

## Varistor Products

### High Energy Industrial Disc

## CA Varistor Series

The CA Series of transient surge suppressors are industrial high-energy disc varistors (MOVs) intended for special applications requiring unique electrical contact or packaging methods provided by the customer. The electrode finish of these devices is solderable and can also be used with pressure contacts. Discs of the same diameter may be stacked.

This series of industrial disc varistors are available in three diameter sizes of 32, 40, and 60mm, with disc thicknesses ranging from 1.8mm minimum to 32mm maximum. They offer a wide voltage range of from 250 to 2800  $V_{M(AC)RMS}$ .

For information on soldering considerations, refer to AN8820 update. "Recommendations for Soldering Terminal Leads to MOV Varistor Discs".

### Features

- Provided In Disc Form For Unique Packaging By Customer
- Solderable Electrode Finish Options
- Pressure Contacts and/or Disc Stacking May be Utilized
- Standard Disc Sizes 32mm, 40mm, and 60mm Diameter
- Available Edge Passivation Insulation
- Wide Operating Voltage Range  $V_{M(AC)RMS}$  250V to 2800V
- High Peak Pulse Current Range . . . . .  $I_{TM}$  20,000A to 70,000A
- Very High Energy Capability  $W_{TM}$  . . . . . 330J to 10,000J
- No Derating Up to 85°C Ambient



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**Absolute Maximum Ratings** For ratings of individual members of a series, see Device Ratings and Specifications chart

	CA SERIES	UNITS
Continuous:		
Steady State Applied Voltage:		
AC Voltage Range ( $V_{M(AC)RMS}$ )	250 to 2800	V
DC Voltage Range ( $V_{M(DC)}$ )	330 to 3500	V
Transient:		
Peak Pulse Current ( $I_{TM}$ )		
For 8/20 $\mu$ s Current Wave (See Figure 2)	20,000 to 70,000	A
Single Pulse Energy Range		
For 2ms Current Square Wave ( $W_{TM}$ )	330 to 10,000	J
Operating Ambient Temperature Range ( $T_A$ )	55 to 85	$^{\circ}C$
Storage Temperature Range ( $T_{STG}$ )	55 to 85	$^{\circ}C$
Temperature Coefficient ( $\alpha_V$ ) of Clamping Voltage ( $V_C$ ) at Specified Test Current	<0.01	$\%^{\circ}C$

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*CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.*

### Device Ratings and Specifications

MODEL NUMBER	SIZE (mm)	MAXIMUM RATINGS (85 $^{\circ}C$ )				SPECIFICATIONS (25 $^{\circ}C$ )				
		CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT			MAX CLAMPING VOLT $V_C$ AT 200A CURRENT (8/20 $\mu$ s)	TYPICAL CAPACITANCE
		$V_{RMS}$	$V_{DC}$	ENERGY (2ms)	PEAK CURRENT (8/20 $\mu$ s)					
		$V_{M(AC)}$	$V_{M(DC)}$	$W_{TM}$	$I_{TM}$	MIN (V)	$V_N(DC)$ (V)	MAX (V)	$V_C$ (V)	f = 1MHz (pF)
V131CA32	32	130	175	200	20000	184	200	228	350	4700
V151CA32	32	150	200	220	20000	212	240	268	410	4000
V251CA32	32	250	330	330	20000	354	390	429	680	2500
V251CA40	40			370	40000				650	5000
V251CA60	60			880	50000				620	10000
V271CA32	32	275	369	360	20000	389	430	473	750	2200
V271CA40	40			400	40000				730	4500
V271CA60	60			950	50000				680	9000
V321CA32	32	320	420	390	20000	462	510	561	850	1900
V321CA40	40			460	40000				830	3800
V321CA60	60			1100	50000				760	7500
V421CA32	32	420	560	400	25000	610	680	748	1200	1500
V421CA40	40			600	40000				1130	3000
V421CA60	60			1500	70000				1060	6000
V481CA32	32	480	640	450	25000	670	750	825	1300	1300
V481CA40	40			650	40000				1240	2700
V481CA60	60			1600	70000				1160	5500
V511CA32	32	510	675	500	25000	735	820	910	1440	1200
V511CA40	40			700	40000				1350	2500
V511CA60	60			1800	70000				1300	5000
V571CA32	32	575	730	550	25000	805	910	1000	1600	1100
V571CA40	40			770	40000				1480	2200
V571CA60	60			2100	70000				1420	4500
V661CA32	32	660	850	600	25000	940	1050	1160	1820	1000
V661CA40	40			900	40000				1720	2000
V661CA60	60			2300	70000				1640	4000

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### Device Ratings and Specifications (continued)

MODEL NUMBER	SIZE (mm)	MAXIMUM RATINGS (85°C)				SPECIFICATIONS (25°C)				
		CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT			MAX CLAMPING VOLT $V_C$ AT 200A CURRENT (8/20 $\mu$ s)	TYPICAL CAPACITANCE f = 1MHz
		$V_{RMS}$	$V_{DC}$	ENERGY (2ms)	PEAK CURRENT (8/20 $\mu$ s)					
		$V_{M(AC)}$ (V)	$V_{M(DC)}$ (V)	$W_{TM}$ (J)	$I_{TM}$ (A)	MIN (V)	$V_{N(DC)}$ (V)	MAX (V)	$V_C$ (V)	(pF)
V751CA32	32	750	970	700	25000	1080	1200	1320	2050	800
V751CA40	40			1050	40000				2000	1800
V751CA60	60			2600	70000				1880	3500
V881CA60	60	880	1150	3200	70000	1290	1500	1650	2340	2700
V112CA60	60	1100	1400	3800	70000	1620	1800	2060	2940	2200
V142CA60	60	1400	1750	5000	70000	2020	2200	2550	3600	1800
V172CA60	60	1700	2150	6000	70000	2500	2700	3030	4300	1500
V202CA60	60	2000	2500	7500	70000	2970	3300	3630	5200	1200
V242CA60	60	2400	3000	8600	70000	3510	3900	4290	6200	1000
V282CA60	60	2800	3500	10000	70000	4230	4700	5170	7400	800

NOTE: Average power dissipation of transients not exceed 1.5W, 2.0W and 2.5W for model 32mm, 40mm and 60mm, respectively.

1. Peak current applies to applications rated up to  $115V_{RMS}$ . Peak Current is 30kA for applications greater than  $115V_{RMS}$ .
2. Peak current applies to applications rated up to  $132V_{RMS}$ . Peak Current is 30kA for applications greater than  $132V_{RMS}$ .

## Power Dissipation Ratings

Should transients occur in rapid succession, the average power dissipation result is the energy (watt-seconds) per pulse times the number of pulses per second. The power so developed must be within the specifications shown on the Device Ratings and Specifications table for the specific device. Furthermore, the operating values need to be derated at high temperatures as shown in Figure 1. Because varistors can only dissipate a relatively small amount of average power they are, therefore, not suitable for repetitive applications that involve substantial amounts of average power dissipation.

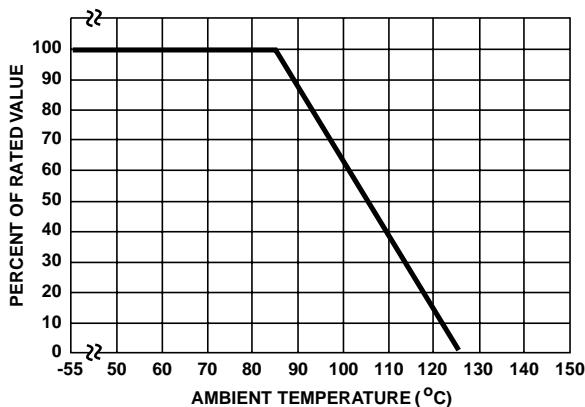
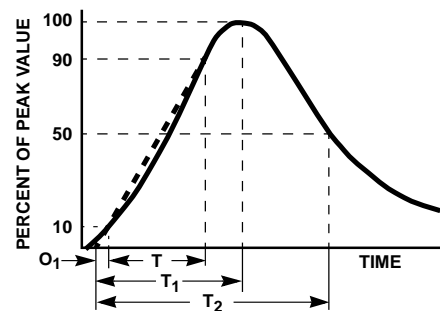


FIGURE 1. CURRENT, ENERGY AND POWER DERATING CURVE



- $O_1$  = Virtual Origin of Wave
- $T$  = Time From 10% to 90% of Peak
- $T_1$  = Virtual Front Time =  $1.25 \cdot t$
- $T_2$  = Virtual Time to Half Value (Impulse Duration)

Example: For an 8/20 $\mu$ s Current Waveform:  
 $8\mu$ s =  $T_1$  = Virtual Front Time  
 $20\mu$ s =  $T_2$  = Virtual Time to Half Value

FIGURE 2. PEAK PULSE CURRENT TEST WAVEFORM

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### Transient V-I Characteristics Curves

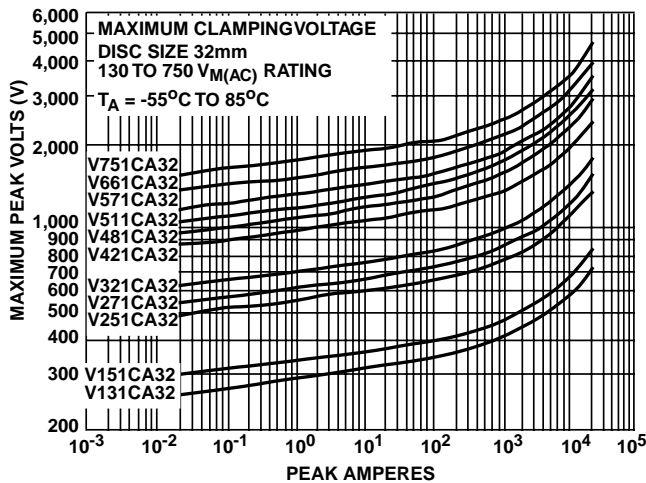


FIGURE 3. CLAMPING VOLTAGE FOR V131CA32 - C751CA32

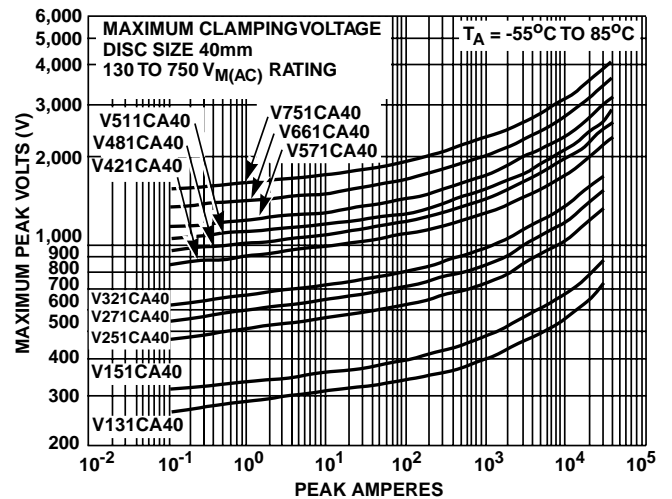


FIGURE 4. CLAMPING VOLTAGE FOR V131CA40 - V751CA40

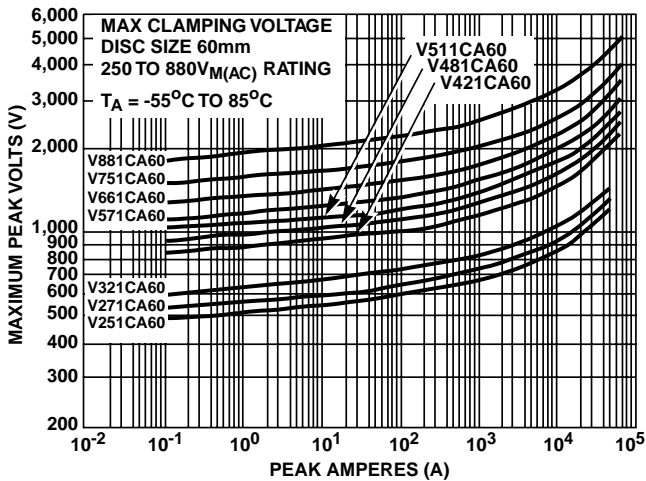


FIGURE 5. CLAMPING VOLTAGE FOR V251CA60 - V881CA60

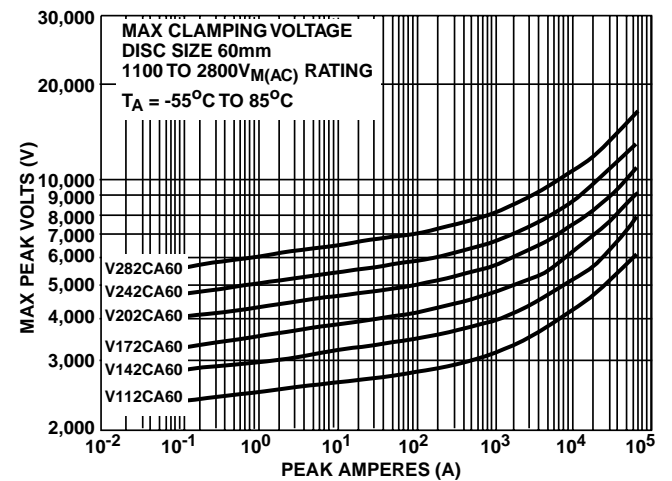


FIGURE 6. CLAMPING VOLTAGE FOR V112CA60 - V282CA60

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#### Pulse Rating Curves

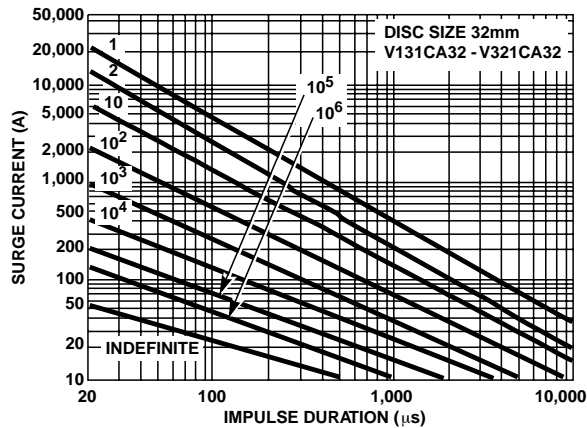


FIGURE 7. SURGE CURRENT RATING CURVES FOR V131CA32 - V321CA32

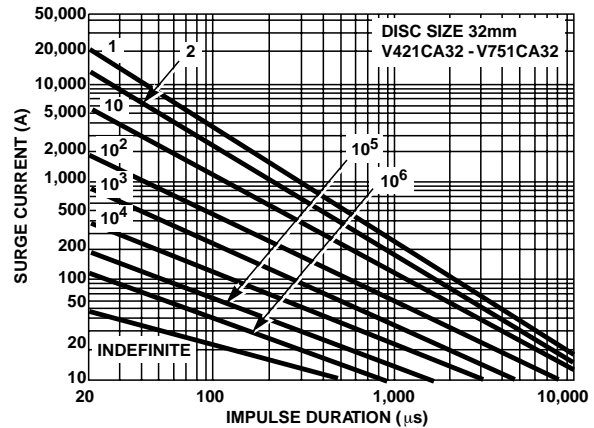


FIGURE 8. SURGE CURRENT RATING CURVES FOR V421CA32 - V751CA32

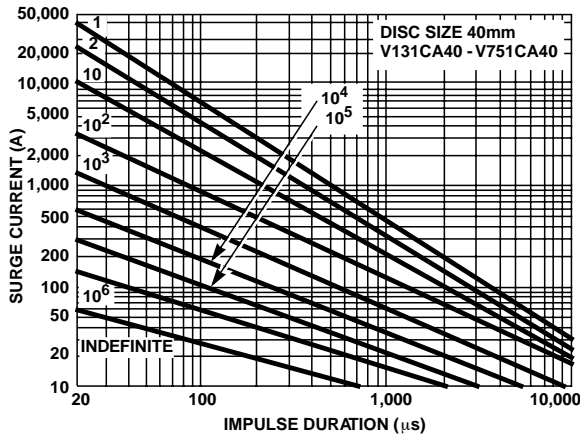


FIGURE 9. SURGE CURRENT RATING CURVES FOR V131CA40 - V751CA40

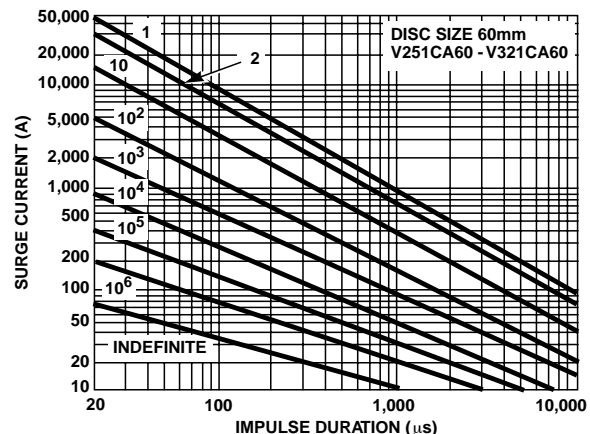


FIGURE 10. SURGE CURRENT RATING CURVES FOR V251CA60 - V321CA60

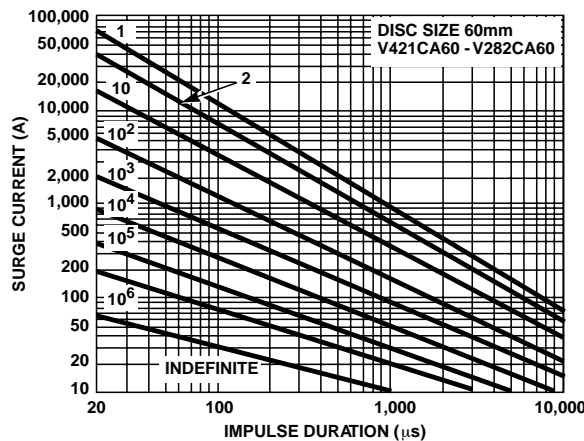


FIGURE 11. SURGE CURRENT RATING CURVES FOR V421CA60 - V282CA60

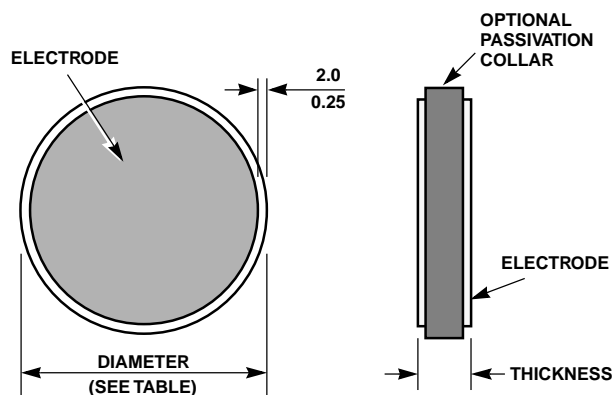
NOTE: If pulse ratings are exceeded, a shift of  $V_{N(DC)}$  (at specified current) of more than  $\pm 10\%$  could result. This type of shift, which normally results in a decrease of  $V_{N(DC)}$ , may result in the device not meeting the original published specifications, but does not prevent the device from continuing to function, and to provide ample protection.

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### Series Dimensions



MODEL SIZE	DISC DIAMETER			
	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
32	31.0	33.0	1.220	1.299
40	38.0	40.0	1.496	1.575
60	58.0	62.0	2.283	2.441

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MODEL $V_{RMS}$ $V_{M(AC)}$	THICKNESS (32mm DISC MODELS)				THICKNESS (40mm AND 60mm DISC MODELS)			
	MILLIMETERS		INCHES		MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
130†	1.4	2.4	0.071	0.094	1.4	2.8	0.055	0.134
150†	1.7	2.8	0.083	0.110	1.5	3.0	0.06	0.150
250	1.6	2.2	0.063	0.087	2.0	2.7	0.079	0.106
275	1.8	2.5	0.071	0.098	2.2	3.0	0.087	0.118
320	2.1	2.9	0.083	0.114	2.6	3.5	0.102	0.138
420	2.9	3.9	0.114	0.154	3.5	4.7	0.138	0.185
480	3.1	4.3	0.122	0.169	3.8	5.2	0.150	0.205
510	3.5	4.7	0.138	0.185	4.2	5.7	0.165	0.224
575	3.8	5.1	0.150	0.201	4.6	6.3	0.181	0.248
660	4.4	6.0	0.173	0.236	5.3	7.2	0.209	0.283
750	5.1	6.9	0.240	0.327	6.1	8.3	0.240	0.327
880††	-	-	-	-	7.3	10.3	0.287	0.406
1100††	-	-	-	-	9.2	13.0	0.362	0.512
1400††	-	-	-	-	11.5	16.0	0.453	0.630
1700††	-	-	-	-	14.0	19.0	0.551	0.748
2000††	-	-	-	-	17.0	22.5	0.669	0.886
2400††	-	-	-	-	20.0	27.0	0.787	1.063
2800††	-	-	-	-	24.0	32.0	0.945	1.260

† Available in 32mm and 40mm only.

†† Available in 60mm size only.

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MODEL NUMBER	SIZE (mm)	TYPICAL DISC WEIGHT (GRAMS)
V131CA32	32	9
V131CA40	40	21
V151CA32	32	11
V151CA40	40	23
V251CA32	32	8
V251CA40	40	17
V251CA60	60	39
V271CA32	32	10
V271CA40	40	18
V271CA60	60	42
V321CA32	32	11
V321CA40	40	22
V321CA60	60	50
V421CA32	32	15
V421CA40	40	28
V421CA60	60	66
V481CA32	32	16
V481CA40	40	31
V481CA60	60	71
V511CA32	32	18
V511CA40	40	35
V511CA60	60	80
V571CA32	32	20
V571CA40	40	38
V571CA60	60	88
V661CA32	32	23
V661CA40	40	44
V661CA60	60	101
V751CA32	32	26
V751CA40	40	51
V751CA60	60	116
V881CA60	60	141
V112CA60	60	178
V142CA60	60	220
V172CA60	60	265
V202CA60	60	317
V242CA60	60	377
V282CA60	60	450

### Passivation Layer

The standard CA Series is supplied with passivation layer around the outside perimeter of the disc forming an electrical insulator as detailed in the dimensional drawing. The CA Series is also available without a passivation layer for applications where the customer provides a suitable encapsulation or potting material as recommended below. (See Ordering Information.)

### Encapsulated Recommendations

After lead attachment, the disc/lead assembly may be coated or encapsulated in a package to provide electrical insulation and isolation from environmental contamination as required by the application. Coating/Filler materials for containers may include silicones, polyurethanes, and some epoxy resins. Two examples of acceptable polyurethanes are Dexter Hysol (US7013, parts A and B) and Rhenatech (resin 4714, hardener 4900), or their equivalents. Materials containing halogens, sulfides, or alkalines are not recommended.

### Electrode Metallization

The standard CA Series is supplied with sintered silver electrodes on CA32 devices and arc-sprayed copper-over-aluminum electrodes for CA40 and CA60 series. CA40 parts are also available with sintered silver electrode, see "Ordering information." In general, when discs are stacked to attain a specific operating voltage or energy capability, the copper finish is typically chosen. Likewise, the copper finish is used with high temperature lead attach soldering operations (wave solder). The silver metallization is typically used for solder reflow lead attach operations (I-R, Vapour-Phase). The recommended temperature profile of a belt-fed convection oven is shown in Figure 13.

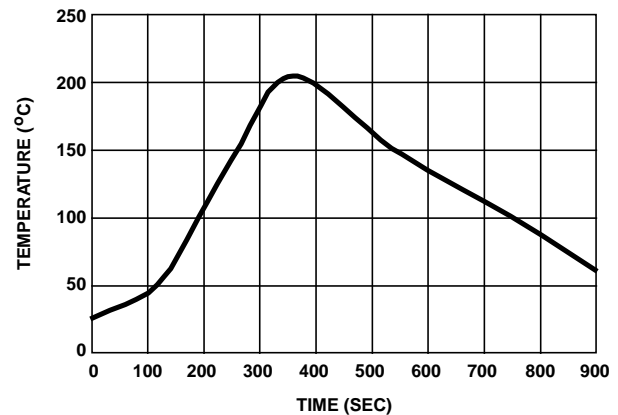


FIGURE 13. TYPICAL BELT OVEN TEMPERATURE PROFILE

### Stacking and Contact Pressure Recommendations

When applications require the stacking of Littelfuse CA discs or when electrical connection is made by pressure contacts, the minimum pressure applied to the disc electrode surface should be 2.2kGs (5 pounds). The maximum recommended pressure applied to the disc electrode is dependent upon diameter size and is given in the following table.

MODEL SIZE (mm)	MAXIMUM PRESSURE
32	16N/CM <sup>2</sup> (23LBs/IN <sup>2</sup> )
40	8N/CM <sup>2</sup> (11.5LBs/IN <sup>2</sup> )
60	4N/CM <sup>2</sup> (5.7LBs/IN <sup>2</sup> )

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#### Ordering Information

The CA Series offers optional electrode finish materials and a glass passivation edge option which must be designated. When ordering, the code letters suffix as shown in the following table must be selected and appended to the standard Model number.

ELECTRODE MATERIAL	NON-PASSIVATED DISC	PASSIVATED DISC
Arc-Sprayed Copper	NC	PC
Sintered Silver	NS	PS

#### NOTES:

1. The 60mm disc types V112CA60 to V282CA60, inclusive, are only supplied with glass passivation and arc-sprayed copper finish electrodes. (That is, with the "PC" option suffix code.)
2. The 32mm size discs are only available with silver metallization.

Note also that the CA Series receives no branding on the disc itself.

#### Packaging and Shipping

The CA Series is supplied in bulk for shipment. Discs are packaged in compartmentalized cartons to protect from scratching or edge-chipping during shipment.

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