	V	235	265	250	V	235	265	250	V	235	265	250	V
Cathode Off Bias Voltage	68	76	72	V	68	76	72	V	68	76	72	V	68	76	72	V
Anode Off Bias Voltage	80	120	100	V	80	120	100	V	80	120	100	V	80	120	100	V
Anode Sustaining Voltage (Typical)	—	—	150	V	—	—	150	V	—	—	150	V	—	—	150	V
Refresh Rate	—	—	70	Hz	—	—	70	Hz	—	—	70	Hz	—	—	70	Hz
Keep Alive Anode Resistor	—	—	1M	Ω	—	—	1M	Ω	—	—	1M	Ω	—	—	1M	Ω
Keep Alive Cathode Resistor	—	—	1M	Ω	—	—	1M	Ω	—	—	1M	Ω	—	—	1M	Ω
Keep Alive Current (Typical)	—	—	50	μA	—	—	50	μA	—	—	50	μA	—	—	50	μA
Display Anode Resistor	—	—	36k	Ω	—	—	24k	Ω	—	—	24k	Ω	—	—	20k	Ω
Display Peak Anode Current	2.5	3.0	2.8	mA	3.7	4.5	4.2	mA	3.5	5.0	4.0	mA	4.0	6.0	5.0	mA
Scan Time per Cathode	70	90	70	μS	70	90	70	μS	60	90	70	μS	120	180	140	μS
Applied Reset Pulse Width	140	180	140	μS	140	180	140	μS	70	180	140	μS	120	180	140	μS

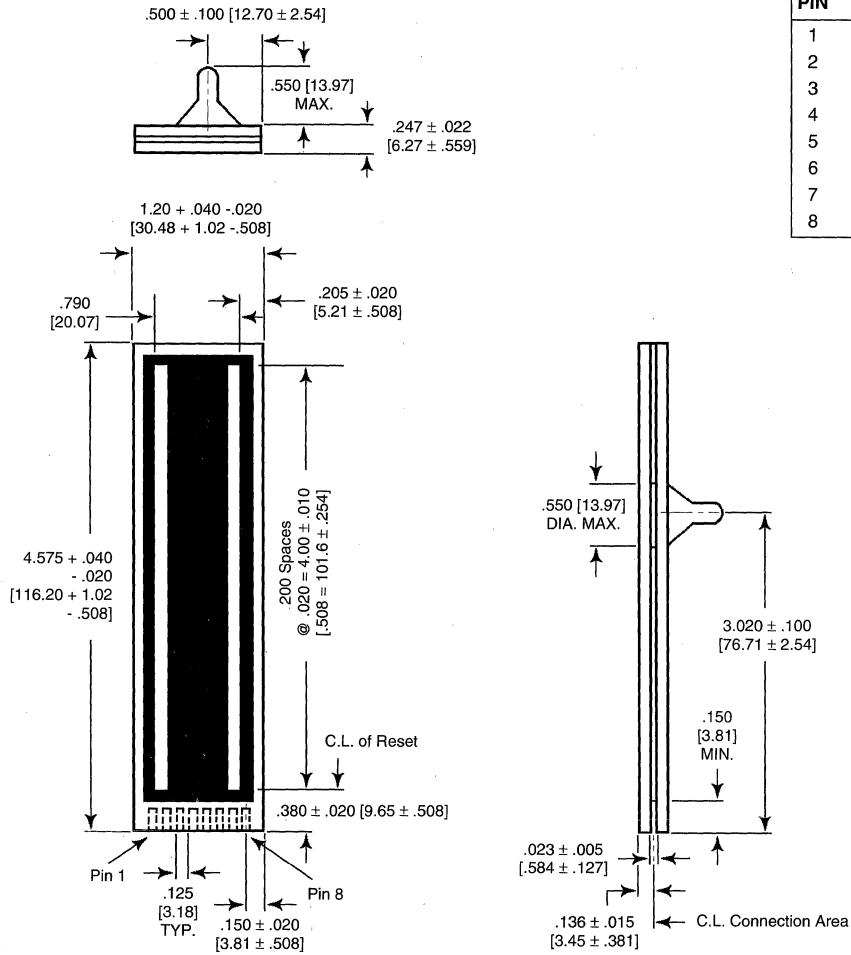
OPTICAL SPECIFICATIONS

	PBG-12201	PBG-12203	PBG-12205	PBG-16101
Elements	201	203	201	101
Resolution	1/2%	1/2%	1/2%	1%
Segment Length	.100"	.150"	.100"	.100"
Segment Width	.011"	.010"	.011"	.020"
Segment Spacing	.020"	.020"	.020"	.050"
Drivers Required	6	12	8	6
Luminance	35 fl	30 fl	70 fl	60 fl
Viewing Angle	120°	120°	120°	120°
Color	Neon Orange	Neon Orange	Neon Orange	Neon Orange

MODEL PBG

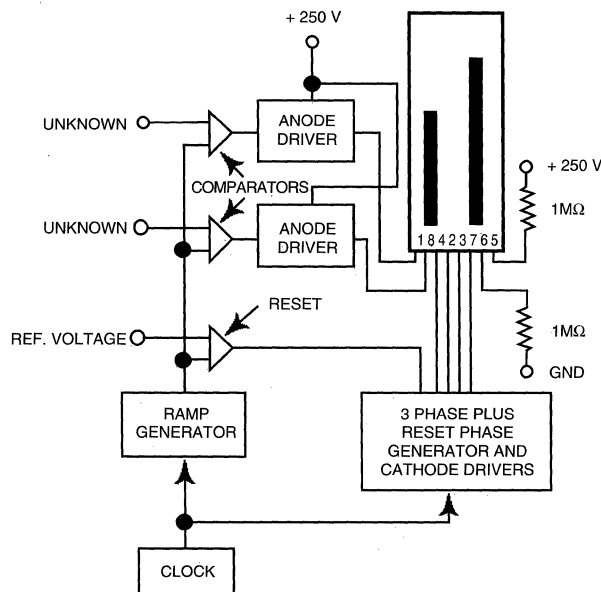
DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

PBG-12201



PIN	CONNECTION
1	Channel No. 1 Anode
2	Phase 1 Cathode
3	Phase 3 Cathode
4	Reset Cathode
5	Keep Alive Anode
6	Keep Alive Cathode
7	Phase 2 Cathode
8	Channel No. 2 Anode

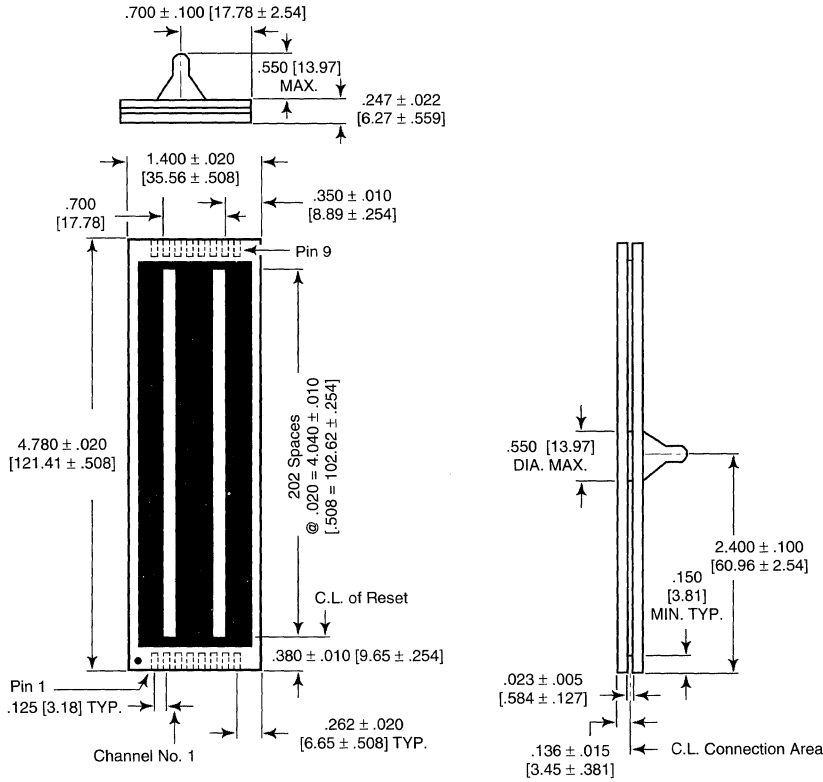
Block Diagram of Typical Drive Circuit



MODEL PBG

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

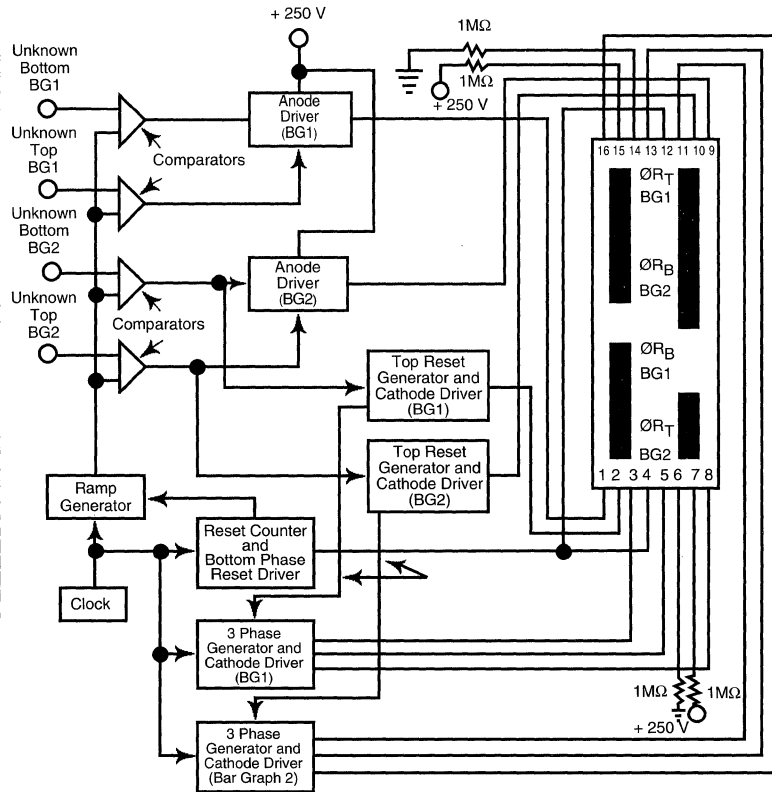
PBG-12203



CHANNEL NO. 1	
PIN	CONNECTION
1	Anode
2	Top Reset Cathode
3	Phase 1 Cathode
4	Bottom Reset Cathode
5	Phase 2 Cathode
6	Keep Alive Cathode
7	Keep Alive Anode
8	Phase 3 Cathode
CHANNEL NO. 2	
PIN	CONNECTION
9	Anode
10	Top Reset Cathode
11	Phase 1 Cathode
12	Bottom Reset Cathode
13	Phase 2 Cathode
14	Keep Alive Cathode
15	Keep Alive Anode
16	Phase 3 Cathode

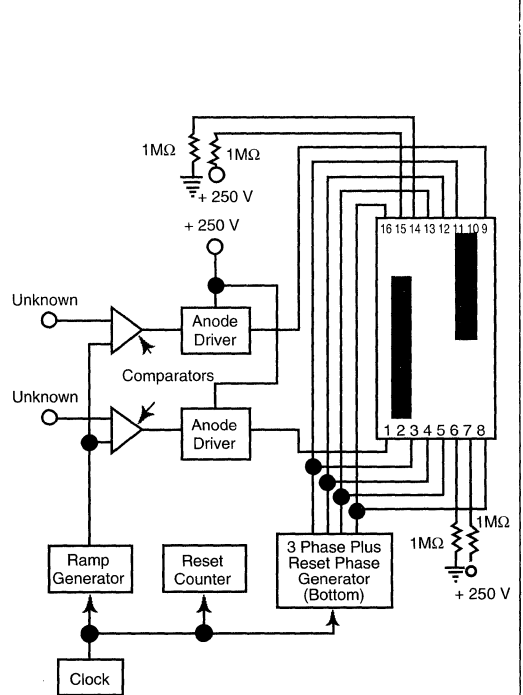
Block Diagram Mode 1 of Operation

Each bar graph scanned from both directions (bottom and top).



Block Diagram Mode 2 of Operation

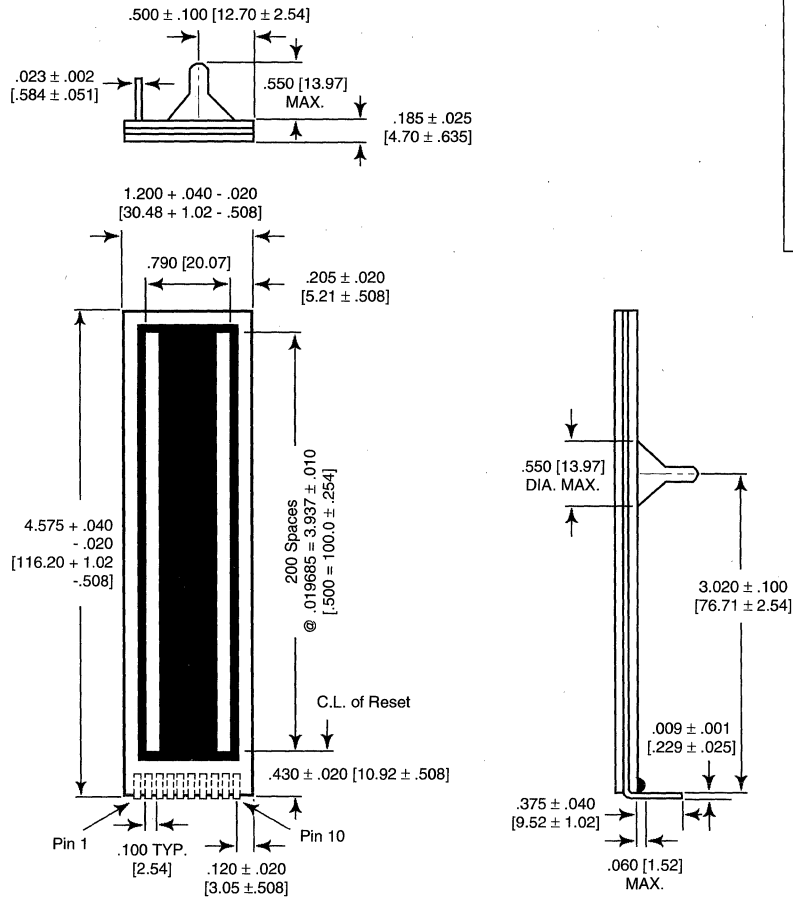
Each bar graph scanned from one direction only.



MODEL PBG

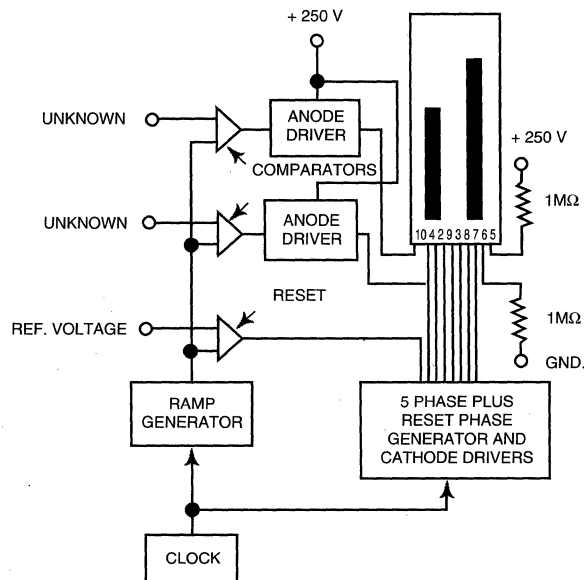
DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

PBG-12205



PIN	CONNECTION
1	Channel No. 1 Anode
2	Phase 2 Cathode
3	Phase 1 Cathode
4	Reset Cathode
5	Keep Alive Anode
6	Keep Alive Cathode
7	Phase 4 Cathode
8	Phase 3 Cathode
9	Phase 5 Cathode
10	Channel No. 2 Anode

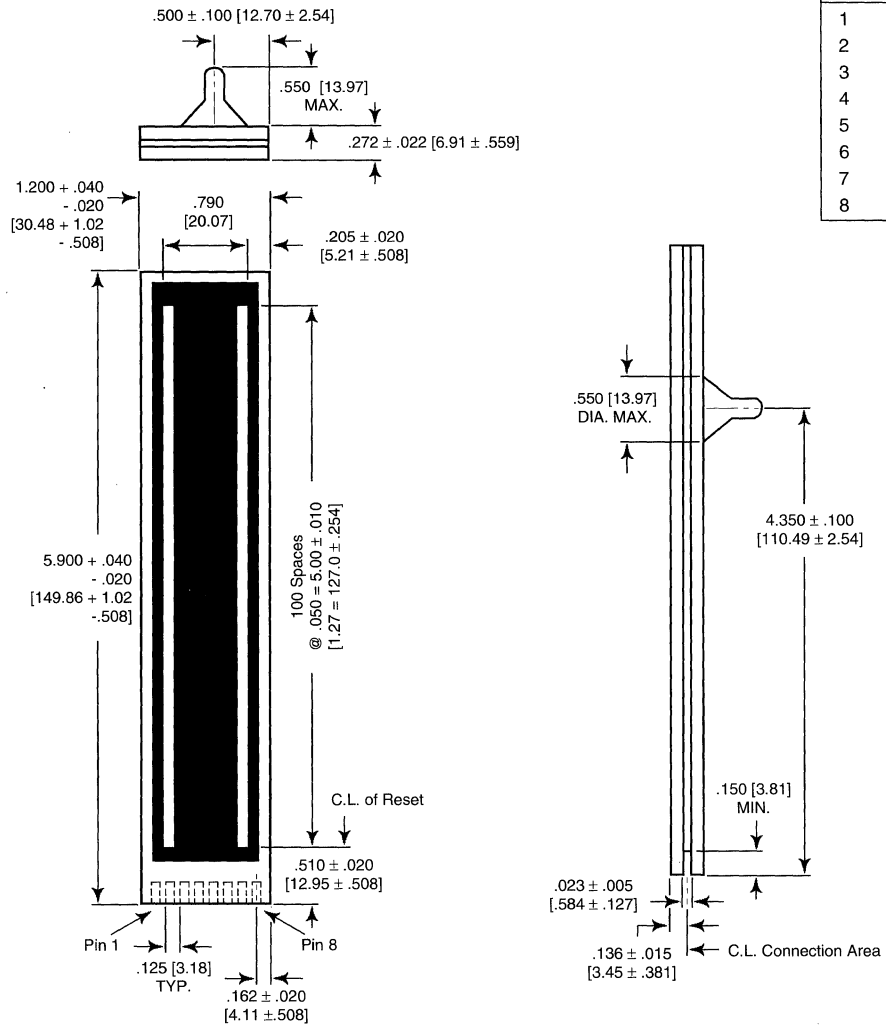
Block Diagram of Typical Drive Circuit



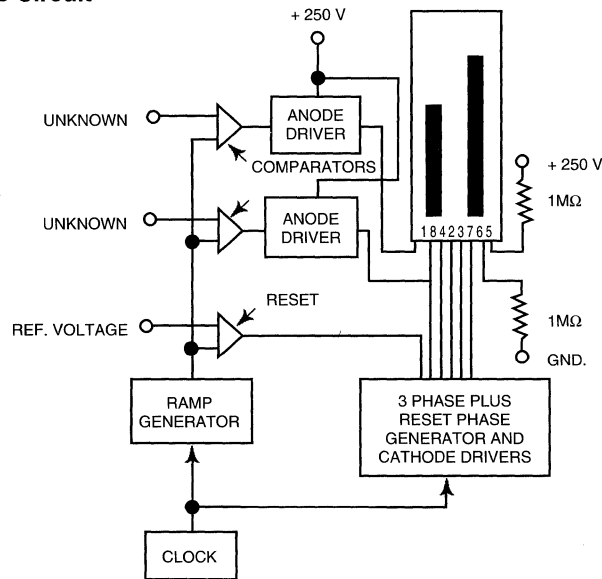
MODEL PBG

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

PBG-16101



Block Diagram of Typical Drive Circuit



MODEL PBG-C

Plasma Panel Displays

Linear Bar Graph



FEATURES

- Extra long columns for extended viewing distances
- At normal viewing distances glow blends into continuous, but precisely controlled bar length
- Unique scanning technique minimizes the number of drivers required
- Available with attached terminals

ENVIRONMENTAL SPECIFICATIONS

Altitude: 0 to 70,000 feet.

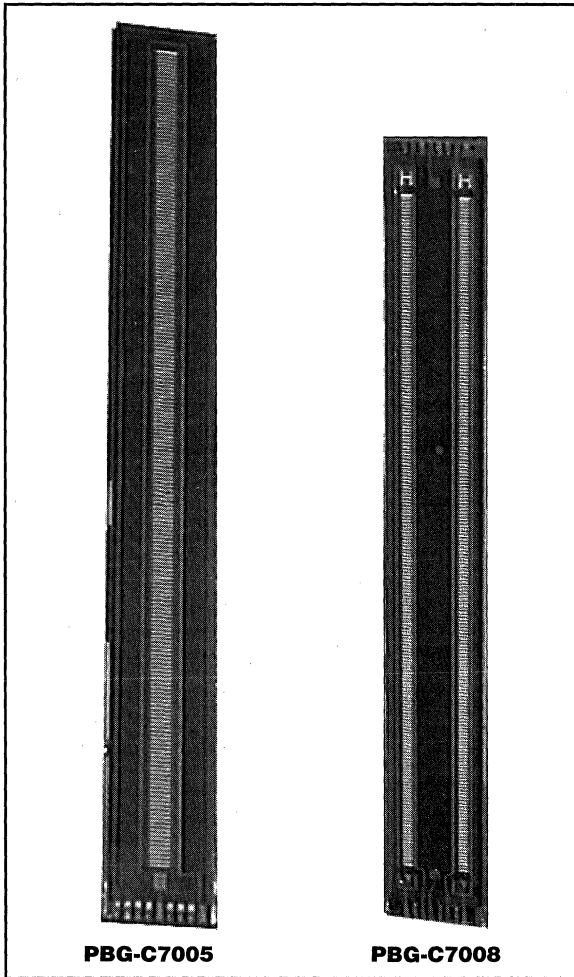
Operating Temperature: 0°C to + 55°C.

Storage Temperature: - 55°C to + 85°C.

Relative Humidity (No condensation): 85% maximum.

Vibration: .018 inches DA, 10 to 50 Hz, 2G, 50 to 2000 Hz.

Shock: 50G, 1/2 sine wave, 11 mS duration.



PBG-C7005

PBG-C7008

OPTICAL SPECIFICATIONS

	PBG-C7005	PBG-C7008
Elements	201	201
Resolution	1/2%	1/2%
Segment Length	.250	.120
Segment Width	.020	.020
Segment Spacing	.050	.0394
Drivers Required	7	8
Luminance	30 fl	30 fl
Viewing Angle	120°	120°
Color	Neon Orange	Neon Orange

ELECTRICAL SPECIFICATIONS

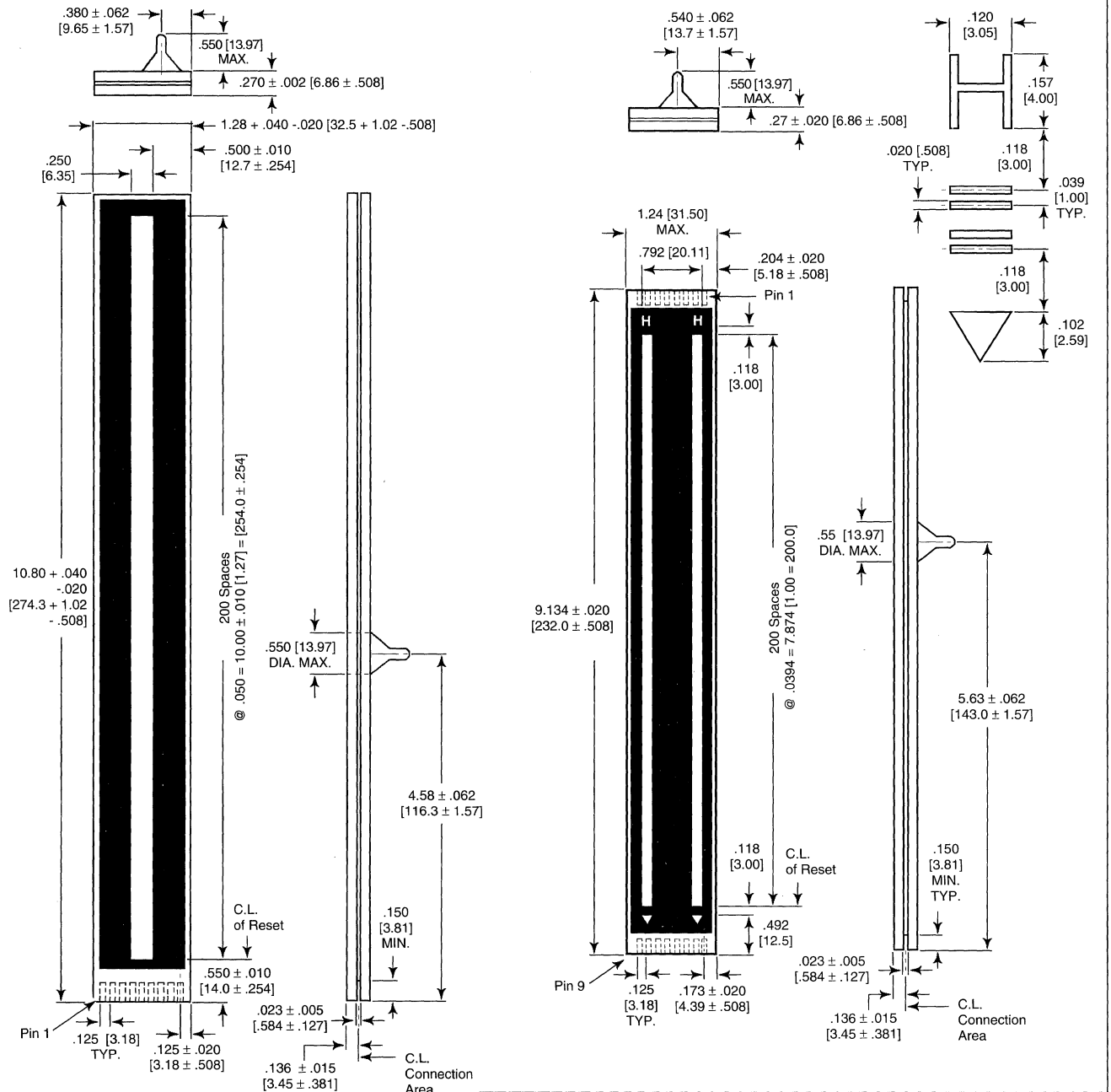
OPERATING PARAMETERS	PBG-C7005				PBG-C7008			
	MINIMUM	MAXIMUM	RECOMMENDED	UNITS	MINIMUM	MAXIMUM	RECOMMENDED	UNITS
Anode Supply Voltage	235	265	250	V	235	265	250	V
Cathode Off Bias Voltage	68	76	72	V	68	76	72	V
Anode Off Bias Voltage	80	120	100	V	80	120	100	V
Anode Sustaining Voltage (Typical)	—	—	150	V	—	—	150	V
Refresh Rate	—	—	66	Hz	—	—	65	Hz
Keep Alive Anode Resistor	—	—	1M	Ω	—	—	1M	Ω
Keep Alive Cathode Resistor	—	—	1M	Ω	—	—	1M	Ω
Keep Alive Current (Typical)	—	—	50	μA	—	—	50	μA
Display Anode Resistor	—	—	6k	Ω	—	—	15k	Ω
Display Peak Anode Current	10	20	15	mA	6	10	8	mA
Scan Time per Cathode	70	150	75	μS	70	150	75	μS
Applied Reset Pulse Width	70	150	75	μS	70	150	75	μS
Character Anode Resistor	—	—	—	—	—	—	6.8k	Ω
Character Anode Current	—	—	—	—	11	15	13	mA

MODEL PBG-C

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

PBG-C7005

PBG-C7008



PIN	CONNECTION	PIN	CONNECTION
1	Phase 1 Cathode	6	Phase 2 Cathode
2	Phase 5 Cathode	7	Phase 4 Cathode
3	Reset Cathode	8	Phase 3 Cathode
4	Keep Alive Cathode	9	Display Anode
5	Keep Alive Anode		
		9	Left ∇ Anode
		10	Phase 1 and H Cathode
		11	Left Bar Anode
		12	Bottom Keep Alive Anode
		13	Bottom Keep Alive Cathode
		14	Right Bar Anode
		15	Reset Cathode
		16	Right ∇ Anode

ORDERING INFORMATION

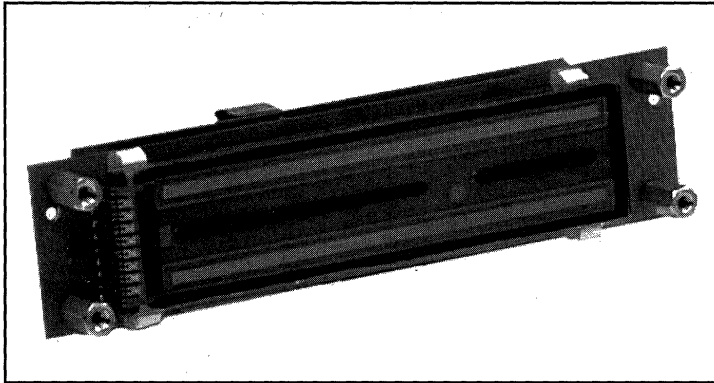
PBG
MODEL

XXXXX
TYPE

MODEL ABG-12205

Plasma Panel Bar Graph Modules

Dual Linear Bar Graph with Drive Electronics, Interface and DC/DC Converter



The ABG-12205 bar graph module is a dual 201 segment plasma bar graph display, drive electronics and interface to give a visual indication of analog input signals from 0 to + 30 volts DC. Two column inputs allow contrasting signals to be compared, or two signals to be monitored. Applications include audio control equipment, electrical power generation, industrial process control and machine controls.

STANDARD ELECTRICAL SPECIFICATIONS				
	MIN.	TYP.	MAX.	UNITS
Panel Supply Voltage	+ 11.4	+ 12.0	+ 12.6	V
Panel Supply Current	—	—	0.75	A
Input Signal	+ 5.0	—	+ 30.0	V
Input Impedance	10k	—	60k	Ohm

FEATURES

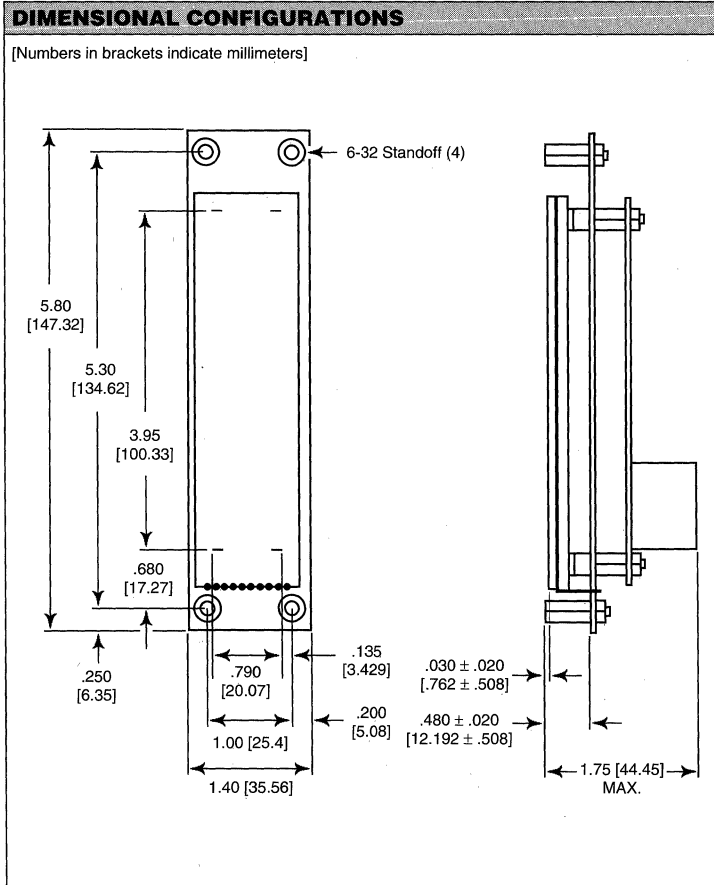
- Low input voltage (only + 12 VDC required)
- Input voltage can be scaled for full scale indication from + 5 to + 30 VDC
- 1/2% resolution
- Glow blends into continuous but precisely controlled bar length
- Compact size
- Wide viewing angle (150°)
- Rugged design
- High brightness

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature: 0°C to + 55°C.
Storage Temperature: - 55°C to + 85°C.
Relative Humidity: 10-85% R.H. non-condensing.
Mechanical Shock: 50G 1/2 sine wave, 11 msec duration, 5 shocks in each of 6 directions.
Vibration: 0.018" [0.46] displacement amplitude from 10 to 50 Hz, 2G acceleration from 50 to 2000 Hz logarithmic sweep rate, along each side of the 3 major axes.

OPTICAL SPECIFICATIONS

Viewing Area: 0.79" [20.1] W x 3.95" [100.3] H.
Elements: 201.
Element Size: 0.011" [0.28] x 0.100" [2.54] L.
Element Pitch: 0.020" [0.51].
Luminance: 70 foot lamberts.
Color: Neon orange.
Viewing Angle: 150° cone.
Refresh Frequency: 70 Hz.



MODEL ABG-12205

GENERAL DESCRIPTION

The ABG-12205 consists of a 5 phase dual linear plasma bar graph display, driver circuitry and an interface circuit. A DC/DC converter is also included to develop the necessary panel voltage.

The display operates on the patented principle known as "glow transfer". The display has 201 cathode elements per column, of which the first element in each column is a "reset" cathode. The remaining cathodes are connected in 5 phases where every 5th cathode is connected. The columns are scanned from the bottom to top by pulsing the reset cathode low, followed by sequentially pulsing each phase low until the top cathode is reached, at which time a new scan is started at the reset cathode. The anodes are energized starting at the time the reset cathode is energized until the desired display height is reached, at which time the anode is turned off for the balance of the scan time. The cathodes are refreshed at a 70 Hz rate so the scan appears to be flicker free.

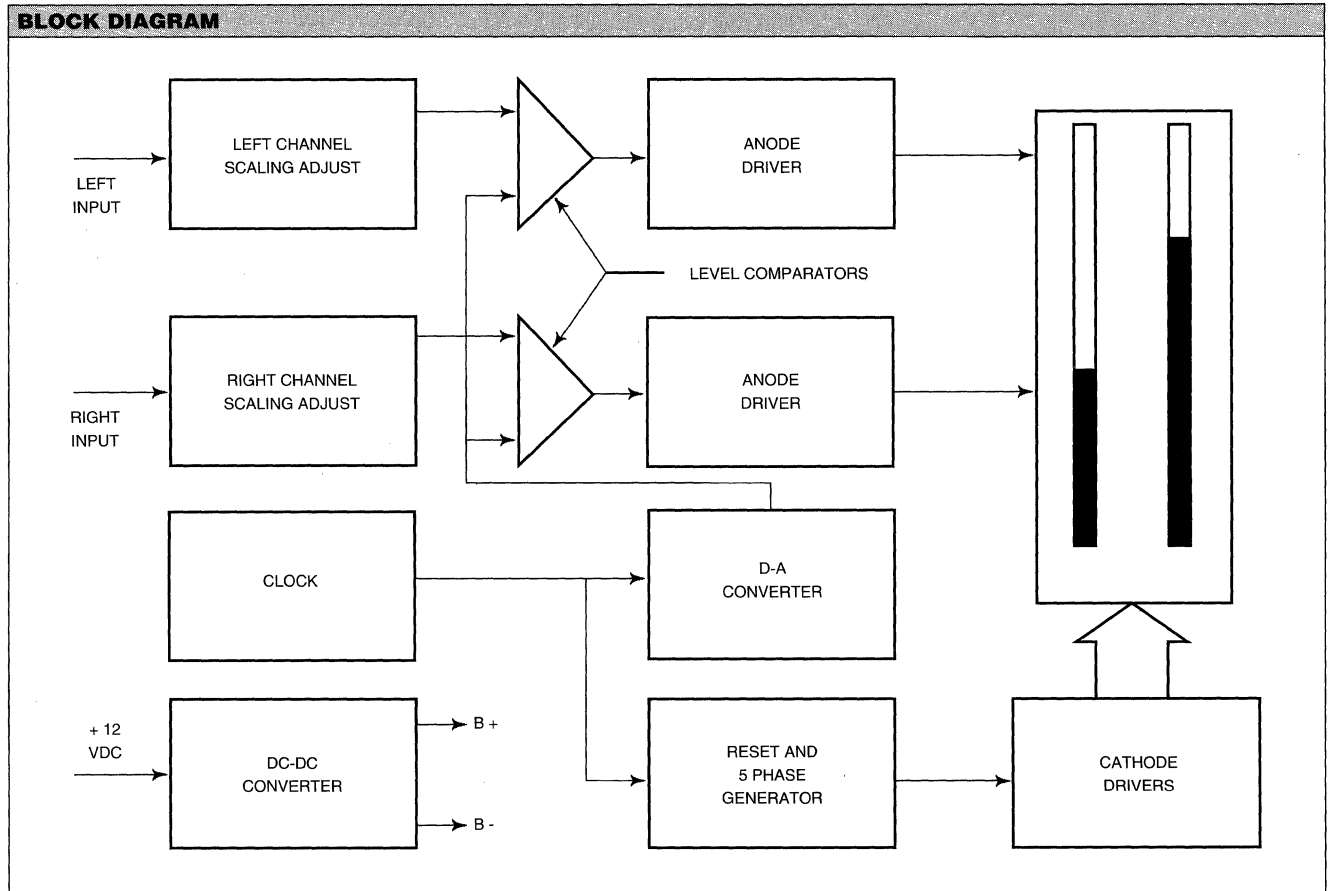
The interface circuit uses a voltage ramp, derived from a D-A converter driven by a clock oscillator and level comparators to control the anode drivers. The unknown (input) signal is applied to one input of the comparator and the voltage ramp applied to the other input. When the ramp voltage coincides with the unknown

signal, the anode driver is turned off, stopping the illumination of the bar graph column at that point on the scan.

The scaling adjustments are made by applying the maximum DC voltage to be measured (up to 30 volts) to the inputs and adjusting the right and left column trimmer resistors so that the columns are illuminated to full scale. (The adjustments are factory set for a 5 volt full scale reading.)

A common return is provided for each input and should be used to minimize noise that could cause the signal on the column to jitter.

PIN DESCRIPTION	
PIN	SIGNAL
1	RIGHT COLUMN INPUT SIGNAL
2	RIGHT COLUMN INPUT GROUND
3	LEFT COLUMN INPUT SIGNAL
4	LEFT COLUMN INPUT GROUND
5	+ 12 VDC
6	GROUND

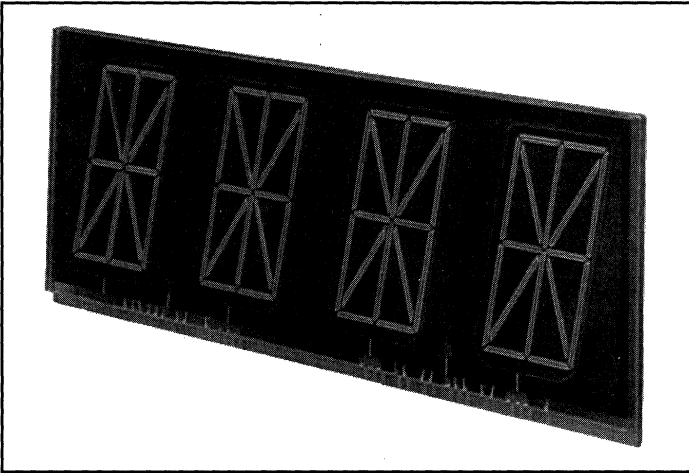


ORDERING INFORMATION

DESCRIPTION	PART NUMBER
Display and Drive Electronics	ABG-12205
Mating Connector Kit	280108-06
Non-Glare Filter (amber circular polarized) - other filters available, contact factory	280109-07

MODEL PD-04A200 Plasma Panel Displays

4 Character, 16 Segment Alphanumeric Display
with 2.00" [50.80] High Characters



FEATURES

- 200 foot lamberts brightness
- Designed for multiplexed operation
- Edgeboard connection
(terminals available as PD-04A200-2)
- End stackable

MAXIMUM RATINGS *

Peak Applied Voltage: 250 volts.
Operating Temperature: 0°C to + 55°C.
Storage Temperature: - 55°C to + 85°C.
Altitude: 70,000 feet.

* Values beyond which the life of the device may be reduced.

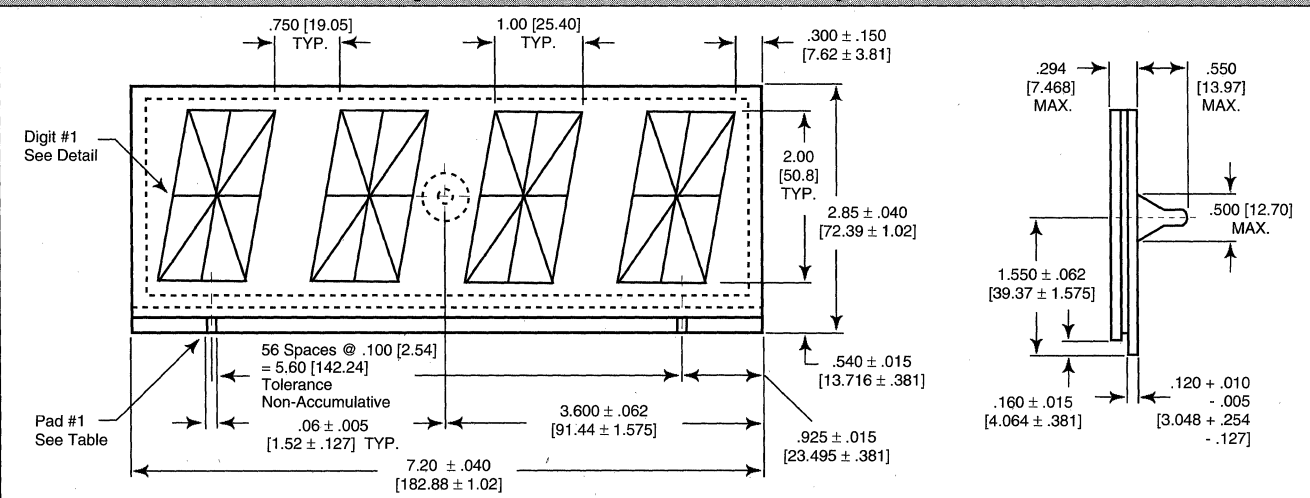
OPTICAL SPECIFICATIONS

Color: Neon orange
(Filterable from red, orange to yellow).
Viewing Angle: 130°.
Color: Neon orange.
Luminance: 200 foot lamberts.

STANDARD ELECTRICAL SPECIFICATIONS

CHARACTERISTIC @ 25°C	MINIMUM	TYPICAL	MAXIMUM	NOTES
Panel Voltage Drop (at typical cathode current)	130 VDC	145 VDC	170 VDC	
Initial Ionization Time (peak cathode voltage - 180)	—	—	5 sec.	
Cathode Segment Current (see drawing for cathode designation)				NOTE: At the specified current, a segment shall glow uniformly over its entire surface with no glow visible on any other part of the panel. † Recommended D.C. keep alive circuit: Use a 1 Megohm resistor in series with cathode and a 1 Megohm resistor in series with anode connected to a 200 VDC source.
Segments a, b, p, l, f and e	2.5 mA	4.3 mA	8.7 mA	
Segments c, d, g, h, i, j, k, m, n and o	5.0 mA	8.6 mA	17.5 mA	
Keep Alive †	25 µA	50 µA	75 µA	
Source Voltage *	- 180 VDC	- 200 VDC	- 220 VDC	* Voltage referenced to anode on voltage.
Anode Off Voltage *	- 35 VDC	- 100 VDC	- 120 VDC	
Cathode Off Voltage *	- 35 VDC	- 100 VDC	- 120 VDC	
Digit Period	80 µsec.	1250 µsec.	2500 µsec.	
Cathode Blanking Interval	20 µsec.	100 µsec.	—	
Cathode Blanking Overlap	10 µsec.	50 µsec.	—	
Display Scan Period	.32 msec.	5 msec.	10 msec.	NOTE: Operating limits do not apply simultaneously, e. g., operation at maximum current may require a longer blanking interval than the minimum specified.
Number of Anodes per Scan	—	4	—	

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



MODEL PD-04A200

DALE CONNECTOR FOR PD-04A200 DISPLAY [Numbers in brackets indicate millimeters]

Part No. ES14-57T-A-R19-720-C

NOTE: For optional mounting brackets, see below.

See Note

Tolerance Non-Accumulative

OPTIONAL MOUNTING BRACKETS [Numbers in brackets indicate millimeters]

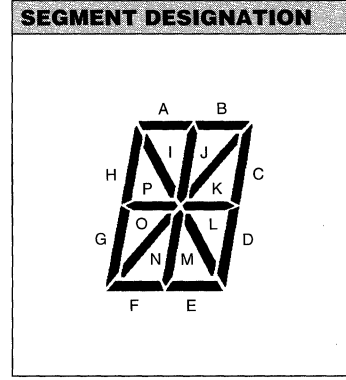
ESBV-1 (Vertical)

ESBP-1 (Parallel)

TERMINAL DESIGNATION

Terminal Pad Connections

1. Anode #1 Digit	13. Segment "G"	25. N/C	37. Anode #3 Digit	49. N/C
2. Anode #1 Digit	14. N/C	26. N/C	38. Anode #3 Digit	50. Segment "D"
3. Anode #1 Digit	15. N/C	27. N/C	39. N/C	51. Segment "C"
4. N/C	16. Segment "I"	28. N/C	40. Segment "O"	52. N/C
5. Segment "B"	17. N/C	29. N/C	41. Segment "N"	53. Anode #4 Digit
6. Segment "A"	18. Anode #2 Digit	30. N/C	42. N/C	54. Anode #4 Digit
7. Segment "J"	19. Anode #2 Digit	31. N/C	43. Segment "P"	55. Anode #4 Digit
8. Segment "M"	20. Anode #2 Digit	32. N/C	44. Segment "F"	56. N/C
9. Segment "L"	21. N/C	33. N/C	45. N/C	57. Segment "K"
10. Left K. A.	22. N/C	34. N/C	46. Anode Right K. A.	
11. Anode Left K. A.	23. N/C	35. N/C	47. Right K. A.	
12. Segment "H"	24. N/C	36. Anode #3 Digit	48. Segment "E"	



ORDERING INFORMATION

Display with Edgeboard Type Connection	PD-04A200
Display with Attached Terminals (Solderable)	PD-04A200-2

MODEL PD-16A040 Plasma Panel Displays

16 Character, 16 Segment Alphanumeric Display
with .400" [10.16] High Characters



FEATURES

- 50 foot lamberts brightness
- Designed for multiplexed operation
- Edgeboard connection
- Low power consumption

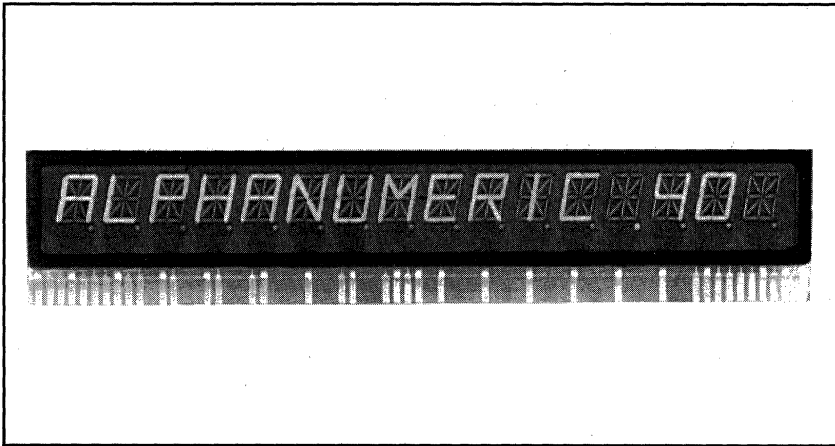
MAXIMUM RATINGS *

Peak Applied Voltage: 250 volts.
Operating Temperature: 0 to + 55°C.
Storage Temperature: - 55°C to + 85°C.
Altitude: 70,000 feet.

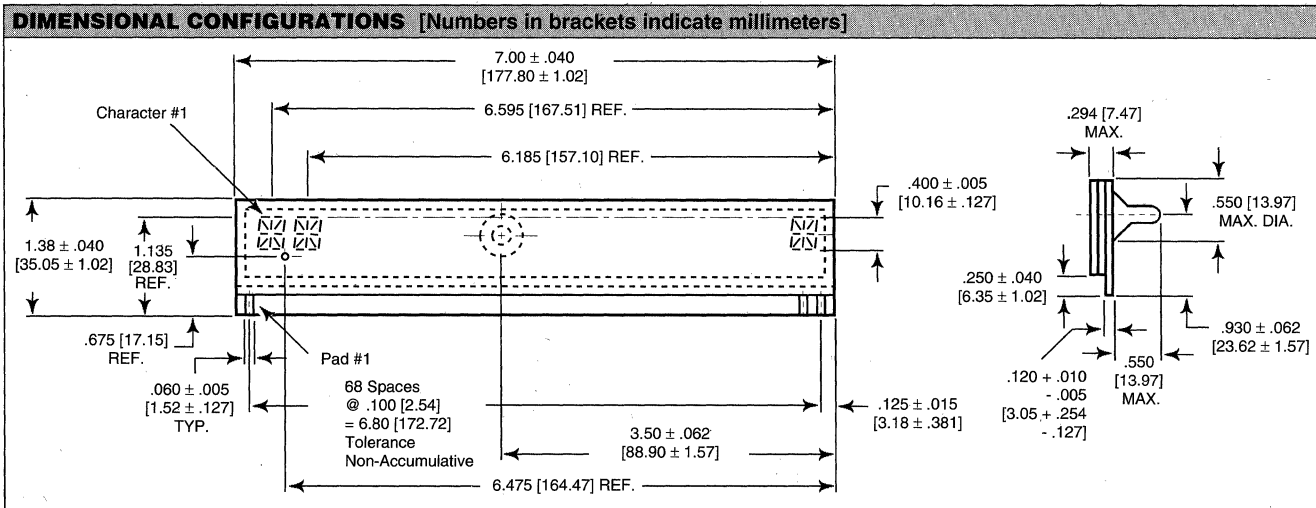
* Values beyond which the life of the device may be reduced.

OPTICAL SPECIFICATIONS

Color: Neon orange
(Filterable from red, orange to yellow).
Viewing Angle: 130°.
Luminance: 50 foot lamberts.



STANDARD ELECTRICAL SPECIFICATIONS				
CHARACTERISTIC @ 25°C	MINIMUM	TYPICAL	MAXIMUM	NOTES
Panel Voltage Drop (at typical cathode current)	130 VDC	145 VDC	170 VDC	
Initial Ionization Time (peak cathode voltage - 180)	—	—	5 sec.	
Cathode Segment Current (see drawing for cathode designation)				
Segments a, b, p, l, f and e	320 µA	400 µA	480 µA	NOTE: At the specified current, a segment shall glow uniformly over its entire surface with no glow visible on any other part of the panel. † Recommended D.C. keep alive circuit: Use a 1 Megohm resistor in series with cathode and a 1 Megohm resistor in series with anode connected to a 200 VDC source.
Segments m and i	480 µA	540 µA	630 µA	
Segments c, d, g, h, j, k, n and o	560 µA	630 µA	680 µA	
Decimal Point	320 µA	400 µA	480 µA	
Keep Alive †	25 µA	50 µA	75 µA	
Source Voltage *	- 180 VDC	- 200 VDC	- 220 VDC	* Voltage referenced to anode on voltage.
Anode Off Voltage *	- 35 VDC	- 100 VDC	- 120 VDC	
Cathode Off Voltage *	- 35 VDC	- 100 VDC	- 120 VDC	
Digit Period	80 µsec.	480 µsec.	600 µsec.	NOTE: Operating limits do not apply simultaneously, e.g. operation at maximum current may require a longer blanking interval than the minimum specified.
Cathode Blanking Interval	40 µsec.	100 µsec.	—	
Cathode Blanking Overlap	20 µsec.	50 µsec.	—	
Display Scan Period	1.3 msec.	7.7 msec.	9.6 msec.	
Number of Anodes per Scan	—	16	—	



MODEL PD-16A040

DALE CONNECTOR FOR PD-16A040 DISPLAY [Numbers in brackets indicate millimeters]

Part No. ES14-69T-A-R3-700-C

NOTE: For optional mounting brackets, see below

SEE NOTE

Tolerance Non-Accumulative

Viewing Side

Dimensions: .025 [.635], .200 [5.08] TYP., .025 [.635], 7.00 [177.80], .100 [2.54] TYP., .008 [.203] ± .0005 [.013] x .020 [.508] ± .002 [.051], .300 [7.62], .125 [3.18] NOM., .110 [2.79], .235 [5.97], .470 [11.94], .125 [3.18], 3/8 [9.52] MAX., .200 [5.08]

OPTIONAL MOUNTING BRACKETS [Numbers in brackets indicate millimeters]

ESBV-1 (Vertical)

Dimensions: .120 ± .002 [3.05 ± .051] DIA., 1/32 [.794], .574 [14.58], 3/8 [9.52], .200 [5.08] TYP., .290 [7.37], .375 [9.52]

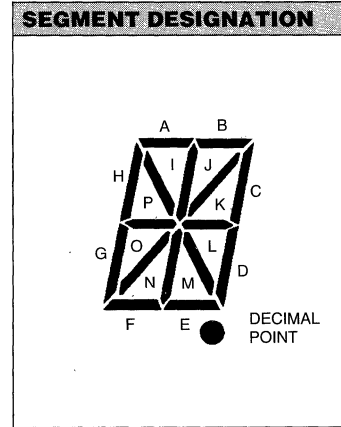
ESBP-1 (Parallel)

Dimensions: 3/8 [9.52], .120 ± .002 [3.05 ± .051] DIA., 1/32 [.794], .285 [7.24], .375 [9.52], 658 [16.71]

TERMINAL DESIGNATION

Terminal Pad Connections

1. Anode, K.A.	15. N/C	29. Anode #7 Digit	43. N/C	57. Anode #14 Digit
2. Segment "C"	16. Anode #4 Digit	30. N/C	44. N/C	58. N/C
3. K.A.	17. Segment "E"	31. N/C	45. Anode #11 Digit	59. N/C
4. Anode #1 Digit	18. N/C	32. Segment "M"	46. N/C	60. Segment "O"
5. Segment "H"	19. N/C	33. Anode #8 Digit	47. N/C	61. Anode #15 Digit
6. Segment "B"	20. Decimal	34. K.A.	48. N/C	62. Segment "L"
7. Segment "A"	21. Anode #5 Digit	35. Anode K.A.	49. Anode #12 Digit	63. Segment "P"
8. Anode #2 Digit	22. N/C	36. N/C	50. N/C	64. Segment "K"
9. Segment "G"	23. N/C	37. Anode #9 Digit	51. N/C	65. Segment "I"
10. Segment "D"	24. N/C	38. N/C	52. N/C	66. Anode #16 Digit
11. N/C	25. Anode #6 Digit	39. N/C	54. Anode #13 Digit	67. K.A.
12. Anode #3 Digit	26. N/C	40. N/C	54. N/C	68. Anode K.A.
13. Segment "F"	27. N/C	41. Anode #10 Digit	55. N/C	69. Segment "J"
14. N/C	28. Segment "N"	42. N/C	56. N/C	

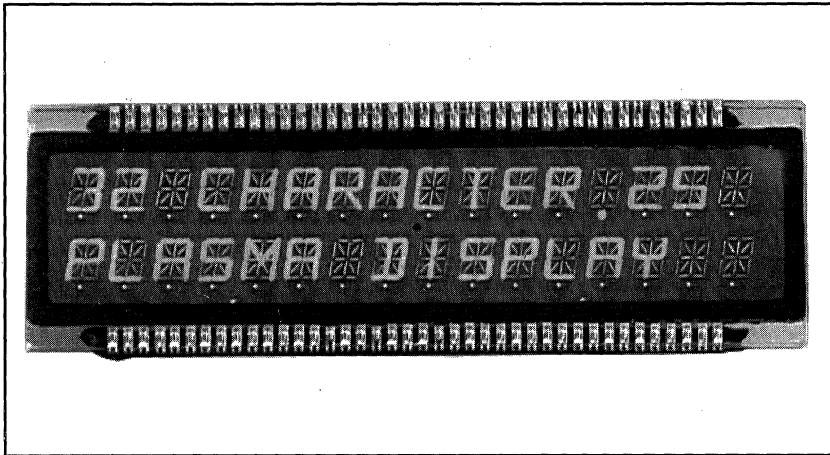


ORDERING INFORMATION

Display with Edgeboard Type Connection	PD-16A040
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MODEL PD-32A025 Plasma Panel Displays

**32 Character, 16 Segment Alphanumeric Display
with .250 [6.35] High Characters**



FEATURES

- 80 foot lamberts brightness
- Multiplexed operation
- Integral terminals
- Low power consumption

MAXIMUM RATINGS *

Peak Applied Voltage: 250 volts.
Operating Temperature: 0 to + 55°C.
Storage Temperature: - 55°C to + 85°.
Altitude: 70,000 feet.

* Values beyond which the life of the device may be reduced.

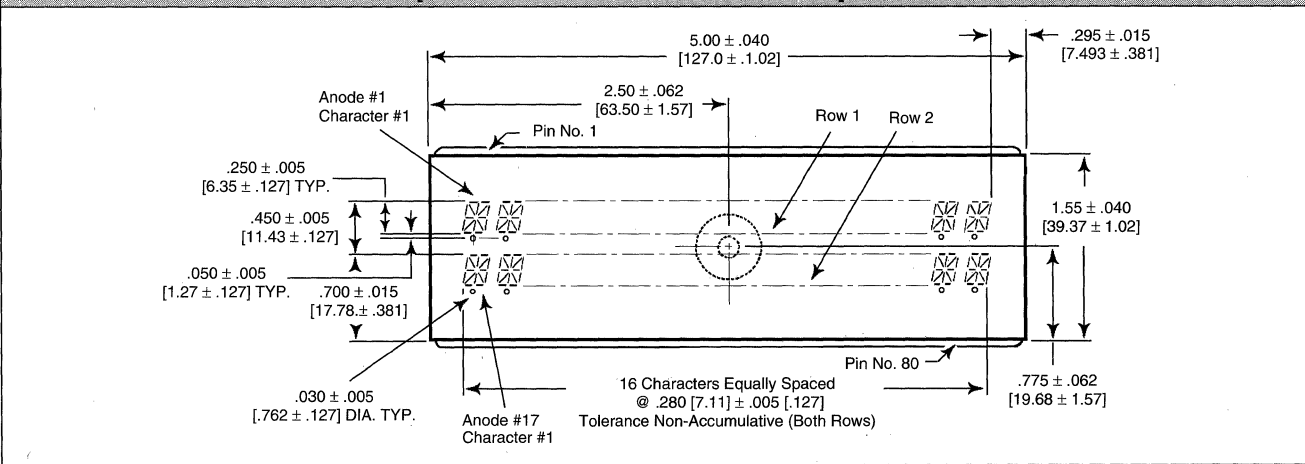
OPTICAL SPECIFICATIONS

Color: Neon orange
 (Filterable from red, orange to yellow).
Viewing Angle: 130°.
Luminance: 80 foot lamberts.

STANDARD ELECTRICAL SPECIFICATIONS

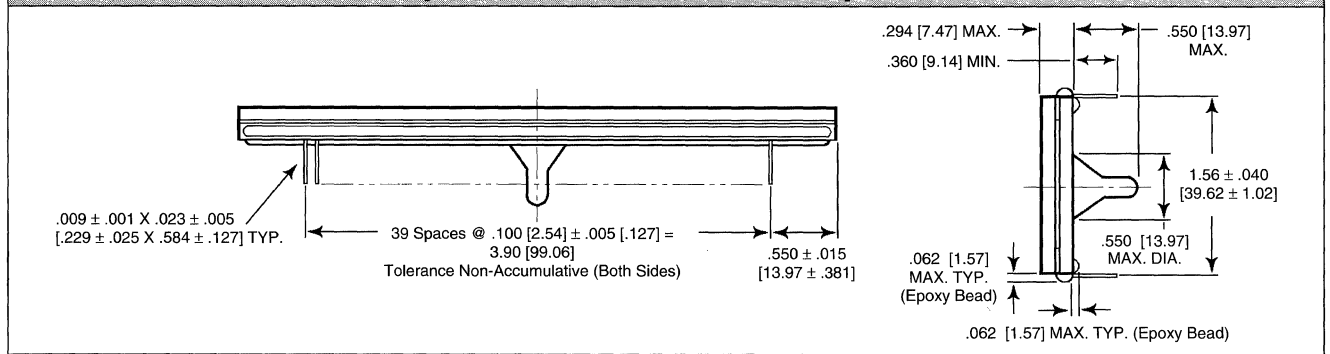
CHARACTERISTIC @ 25°C	MINIMUM	TYPICAL	MAXIMUM	NOTES
Panel Voltage Drop (at typical cathode current)	130 VDC	145 VDC	170 VDC	
Initial Ionization Time (peak cathode voltage - 180)	—	—	5 sec.	
Cathode Segment Current (see drawing for cathode designation)				
Segments a, d, f, j, n and t	180 μA	230 μA	280 μA	NOTE: At the specified current, a segment shall glow uniformly over its entire surface with no glow visible on any other part of the panel. † Recommended D.C. keep alive circuit: Use a 1 Megohm resistor in series with cathode and a 1 Megohm resistor in series with anode connected to a 200 VDC source.
Segments b, c, g, h, l and r	270 μA	350 μA	430 μA	
Segments k and p	210 μA	280 μA	350 μA	
Segments m and s	225 μA	300 μA	375 μA	
Decimal Point e	135 μA	180 μA	225 μA	
Keep Alive †	25 μA	50 μA	75 μA	
Source Voltage *	- 180 VDC	- 200 VDC	- 220 VDC	* Voltage referenced to anode on voltage.
Anode Off Voltage *	- 35 VDC	- 100 VDC	- 120 VDC	
Cathode Off Voltage *	- 35 VDC	- 100 VDC	- 120 VDC	
Digit Period	80 μsec.	480 μsec.	600 μsec.	NOTE: Operating limits do not apply simultaneously, e.g. operation at maximum current may require a longer blanking interval than the minimum specified.
Cathode Blanking Interval	20 μsec.	100 μsec.	—	
Cathode Blanking Overlap	10 μsec.	50 μsec.	—	
Display Scan Period	1.3 μsec.	7.7 msec.	9.6 msec.	
Number of Anodes per Scan	—	16	—	

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]



MODEL PD-32A025

DIMENSIONAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

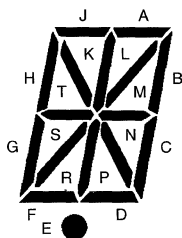


TERMINAL DESIGNATION

Terminal Pad Connections

TERMINATING PAD NO.	ROW NO.	SEGMENT	ANODE POSITION	TERMINATING PAD NO.	ROW NO.	SEGMENT	ANODE POSITION
1	1	—	1	41	2	—	17
2	1	D	—	42	2	H	—
3	1	—	2	43	2	—	18
4	1	E	—	44	2	B	—
5	1	—	3	45	2	—	19
6	1	F	—	46	2	A	—
7	1	J	—	47	2	—	20
8	1	—	4	48	2	J	—
9	1	N/C	—	49	2	—	Left K.A.
10	1	H	—	50	2	L	—
11	1	—	5	51	2	—	21
12	1	L	—	52	2	Left K.A.	—
13	1	—	6	53	2	—	22
14	1	A	—	54	2	E	—
15	1	M	—	55	2	N/C	—
16	1	—	7	56	2	—	23
17	1	N/C	—	57	2	R	—
18	1	K	—	58	2	N/C	—
19	1	—	8	59	2	—	24
20	1	N	—	60	2	S	—
21	1	N/C	—	61	2	—	25
22	1	—	9	62	2	N/C	—
23	1	T	—	63	2	C	—
24	1	N/C	—	64	2	—	26
25	1	—	10	65	2	D	—
26	1	P	—	66	2	G	—
27	1	—	11	67	2	—	27
28	1	N/C	—	68	2	F	—
29	1	R	—	69	2	—	28
30	1	—	12	70	2	Right K.A.	—
31	1	N/C	—	71	2	—	Right K.A.
32	1	B	—	72	2	P	—
33	1	—	13	73	2	—	29
34	1	S	—	74	2	T	—
35	1	N/C	—	75	2	—	30
36	1	—	14	76	2	N	—
37	1	C	—	77	2	K	—
38	1	—	15	78	2	—	31
39	1	G	—	79	2	M	—
40	1	—	16	80	2	—	32

SEGMENT DESIGNATION



ORDERING INFORMATION

Display with Integral Connector Pins PD-32A025



Military Product Identification

MILITARY PART ORDERING EXAMPLES

To help in ordering, the following are representative samples of military part numbers cross-referenced to Dale® part numbers. For complete information, consult Military Specification Qualified Products List.

RESISTORS: Fixed and Variable

<p>MIL-R-26E (Basic [RW]) (Established Reliability MIL-R-39007 [RWR]) RW80 $\frac{U}{1}$ $\frac{49R9}{2}$ $\frac{F}{3}$ = Dale Type $\frac{G-3}{1}$ 49.9 ohm $\frac{1\%}{4}$ RW69 $\frac{V}{1}$ $\frac{101}{2}$ = Dale Type CW-2C-1 100 ohm, 5% $\frac{1}{1}$ $\frac{2}{2}$ $\frac{3}{3}$ $\frac{4}{4}$</p>	<p>1. Style 2. Characteristic 3. Resistance Value 4. Tolerance</p> <p>1. Style 2. Characteristic 3. Value (Tolerance below 1 ohm 10%, 1 ohm and up 5%)</p>
<p>MIL-R-10509F (Basic [RN]) (Established Reliability MIL-R-55182 [RNR]) RN60 $\frac{D}{1}$ $\frac{1003}{2}$ $\frac{F}{3}$ = Dale Type CMF-60 T-1 100k $\frac{1\%}{4}$ $\frac{1}{1}$ $\frac{2}{2}$ $\frac{3}{3}$ $\frac{4}{4}$</p>	<p>1. Style 2. Characteristic - Temperature Coefficient 3. Resistance Value 4. Tolerance</p>
<p>MIL-R-18546D (Basic [RE]) (Established Reliability MIL-R-39009 [RER]) RE65 $\frac{G}{1}$ $\frac{1001}{2}$ = Dale Type RH-10 $\frac{1k}{3}$ $\frac{1}{1}$ $\frac{2}{2}$ $\frac{3}{3}$</p>	<p>NOTE: 1% tolerance per Military Specification.</p> <p>1. Style 2. Characteristic - Maximum continuous operating temperatures 3. Resistance Value</p>
<p>MIL-R-22684C (Basic [RL]) (Established Reliability MIL-R-39017 [RLR]) RL07 $\frac{S}{1}$ $\frac{103}{2}$ $\frac{J}{3}$ = Dale Type CMF-07 10k $\frac{5\%}{4}$ $\frac{1}{1}$ $\frac{2}{2}$ $\frac{3}{3}$ $\frac{4}{4}$</p>	<p>NOTE: Parts will be color banded.</p> <p>1. Style 2. Terminal 3. Resistance Value 4. Tolerance</p>
<p>MIL-R-22097F (Basic [RJ]) (Established Reliability MIL-R-39035 [RJR]) RJ24 $\frac{F}{1}$ $\frac{P}{2}$ $\frac{103}{3}$ = Techno Type $\frac{412}{1,3}$ 1k $\frac{10\%}{4}$ $\frac{1}{1}$ $\frac{2}{2}$ $\frac{3}{3}$ $\frac{4}{4}$</p>	<p>NOTE: 10% tolerance per Military Specification.</p> <p>1. Style 2. Characteristic 3. Terminal 4. Resistance</p>
<p>MIL-R-27208C (Basic [RT]) (Established Reliability MIL-R-39015 [RTR]) RT24 $\frac{C}{1}$ $\frac{2}{2}$ $\frac{P}{3}$ $\frac{102}{4}$ = Techno Type 126S $\frac{1k}{1,4}$ $\frac{5\%}{5}$ $\frac{1}{1}$ $\frac{2}{2}$ $\frac{3}{3}$ $\frac{4}{4}$ $\frac{5}{5}$</p>	<p>NOTE: 5% tolerance per Military Specification.</p> <p>1. Style 2. Resistance - Temperature Characteristic 3. Temperature Characteristic 4. Terminal 5. Resistance</p>
<p>MIL-R-39007G (Established Reliability [RWR]) (Basic - MIL-R-26 [RW]) RWR74 $\frac{S}{1}$ $\frac{10R1}{2}$ $\frac{F}{3}$ $\frac{R}{4}$ = Dale Type ESS-5 10.1 ohm $\frac{1\%}{4}$ $\frac{R}{5}$ $\frac{1}{1}$ $\frac{2}{2}$ $\frac{3}{3}$ $\frac{4}{4}$ $\frac{5}{5}$</p>	<p>1. Style 2. Terminal 3. Resistance Value 4. Tolerance 5. Failure Rate Level</p>
<p>MIL-R-39009C (Established Reliability [RER]) (Basic - MIL-R-18546 [RE]) RER65 $\frac{F}{1}$ $\frac{1001}{2}$ $\frac{R}{3}$ = Dale Type ERH-10 $\frac{1\%}{2}$ $\frac{1k}{3}$ $\frac{R}{4}$ $\frac{1}{1}$ $\frac{2}{2}$ $\frac{3}{3}$ $\frac{4}{4}$</p>	<p>1. Style 2. Tolerance 3. Resistance Value 4. Failure Rate Level</p>
<p>MIL-R-39015C (Established Reliability [RTR]) (Basic - MIL-R-27208 [RT]) RTR24 $\frac{D}{1}$ $\frac{P}{2}$ $\frac{102}{3}$ $\frac{R}{4}$ = Techno Type M39015/3 007 $\frac{P}{3}$ $\frac{R}{5}$ $\frac{1}{1}$ $\frac{2}{2}$ $\frac{3}{3}$ $\frac{4}{4}$ $\frac{5}{5}$</p> <p>NOTE: 5% tolerance per Military Specification.</p>	<p>1. Style 2. Characteristic 3. Terminal 4. Resistance 5. Failure Rate Level</p>
<p>MIL-R-39017E (Established Reliability [RLR]) (Basic - MIL-R-22684 [RL]) RLR07 $\frac{C}{1}$ $\frac{1002}{2}$ $\frac{G}{3}$ $\frac{R}{4}$ = Dale Type ERL-07 10k $\frac{2\%}{4}$ $\frac{R}{5}$ $\frac{1}{1}$ $\frac{2}{2}$ $\frac{3}{3}$ $\frac{4}{4}$ $\frac{5}{5}$</p>	<p>1. Style 2. Terminal Type 3. Resistance Value 4. Tolerance 5. Failure Rate Level</p>
<p>MIL-R-39035B (Established Reliability [RJR]) (Basic - MIL-R-22097 [RJ]) RJR24 $\frac{F}{1}$ $\frac{P}{2}$ $\frac{102}{3}$ $\frac{R}{4}$ = Techno Type RJR24 $\frac{F}{1}$ $\frac{P}{2}$ $\frac{1k}{3}$ $\frac{10\%}{4}$ $\frac{1}{1}$ $\frac{2}{2}$ $\frac{3}{3}$ $\frac{4}{4}$</p> <p>NOTE: 10% tolerance per Military Specification.</p>	<p>1. Style 2. Characteristic 3. Terminal 4. Resistance 5. Failure Rate Level</p>
<p>MIL-R-49465A (Basic [RLV]) (Established Reliability - None) M49465 $\frac{02}{1}$ $\frac{L}{2}$ $\frac{R0100}{3}$ $\frac{J}{4}$ = Dale Type CPSL-3-6 0.01 ohm $\frac{5\%}{5}$ $\frac{1}{1}$ $\frac{2}{2}$ $\frac{3}{3}$ $\frac{4}{4}$ $\frac{5}{5}$</p>	<p>NOTE: L Characteristic.</p> <p>1. Military Specification 2. Specification Sheet Number 3. Characteristic 4. Resistance Value 5. Tolerance</p>
<p>MIL-R-55182F (Established Reliability [RNR]) (Basic MIL-R-10509 [RN]) RNC55 $\frac{H}{1}$ $\frac{49R9}{2}$ $\frac{F}{3}$ $\frac{S}{4}$ = Dale Type ERC-55 T-2 49.9 ohm $\frac{1\%}{4}$ $\frac{S}{5}$ $\frac{1}{1}$ $\frac{2}{2}$ $\frac{3}{3}$ $\frac{4}{4}$ $\frac{5}{5}$</p>	<p>1. Style 2. Characteristic/Temperature Coefficient 3. Resistance Value 4. Tolerance 5. Failure Rate Level</p>
<p>MIL-R-55342E (Established Reliability [RM]) (Basic - None) M55342 $\frac{M}{1}$ $\frac{02}{2}$ $\frac{S}{3}$ $\frac{100E}{4}$ $\frac{R}{5}$ = Dale Type RCM550 100k $\frac{1\%}{5}$ $\frac{R}{6}$ $\frac{1}{1}$ $\frac{2}{2}$ $\frac{3}{3}$ $\frac{4}{4}$ $\frac{5}{5}$ $\frac{6}{6}$</p> <p>NOTES: M Characteristic. One surface, pretinned, solderable terminations. D55342 is used for 07 detail specification sheet. Separate code for resistance value and tolerance is used in this Military Specification.</p>	<p>1. Military Specification 2. Characteristic 3. Specification Sheet Number 4. Termination Material 5. Resistance Value and Tolerance 6. Failure Rate Level</p>

Military Product Identification

MILITARY PART ORDERING EXAMPLES			
RACK AND PANEL CONNECTORS			
MIL-C-28748A (Basic) (Established Reliability - None)		1. Military Specification 2. Specification Sheet Number 3. Insert Designator (B-7 Contacts) 4. Shield (0 = None)	
M28748	$\frac{7}{1}$ $\frac{B}{2}$ $\frac{0}{3}$ $\frac{0}{4}$ $\frac{F}{5}$ $\frac{1A}{6}$ = Dale Type	MMP22G5	$\frac{7}{3}$ $\frac{SL2L}{6}$ 5. Shell Polarization (0 = None) 6. Jackscrews or Guidepins 7. Contacts (1A = 100 percent size 22)
RESISTOR NETWORKS			
MIL-R-83401F (Basic [RZ]) (Established Reliability MIL-R-874 [RZR])		NOTE: M Characteristic.	
M8340101	$\frac{M}{1,2}$ $\frac{1003}{3,4}$ $\frac{G}{5}$ $\frac{A}{6}$ = Dale Type	MDM $\frac{100k}{4}$ $\frac{2\%}{5}$ $\frac{A}{6}$	1. Military Specification 2. Specification Sheet Number 3. Characteristic 4. Resistance Value 5. Tolerance 6. Schematic
Resistance Value Examples			
Three Digit Figure 100 = 10 ohm, 101 = 100 ohm 102 = 1k ohm, 203 = 20k ohm		Four Digit Figure 49R9 = 49.9 ohm, 1000 = 100 ohm 1001 = 1k ohm, 1004 = 1 Megohm	Five Digit Figure 10R60 = 10.6 ohm, 10000 = 1k ohm 12701 = 12.7k ohm, 10202 = 102k ohm
Tolerance Examples			
A = ± 0.05%		B = ± 0.10%	D = ± 0.50%
		F = ± 1.0%	G = ± 2.0%
			J = ± 5.0%
TRANSFORMERS AND INDUCTORS			
MIL-T-27E (Basic [TF]) (Established Reliability - None)		1. Military Specification 2. Specification Sheet Number 3. Specification Sheet Dash Number Indicating Value and Electrical Ratings	
M27	$\frac{215}{1}$ $\frac{05}{2}$ = Dale Type	TE-3QOTR 1.0 mH 2%	
MIL-C-15305E (Basic [LT]) (Established Reliability MIL-C-39010)		NOTES: Parts will be color banded. Value per Military Standard dash number.	
LT	$\frac{4}{1}$ $\frac{K}{2}$ $\frac{3}{3}$ = Dale Type	IM-2 (.10 µH to 1.00 µH) 10%	1. Style 2. Grade and Class 3. Family K = Coil, Radio Frequency, Fixed

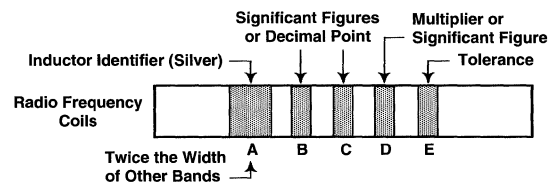
MILITARY COLOR CODES - FILM RESISTORS			
BAND A & B		BAND C	
COLOR	1st and 2nd SIGNIFICANT FIGURE	COLOR	VALUE MULTIPLIER
Black	0	Black	1
Brown	1	Brown	10
Red	2	Red	100
Orange	3	Orange	1,000
Yellow	4	Yellow	10,000
Green	5	Green	100,000
Blue	6	Blue	1,000,000
Purple (Violet)	7	Silver	0.01
Gray	8	Gold	0.1
White	9		
BAND D		BAND E	
COLOR	RESISTANCE TOLERANCE (Percent)	COLOR	TERMINAL
Gold	± 5%	White	Solderable
Red	± 2%		

8 1/2 x 11 & Pocket-Size Color Code ID Charts

For a 8 1/2 x 11 chart, or a supply of pocket-size charts showing actual colors used in marking film resistors and RF chokes, write to Dale Electronics, Inc., Advertising Department, 2064 12th Avenue, P.O. Box 609, Columbus, NE 68602-0609 or call (402) 563-6417.

Indicate size and type of chart desired: Film Resistor chart or RF Choke.

MILITARY COLOR CODES - RF COILS			
COLOR	BAND A & B	BAND C	BAND C
COLOR	SIGNIFICANT FIGURES or DECIMAL POINT	MULTIPLIER* or SIGNIFICANT FIGURE	INDUCTANCE TOLERANCE
Black	0	1	—
Brown	1	10	± 1%
Red	2	100	± 2%
Orange	3	1,000	± 3%
Yellow	4	10,000	± 4%
Green	5	—	—
Blue	6	—	—
Violet	7	—	—
Gray	8	—	—
White	9	—	—
None**	—	—	± 20%
Silver	—	—	± 10%
Gold	Decimal Point	—	± 5%



Band "A" is twice the width of the other bands and is silver in color to identify part as an inductor. ***

For Inductance Values Less Than 10 either Band "B" or Band "C" will be gold and will represent the decimal point. The other two bands ("B" and "D" or "C" and "D") will represent significant figures.

For Inductance Values of 10 or More Band "B" and Band "C" represent significant figures and Band "D" is the Multiplier.

For small units, dots may be used in place of bands.

* The multiplier is the factor by which two significant figures are multiplied to yield the nominal inductance value.

** Indicates body color.

*** Coated inductors are marked with four color bands, the first being a double wide significant figure or decimal point in lieu of the double wide silver inductor identifier.

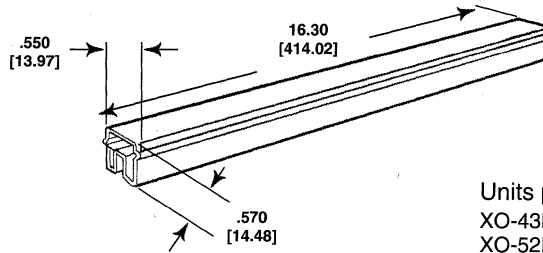


Packaging Methods

Oscillators and Resistor Networks

HYBRID CRYSTAL CLOCK OSCILLATORS [Numbers in brackets indicate millimeters]

- XO-43B
- XO-52B
- XOSM-52B, BE
- XO-53B
- XO-54B, BD, BE

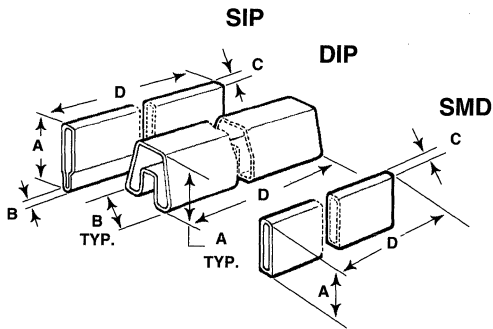


Units per Tube

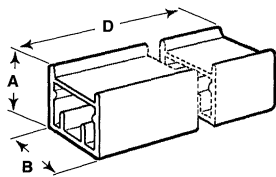
XO-43B, XO-53B, XO-54B, BD, BE: 20 Pieces.
XO-52B, XOSM-52B, BE: 33 Pieces.

DALE ELECTRONICS, INC., 1155 W. 23rd Street, Tempe, AZ 85282-1883 • Phone (602) 967-7874 • Fax 602-829-9314

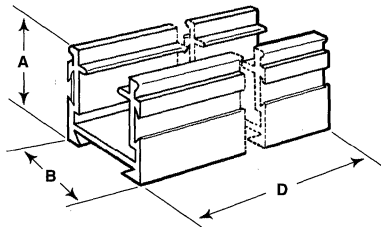
RESISTOR NETWORKS [Numbers in brackets indicate millimeters]



Side-By-Side SIP



Flat Pack



END-TO-END TUBE PACK DIMENSIONS

	A	B	C	D
DIP	1/2	.600	—	22 1/4
	[12.70]	[15.24]		[565.15]
SIP	.430	.040	.120	23 1/2
Low Profile	[10.92]	[1.02]	[3.05]	[596.90]
SIP	.605	.040	.120	23 1/2
High Profile	[15.37]	[1.02]	[3.05]	[596.90]

SURFACE MOUNT NETWORKS

SOGC	.400	.150	—	23 1/2
	[10.16]	[3.81]		[596.90]
SOMC	.400	.150	—	23 1/2
	[10.16]	[3.81]		[596.90]

SIDE-BY-SIDE SIP

10 PIN	.650	1.10	—	19
	[16.51]	[27.94]		[482.60]
8 PIN	.650	.860	—	19
	[16.51]	[21.84]		[482.60]
6 PIN	.650	.700	—	19
	[16.51]	[17.78]		[482.60]
4 PIN	.650	.500	—	19
	[16.51]	[12.70]		[482.60]

FLAT PACK

DFP	1.38	1.10	—	19 7/8
	[35.05]	[27.94]		[504.82]
DFM	1.38	1.10	—	19 7/8
	[35.05]	[27.94]		[504.82]

STANDARD (•) AND OPTIONAL (X) PACKAGING

PACKAGING STYLES	DUAL-IN-LINE			FLAT PACKS		SINGLE-IN-LINE					SURFACE MOUNT	
	MDM	MDP	RC MOLDED	DFM	DFP	CSC	MSM	MSP	RC COATED	RC MOLDED	SOGC	SOMC
End-to-End Magazine (Tube)	•	•	•	•	•	X	•	•		•	•	
Poly Bag				X	X	•				•		
Side-by-Side SIP							X	X				
Tape and Reel											X	X

• End-To-End Magazine (Tube) Pack DIP/SIP:

A magazine pack for single-in-line and dual-in-line resistor networks. Quantity per pack dependent on size of units. Maximum tube length is 23 1/2" [596.90]. Width and depth of tube dependent on size of individual resistor network.

• Poly Bag

Units are packaged in poly bags and then packed in boxes.

• Magazine (Tube) Pack Flat Pack:

All flat packs are packaged in individual protective carriers that are considered as part of all flat pack units. Flat pack units are then packed in magazines (tubes).

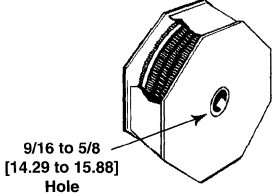
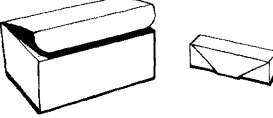
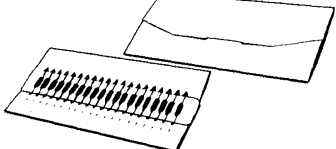
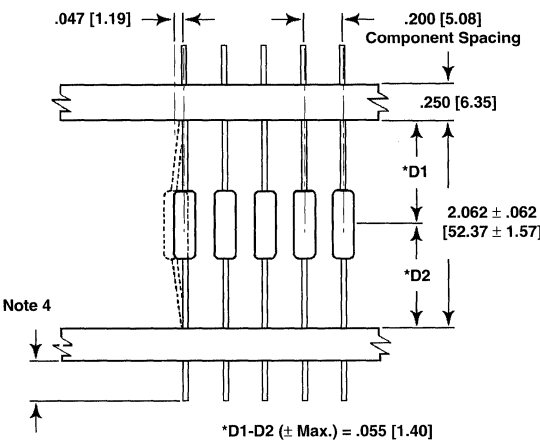
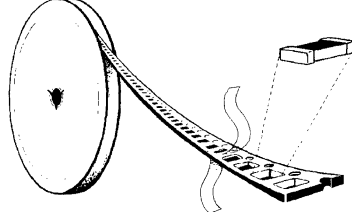
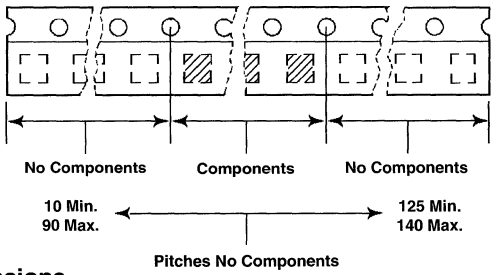
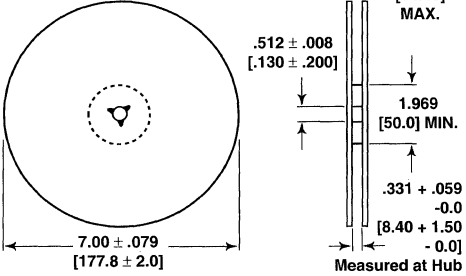
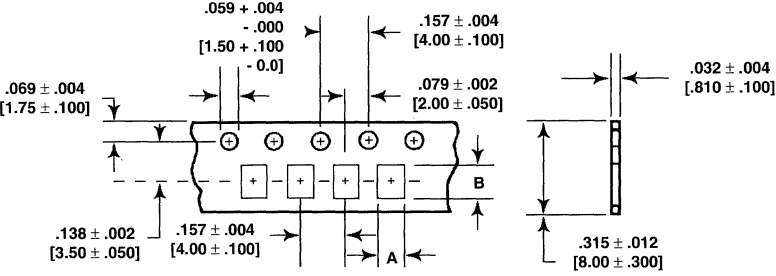
X Special Packaging:

Blister, vial, military, antistatic and customer special packaging can be provided. Consult factory for information.

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Packaging Methods

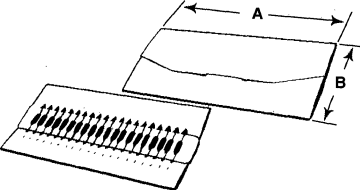
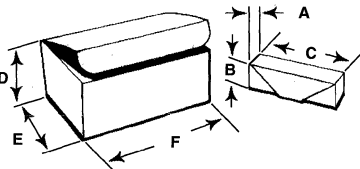
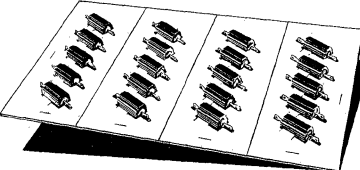
Film Resistors

FILM RESISTORS [Numbers in brackets indicate millimeters]														
Taped Lead and Reel Package 	MODELS CMF-50, ERL-05, ERC-50, CCF-05	MAXIMUM UNITS PER REEL 5000												
	CCF-07, CCF-55, CMF-55, CPF-1, CMF-07, ERL-07, ERC-55	5000												
	CCF-60, CMF-60, CMF-20, ERL-20, ERC-60, CPF-2	2500												
	CMF-65, CPF-3, ERC-65	2000												
Bulk Pack 	Resistors are uniformly packaged 100 per box with 10 unit boxes per intermediate container.													
Lacer Pack 	Resistor body placed in slot, held in place with tongue insert. Terminals protected within folder. 20 units per folder.													
Lead Taping Dimensions 														
Notes: 1. Quantity per reel: (See table). 2. A minimum of 18" [457] bare tape leader shall be provided at each end of the reel. 3. Protection between layers of components provided by Kraft paper separator. 4. Lead trimming 1/16" [1.59] from tape edge is available on request. Standard on CCF-07, CCF-50, CCF-55 and CCF-60. 5. Marking of reeled components in 100 piece intervals available on request. Consult factory.														
Tape and Reel Specifications														
Reel 	Tape 													
Reel Dimensions 	Tape Dimensions 													
Marking: All required marking to be on unit package. Individual part marking is available. Stocked, CRCW1206, 5% units are marked with 3 digit value code. Packaging: Bulk Package = 1000 pieces per plastic bag. 8mm Reel = 5000 pieces per reel per EIA Standard RS-481.	<table border="1"> <thead> <tr> <th>MODEL</th> <th>A ± .005 [± .130]</th> <th>B + .005 [± .130]</th> </tr> </thead> <tbody> <tr> <td>CRCW0805</td> <td>.070 [1.78]</td> <td>.100 [2.54]</td> </tr> <tr> <td>CRCW1206</td> <td>.080 [2.03]</td> <td>.142 [3.61]</td> </tr> <tr> <td>CRCW1210</td> <td>.115 [2.92]</td> <td>.142 [3.61]</td> </tr> </tbody> </table>		MODEL	A ± .005 [± .130]	B + .005 [± .130]	CRCW0805	.070 [1.78]	.100 [2.54]	CRCW1206	.080 [2.03]	.142 [3.61]	CRCW1210	.115 [2.92]	.142 [3.61]
MODEL	A ± .005 [± .130]	B + .005 [± .130]												
CRCW0805	.070 [1.78]	.100 [2.54]												
CRCW1206	.080 [2.03]	.142 [3.61]												
CRCW1210	.115 [2.92]	.142 [3.61]												



Packaging Methods

Wirewound Resistors

WIREWOUND RESISTORS [Numbers in brackets indicate millimeters]							
Lacer Pack 	MODELS	A	B	Resistor body placed in slot, held in place with tongue insert. Terminals protected within folder. 20 units per folder.			
	RS-1/8, RS-1/4, RS-1/2, RS-1A, RS-1B, RS-1M, G-1, G-2, G-3	8 1/2 [215.90]	3 3/4 [95.25]				
	RS-2, RS-2A, RS-2B, RS-2C, G-5, G-5A, G-5C	8 1/2 [215.90]	4 [101.60]				
	RS-5, RS-7, G-6, G-10	11 [279.40]	5 [127.00]				
	RS-10, G-12, G-15, DC-2	14 13/16 [376.24]	6 1/16 [153.99]				
CW Series (Same as RS Series)							
Bulk Pack 	MODELS	A	B	C	D	E	F
	RS-1/8, RS-1/4, RS-1/2, RS-1M, CW-1/2, CW-1M, G-1, G-2, EGS-1, EGN-1, EGW-1, EGS-2, EGW-2, MWA-8, MWA-10	1 [25.4]	1 [25.4]	3 5/8 [92.1]	2 1/4 [57.1]	3 3/4 [95.2]	5 3/8 [136.5]
	RS-1A, RS-1B, CW-1, G-3, EGS-3, EGN-3, EGW-3	1 1/2 [38.1]	1 1/2 [38.1]	3 5/8 [92.1]	5 [127.0]	3 7/8 [98.4]	7 3/4 [196.8]
	RS-2, RS-2A, CW-2, CW-2A, G-5A, ESN-2A, ESS-2A, ESW-2A	3 [76.2]	2 1/4 [57.1]	4 1/8 [104.7]	6 [152.4]	7 1/4 [184.2]	12 [304.8]
	RS-2B, RS-2M, CW-2B, CW-2M, G-5, ESN-2B, ESS-2B, ESW-2B, LVR-3	2 [50.8]	2 [50.8]	3 7/8 [98.4]	6 [152.4]	7 1/4 [184.2]	12 [304.8]
	RS-2C, CW-2C, G-5C	2 5/8 [66.8]	2 1/2 [63.5]	4 [101.6]	6 [152.4]	7 1/4 [184.2]	12 [304.8]
	RS-5, RS-5-69, CW-5, CW-5-5, G-10, ESN-5, ESS-5, ESW-5, EGN-10, EGS-10, EGW-10, LVR-5	3 [76.2]	3 1/2 [88.9]	4 1/4 [107.9]	6 [152.4]	7 1/4 [184.2]	12 [304.8]
	RS-7, CW-7, G-12	3 7/8 [98.4]	2 1/2 [63.5]	4 5/8 [117.4]	7 1/2 [190.5]	7 1/2 [190.5]	15.5 [393.7]
	RS-10, CW-10, G-15, LVR-10	4 [101.6]	4 [101.6]	5 1/4 [133.3]	9 3/4 [247.6]	12 [304.8]	14.5 [368.3]
	Axial units are uniformly packaged 100 per box with 10 unit boxes per immediate container.						
	Card Pack 	MODELS	QTY./PACK		TEAR OFF QTY.		Housing placed in slot and held in place with foldover protective paper. Each pack perforated to tear off into four smaller packs.
RH-5, NH-5, ERH-5, ENH-5, HG-5		40		10			
RH-10, NH-10, ERH-10, ENH-10, HG-10		40		10			
RH-25, NH-25, ERH-25, ENH-25, HG-25		20		5			
RH-50, NH-50, ERH-50, ENH-50, HG-50		20		5			
Ammo Pack	Resistors are lead taped, the same as in Reel Pack (see next page), then they are placed in a continuous "S" pattern (without paper inner leaf) in an appropriate box.						
Skin Pack	A versatile packaging method. Units are placed on double-faced corrugated board, then skin packed to board with polyfilm. Most resistor types are in multiples of five with insert strips.						
Military and Special Packaging	Military packaging per MIL-P-116, Method 1A8. Blister pack, foam pack and vial pack also available for special requirements.						



Packaging Methods

Wirewound Resistors, NTC Thermistors, Connectors

WIREWOUND RESISTORS [Numbers in brackets indicate millimeters]

Reel Pack
Dale® Standard Packaging Technique

Note 3 →

9/16 to 5/8
[14.29 to 15.88]
Hole

Lead tape reel packaging of axial lead components available per EIA RS 296 standard upon request.

Note 1: Component Spacing Standard Options:

Maximum Body Diameter	Spacing
0 - .200 [0 - 5.08]	.200 [5.08]
.201 - .375 [5.11 - 9.52]	.375 [9.52]
.376 - .400 [9.55 - 10.16]	.400 [10.16]

MODELS	MAXIMUM UNITS PER REEL		PITCH (Note 1)	TAPE SPACING (Note 2)
	SMALL FLANGE "B" 7 1/2 [190.50]	LARGE FLANGE "A" 11 3/32 [281.78]		
RS-1/8, RS-1/4, RS-1/2, G-1, G-2, CW-1/2	2000	4500	.200 [5.08]	2 7/8 [73.02]
RS-1A, RS-1B, G-3, CW-1, CW-1M	1500	4000	.200 [5.08]	2 7/8 [73.02]
CA-1, CA-2 (Note 4)	1350	3000	.200 [5.08]	2 7/8 [73.02]
RS-2A, RS-2B, RS-2M, CW-2A, CW-2B, CW-2M, G-5, G-5A	650	1200	.375 [9.52]	2 7/8 [73.02]
LVR-3	500	1000	.375 [9.52]	2 7/8 [73.02]
RS-2, RS-2C, CW-2, CW-2C, G-5C, G-6, LVR-2	450	1000	.375 [9.52]	2 7/8 [73.02]
RS-5, RS-7, CW-5, CW-7, G-10, G-12	—	800	.375 [9.52]	2 7/8 [73.02]
LVR-5	—	700	.375 [9.52]	2 7/8 [73.02]
RS-10, CW-10, G-15, LVR-10, MF-1	—	600	.400 [101.60]	3 3/8 [85.72]

Note 2: Tape spacings standard options of 2 1/16" [52.39], 2 1/2" [63.50] available on request.
Note 3: Lead trimming 1/16" [1.59] from tape edge available on request as a standard option.
Note 4: CA-4000 and CA-5000 series resistors will be taped at .200 pitch, tape space will be dependent upon body length.

DALE ELECTRONICS, INC., 1122 23rd Street, Columbus, NE 68601-3647 • Phone (402) 563-6506 • Fax 402-563-6418

NTC THERMISTORS			
PACKAGING CODE	TYPE	DESCRIPTION	DALE ELECTRONICS, INC.
P06	Bulk	Coated, leaded thermistors in a 4" x 6" antistatic plastic bag.	P.O. Box 26728
P20	Bulk	Disc style thermistors in a 4" x 6" or 6.5" x 10" antistatic plastic bag.	El Paso, TX 79926-6728
R58	Tape & Reel	Chip style thermistors in 8mm embossed plastic tape.	Phone (915) 592-3253
R85	Tape & Reel	Chip style thermistors in 12mm embossed plastic tape.	Fax 915-595-8199
T06	Tray	Chip style thermistors in molded waffle style trays.	

CONNECTORS [Numbers in brackets indicate millimeters]

Insert Tray

12.0
[305.0]

14.5
[368.0]

MODELS	APPROX. UNITS PER LAYER	APPROX. UNITS PER BOX
EB7	100	500-900
EB8	100	500-900
EBT156	100	500-900

High impact styrene, vacuum formed to protect individual units and for easy dispersal from tray.

Skin Packaging, heat seal per MIL-P-116. Level A, Method 1A-8, special boxing and other methods are available.

DALE ELECTRONICS, INC.
P.O. Box 180
Yankton, SD 57078-0180
Phone (605) 665-9301
Fax 605-665-1627

Packaging Methods

Inductors and Transformers

RF CHOKES - AXIAL LEAD [Numbers in brackets indicate millimeters]

Reel Pack	AMMO PACK CODES	PKG. ORDER CODE	MODEL	UNITS PER REEL		TAPE SPACING	
				PER REEL	PITCH		
<p>11 3/32 [281.78]</p> <p>9/16 to 5/8 [14.29 to 15.88] Hole</p>	K16	R36	IM/IR2	4000	.200 [5.08]	2 1/16 [52.39]	
			IMS-2	4000	.200 [5.08]	2 1/16 [52.39]	
			IRF-1	4000	.200 [5.08]	2 1/16 [52.39]	
	K05	R16	IM/IR-4/IMS-5	2500	.200 [5.08]	2 1/16 [52.39]	
			IRF-3	2500	.200 [5.08]	2 1/16 [52.39]	
			IM-6	1250	.400 [10.16]	2 1/16 [52.39]	
			IM-8	1000	.400 [10.16]	2 1/16 [52.39]	
			IM-10	800	.400 [10.16]	2 1/16 [52.39]	

Lead tape and reel packaging of axial lead components meets EIA RS 296 standard, including lead trimming.

Ammo Pack:
RF Chokes are lead taped the same as in reel pack, then placed in a continuous "S" pattern (without paper inner leaf) in an appropriate box.

Bulk Pack	PKG ORDER CODE	MODE	UNIT BOX		INTERMEDIATE BOX			
			A	B	C	D	E	F
	B08	IM/IR-2 (200/Box)	1	1 3/8	3 5/8	3	3 3/4	5 3/8
			[25.4]	[34.9]	[92.1]	[76.2]	[95.2]	[136.5]
	IM/IR-4 (200/Box)	1 1/2	2	3 7/8	4 1/4	4	10 1/4	
		[38.1]	[50.8]	[98.4]	[106.4]	[101.6]	[198.4]	
	IMS-5 (200/Box)	2	2	3 7/8	4 1/4	4	10 1/4	
[50.]	[50.8]	[98.4]	[108.0]	[101.6]	[260.4]			
IM-6 (200/Box)	2 1/4	2 1/4	3 7/8	4 3/4	4	11 1/2		
[57.2]	[57.2]	[98.4]	[120.7]	[101.6]	[292.1]			

Axial units are uniformly packaged 200 per box, with 10 unit boxes per intermediate container.

Note:
70 per Box for IM-8, IM-9, IM-10.

SURFACE MOUNT INDUCTORS [Numbers in brackets indicate millimeters]

Tape and Reel Pack			
<p>User Direction of Feed</p>			
<p>Carrier Dimensions</p>			
MODEL	PKG. ORDER CODE	REEL SIZE (Flange)	UNITS PER REEL
IMC-1812	R13	"A" 13 [330.2]	2000
ISC-1812	R73*	"A" 7 [177.8]	500
IMC-1210	R99	"A" 7 [177.8]	2000

* Additional Charge

Note: ESD Packaging also available.

Bulk Pack	PKG ORDER CODE	MODELS	UNIT BOX		INTERMEDIATE BOX			
			A	B	C	D	E	F
	B13	IMC-1812	1	1 3/8	3 5/8	3	3 3/4	5 3/8
		ISC-1812	[25.4]	[34.9]	[92.1]	[76.2]	[95.2]	[136.5]
		IMC-1210						

Surface mount units are packaged 500 per box, with 10 unit boxes per intermediate container.

TRANSFORMERS [Numbers in brackets indicate millimeters]

Insert Layer Pack	MODELS	SIZES	UNITS PER LAYER	APPROXIMATE	Skin Pack
				UNITS PER BOX	
<p>12 [305] 12 [305]</p>	PL-11	3/4 Watt	60	300	<p>A versatile packaging method. Units are placed on double-faced corrugated board, then skin packed to the board with polyfilm. Most component types are in multiples of five. For small parts, an "egg crate" partition is placed on the board. Quantity per board depends on component size. Parts typically skin packed include toroids; special transformers and some connectors. Consult factory.</p>
	PL-12	1 1/2 Watt	48	144	
	PL-13	1 1/2 Watt	35	105	
	PL-14	10 Watt	24	72	

Die cut corrugated cardboard to fit each of 5 basic sizes.

Cushion wrapping, styrofoam and other types of packaging methods are available for special sizes and configurations.

DALE ELECTRONICS, INC. / 1122 23RD STREET / COLUMBUS, NE 68601-3647 USA
PHONE (402) 564-3131 / FAX (402) 563-6418

