

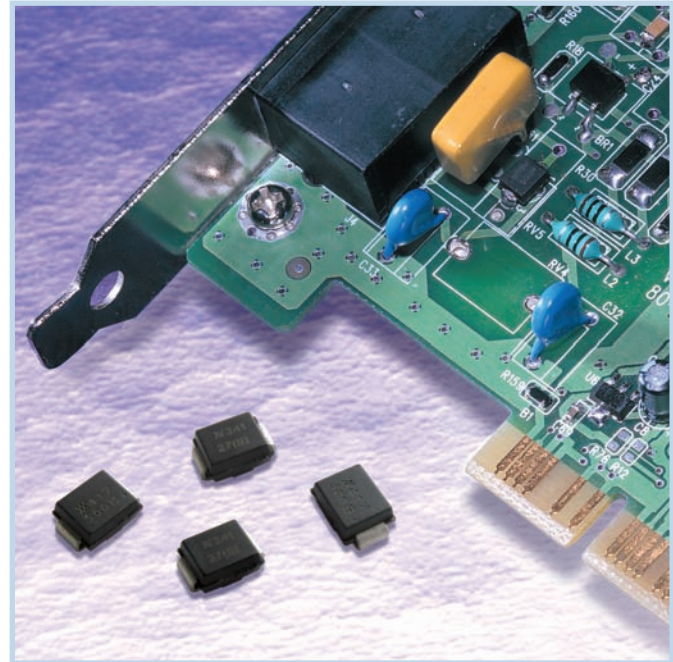


# SiBar Thyristor Surge Protectors

SiBar thyristor surge protection devices help protect sensitive telecom and datacom equipment from overvoltage events, including lightning transients. The devices operate as shunt devices in response to a surge that exceeds the breakover voltage. When the voltage exceeds the breakover voltage the SiBar device “folds back”, creating a low-impedance path, effectively shorting out the overvoltage condition.

Compliant with major standards such as GR-1089 Core, ITU-T-K20/K21, IEC61000-4-5 and FCC part 68, and UL1950, SiBar devices provide fast, bidirectional protection on communications network equipment, including analog and digital linecards, xDSL and ISDN modems, set-top boxes, T1 equipment, Voice over IP (VoIP) and Power over Ethernet (PoE) equipment.

The SiBar thyristor’s low on-state voltage allows for smaller form factor devices - as compared with clamping devices of comparable energy handling capability, and their relatively low capacitance makes them suitable for high data rate circuits.



## Benefits

- Helps provide protection for sensitive telecom electronic equipment
- Low-leakage current
- Low-power dissipation
- Fast, reliable operation
- No wear-out mechanisms
- Helps designers meet worldwide telecom standards
- Helps reduce warranty and service costs
- Easy installation
- Helps improve power efficiency of equipment

## Features

- RoHS compliant
- Bi-directional crowbar transient voltage protection
- High off-state impedance
- Low on-state voltage
- High surge capability
- Expanded voltage offerings (58V-320V)
- Short-circuit failure mode
- Surface-mount technology

## Applications

- Modems
- Fax machines
- Phones
- PBX systems
- POS systems
- Analog and digital linecards (xDSL, T1/E1)
- Other customer premise and central office network equipment

## Protection Application Guide for SiBar Thyristor Surge Protectors

To use this guide, follow the steps below:

1. Select your equipment type from the guide below.
2. Select the type of protection depending on the agency and regional specifications in the second column.

Application	Region/ Specification	SiBar Thyristor Surge Protectors*	Overcurrent Protection		
			Form Factor Radial-leaded	Surface-mount	Chip
<b>Customer premises equipment, IT equipment</b> Analog modems, V.90 modems, ISDN modems, xDSL modems, ADSL splitters, phone sets, fax machines, answering machines, caller ID, internet appliances, PBX systems, POS terminals, wall plugs	<b>North America</b> TIA-968-A, UL 60950, GR1089 Port Type 3‡	TVBxxx(N)SA-L TVBxxx(N)SB-L TVAxxx(N)SA-L	TRF600-150 TRF600-160 TRF600-400	TS600-170F TS600-200F TSM600-250F TSM600-400F	
	<b>Europe/Asia/ South America</b> ITU K.21	TVBxxx(N)SA-L TVAxxx(N)SA-L	TRF250-120 TRF250-120T TRF250-145 TRF250-183 TRF250-184	TS250-130F TSV250-130F	
<b>Access network equipment (†)</b> Remote terminals, line repeaters, multiplexers, cross-connects, WAN equipment	<b>North America</b> GR1089 Port Type 5‡	TVBxxx(N)SC-L	TRF600-160 TRF600-400	TS600-170F TS600-200F TS600-400F TSM600-250F TSM600-400F FT600-1250‡	
	<b>Europe/Asia/ South America</b> ITU K.45	TVBxxx(N)SA-L TVAxxx(N)SA-L	TRF250-120 TRF250-120T TRF250-145 TRF250-183 TRF250-184	TS250-130F TSV250-130F	
<b>Central office switching equipment (†)</b> Analog/POTS linecards, ISDN linecards, xDSL modems, ADSL/VDSL splitters, T1/E1 linecards, multiplexers, CSU/DSU, servers	<b>North America</b> GR1089 Port Type 1‡	TVBxxx(N)SC-L	TRF600-160 TRF600-400	TS600-170F TS600-200F TS600-400F TSM600-250F TSM600-400F FT600-1250‡	
	<b>Europe/Asia/ South America</b> ITU K.20	TVBxxx(N)SA-L TVAxxx(N)SA-L	TRF250-120 TRF250-120T TRF250-145 TRF250-183 TRF250-184	TS250-130F TSV250-130F	TCF250-180
<b>Primary protection modules (†)</b> MDF modules, Network Interface Devices (NID)	<b>North America</b> Telcordia GR-974	N/A	TRF250-183 TRF250-184		
	<b>Europe/Asia/ South America</b> ITU K.20	TVBxxx(N)SA-L TVBxxx(N)SB-L TVBxxx(N)SC-L	TRF250-080U TRF250-120 TRF250-120T TRF250-145 TRF250-183 TRF250-184	TSL250-080F TS250-130F TSV250-130F	TCF250-100T TCF250-120T TCF250-145T TCF250-180
<b>Short-haul/intrabuilding communications equipment (†)</b> LAN equipment, VoIP cards, cable telephony NIUs, wireless local loop handsets	<b>North America</b> GR1089 Port Type 2‡ GR1089 Port Type 4‡	TVBxxx(N)SA-L TVAxxx(N)SA-L	TRF250-080U TRF250-120 TRF250-120T TRF250-145 TRF250-183 TRF250-184	TSL250-080F TS250-130F TSV250-130F	
	<b>Europe/Asia/ South America</b> ITU K.21	TVBxxx(N)SA-L TVAxxx(N)SA-L	TRF250-120 TRF250-120T TRF250-145 TRF250-183 TRF250-184	TS250-130F TSV250-130F	

**Protection Application Guide for SiBar Thyristor Surge Protectors**

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Application	Region/ Specification	SiBar Thyristor Surge Protectors*	Overcurrent Protection		
			Form Factor Radial-leaded	Surface-mount	Chip
<b>LAN intrabuilding power cross protection</b> LAN equipment, VoIP cards, IP phones	North America GR1089 Port Type 4‡	TVBxxx(N)SA-L TVAxix(N)SA-L	TRF250-080U	TSL250-080F	
			TRF250-120	TS250-130F	
			TRF250-120T	TSV250-130F	
			TRF250-145		
			TRF250-183		
		TRF250-184			
<b>IEEE 802.3AF/AT Power over Ethernet protection</b>		TVB058(N)SA-L		decaSMDC050F/60-2††	
Powered Ethernet switches and terminals, IP phones, wireless LAN base stations, microcellular base stations, VoIP cards		TVB058NSB-L TVB058NSC-L			
<b>Cable telephony powering system</b>		N/A	BBRF550 ‡‡ BBRF750 ‡‡		

**Note :** This list is not exhaustive. Tyco Electronics welcomes our customers' input for additional application ideas.

- \* For more information on PolySwitch resettable devices, refer to the telecommunications and networking devices section.
- † For improved line balance in these applications, resistance-matched parts are recommended.
- ‡ May require additional impedance or coordination with primary protector
- \*\* FT600-1250 are surface mount telecom fuses. FT600-0500 and FT600-2000 reference also available. See telecom fuse section.
- †† For details on decaSMDC050F/60-2, see the PolySwitch surface-mount devices section.
- ‡‡ For details on BBRF series, see the PolySwitch radial-leaded devices section.

**Table SB1 Electrical Characteristics, Part Marking and Agency Approval for SiBar Thyristor Surge Protectors**

Part Number	V <sub>DM</sub> Max. (V)	V <sub>BO</sub> Max. (V)	I <sub>H</sub> Min. (mA)	V <sub>T</sub> Max. (V)	C <sub>1</sub> @50V Typ. (pF)	C <sub>2</sub> @ 2V Typ. (pF)	Part Marking	UL Approval
<b>SMA 50A Standard "SA" and "NSA" Devices</b>								
TVA170SA-L	170	265	150	4.0	20	39	170A	X
TVA170NSA-L	170	220	150	4.0	20	39	17NA	X
TVA200SA-L	200	320	150	4.0	17	33	200A	X
TVA220NSA-L	220	300	150	4.0	17	33	22NA	X
TVA270SA-L	270	365	150	4.0	16	31	270A	X
TVA275NSA-L	275	350	150	4.0	16	31	27NA	X
<b>SMB 50A Standard "SA" and "NSA" Devices</b>								
TVB058SA-L	58	77	150	4.0	43	80	058A	-
TVB058NSA-L	58	77	150	4.0	44	84	58NA	X
TVB065NSA-L	65	88	150	4.0	41	79	65NA	X
TVB075NSA-L	75	98	150	4.0	34	65	75NA	X
TVB090NSA-L	90	130	150	4.0	31	58	90NA	X
TVB120NSA-L	120	160	150	4.0	24	46	12NA	X
TVB140NSA-L	140	180	150	4.0	23	44	14NA	X
TVB170SA-L	170	265	150	4.0	18	35	170A	X
TVB170NSA-L	170	220	150	4.0	20	39	17NA	X
TVB180SA-L	180	219	150	4.0	30 (MAX)	60 (MAX)	180A	X
TVB180NSA-L	180	240	150	4.0	19	37	18NA	X
TVB190NSA-L	190	260	150	4.0	19	36	19NA	X
TVB200SA-L	200	320	150	4.0	18	35	200A	X
TVB220NSA-L	220	300	150	4.0	17	33	22NA	X
TVB270SA-L	270	365	150	4.0	15	32	270A	X
TVB275NSA-L	275	350	150	4.0	15	31	27NA	X
TVB300SA-L	300	400	150	4.0	14	27	300A	X
TVB320NSA-L	320	400	150	4.0	14	27	32NA	X

**Table SB1 Electrical Characteristics, Part Marking and Agency Approval for SiBar Thyristor Surge Protectors**

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Part Number	V <sub>DM</sub> Max. (V)	V <sub>BO</sub> Max. (V)	I <sub>H</sub> Min. (mA)	V <sub>T</sub> Max. (V)	C <sub>1</sub> @50V Typ. (pF)	C <sub>2</sub> @ 2V Typ. (pF)	Part Marking	UL Approval
<b>SMB 80A Standard "SB" and "NSB" Devices</b>								
TVB058NSB-L	58	77	150	4.0	67	129	58NB	X
TVB065NSB-L	65	88	150	4.0	64	123	65NB	X
TVB075NSB-L	75	98	150	4.0	63	122	75NB	X
TVB090NSB-L	90	130	150	4.0	49	95	90NB	X
TVB120NSB-L	120	160	150	4.0	38	75	12NB	X
TVB140NSB-L	140	180	150	4.0	36	70	14NB	X
TVB170NSB-L	170	220	150	4.0	29	59	17NB	X
TVB180NSB-L	180	240	150	4.0	29	59	18NB	X
TVB190NSB-L	190	260	150	4.0	28	56	19NB	X
TVB200SB-L	200	320	150	4.0	30	49	200B	X
TVB220NSB-L	220	300	150	4.0	26	52	22NB	X
TVB270SB-L	270	350	150	4.0	25	50	270B	X
TVB275NSB-L	275	350	150	4.0	23	47	27NB	X
TVB300SB-L	300	400	150	4.0	21	42	300B	X
TVB320NSB-L	320	400	150	4.0	22	44	32NB	X
<b>SMB 100A Standard "SC" and "NSC" Devices</b>								
TVB058NSC-L	58	77	150	4.0	114	222	58NC	X
TVB065NSC-L	65	88	150	4.0	103	198	65NC	X
TVB075NSC-L	75	98	150	4.0	90	176	75NC	X
TVB090NSC-L	90	130	150	4.0	79	154	90NC	X
TVB120NSC-L	120	160	150	4.0	72	140	12NC	X
TVB140NSC-L	140	180	150	4.0	66	130	14NC	X
TVB170SC-L	170	265	150	4.0	60	125	170C	X
TVB170NSC-L	170	220	150	4.0	48	99	17NC	X
TVB180NSC-L	180	240	150	4.0	48	97	18NC	X
TVB190NSC-L	190	260	150	4.0	44	90	19NC	X
TVB200SC-L	200	320	150	4.0	55	115	200C	X
TVB220NSC-L	220	300	150	4.0	41	81	22NC	X
TVB270SC-L	270	365	150	4.0	50	110	270C	X
TVB275NSC-L	275	350	150	4.0	38	76	27NC	X
TVB300SC-L	300	400	150	4.0	47	98	300C	X
TVB320NSC-L	320	400	150	4.0	35	71	32NC	X

**Notes :** All electrical characteristics are measured at 25°C.

V<sub>DM</sub> measured per UL497B pulse requirements: at max. off-state leakage current (I<sub>DM</sub>) = 5μA.

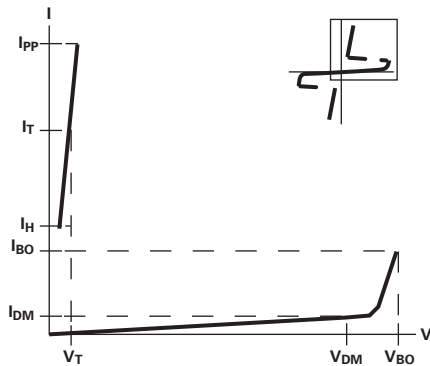
V<sub>BO</sub> measured at 100V/μs.

**Table SB2 Surge Current Rating for SiBar Thyristor Surge Protectors**

Part Number	TIA-968			Telcordia GR-1089*		IEC61000-4-5	ITU K.20/21/45*	I <sub>TSM</sub> Min. (A)	di/dt (A/μs)	dV/dt (V/μs)
	Type A	Type B		I <sub>PP</sub> (A) 10 x 1000μs	I <sub>PP</sub> (A) 2 x 10μs	I <sub>PP</sub> (A) 8 x 20μs	I <sub>PP</sub> (A) 5 x 310μs (V <sub>OC</sub> : 10x700μs)			
	I <sub>PP</sub> (A) 5 x 320μs	I <sub>PP</sub> (A) 10 x 560μs	I <sub>PP</sub> (A) 10 x 160μs							
TVAx <sub>xx</sub> SA-L	90	70	100	50	150	150	90	22	500	2000
TVAx <sub>xx</sub> NSA-L	90	70	100	50	150	150	90	22	500	2000
TVB180SA-L	—	75	110	50	—	—	100	32	500	2000
TVB <sub>xx</sub> SA-L	90	70	100	50	150	150	90	22	500	2000
TVB <sub>xx</sub> NSA-L	90	70	100	50	150	150	90	22	500	2000
TVB <sub>xx</sub> SB-L	100	100	150	80	250	250	100	30	500	2000
TVB <sub>xx</sub> NSB-L	100	100	150	80	250	250	100	30	500	2000
TVB <sub>xx</sub> SC-L	150	150	200	100	500	400	150	60	500	2000
TVB <sub>xx</sub> NSC-L	150	150	200	100	500	400	200	60	500	2000

Notes : I<sub>TSM</sub> : peak on-state surge current is measured at 60 Hz, one cycle.  
 di/dt : critical rate-of-rise of on-state current (pulsed power amplifier V<sub>max</sub> = 600V; C = 30μF).  
 dV/dt: critical rate-of-rise of off-stage voltage (linear wave form, V<sub>D</sub> = rated V<sub>BO</sub>, T<sub>J</sub> = 25°C

\* Lightning current wave forms for applicable industry specification.

**Figure SB1 Voltage-Current Characteristics for SiBar Thyristor Surge Protectors**


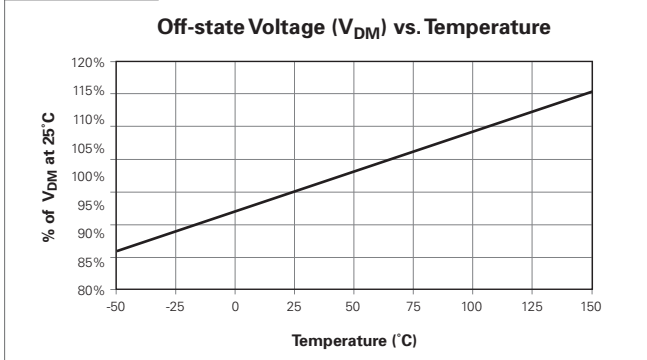
The voltage current (V-I) is useful in depicting the electrical characteristics of the SiBar thyristor surge protectors in relation to each other.

**Table SB3 Parameter Definitions for SiBar Thyristor Surge Protectors**

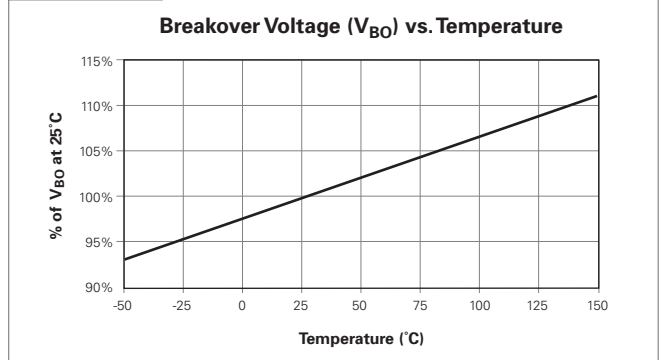
Symbol	Parameter	Definition
V <sub>BO</sub>	Breakover voltage	Maximum voltage across the device at breakdown measured under a specified voltage and current rate of rise.
I <sub>BO</sub>	Breakover current	Instantaneous current flowing at the breakover voltage (V <sub>BO</sub> ).
I <sub>H</sub>	Hold current	Minimum current required to maintain the device in the on-state.
I <sub>T</sub>	On-state current	Current through the device in the on-state condition.
V <sub>T</sub>	On-state voltage	Voltage across the device in the on-state condition at a specified current (I <sub>T</sub> ).
V <sub>DM</sub>	Maximum off-state voltage	Maximum DC voltage that can be applied to the device while maintaining it in the off-state condition.
I <sub>DM</sub>	Off-state current	Maximum DC value of current that results from the application of the maximum off-state voltage.
I <sub>PP</sub>	Peak pulse current	Rated peak pulse current of specified amplitude and waveshape that may be applied without damage.
di/dt	Critical rate of rise of on-state current	Maximum current rate of rise the device can withstand without damage.
dV/dt	Critical rate of rise of off-state voltage	Maximum voltage rate of rise the device can withstand without turning on.

**Figure SB2-SB5 Typical Electrical Characteristics vs. Temperature for SiBar Thyristor Surge Protectors**

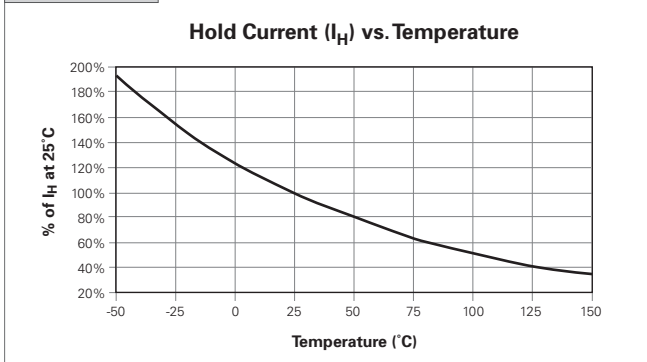
**Figure SB2**



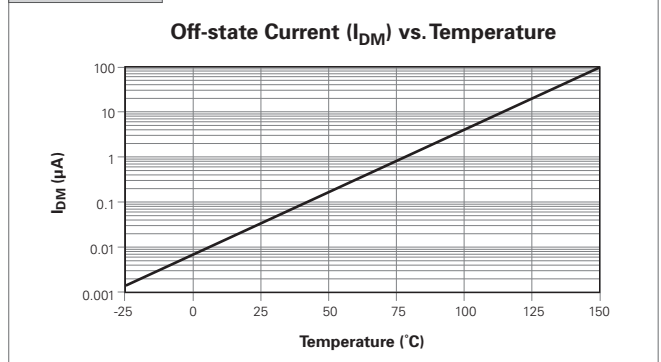
**Figure SB3**



**Figure SB4**



**Figure SB5**



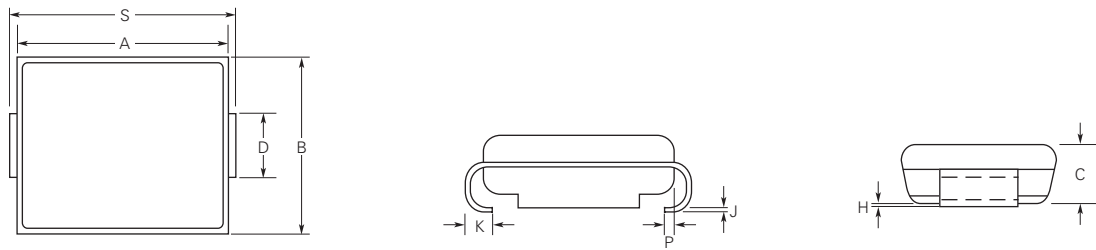
**Table SB4 Dimensions for SiBar Thyristor Surge Protectors in Millimeters (Inches)**

Dimension	A		B		C		D*		H		J		K		P	S	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Ref.	Min.	Max.
SMB Package:	4.06	4.57	3.30	3.94	1.90	2.41	1.95	2.20	0.051	0.200	0.150	0.31	0.76	1.27	0.51	5.21	5.59
TVBxxx(N)Sx-L	(0.160)	(0.180)	(0.130)	(0.155)	(0.075)	(0.095)	(0.077)	(0.087)	(0.002)	(0.008)	(0.006)	(0.012)	(0.030)	(0.050)	(0.020)	(0.205)	(0.220)
SMA Package:	4.06	4.57	2.25	2.92	1.90	2.41	1.25	1.65	0.051	0.200	0.150	0.41	0.76	1.52	0.51	4.80	5.59
TVAxxx(N)Sx-L	(0.160)	(0.180)	(0.089)	(0.115)	(0.075)	(0.095)	(0.049)	(0.065)	(0.002)	(0.008)	(0.006)	(0.016)	(0.030)	(0.060)	(0.020)	(0.189)	(0.220)

**Notes :** TVA series devices use industry standard SMA package type. (JEDEC DO-214AC)  
 TVB series devices use industry standard SMB package type. (JEDEC DO-214AA)  
 All devices are bidirectional and may be oriented in either direction for installation.

\* Dimension D is measured within dimension P.

**Figure SB6 Dimension Figure for SiBar Thyristor Surge Protectors**



**Table SB5 Physical Characteristics and Environmental Specifications for SiBar Thyristor Surge Protectors**

Lead material	Matte tin finish (-L devices)
Encapsulating material	Epoxy, meets UL94V-0 requirements
Solderability	per MIL-STD-750, Method 2026
Solder heat withstand	per MIL-STD-750, Method 2031
Solvent resistance	per MIL-STD-750, Method 1022
Mechanical shock	per MIL-STD-750, Method 2016
Vibration	per MIL-STD-750, Method 2056
Storage temperature (°C)	-55°C to 150°C
Operating temperature (°C)	-40°C to 125°C
Junction temperature (°C)	175°C
Maximum lead temperature for soldering purpose; for 10s (°C)	260°C

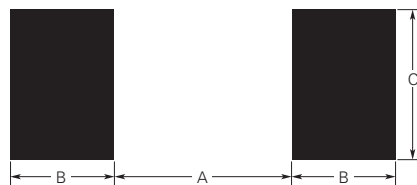
**Table SB6 Reliability Tests for SiBar Thyristor Surge Protectors**

Test	Conditions	Duration
High temperature, reverse bias	+100°C, 50V <sub>DC</sub> bias	1000 hours
High humidity, high temperature, reverse bias	85% RH, +85°C, 50V <sub>DC</sub> bias	1000 hours
High temperature storage life	+150°C	1000 hours
Temperature cycling	-65°C to +150°C, 15 minute dwell	1000 cycles
Autoclave	100% RH, +121°C, 15 PSI	96 hours

**Table SB7 Packaging Information for SiBar Thyristor Surge Protectors**

Part Description	Tape and Reel Quantity	Standard Package	Recommended Pad Layout in Millimeters (Inches)		
			Dimension A (Nom.)	Dimension B (Nom.)	Dimension C (Nom.)
TVAx <sub>xxx</sub> SA-L	5,000	20,000	2.000 (0.079)	2.000 (0.079)	2.000 (0.079)
TVAx <sub>xxx</sub> NSA-L	5,000	20,000	2.000 (0.079)	2.000 (0.079)	2.000 (0.079)
TVB <sub>xxx</sub> SA-L	2,500	10,000	2.261 (0.089)	2.159 (0.085)	2.743 (0.108)
TVB <sub>xxx</sub> NSA-L	2,500	10,000	2.261 (0.089)	2.159 (0.085)	2.743 (0.108)
TVB <sub>xxx</sub> SB-L	2,500	10,000	2.261 (0.089)	2.159 (0.085)	2.743 (0.108)
TVB <sub>xxx</sub> NSB-L	2,500	10,000	2.261 (0.089)	2.159 (0.085)	2.743 (0.108)
TVB <sub>xxx</sub> SC-L	2,500	10,000	2.261 (0.089)	2.159 (0.085)	2.743 (0.108)
TVB <sub>xxx</sub> NSC-L	2,500	10,000	2.261 (0.089)	2.159 (0.085)	2.743 (0.108)

**Figure SB7 Recommended Pad Layout for SiBar Thyristor Surge Protectors**



Agency Recognition for SiBar Thyristor Surge Protectors

UL497B

File # E179610

Solder Reflow and Rework Recommendations for SiBar Thyristor Surge Protectors

SiBar thyristors are compatible with standard reflow and wave soldering techniques.

**Solder Reflow**

- Recommended reflow methods: IR, vapor phase oven, hot air oven.
- Always preheat the device to prevent excessive thermal shock and stress.
- Recommended maximum paste thickness of 0.25mm (0.010 in.).
- Devices may be cleaned using standard industry methods and solvents.

**Solder Rework**

- Use standard industry practices for the SiBar Thyristor Surge Protectors.

Figure SB8

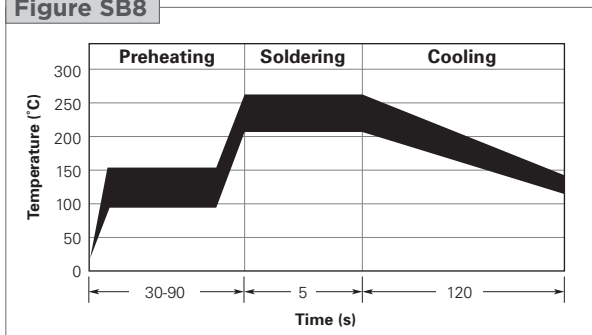
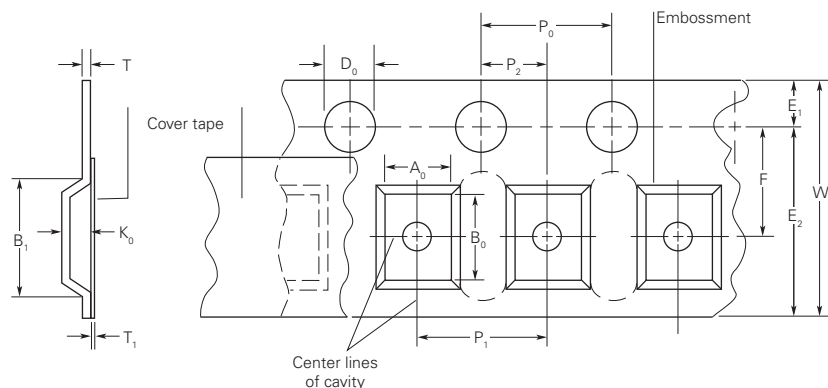


Table SB8 EIA Tape and Reel Specifications for SiBar Thyristor Surge Protectors

SiBar thyristors are supplied on tape and reel per EIA481-1 standard. (See Figure SB9 and SB10 for details.)

Description	TVB Series		TVA Series	
	Dimensions (mm)	Tolerance (mm)	Dimensions (mm)	Tolerance (mm)
W	12	+/- 0.30	12	+/- 0.3
P <sub>0</sub>	4.0	+/- 0.10	4.0	+/- 0.10
P <sub>1</sub>	8.0	+/- 0.10	8.0	+/- 0.10
P <sub>2</sub>	2.0	+/- 0.10	2.0	+/- 0.10
A <sub>0</sub>	4.3	—	2.9	+/- 0.10
B <sub>0</sub>	6.2	—	5.59	+/- 0.10
B <sub>1</sub> max.	8.2	—	8.2	—
D <sub>0</sub>	1.5	+ 0.1, -0.0	1.5	+ 0.1, -0
F	5.5	+/- 0.05	5.5	+/- 0.05
E <sub>1</sub>	1.75	+/- 0.10	1.75	+/- 0.10
E <sub>2</sub> min.	9.85	—	9.85	—
T max.	0.6	—	0.6	—
T <sub>1</sub> max.	0.1	—	0.1	—
K <sub>0</sub> max.	2.59	+/- 0.10	2.36	+/- 0.10
Leader min.	390	—	390	—
Trailer min.	160	—	160	—

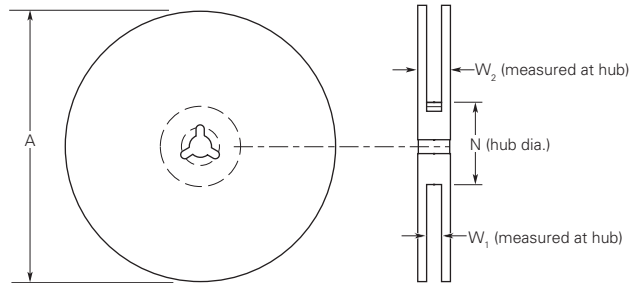
Figure SB9 EIA Referenced Taped Component Dimensions for SiBar Thyristor Surge Protectors



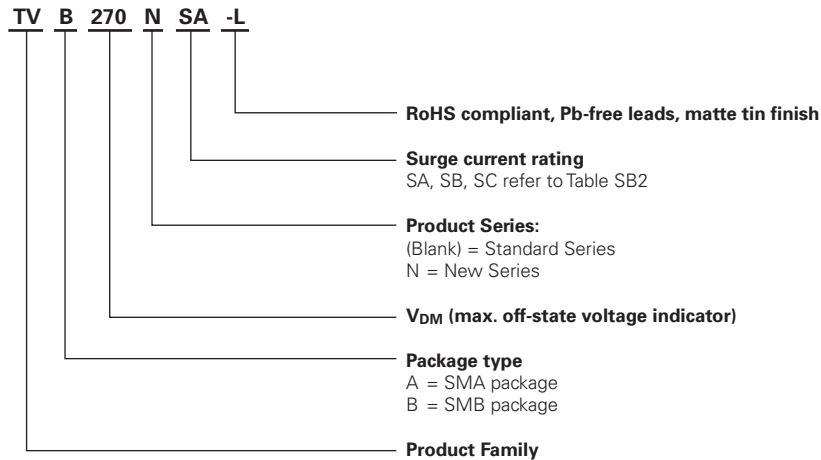
**Figure SB10 EIA Referenced Reel Dimensions for SiBar Thyristor Surge Protectors**

**Reel Dimension**

A max.	330
N min.	50
W <sub>1</sub>	12.4 + 2.0, -0
W <sub>2</sub> max.	18.4

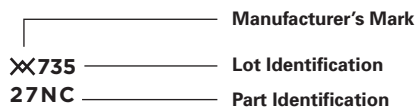


**Part Numbering System for SiBar Thyristor Surge Protectors**



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**Marking Reference Guide - Example**



**Warning :**

- Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- The devices are intended for protection against damage caused by occasional overvoltage fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, and mechanical procedures for electronic components.

