

**SIDAC**  <sup>®</sup>  
Solid State Overvoltage Protection

Product  
Catalog



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## General Information

In the standby mode SIDACtors exhibit a high off-state impedance which eliminates excessive leakage currents and makes them appear transparent to the circuits they protect. Upon application of a voltage exceeding the break-over voltage ( $V_{BO}$ ), SIDACtors crowbar (switch from a high off state impedance to a low on state impedance) and simulate a short until the current flowing through the device is either interrupted or drops below the SIDACtor's holding current ( $I_H$ ), at which time the SIDACtor will reset.

When protecting telecommunication circuits the SIDACtor is connected across the tip-ring interface for metallic protection and the tip-ring-ground interface for longitudinal protection, typically behind some type of current limiting device such as a slow blow fuse. Common applications are:

- Central office line cards
- T-1/E-1, ISDN, and DSL transmission equipment
- Customer Premise Equipment (CPE) such as phones, modems, and caller ID adjunct boxes
- PBX's, KSU's and other switches
- Primary protection including main distribution frames, 5-pin modules, building entrance equipment and station protection modules.

Other applications that use the SIDACtor are data lines, security systems, CATV line amplifiers & power inserters. The SIDACtor is also used to protect solenoids in sprinkler systems and thyristors such as SCR's and triacs in motor speed controls. It should be noted though that when used in these applications, the short circuit AC current of the circuit being protected can not exceed the AC current rating of the SIDACtor, and the short circuit DC current must be below the minimum holding current ( $I_H$ ) of the SIDACtor (in order for the SIDACtor to reset).

The SIDACtor is the predominant choice for today's telecom protection needs because it offers absolute surge suppression regardless of the surge current level and rate of applied voltage (dv/dt). Unlike other devices, the SIDACtor:

- Can not be damaged by voltage
- Eliminates the hysteresis and heat dissipation typically found with a clamping device
- Eliminates voltage overshoot caused by fast rising transients
- Is non-degenerative
- Will not fatigue
- Has negligible capacitance making it ideal for high speed transmission equipment

**$V_{BO}$  – Breakover Voltage**

$V_{BO}$  (MIN) — Minimum voltage at which conduction will begin.

$V_{BO}$  (MAX) — Maximum voltage at which conduction will begin.

 **$I_{BO}$  – Breakover Current**

Current at the breakover point ( $V_{BO}$ ).

 **$I_{PP}$  – Peak Pulse Current**

Maximum rated impulse current.

 **$I_{TSM}$  – Peak One Cycle Surge Current**

Maximum rated one cycle AC surge current.

 **$I_T$  – On-state Current**

Continuous rated on-state current.

 **$V_T$  – On-state Voltage**

Voltage drop at rated on-state current.

 **$I_H$  – Holding Current**

Minimum current required to maintain on-state mode.

 **$C_O$  – Off-state Capacitance**

Typical off-state capacitance.

 **$di/dt$  – Critical Rate-of-rise On-state Current**

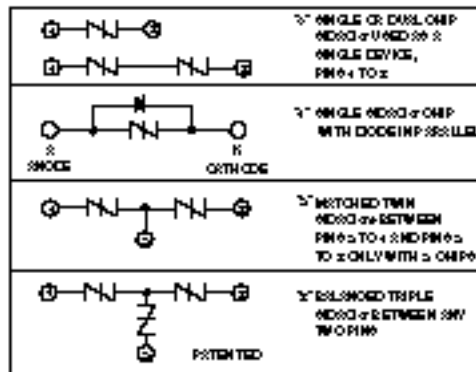
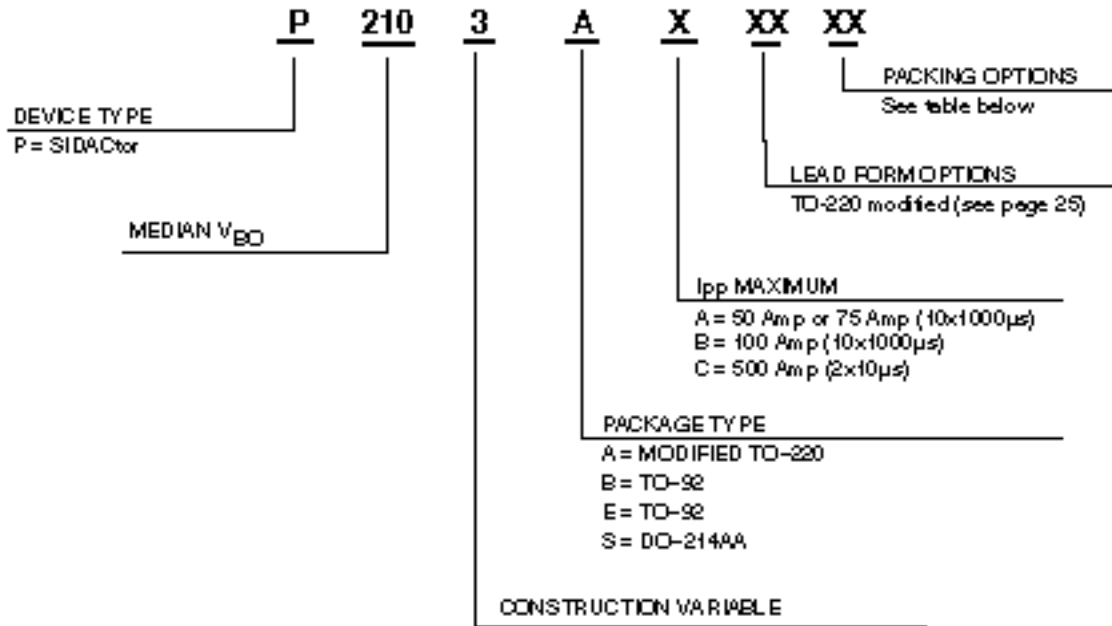
Maximum rated rate-of-rise current.

 **$V_F$  – Forward Voltage**

Maximum forward voltage across the P0641SA while in the on-state  
(See Figure 3C on page 13).

# Ordering Information

## Part Number Definition



## Device Packing Options

Package Type	Description	Packing Quantity	Added Suffix	Optional	Industry Standard
TO-92	Bulk Pack	2000		Standard	None
	Tape and Reel Pack	2000	RP	Option	EIA RS-468-A
	Tape and Ammo Pack	2000	AP	Option	EIA RS-468-A
TO-220	Bulk Pack	500		Standard	None
	Clear Plastic Magazine or Tube Pack	50	TP	Option	None
	Tape and Reel Pack	700	RP	Option	EIA RS-468-A
	Tape and Reel Pack for Type 61 Leadform	700	RP	Option	EIA RS-468-A
DO-214AA	Embossed Carrier Reel Pack	2500	RP	Standard	EIA-481-1
	Bulk Pack	5000		Option	None

Detailed packaging drawings are available from the factory upon request.

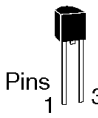
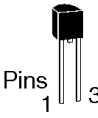
Standard lead spacing is .200" for TO-92 Reel Pack. For other spacing requirements

## Quality Assurance

100% Testing is a constant monitor for Quality Assurance.

Test Description	Condition	Comments
1. Surge ( $I_{PP}$ )	Rated Current.	Repeated 2 times in the normal sequence of testing, except for TO-220 which is repeated 4 times.
2. Breakover Voltage ( $V_{BO}$ )	$V_{BO}$ in forward and reverse directions (see note 13).	All devices fully characterized on voltage to ensure proper operation and reliability.
3. Holding Current ( $I_H$ )	Measured for the rated minimum value.	This ensures proper delatch (turn-off) after surge current condition.
4. Peak On-State Voltage ( $V_T$ )	Measured with 1 amp RMS or DC current.	Ensures low power dissipation in on-state.
5. Leakage Current ( $I_{DRM}$ )	Measured at 80% of rated $V_{BO}$ .	Ensures long term reliability.

# Electrical Specifications

Package Type	Package	Part Number	V <sub>BO</sub>		I <sub>BO</sub>	I <sub>PP</sub>				I <sub>TSM</sub>	
			Breakover Voltage (Instantaneous Clamping Voltage) (1)(3)(8)(12) Volts		Break-over Current	Peak Pulse Current T <sub>J</sub> ≤ 150°C (5) (9) Amps				Peak One Cycle Surge Current (13)	
			PINS 1 to 3		μAmps	2x10 μs	10x160 μs	10x560 μs	10x1000 μs	Amps	
			MIN	MAX	MAX	MAX	MAX	MAX	MAX	60Hz	50Hz
E TYPE 70		P0300EA70	27	36	10		100	50	50	30	25
		P0640EA70	58	70	10		150	75	75	30	25
		P0720EA70	65	80	10		150	75	75	30	25
		P0800EA70	75	95	10		150	75	75	30	25
		P1100EA70	90	125	10		100	50	50	30	25
		P1300EA70	120	145	10		100	50	50	30	25
		P1500EA70	140	170	10		100	50	50	30	25
		P2300EA70 (10)	190	265	10		100	50	50	30	25
		P2600EA70 (10)	220	300	10		100	50	50	30	25
		P3100EA70 (10)	275	350	10		100	50	50	30	25
		P3500EA70 (10)	300	400	10		100	50	50	30	25
B TYPE 70		P2300BA70 (10)	190	265	10		150	100	100	60	50
		P2600BA70 (10)	220	300	10		150	100	100	60	50
		P3100BA70 (10)	275	350	10		150	100	100	60	50
		P3500BA70 (10)	300	400	10		150	100	100	60	50
		P1500EC70 (10)	140	170	10		500	200	100	100	60

## General Notes

- All measurements are made at 60Hz with a resistive load at an ambient temperature of +25°C unless otherwise specified.
- Storage temperature range (T<sub>S</sub>) is -65°C to +150°C.
- The case temperature (T<sub>C</sub>) is measured as shown on the dimensional outline drawings. See "Package Dimensions" section (page 23).
- Junction temperature range (T<sub>J</sub>) is -40°C to +150°C on all devices except for P0300EA70, P0300SA, and P0602AA where T<sub>J</sub> is -40°C to +125°C.
- The maximum lead solder temperature (for any soldering process) is +230°C for 10 seconds maximum: ≥ 1/16" (1.59mm) from case.
- All SIDACTors (except P0641SA) are bidirectional and all electrical parameters apply to both the forward and reverse polarities.
- All SIDACTors are recognized under UL 497B "Protectors for Data Communications and Fire Alarm Circuits", UL File #E133083.

- All SIDACTor leads are Tin/Lead plated with no less than 5% lead content.
- All SIDACTors meet the surge requirements of the following standards:

CCITT K17 - K20	10/700 μs	1.5 kV
	5/310 μs	38 A
VDE 0433	10/700 μs	2 kV
	5/200 μs	50 A
CNET	0.5/700 μs	1.5 kV
	0.2/310 μs	38 A

## Electrical Isolation

Teccor's electrically isolated TO-92 and modified TO-220 SIDACTor will withstand a high potential test of 1600 VAC RMS from leads to case over the operating temperature range.

# Electrical Specifications

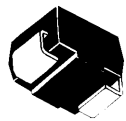
$I_T$	$I_H$	$V_T$	$C_O$		$di/dt$
Continuous On-State DC or RMS Current (6)(14)	Holding Current (2)	Peak On-State Voltage $I_T = 1$ amp (16)	Off-State Capacitance at 1kHz 1VAC with 50VDC Bias (4)	Off-State Capacitance at 1MHz 15mVAC with 50VDC Bias (4)	Critical Rate of Rise of On-State Current
Amps	mAmps	Volts	pF	pF	Amps/ $\mu$ s
MAX	MIN	MAX	TYP	TYP	MAX
1.0	50	5.0	90 (18)	90 (18)	100
1.0	150	5.0	70	70	100
1.0	150	5.0	70	70	100
1.0	150	5.0	70	70	100
1.0	150	5.0	50	50	100
1.0	150	5.0	45	45	100
1.0	150	5.0	35	35	100
1.0	150	5.0	50	50	100
1.0	150	5.0	40	40	100
1.0	150	5.0	40	40	100
1.0	150	5.0	40	40	100
1.0	150	5.0	50	50	100
1.0	150	5.0	40	40	100
1.0	150	5.0	40	40	100
1.0	150	5.0	40	40	100
1.0	150	5.0	45	45	100

## Applications Guide

See Referenced Device Application Notes for Device Recommendations		
Application	Description	Application Note
FCC Part 68	Connection of Terminal Equipment to the Telephone Network	AN1010 (Pg. 14) AN1011 (Pg. 14)
UL 1459	Telephone Equipment Safety	AN1010 AN1011
Bellcore GR-1089-CORE	Compatibility and Safety for Network Telecommunications Equipment	AN1012 (Pg. 15)
Bellcore GR-974-CORE	Telecommunications Primary Line Protector Units for Central Office and Station	Call factory for assistance
SLIC	Subscriber Line Interface Circuit	AN1013 (Pg. 15)
PTC	Using PTCs to Pass FCC Part 68 and UL1459	AN1020 (Pg. 20)
ISDN	ISDN	AN1025 (Pg. 20)
T1	T1 Digital Line Card	AN1023 (Pg. 21)

Notes (in parenthesis) to electrical specifications can be found on pages 8-9.

# Electrical Specifications

Package Type	Package	Part Number	$V_{BO}$		$I_{BO}$	$I_{PP}$				$I_{TSM}$	
			Breakover Voltage (1) (3) (8) (12)  (Instantaneous clamping voltage)		Break-over Current	Peak Pulse Current $T_J \leq 150^\circ\text{C}$ (5) (9)				Peak One Cycle Surge Current (13)	
			Volts			Amps					
			MIN	MAX	MAX	2x10 $\mu\text{s}$	10x160 $\mu\text{s}$	10x560 $\mu\text{s}$	10x1000 $\mu\text{s}$	60Hz	50Hz
S		P0300SA	27	36	10		100	50	50	30	25
		P0640SA	58	70	10		150	75	75	30	25
		P0641SA (15)	58	70	10		150	75	75	30	25
		P0720SA	65	80	10		150	75	75	30	25
		P0800SA	75	95	10		150	75	75	30	25
		P1100SA	90	125	10		100	50	50	30	25
		P1300SA	120	145	10		100	50	50	30	25
		P1500SA	140	170	10		100	50	50	30	25
		P2300SA (10)	190	265	10		100	50	50	30	25
		P2600SA (10)	220	300	10		100	50	50	30	25
		P3100SA (10)	275	350	10		100	50	50	30	25
		P3500SA (10)	300	400	10		100	50	50	30	25
		P2300SB (10)	190	265	10		150	100	100	60	50
		P2600SB (10)	220	300	10		150	100	100	60	50
		P3100SB (10)	275	350	10		150	100	100	60	50
		P3500SB (10)	300	400	10		150	100	100	60	50
		P1500SC (10)	140	170	10	500	200	100	100	60	50

## DO-214 Part Numbers/Part Markings

Standardized Part Number	Symbolized Part Number
P0300SA	P03A
P0640SA	P06A
P0641SA	P61A
P0720SA	P07A
P0800SA	P08A
P1100SA	P11A
P1300SA	P13A
P1500SA	P15A
P1500SC	P15C
P2300SA	P23A
P2300SB	P23B
P2600SA	P26A
P2600SB	P26B
P3100SA	P31A
P3100SB	P31B
P3500SA	P35A
P3500SB	P35B

NOTE: On the DO-214 package, date code is located below the Symbolized Part Number. TO-92 and TO-220 devices have full part numbers and a date code printed on the part.

## Notes To Electrical Specifications

1. See Figure 4 for  $V_{BO}$  change vs. junction temperature.
2. See Figure 2 For  $I_H$  vs. case temperature.
3. All devices have a negative resistance slope unless otherwise noted. Negative resistance slope devices'  $V_{BO}$  is measured at an applied rate-of-rise of voltage  $\leq 1$  kV/Sec. See Figure 3A for V-I characteristics.
4. Capacitance imbalance between forward and reverse polarities is typically  $\leq 15$  pF.
5. See Figure 1 (A, B, C) for Pulse Wave Form.
6. Maximum  $T_C$  is  $110^\circ\text{C}$  for TO-92 and  $115^\circ\text{C}$  for modified TO-220, except maximum  $T_C$  is  $75^\circ\text{C}$  for P0300SA, P0300EA70 and  $95^\circ\text{C}$  for P0602AA.  $T_C$  is  $110^\circ\text{C}$  for DO-214.
7. During simultaneous surging of pins 1 & 3, the current rating of Pin 2 doubles (2X).
8. Between any two pins.

# Electrical Specifications

$I_T$	$I_H$	$V_F$	$V_T$	$C_O$		$di/dt$
Continuous On-State DC or RMS Current (6)(14)	Holding Current (2)	Forward Voltage Drop	Peak On-State Voltage $I_T = 1$ Amp (16)	Off-State Capacitance at 1kHz 1VAC with 50VDC Bias (4)	Off-State Capacitance at 1MHz 15mVAC with 50VDC Bias (4)	Critical Rate of Rise of On-State Current
Amps	mAmps	Volts	Volts	pF	pF	Amps/ $\mu$ s
MAX	MIN		MAX	TYP	TYP	MAX
1.0	50		5.0	90 (18)	90 (18)	100
1.0	150		5.0	70	70	100
1.0	150	5.0	5.0	40	113	100
1.0	150		5.0	70	70	100
1.0	150		5.0	70	70	100
1.0	150		5.0	50	50	100
1.0	150		5.0	45	45	100
1.0	150		5.0	35	35	100
1.0	150		5.0	50	50	100
1.0	150		5.0	40	40	100
1.0	150		5.0	40	40	100
1.0	150		5.0	40	40	100
1.0	150		5.0	50	50	100
1.0	150		5.0	40	40	100
1.0	150		5.0	40	40	100
1.0	150		5.0	40	40	100
1.0	150		5.0	42	40	100

9. The current wave virtual front duration is 1.25X rise time from 10% to 90% of crest. Virtual zero is defined as the intersection with the zero axis of a straight line drawn through points on the front of the current wave of 10% and 90% crest. Waveforms defined per IEEE/ANSI C62.1.

10. See Figure 3B for V-I characteristics.

11. 260mA minimum  $I_H$  is available from the factory on special request.

12. The UL497B rate-of-rise of voltage requirements for  $V_{BO}$  testing is 100V/s, 100V/ $\mu$ s, 500V/ $\mu$ s, and 1kV/ $\mu$ s. All SIDACTors  $V_{BO}$ 's to be  $\pm 10\%$  of ratings.

13. For more than one full cycle rating, see Figure 7.

14. Thermal Resistance:

PxxxSA	DO214-AA	$R_{\theta JC} = 28^\circ\text{C/Watt}$ and $R_{\theta JA} = 90^\circ\text{C/Watt}$
PxxxSB, SC	DO214-AA	$R_{\theta JC} = 26^\circ\text{C/Watt}$ and $R_{\theta JA} = 85^\circ\text{C/Watt}$
PxxxEA70	TO-92	$R_{\theta JC} = 28^\circ\text{C/Watt}$ and $R_{\theta JA} = 90^\circ\text{C/Watt}$
PxxxBA70	TO-92	$R_{\theta JC} = 26^\circ\text{C/Watt}$ and $R_{\theta JA} = 85^\circ\text{C/Watt}$
PxxxAA	TO-220	$R_{\theta JC} = 12^\circ\text{C/Watt}$ and $R_{\theta JA} = 50^\circ\text{C/Watt}$
PxxxAB, AC	TO-220	$R_{\theta JC} = 12^\circ\text{C/Watt}$ and $R_{\theta JA} = 50^\circ\text{C/Watt}$


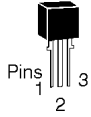
15. See Figure 3C for V-I characteristics.

16. See Figure 5.

17. See Figure 6.

18.  $C_O$  is measured at 20VDC bias on P0300SA, P0300EA70, and P0602AA.

# Electrical Specifications

Package Type	Package	Part Number	$V_{BO}$				$I_{BO}$	$I_{PP}$				$I_{TSM}$		
			Breakover Voltage (Instantaneous Clamping Voltage) (1)(3)(8)(12)					Break-over Current  $\mu\text{Amps}$	Peak Pulse Current $T_J \leq 150^\circ\text{C}$ (5) (9)				Peak One Cycle Surge Current (13)	
			Volts						Amps				Amps	
			PINS 1 to 3		PINS 3 to 2 1 to 2				2x10 $\mu\text{s}$ (7)	10x160 $\mu\text{s}$ (7)	10x560 $\mu\text{s}$ (7)	10x1000 $\mu\text{s}$ (7)	60Hz	50Hz
MIN	MAX	MIN	MAX	MAX	MIN	MAX	MAX	MAX						
A TYPE 61		P2000AA61	190	215			10		100	50	50	30	25	
		P2200AA61	205	230			10		100	50	50	30	25	
		P2400AA61	220	250			10		100	50	50	30	25	
		P2500AA61	240	280			10		100	50	50	30	25	
		P3000AA61	270	330			10		100	50	50	30	25	
		P3300AA61	300	360			10		100	50	50	30	25	
A		P0602AA	54	72	27	36	10		100	50	50	30	25	
		P1602AA	120	190	60	95	10		100	50	50	30	25	
		P2202AA	190	250	95	125	10		100	50	50	30	25	
		P2702AA	240	300	120	150	10		100	50	50	30	25	
		P3002AA	280	320	140	160	10		100	50	50	30	25	
		P4802AA (10)	440	580	220	290	10		100	50	50	30	25	
		P6002AA (10)	540	720	270	360	10		100	50	50	30	25	
		P1602AB	120	190	60	95	10		150	100	100	60	50	
		P2202AB	190	250	95	125	10		150	100	100	60	50	
		P2702AB	240	300	120	150	10		150	100	100	60	50	
		P3002AB	280	320	140	160	10		150	100	100	60	50	
		P4802AB(10)	440	580	220	290	10		150	100	100	60	50	
		P6002AB(10)	540	720	270	360	10		150	100	100	60	50	
		P1553AA	140	170	140	170	10		100	50	50	30	25	
		P2103AA	180	240	180	240	10		100	50	50	30	25	
		P2353AA	210	265	210	265	10		100	50	50	30	25	
		P2703AA	240	300	240	300	10		100	50	50	30	25	
		P3203AA	280	350	280	350	10		100	50	50	30	25	
		P3403AA	300	380	300	380	10		100	50	50	30	25	
		P1553AB	140	170	140	170	10		150	100	100	60	50	
		P2103AB	180	240	180	240	10		150	100	100	60	50	
		P2353AB	210	265	210	265	10		150	100	100	60	50	
		P2703AB	240	300	240	300	10		150	100	100	60	50	
		P3203AB	280	350	280	350	10		150	100	100	60	50	
		P3403AB	300	380	300	380	10		150	100	100	60	50	
		P3002AC	270	330	135	165	10	500	200	100	100	60	50	
		P3203AC	280	350	280	350	10	500	200	100	100	60	50	

Notes (in parenthesis) to electrical specifications can be found on pages 8-9.

# Electrical Specifications

$I_T$	$I_H$	$V_T$		$C_o$				di/dt
		Peak On-State Voltage $I_T = 1\text{Amp}$ (17) Volts		Off-State Capacitance at 1kHz 1VAC with 50 VDC Bias (4) pF		Off-State Capacitance at 1MHz 15mVAC with 50 VDC Bias (4) pF		
Amps	mAmps	PINS 3 to 2 1 to 2	PINS 1 to 3	PINS 3 to 2 1 to 2	PINS 1 to 3	PINS 3 to 2 1 to 2	PINS 1 to 3	Amps/ $\mu$ s
MAX	MIN	MAX	MAX			TYP	TYP	MAX
1.0	150		10.0		30		30	100
1.0	150		10.0		30		30	100
1.0	150		10.0		30		30	100
1.0	150		10.0		30		30	100
1.0	150		10.0		25		25	100
1.0	150		10.0		25		25	100
1.0	50	5.0	10.0	90 (18)	45 (18)	90 (18)	45 (18)	100
1.0	150	5.0	10.0	140	85	140	85	100
1.0	150	5.0	10.0	50	30	50	30	100
1.0	150	5.0	10.0	45	30	45	30	100
1.0	150	5.0	10.0	40	25	40	25	100
1.0	200 (11)	5.0	10.0	50	35	50	35	100
1.0	200 (11)	5.0	10.0	50	30	50	30	100
1.0	200 (11)	5.0	10.0	140	85	140	85	100
1.0	200 (11)	5.0	10.0	90	60	90	60	100
1.0	200 (11)	5.0	10.0	80	50	80	50	100
1.0	200 (11)	5.0	10.0	75	45	75	45	100
1.0	200 (11)	5.0	10.0	50	35	50	35	100
1.0	200 (11)	5.0	10.0	50	30	50	30	100
1.0	150	10.0	10.0	50	40	50	40	100
1.0	150	10.0	10.0	45	35	45	35	100
1.0	150	10.0	10.0	40	30	40	30	100
1.0	150	10.0	10.0	35	25	35	25	100
1.0	150	10.0	10.0	50	40	50	40	100
1.0	150	10.0	10.0	50	40	50	40	100
1.0	200 (11)	10.0	10.0	100	80	100	80	100
1.0	200 (11)	10.0	10.0	80	60	80	60	100
1.0	200 (11)	10.0	10.0	70	55	70	55	100
1.0	200 (11)	10.0	10.0	60	50	60	50	100
1.0	200 (11)	10.0	10.0	50	40	50	40	100
1.0	200 (11)	10.0	10.0	50	40	50	40	100
1.0	200 (11)	5.0	10.0	45	30	45	30	100
1.0	200 (11)	5.0	10.0	40	30	40	30	100

# Electrical Specifications

Figure 1A - Pulse Wave Form (10 x 1000 $\mu$ s)

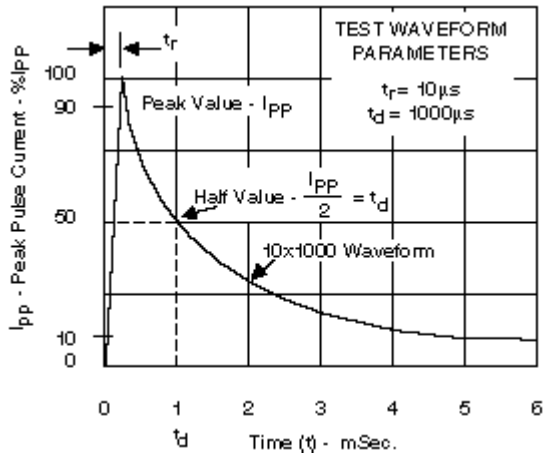


Figure 1B - Pulse Wave Form (10 x 560 $\mu$ s)

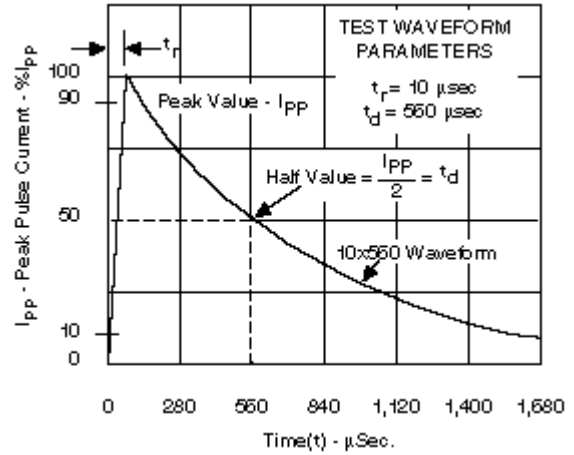


Figure 1C - Pulse Wave Form (10 x 160 $\mu$ s)

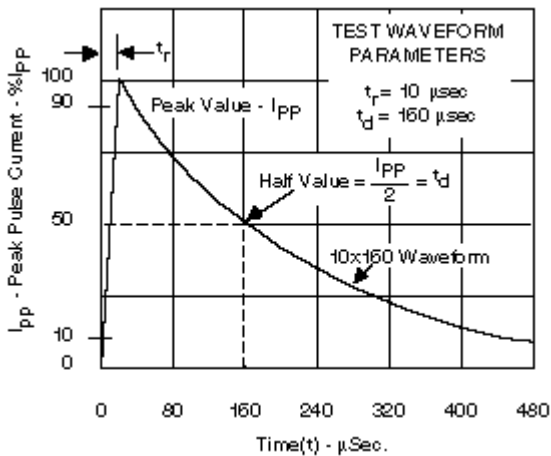


Figure 2 - Normalized DC holding Current vs Case Temperature

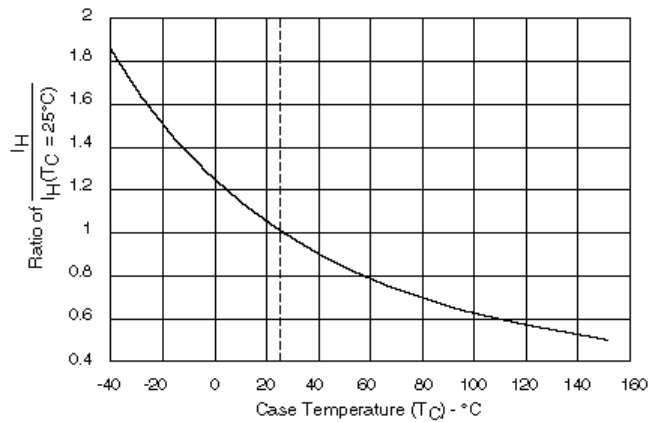


Figure 3A - V-I Characteristics of Devices with Negative Resistance

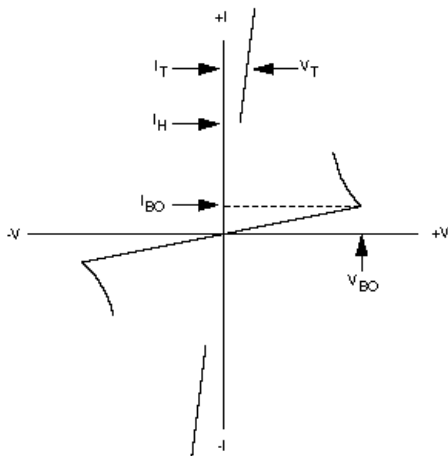
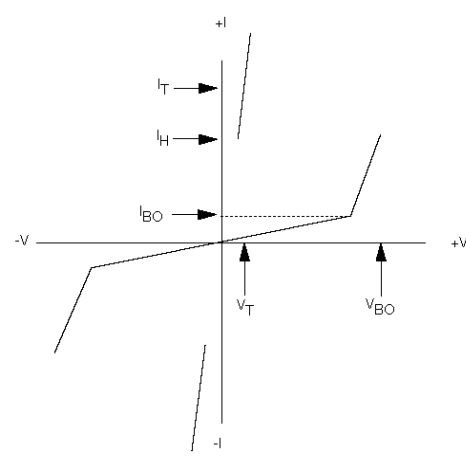


Figure 3B - V-I Characteristics of Devices with Positive Switching Slopes



# Electrical Specifications

Figure 3C - V-I Characteristics of devices with a Forward Diode and Reverse Negative Resistance

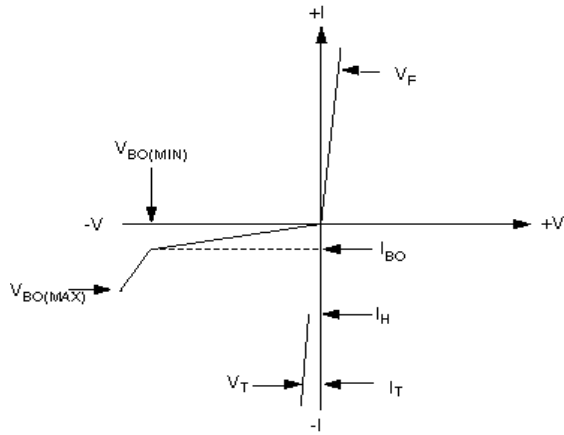


Figure 4 - Normalized  $V_{BO}$  Change vs Junction Temperature

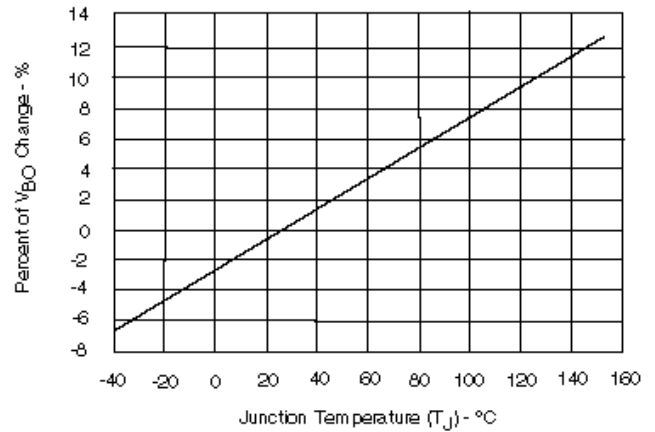


Figure 5 - Peak On-State Voltage vs Peak On-State Current for DO-214AA and TO-92 (Typical)

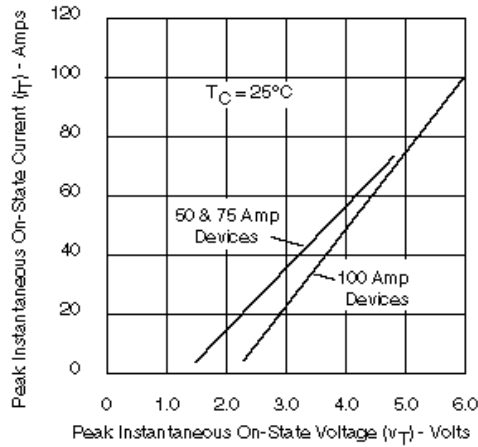


Figure 6 - Peak On-State Voltage vs Peak On-State Current for Modified T0-220, Pins 1 to 3 (Typical)

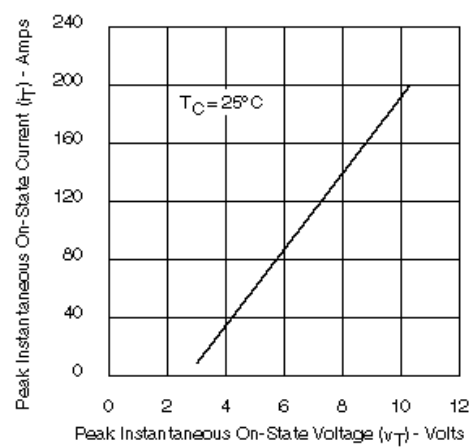
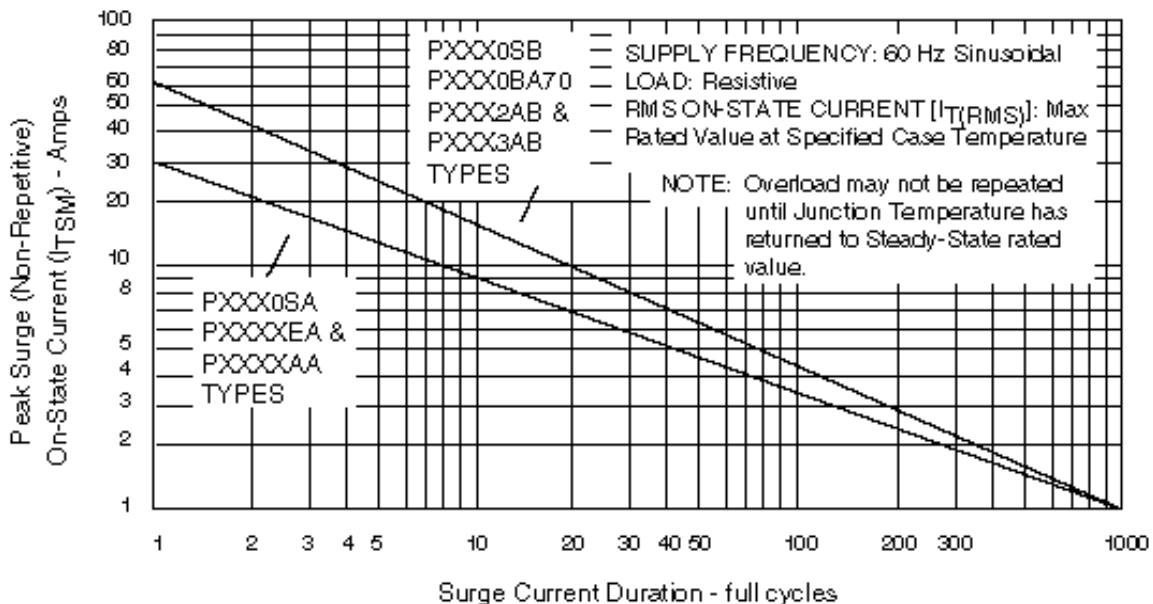
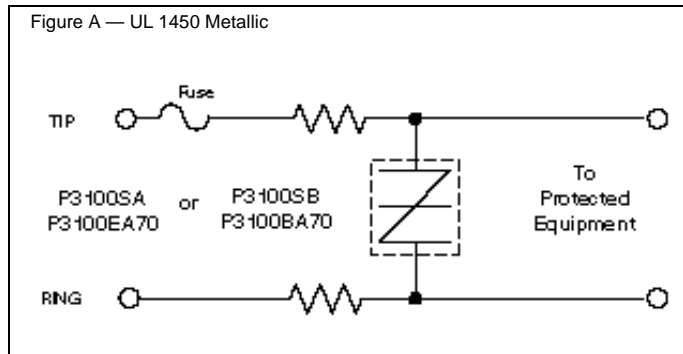


Figure 7 - Peak Surge On-State Current vs Surge Current Duration

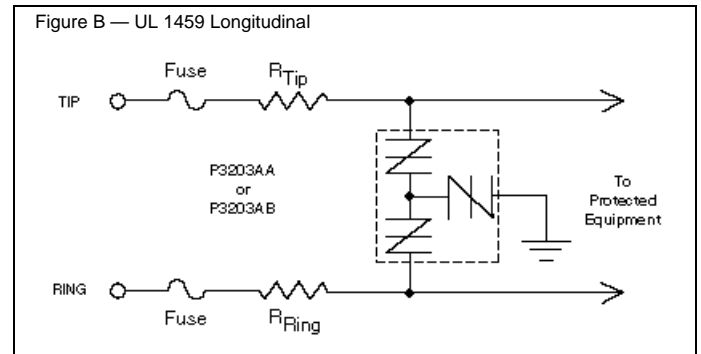


# Application Notes

## AN1010 - FCC Part 68 and UL 1459 Metallic Protection



## AN1011 - FCC Part 68 and UL 1459 Longitudinal Protection



### Consideration for Metallic Surge 800V, 100A, 10x560 $\mu$ s

Selected Fuse Bel Fuse type MJS or Littlefuse Series 230 mA	Fuse 10x560 $\mu$ s Rating  Amps	$R_{TOT}$  MIN $\Omega$	$R_T$ & $R_R$  MIN $\Omega$	Required 10x560 $\mu$ s $I_{PP}$ of SIDACTor  Amps
350	25	32.0	12	50
400	28	28.6	10	50
500	35	23.0	7	50
600	43	18.6	5	50
700	50	16.0	4	50
1000	78	10.3	1.15	100

$$R_{TOT} = R_S + R_T + R_R$$

( $R_S$  = Source Impedance of Surge Generator)

$$R_{TOT} = \frac{V_{PK}(\text{Surge})}{I_{PP}(\text{Fuse})}$$

1. To meet UL1459, a current-limiting device (e.g. PTC, fuse) must be used. The 10x560 $\mu$ s  $I_{PP}$  rating listed above is the maximum  $I_{PP}$  surge limitation of the selected Bel fuse (type MJS) without  $R_T$  and  $R_R$ .

2.  $R_T$  and  $R_R$  are optional with the SIDACTor. They are used to limit the 100A, 10x560 $\mu$ s surge within the rating of the selected fuse. I.E., 19

for a 500mA fuse an additional 15 $\Omega$  ( $R_T=7.5\Omega$ ,  $R_R=7.5\Omega$ ) is necessary to prevent the fuse from opening during FCC Part 68 surge. Hence,  $R_T$  and  $R_R$  allow the circuit to pass Part 68 operationally.

3. If desired,  $R_T$  and  $R_R$  may be eliminated. This will allow the circuit still to pass Part 68 and UL1459; however, it will pass FCC Part 68 non-operationally since the fuse will open.

4. The robustness of a circuit designed to pass FCC Part 68 non-operationally is dependent on the size of fuse used. The SIDACTor allows the engineer to use up to a full 1A fuse without any series resistance. See required 10x560 $\mu$ s  $I_{PP}$  of SIDACTor to determine the proper value of the SIDACTor for the selected fuse.

5. See application notes AN1017, AN1018, and AN1019 for detailed descriptions of FCC Part 68, UL1459, and circuit component value calculations.

### Consideration for Longitudinal Surge 1500V, 200A, 10x160 $\mu$ s

Selected Fuse Bel Fuse type MJS or Littlefuse Series 230 mA	Fuse 10x160 $\mu$ s Rating  Amps	$R_{TOT}$  MIN $\Omega$	$R_T$ & $R_R$  MIN $\Omega$	Required 10x160 $\mu$ s $I_{PP}$ of SIDACTor  Amps
350	45	33.3	25.3	100
400	52	28.9	20.9	100
500	65	23.1	15.1	100
600	78	19.3	11.3	100
700	91	16.5	8.5	100
1000	130	11.6	4.1	150

$$R_{TOT} = R_S + R_T + R_R \text{ (or) } R_S + R_R$$

$$R_{TOT} = \frac{V_{PK}(\text{Surge})}{I_{PP}(\text{Fuse})}$$

1. To meet UL1459, a current-limiting device (e.g. PTC, fuse) must be used. The 10x160 $\mu$ s  $I_{PP}$  rating listed above is the maximum  $I_{PP}$  surge limitation of the selected Bel fuse (type MJS) without  $R_T$  and  $R_R$ .

2.  $R_T$  and  $R_R$  are optional with the SIDACTor. They are used to limit the 200A, 10x160 $\mu$ s surge within the rating of the selected fuse. I.E., for a 500mA fuse an additional 15.1 $\Omega$  on  $R_T$  and  $R_R$  is necessary to prevent the fuse from opening during FCC Part 68 surge. Hence,  $R_T$  and  $R_R$  allow the circuit to pass Part 68 operationally.

3. If desired,  $R_T$  and  $R_R$  may be eliminated. This will allow the circuit still to pass Part 68 and UL1459; however, it will pass FCC Part 68 non-operationally since the fuse will open.

4. The robustness of a circuit designed to pass FCC Part 68 non-operationally is dependent on the size of fuse used. The SIDACTor allows the engineer to use up to a full 1A fuse without any series resistance. See required 10x160 $\mu$ s  $I_{PP}$  of SIDACTor to determine the proper value of the SIDACTor for the selected fuse.

5. See application notes AN1017, AN1018, and AN1019 for detailed descriptions of FCC Part 68, UL1459, and circuit component value calculations.

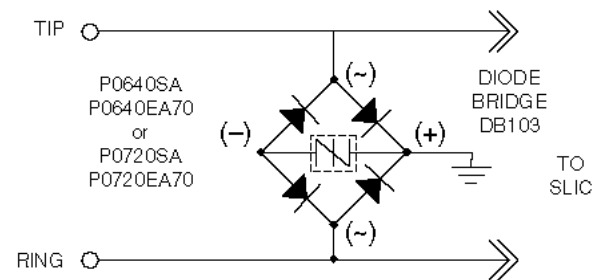
**Bellcore GR-1089 CORE, Table 4-2  
First Level Lightning Surge Test (Telecommunications Port).**

Surge Test Number	Peak voltage Volts	Peak Current Amps	Waveform time $\mu$ Sec	P1500EC70 P1500SC P3002AC P3203AC	Required $R_{Tip}$ & $R_{Ring}$ $\Omega$
1	$\pm 600$	100	10 x 1000	Withstand	None
2	$\pm 1000$	100	10 x 360	Withstand	None
3	$\pm 1000$	100	10 x 1000	Withstand	None
4	$\pm 2500$	500	2 x 10	Withstand	None
5	$\pm 1000$	25	10 x 360	Withstand	None

### AN1012 - Bellcore GR-1089-CORE

“Electromagnetic Compatibility and Electrical Safety Generic Criteria for Network Telecommunications Equipment”. Table 4-2, First Level Lightning Surge tests (Telecommunications Port). There are designs and designers that prefer or require overvoltage protection devices that can withstand all 5 surges of Table 4-2 without the use of any series resistance (0 $\Omega$ ). Meeting the challenge, Teccor has developed devices specifically to pass operationally all 5 surges of Table 4-2. Teccor recommends the following Devices: P1500EC70, P1500SC, P3002AC, or P3203AC. These devices are rated with an  $I_{PP}$  surge of 100 amp 10x1000 $\mu$ s and 500 amp 2x10 $\mu$ s (Surge #4).

Figure C — SLIC Protection Using a SIDACTor and a Diode Bridge



### AN1013 - SLIC (Subscriber Line Interface Circuit)

SLICs (Subscriber Line Interface Circuits) are normally operated from a nominal -50VDC supply (with respect to ground), located behind the ring generator or ring detection circuit and are not exposed to ring voltages. Protection of the SLIC is accomplished by using a diode for positive overvoltage protection and a SIDACTor for all negative overvoltages exceeding the -50VDC supply voltage (typically -56.6VDC). The SIDACTor minimum  $V_{BO}$  should be greater than the typical supply voltage to insure non-operation of the SIDACTor during normal operation.

**Figure C** shows how to protect a SLIC with a single SIDACTor and a diode bridge. The P0640EA70 or P0640SA SIDACTors offer  $V_{BO}$ s of 58 volts minimum & 70 volts maximum with the ability to hold fast rising transients up to 1kV/ $\mu$ sec to 70 volts maximum, thus protecting sensitive SLICs. The bridge may be a 4 pin DIP (surface mount package if preferred) or discrete components. The cost of this protection scheme is approximately one half that of single SLIC protection components other manufacturers offer.

**Figures D** and **E** show how to protect a SLIC with either a single P1602AA and two diodes or two discrete P0641SA (DO-214AA, surface mount packages). The P0641SA contains one 58V $_{MIN}$  – 70V $_{MAX}$  SIDACTor chip and a diode.

Figure D — SLIC Protection Using a SIDACTor and Two Diodes

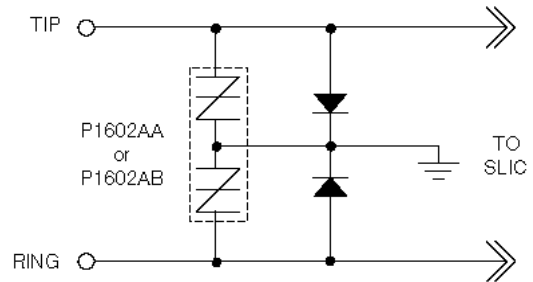
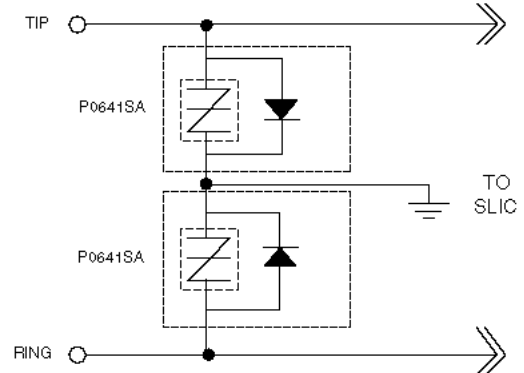


Figure E — SLIC Protection Using Two P0641SA SIDACTor packages

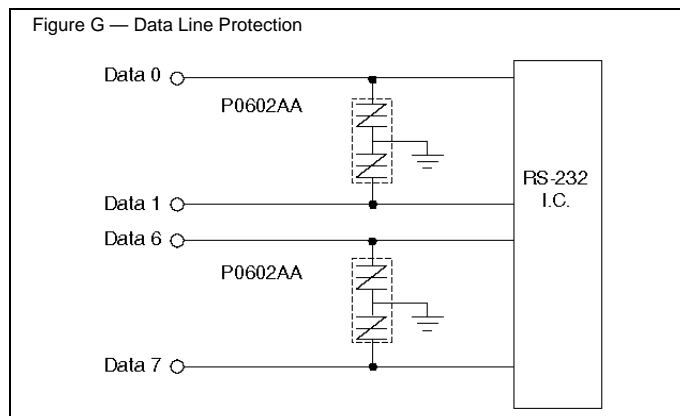
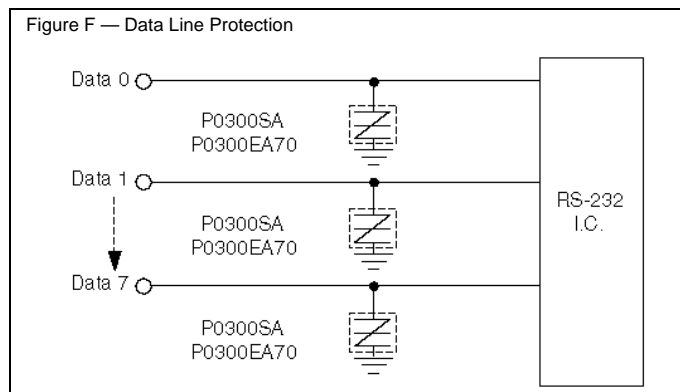


# Application Notes

## AN1014 - Low Voltage Data Line Protection

AC and data lines are often run in close proximity of each other which can result in overvoltages being induced on to data lines. Teccor SIDACtors can be used to protect data lines from AC induced over-voltage conditions.

Figures F and G show how P0300SA, P0300EA70, and P0602AA SIDACtors can be used to protect low voltage data lines. The recommended devices have a Peak One Cycle Surge Current rating of 30 Amps and a continuous current rating of 1 Amp RMS.

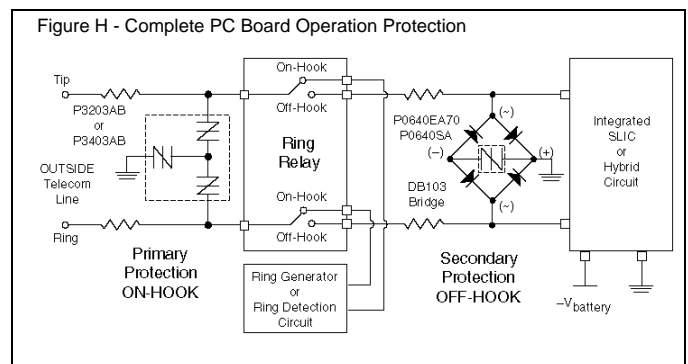


## AN1015 - Teccor Patented 3-Chip “Y” Configuration

The patented TECCOR 3-chip “Y” configuration (using two SIDACtor chips in series between any terminal pair) offers additional protection in its operation. Example: When an overvoltage surge occurs on a typical telecommunication twisted pair line, a simultaneous longitudinal surge occurs (between Tip to ground and Ring to ground). The Tip or Ring terminal SIDACtor chip with the lowest  $V_{B0}$  and the center (or Ground) SIDACtor chip will turn-on first (to the device's  $V_{TM}$ ). This leaves the opposite side of the 3-chip SIDACtor protector at the  $V_{B0}$  of only one SIDACtor chip to ground, or approximately  $1/2 V_{B0}$  rating of the device. The simultaneous voltage surge on the opposite side will also be at least at a voltage equal to  $V_{B0}$  so the opposite side SIDACtor chip (at  $1/2 V_{B0}$ ) will turn-on also. The low  $I_H$  of the center (or ground) SIDACtor chip allows it to be the first SIDACtor chip to turn-on and the last to turn-off, to force and maintain the connection or path to ground. This patented 3-chip SIDACtor offers differential voltages between Tip and Ring terminals limited to approximately  $1/2 V_{B0}$  maximum rating of the device occurring typically within a few hundred nanoseconds during a simultaneous longitudinal voltage surge.

## AN1016 - On-Hook & Off-Hook Protection Requirements

FCC, UL, Bellcore, etc. require telecommunications equipment to be surged in all its operating states. This refers to the two commonly referred to states as “On-Hook” state (ring generator or ring detection monitoring) and the “Off-Hook” state (operational state). The On-Hook state must allow operation of the normal battery voltage (DC bias) plus ring voltage without interference. The Off-Hook state should only allow operation of the battery voltage (DC bias) plus operation signals and has a typical maximum of 70 to 80 volts (FCC Part 68 has a 70 volt maximum). Telecommunications equipment needs **primary** protection for the On-Hook surge and **secondary** protection for the Off-Hook surge (see AN1013, SLIC protection schemes). The two applications have different voltage protection requirements and therefore two overvoltage protectors are required. See Figure H below for circuit protection scheme.



## AN1017 - FCC Rules Part 68, Subpart D Metallic Voltage Surge, Detailed

The FCC Part 68 telecom Metallic Voltage Surge is an 800 volt, 100 amp  $10 \times 560 \mu s$  surge applied metallicly (Line to Line) between tip and ring of a 2-wire connection. To select the proper SIDACtor  $V_{B0}$  and calculate the Tip and Ring impedances required to limit the surge current within the surge current ratings of the SIDACtor, see Telecom Application Notes section on circuit calculations. To survive operational and against a metallic voltage surge, see Figures I, J, and K.

Figure I shows how to protect against an on-hook metallic surge without utilizing any circuit impedance using a P3100SB or P3100BA70. This is because the surge current rating of the overvoltage protection device (100 amp  $10 \times 1000 \mu s$ ) is greater than the surge requirement.

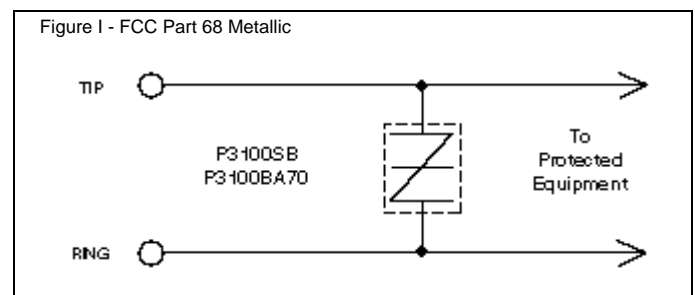


Figure J shows how to protect against an on-hook metallic surge utilizing circuit impedances to reduce the 100 amp metallic surge to less than the 50 amp  $10 \times 1000 \mu s$  surge capability of the P3100SA or P3100EA70.

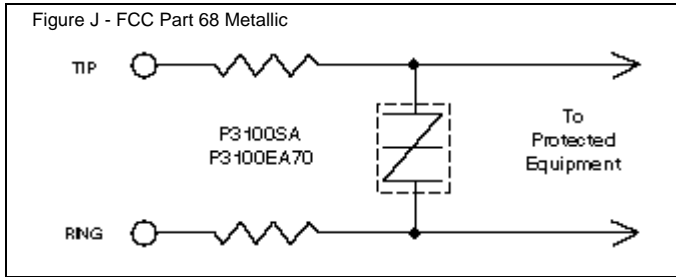
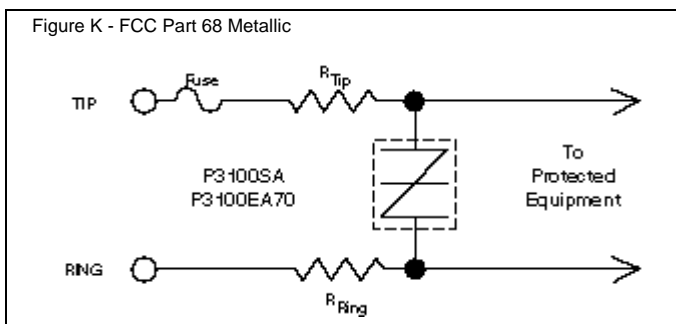


Figure K is the same as Figure J except it utilizes one fuse. The National Electric Code (NEC) article 800 states that telecommunication lines with no connections or paths to ground are only required to incorporate one overcurrent protection device (fuse) in series with either Tip or Ring.



### Longitudinal Voltage Surge

The FCC Part 68 telecom Longitudinal Voltage Surge is a 1500 volt, 200 amp 10x160 $\mu$ s surge applied longitudinally (Line to Ground), between tip to ground, ring to ground and tip tied to ring to ground. This surge has the highest peak current of the two FCC Part 68 telecom voltage surges. A circuit designed to withstand the Longitudinal voltage Surge should also survive the Metallic voltage Surge. The tip and ring impedances should be selected to reduce the applied surge current to within the selected SIDACtor's surge rating. To calculate the Tip and Ring impedance, see Telecom Application Notes section on circuit calculations. To survive operational against an on-hook longitudinal voltage surge, see Figures L, M, N, and O.

Figures L and M show how to protect against a longitudinal surge with a single SIDACtor or two individual devices. A design consideration should be to know that during a Metallic voltage Surge, the protected circuit will see a voltage equal to two times the  $V_{BO}$  (breakover voltage) of the selected device.

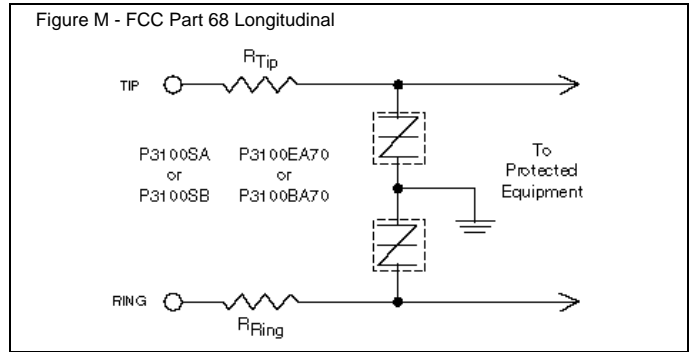
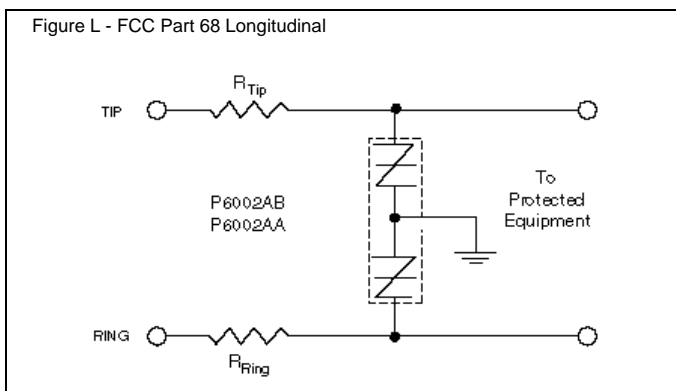


Figure N shows a "Delta" configuration protection solution. It is the same as Figure L and M, except it has a third SIDACtor added between Tip and Ring that will limit the Metallic voltage Surge to its breakover voltage ( $V_{BO}$ ) level.

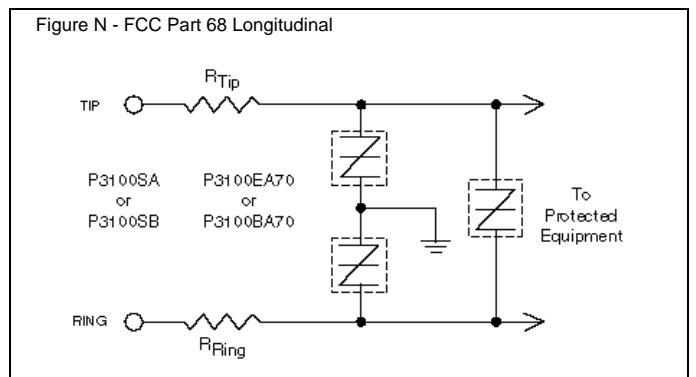
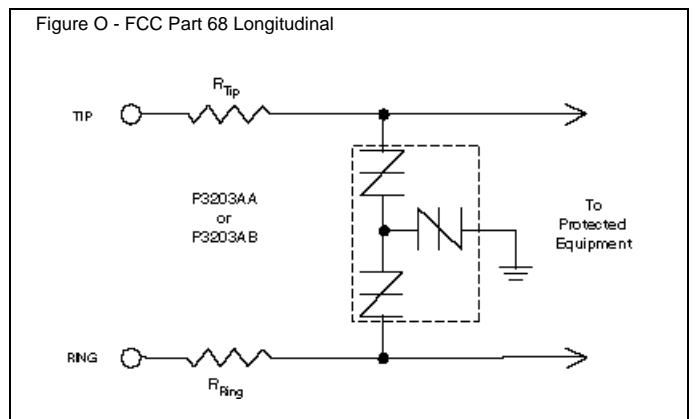


Figure O shows a Balanced "Y" configuration protection solution. This unique Teccor patented 3 chip "Y" configuration (using 2 SIDACtor chips in series between any two terminals) offers additional protection in its operation. See Telecom Applications Note explaining the patented 3 chip "Y" configuration operation.



# Application Notes

## AN1018 - UL 1459 (Standard for Telephone Equipment) and CSA-C22.2 No. 225 (Telecommunications Equipment), Detailed

The UL 1459 and CSA-C22.2 No. 225 Metallic (M), differential mode (Line to Line) and Longitudinal (L), common mode (Line to Ground), AC open circuit voltage and short circuit current test levels at 50 or 60 Hz are as follows:

Test M-1 or L-1: 600 V<sub>RMS</sub>, 40 A<sub>RMS</sub>, applied for 1.5 seconds.

Test M-2 or L-2: 600 V<sub>RMS</sub>, 7A<sub>RMS</sub>, applied for 5.0 seconds.

Test M-3 or L-3:

A. 600 V<sub>RMS</sub>, 2.2 A<sub>RMS</sub> and

B. This test is conducted at less than 2.2 A<sub>RMS</sub>, 600 V<sub>RMS</sub>, with the short circuit current set just below the current interrupting device's (fuse or PTC) activation level.

Test M-4 or L-4: 200 V<sub>RMS</sub>, 2.2A<sub>RMS</sub>; This test is conducted with the voltage set just below the breakdown voltage (V<sub>B0</sub>) of the overvoltage protection device (SIDACTor) and short circuit current just below the current interrupting device's (fuse or PTC) activation level.

Test L-5: 120 V<sub>RMS</sub>, 25A<sub>RMS</sub>

Test M-3, L-3, M-4, L-4 and L-5: are conducted for 30 minutes or until an open circuit condition occurs.

**Note:** Longitudinal surges are conducted simultaneously (Tip to Ground and Ring to Ground).

**Compliance** with the testing is determined by the following:

Telecom equipment shall not present a risk of fire (no ignition or charring of the cheese cloth indicator), no electrical shock and it shall not interrupt the current during the test (open the UL circuit wiring simulator, a fuse, Bussman Mfg. Co. type MDQ 1.6 amp).

### Using SIDACTors (overvoltage surge protectors) in circuits to comply with UL 1459 and CSA-C22.2 No. 225 requirements:

**Note:** U.L. requires components used to be U.L. recognized. CSA-C22.2 No. 225 does not require the components used to be CSA certified. Only the final product meets the CSA requirements.

SIDACTors are recognized under UL 497B (Standard for Secondary protectors for data communications and fire alarm circuits).

SIDACTor epoxy used is UL recognized and the encapsulated body passes UL 94V-0 requirements for flammability.

SIDACTors have 1600VAC<sub>RMS</sub> electrical isolation between the leads and the case.

SIDACTors are offered with V<sub>B0</sub>'s (breakover voltages) greater than the normal operating voltages.

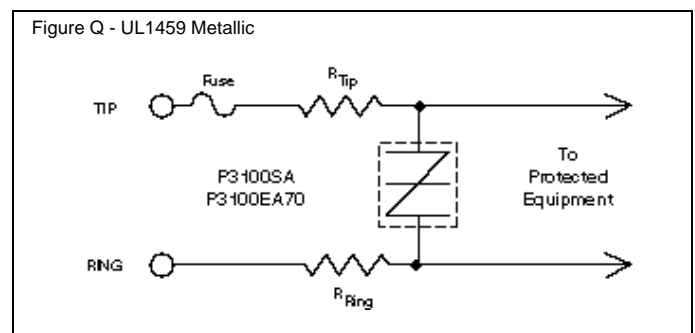
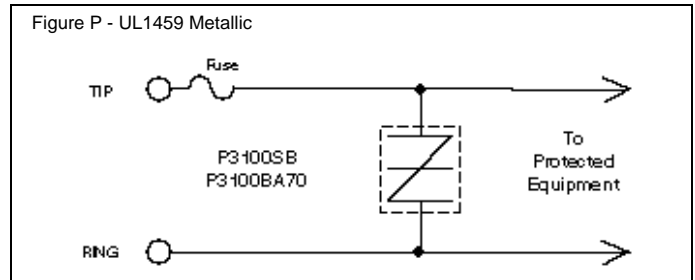
SIDACTors will withstand the UL surges for the duration required for the UL circuit 1.6A fuse to clear (open). If the SIDACTors surge current rating is exceeded, the SIDACTor will fail shorted and not open.

**UL 1459 Solution:** Use a SIDACTor (overvoltage surge protector) and add a fuse or a resettable device, PTC (Positive Temperature Coefficient). The minimum value of the fuse required is determined by the maximum normal operating circuit currents (to allow normal circuit operation). The maximum fuse value is the UL circuit wiring simulator, the Bussman Mfg. type MDQ 1.6 amp fuse. Typical fuse values are between 250 mA and 1.0 amp. See Telecom Application Notes on circuit impedance calculations. Telecom equipment that must comply with UL 1459 must also comply with FCC Rules Part 68 Subpart D. To comply with UL 1459 and CSA-C22.2 No. 225 surge testing (by interrupting overcurrent, open) and remain operational after FCC Rules Part 68 Subpart D on-hook Metallic and Longitudinal voltage Surges, see the following examples:

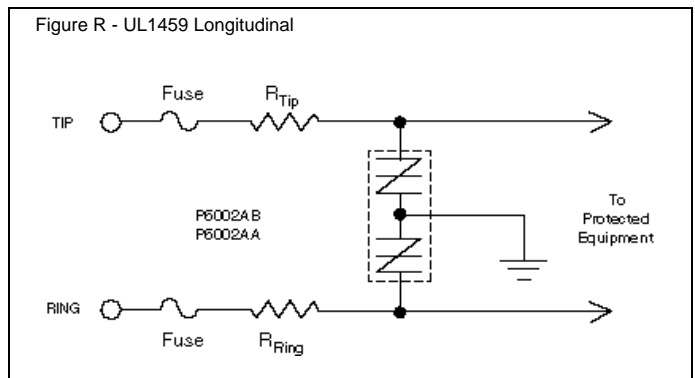
**Figure P** shows a single SIDACTor and a fuse to protect against the on-hook UL Metallic surges. Note that FCC Part 68 does not require the circuit to be operational after the FCC surges.

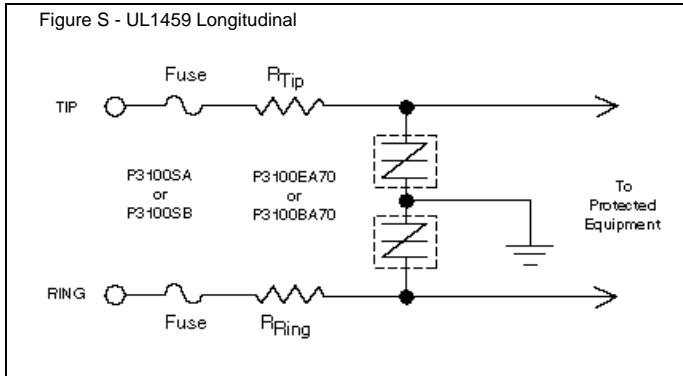
**Figure Q** shows a single SIDACTor, resistor, and a fuse to protect against the on-hook UL Metallic surges. The resistor values are selected in conjunction with the fuse to pass FCC Metallic voltage Surge. A substitute for the fuse would be a PTC.

See Application Note AN1020.

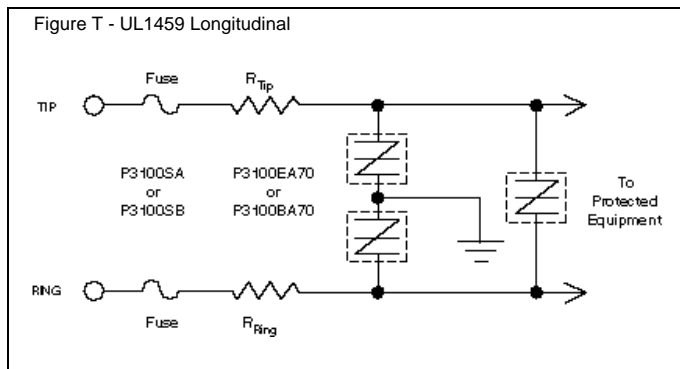


**Figures R and S** show a common scheme to protect against the on-hook UL surges using SIDACTor(s) and fuses. A design consideration should be to know that during a Metallic voltage Surge, the protected circuit will see a voltage equal to two times the V<sub>B0</sub> (breakover voltage) of the selected overvoltage protection device.

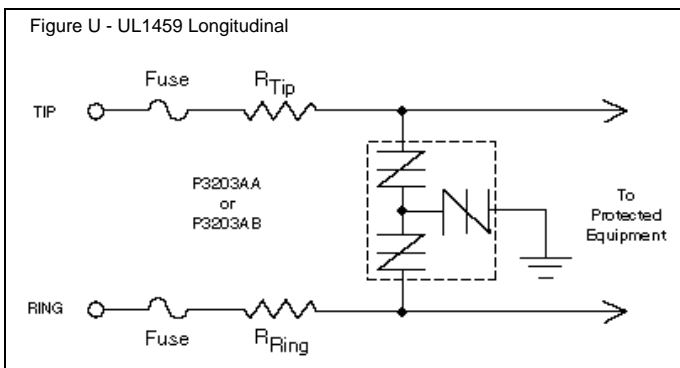




**Figure T** shows a “Delta” configuration protection solution. It is the same as **Figures R** and **S** except it has a third SIDACTor added between Tip and Ring that will limit the Metallic voltage Surge to its  $V_{B0}$  (breakover voltage) level.



**Figure U** shows a Balanced “Y” configuration protection solution using a Teccor patented 3 chip “Y” configuration P3203AB or P3403AB (with 150 amp 10x160μS surge capability) or the P3203AA or P3403AA (100 amp 10x160μS surge capability).



## AN1019 - Circuit Calculations for FCC Part 68 and UL 1459

Selecting the proper SIDACTor  $V_{B0}$  (Breakover voltage): take the circuit maximum operating Ring RMS voltage, convert this to a peak voltage and add the maximum operating dc bias.

$$V_{B0} \text{ (minimum)} = \sqrt{2[\text{RMS ring voltage maximum}] + [\text{DC bias maximum}]}$$

### EXAMPLE:

$$V_{B0} \text{ (minimum)} = \sqrt{2[150 V_{\text{RMS maximum}}] + [56.6\text{VDC maximum}]}$$

$$V_{B0} \text{ (minimum)} = [212V_{\text{Peak}}] + [56.6\text{V dc}] = 268.6V_{\text{Peak}}$$

The SIDACTor  $V_{B0}$  (minimum) should be greater than your maximum circuit operating voltages and the  $V_{B0}$  (maximum) should be the protected components maximum voltage withstanding rating. A device with a  $V_{B0}$  (minimum) = 275 volts will work for this example.

The following equations are necessary for calculating the surge path impedances. Impedances can then be added to the circuit's series surge path to reduce the applied peak surge current to a value within the current carrying capabilities of the components used (SIDACTor and the fuse).

**( $R_S$ ) Surge Generator Internal Source Impedance:** Open Circuit voltage divided by the Short Circuit Current.

$$\text{Source Impedance } R_S = \frac{V_{\text{Peak}}}{I_{\text{Peak}}}$$

**( $\Sigma R_{(\text{long})}$ ) Longitudinal Total Loop Impedance:** Sum of all Loop Impedances in *either* Tip or Ring line to ground (but not both) including the Source Impedance.

$$\text{Longitudinal } \Sigma R_{\text{Tip (long)}} = R_S + R_{\text{Tip}}$$

$$\text{Note: } R_{\text{Tip}} = R_{\text{Ring}}$$

— Or —

$$\text{Longitudinal } \Sigma R_{\text{Ring (long)}} = R_S + R_{\text{Ring}}$$

$$\text{Note: } R_{\text{Tip(long)}} = R_{\text{Ring(long)}}$$

**( $I_{\text{Peak (long)}}$ ) Longitudinal Peak Surge Current:** Open Circuit voltage divided by the Sum of all Longitudinal Loop impedances.

$$\text{Longitudinal Tip } I_{\text{Peak(long)}} = \frac{V_{\text{Peak}}}{\Sigma R_{\text{Tip(long)}}$$

— Or —

$$\text{Longitudinal Ring } I_{\text{Peak(long)}} = \frac{V_{\text{Peak}}}{\Sigma R_{\text{Ring(long)}}$$

**( $\Sigma R_{(\text{metal})}$ ) Metallic Total Loop Impedance:** Sum of all Loop Impedances in Tip and Ring including the Source Impedance.

$$\text{Metallic } \Sigma R_{(\text{metal})} = R_S + R_{\text{Tip}} + R_{\text{Ring}} \quad \text{If } R_{\text{Tip}} = R_{\text{Ring}}$$

$$\text{then Metallic } \Sigma R_{(\text{metal})} = R_S + [2R_{\text{Tip}}]$$

**( $I_{\text{Peak (metal)}}$ ) Metallic Peak Surge Current:** Open Circuit voltage divided by the Sum of all Metallic Loop Impedances.

$$\text{Metallic } I_{\text{Peak(metal)}} = \frac{V_{\text{Peak}}}{\Sigma R_{\text{metal}}}$$

The following examples show how to calculate the values of  $R_{\text{Tip}}$  and  $R_{\text{Ring}}$  to reduce the applied surge current to within the surge ratings of the components used and to remain operational after the surges.

**Fuse Selection:** Calculate the value of  $R_{\text{Tip}}$  &  $R_{\text{Ring}}$  by first selecting a fuse using its applicable waveform surge withstanding rating, calculate  $\Sigma R_{(\text{metal})}$  or  $\Sigma R_{(\text{long})}$  then  $R_{\text{Tip}}$  &  $R_{\text{Ring}}$ . Then select a SIDACTor with an  $I_{\text{pp}}$  10x1000μSec. or 10x160μSec. greater than or equal to the fuse  $I_{\text{Peak}}$  10x560μSec. or 10x160μSec.

# Application Notes

**EXAMPLE 1:** FCC Part 68 Metallic Surge (Line to Line), 800 volt, 100 amp 10x560µSec.

$$\text{Metallic } R_S = \frac{800\text{Volts}}{100\text{Amps}} = 8.0\Omega$$

$$\text{Metallic } \Sigma R_{(\text{metal})} = \frac{800\text{Volts}}{I_{\text{Peak}}(\text{Fuse } 10x560)}$$

$$\text{Metallic } R_{\text{Tip}} = \frac{[\Sigma R_{(\text{metal})} - R_S]}{2}$$

Note:  $R_{\text{TIP}} = R_{\text{RING}}$

## Metallic

Selected BEL FUSE Type MJS Value	Fuse 10v560 µSec. Withstanding Rating (1)	Calculated $\Sigma R_{(\text{metal})}$	Calculated (2) $R_{\text{TIP}} \& R_{\text{RING}}$	SIDACTor (4) Required $I_{\text{pp}}$ 10x1000µS
mA	Amps	Ohms	Ohms	Amps
		MIN	MIN	
250	15	53.3	22.7	50
350	25	32.0	12.0	50
400	28	28.6	10.3	50
500	35	23.0	7.5	50
600	43	18.6	5.3	50
700	50	16.0	4.0	50
800	62	12.9	2.5	100 (3)
1000	78	10.3	1.2	100 (3)
1250	100	8.0	0.0	100 (3)

### Notes:

- (1) The Fuse Type and Waveform withstanding rating are BEL FUSE INC. type MJS. (NOTE: Littlefuse series 230 fuses will have similar surge ratings and are acceptable substitutes.)
- (2)  $R_{\text{TIP}} \& R_{\text{RING}}$  values are minimum and should be chosen from the next higher standard ohm value.
- (3) If a 50 amp 10x1000µSec. rated SIDACTor is preferred, use a 4.0Ω or greater resistor for  $R_{\text{TIP}} \& R_{\text{RING}}$ .
- (4) The SIDACTor should be selected with an  $I_{\text{pp}}$  10x1000µSec. equal to or greater than the applied 10x560µSec. surge current.

**EXAMPLE 2:** FCC Part 68 Longitudinal Surge (Line to Ground), 1500 volt, 200 amp 10x160µSec.

$$\text{Longitudinal } R_S = \frac{1500\text{V}}{200\text{Amps}} = 7.5\Omega$$

$$\text{Longitudinal } \Sigma R_{(\text{long})} = \frac{1500\text{V}}{I_{\text{Peak}}(\text{Fuse } 10x160)}$$

$$\text{Longitudinal } R_{\text{Tip}} = [\Sigma R_{(\text{long})} - R_S] \quad \text{Note: } R_{\text{TIP}} = R_{\text{RING}}$$

## Longitudinal

Selected BEL FUSE Type MJS Value	Fuse 10v160µS Withstanding Rating (1)	Calculated $\Sigma R_{(\text{long})}$	Calculated (2) $R_{\text{TIP}} \& R_{\text{RING}}$	SIDACTor (4) Required $I_{\text{pp}}$ 10x160µS
mA	Amps	Ohms	Ohms	Amps
		MIN	MIN	
250	32	46.9	39.4	100
350	45	33.3	25.3	100
400	52	28.9	20.9	100
500	65	23.1	15.1	100
600	78	19.3	11.3	100
700	91	16.5	8.5	100
800	104	14.3	7.0	100
1000	130	11.6	4.1	150
1250	162	9.3	2.5 (3)	150

### Notes:

- (1) The Fuse Type and Waveform withstanding rating are BEL FUSE INC. type MJS. (NOTE: Littlefuse series 230 fuses will have similar surge ratings and are acceptable substitutes.)
- (2)  $R_{\text{TIP}} \& R_{\text{RING}}$  values are minimum and should be chosen from the next higher standard ohm value.
- (3) A 2.5Ω resistor was chosen (as opposed to the actual 1.8Ω) to limit the peak current to within the rated value of the SIDACTor 10x160µSec. and not the fuse.
- (4) The SIDACTor should be selected with an  $I_{\text{pp}}$  10x160µSec. equal to or greater than the applied 10x160µSec. surge current.

## AN1020 - Using PTCs

**Figures V and W** are suggested methods of passing FCC Part 68 metallic and longitudinal surges operationally, as well as complying with UL1459 using PTC's. The PTC resettable fuse circuit protector is a UL recognized Positive Temperature Coefficient (PTC) resistor. When an overcurrent condition occurs, the PTC dramatically increases in resistance from its base resistance. The surge current is reduced typically to a few milliamps, that is, no significant current flow. After the over current condition subsides, the PTC resets to its base resistance allowing normal circuit operation to continue.

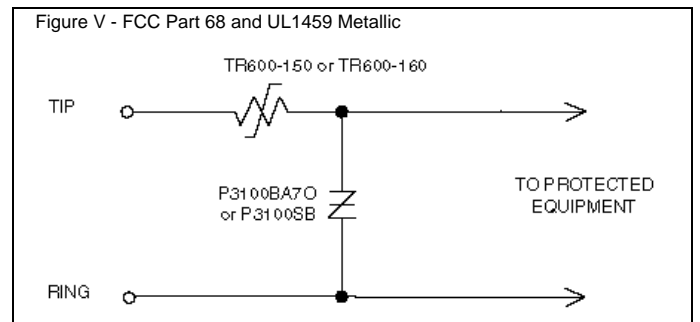
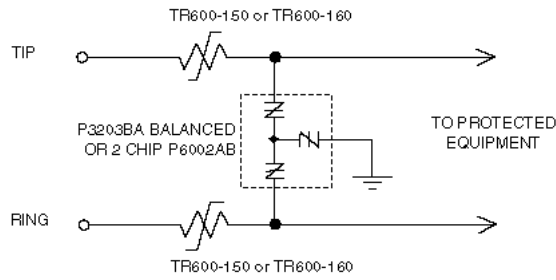


Figure W - FCC Part 68 and UL1459 Longitudinal



## AN1021 - SIDACtors Used In AC Circuits

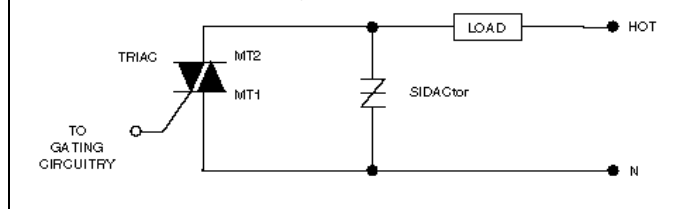
SIDACtors can be used in any number of AC applications where the normal operating current of the line being protected is limited to less than the holding current ( $I_H$ ) and the AC surge capability rating ( $I_{TSM}$ ) of the SIDACtor.

Figure X shows a typical AC circuit application where a SIDACtor is used to protect a triac from an overvoltage surge. The requirements for using a SIDACtor in this application are:

- SIDACtor must be placed behind the Load
- SIDACtor  $V_{BO} < \text{Triac } V_{DRM}$
- SIDACtor  $V_{BO} > \text{supply voltage (peak)}$

Examples of AC applications where SIDACtors can be used include security system sensors, zoning lines, sprinkler systems, and the input side of a solid state relays.

Figure X - Typical AC Applications Using SIDACtors as Transient Overvoltage Protectors



## AN1022 - Proposed changes to FCC Part 68

Several proposed changes to FCC Part 68 testing are currently before the Federal Communications Commission. One significant change to FCC Part 68 testing is in the area of *Environmental Simulation*.

The environmental simulation section of FCC Part 68 includes surge testing requirements for Terminal Equipment. The following table summarizes the existing and proposed FCC Part 68 surge testing:

### Current Part 68 Surges

Surge Type	Peak Volt. (V)	Rise/Decay $\mu\text{s}$	Current (A)	Rise/Decay $\mu\text{s}$	App. in each polarity
A-Metallic	800	10 x 560	100	10 x 560	1
A-Longitudinal	1500	10 x 160	200	10 x 160	1

### Proposed Surges

B-Metallic	1000	9 x 720	25	5 x 320	1
B-Longitudinal	1500	9 x 720	37.5	5 x 320	1

The allowed failure mode for a Type A surge is either open-circuit (permanent on-hook condition) or a short circuit to ground. Any equipment that fails short to ground after a surge must be designed in such a way as to cause the equipment to either be disconnected or repaired rapidly after such a state is reached should it occur in service.

Equipment subject to Type B surges (currently proposed before the FCC) must withstand the lower levels of surge energy without causing permanent opening or shorting of the interface circuitry.

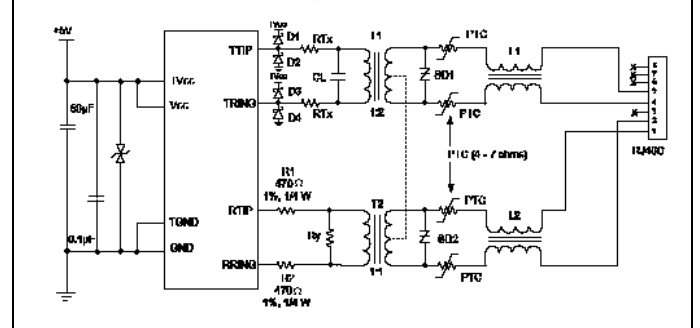
FCC Part 68 testing is referenced in applications notes AN1010, AN1011, AN1017, and AN1019. The referenced applications notes provide effective solutions for passing the Type A FCC surging and also the proposed Type B surge testing requirements.

## AN1023 - Protection for T1 Digital Line Cards

The broader deployment of T1 Line Cards into applications outside the central office requires enhanced secondary protection of T1 circuitry. T1 lines running between customer premises equipment and the central office are subject to overvoltage and over current stresses from lightning strikes and power crosses. SIDACtors can be used to protect critical T1 transceiver chips from excessive levels of transient energy.

Figure Y shows a protection scheme that uses two Teccor SIDACtors on the line side of the T1 coupling transformer (T1 & T2). Typical SIDACtor devices used in this application would be P0300EA70 or a P0300SA (SD1 & SD2).

Figure Y - Protection Scheme Using Two SIDACtors on Line Side of T1 Coupling Transformer



The Teccor SIDACtors provide the first layer of protection for the circuit shown in Figure Y. The SIDACtor will effectively provide protection from lightning surges and AC power cross. T1 & T2 coupling transformers provide a second layer of high isolation protection (typically 1500 - 3000 V) against longitudinal surges. D1 - D4 and R1 - R2 provided a final layer of protection by providing voltage and current protection for any residual energy that may have coupled through the Isolation line transformers. (T1 & T2)

## FCC Part 68

FCC registration is required for all terminal equipment intended for direct connection to the public network. The P0300SA will pass the FCC's 100 A 10x 560  $\mu\text{s}$  surge operationally. The PTC's 4-7 ohms of off-state resistance will provide the necessary series resistance to reduce the 100A surge down to the P0300SA's 50 amp rating. (Ref. AN1010, AN1019)

# Application Notes

## Bellcore GR-1089-CORE

If the Line Card is subject to Bellcore GR-1089-CORE testing, the following change must be made to the circuit to insure compliance.

An additional series resistance of 19 ohms is required on each leg of the circuit to ensure the SIDACtor will survive the 500 A 2x10 $\mu$ s metallic surge operationally. The isolation transformer will provide protection from longitudinal surges. Note: Careful analysis of the transformer is required to prevent damage or safety hazards resulting from transformer ratings being exceeded during First and Second level immunity testing. (Ref. AN1012, AN1020).

Teccor now offers a line of "SC" SIDACtors designed to meet Bellcore GR-1089-CORE surge requirements without the use of additional series resistance. *Please contact the factory for data sheets.*

## UL 1459

All T1 interface circuits must have shock and fire hazard protection in order to pass UL 1459. In **Figure Y** two PTCs are used on the transmit and receive lines to protect the equipment from the 600 VAC power cross tests that all equipment is subjected to as part of UL 1459 evaluations. The SIDACtor will provide the added benefit of limiting the power cross to its Maximum  $V_{BO}$  during the power cross tests. (Ref. AN1020)

## AN1024 - Bi-National Safety Standard UL 1950

The requirements and tests listed in UL 1950 under "Protection against overvoltage" are essentially the same requirements and tests as listed in UL 1459 under "Overvoltage testing". The major difference in UL 1950 and UL 1459 overvoltage testing is in the allowed design exceptions that were adopted into the new Bi-national standard. The design exceptions of UL 1950 allow the designer greater flexibility in the designing overvoltage protection into telecommunications or business equipment. (NOTE: Reference section 6.3.3.1 of UL 1950 when selecting the  $V_{BO}$  of SIDACtors intended for connection to ground)

Applications notes AN1010, AN1011, AN1018, AN1019 that reference UL1459 are still valid applications with respect to UL 1950. By meeting the surge requirements of UL1459, the equipment has essentially met the worst case overvoltage testing scenario of UL 1950.

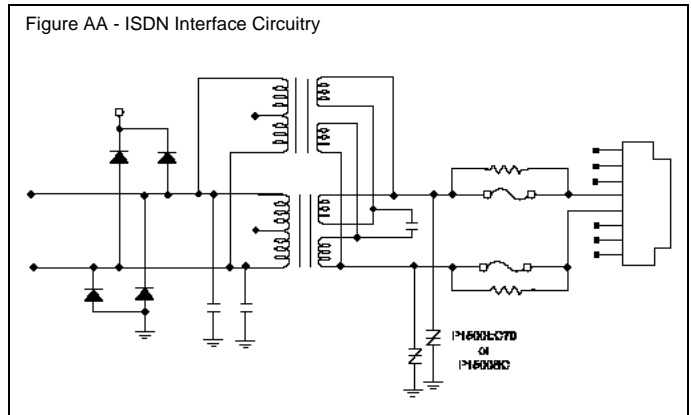
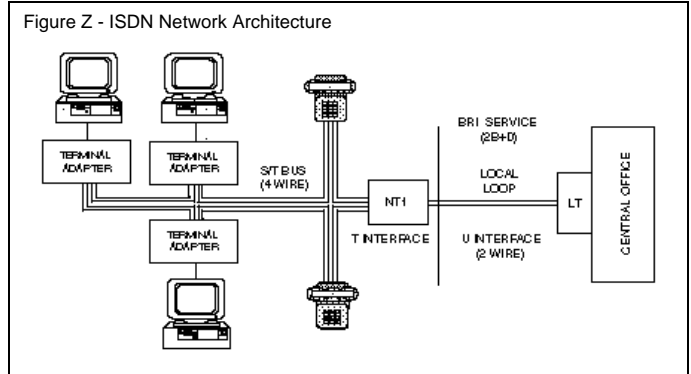
Implementation of the new Bi-National Standard is shown below.

July 28, 1996 - April 1, 2000	The new bi-national standard will be used to evaluate new products unless the use of another specification is requested in writing. (UL 1459)
From April 1, 2000	Products previously approved in accordance with UL 1459 or other national standards will be considered approved until April 5, 2005
As of April 5, 2005	All products whether new or previously approved, will be evaluated against the new bi-national standard

## AN1025 - ISDN Applications

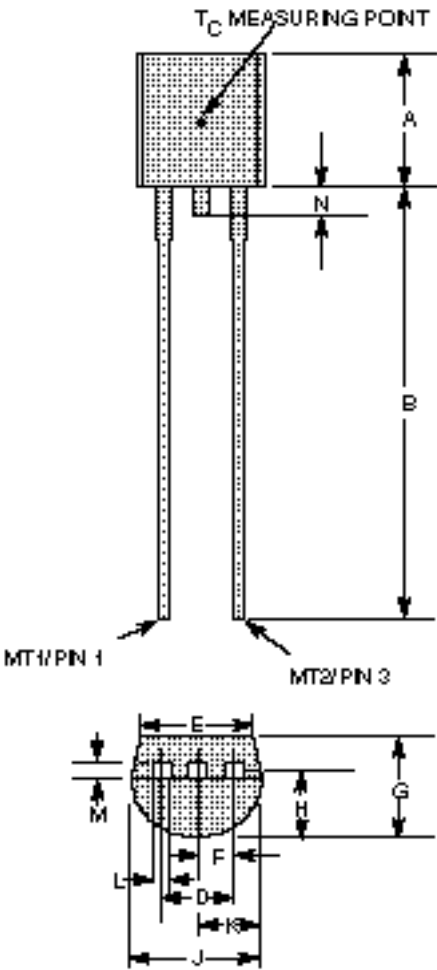
SIDACtors are used to protect ISDN terminal (NT1) and line termination (LT) equipment. **Figure Z** illustrates the locations where SIDACtors are typically used in protecting ISDN equipment. **Figure AA** is a specific example of how SIDACtors are used in protecting interface circuitry.

Registration of network termination equipment (NT1) is required by the FCC. ISDN interface circuitry will be required to undergo FCC environmental testing. (Ref. AN1011, AN1017, AN1019, and AN1022)



# Package Dimensions

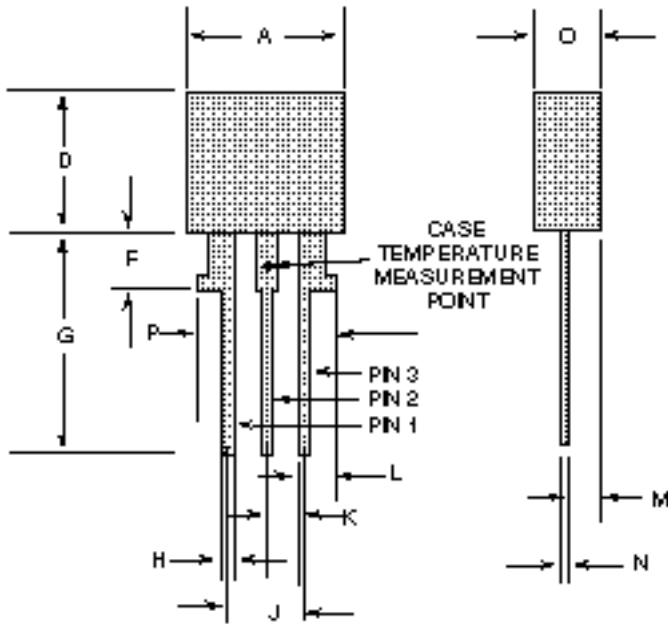
“B” and “E” PACKAGE  
 (TYPE 70 leadform)  
 TO-92 (Isolated)



DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.176	.196	4.47	4.98
B	.500		12.70	
D	.095	.105	2.41	2.67
E	.150		3.81	
F	.046	.054	1.16	1.37
G	.135	.145	3.43	3.68
H	.088	.096	2.23	2.44
J	.176	.186	4.47	4.73
K	.088	.096	2.23	2.44
L	.013	.019	0.33	0.48
M	.013	.017	0.33	0.43
N		.060		.152

# Package Dimensions

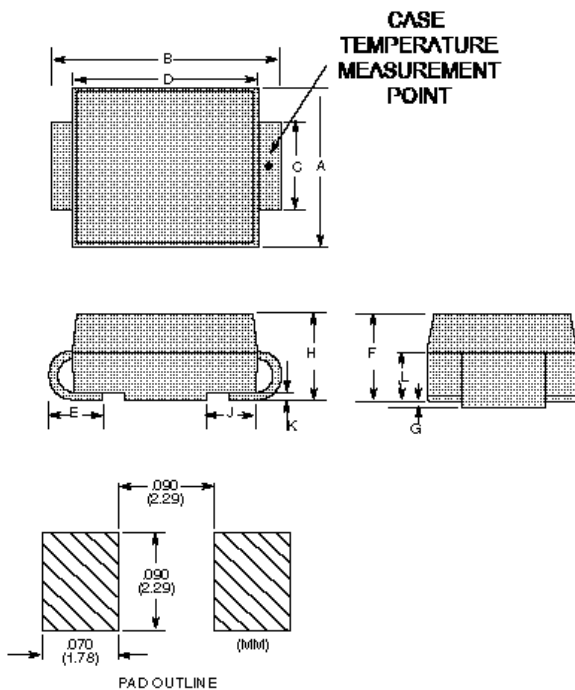
## “A” PACKAGE MODIFIED DO-220 (Isolated)



DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.400	0.410	10.16	10.42
D	0.360	0.375	9.14	9.53
F	0.110	0.130	2.80	3.30
G	0.540	0.575	13.71	14.61
H	0.025	0.035	0.63	0.89
J	0.195	0.205	4.95	5.21
K	0.095	0.105	2.41	2.67
L	0.075	0.085	1.90	2.16
M	0.070	0.085	1.78	2.16
N	0.018	0.024	0.46	0.61
O	0.178	0.188	4.52	4.78
P	0.310		7.87	

All leads insulated from case.  
Case is electrically nonconductive.

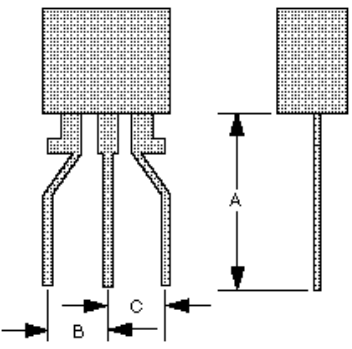
## “S” PACKAGE DO-214AA



DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.140	.155	3.56	3.94
B	.205	.220	5.21	5.59
C	.077	.089	1.96	2.26
D	.166	.180	4.22	4.57
E	.036	.056	.914	1.42
F	.075	.085	1.91	2.16
G	.004	.008	.102	.203
H	.080	.094	2.03	2.39
J	.043	.053	1.09	1.35
K	.008	.012	.203	.305
L	.039	.049	.991	1.25

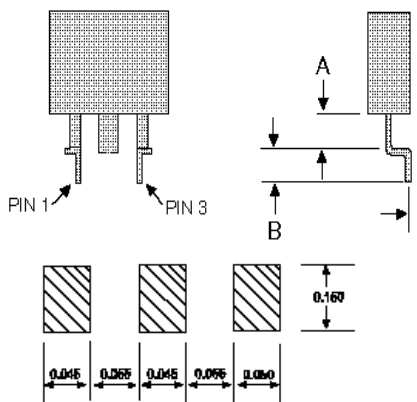
## LEAD FORM OPTIONS-MODIFIED TO-220, A PACKAGE

**TYPE 60  
"A" PACKAGE**



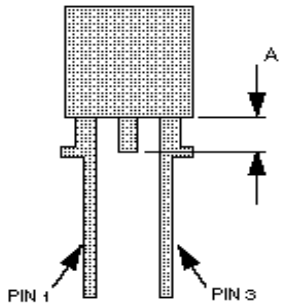
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.485		12.32	
B	.162	.192	4.11	4.88
C	.162	.192	4.11	4.88

**TYPE 64  
"A" PACKAGE**



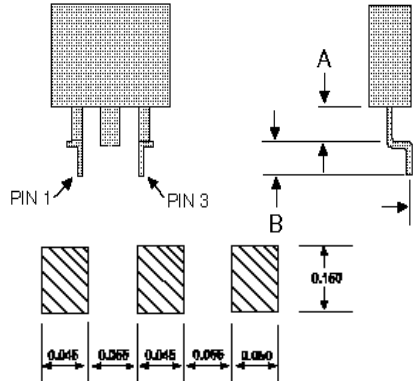
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.080	0.100	2.03	2.54
B	0.110	0.130	2.79	3.30
C		0.010		.254

**TYPE 61  
"A" PACKAGE**



DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.030	.060	.762	1.52

**TYPE 69  
"A" PACKAGE**



DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.080	0.100	2.03	2.54
B	0.110	0.130	2.79	3.30
C		0.010		.254

# Notes



**Notes**

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Please call the factory for further information.

Revised: June, 1997

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**DE**