BRD8009/D
Rev. 1, Apr-2001

Transient Voltage Suppression Devices

ON Semiconductor™

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BRD8009/D
Rev. 1, Apr–2001

ON Semiconductor™

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150	5.6 V–33 V	SC–59, C = 280 pF, Quad Diode	MMQA	–
400	5 V–78 V	SMA	1SMA5.0A	55
400	10 V–78 V	SMA (Bidirectional)	1SMA10CA	58
600	5 V–170 V	SMB	1SMB5.0A	61
600	10 V–78 V	SMB (Bidirectional)	1SMB10CA	67
600	5.8 V–171 V	SMB	P6SMB6.8A	72
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1500	5.8 V–77.8 V	SMC	1.5SMC6.8A	82
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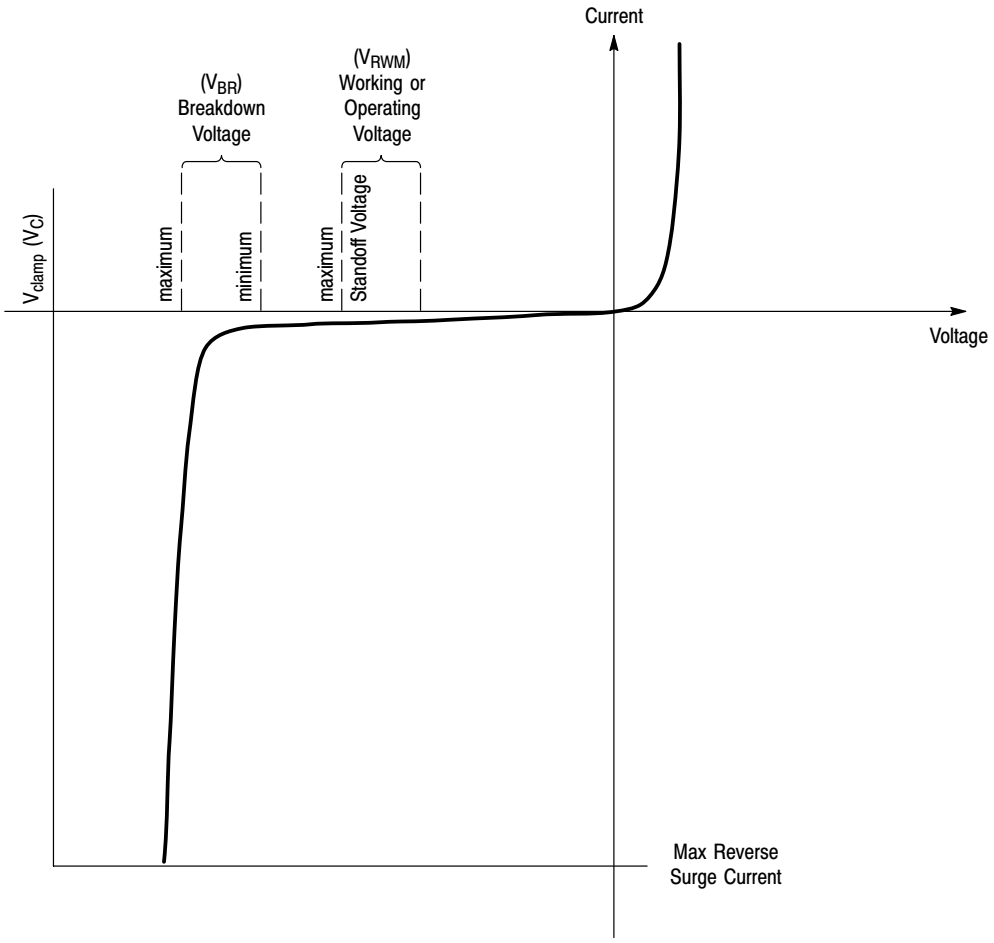
*Nominal Breakdown Voltage

TVS Definition of Voltage Terms



Custom TVS Designs

For large volume specials, ON Semiconductors has design capability covering a wide range of voltage, capacitance, package, power surge, and transient surge.

Surge Specs

- IEC–4–2 Contact Discharge
- MIL STD 883 Method 3015–6 (Human Body Model)
- 10 μs/1000 μs Pulse
- 8 μs/20 μs Pulse

Capacitance Specs

Capacitance	Application
280 pF	Low Speed (RS 232)
90 pF	Medium Speed
5 pF	High Speed (USB, Fire Wire)

Voltage Specs

- 6 Volts–200 Volts

Discrete Packages from ON Semiconductor for TVS

SOD–323

SOD–123

SOT–23

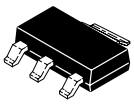
Micro–8

TSOP–6

SC–59

SC–70

SC–88/SOT–363 (5 or 6 Leads)



SOT–223

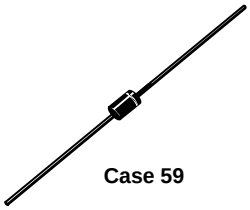
Powermite

SMA

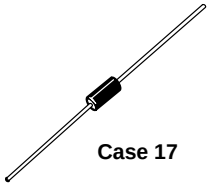
SMB

SMC

Axial Leaded Packages



Case 59



Case 17

Case 41A

SA5.0A Series

500 Watt Peak Power MiniMOSORB™ Zener Transient Voltage Suppressors

Unidirectional*

The SA5.0A series is designed to protect voltage sensitive components from high voltage, high energy transients. They have excellent clamping capability, high surge capability, low zener impedance and fast response time. The SA5.0A series is supplied in ON Semiconductor's exclusive, cost-effective, highly reliable Surmetic™ axial leaded package and is ideally-suited for use in communication systems, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/consumer applications.

Specification Features:

- Working Peak Reverse Voltage Range – 5 to 170 V
- Peak Power – 500 Watts @ 1 ms
- ESD Rating of Class 3 (>16 KV) per Human Body Model
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 1 μA above 8.5 V
- UL 497B for Isolated Loop Circuit Protection
- Maximum Temperature Coefficient Specified
- Response Time is typically < 1 ns

Mechanical Characteristics:

CASE: Void-free, Transfer-molded, Thermosetting plastic
FINISH: All external surfaces are corrosion resistant and leads are readily solderable
MAXIMUM LEAD TEMPERATURE FOR SOLDERING: 230°C, 1/16″ from the case for 10 seconds
POLARITY: Cathode indicated by polarity band.
MOUNTING POSITION: Any

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (Note 1.) @ $T_L \le 25°C$	P_{PK}	500	Watts
Steady State Power Dissipation @ $T_L \le 75°C$, Lead Length = 3/8″ Derated above $T_L = 75°C$	P_D	3.0 30	Watts mW/°C
Thermal Resistance, Junction–to–Lead	$R_{\theta JL}$	33.3	°C/W
Forward Surge Current (Note 2.) @ $T_A = 25°C$	I_{FSM}	70	Amps
Operating and Storage Temperature Range	T_J, T_{stg}	– 55 to +175	°C

1. Nonrepetitive current pulse per Figure 4 and derated above $T_A = 25°C$ per Figure 2.
2. 1/2 sine wave (or equivalent square wave), PW = 8.3 ms, duty cycle = 4 pulses per minute

*Please see SA5.0CA – SA170CA for Bidirectional devices.

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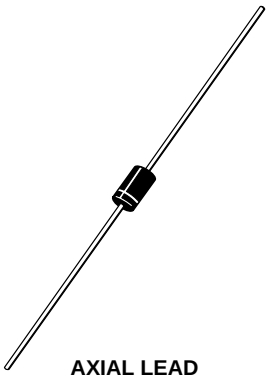
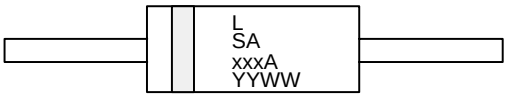


AXIAL LEAD
CASE 59
PLASTIC



L = Assembly Location
SAxxxA = ON Device Code
YY = Year
WW = Work Week

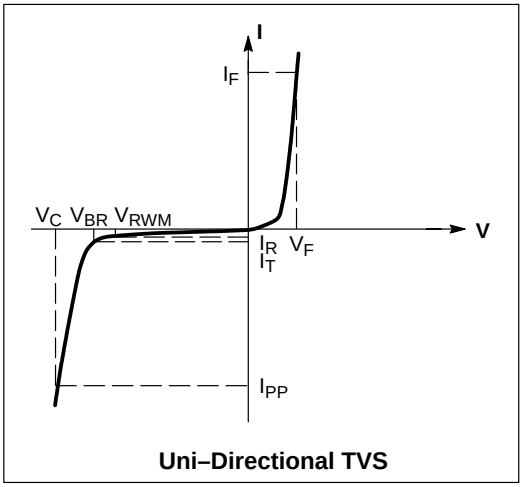
ORDERING INFORMATION

Device	Package	Shipping
SAxxxA	Axial Lead	1000 Units/Box
SAxxxARL	Axial Lead	5000/Tape & Reel

Devices listed in ***bold, italic*** are ON Semiconductor **Preferred** devices. **Preferred** devices are recommended choices for future use and best overall value.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted, V_F = 3.5 V Max. @ I_F (Note 6.) = 35 A)

Symbol	Parameter
I_{PP}	Maximum Reverse Peak Pulse Current
V_C	Clamping Voltage @ I_{PP}
V_{RWM}	Working Peak Reverse Voltage
I_R	Maximum Reverse Leakage Current @ V_{RWM}
V_{BR}	Breakdown Voltage @ I_T
I_T	Test Current
ΘV_{BR}	Maximum Temperature Variation of V_{BR}
I_F	Forward Current
V_F	Forward Voltage @ I_F



Uni–Directional TVS

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted, V_F = 3.5 V Max. @ I_F (Note 6.) = 35 A)

Device	Device Marking	V_{RWM} (Note 3.)	I_R @ V_{RWM}	Breakdown Voltage V_{BR} (Note 4.) (Volts)			@ I_T	V_C @ I_{PP} (Note 5.) V_C	I_{PP}	ΘV_{BR}
		Volts	μA	Min	Nom	Max	mA	Volts	A	mV/°C
SA5.0A	SA5.0A	5	600	6.4	6.7	7	10	9.2	54.3	5
SA6.0A	SA6.0A	6	600	6.67	7.02	7.37	10	10.3	48.5	5
SA7.0A	SA7.0A	7	150	7.78	8.19	8.6	10	12	41.7	6
SA7.5A	SA7.5A	7.5	50	8.33	8.77	9.21	1	12.9	38.8	7
SA8.0A	SA8.0A	8	25	8.89	9.36	9.83	1	13.6	36.7	7
SA8.5A	SA8.5A	8.5	5	9.44	9.92	10.4	1	14.4	34.7	8
SA9.0A	SA9.0A	9	1	10	10.55	11.1	1	15.4	32.5	9
SA10A	SA10A	10	1	11.1	11.7	12.3	1	17	29.4	10
SA11A	***SA11A***	***11***	***1***	***12.2***	***12.85***	***13.5***	***1***	***18.2***	***27.4***	***11***
SA12A	SA12A	12	1	13.3	14	14.7	1	19.9	25.1	12
SA13A	SA13A	13	1	14.4	15.15	15.9	1	21.5	23.2	13
SA14A	SA14A	14	1	15.6	16.4	17.2	1	23.2	21.5	14
SA15A	SA15A	15	1	16.7	17.6	18.5	1	24.4	20.6	16
SA16A	SA16A	16	1	17.8	18.75	19.7	1	26	19.2	17
SA17A	SA17A	17	1	18.9	19.9	20.9	1	27.6	18.1	19
SA18A	SA18A	18	1	20	21.05	22.1	1	29.2	17.2	20
SA20A	SA20A	20	1	22.2	23.35	24.5	1	32.4	15.4	23
SA22A	SA22A	22	1	24.4	25.65	26.9	1	35.5	14.1	25
SA24A	SA24A	24	1	26.7	28.1	29.5	1	38.9	12.8	28
SA26A	SA26A	26	1	28.9	30.4	31.9	1	42.1	11.9	30
SA28A	SA28A	28	1	31.1	32.75	34.4	1	45.4	11	31
SA30A	SA30A	30	1	33.3	35.05	36.8	1	48.4	10.3	36
SA33A	SA33A	33	1	36.7	38.65	40.6	1	53.3	9.4	39
SA36A	SA36A	36	1	40	42.1	44.2	1	58.1	8.6	41
SA40A	SA40A	40	1	44.4	46.55	49.1	1	64.5	7.8	46
SA43A	SA43A	43	1	47.8	50.3	52.8	1	69.4	7.2	50
SA45A	SA45A	45	1	50	52.65	55.3	1	72.7	6.9	52
SA48A	SA48A	48	1	53.3	56.1	58.9	1	77.4	6.5	56
SA51A	SA51A	51	1	56.7	59.7	62.7	1	82.4	6.1	61
SA58A	SA58A	58	1	64.4	67.8	71.2	1	93.6	5.3	70
SA60A	SA60A	60	1	66.7	70.2	73.7	1	96.8	5.2	71
SA64A	SA64A	64	1	71.1	74.85	78.6	1	103	4.9	76
SA70A	SA70A	70	1	77.8	81.9	86	1	113	4.4	85
SA78A	SA78A	78	1	86.7	91.25	95.8	1	126	4.0	95
SA90A	***SA90A***	***90***	***1***	***100***	***105.5***	***111***	***1***	***146***	***3.4***	***110***
SA100A	SA100A	100	1	111	117	123	1	162	3.1	123
SA110A	SA110A	110	1	122	128.5	135	1	177	2.8	133
SA120A	SA120A	120	1	133	140	147	1	193	2.5	146
SA130A	SA130A	130	1	144	151.5	159	1	209	2.4	158
SA150A	SA150A	150	1	167	176	185	1	243	2.1	184
SA160A	SA160A	160	1	178	187.5	197	1	259	1.9	196
SA170A	SA170A	170	1	189	199	209	1	275	1.8	208

NOTES:

3. MiniMOSORB™ transients suppressor is normally selected according to the maximum working peak reverse voltage (V_{RWM}), which should be equal to or greater than the dc or continuous peak operating voltage level.
4. V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C.
5. Surge current waveform per Figure 4 and derate per Figures 1 and 2.
6. 1/2 sine wave (or equivalent square wave), PW = 8.3 ms, duty cycle = 4 pulses per minute

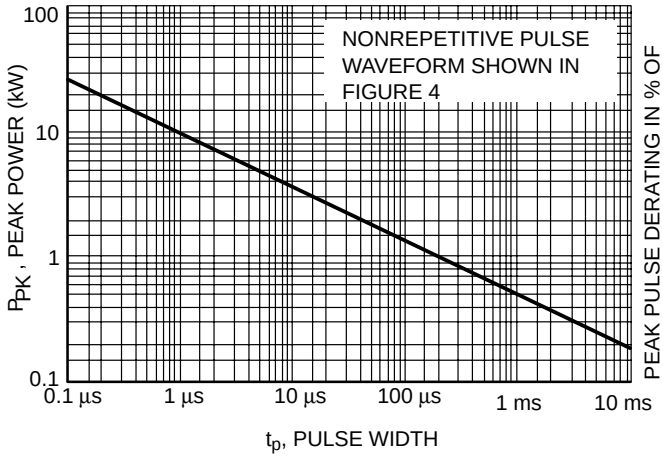


Figure 1. Pulse Rating Curve

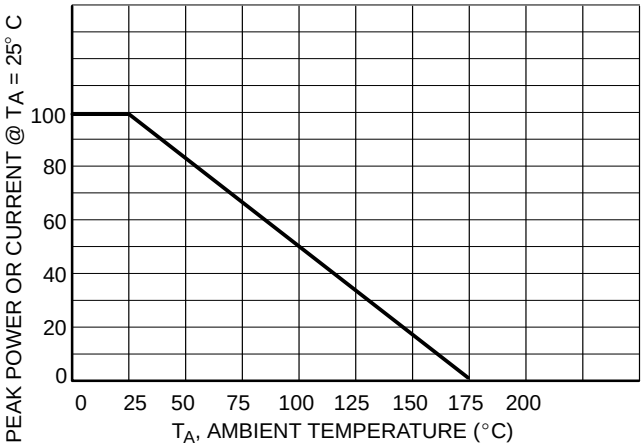


Figure 2. Pulse Derating Curve

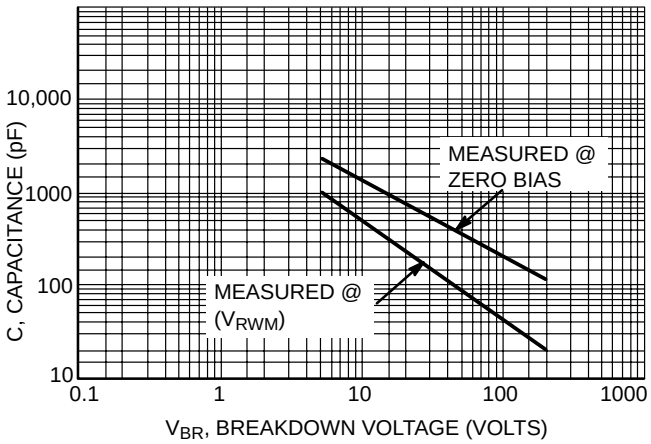


Figure 3. Capacitance versus Breakdown Voltage

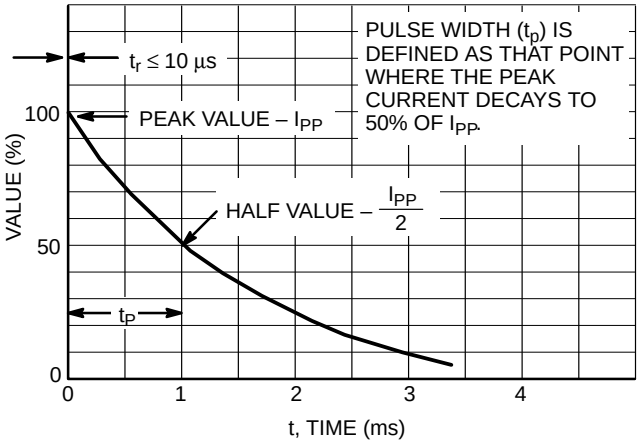


Figure 4. Pulse Waveform

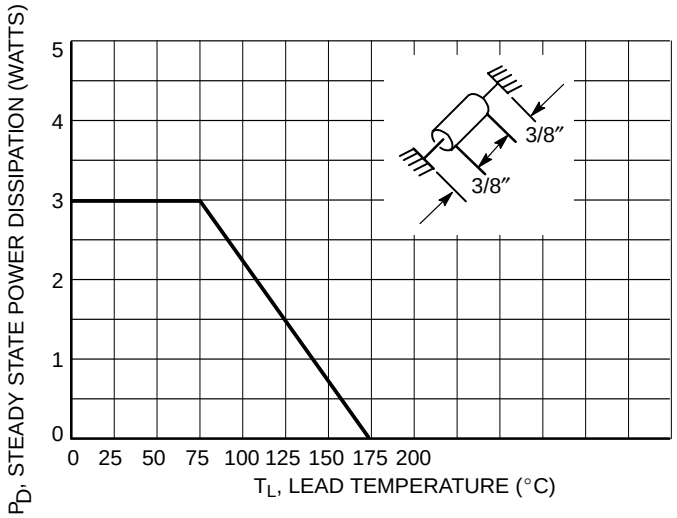


Figure 5. Steady State Power Derating

UL RECOGNITION*

The entire series including the bidirectional CA suffix has *Underwriters Laboratory Recognition* for the classification of protectors (QVGV2) under the UL standard for safety 497B and File #E 116110. Many competitors only have one or two devices recognized or have recognition in a non-protective category. Some competitors have no recognition at all. With the UL497B recognition, our parts successfully passed several tests including Strike Voltage Breakdown test, Endurance Conditioning, Temperature test, Dielectric Voltage-Withstand test, Discharge test and several more.

Whereas, some competitors have only passed a flammability test for the package material, we have been recognized for much more to be included in their protector category.

*Applies to SA5.0A, CA – SA170A, CA.

SA5.0CA Series

500 Watt Peak Power MiniMOSORB™ Zener Transient Voltage Suppressors

Bidirectional*

The SA5.0CA series is designed to protect voltage sensitive components from high voltage, high–energy transients. They have excellent clamping capability, high surge capability, low zener impedance and fast response time. The SA5.0CA series is supplied in ON Semiconductor's exclusive, cost-effective, highly reliable Surmetic™ axial leaded package and is ideally-suited for use in communication systems, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/consumer applications.

Specification Features:

- Working Peak Reverse Voltage Range – 5.0 to 170 V
- Peak Power – 500 Watts @ 1 ms
- ESD Rating of Class 3 (>16 KV) per Human Body Model
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 1 μA above 8.5 V
- UL 497B for Isolated Loop Circuit Protection
- Maximum Temperature Coefficient Specified
- Response Time is typically < 1 ns

Mechanical Characteristics:

CASE: Void-free, Transfer-molded, Thermosetting plastic
FINISH: All external surfaces are corrosion resistant and leads are readily solderable
MAXIMUM LEAD TEMPERATURE FOR SOLDERING PURPOSES: 230°C, 1/16″ from the case for 10 seconds
POLARITY: Cathode band does not imply polarity
MOUNTING POSITION: Any

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (Note 1.) @ $T_L \le 25°C$	P_{PK}	500	Watts
Steady State Power Dissipation @ $T_L \le 75°C$, Lead Length = 3/8″ Derated above $T_L = 75°C$	P_D	3.0 30	Watts mW/°C
Thermal Resistance, Junction–to–Lead	$R_{\theta JL}$	33.3	°C/W
Operating and Storage Temperature Range	T_J, T_{stg}	– 55 to +175	°C

1. Nonrepetitive current pulse per Figure 3 and derated above $T_A = 25°C$ per Figure 2.

*Please see SA5.0A to SA170A for Unidirectional devices.

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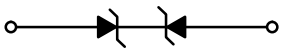
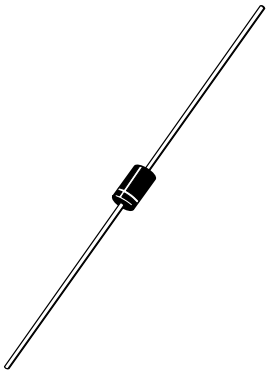
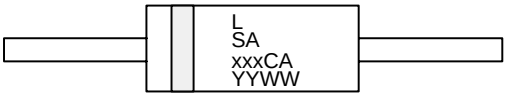




AXIAL LEAD
CASE 59
PLASTIC



L = Assembly Location
SAxxxCA = ON Device Code
YY = Year
WW = Work Week

ORDERING INFORMATION

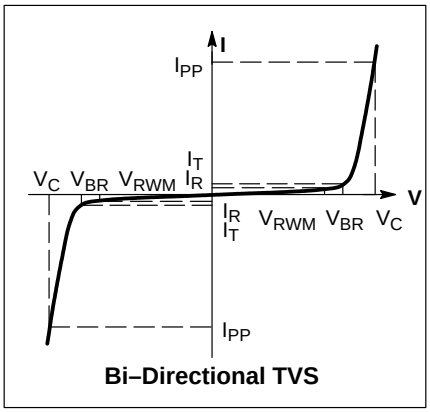
Device	Package	Shipping
SAxxxCA	Axial Lead	1000 Units/Box
SAxxxCARL	Axial Lead	5000/Tape & Reel

Devices listed in ***bold, italic*** are ON Semiconductor **Preferred** devices. **Preferred** devices are recommended choices for future use and best overall value.

ELECTRICAL CHARACTERISTICS

(T_A = 25°C unless otherwise noted)

Symbol	Parameter
I_{PP}	Maximum Reverse Peak Pulse Current
V_C	Clamping Voltage @ I_{PP}
V_{RWM}	Working Peak Reverse Voltage
I_R	Maximum Reverse Leakage Current @ V_{RWM}
V_{BR}	Breakdown Voltage @ I_T
I_T	Test Current
ΘV_{BR}	Maximum Temperature Variation of V_{BR}



Bi–Directional TVS

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Device	Device Marking	V_{RWM} (Note 2.)	I_R @ V_{RWM}	Breakdown Voltage				V_C @ I_{PP} (Note 4.)		ΘV_{BR}
				V_{BR} (Note 3.) (Volts)			@ I_T	V_C	I_{PP}	
		(Volts)	(μA)	Min	Nom	Max	(mA)	(Volts)	(A)	(mV/°C)
SA5.0CA	SA5.0CA	5	600	6.4	6.7	7	10	9.2	54.3	5
SA6.0CA	SA6.0CA	6	600	6.67	7.02	7.37	10	10.3	48.5	5
SA6.5CA	***SA6.5CA***	***6.5***	***400***	***7.22***	***7.60***	***7.98***	***10***	***11.2***	***44.7***	***5***
SA7.0CA	SA7.0CA	7	150	7.78	8.19	8.6	10	12	41.7	6
SA7.5CA	SA7.5CA	7.5	50	8.33	8.77	9.21	1	12.9	38.8	7
SA8.0CA	SA8.0CA	8	25	8.89	9.36	9.83	1	13.6	36.7	7
SA8.5CA	SA8.5CA	8.5	5	9.44	9.92	10.4	1	14.4	34.7	8
SA9.0CA	SA9.0CA	9	1	10	10.55	11.1	1	15.4	32.5	9
SA10CA	SA10CA	10	1	11.1	11.7	12.3	1	17	29.4	10
SA11CA	SA11CA	11	1	12.2	12.85	13.5	1	18.2	27.4	11
SA12CA	***SA12CA***	***12***	***1***	***13.3***	***14***	***14.7***	***1***	***19.9***	***25.1***	***12***
SA13CA	***SA13CA***	***13***	***1***	***14.4***	***15.15***	***15.9***	***1***	***21.5***	***23.2***	***13***
SA14CA	SA14CA	14	1	15.6	16.4	17.2	1	23.2	21.5	14
SA15CA	***SA15CA***	***15***	***1***	***16.7***	***17.6***	***18.5***	***1***	***24.4***	***20.6***	***16***
SA16CA	SA16CA	16	1	17.8	18.75	19.7	1	26	19.2	17
SA17CA	SA17CA	17	1	18.9	19.9	20.9	1	27.6	18.1	19
SA18CA	***SA18CA***	***18***	***1***	***20***	***21.05***	***22.1***	***1***	***29.2***	***17.2***	***20***
SA20CA	SA20CA	20	1	22.2	23.35	24.5	1	32.4	15.4	23
SA22CA	SA22CA	22	1	24.4	25.65	26.9	1	35.5	14.1	25
SA24CA	***SA24CA***	***24***	***1***	***26.7***	***28.1***	***29.5***	***1***	***38.9***	***12.8***	***28***
SA26CA	SA26CA	26	1	28.9	30.4	31.9	1	42.1	11.9	30
SA28CA	SA28CA	28	1	31.1	32.75	34.4	1	454	11	31
SA30CA	SA30CA	30	1	33.3	35.05	36.8	1	48.4	10.3	36
SA33CA	SA33CA	33	1	36.7	38.65	40.6	1	53.3	9.4	39
SA36CA	SA36CA	36	1	40	42.1	44.2	1	58.1	8.6	41
SA40CA	SA40CA	40	1	44.4	46.55	49.1	1	64.5	7.8	46
SA43CA	SA43CA	43	1	47.8	50.3	52.8	1	69.4	7.2	50
SA45CA	SA45CA	45	1	50	52.65	55.3	1	72.7	6.9	52
SA48CA	SA48CA	48	1	53.3	56.1	58.9	1	77.4	6.5	56
SA51CA	SA51CA	51	1	56.7	59.7	62.7	1	82.4	6.1	61
SA58CA	SA58CA	58	1	64.4	67.8	71.2	1	93.6	5.3	70
SA60CA	SA60CA	60	1	66.7	70.2	73.7	1	96.8	5.2	71

NOTES:

2. MiniMOSORB™ transient suppressors are normally selected according to the maximum working peak reverse voltage (V_{RWM}), which should be equal to or greater than the dc or continuous peak operating voltage level.
3. V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C.
4. Surge current waveform per Figure 3 and derate per Figures 1 and 2.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Device	Device Marking	V_{RWM} (Note 2.)	I_R @ V_{RWM}	Breakdown Voltage				V_C @ I_{PP} (Note 4.)		ΘV_{BR}
				V_{BR} (Note 3.) (Volts)			@ I_T	V_C	I_{PP}	
		(Volts)	(μA)	Min	Nom	Max	(mA)	(Volts)	(A)	(mV/°C)
SA64CA	SA64CA	64	1	71.1	74.85	78.6	1	103	4.9	76
SA70CA	SA70CA	70	1	77.8	81.9	86	1	113	4.4	85
SA78CA	SA78CA	78	1	86.7	91.25	95.8	1	126	4.0	95
SA85CA	SA85CA	85	1	94.4	99.2	104	1	137	3.6	103
SA90CA	SA90CA	90	1	100	105.5	111	1	146	3.4	110
SA100CA	SA100CA	100	1	111	117	123	1	162	3.1	123
SA110CA	SA110CA	110	1	122	128.5	135	1	177	2.8	133
SA120CA	SA120CA	120	1	133	140	147	1	193	2.5	146
SA130CA	SA130CA	130	1	144	151.5	159	1	209	2.4	158
SA150CA	SA150CA	150	1	167	176	185	1	243	2.1	184
SA160CA	SA160CA	160	1	178	187.5	197	1	259	1.9	196
SA170CA	SA170CA	170	1	189	199	209	1	275	1.8	208

NOTES:

2. MiniMOSORB™ transient suppressors are normally selected according to the maximum working peak reverse voltage (V_{RWM}), which should be equal to or greater than the dc or continuous peak operating voltage level.
3. V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C.
4. Surge current waveform per Figure 3 and derate per Figures 1 and 2.

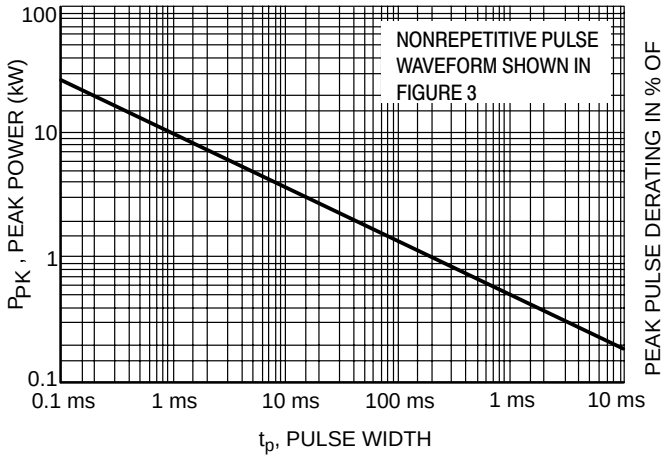


Figure 1. Pulse Rating Curve

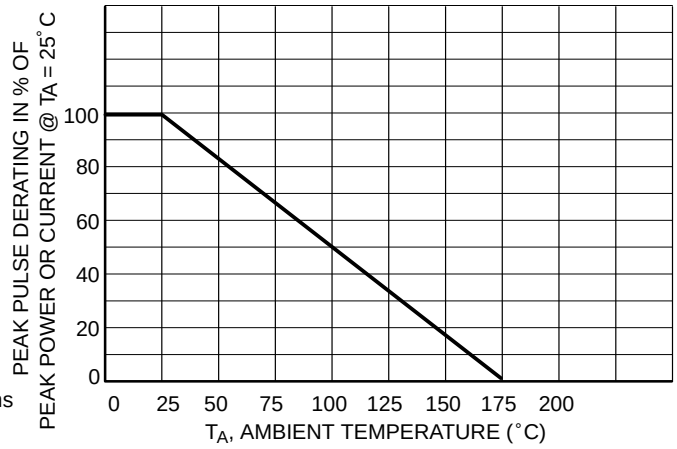


Figure 2. Pulse Derating Curve

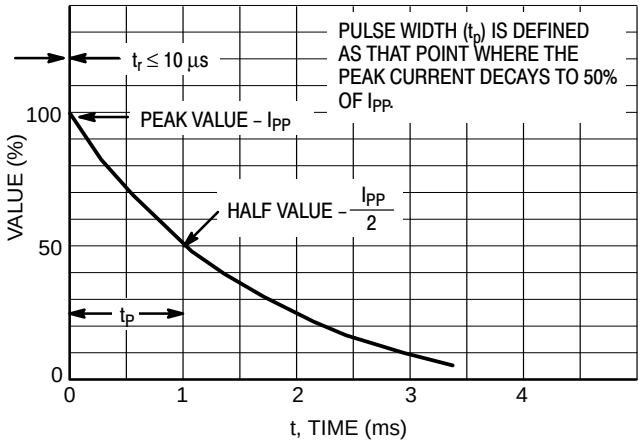


Figure 3. Pulse Waveform

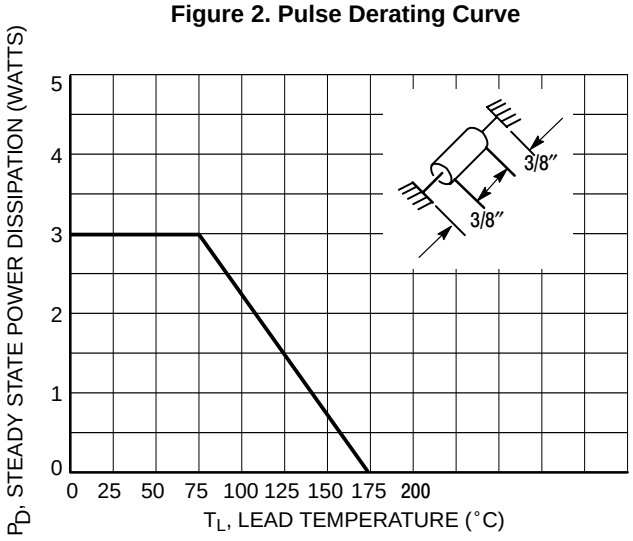


Figure 4. Steady State Power Derating

UL RECOGNITION*

The entire series including the bidirectional CA suffix has *Underwriters Laboratory Recognition* for the classification of protectors (QVGV2) under the UL standard for safety 497B and File #E 116110. Many competitors only have one or two devices recognized or have recognition in a non-protective category. Some competitors have no recognition at all. With the UL497B recognition, our parts successfully passed several tests including Strike Voltage Breakdown test, Endurance Conditioning, Temperature test, Dielectric Voltage-Withstand test, Discharge test and several more.

Whereas, some competitors have only passed a flammability test for the package material, we have been recognized for much more to be included in their protector category.

*Applies to SA5.0A, CA – SA170A, CA.

P6KE6.8A Series

600 Watt Peak Power Surmetic™ -40 Zener Transient Voltage Suppressors

Unidirectional*

The P6KE6.8A series is designed to protect voltage sensitive components from high voltage, high energy transients. They have excellent clamping capability, high surge capability, low zener impedance and fast response time. These devices are ON Semiconductor's exclusive, cost-effective, highly reliable Surmetic™ axial leaded package and is ideally-suited for use in communication systems, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/consumer applications.

Specification Features:

- Working Peak Reverse Voltage Range – 5.8 to 171 V
- Peak Power – 600 Watts @ 1 ms
- ESD Rating of Class 3 (>16 KV) per Human Body Model
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5 μA above 10 V
- Maximum Temperature Coefficient Specified
- UL 497B for Isolated Loop Circuit Protection
- Response Time is typically < 1 ns

Mechanical Characteristics:
CASE: Void-free, Transfer-molded, Thermosetting plastic
FINISH: All external surfaces are corrosion resistant and leads are readily solderable
MAXIMUM LEAD TEMPERATURE FOR SOLDERING:
230°C, 1/16″ from the case for 10 seconds
POLARITY: Cathode indicated by polarity band
MOUNTING POSITION: Any

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (Note 1.) @ $T_L \le 25°C$	P_{PK}	600	Watts
Steady State Power Dissipation @ $T_L \le 75°C$, Lead Length = 3/8″ Derated above $T_L = 75°C$	P_D	5.0 50	Watts mW/°C
Thermal Resistance, Junction–to–Lead	$R_{\theta JL}$	15	°C/W
Forward Surge Current (Note 2.) @ $T_A = 25°C$	I_{FSM}	100	Amps
Operating and Storage Temperature Range	T_J, T_{stg}	– 55 to +150	°C

1. Nonrepetitive current pulse per Figure 4 and derated above $T_A = 25°C$ per Figure 2.
2. 1/2 sine wave (or equivalent square wave), PW = 8.3 ms, duty cycle = 4 pulses per minute maximum.

*Please see P6KE6.8CA – P6KE200CA for Bidirectional devices.

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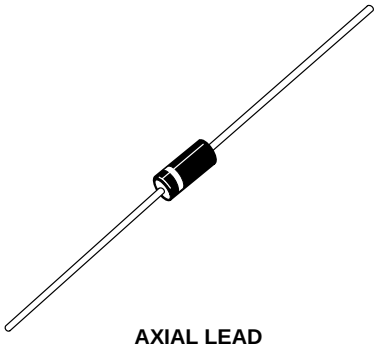


AXIAL LEAD
CASE 17
STYLE 1

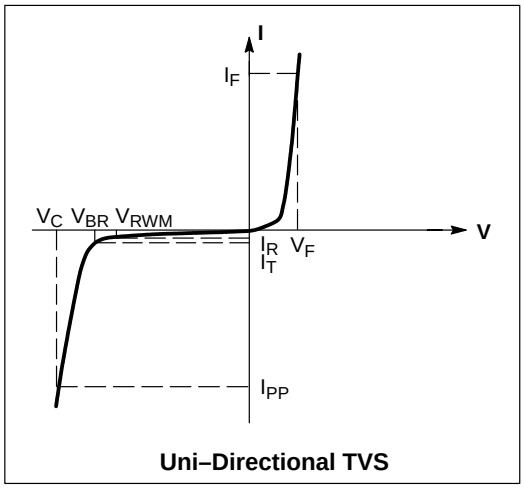
L = Assembly Location
P6KExxxA = ON Device Code
YY = Year
WW = Work Week

ORDERING INFORMATION

Device	Package	Shipping
P6KExxxA	Axial Lead	1000 Units/Box
P6KExxxARL	Axial Lead	4000/Tape & Reel

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted, V_F = 3.5 V Max. @ I_F (Note 6.) = 50 A)

Symbol	Parameter
I_{PP}	Maximum Reverse Peak Pulse Current
V_C	Clamping Voltage @ I_{PP}
V_{RWM}	Working Peak Reverse Voltage
I_R	Maximum Reverse Leakage Current @ V_{RWM}
V_{BR}	Breakdown Voltage @ I_T
I_T	Test Current
ΘV_{BR}	Maximum Temperature Coefficient of V_{BR}
I_F	Forward Current
V_F	Forward Voltage @ I_F



Uni–Directional TVS

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted, V_F = 3.5 V Max. @ I_F (Note 6.) = 50 A)

Device	Device Marking	V_{RWM} (Note 3.)	I_R @ V_{RWM}	Breakdown Voltage				V_C @ I_{PP} (Note 5.)		ΘV_{BR}
				V_{BR} (Note 4.) (Volts)			@ I_T	V_C	I_{PP}	
		Volts	μA	Min	Nom	Max	mA	Volts	A	%/°C
P6KE6.8A	P6KE6.8A	5.8	1000	6.45	6.80	7.14	10	10.5	57	0.057
P6KE7.5A	P6KE7.5A	6.4	500	7.13	7.51	7.88	10	11.3	53	0.061
P6KE8.2A	P6KE8.2A	7.02	200	7.79	8.2	8.61	10	12.1	50	0.065
P6KE9.1A	P6KE9.1A	7.78	50	8.65	9.1	9.55	1	13.4	45	0.068
P6KE10A	P6KE10A	8.55	10	9.5	10	10.5	1	14.5	41	0.073
P6KE11A	P6KE11A	9.4	5	10.5	11.05	11.6	1	15.6	38	0.075
P6KE12A	P6KE12A	10.2	5	11.4	12	12.6	1	16.7	36	0.078
P6KE13A	P6KE13A	11.1	5	12.4	13.05	13.7	1	18.2	33	0.081
P6KE15A	P6KE15A	12.8	5	14.3	15.05	15.8	1	21.2	28	0.084
P6KE16A	P6KE16A	13.6	5	15.2	16	16.8	1	22.5	27	0.086
P6KE18A	P6KE18A	15.3	5	17.1	18	18.9	1	25.2	24	0.088
P6KE20A	P6KE20A	17.1	5	19	20	21	1	27.7	22	0.09
P6KE22A	P6KE22A	18.8	5	20.9	22	23.1	1	30.6	20	0.092
P6KE24A	P6KE24A	20.5	5	22.8	24	25.2	1	33.2	18	0.094
P6KE27A	P6KE27A	23.1	5	25.7	27.05	28.4	1	37.5	16	0.096
P6KE30A	P6KE30A	25.6	5	28.5	30	31.5	1	41.4	14.4	0.097
P6KE33A	P6KE33A	28.2	5	31.4	33.05	34.7	1	45.7	13.2	0.098
P6KE36A	P6KE36A	30.8	5	34.2	36	37.8	1	49.9	12	0.099
P6KE39A	P6KE39A	33.3	5	37.1	39.05	41	1	53.9	11.2	0.1
P6KE43A	P6KE43A	36.8	5	40.9	43.05	45.2	1	59.3	10.1	0.101
P6KE47A	P6KE47A	40.2	5	44.7	47.05	49.4	1	64.8	9.3	0.101
P6KE51A	P6KE51A	43.6	5	48.5	51.05	53.6	1	70.1	8.6	0.102
P6KE56A	P6KE56A	47.8	5	53.2	56	58.8	1	77	7.8	0.103
P6KE62A	P6KE62A	53	5	58.9	62	65.1	1	85	7.1	0.104
P6KE68A	P6KE68A	58.1	5	64.6	68	71.4	1	92	6.5	0.104
P6KE75A	P6KE75A	64.1	5	71.3	75.05	78.8	1	103	5.8	0.105
P6KE82A	P6KE82A	70.1	5	77.9	82	86.1	1	113	5.3	0.105
P6KE91A	P6KE91A	77.8	5	86.5	91	95.5	1	125	4.8	0.106
P6KE100A	P6KE100A	85.5	5	95	100	105	1	137	4.4	0.106
P6KE110A	P6KE110A	94	5	105	110.5	116	1	152	4	0.107
P6KE120A	P6KE120A	102	5	114	120	126	1	165	3.6	0.107
P6KE130A	P6KE130A	111	5	124	130.5	137	1	179	3.3	0.107
P6KE150A	P6KE150A	128	5	143	150.5	158	1	207	2.9	0.108
P6KE160A	P6KE160A	136	5	152	160	168	1	219	2.7	0.108
P6KE170A	P6KE170A	145	5	162	170.5	179	1	234	2.6	0.108
P6KE180A	P6KE180A	154	5	171	180	189	1	246	2.4	0.108
P6KE200A	P6KE200A	171	5	190	200	210	1	274	2.2	0.108

3. A transient suppressor is normally selected according to the maximum working peak reverse voltage (V_{RWM}), which should be equal to or greater than the dc or continuous peak operating voltage level.
4. V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C
5. Surge current waveform per Figure 4 and derate per Figures 1 and 2.
6. 1/2 sine wave (or equivalent square wave), PW = 8.3 ms, duty cycle = 4 pulses per minute maximum.

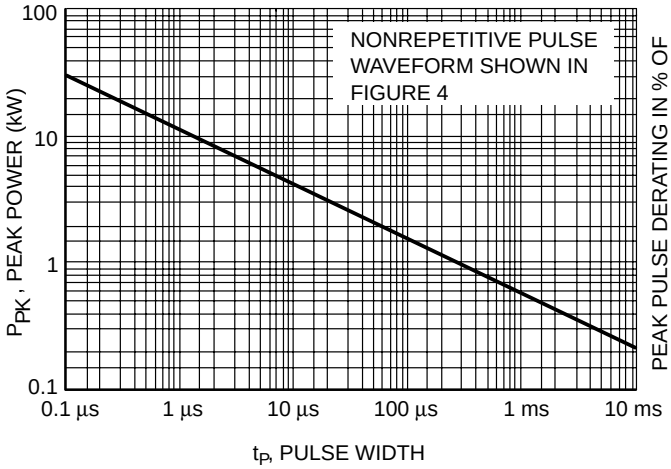


Figure 1. Pulse Rating Curve

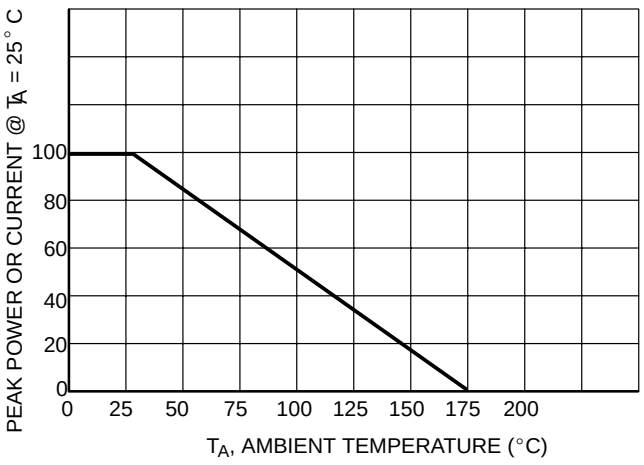


Figure 2. Pulse Derating Curve

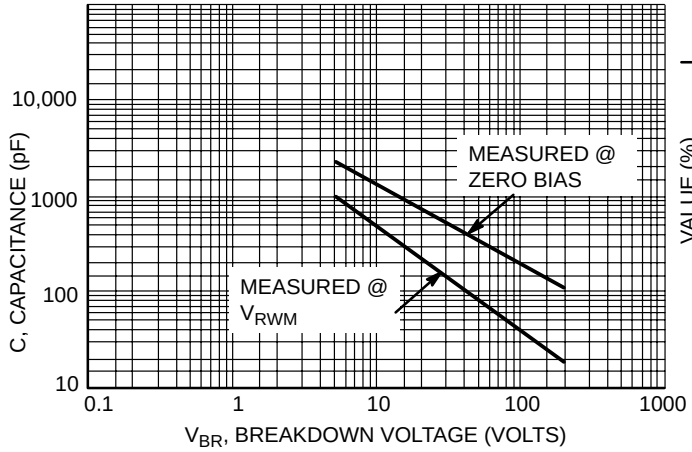


Figure 3. Capacitance versus Breakdown Voltage

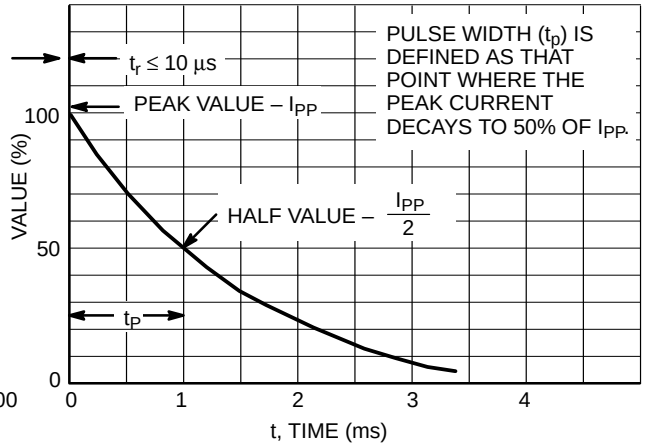


Figure 4. Pulse Waveform

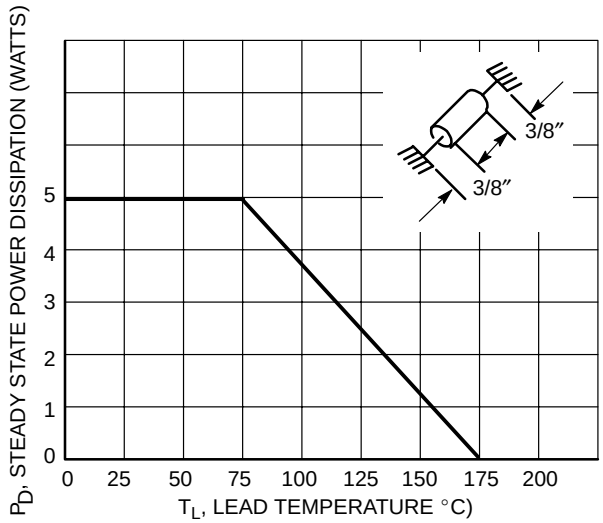


Figure 5. Steady State Power Derating

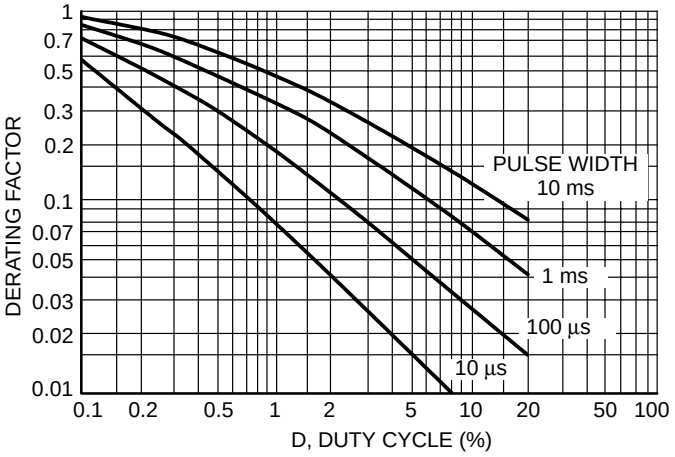


Figure 6. Typical Derating Factor for Duty Cycle

APPLICATION NOTES

RESPONSE TIME

In most applications, the transient suppressor device is placed in parallel with the equipment or component to be protected. In this situation, there is a time delay associated with the capacitance of the device and an overshoot condition associated with the inductance of the device and the inductance of the connection method. The capacitance effect is of minor importance in the parallel protection scheme because it only produces a time delay in the transition from the operating voltage to the clamp voltage as shown in Figure 7.

The inductive effects in the device are due to actual turn-on time (time required for the device to go from zero current to full current) and lead inductance. This inductive effect produces an overshoot in the voltage across the equipment or component being protected as shown in Figure 8. Minimizing this overshoot is very important in the application, since the main purpose for adding a transient suppressor is to clamp voltage spikes. The P6KE6.8A series has very good response time, typically < 1 ns and negligible inductance. However, external inductive effects could produce unacceptable overshoot. Proper circuit layout, minimum lead lengths and placing the suppressor device as close as possible to the equipment or components to be protected will minimize this overshoot.

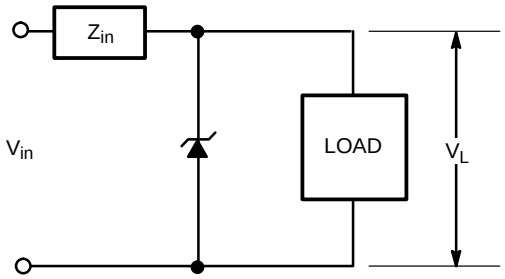
Some input impedance represented by Z_{in} is essential to prevent overstress of the protection device. This impedance should be as high as possible, without restricting the circuit operation.

DUTY CYCLE DERATING

The data of Figure 1 applies for non-repetitive conditions and at a lead temperature of 25°C. If the duty cycle increases, the peak power must be reduced as indicated by the curves of Figure 6. Average power must be derated as the lead or ambient temperature rises above 25°C. The average power derating curve normally given on data sheets may be normalized and used for this purpose.

At first glance the derating curves of Figure 6 appear to be in error as the 10 ms pulse has a higher derating factor than the 10 μs pulse. However, when the derating factor for a given pulse of Figure 6 is multiplied by the peak power value of Figure 1 for the same pulse, the results follow the expected trend.

TYPICAL PROTECTION CIRCUIT



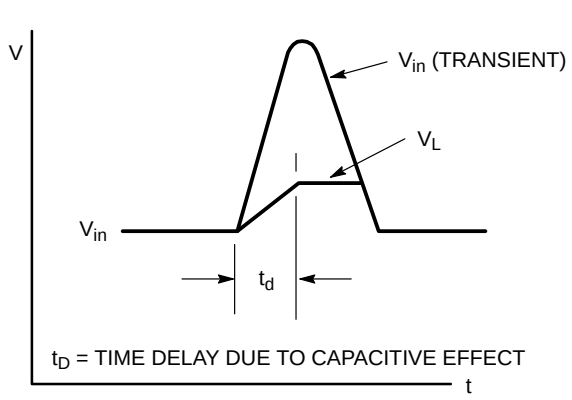


Figure 7.

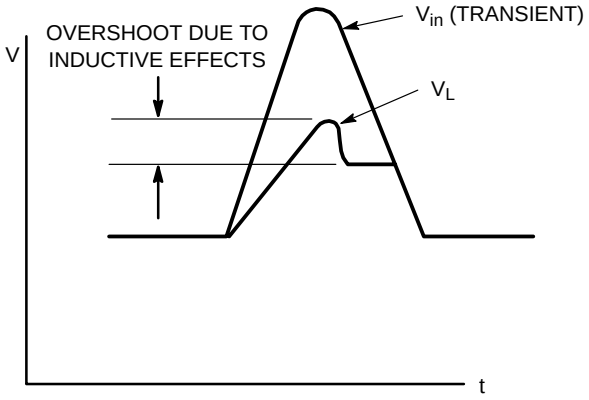


Figure 8.

UL RECOGNITION*

The entire series including the bidirectional CA suffix has *Underwriters Laboratory Recognition* for the classification of protectors (QVGV2) under the UL standard for safety 497B and File #E 116110. Many competitors only have one or two devices recognized or have recognition in a non-protective category. Some competitors have no recognition at all. With the UL497B recognition, our parts successfully passed several tests including Strike Voltage Breakdown test, Endurance Conditioning, Temperature test, Dielectric Voltage-Withstand test, Discharge test and several more.

Whereas, some competitors have only passed a flammability test for the package material, we have been recognized for much more to be included in their protector category.

*Applies to P6KE6.8A, CA – P6KE200A, CA.

P6KE6.8CA Series

600 Watt Peak Power Surmetic™ -40 Zener Transient Voltage Suppressors

Bidirectional*

The P6KE6.8CA series is designed to protect voltage sensitive components from high voltage, high energy transients. They have excellent clamping capability, high surge capability, low zener impedance and fast response time. These devices are ON Semiconductor's exclusive, cost-effective, highly reliable Surmetic axial leaded package and is ideally-suited for use in communication systems, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/consumer applications.

Specification Features:

- Working Peak Reverse Voltage Range – 5.8 to 171 V
- Peak Power – 600 Watts @ 1 ms
- ESD Rating of class 3 (>16 KV) per Human Body Model
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5 μA above 10 V
- Maximum Temperature Coefficient Specified
- UL 497B for Isolated Loop Circuit Protection
- Response Time is Typically < 1 ns

Mechanical Characteristics:

CASE: Void-free, Transfer-molded, Thermosetting plastic
FINISH: All external surfaces are corrosion resistant and leads are readily solderable
MAXIMUM LEAD TEMPERATURE FOR SOLDERING PURPOSES: 230°C, 1/16" from the case for 10 seconds
POLARITY: Cathode band does not imply polarity
MOUNTING POSITION: Any

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (Note 1.) @ $T_L \le 25°C$	P_{PK}	600	Watts
Steady State Power Dissipation @ $T_L \le 75°C$, Lead Length = 3/8″ Derated above $T_L = 75°C$	P_D	5 50	Watts mW/°C
Thermal Resistance, Junction–to–Lead	$R_{\theta JL}$	15	°C/W
Operating and Storage Temperature Range	T_J, T_{stg}	– 55 to +150	°C

1. Nonrepetitive current pulse per Figure 3 and derated above $T_A = 25°C$ per Figure 2.

*Please see P6KE6.8A – P6KE200A for Unidirectional devices.

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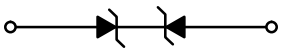


AXIAL LEAD
CASE 17
PLASTIC

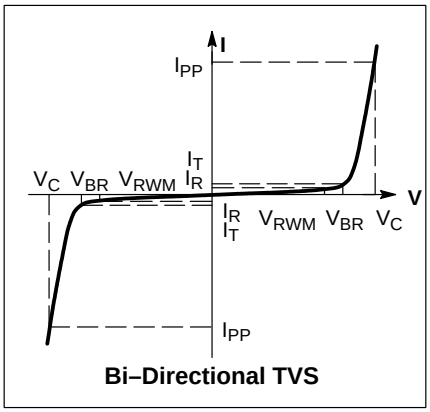
L = Assembly Location
P6KExxxCA = ON Device Code
YY = Year
WW = Work Week

ORDERING INFORMATION

Device	Package	Shipping
P6KExxxCA	Axial Lead	1000 Units/Box
P6KExxxCARL	Axial Lead	4000/Tape & Reel

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Parameter
I_{PP}	Maximum Reverse Peak Pulse Current
V_C	Clamping Voltage @ I_{PP}
V_{RWM}	Working Peak Reverse Voltage
I_R	Maximum Reverse Leakage Current @ V_{RWM}
V_{BR}	Breakdown Voltage @ I_T
I_T	Test Current
ΘV_{BR}	Maximum Temperature Variation of V_{BR}



Bi–Directional TVS

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Device	Device Marking	V_{RWM} (Note 2.)	I_R @ V_{RWM}	Breakdown Voltage				V_C @ I_{PP} (Note 4.)		ΘV_{BR}
				V_{BR} (Note 3.) (Volts)			@ I_T	V_C	I_{PP}	
		(Volts)	(μA)	Min	Nom	Max	(mA)	(Volts)	(A)	(%/°C)
P6KE6.8CA	P6KE6.8CA	5.8	1000	6.45	6.80	7.14	10	10.5	57	0.057
P6KE7.5CA	P6KE7.5CA	6.4	500	7.13	7.51	7.88	10	11.3	53	0.061
P6KE8.2CA	P6KE8.2CA	7.02	200	7.79	8.2	8.61	10	12.1	50	0.065
P6KE9.1CA	P6KE9.1CA	7.78	50	8.65	9.1	9.55	1	13.4	45	0.068
P6KE10CA	P6KE10CA	8.55	10	9.5	10	10.5	1	14.5	41	0.073
P6KE11CA	P6KE11CA	9.4	5	10.5	11.05	11.6	1	15.6	38	0.075
P6KE12CA	P6KE12CA	10.2	5	11.4	12	12.6	1	16.7	36	0.078
P6KE13CA	P6KE13CA	11.1	5	12.4	13.05	13.7	1	18.2	33	0.081
P6KE15CA	P6KE15CA	12.8	5	14.3	15.05	15.8	1	21.2	28	0.084
P6KE16CA	P6KE16CA	13.6	5	15.2	16	16.8	1	22.5	27	0.086
P6KE18CA	P6KE18CA	15.3	5	17.1	18	18.9	1	25.2	24	0.088
P6KE20CA	P6KE20CA	17.1	5	19	20	21	1	27.7	22	0.09
P6KE22CA	P6KE22CA	18.8	5	20.9	22	23.1	1	30.6	20	0.092
P6KE24CA	P6KE24CA	20.5	5	22.8	24	25.2	1	33.2	18	0.094
P6KE27CA	P6KE27CA	23.1	5	25.7	27.05	28.4	1	37.5	16	0.096
P6KE30CA	P6KE30CA	25.6	5	28.5	30	31.5	1	41.4	14.4	0.097
P6KE33CA	P6KE33CA	28.2	5	31.4	33.05	34.7	1	45.7	13.2	0.098
P6KE36CA	P6KE36CA	30.8	5	34.2	36	37.8	1	49.9	12	0.099
P6KE39CA	P6KE39CA	33.3	5	37.1	39.05	41	1	53.9	11.2	0.1
P6KE43CA	P6KE43CA	36.8	5	40.9	43.05	45.2	1	59.3	10.1	0.101
P6KE47CA	P6KE47CA	40.2	5	44.7	47.05	49.4	1	64.8	9.3	0.101
P6KE51CA	P6KE51CA	43.6	5	48.5	51.05	53.6	1	70.1	8.6	0.102
P6KE56CA	P6KE56CA	47.8	5	53.2	56	58.8	1	77	7.8	0.103
P6KE62CA	P6KE62CA	53	5	58.9	62	65.1	1	85	7.1	0.104
P6KE68CA	P6KE68CA	58.1	5	64.6	68	71.4	1	92	6.5	0.104
P6KE75CA	P6KE75CA	64.1	5	71.3	75.05	78.8	1	103	5.8	0.105
P6KE82CA	P6KE82CA	70.1	5	77.9	82	86.1	1	113	5.3	0.105
P6KE91CA	P6KE91CA	77.8	5	86.5	91	95.5	1	125	4.8	0.106
P6KE100CA	P6KE100CA	85.5	5	95	100	105	1	137	4.4	0.106
P6KE110CA	P6KE110CA	94	5	105	110.5	116	1	152	4	0.107
P6KE120CA	P6KE120CA	102	5	114	120	126	1	165	3.6	0.107
P6KE130CA	P6KE130CA	111	5	124	130.5	137	1	179	3.3	0.107
P6KE150CA	P6KE150CA	128	5	143	150.5	158	1	207	2.9	0.108
P6KE160CA	P6KE160CA	136	5	152	160	168	1	219	2.7	0.108
P6KE170CA	P6KE170CA	145	5	162	170.5	179	1	234	2.6	0.108
P6KE180CA	P6KE180CA	154	5	171	180	189	1	246	2.4	0.108
P6KE200CA	P6KE200CA	171	5	190	200	210	1	274	2.2	0.108

2. A transient suppressor is normally selected according to the maximum working peak reverse voltage (V_{RWM}), which should be equal to or greater than the dc or continuous peak operating voltage level.
3. V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C.
4. Surge current waveform per Figure 3 and derate per Figures 1 and 2.

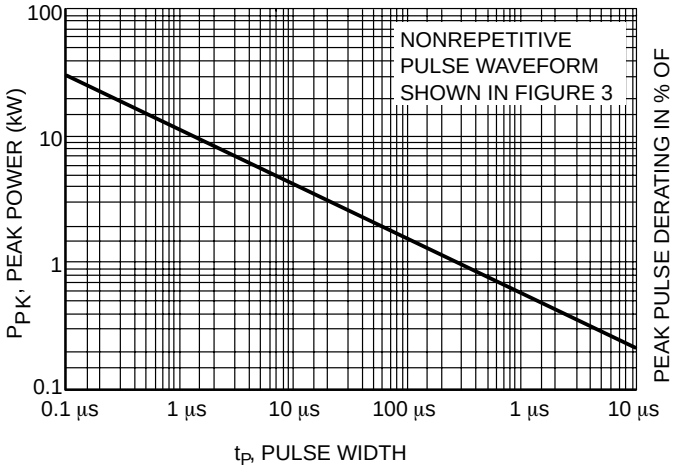


Figure 1. Pulse Rating Curve

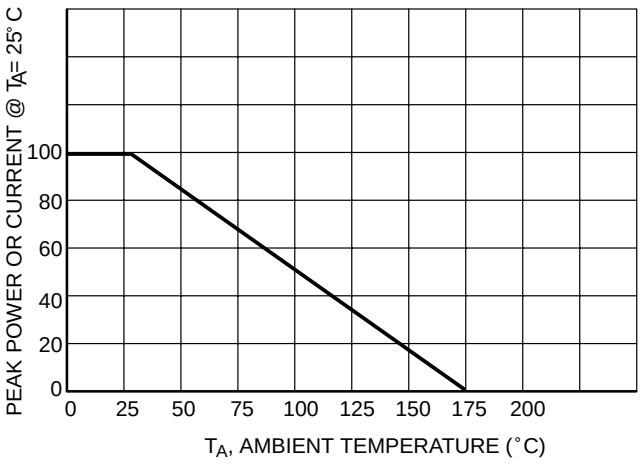


Figure 2. Pulse Derating Curve

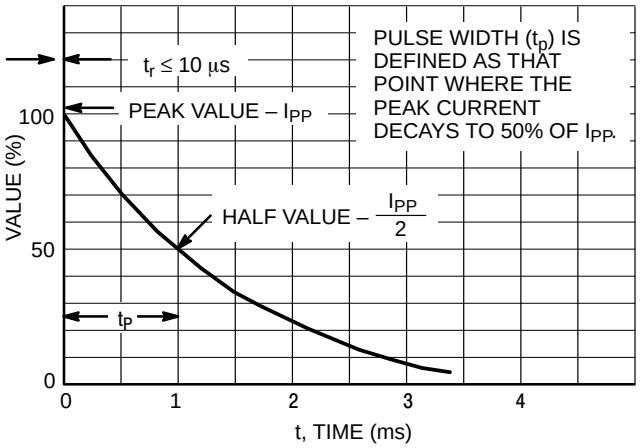


Figure 3. Pulse Waveform

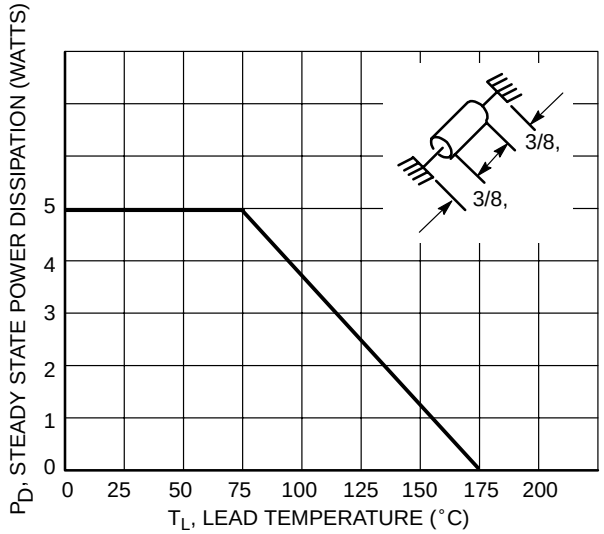


Figure 4. Steady State Power Derating

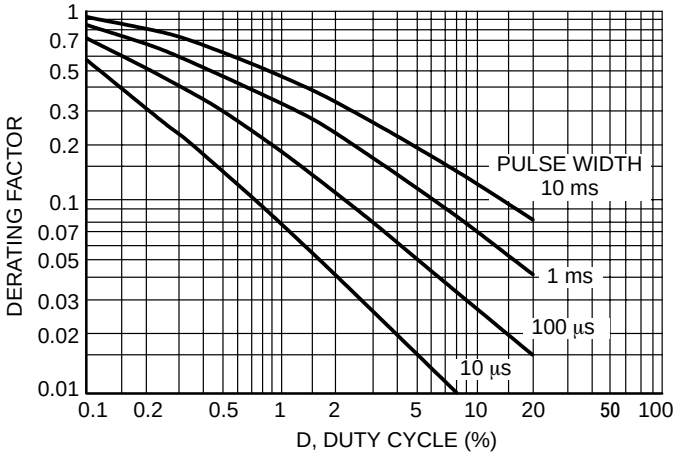


Figure 5. Typical Derating Factor for Duty Cycle

APPLICATION NOTES

RESPONSE TIME

In most applications, the transient suppressor device is placed in parallel with the equipment or component to be protected. In this situation, there is a time delay associated with the capacitance of the device and an overshoot condition associated with the inductance of the device and the inductance of the connection method. The capacitance effect is of minor importance in the parallel protection scheme because it only produces a time delay in the transition from the operating voltage to the clamp voltage as shown in Figure 6.

The inductive effects in the device are due to actual turn-on time (time required for the device to go from zero current to full current) and lead inductance. This inductive effect produces an overshoot in the voltage across the equipment or component being protected as shown in Figure 7. Minimizing this overshoot is very important in the application, since the main purpose for adding a transient suppressor is to clamp voltage spikes. The P6KE6.8A series has very good response time, typically < 1 ns and negligible inductance. However, external inductive effects could produce unacceptable overshoot. Proper circuit layout, minimum lead lengths and placing the suppressor device as close as possible to the equipment or components to be protected will minimize this overshoot.

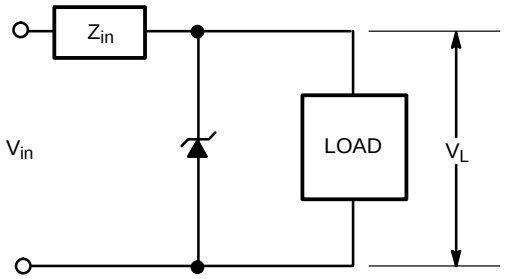
Some input impedance represented by Z_{in} is essential to prevent overstress of the protection device. This impedance should be as high as possible, without restricting the circuit operation.

DUTY CYCLE DERATING

The data of Figure 1 applies for non-repetitive conditions and at a lead temperature of 25°C. If the duty cycle increases, the peak power must be reduced as indicated by the curves of Figure 5. Average power must be derated as the lead or ambient temperature rises above 25°C. The average power derating curve normally given on data sheets may be normalized and used for this purpose.

At first glance the derating curves of Figure 5 appear to be in error as the 10 ms pulse has a higher derating factor than the 10 μs pulse. However, when the derating factor for a given pulse of Figure 5 is multiplied by the peak power value of Figure 1 for the same pulse, the results follow the expected trend.

TYPICAL PROTECTION CIRCUIT



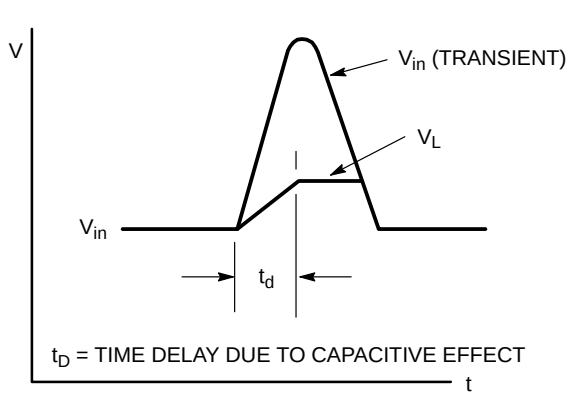


Figure 6.

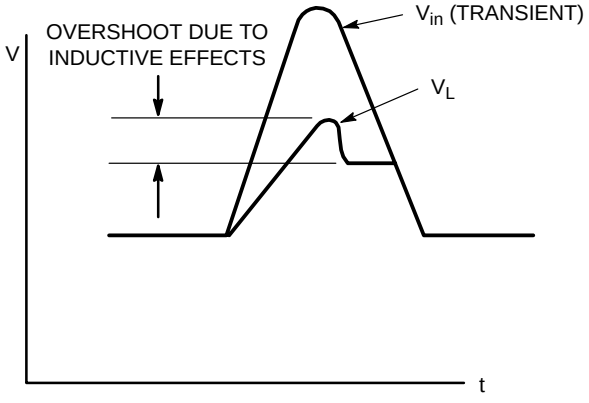


Figure 7.

UL RECOGNITION*

The entire series including the bidirectional CA suffix has *Underwriters Laboratory Recognition* for the classification of protectors (QVGV2) under the UL standard for safety 497B and File #E 116110. Many competitors only have one or two devices recognized or have recognition in a non-protective category. Some competitors have no recognition at all. With the UL497B recognition, our parts successfully passed several tests including Strike Voltage Breakdown test, Endurance Conditioning, Temperature test, Dielectric Voltage-Withstand test, Discharge test and several more.

Whereas, some competitors have only passed a flammability test for the package material, we have been recognized for much more to be included in their protector category.

*Applies to P6KE6.8A, CA – P6KE200A, CA.

1N6267A Series

1500 Watt Mosorb™ Zener Transient Voltage Suppressors

Unidirectional*

Mosorb devices are designed to protect voltage sensitive components from high voltage, high–energy transients. They have excellent clamping capability, high surge capability, low zener impedance and fast response time. These devices are ON Semiconductor's exclusive, cost-effective, highly reliable Surmetic™ axial leaded package and are ideally-suited for use in communication systems, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/consumer applications, to protect CMOS, MOS and Bipolar integrated circuits.

Specification Features:

- Working Peak Reverse Voltage Range – 5.8 V to 214 V
- Peak Power – 1500 Watts @ 1 ms
- ESD Rating of Class 3 (>16 KV) per Human Body Model
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5 μA Above 10 V
- UL 497B for Isolated Loop Circuit Protection
- Response Time is Typically < 1 ns

Mechanical Characteristics:

CASE: Void-free, transfer-molded, thermosetting plastic
FINISH: All external surfaces are corrosion resistant and leads are readily solderable
MAXIMUM LEAD TEMPERATURE FOR SOLDERING PURPOSES: 230°C, 1/16″ from the case for 10 seconds
POLARITY: Cathode indicated by polarity band
MOUNTING POSITION: Any

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (Note 1.) @ $T_L \le 25°C$	P_{PK}	1500	Watts
Steady State Power Dissipation @ $T_L \le 75°C$, Lead Length = 3/8″ Derated above $T_L = 75°C$	P_D	5.0 20	Watts mW/°C
Thermal Resistance, Junction–to–Lead	$R_{\theta JL}$	20	°C/W
Forward Surge Current (Note 2.) @ $T_A = 25°C$	I_{FSM}	200	Amps
Operating and Storage Temperature Range	T_J, T_{stg}	– 65 to +175	°C

1. Nonrepetitive current pulse per Figure 5 and derated above $T_A = 25°C$ per Figure 2.
2. 1/2 sine wave (or equivalent square wave), PW = 8.3 ms, duty cycle = 4 pulses per minute maximum.

*Please see 1.5KE6.8CA to 1.5KE250CA for Bidirectional Devices

ON Semiconductor™

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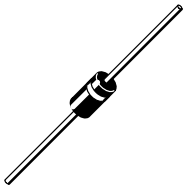
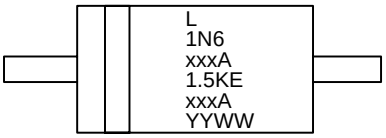


AXIAL LEAD
CASE 41A
PLASTIC



L = Assembly Location
1N6xxxA = JEDEC Device Code
1.5KExxxA = ON Device Code
YY = Year
WW = Work Week

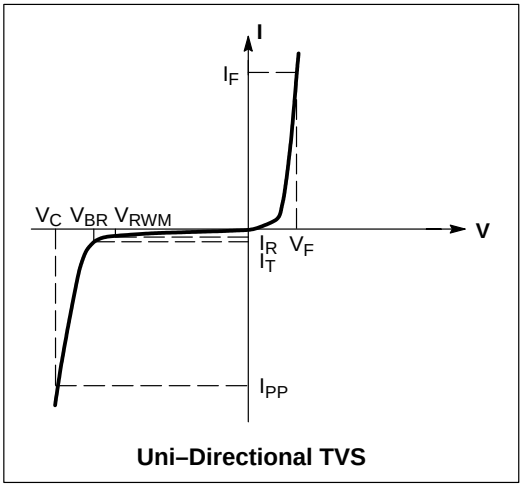
ORDERING INFORMATION

Device	Package	Shipping
1.5KExxxA	Axial Lead	500 Units/Box
1.5KExxxARL4	Axial Lead	1500/Tape & Reel
1N6xxxA	Axial Lead	500 Units/Box
1N6xxxARL4	Axial Lead	1500/Tape & Reel

Devices listed in ***bold, italic*** are ON Semiconductor **Preferred** devices. **Preferred** devices are recommended choices for future use and best overall value.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted, V_F = 3.5 V Max., I_F (Note 3.) = 100 A)

Symbol	Parameter
I_{PP}	Maximum Reverse Peak Pulse Current
V_C	Clamping Voltage @ I_{PP}
V_{RWM}	Working Peak Reverse Voltage
I_R	Maximum Reverse Leakage Current @ V_{RWM}
V_{BR}	Breakdown Voltage @ I_T
I_T	Test Current
ΘV_{BR}	Maximum Temperature Coefficient of V_{BR}
I_F	Forward Current
V_F	Forward Voltage @ I_F



Uni–Directional TVS

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted, V_F = 3.5 V Max. @ I_F (Note 3.) = 100 A)

Device	JEDEC Device (Note 4.)	V_{RWM} (Note 5.) (Volts)	I_R @ V_{RWM} (μA)	Breakdown Voltage V_{BR} (Note 6.) (Volts) Min	Nom	Max	@ I_T (mA)	V_C @ I_{PP} (Note 7.) V_C (Volts)	I_{PP} (A)	ΘV_{BR} (%/°C)
1.5KE6.8A	***1N6267A***	***5.8***	***1000***	***6.45***	***6.8***	***7.14***	***10***	***10.5***	***143***	***0.057***
1.5KE7.5A	1N6268A	6.4	500	7.13	7.5	7.88	10	11.3	132	0.061
1.5KE8.2A	1N6269A	7.02	200	7.79	8.2	8.61	10	12.1	124	0.065
1.5KE9.1A	1N6270A	7.78	50	8.65	9.1	9.55	1	13.4	112	0.068
1.5KE10A	1N6271A	8.55	10	9.5	10	10.5	1	14.5	103	0.073
1.5KE11A	1N6272A	9.4	5	10.5	11	11.6	1	15.6	96	0.075
1.5KE12A	1N6273A	10.2	5	11.4	12	12.6	1	16.7	90	0.078
1.5KE13A	1N6274A	11.1	5	12.4	13	13.7	1	18.2	82	0.081
1.5KE15A	***1N6275A***	***12.8***	***5***	***14.3***	***15***	***15.8***	***1***	***21.2***	***71***	***0.084***
1.5KE16A	1N6276A	13.6	5	15.2	16	16.8	1	22.5	67	0.086
1.5KE18A	1N6277A	15.3	5	17.1	18	18.9	1	25.2	59.5	0.088
1.5KE20A	1N6278A	17.1	5	19	20	21	1	27.7	54	0.09
1.5KE22A	1N6279A	***18.8***	***5***	***20.9***	***22***	***23.1***	***1***	***30.6***	***49***	***0.092***
1.5KE24A	***1N6280A***	***20.5***	***5***	***22.8***	***24***	***25.2***	***1***	***33.2***	***45***	***0.094***
1.5KE27A	***1N6281A***	***23.1***	***5***	***25.7***	***27***	***28.4***	***1***	***37.5***	***40***	***0.096***
1.5KE30A	***1N6282A***	***25.6***	***5***	***28.5***	***30***	***31.5***	***1***	***41.4***	***36***	***0.097***
1.5KE33A	***1N6283A***	***28.2***	***5***	***31.4***	***33***	***34.7***	***1***	***45.7***	***33***	***0.098***
1.5KE36A	1N6284A	30.8	5	34.2	36	37.8	1	49.9	30	0.099
1.5KE39A	***1N6285A***	***33.3***	***5***	***37.1***	***39***	***41***	***1***	***53.9***	***28***	***0.1***
1.5KE43A	1N6286A	36.8	5	40.9	43	45.2	1	59.3	25.3	0.101
1.5KE47A	1N6287A	40.2	5	44.7	47	49.4	1	64.8	23.2	0.101
1.5KE51A	***1N6288A***	***43.6***	***5***	***48.5***	***51***	***53.6***	***1***	***70.1***	***21.4***	***0.102***
1.5KE56A	1N6289	***47.8***	***5***	***53.2***	***56***	***58.8***	***1***	***77***	***19.5***	***0.103***
1.5KE62A	1N6290A	53	5	58.9	62	65.1	1	85	17.7	0.104
1.5KE68A	1N6291A	58.1	5	64.6	68	71.4	1	92	16.3	0.104
1.5KE75A	1N6292A	64.1	5	71.3	75	78.8	1	103	14.6	0.105
1.5KE82A	1N6293A	70.1	5	77.9	82	86.1	1	113	13.3	0.105
1.5KE91A	1N6294A	77.8	5	86.5	91	95.5	1	125	12	0.106
1.5KE100A	1N6295A	85.5	5	95	100	105	1	137	11	0.106
1.5KE110A	1N6296A	94	5	105	110	116	1	152	9.9	0.107
1.5KE120A	1N6297A	102	5	114	120	126	1	165	9.1	0.107
1.5KE130A	1N6298A	111	5	124	130	137	1	179	8.4	0.107
1.5KE150A	1N6299A	128	5	143	150	158	1	207	7.2	0.108
1.5KE160A	1N6300A	136	5	152	160	168	1	219	6.8	0.108
1.5KE170A	1N6301A	145	5	162	170	179	1	234	6.4	0.108
1.5KE180A	1N6302A	154	5	171	180	189	1	246	6.1	0.108
1.5KE200A	1N6303A	171	5	190	200	210	1	274	5.5	0.108
1.5KE220A		185	5	209	220	231	1	328	4.6	0.109
1.5KE250A		214	5	237	250	263	1	344	5	0.109

3. 1/2 sine wave (or equivalent square wave), PW = 8.3 ms, duty cycle = 4 pulses per minute maximum.
4. Indicates JEDEC registered data
5. A transient suppressor is normally selected according to the maximum working peak reverse voltage (V_{RWM}), which should be equal to or greater than the dc or continuous peak operating voltage level.
6. V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C
7. Surge current waveform per Figure 5 and derate per Figures 1 and 2.

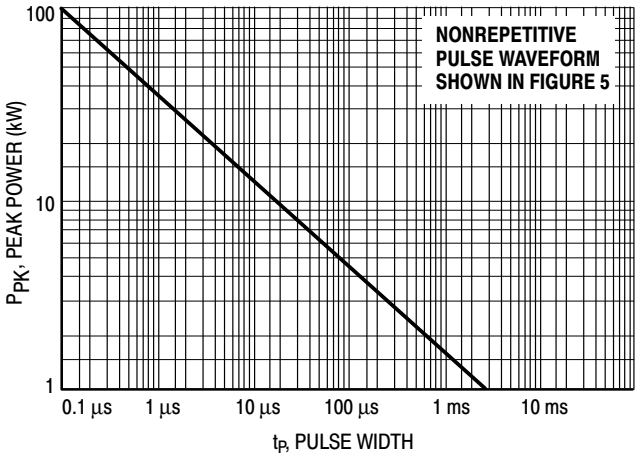


Figure 1. Pulse Rating Curve

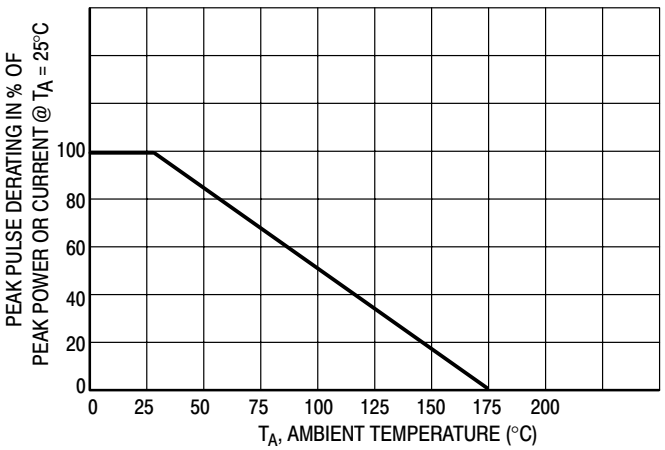


Figure 2. Pulse Derating Curve

1N6373, ICTE-5, MPTE-5,
through
1N6389, ICTE-45, C, MPTE-45, C

1N6267A/1.5KE6.8A
through
1N6303A/1.5KE200A

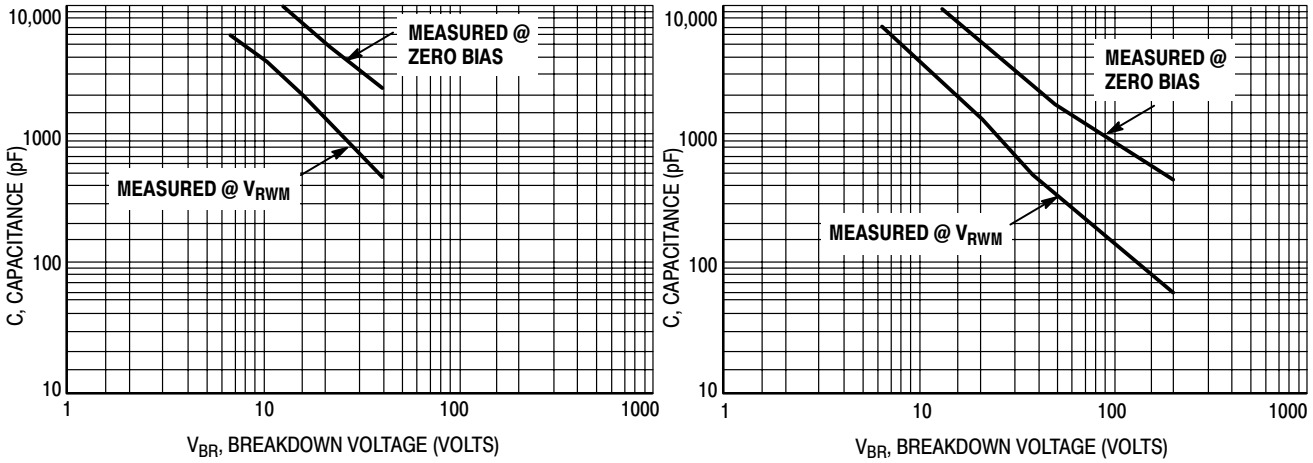


Figure 3. Capacitance versus Breakdown Voltage

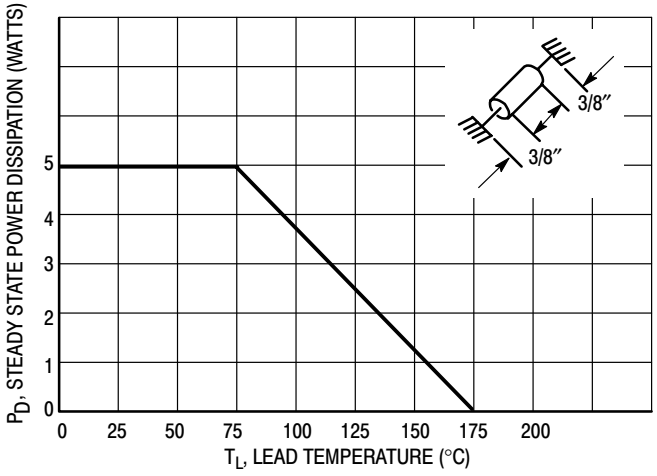


Figure 4. Steady State Power Derating

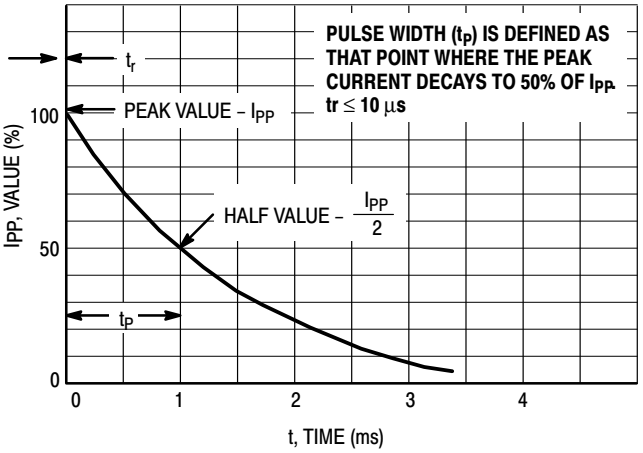


Figure 5. Pulse Waveform

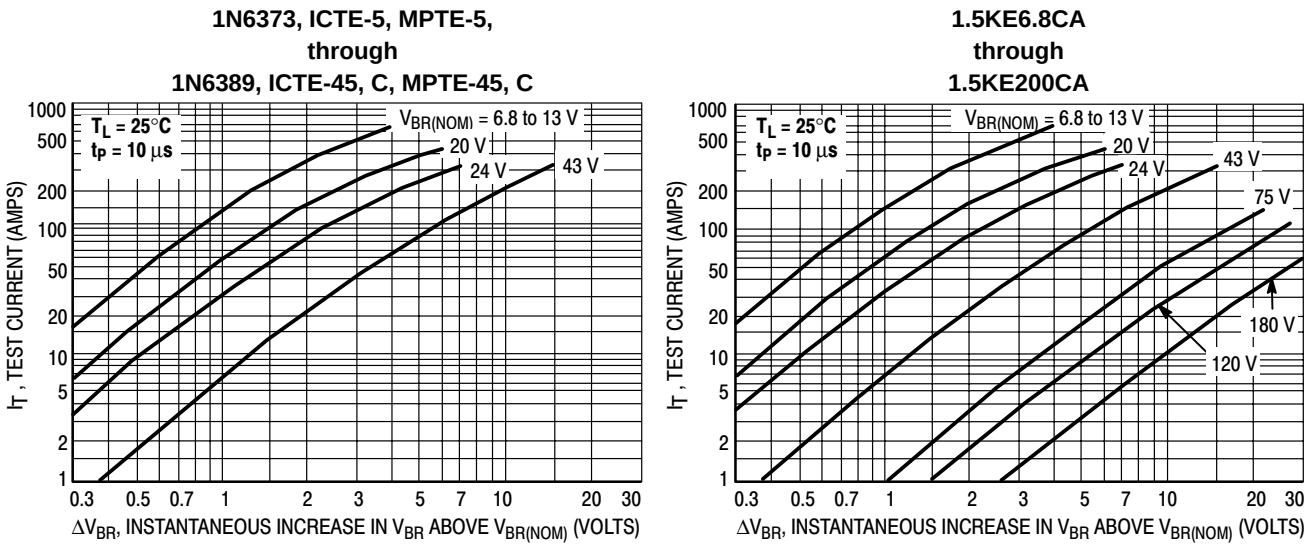


Figure 6. Dynamic Impedance

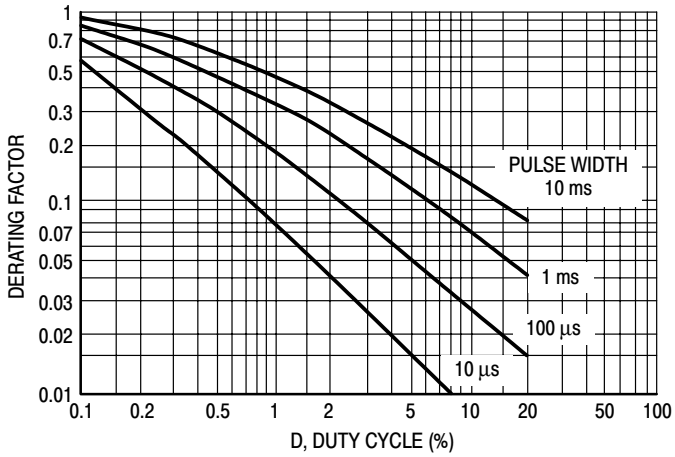


Figure 7. Typical Derating Factor for Duty Cycle

APPLICATION NOTES

RESPONSE TIME

In most applications, the transient suppressor device is placed in parallel with the equipment or component to be protected. In this situation, there is a time delay associated with the capacitance of the device and an overshoot condition associated with the inductance of the device and the inductance of the connection method. The capacitance effect is of minor importance in the parallel protection scheme because it only produces a time delay in the transition from the operating voltage to the clamp voltage as shown in Figure 8.

The inductive effects in the device are due to actual turn-on time (time required for the device to go from zero current to full current) and lead inductance. This inductive effect produces an overshoot in the voltage across the equipment or component being protected as shown in Figure 9. Minimizing this overshoot is very important in the application, since the main purpose for adding a transient suppressor is to clamp voltage spikes. These devices have excellent response time, typically in the picosecond range and negligible inductance. However, external inductive effects could produce unacceptable overshoot. Proper circuit layout, minimum lead lengths and placing the suppressor device as close as possible to the equipment or components to be protected will minimize this overshoot.

Some input impedance represented by Z_{in} is essential to prevent overstress of the protection device. This impedance should be as high as possible, without restricting the circuit operation.

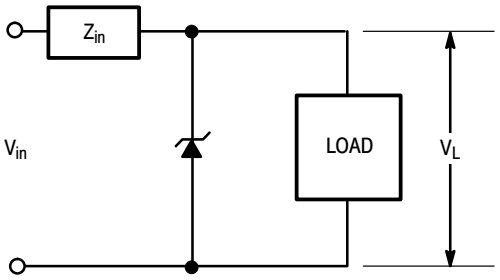
DUTY CYCLE DERATING

The data of Figure 1 applies for non-repetitive conditions and at a lead temperature of 25°C. If the duty cycle increases, the peak power must be reduced as indicated by the curves of Figure 7. Average power must be derated as the lead or

ambient temperature rises above 25°C. The average power derating curve normally given on data sheets may be normalized and used for this purpose.

At first glance the derating curves of Figure 7 appear to be in error as the 10 ms pulse has a higher derating factor than the 10 μs pulse. However, when the derating factor for a given pulse of Figure 7 is multiplied by the peak power value of Figure 1 for the same pulse, the results follow the expected trend.

TYPICAL PROTECTION CIRCUIT



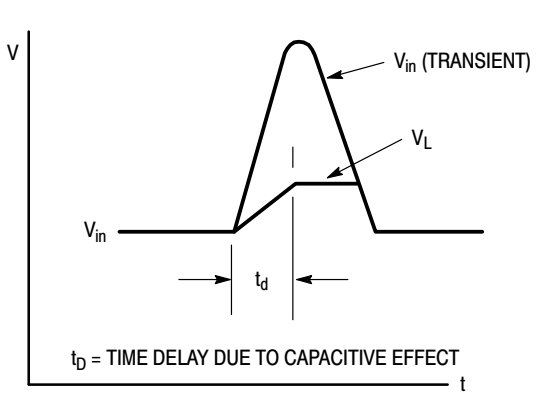


Figure 8.

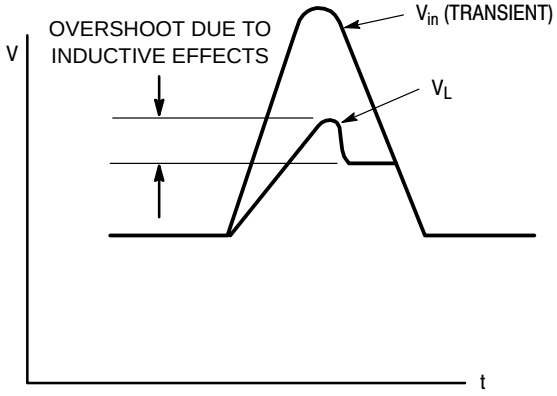


Figure 9.

UL RECOGNITION*

The entire series has *Underwriters Laboratory Recognition* for the classification of protectors (QVGV2) under the UL standard for safety 497B and File #116110. Many competitors only have one or two devices recognized or have recognition in a non-protective category. Some competitors have no recognition at all. With the UL497B recognition, our parts successfully passed several tests including Strike Voltage Breakdown test, Endurance Conditioning, Temperature test, Dielectric Voltage-Withstand test, Discharge test and several more.

Whereas, some competitors have only passed a flammability test for the package material, we have been recognized for much more to be included in their Protector category.

*Applies to 1.5KE6.8A, CA thru 1.5KE250A, CA

CLIPPER BIDIRECTIONAL DEVICES

1. Clipper-bidirectional devices are available in the 1.5KEXXA series and are designated with a “CA” suffix; for example, 1.5KE18CA. Contact your nearest ON Semiconductor representative.
2. Clipper-bidirectional part numbers are tested in both directions to electrical parameters in preceeding table (except for V_F which does not apply).
3. The 1N6267A through 1N6303A series are JEDEC registered devices and the registration does not include a “CA” suffix. To order clipper-bidirectional devices one must add CA to the 1.5KE device title.

1.5KE6.8CA Series

1500 Watt Mosorb™ Zener Transient Voltage Suppressors

Bidirectional*

Mosorb devices are designed to protect voltage sensitive components from high voltage, high–energy transients. They have excellent clamping capability, high surge capability, low zener impedance and fast response time. These devices are ON Semiconductor's exclusive, cost-effective, highly reliable Surmetic axial leaded package and are ideally-suited for use in communication systems, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/ consumer applications, to protect CMOS, MOS and Bipolar integrated circuits.

Specification Features:

- Working Peak Reverse Voltage Range – 5.8 V to 214 V
- Peak Power – 1500 Watts @ 1 ms
- ESD Rating of Class 3 (>16 KV) per Human Body Model
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5 μA above 10 V
- UL 497B for Isolated Loop Circuit Protection
- Response Time is typically < 1 ns

Mechanical Characteristics:

CASE: Void-free, transfer-molded, thermosetting plastic
FINISH: All external surfaces are corrosion resistant and leads are readily solderable
MAXIMUM LEAD TEMPERATURE FOR SOLDERING PURPOSES: 230°C, 1/16″ from the case for 10 seconds
POLARITY: Cathode band does not imply polarity
MOUNTING POSITION: Any

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (Note 1.) @ $T_L \le 25°C$	P_{PK}	1500	Watts
Steady State Power Dissipation @ $T_L \le 75°C$, Lead Length = 3/8″ Derated above $T_L = 75°C$	P_D	5.0 20	Watts mW/°C
Thermal Resistance, Junction–to–Lead	$R_{\theta JL}$	20	°C/W
Operating and Storage Temperature Range	T_J, T_{stg}	– 65 to +175	°C

1. Nonrepetitive current pulse per Figure 4 and derated above $T_A = 25°C$ per Figure 2.

*Please see 1N6267A to 1N6306A (1.5KE6.8A – 1.5KE250A) for Unidirectional Devices

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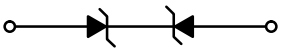
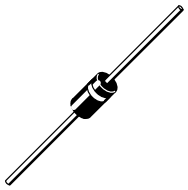
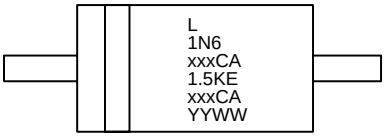




AXIAL LEAD
CASE 41A
PLASTIC



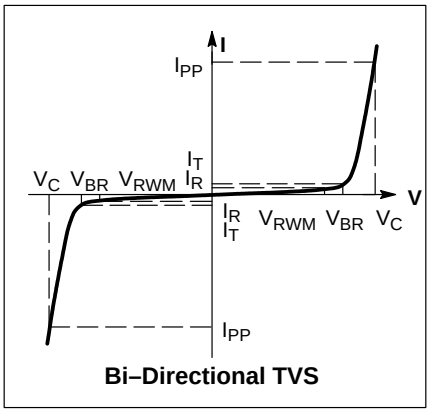
L = Assembly Location
1N6xxxCA = JEDEC Device Code
1.5KExxxCA = ON Device Code
YY = Year
WW = Work Week

ORDERING INFORMATION

Device	Packaging	Shipping
1.5KExxCA	Axial Lead	500 Units/Box
1.5KExxCARL4	Axial Lead	1500/Tape & Reel

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Parameter
I_{PP}	Maximum Reverse Peak Pulse Current
V_C	Clamping Voltage @ I_{PP}
V_{RWM}	Working Peak Reverse Voltage
I_R	Maximum Reverse Leakage Current @ V_{RWM}
V_{BR}	Breakdown Voltage @ I_T
I_T	Test Current
ΘV_{BR}	Maximum Temperature Coefficient of V_{BR}



Bi–Directional TVS

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Device	V_{RWM} (Note 2.) (Volts)	I_R @ V_{RWM} (μA)	Breakdown Voltage V_{BR} (Note 3.) (Volts) Min	Nom	Max	@ I_T (mA)	V_C @ I_{PP} (Note 4.) V_C (Volts)	I_{PP} (A)	ΘV$_{BR}$ (%/°C)
1.5KE6.8CA	5.8	1000	6.45	6.8	7.14	10	10.5	143	0.057
1.5KE7.5CA	6.4	500	7.13	7.5	7.88	10	11.3	132	0.061
1.5KE8.2CA	7.02	200	7.79	8.2	8.61	10	12.1	124	0.065
1.5KE9.1CA	7.78	50	8.65	9.1	9.55	1	13.4	112	0.068
1.5KE10CA	8.55	10	9.5	10	10.5	1	14.5	103	0.073
1.5KE11CA	9.4	5	10.5	11	11.6	1	15.6	96	0.075
1.5KE12CA	10.2	5	11.4	12	12.6	1	16.7	90	0.078
1.5KE13CA	11.1	5	12.4	13	13.7	1	18.2	82	0.081
1.5KE15CA	12.8	5	14.3	15	15.8	1	21.2	71	0.084
1.5KE16CA	13.6	5	15.2	16	16.8	1	22.5	67	0.086
1.5KE18CA	15.3	5	17.1	18	18.9	1	25.2	59.5	0.088
1.5KE20CA	17.1	5	19	20	21	1	27.7	54	0.09
1.5KE22CA	18.8	5	20.9	22	23.1	1	30.6	49	0.092
1.5KE24CA	20.5	5	22.8	24	25.2	1	33.2	45	0.094
1.5KE27CA	23.1	5	25.7	27	28.4	1	37.5	40	0.096
1.5KE30CA	25.6	5	28.5	30	31.5	1	41.4	36	0.097
1.5KE33CA	28.2	5	31.4	33	34.7	1	45.7	33	0.098
1.5KE36CA	30.8	5	34.2	36	37.8	1	49.9	30	0.099
1.5KE39CA	33.3	5	37.1	39	41	1	53.9	28	0.1
1.5KE43CA	36.8	5	40.9	43	45.2	1	59.3	25.3	0.101
1.5KE47CA	40.2	5	44.7	47	49.4	1	64.8	23.2	0.101
1.5KE51CA	43.6	5	48.5	51	53.6	1	70.1	21.4	0.102
1.5KE56CA	47.8	5	53.2	56	58.8	1	77	19.5	0.103
1.5KE62CA	53	5	58.9	62	65.1	1	85	17.7	0.104
1.5KE68CA	58.1	5	64.6	68	71.4	1	92	16.3	0.104
1.5KE75CA	64.1	5	71.3	75	78.8	1	103	14.6	0.105
1.5KE82CA	70.1	5	77.9	82	86.1	1	113	13.3	0.105
1.5KE91CA	77.8	5	86.5	91	95.5	1	125	12	0.106
1.5KE100CA	85.5	5	95	100	105	1	137	11	0.106
1.5KE110CA	94	5	105	110	116	1	152	9.9	0.107
1.5KE120CA	102	5	114	120	126	1	165	9.1	0.107
1.5KE130CA	111	5	124	130	137	1	179	8.4	0.107
1.5KE150CA	128	5	143	150	158	1	207	7.2	0.108
1.5KE160CA	136	5	152	160	168	1	219	6.8	0.108
1.5KE170CA	145	5	162	170	179	1	234	6.4	0.108
1.5KE180CA	154	5	171	180	189	1	246	6.1	0.108
1.5KE200CA	171	5	190	200	210	1	274	5.5	0.108
1.5KE220CA	185	5	209	220	231	1	328	4.6	0.109
1.5KE250CA	214	5	237	250	263	1	344	5	0.109

2. A transient suppressor is normally selected according to the maximum working peak reverse voltage (V_{RWM}), which should be equal to or greater than the dc or continuous peak operating voltage level.
3. V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C.
4. Surge current waveform per Figure 4 and derate per Figures 1 and 2.

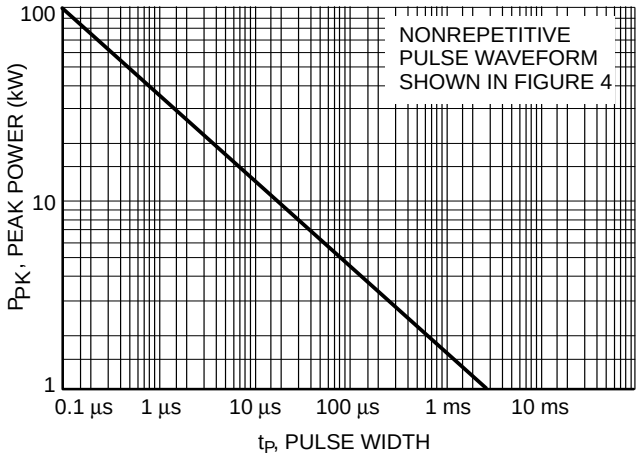


Figure 1. Pulse Rating Curve

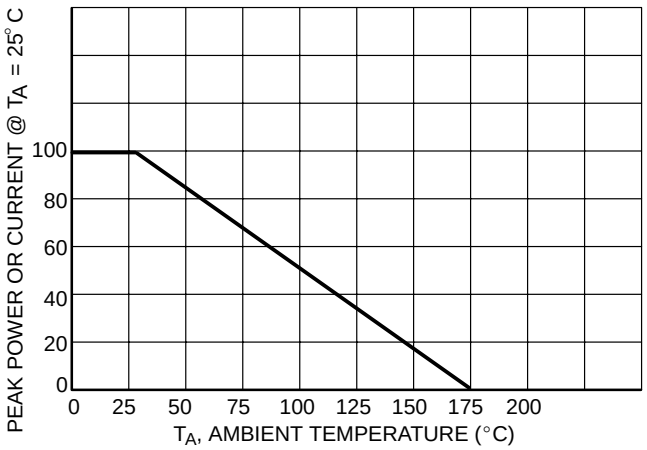


Figure 2. Pulse Derating Curve

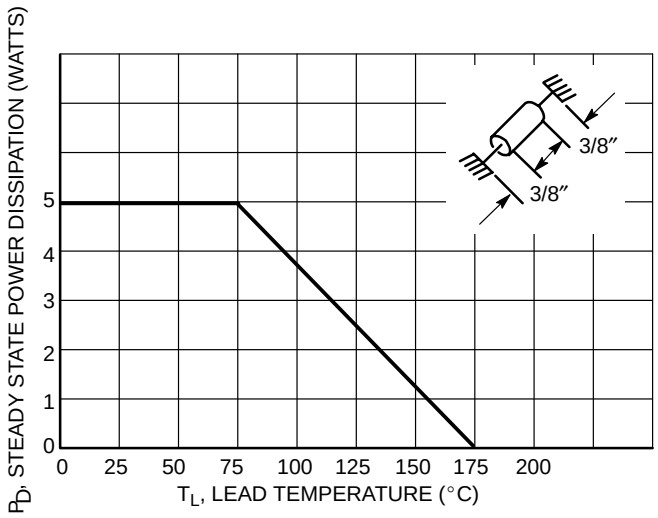


Figure 3. Steady State Power Derating

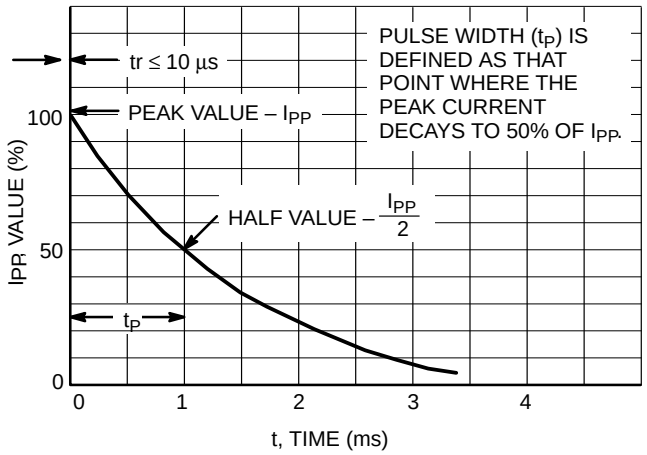


Figure 4. Pulse Waveform

1N6373, ICTE-5, MPTE-5,
through
1N6389, ICTE-45, C, MPTE-45, C

1.5KE6.8CA
through
1.5KE200CA

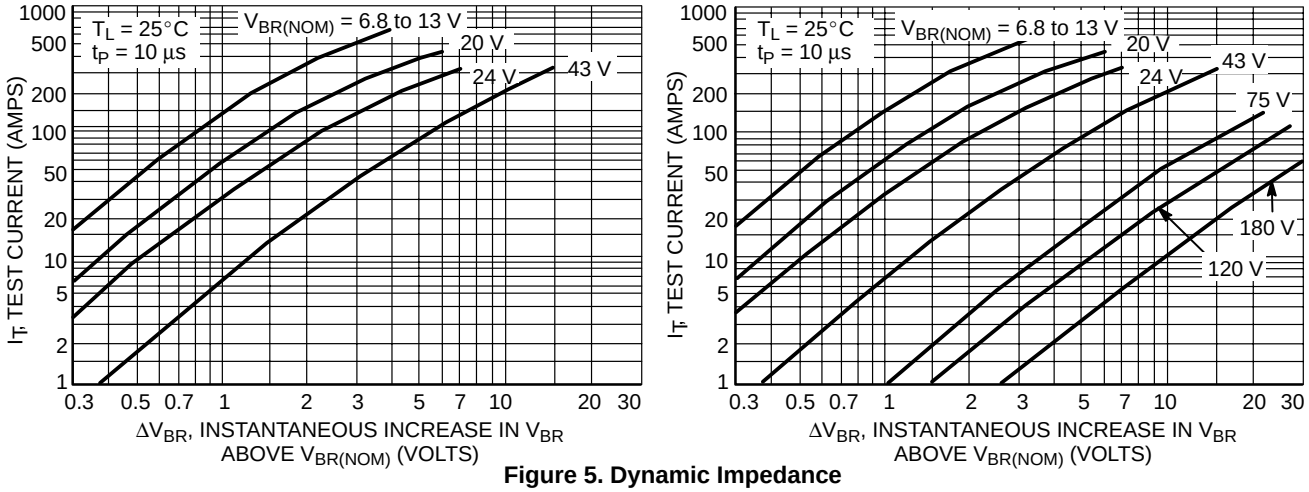


Figure 5. Dynamic Impedance

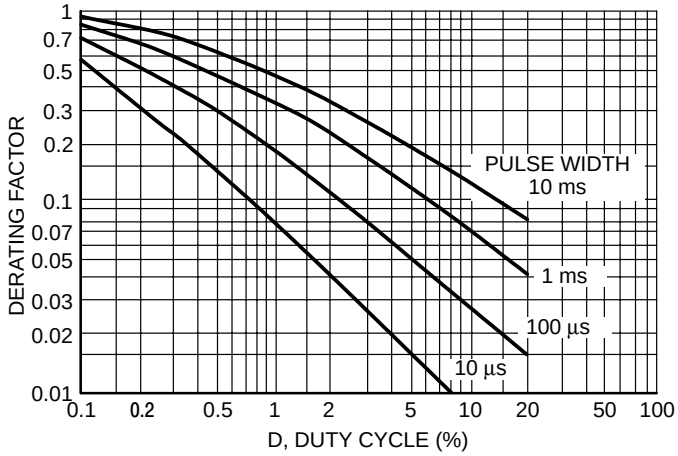


Figure 6. Typical Derating Factor for Duty Cycle

APPLICATION NOTES

RESPONSE TIME

In most applications, the transient suppressor device is placed in parallel with the equipment or component to be protected. In this situation, there is a time delay associated with the capacitance of the device and an overshoot condition associated with the inductance of the device and the inductance of the connection method. The capacitance effect is of minor importance in the parallel protection scheme because it only produces a time delay in the transition from the operating voltage to the clamp voltage as shown in Figure 7.

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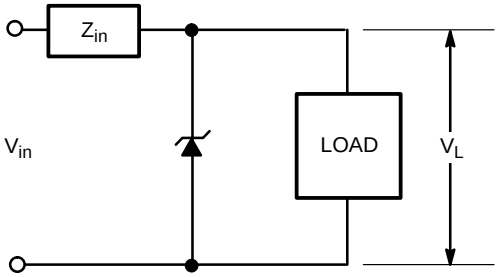
DUTY CYCLE DERATING

The data of Figure 1 applies for non-repetitive conditions and at a lead temperature of 25°C. If the duty cycle increases, the peak power must be reduced as indicated by the curves of Figure 6. Average power must be derated as the lead or ambient temperature rises above 25°C. The average power derating curve normally given on data sheets may be normalized and used for this purpose.

At first glance the derating curves of Figure 6 appear to be in error as the 10 ms pulse has a higher derating factor than the 10 μs pulse. However, when the derating factor for a given pulse of Figure 6 is multiplied by the peak power value of Figure 1 for the same pulse, the results follow the expected trend.

TYPICAL PROTECTION CIRCUIT



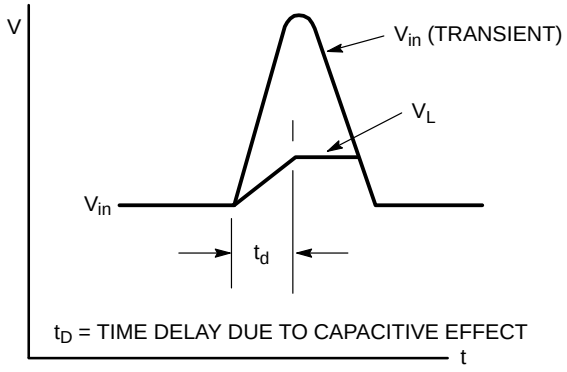


Figure 7.

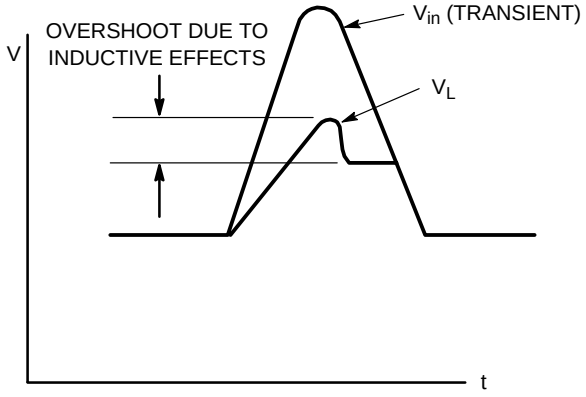


Figure 8.

UL RECOGNITION*

The entire series has *Underwriters Laboratory Recognition* for the classification of protectors (QVGV2) under the UL standard for safety 497B and File #116110. Many competitors only have one or two devices recognized or have recognition in a non-protective category. Some competitors have no recognition at all. With the UL497B recognition, our parts successfully passed several tests including Strike Voltage Breakdown test, Endurance Conditioning, Temperature test, Dielectric Voltage-Withstand test, Discharge test and several more.

Whereas, some competitors have only passed a flammability test for the package material, we have been recognized for much more to be included in their Protector category.

*Applies to 1.5KE6.8CA – 1.5KE250CA

CLIPPER BIDIRECTIONAL DEVICES

1. Clipper-bidirectional devices are available in the 1.5KEXXA series and are designated with a “CA” suffix; for example, 1.5KE18CA. Contact your nearest ON Semiconductor representative.
2. Clipper-bidirectional part numbers are tested in both directions to electrical parameters in preceeding table (except for V_F which does not apply).
3. The 1N6267A through 1N6303A series are JEDEC registered devices and the registration does not include a “CA” suffix. To order clipper-bidirectional devices one must add CA to the 1.5KE device title.

MMBZ5V6ALT1 Series

Preferred Devices

24 and 40 Watt Peak Power Zener Transient Voltage Suppressors

SOT–23 Dual Common Anode Zeners for ESD Protection

These dual monolithic silicon zener diodes are designed for applications requiring transient overvoltage protection capability. They are intended for use in voltage and ESD sensitive equipment such as computers, printers, business machines, communication systems, medical equipment and other applications. Their dual junction common anode design protects two separate lines using only one package. These devices are ideal for situations where board space is at a premium.

Specification Features:

- SOT–23 Package Allows Either Two Separate Unidirectional Configurations or a Single Bidirectional Configuration
- Working Peak Reverse Voltage Range – 3 V to 26 V
- Standard Zener Breakdown Voltage Range – 5.6 V to 33 V
- Peak Power – 24 or 40 Watts @ 1.0 ms (Unidirectional), per Figure 5. Waveform
- ESD Rating of Class N (exceeding 16 kV) per the Human Body Model
- Maximum Clamping Voltage @ Peak Pulse Current
- Low Leakage < 5.0 μA
- Flammability Rating UL 94V–O

Mechanical Characteristics:

CASE: Void-free, transfer-molded, thermosetting plastic case
FINISH: Corrosion resistant finish, easily solderable
MAXIMUM CASE TEMPERATURE FOR SOLDERING PURPOSES: 260°C for 10 Seconds
Package designed for optimal automated board assembly
Small package size for high density applications
Available in 8 mm Tape and Reel

Use the Device Number to order the 7 inch/3,000 unit reel. Replace the “T1” with “T3” in the Device Number to order the 13 inch/10,000 unit reel.

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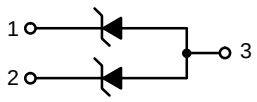
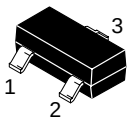
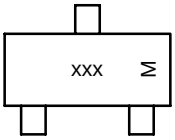
PIN 1. CATHODE
2. CATHODE
3. ANODE





SOT–23
CASE 318
STYLE 12

MARKING DIAGRAM



xxx = Device Code
M = Date Code

ORDERING INFORMATION

Device	Package	Shipping
MMBZ5V6ALT1	SOT–23	3000/Tape & Reel
MMBZ6V2ALT1	SOT–23	3000/Tape & Reel
MMBZ6V8ALT1	SOT–23	3000/Tape & Reel
MMBZ9V1ALT1	SOT–23	3000/Tape & Reel
MMBZ10VALT1	SOT–23	3000/Tape & Reel
MMBZ12VALT1	SOT–23	3000/Tape & Reel
MMBZ15VALT1	SOT–23	3000/Tape & Reel
MMBZ18VALT1	SOT–23	3000/Tape & Reel
MMBZ20VALT1	SOT–23	3000/Tape & Reel
MMBZ27VALT1	SOT–23	3000/Tape & Reel
MMBZ33VALT1	SOT–23	3000/Tape & Reel

Preferred devices are recommended choices for future use and best overall value.

DEVICE MARKING INFORMATION

See specific marking information in the device marking column of the table on page 42 of this data sheet.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation @ 1.0 ms (Note 1.) MMBZ5V6ALT1 thru MMBZ10VALT1 @ $T_L \le 25°C$ MMBZ12VALT1 thru MMBZ33VALT1	P_{pk}	24 40	Watts
Total Power Dissipation on FR–5 Board (Note 2.) @ $T_A = 25°C$ Derate above 25°C	P_D	225 1.8	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/W
Total Power Dissipation on Alumina Substrate (Note 3.) @ $T_A = 25°C$ Derate above 25°C	P_D	300 2.4	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/W
Junction and Storage Temperature Range	T_J, T_{stg}	– 55 to +150	°C
Lead Solder Temperature – Maximum (10 Second Duration)	T_L	260	°C

1. Non–repetitive current pulse per Figure 5. and derate above $T_A = 25°C$ per Figure 6.
2. FR–5 = 1.0 x 0.75 x 0.62 in.
3. Alumina = 0.4 x 0.3 x 0.024 in., 99.5% alumina

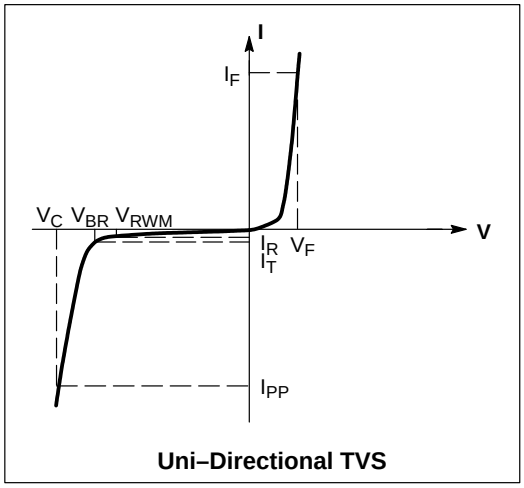
*Other voltages may be available upon request

ELECTRICAL CHARACTERISTICS

($T_A = 25°C$ unless otherwise noted)

UNIDIRECTIONAL (Circuit tied to Pins 1 and 3 or 2 and 3)

Symbol	Parameter
I_{PP}	Maximum Reverse Peak Pulse Current
V_C	Clamping Voltage @ I_{PP}
V_{RWM}	Working Peak Reverse Voltage
I_R	Maximum Reverse Leakage Current @ V_{RWM}
V_{BR}	Breakdown Voltage @ I_T
I_T	Test Current
ΘV_{BR}	Maximum Temperature Coefficient of V_{BR}
I_F	Forward Current
V_F	Forward Voltage @ I_F
Z_{ZT}	Maximum Zener Impedance @ I_{ZT}
I_{ZK}	Reverse Current
Z_{ZK}	Maximum Zener Impedance @ I_{ZK}



Uni–Directional TVS

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)
UNIDIRECTIONAL (Circuit tied to Pins 1 and 3 or Pins 2 and 3)

(V_F = 0.9 V Max @ I_F = 10 mA) **24 WATTS**

Device	Device Marking	V_{RWM}	I_R @ V_{RWM}	Breakdown Voltage				Max Zener Impedance (Note 5.)			V_C @ I_{PP} (Note 6.)		ΘV_{BR}
				V_{BR} (Note 4.) (V)			@ I_T	Z_{ZT} @ I_{ZT}	Z_{ZK} @ I_{ZK}		V_C	I_{PP}	
		Volts	μA	Min	Nom	Max	mA	Ω	Ω	mA	V	A	mV/°C
MMBZ5V6ALT1	5A6	3.0	5.0	5.32	5.6	5.88	20	11	1600	0.25	8.0	3.0	1.26
MMBZ6V2ALT1	6A2	3.0	0.5	5.89	6.2	6.51	1.0	–	–	–	8.7	2.76	2.80

(V_F = 1.1 V Max @ I_F = 200 mA)

Device	Device Marking	V_{RWM}	I_R @ V_{RWM}	Breakdown Voltage				V_C @ I_{PP} (Note 6.)		ΘV_{BR}
				V_{BR} (Note 4.) (V)			@ I_T	V_C	I_{PP}	
		Volts	μA	Min	Nom	Max	mA	V	A	mV/°C
MMBZ6V8ALT1	6A8	4.5	0.5	6.46	6.8	7.14	1.0	9.6	2.5	3.4
MMBZ9V1ALT1	9A1	6.0	0.3	8.65	9.1	9.56	1.0	14	1.7	7.5
MMBZ10VALT1	10A	6.5	0.3	9.50	10	10.5	1.0	14.2	1.7	7.5

(V_F = 1.1 V Max @ I_F = 200 mA) **40 WATTS**

Device	Device Marking	V_{RWM}	I_R @ V_{RWM}	Breakdown Voltage				V_C @ I_{PP} (Note 6.)		ΘV_{BR}
				V_{BR} (Note 4.) (V)			@ I_T	V_C	I_{PP}	
		Volts	nA	Min	Nom	Max	mA	V	A	mV/°C
MMBZ12VALT1	12A	8.5	200	11.40	12	12.60	1.0	17	2.35	7.5
MMBZ15VALT1	15A	12	50	14.25	15	15.75	1.0	21	1.9	12.3
MMBZ18VALT1	18A	14.5	50	17.10	18	18.90	1.0	25	1.6	15.3
MMBZ20VALT1	20A	17	50	19.00	20	21.00	1.0	28	1.4	17.2
MMBZ27VALT1	27A	22	50	25.65	27	28.35	1.0	40	1.0	24.3
MMBZ33VALT1	33A	26	50	31.35	33	34.65	1.0	46	0.87	30.4

4. V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C.
5. Z_{ZT} and Z_{ZK} are measured by dividing the AC voltage drop across the device by the AC current applied. The specified limits are for $I_{Z(AC)}$ = 0.1 $I_{Z(DC)}$, with the AC frequency = 1.0 kHz.
6. Surge current waveform per Figure 5. and derate per Figure 6.

TYPICAL CHARACTERISTICS

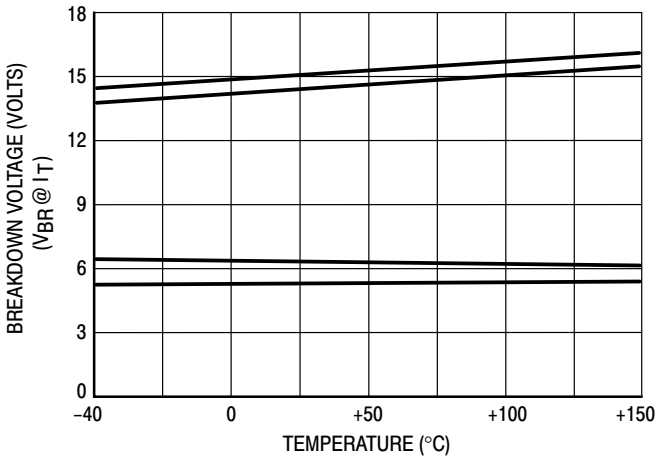


Figure 1. Typical Breakdown Voltage versus Temperature
(Upper curve for each voltage is bidirectional mode, lower curve is unidirectional mode)

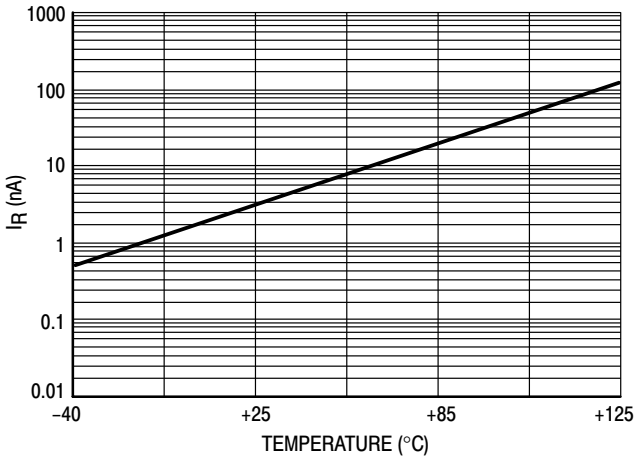


Figure 2. Typical Leakage Current versus Temperature

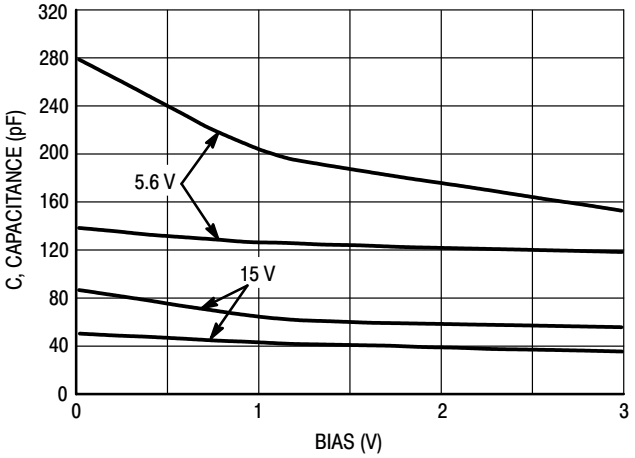


Figure 3. Typical Capacitance versus Bias Voltage
(Upper curve for each voltage is unidirectional mode, lower curve is bidirectional mode)

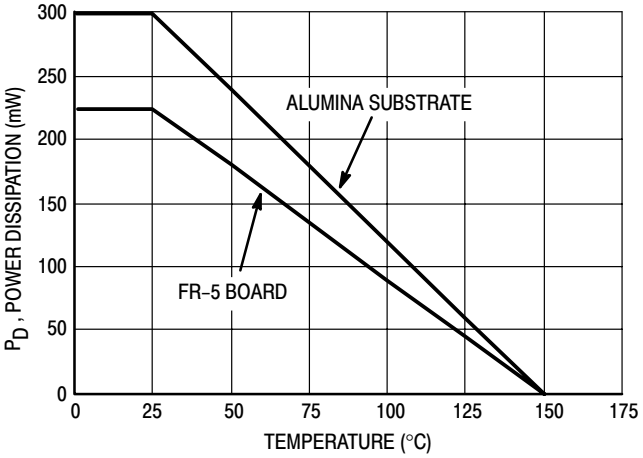


Figure 4. Steady State Power Derating Curve

TYPICAL CHARACTERISTICS

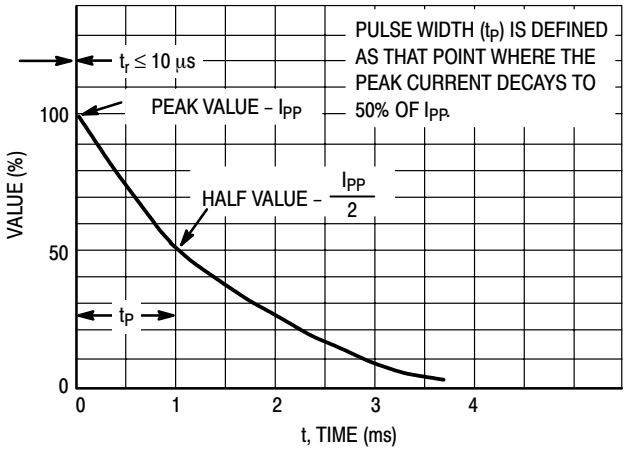


Figure 5. Pulse Waveform

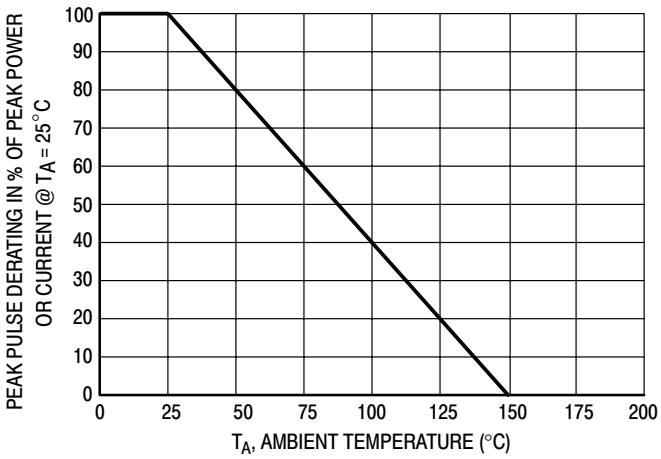


Figure 6. Pulse Derating Curve

MMBZ5V6ALT1

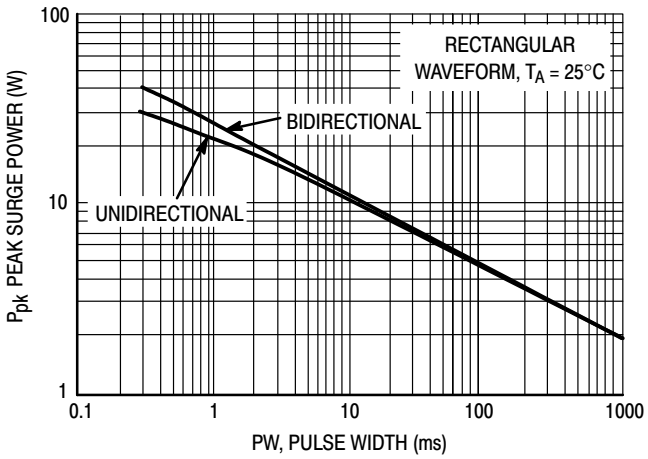


Figure 7. Maximum Non−repetitive Surge Power, P_{pk} versus PW

Power is defined as V_{RSM} x I_Z(pk) where V_{RSM} is the clamping voltage at I_Z(pk).

MMBZ5V6ALT1

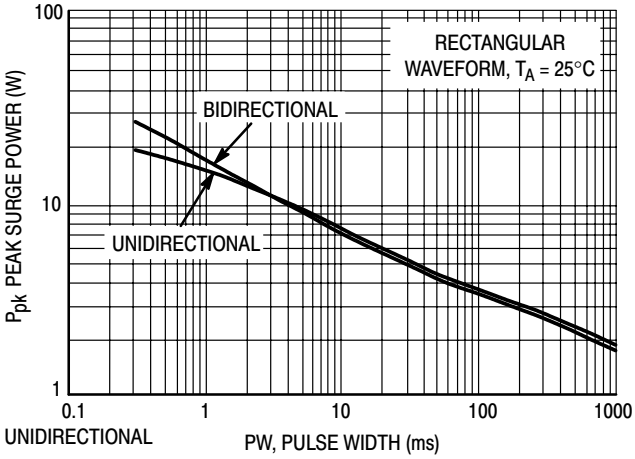


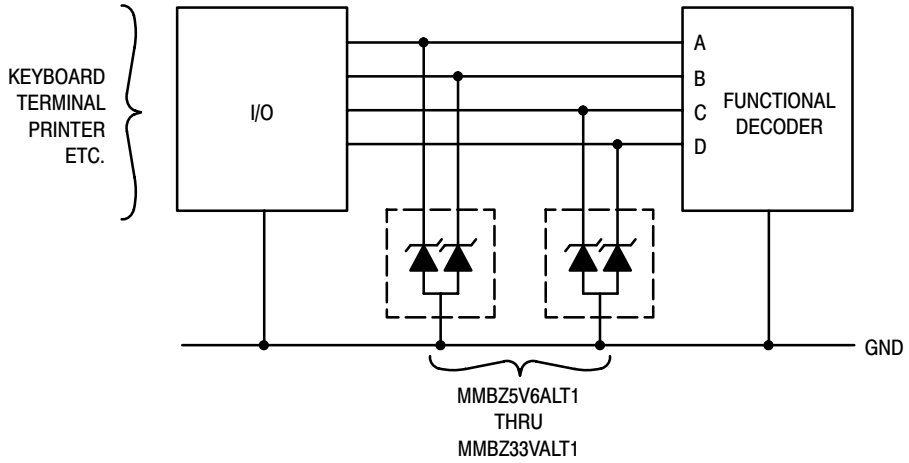
Figure 8. Maximum Non−repetitive Surge Power, P_{pk}(NOM) versus PW

Power is defined as V_Z(NOM) x I_Z(pk) where V_Z(NOM) is the nominal zener voltage measured at the low test current used for voltage classification.

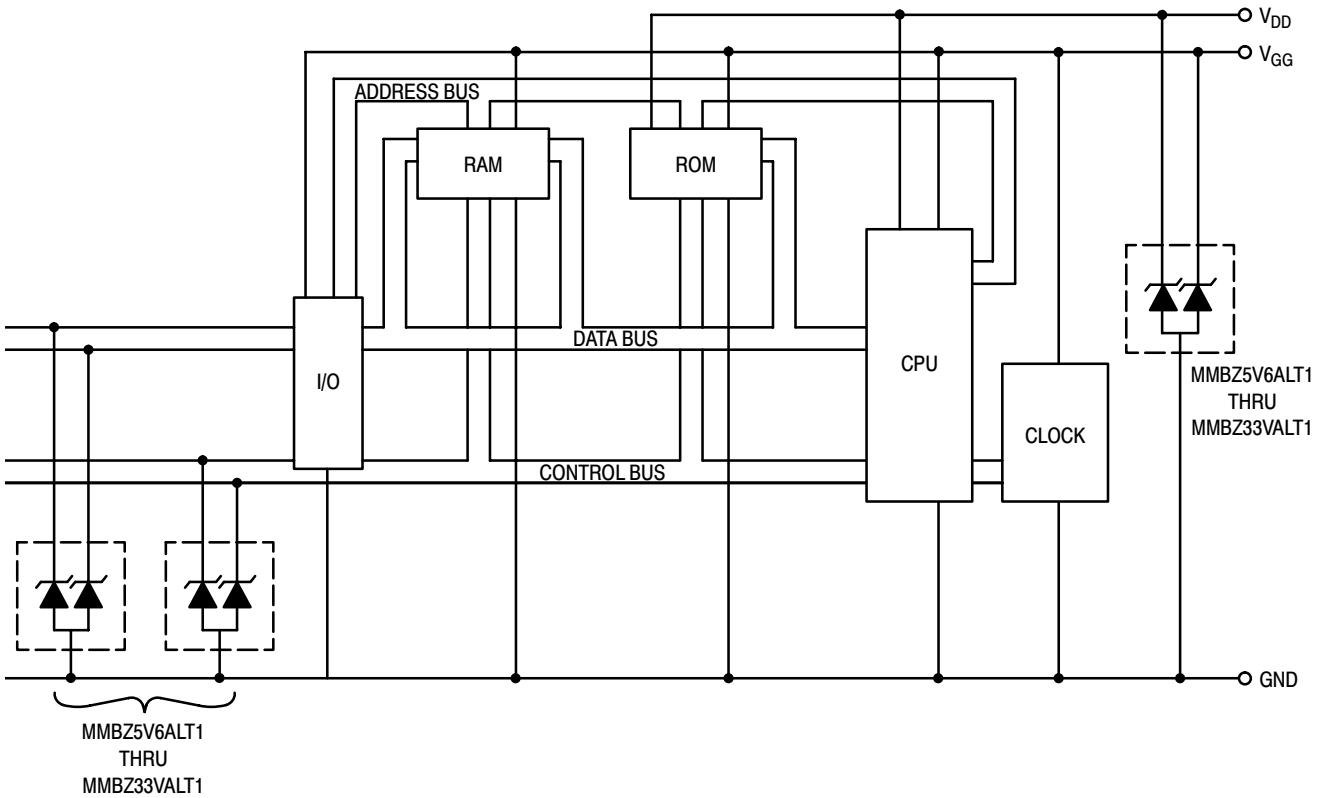
TYPICAL COMMON ANODE APPLICATIONS

A quad junction common anode design in a SOT–23 package protects four separate lines using only one package. This adds flexibility and creativity to PCB design especially when board space is at a premium. Two simplified examples of TVS applications are illustrated below.

Computer Interface Protection



Microprocessor Protection



SOLDERING PRECAUTIONS

MMBZ15VDLT1, MMBZ27VCLT1

Preferred Devices

40 Watt Peak Power Zener Transient Voltage Suppressors

SOT–23 Dual Common Cathode Zeners for ESD Protection

These dual monolithic silicon zener diodes are designed for applications requiring transient overvoltage protection capability. They are intended for use in voltage and ESD sensitive equipment such as computers, printers, business machines, communication systems, medical equipment and other applications. Their dual junction common cathode design protects two separate lines using only one package. These devices are ideal for situations where board space is at a premium.

Specification Features:

- SOT–23 Package Allows Either Two Separate Unidirectional Configurations or a Single Bidirectional Configuration
- Working Peak Reverse Voltage Range – 12.8 V, 22 V
- Standard Zener Breakdown Voltage Range – 15 V, 27 V
- Peak Power – 40 Watts @ 1.0 ms (Bidirectional), per Figure 5. Waveform
- ESD Rating of Class N (exceeding 16 kV) per the Human Body Model
- Maximum Clamping Voltage @ Peak Pulse Current
- Low Leakage < 100 nA
- Flammability Rating UL 94V–O

Mechanical Characteristics:

CASE: Void-free, transfer-molded, thermosetting plastic case
FINISH: Corrosion resistant finish, easily solderable
MAXIMUM CASE TEMPERATURE FOR SOLDERING PURPOSES: 260°C for 10 Seconds
Package designed for optimal automated board assembly
Small package size for high density applications
Available in 8 mm Tape and Reel

Use the Device Number to order the 7 inch/3,000 unit reel. Replace the “T1” with “T3” in the Device Number to order the 13 inch/10,000 unit reel.

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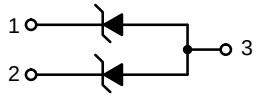
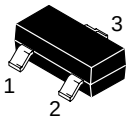
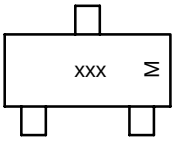


PIN 1. ANODE
2. ANODE
3. CATHODE



SOT–23
CASE 318
STYLE 9

MARKING DIAGRAM



xxx = 15D or 27C
M = Date Code

ORDERING INFORMATION

Device	Package	Shipping
MMBZ15VDLT1	SOT–23	3000/Tape & Reel
MMBZ15VDLT3	SOT–23	10,000/Tape & Reel
MMBZ27VCLT1	SOT–23	3000/Tape & Reel

Preferred devices are recommended choices for future use and best overall value.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation @ 1.0 ms (Note 1.) @ $T_L \le 25°C$	P_{pk}	40	Watts
Total Power Dissipation on FR–5 Board (Note 2.) @ $T_A = 25°C$ Derate above 25°C	P_D	225 1.8	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/W
Total Power Dissipation on Alumina Substrate (Note 3.) @ $T_A = 25°C$ Derate above 25°C	P_D	300 2.4	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/W
Junction and Storage Temperature Range	T_J, T_{stg}	– 55 to +150	°C
Lead Solder Temperature – Maximum (10 Second Duration)	T_L	230	°C

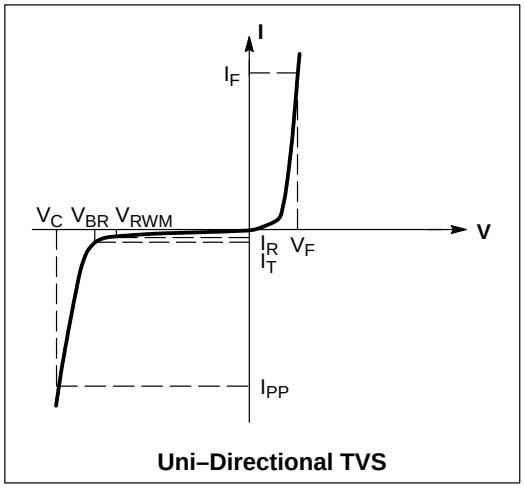
1. Non–repetitive current pulse per Figure 5. and derate above $T_A = 25°C$ per Figure 6.
2. FR–5 = 1.0 x 0.75 x 0.62 in.
3. Alumina = 0.4 x 0.3 x 0.024 in., 99.5% alumina

ELECTRICAL CHARACTERISTICS

($T_A = 25°C$ unless otherwise noted)

UNIDIRECTIONAL (Circuit tied to Pins 1 and 3 or 2 and 3)

Symbol	Parameter
I_{PP}	Maximum Reverse Peak Pulse Current
V_C	Clamping Voltage @ I_{PP}
V_{RWM}	Working Peak Reverse Voltage
I_R	Maximum Reverse Leakage Current @ V_{RWM}
V_{BR}	Breakdown Voltage @ I_T
I_T	Test Current
ΘV_{BR}	Maximum Temperature Coefficient of V_{BR}
I_F	Forward Current
V_F	Forward Voltage @ I_F



Uni–Directional TVS

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)
UNIDIRECTIONAL (Circuit tied to Pins 1 and 3 or Pins 2 and 3)

(V_F = 0.9 V Max @ I_F = 10 mA)

Device	Device Marking	V_{RWM}	I_R @ V_{RWM}	Breakdown Voltage V_{BR} (Note 4.) (V)			@ I_T	V_C @ I_{PP} (Note 5.) V_C	I_{PP}	ΘV_{BR}
		Volts	nA	Min	Nom	Max	mA	V	A	mV/°C
MMBZ15VDLT1	15D	12.8	100	14.3	15	15.8	1.0	21.2	1.9	12

(V_F = 1.1 V Max @ I_F = 200 mA)

Device	Device Marking	V_{RWM}	I_R @ V_{RWM}	Breakdown Voltage V_{BR} (Note 4.) (V)			@ I_T	V_C @ I_{PP} (Note 5.) V_C	I_{PP}	ΘV_{BR}
		Volts	nA	Min	Nom	Max	mA	V	A	mV/°C
MMBZ27VCLT1	27C	22	50	25.65	27	28.35	1.0	38	1.0	26

4. V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C.
5. Surge current waveform per Figure 5. and derate per Figure 6.

TYPICAL CHARACTERISTICS

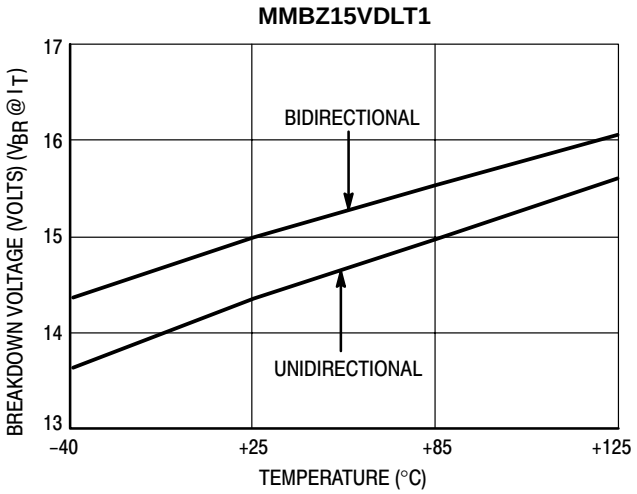


Figure 1. Typical Breakdown Voltage versus Temperature

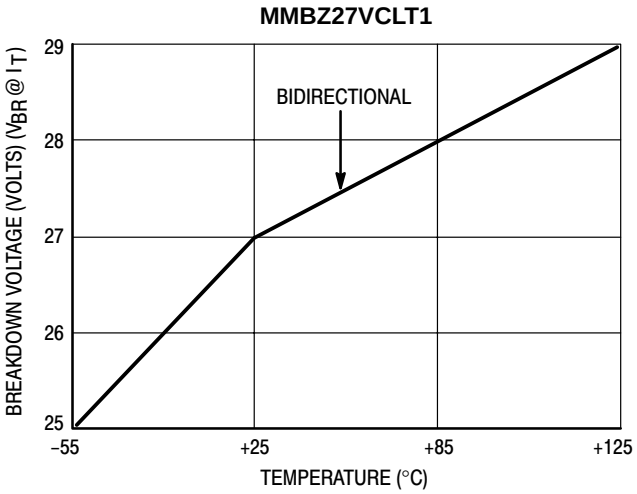


Figure 2. Typical Breakdown Voltage versus Temperature

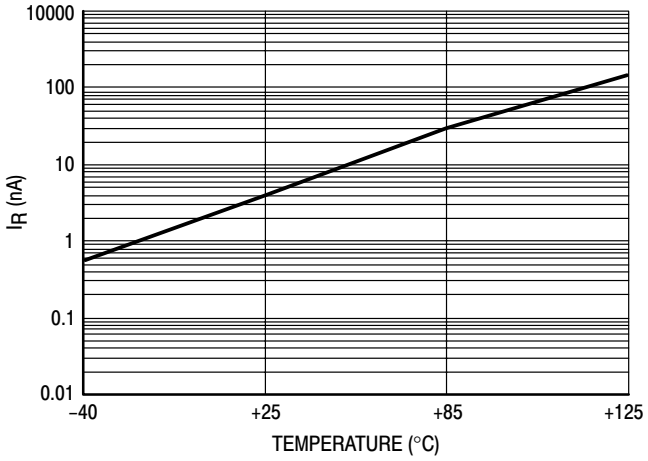


Figure 3. Typical Leakage Current versus Temperature

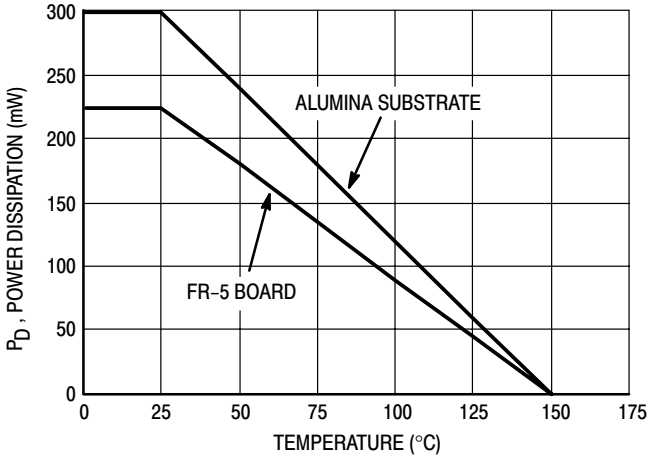


Figure 4. Steady State Power Derating Curve

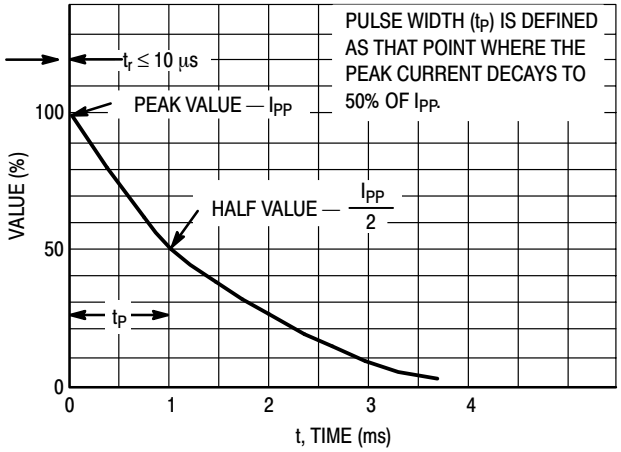


Figure 5. Pulse Waveform

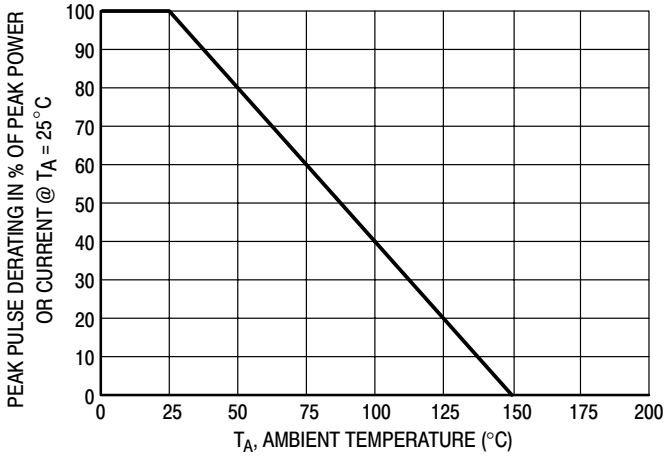


Figure 6. Pulse Derating Curve

SOLDERING PRECAUTIONS

MMQA5V6T1 Series

24 Watt Peak Power Zener Transient Voltage Suppressors

SC–59 Quad Common Anode for Zeners ESD Protection

These quad monolithic silicon voltage suppressors are designed for applications requiring transient voltage protection capability. They are intended for use in voltage and ESD sensitive equipment such as computers, printers, business machines, communication systems, medical equipment, and other applications. Their quad junction common anode design protects four separate lines using only one package. These devices are ideal for situations where board space is at a premium.

Specification Features:

- SC–59 Package Allows Four Separate Unidirectional Configurations
- Working Peak Reverse Voltage Range – 3.0 V to 2.5 V
- Standard Zener Breakdown Voltage Range – 5.6 V to 33 V
- Peak Power – Minimum 24 W @ 1 ms (Unidirectional), per Figure 5
- Peak Power – Minimum 150 W @ 20 μs (Unidirectional), per Figure 6
- ESD Rating of Class 3 (> 16 KV) per Human Body Model
- Maximum Clamp Voltage @ Peak Pulse Current
- Package Designed for Optimal Automated Board Assembly
- Small Package Size for High Density Applications
- Low Leakage < 2.0 μA

Mechanical Characteristics:

CASE: Void-free, transfer-molded, thermosetting plastic

FINISH: All external surfaces are corrosion resistant and leads are readily solderable

MAXIMUM CASE TEMPERATURE FOR SOLDERING PURPOSES: 260°C for 10 Seconds

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (Note 1.) @ 1.0 ms @ $T_L \le 25°C$	P_{PK}	24	W
Peak Power Dissipation (Note 2.) @ 20 μs @ $T_L \le 25°C$	P_{PK}	150	W
Total Power Dissipation (Note 3.) @ $T_A = 25°C$ Derate Above 25°C Thermal Resistance – Junction to Ambient	P_D $R_{\theta JA}$	225 1.8 556	mW mW/°C °C/W
Total Power Dissipation (Note 4.) @ $T_A = 25°C$ Derate Above 25°C Thermal Resistance – Junction to Ambient	P_D $R_{\theta JA}$	300 2.4 417	mW mW/°C °C/W
Junction and Storage Temperature Range	T_J, T_{stg}	–55 to +150	°C

1. Nonrepetitive current pulse per Figure 5 and derated above $T_A = 25°C$ per Figure 4
2. Nonrepetitive current pulse per Figure 6 and derated above $T_A = 25°C$ per Figure 4
3. FR–5 board = 1.0 X 0.75 X 0.62 in.
4. Alumina substrate = 0.4 X 0.3 X 0.024 in., 99.5% alumina

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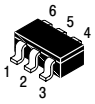
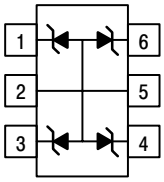
PIN ASSIGNMENT

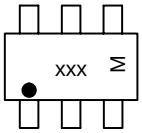


SC–59
CASE 318F
STYLE 1



PIN 1. CATHODE
2. ANODE
3. CATHODE
4. CATHODE
5. ANODE
6. CATHODE

MARKING DIAGRAM



xxx = Device Code
(See Table Next Page)
M = Date Code

ORDERING INFORMATION

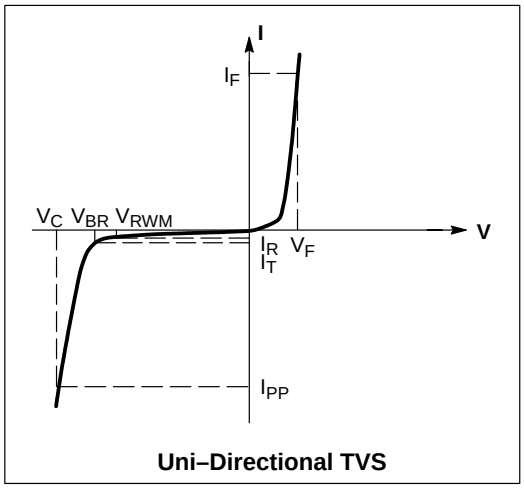
Device †	Package	Shipping
MMQAxxxT1	SC–59	3000/Tape & Reel
MMQAxxxT3	SC–59	10,000/Tape & Reel

†The “T1” suffix refers to an 8 mm, 7 inch reel.
The “T3” suffix refers to an 8 mm, 13 inch reel.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted, V_F = 0.9 V Max. @ I_F (Note 5.) = 10 mA)

Unidirectional (Circuit tied to Pins 1, 2 and 5; Pins 2, 3 and 5; or 2, 4 and 6; or Pins 2, 5 and 6)

Symbol	Parameter
I_{PP}	Maximum Reverse Peak Pulse Current
V_C	Clamping Voltage @ I_{PP}
V_{RWM}	Working Peak Reverse Voltage
I_R	Maximum Reverse Leakage Current @ V_{RWM}
Z_{ZT}	Maximum Zener Impedance @ I_{ZT}
V_{BR}	Breakdown Voltage @ I_T
I_T	Test Current
ΘV_{BR}	Maximum Temperature Coefficient of V_{BR}
I_F	Forward Current
V_F	Forward Voltage @ I_F



Uni–Directional TVS

ELECTRICAL CHARACTERISTICS

Device	Device Marking	V_{RWM}	I_R @ V_{RWM}	Breakdown Voltage				Z_{ZT} (Note 6.) @ I_{ZT}		V_C @ I_{PP} (Note 7.)		ΘV_{BR}
				V_{BR} (Note 5.) (Volts)			@ I_T			V_C	I_{PP}	
		Volts	nA	Min	Nom	Max	mA	Ω	mA	Volts	Amps	mW/°C
MMQA5V6T1	5A6	3.0	2000	5.32	5.6	5.88	1.0	400	1.0	8.0	3.0	1.26
MMQA6V2T1	6A2	4.0	700	5.89	6.2	6.51	1.0	300	1.0	9.0	2.66	10.6
MMQA6V8T1	6A8	4.3	500	6.46	6.8	7.14	1.0	300	1.0	9.8	2.45	10.9
MMQA12VT1	12A	9.1	75	11.4	12	12.6	1.0	80	1.0	17.3	1.39	14
MMQA13VT1	13A	9.8	75	12.35	13	13.65	1.0	80	1.0	18.6	1.29	15
MMQA15VT1	15A	11	75	14.25	15	15.75	1.0	80	1.0	21.7	1.1	16
MMQA18VT1	18A	14	75	17.1	18	18.9	1.0	80	1.0	26	0.923	19
MMQA20VT1	20A	15	75	19.0	20	21.0	1.0	80	1.0	28.6	0.84	20.1
MMQA21VT1	21A	16	75	19.95	21	22.05	1.0	80	1.0	30.3	0.792	21
MMQA22VT1	22A	17	75	20.9	22	23.1	1.0	80	1.0	31.7	0.758	22
MMQA24VT1	24A	18	75	22.8	24	25.2	1.0	100	1.0	34.6	0.694	25
MMQA27VT1	27A	21	75	25.65	27	28.35	1.0	125	1.0	39.0	0.615	28
MMQA30VT1	30A	23	75	28.5	30	31.5	1.0	150	1.0	43.3	0.554	32
MMQA33VT1	33A	25	75	31.35	33	34.65	1.0	200	1.0	48.6	0.504	37

5. V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C
6. Z_{ZT} is measured by dividing the AC voltage drop across the device by the AC current supplied. The specified limits are I_Z(ac) = 0.1 I_Z(dc) with the AC frequency = 1.0 kHz
7. Surge current waveform per Figure 5 and derate per Figure 4

TYPICAL CHARACTERISTICS

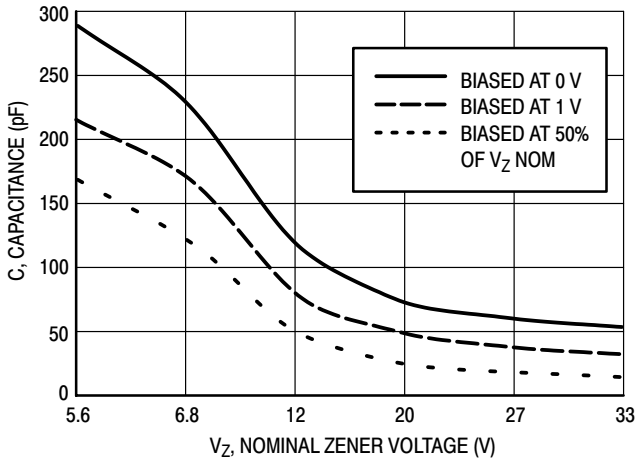


Figure 1. Typical Capacitance

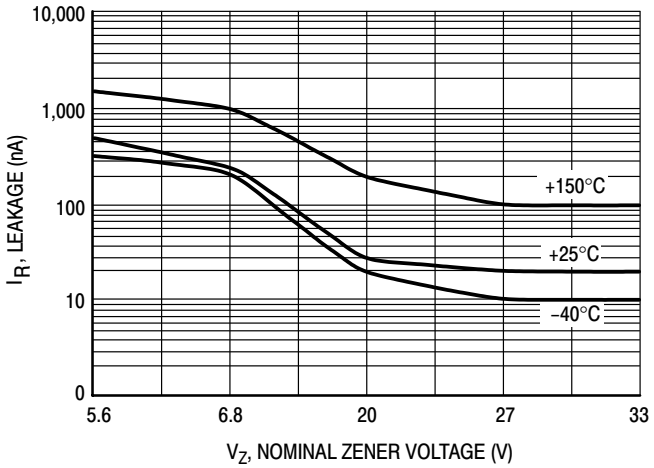


Figure 2. Typical Leakage Current

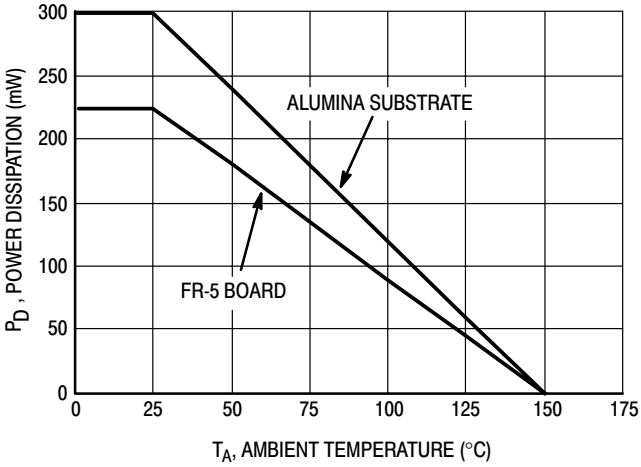


Figure 3. Steady State Power Derating Curve

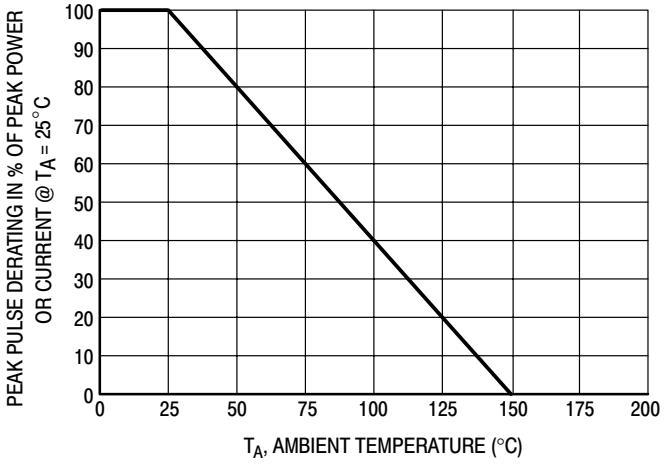


Figure 4. Pulse Derating Curve

TYPICAL CHARACTERISTICS

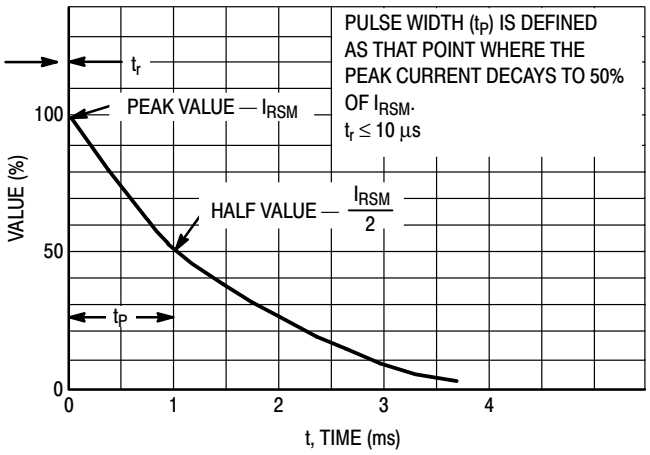


Figure 5. 10 × 1000 μs Pulse Waveform

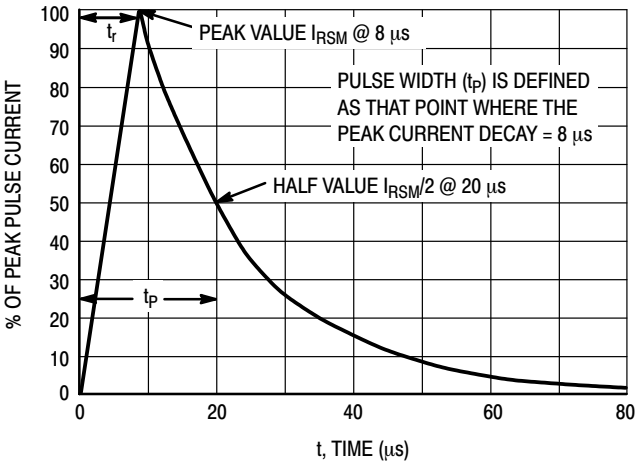


Figure 6. 8 × 20 μs Pulse Waveform

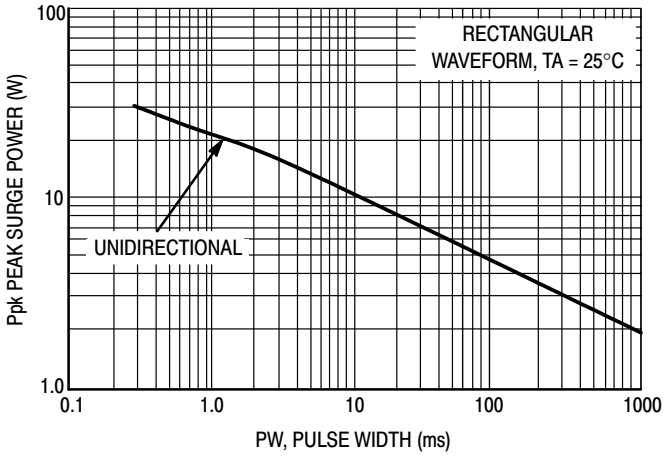


Figure 7. Maximum Non−Repetitive Surge Power, Ppk versus PW

Power is defined as V_{RSM} x I_Z(pk) where V_{RSM} is the clamping voltage at I_Z(pk).

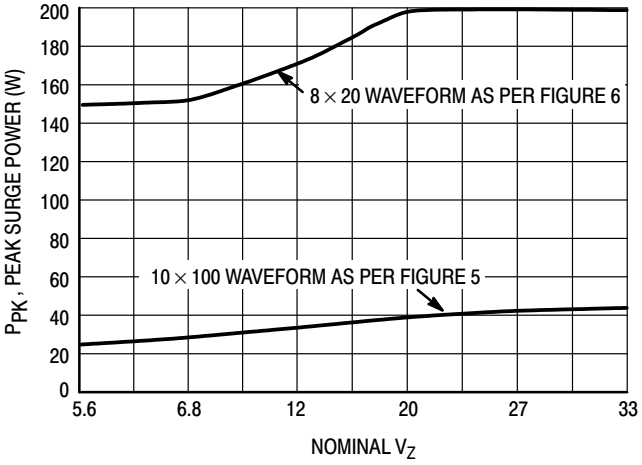
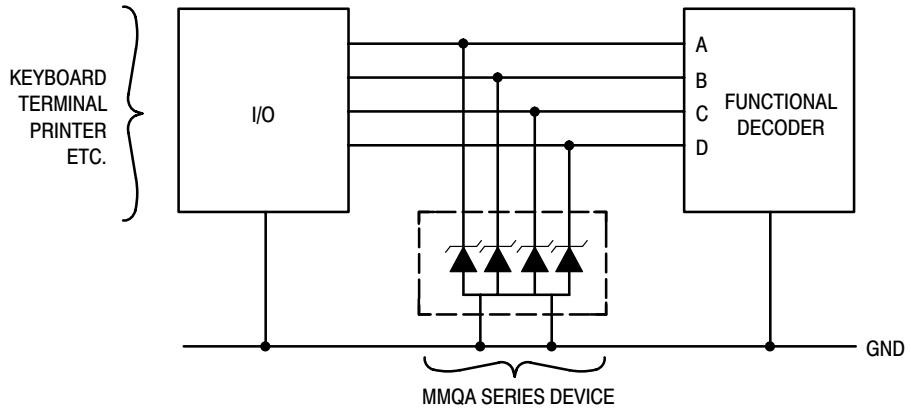


Figure 8. Typical Maximum Non−Repetitive Surge Power, Ppk versus V_{BR}

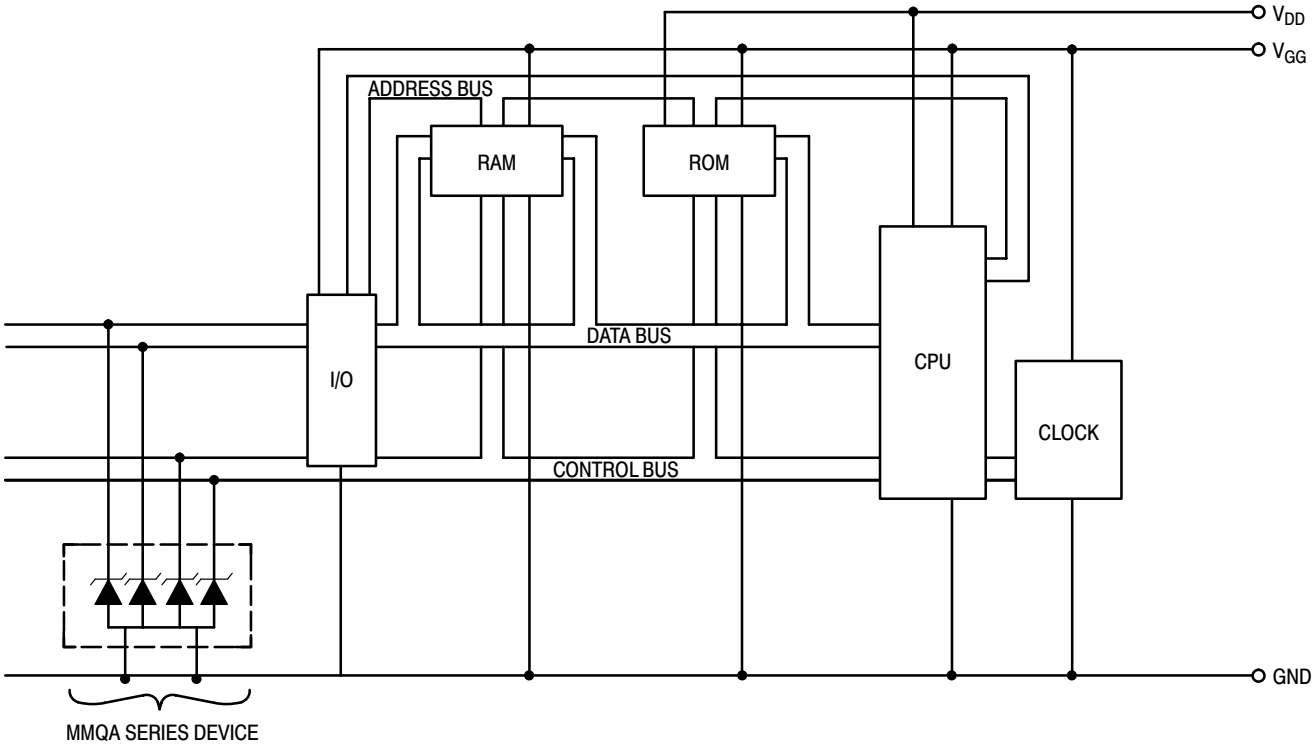
TYPICAL COMMON ANODE APPLICATIONS

A quad junction common anode design in a SC-74 package protects four separate lines using only one package. This adds flexibility and creativity to PCB design especially when board space is at a premium. A simplified example of MMQA Series Device applications is illustrated below.

Computer Interface Protection



Microprocessor Protection



1SMA5.0AT3 Series

400 Watt Peak Power Zener Transient Voltage Suppressors

Unidirectional*

The SMA series is designed to protect voltage sensitive components from high voltage, high energy transients. They have excellent clamping capability, high surge capability, low zener impedance and fast response time. The SMA series is supplied in ON Semiconductor's exclusive, cost-effective, highly reliable Surmetic™ package and is ideally suited for use in communication systems, automotive, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/consumer applications.

Specification Features:

- Working Peak Reverse Voltage Range – 5.0 V to 78 V
- Standard Zener Breakdown Voltage Range – 6.7 V to 91.25 V
- Peak Power – 400 Watts @ 1 ms
- ESD Rating of Class 3 (> 16 KV) per Human Body Model
- Response Time is Typically < 1 ns
- Flat Handling Surface for Accurate Placement
- Package Design for Top Slide or Bottom Circuit Board Mounting
- Low Profile Package

Mechanical Characteristics:

CASE: Void-free, transfer-molded plastic

FINISH: All external surfaces are corrosion resistant and leads are readily solderable

MAXIMUM CASE TEMPERATURE FOR SOLDERING PURPOSES: 260°C for 10 Seconds

POLARITY: Cathode indicated by molded polarity notch or polarity band

MOUNTING POSITION: Any

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (Note 1.) @ T_L = 25°C, Pulse Width = 1 ms	P_{PK}	400	W
DC Power Dissipation @ T_L = 75°C Measured Zero Lead Length (Note 2.) Derate Above 75°C Thermal Resistance from Junction to Lead	P_D $R_{\theta JL}$	1.5 20 50	W mW/°C °C/W
DC Power Dissipation (Note 3.) @ T_A = 25°C Derate Above 25°C Thermal Resistance from Junction to Ambient	P_D $R_{\theta JA}$	0.5 4.0 250	W mW/°C °C/W
Operating and Storage Temperature Range	T_J, T_{stg}	–65 to +150	°C

1. 10 X 1000 μs, non–repetitive
2. 1″ square copper pad, FR–4 board
3. FR–4 board, using ON Semiconductor minimum recommended footprint, as shown in 403B case outline dimensions spec.

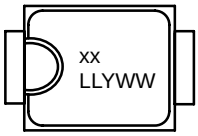
ON Semiconductor™

http://onsemi.com

PLASTIC SURFACE MOUNT ZENER OVERVOLTAGE TRANSIENT SUPPRESSORS 5.0–78 VOLTS V_R 400 WATTS PEAK POWER

SMA
CASE 403B
PLASTIC

MARKING DIAGRAM



xx = Specific Device Code (See Table Next Page)
LL = Assembly Location
Y = Year
WW = Work Week

ORDERING INFORMATION

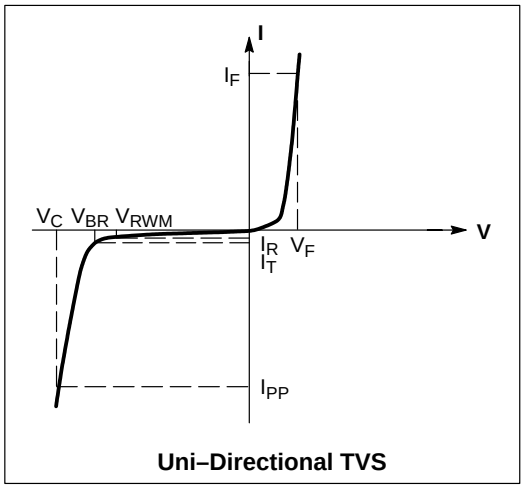
Device †	Package	Shipping
1SMAxxAT3	SMA	5000/Tape & Reel

*Please see 1SMA10CAT3 to 1SMA78CAT3 for Bidirectional devices.

†The "T3" suffix refers to a 13 inch reel.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted, V_F = 3.5 V Max. @ I_F = 40 A for all types)

Symbol	Parameter
I_{PP}	Maximum Reverse Peak Pulse Current
V_C	Clamping Voltage @ I_{PP}
V_{RWM}	Working Peak Reverse Voltage
I_R	Maximum Reverse Leakage Current @ V_{RWM}
V_{BR}	Breakdown Voltage @ I_T
I_T	Test Current
I_F	Forward Current
V_F	Forward Voltage @ I_F



Uni–Directional TVS

ELECTRICAL CHARACTERISTICS

Device	Device Marking	V_{RWM}	I_R @ V_{RWM}	Breakdown Voltage				V_C @ I_{PP}	
				V_{BR} (Volts)			@ I_T	V_C	I_{PP}
		Volts	μA	Min	Nom	Max	mA	Volts	Amps
1SMA5.0AT3	QE	5.0	400	6.4	6.7	7.0	10	9.2	43.5
1SMA6.0AT3	QG	6.0	400	6.67	7.02	7.37	10	10.3	38.8
1SMA6.5AT3	QK	6.5	250	7.22	7.6	7.98	10	11.2	35.7
1SMA7.0AT3	QM	7.0	250	7.78	8.19	8.6	10	12.0	33.3
1SMA7.5AT3	QP	7.5	50	8.33	8.77	9.21	1	12.9	31.0
1SMA8.0AT3	QR	8.0	25	8.89	9.36	9.83	1	13.6	29.4
1SMA8.5AT3	QT	8.5	5.0	9.44	9.92	10.4	1	14.4	27.8
1SMA9.0AT3	QV	9.0	2.5	10	10.55	11.1	1	15.4	26.0
1SMA10AT3	QX	10	2.5	11.1	11.7	12.3	1	17.0	23.5
1SMA11AT3	QZ	11	2.5	12.2	12.85	13.5	1	18.2	22.0
1SMA12AT3	RE	12	2.5	13.3	14.0	14.7	1	19.9	20.1
1SMA13AT3	RG	13	2.5	14.4	15.15	15.9	1	21.5	18.6
1SMA14AT3	RK	14	2.5	15.6	16.4	17.2	1	23.2	17.2
1SMA15AT3	RM	15	2.5	16.7	17.6	18.5	1	24.4	16.4
1SMA16AT3	RP	16	2.5	17.8	18.75	19.7	1	26.0	15.4
1SMA17AT3	RR	17	2.5	18.9	19.9	20.9	1	27.6	14.5
1SMA18AT3	RT	18	2.5	20	21.05	22.1	1	29.2	13.7
1SMA20AT3	RV	20	2.5	22.2	23.35	24.5	1	32.4	12.3
1SMA22AT3	RX	22	2.5	24.4	25.65	26.9	1	35.5	11.3
1SMA24AT3	RZ	24	2.5	26.7	28.1	29.5	1	38.9	10.3
1SMA26AT3	SE	26	2.5	28.9	30.4	31.9	1	42.1	9.5
1SMA28AT3	SG	28	2.5	31.1	32.75	34.4	1	45.4	8.8
1SMA30AT3	SK	30	2.5	33.3	35.05	36.8	1	48.4	8.3
1SMA33AT3	SM	33	2.5	36.7	38.65	40.6	1	53.3	7.5
1SMA36AT3	SP	36	2.5	40	42.1	44.2	1	58.1	6.9
1SMA40AT3	SR	40	2.5	44.4	46.75	49.1	1	64.5	6.2
1SMA43AT3	ST	43	2.5	47.8	50.3	52.8	1	69.4	5.8
1SMA45AT3	SV	45	2.5	50	52.65	55.3	1	72.2	5.5
1SMA48AT3	SX	48	2.5	53.3	56.1	58.9	1	77.4	5.2
1SMA51AT3	SZ	51	2.5	56.7	59.7	62.7	1	82.4	4.9
1SMA54AT3	TE	54	2.5	60	63.15	66.3	1	87.1	4.6
1SMA58AT3	TG	58	2.5	64.4	67.8	71.5	1	93.6	4.3
1SMA60AT3	TK	60	2.5	66.7	70.2	73.7	1	96.8	4.1
1SMA64AT3	TM	64	2.5	71.1	74.85	78.6	1	103	3.9
1SMA70AT3	TP	70	2.5	77.8	81.9	86.0	1	113	3.5
1SMA75AT3	TR	75	2.5	83.3	87.7	92.1	1	121	3.3
1SMA78AT3	TS	78	2.5	86.7	91.25	95.8	1	126	3.2

RATING AND TYPICAL CHARACTERISTIC CURVES

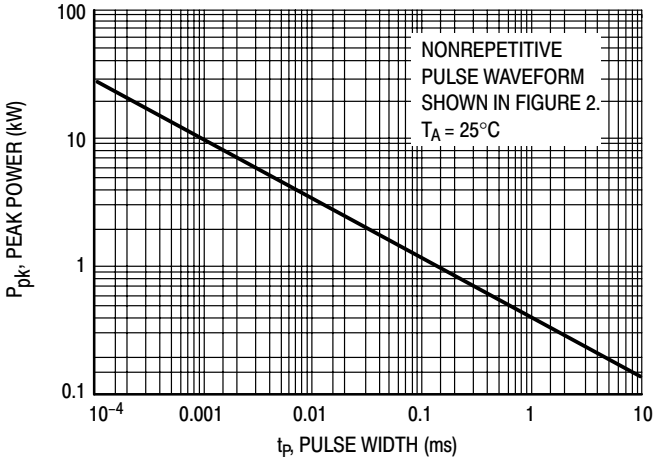


Figure 1. Pulse Rating Curve

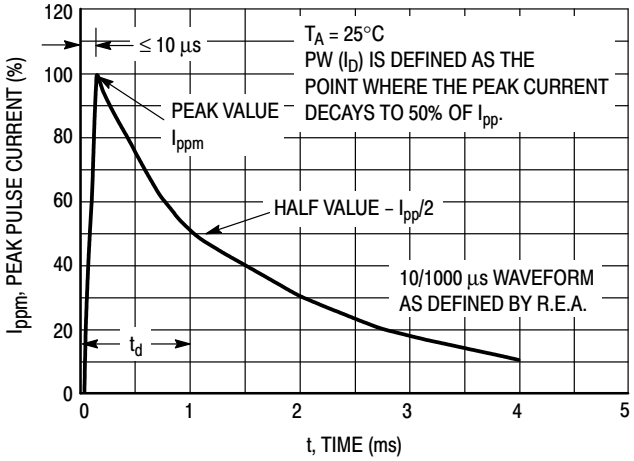


Figure 2. Pulse Waveform

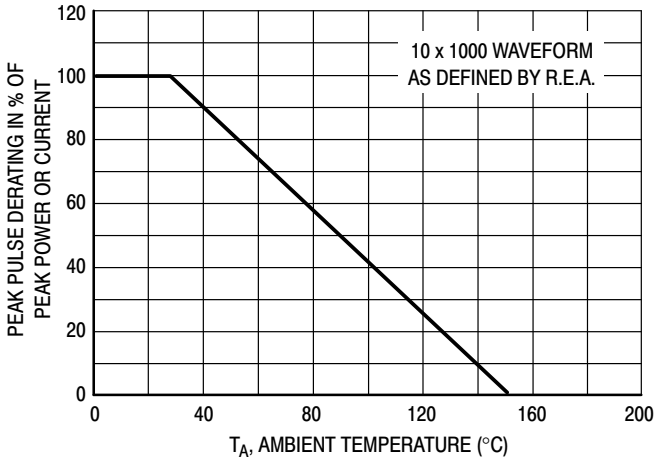


Figure 3. Pulse Derating Curve

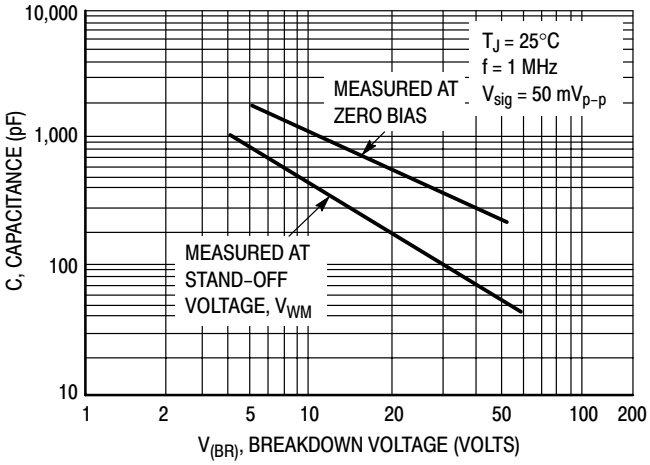


Figure 4. Typical Junction Capacitance

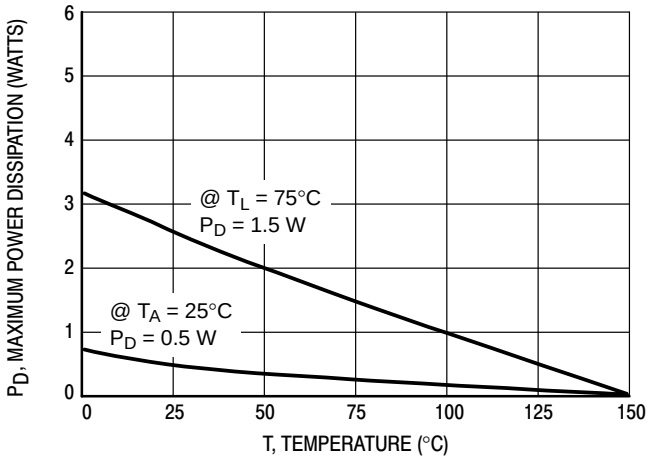


Figure 5. Steady State Power Derating

1SMA10CAT3 Series

400 Watt Peak Power Zener Transient Voltage Suppressors

Bidirectional*

The SMA series is designed to protect voltage sensitive components from high voltage, high energy transients. They have excellent clamping capability, high surge capability, low zener impedance and fast response time. The SMA series is supplied in ON Semiconductor's exclusive, cost-effective, highly reliable Surmetic™ package and is ideally suited for use in communication systems, automotive, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/consumer applications.

Specification Features:

- Working Peak Reverse Voltage Range – 10 V to 78 V
- Standard Zener Breakdown Voltage Range – 11.7 V to 91.3 V
- Peak Power – 400 Watts @ 1 ms
- ESD Rating of Class 3 (> 16 KV) per Human Body Model
- Response Time is Typically < 1 ns
- Flat Handling Surface for Accurate Placement
- Package Design for Top Slide or Bottom Circuit Board Mounting
- Low Profile Package

Mechanical Characteristics:

CASE: Void-free, transfer-molded plastic

FINISH: All external surfaces are corrosion resistant and leads are readily solderable

MAXIMUM CASE TEMPERATURE FOR SOLDERING PURPOSES: 260°C for 10 Seconds

POLARITY: Cathode polarity notch does not indicate polarity

MOUNTING POSITION: Any

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (Note 1.) @ T_L = 25°C, Pulse Width = 1 ms	P_{PK}	400	W
DC Power Dissipation @ T_L = 75°C Measured Zero Lead Length (Note 2.)	P_D	1.5	W
Derate Above 75°C		20	mW/°C
Thermal Resistance from Junction to Lead	$R_{\theta JL}$	50	°C/W
DC Power Dissipation (Note 3.) @ T_A = 25°C	P_D	0.5	W
Derate Above 25°C		4.0	mW/°C
Thermal Resistance from Junction to Ambient	$R_{\theta JA}$	250	°C/W
Operating and Storage Temperature Range	T_J, T_{stg}	–65 to +150	°C

1. 10 X 1000 μs, non–repetitive
2. 1″ square copper pad, FR–4 board
3. FR–4 board, using ON Semiconductor minimum recommended footprint, as shown in 403B case outline dimensions spec.

*Please see 1SMA5.0AT3 to 1SMA78AT3 for Unidirectional devices.

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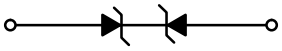
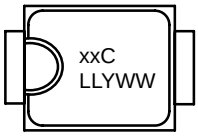
PLASTIC SURFACE MOUNT ZENER OVERVOLTAGE TRANSIENT SUPPRESSORS 10–78 VOLTS V_R 400 WATTS PEAK POWER



SMA
CASE 403B
PLASTIC

MARKING DIAGRAM



xxC = Specific Device Code (See Table Next Page)
LL = Assembly Location
Y = Year
WW = Work Week

ORDERING INFORMATION

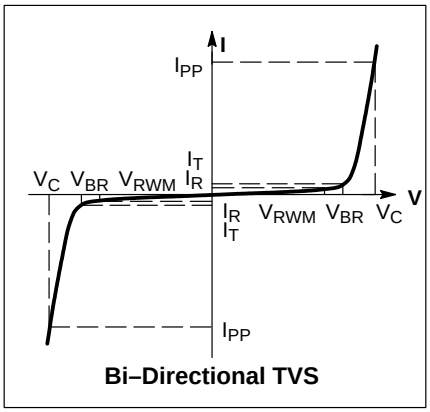
Device †	Package	Shipping
1SMAxxCAT3	SMA	5000/Tape & Reel

†The "T3" suffix refers to a 13 inch reel.

ELECTRICAL CHARACTERISTICS

(T_A = 25°C unless otherwise noted)

Symbol	Parameter
I_{PP}	Maximum Reverse Peak Pulse Current
V_C	Clamping Voltage @ I_{PP}
V_{RWM}	Working Peak Reverse Voltage
I_R	Maximum Reverse Leakage Current @ V_{RWM}
V_{BR}	Breakdown Voltage @ I_T
I_T	Test Current



Bi–Directional TVS

ELECTRICAL CHARACTERISTICS

Device	Device Marking	V_{RWM}	I_R @ V_{RWM}	Breakdown Voltage				V_C @ I_{PP}	
				V_{BR} (Volts)			@ I_T	V_C	I_{PP}
		Volts	μA	Min	Nom	Max	mA	Volts	Amps
1SMA10CAT3	QXC	10	2.5	11.1	11.69	12.27	1.0	17.0	23.5
1SMA11CAT3	QZC	11	2.5	12.2	12.84	13.48	1.0	18.2	22.0
1SMA12CAT3	REC	12	2.5	13.3	14.00	14.70	1.0	19.9	20.1
1SMA13CAT3	RGC	13	2.5	14.4	15.16	15.92	1.0	21.5	18.6
1SMA14CAT3	RKC	14	2.5	15.6	16.42	17.24	1.0	23.2	17.2
1SMA15CAT3	RMC	15	2.5	16.7	17.58	18.46	1.0	24.4	16.4
1SMA16CAT3	RPC	16	2.5	17.8	18.74	19.67	1.0	26.0	15.4
1SMA17CAT3	RRC	17	2.5	18.9	19.90	20.89	1.0	27.6	14.5
1SMA18CAT3	RTC	18	2.5	20	21.06	22.11	1.0	29.2	13.7
1SMA20CAT3	RVC	20	2.5	22.2	23.37	24.54	1.0	32.4	12.3
1SMA22CAT3	RXC	22	2.5	24.4	25.69	26.97	1.0	35.5	11.3
1SMA24CAT3	RZC	24	2.5	26.7	28.11	29.51	1.0	38.9	10.3
1SMA26CAT3	SEC	26	2.5	28.9	30.42	31.94	1.0	42.1	9.5
1SMA28CAT3	SGC	28	2.5	31.1	32.74	34.37	1.0	45.4	8.8
1SMA30CAT3	SKC	30	2.5	33.3	35.06	36.81	1.0	48.4	8.3
1SMA33CAT3	SMC	33	2.5	36.7	38.63	40.56	1.0	53.3	7.5
1SMA36CAT3	SPC	36	2.5	40	42.11	44.21	1.0	58.1	6.9
1SMA40CAT3	SRC	40	2.5	44.4	46.74	49.07	1.0	64.5	6.2
1SMA43CAT3	STC	43	2.5	47.8	50.32	52.83	1.0	69.4	5.8
1SMA45CAT3	SVC	45	2.5	50	52.63	55.26	1.0	72.2	5.5
1SMA48CAT3	SXC	48	2.5	53.3	56.11	58.91	1.0	77.4	5.2
1SMA51CAT3	SZC	51	2.5	56.7	59.69	62.67	1.0	82.4	4.9
1SMA54CAT3	TEC	54	2.5	60	63.16	66.32	1.0	87.1	4.6
1SMA58CAT3	TGC	58	2.5	64.4	67.79	71.18	1.0	93.6	4.3
1SMA60CAT3	TKC	60	2.5	66.7	70.21	73.72	1.0	96.8	4.1
1SMA64CAT3	TMC	64	2.5	71.1	74.84	78.58	1.0	103	3.9
1SMA70CAT3	TPC	70	2.5	77.8	81.90	85.99	1.0	113	3.5
1SMA75CAT3	TRC	75	2.5	83.3	87.69	92.07	1.0	121	3.3
1SMA78CAT3	TTC	78	2.5	86.7	91.27	95.83	1.0	126	3.2

RATING AND TYPICAL CHARACTERISTIC CURVES

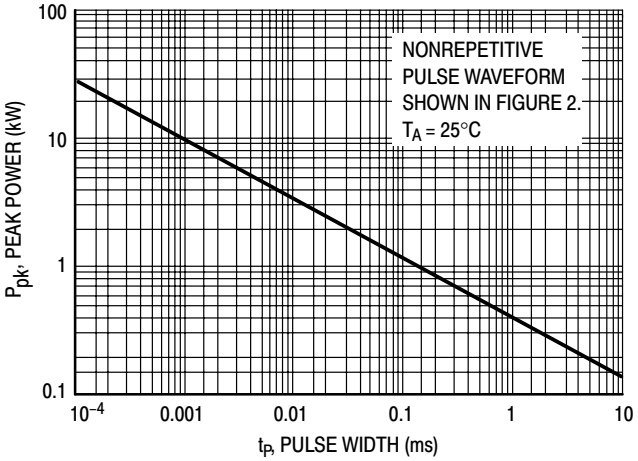


Figure 1. Pulse Rating Curve

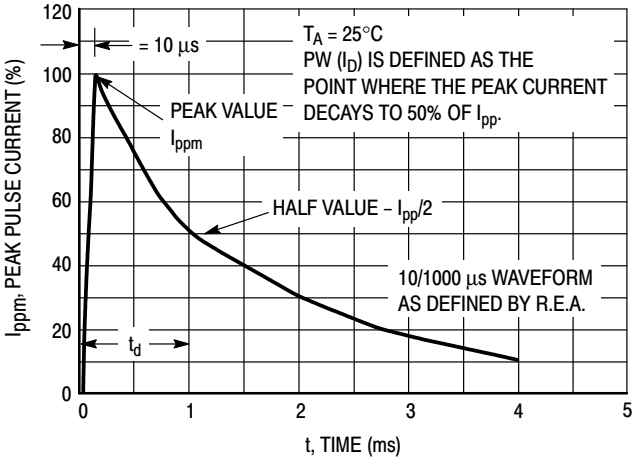


Figure 2. Pulse Waveform

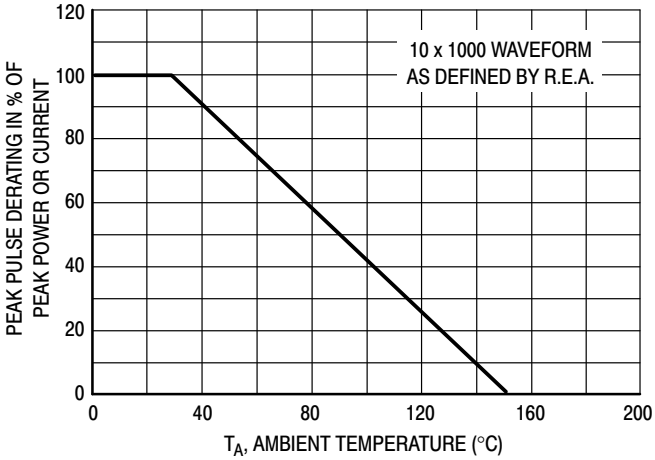


Figure 3. Pulse Derating Curve

1SMB5.0AT3 Series

600 Watt Peak Power Zener Transient Voltage Suppressors

Unidirectional*

The SMB series is designed to protect voltage sensitive components from high voltage, high energy transients. They have excellent clamping capability, high surge capability, low zener impedance and fast response time. The SMB series is supplied in ON Semiconductor's exclusive, cost-effective, highly reliable Surmetic™ package and is ideally suited for use in communication systems, automotive, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/consumer applications.

Specification Features:

- Working Peak Reverse Voltage Range – 5.0 V to 170 V
- Standard Zener Breakdown Voltage Range – 6.7 V to 199 V
- Peak Power – 600 Watts @ 1 ms
- ESD Rating of Class 3 (>16 KV) per Human Body Model
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5 μA Above 10 V
- UL 497B for Isolated Loop Circuit Protection
- Response Time is Typically < 1 ns

Mechanical Characteristics:

CASE: Void-free, transfer-molded, thermosetting plastic

FINISH: All external surfaces are corrosion resistant and leads are readily solderable

MAXIMUM CASE TEMPERATURE FOR SOLDERING PURPOSES: 260°C for 10 Seconds

LEADS: Modified L–Bend providing more contact area to bond pads

POLARITY: Cathode indicated by polarity band

MOUNTING POSITION: Any

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (Note 1.) @ T_L = 25°C, Pulse Width = 1 ms	P_{PK}	600	W
DC Power Dissipation @ T_L = 75°C Measured Zero Lead Length (Note 2.) Derate Above 75°C Thermal Resistance from Junction to Lead	P_D $R_{\theta JL}$	3.0 40 25	W mW/°C °C/W
DC Power Dissipation (Note 3.) @ T_A = 25°C Derate Above 25°C Thermal Resistance from Junction to Ambient	P_D $R_{\theta JA}$	0.55 4.4 226	W mW/°C °C/W
Operating and Storage Temperature Range	T_J, T_{stg}	–65 to +150	°C

1. 10 X 1000 μs, non–repetitive
2. 1″ square copper pad, FR–4 board
3. FR–4 board, using ON Semiconductor minimum recommended footprint, as shown in 403B case outline dimensions spec.

*Please see 1SMB10CAT3 to 1SMB78CAT3 for Bidirectional devices.

ON Semiconductor™

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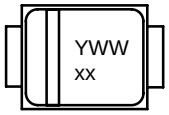
PLASTIC SURFACE MOUNT ZENER OVERVOLTAGE TRANSIENT SUPPRESSORS 5.0–170 VOLTS 600 WATT PEAK POWER

SMB
CASE 403A
PLASTIC

MARKING DIAGRAM



Y = Year
WW = Work Week
xx = Specific Device Code
(See Table Page 63)

ORDERING INFORMATION

Device †	Package	Shipping
1SMBxxxAT3	SMB	2500/Tape & Reel

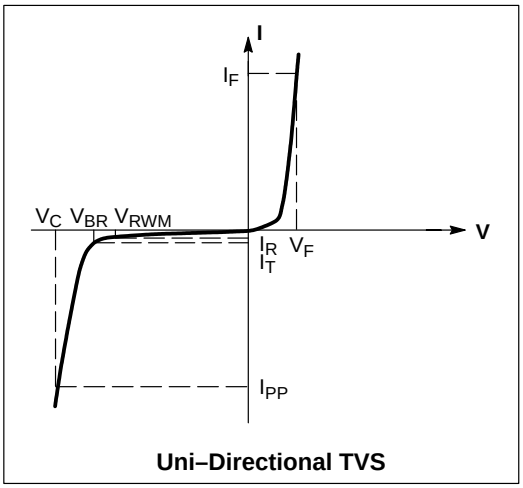
Devices listed in ***bold, italic*** are ON Semiconductor **Preferred** devices. **Preferred** devices are recommended choices for future use and best overall value.

†The "T3" suffix refers to a 13 inch reel.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted, V_F = 3.5 V Max. @ I_F (Note 4.) = 30 A)

Symbol	Parameter
I_{PP}	Maximum Reverse Peak Pulse Current
V_C	Clamping Voltage @ I_{PP}
V_{RWM}	Working Peak Reverse Voltage
I_R	Maximum Reverse Leakage Current @ V_{RWM}
V_{BR}	Breakdown Voltage @ I_T
I_T	Test Current
I_F	Forward Current
V_F	Forward Voltage @ I_F

4. 1/2 sine wave (or equivalent square wave), PW = 8.3 ms, duty cycle = 4 pulses per minute maximum.



Uni–Directional TVS

ELECTRICAL CHARACTERISTICS (Devices listed in bold, italic are ON Semiconductor Preferred devices.)

Device	Device Marking	V_{RWM} (Note 5.)	I_R @ V_{RWM}	Breakdown Voltage				V_C @ I_{PP} (Note 7.)	
				V_{BR} (Note 6.) Volts			@ I_T	V_C	I_{PP}
		Volts	μA	Min	Nom	Max	mA	Volts	Amps
1SMB5.0AT3	***KE***	***5.0***	***800***	***6.40***	***6.7***	***7.0***	***10***	***9.2***	***65.2***
1SMB6.0AT3	***KG***	***6.0***	***800***	***6.67***	***7.02***	***7.37***	***10***	***10.3***	***58.3***
1SMB6.5AT3	KK	6.5	500	7.22	7.6	7.98	10	11.2	53.6
1SMB7.0AT3	KM	7.0	500	7.78	8.19	8.6	10	12.0	50.0
1SMB7.5AT3	KP	7.5	100	8.33	8.77	9.21	1.0	12.9	46.5
1SMB8.0AT3	KR	8.0	50	8.89	9.36	9.83	1.0	13.6	44.1
1SMB8.5AT3	KT	8.5	10	9.44	9.92	10.4	1.0	14.4	41.7
1SMB9.0AT3	KV	9.0	5.0	10.0	10.55	11.1	1.0	15.4	39.0
1SMB10AT3	KX	10	5.0	11.1	11.7	12.3	1.0	17.0	35.3
1SMB11AT3	KZ	11	5.0	12.2	12.85	13.5	1.0	18.2	33.0
1SMB12AT3	LE	12	5.0	13.3	14	14.7	1.0	19.9	30.2
1SMB13AT3	LG	13	5.0	14.4	15.15	15.9	1.0	21.5	27.9
1SMB14AT3	LK	14	5.0	15.6	16.4	17.2	1.0	23.2	25.8
1SMB15AT3	LM	15	5.0	16.7	17.6	18.5	1.0	24.4	24.0
1SMB16AT3	LP	16	5.0	17.8	18.75	19.7	1.0	26.0	23.1
1SMB17AT3	LR	17	5.0	18.9	19.9	20.9	1.0	27.6	21.7
1SMB18AT3	LT	18	5.0	20.0	21.05	22.1	1.0	29.2	20.5
1SMB20AT3	LV	20	5.0	22.2	23.35	24.5	1.0	32.4	18.5
1SMB22AT3	***LX***	***22***	***5.0***	***24.4***	***25.65***	***26.9***	***1.0***	***35.5***	***16.9***
1SMB24AT3	LZ	24	5.0	26.7	28.1	29.5	1.0	38.9	15.4
1SMB26AT3	ME	26	5.0	28.9	30.4	31.9	1.0	42.1	14.2
1SMB28AT3	MG	28	5.0	31.1	32.75	34.4	1.0	45.4	13.2
1SMB30AT3	MK	30	5.0	33.3	35.05	36.8	1.0	48.4	12.4
1SMB33AT3	MM	33	5.0	36.7	38.65	40.6	1.0	53.3	11.3
1SMB36AT3	MP	36	5.0	40.0	42.1	44.2	1.0	58.1	10.3
1SMB40AT3	MR	40	5.0	44.4	46.75	49.1	1.0	64.5	9.3
1SMB43AT3	MT	43	5.0	47.8	50.3	52.8	1.0	69.4	8.6
1SMB45AT3	MV	45	5.0	50.0	52.65	55.3	1.0	72.7	8.3
1SMB48AT3	MX	48	5.0	53.3	56.1	58.9	1.0	77.4	7.7
1SMB51AT3	MZ	51	5.0	56.7	59.7	62.7	1.0	82.4	7.3
1SMB54AT3	NE	54	5.0	60.0	63.15	66.3	1.0	87.1	6.9
1SMB58AT3	***NG***	***58***	***5.0***	***64.4***	***67.8***	***71.2***	***1.0***	***93.6***	***6.4***
1SMB60AT3	NK	60	5.0	66.7	70.2	73.7	1.0	96.8	6.2
1SMB64AT3	NM	64	5.0	71.1	74.85	78.6	1.0	103	5.8
1SMB70AT3	NP	70	5.0	77.8	81.9	86	1.0	113	5.3
1SMB75AT3	NR	75	5.0	83.3	87.7	92.1	1.0	121	4.9
1SMB78AT3	NT	78	5.0	86.7	91.25	95.8	1.0	126	4.7
1SMB85AT3	NV	85	5.0	94.4	99.2	104	1.0	137	4.4
1SMB90AT3	NX	90	5.0	100	105.5	111	1.0	146	4.1
1SMB100AT3	NZ	100	5.0	111	117	123	1.0	162	3.7
1SMB110AT3	PE	110	5.0	122	128.5	135	1.0	177	3.4
1SMB120AT3	PG	120	5.0	133	140	147	1.0	193	3.1
1SMB130AT3	PK	130	5.0	144	151.5	159	1.0	209	2.9
1SMB150AT3	PM	150	5.0	167	176	185	1.0	243	2.5
1SMB160AT3	PP	160	5.0	178	187.5	197	1.0	259	2.3
1SMB170AT3	PR	170	5.0	189	199	209	1.0	275	2.2

5. A transient suppressor is normally selected according to the maximum working peak reverse voltage (V_{RWM}), which should be equal to or greater than the DC or continuous peak operating voltage level.
6. V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C.
7. Surge current waveform per Figure 2 and derate per Figure 3 of the General Data – 600 W at the beginning of this group.

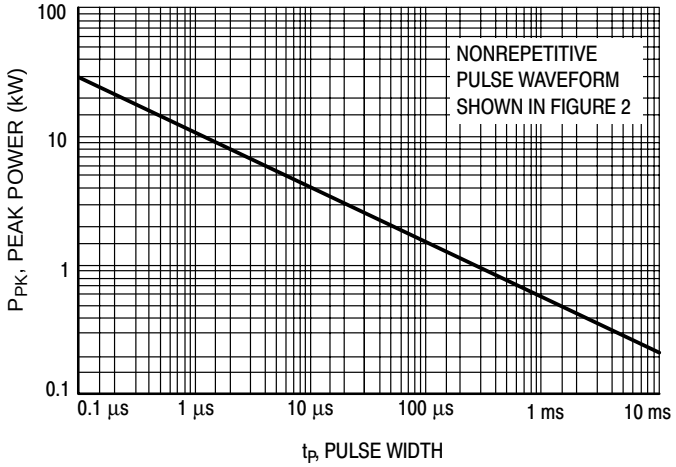


Figure 1. Pulse Rating Curve

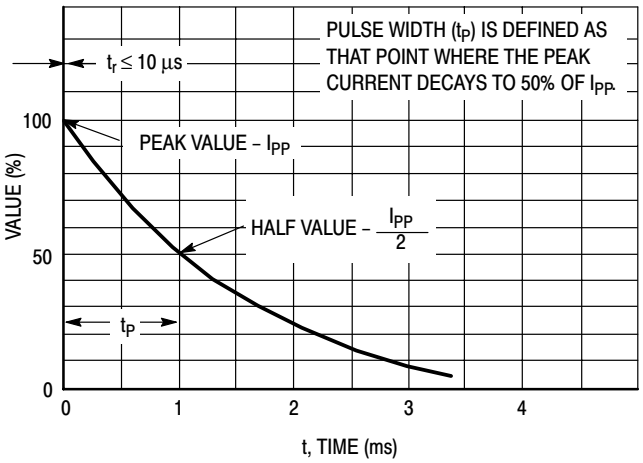


Figure 2. Pulse Waveform

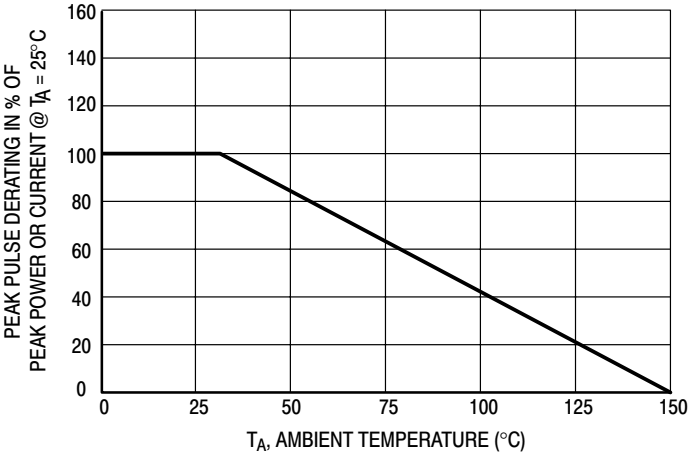
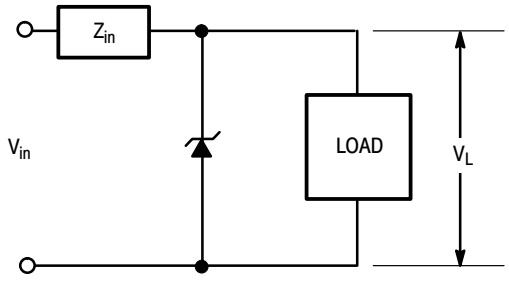


Figure 3. Pulse Derating Curve

TYPICAL PROTECTION CIRCUIT



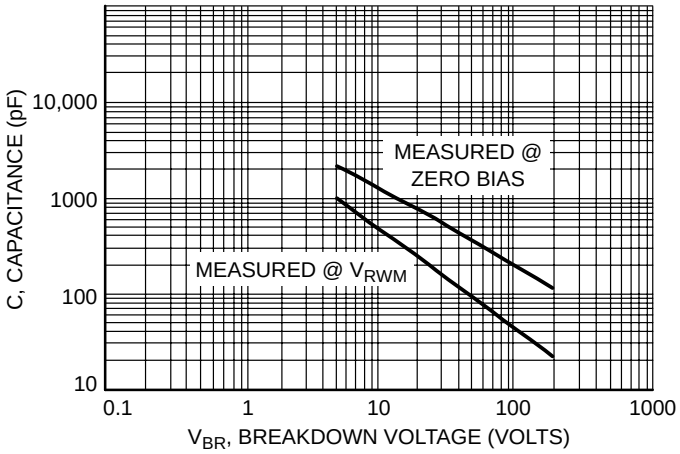


Figure 4. Capacitance versus Breakdown Voltage

APPLICATION NOTES

RESPONSE TIME

In most applications, the transient suppressor device is placed in parallel with the equipment or component to be protected. In this situation, there is a time delay associated with the capacitance of the device and an overshoot condition associated with the inductance of the device and the inductance of the connection method. The capacitive effect is of minor importance in the parallel protection scheme because it only produces a time delay in the transition from the operating voltage to the clamp voltage as shown in Figure 5.

The inductive effects in the device are due to actual turn-on time (time required for the device to go from zero current to full current) and lead inductance. This inductive effect produces an overshoot in the voltage across the equipment or component being protected as shown in Figure 6. Minimizing this overshoot is very important in the application, since the main purpose for adding a transient suppressor is to clamp voltage spikes. The SMB series have a very good response time, typically < 1 ns and negligible inductance. However, external inductive effects could produce unacceptable overshoot. Proper circuit layout, minimum lead lengths and placing the suppressor device as close as possible to the equipment or components to be protected will minimize this overshoot.

Some input impedance represented by Z_{in} is essential to prevent overstress of the protection device. This impedance should be as high as possible, without restricting the circuit operation.

DUTY CYCLE DERATING

The data of Figure 1 applies for non-repetitive conditions and at a lead temperature of 25°C. If the duty cycle increases, the peak power must be reduced as indicated by the curves of Figure 7. Average power must be derated as the lead or ambient temperature rises above 25°C. The average power derating curve normally given on data sheets may be normalized and used for this purpose.

At first glance the derating curves of Figure 7 appear to be in error as the 10 ms pulse has a higher derating factor than the 10 μs pulse. However, when the derating factor for a given pulse of Figure 7 is multiplied by the peak power value of Figure 1 for the same pulse, the results follow the expected trend.

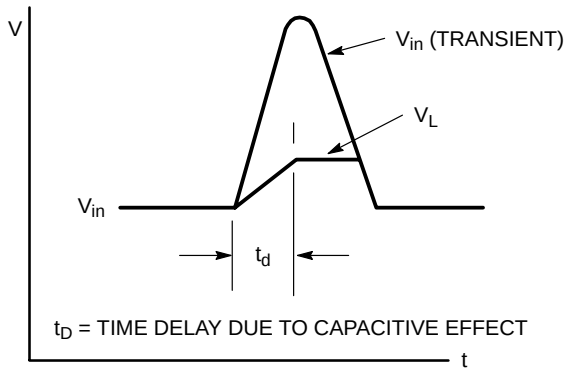


Figure 5.

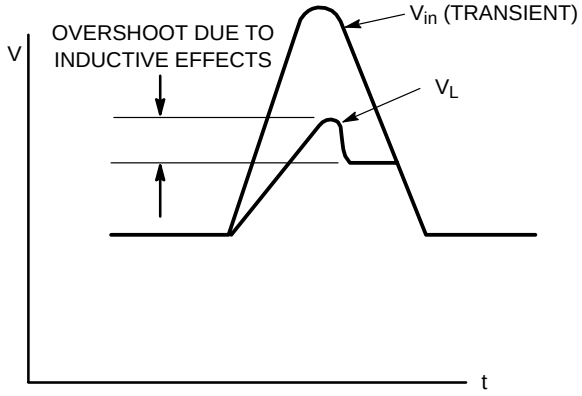


Figure 6.

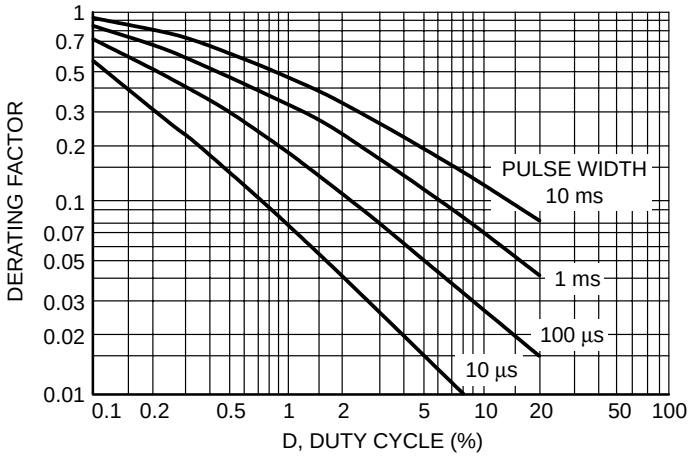


Figure 7. Typical Derating Factor for Duty Cycle

UL RECOGNITION

The entire series has *Underwriters Laboratory Recognition* for the classification of protectors (QVGV2) under the UL standard for safety 497B and File #116110. Many competitors only have one or two devices recognized or have recognition in a non-protective category. Some competitors have no recognition at all. With the UL497B recognition, our parts successfully passed several tests including Strike Voltage Breakdown test, Endurance Conditioning, Temperature test, Dielectric Voltage-Withstand test, Discharge test and several more.

Whereas, some competitors have only passed a flammability test for the package material, we have been recognized for much more to be included in their Protector category.

1SMB10CAT3 Series

600 Watt Peak Power Zener Transient Voltage Suppressors

Bidirectional*

The SMB series is designed to protect voltage sensitive components from high voltage, high energy transients. They have excellent clamping capability, high surge capability, low zener impedance and fast response time. The SMB series is supplied in ON Semiconductor's exclusive, cost-effective, highly reliable Surmetic™ package and is ideally suited for use in communication systems, automotive, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/consumer applications.

Specification Features:

- Working Peak Reverse Voltage Range – 10 V to 78 V
- Standard Zener Breakdown Voltage Range – 11.7 V to 91.3 V
- Peak Power – 600 Watts @ 1 ms
- ESD Rating of Class 3 (> 16 KV) per Human Body Model
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5 μA Above 10 V
- UL 497B for Isolated Loop Circuit Protection
- Response Time is Typically < 1 ns

Mechanical Characteristics:

CASE: Void-free, transfer-molded, thermosetting plastic

FINISH: All external surfaces are corrosion resistant and leads are readily solderable

MAXIMUM CASE TEMPERATURE FOR SOLDERING PURPOSES: 260°C for 10 Seconds

LEADS: Modified L–Bend providing more contact area to bond pads

POLARITY: Polarity band will not be indicated

MOUNTING POSITION: Any

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (Note 1.) @ T_L = 25°C, Pulse Width = 1 ms	P_{PK}	600	W
DC Power Dissipation @ T_L = 75°C Measured Zero Lead Length (Note 2.) Derate Above 75°C Thermal Resistance from Junction to Lead	P_D $R_{\theta JL}$	3.0 40 25	W mW/°C °C/W
DC Power Dissipation (Note 3.) @ T_A = 25°C Derate Above 25°C Thermal Resistance from Junction to Ambient	P_D $R_{\theta JA}$	0.55 4.4 226	W mW/°C °C/W
Operating and Storage Temperature Range	T_J, T_{stg}	–65 to +150	°C

1. 10 X 1000 μs, non–repetitive
2. 1″ square copper pad, FR–4 board
3. FR–4 board, using ON Semiconductor minimum recommended footprint, as shown in 403B case outline dimensions spec.

*Please see 1SMB5.0AT3 to 1SMB170AT3 for Unidirectional devices.

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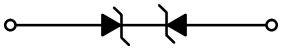
PLASTIC SURFACE MOUNT ZENER OVERVOLTAGE TRANSIENT SUPPRESSORS 10–78 VOLTS 600 WATT PEAK POWER



SMB
CASE 403A
PLASTIC

MARKING DIAGRAM

Y = Year
WW = Work Week
xxC = Specific Device Code (See Table Next Page)

ORDERING INFORMATION

Device †	Package	Shipping
1SMBxxCAT3	SMB	2500/Tape & Reel

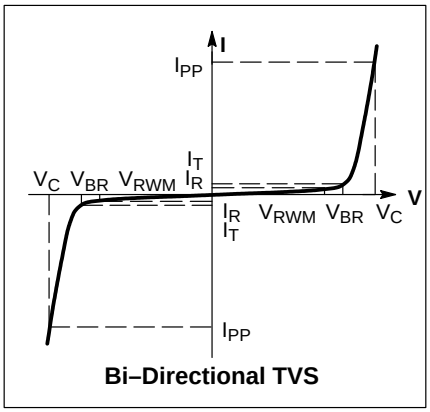
Devices listed in ***bold, italic*** are ON Semiconductor **Preferred** devices. **Preferred** devices are recommended choices for future use and best overall value.

†The "T3" suffix refers to a 13 inch reel.

ELECTRICAL CHARACTERISTICS

(T_A = 25°C unless otherwise noted)

Symbol	Parameter
I_{PP}	Maximum Reverse Peak Pulse Current
V_C	Clamping Voltage @ I_{PP}
V_{RWM}	Working Peak Reverse Voltage
I_R	Maximum Reverse Leakage Current @ V_{RWM}
V_{BR}	Breakdown Voltage @ I_T
I_T	Test Current



Bi–Directional TVS

ELECTRICAL CHARACTERISTICS (Devices listed in bold, italic are ON Semiconductor Preferred devices.)

Device	Device Marking	V_{RWM} (Note 4.)	I_R @ V_{RWM}	Breakdown Voltage				V_C @ I_{PP} (Note 6.)	
				V_{BR} (Note 5.) Volts			@ I_T	V_C	I_{PP}
		Volts	μA	Min	Nom	Max	mA	Volts	Amps
1SMB10CAT3	KXC	10	5.0	11.1	11.69	12.27	1.0	17.0	35.3
1SMB11CAT3	KZC	11	5.0	12.2	12.84	13.5	1.0	18.2	33.0
1SMB12CAT3	LEC	12	5.0	13.3	14.00	14.7	1.0	19.9	30.2
1SMB13CAT3	LGC	13	5.0	14.4	15.16	15.9	1.0	21.5	27.9
1SMB14CAT3	LKC	14	5.0	15.6	16.42	17.2	1.0	23.2	25.8
1SMB15CAT3	***LMC***	***15***	***5.0***	***16.7***	***17.58***	***18.5***	***1.0***	***24.4***	***24.0***
1SMB16CAT3	LPC	16	5.0	17.8	18.74	19.7	1.0	26.0	23.1
1SMB17CAT3	LRC	17	5.0	18.9	19.90	20.9	1.0	27.6	21.7
1SMB18CAT3	LTC	18	5.0	20.0	21.06	22.1	1.0	29.2	20.5
1SMB20CAT3	LVC	20	5.0	22.2	23.37	24.5	1.0	32.4	18.5
1SMB22CAT3	LXC	22	5.0	24.4	25.69	27.0	1.0	35.5	16.9
1SMB24CAT3	LZC	24	5.0	26.7	28.11	29.5	1.0	38.9	15.4
1SMB26CAT3	MEC	26	5.0	28.9	30.42	31.9	1.0	42.1	14.2
1SMB28CAT3	MGC	28	5.0	31.1	32.74	34.4	1.0	45.4	13.2
1SMB30CAT3	MKC	30	5.0	33.3	35.06	36.8	1.0	48.4	12.4
1SMB33CAT3	MMC	33	5.0	36.7	38.63	40.6	1.0	53.3	11.3
1SMB36CAT3	MPC	36	5.0	40.0	42.11	44.2	1.0	58.1	10.3
1SMB40CAT3	MRC	40	5.0	44.4	46.74	49.1	1.0	64.5	9.3
1SMB43CAT3	MTC	43	5.0	47.8	50.32	52.8	1.0	69.4	8.6
1SMB45CAT3	MVC	45	5.0	50.0	52.63	55.3	1.0	72.2	8.3
1SMB48CAT3	MXC	48	5.0	53.3	56.11	58.9	1.0	77.4	7.7
1SMB51CAT3	MZC	51	5.0	56.7	59.69	62.7	1.0	82.4	7.3
1SMB54CAT3	NEC	54	5.0	60.0	63.16	66.32	1.0	87.1	6.9
1SMB58CAT3	NGC	58	5.0	64.4	67.79	71.18	1.0	93.6	6.4
1SMB60CAT3	NKC	60	5.0	66.7	70.21	73.72	1.0	96.8	6.2
1SMB64CAT3	NMC	64	5.0	71.1	74.84	78.58	1.0	103	5.8
1SMB70CAT3	NPC	70	5.0	77.8	81.90	85.99	1.0	113	5.3
1SMB75CAT3	NRC	75	5.0	83.3	91.65	92.07	1.0	121	4.9
1SMB78CAT3	NTC	78	5.0	86.7	91.26	95.83	1.0	126	4.7

4. A transient suppressor is normally selected according to the maximum working peak reverse voltage (V_{RWM}), which should be equal to or greater than the DC or continuous peak operating voltage level.
5. V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C.
6. Surge current waveform per Figure 2 and derate per Figure 3 of the General Data – 600 Watt at the beginning of this group.

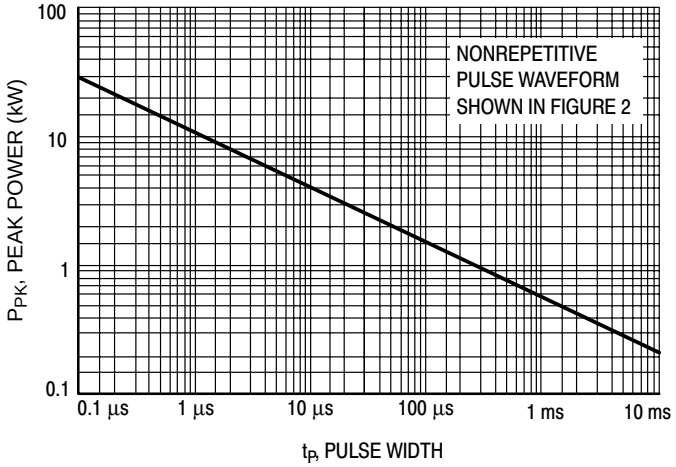


Figure 1. Pulse Rating Curve

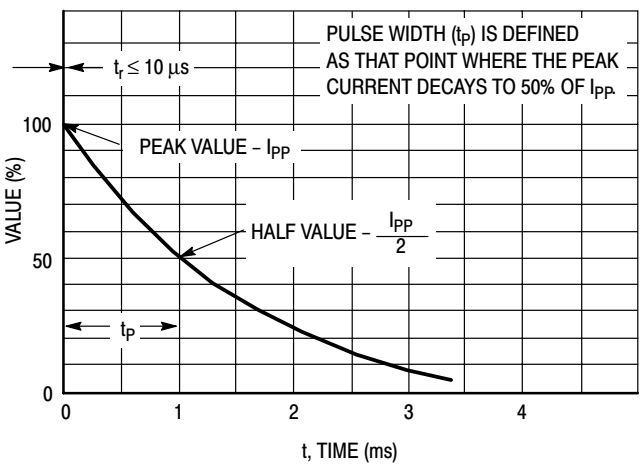


Figure 2. Pulse Waveform

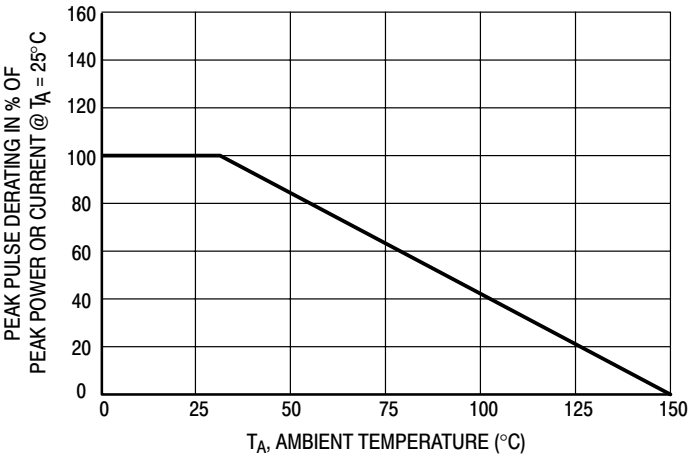
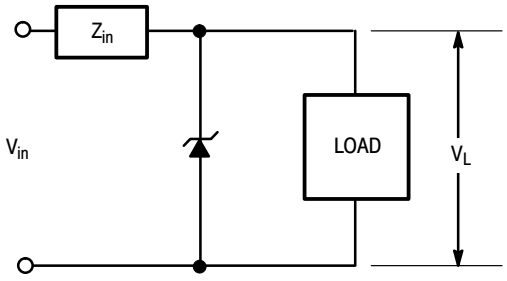


Figure 3. Pulse Derating Curve

TYPICAL PROTECTION CIRCUIT



APPLICATION NOTES

RESPONSE TIME

In most applications, the transient suppressor device is placed in parallel with the equipment or component to be protected. In this situation, there is a time delay associated with the capacitance of the device and an overshoot condition associated with the inductance of the device and the inductance of the connection method. The capacitive effect is of minor importance in the parallel protection scheme because it only produces a time delay in the transition from the operating voltage to the clamp voltage as shown in Figure 4.

The inductive effects in the device are due to actual turn-on time (time required for the device to go from zero current to full current) and lead inductance. This inductive effect produces an overshoot in the voltage across the equipment or component being protected as shown in Figure 5. Minimizing this overshoot is very important in the application, since the main purpose for adding a transient suppressor is to clamp voltage spikes. The SMB series have a very good response time, typically < 1 ns and negligible inductance. However, external inductive effects could produce unacceptable overshoot. Proper circuit layout, minimum lead lengths and placing the suppressor device as close as possible to the equipment or components to be protected will minimize this overshoot.

Some input impedance represented by Z_{in} is essential to prevent overstress of the protection device. This impedance should be as high as possible, without restricting the circuit operation.

DUTY CYCLE DERATING

The data of Figure 1 applies for non-repetitive conditions and at a lead temperature of 25°C. If the duty cycle increases, the peak power must be reduced as indicated by the curves of Figure 6. Average power must be derated as the lead or ambient temperature rises above 25°C. The average power derating curve normally given on data sheets may be normalized and used for this purpose.

At first glance the derating curves of Figure 6 appear to be in error as the 10 ms pulse has a higher derating factor than the 10 μs pulse. However, when the derating factor for a given pulse of Figure 6 is multiplied by the peak power value of Figure 1 for the same pulse, the results follow the expected trend.

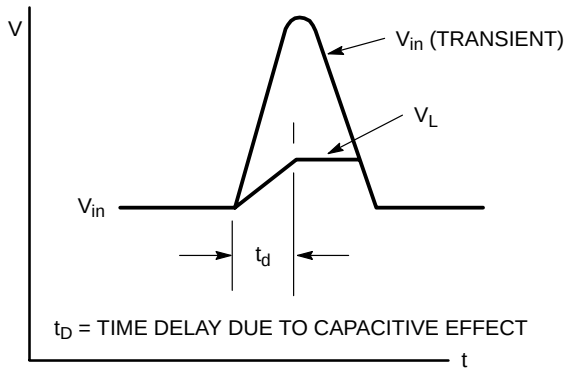


Figure 4.

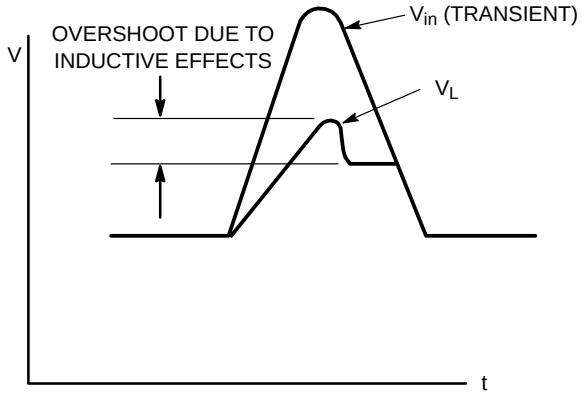


Figure 5.

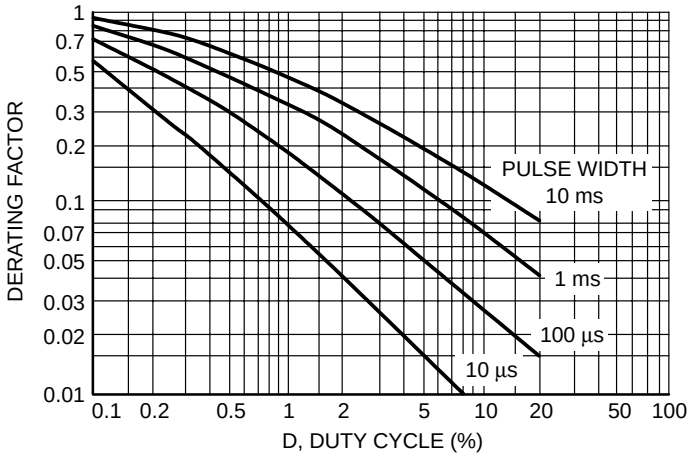


Figure 6. Typical Derating Factor for Duty Cycle

UL RECOGNITION

The entire series has *Underwriters Laboratory Recognition* for the classification of protectors (QVGV2) under the UL standard for safety 497B and File #116110. Many competitors only have one or two devices recognized or have recognition in a non-protective category. Some competitors have no recognition at all. With the UL497B recognition, our parts successfully passed several tests including Strike Voltage Breakdown test, Endurance Conditioning, Temperature test, Dielectric Voltage-Withstand test, Discharge test and several more.

Whereas, some competitors have only passed a flammability test for the package material, we have been recognized for much more to be included in their Protector category.

P6SMB6.8AT3 Series

600 Watt Peak Power Zener Transient Voltage Suppressors

Unidirectional*

The SMB series is designed to protect voltage sensitive components from high voltage, high energy transients. They have excellent clamping capability, high surge capability, low zener impedance and fast response time. The SMB series is supplied in ON Semiconductor's exclusive, cost-effective, highly reliable Surmetic™ package and is ideally suited for use in communication systems, automotive, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/consumer applications.

Specification Features:

- Working Peak Reverse Voltage Range – 5.8 to 171 V
- Standard Zener Breakdown Voltage Range – 6.8 to 200 V
- Peak Power – 600 Watts @ 1 ms
- ESD Rating of Class 3 (>16 KV) per Human Body Model
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5 μA Above 10 V
- UL 497B for Isolated Loop Circuit Protection
- Response Time is Typically < 1 ns

Mechanical Characteristics:

CASE: Void-free, transfer-molded, thermosetting plastic

FINISH: All external surfaces are corrosion resistant and leads are readily solderable

MAXIMUM CASE TEMPERATURE FOR SOLDERING PURPOSES: 260°C for 10 Seconds

LEADS: Modified L–Bend providing more contact area to bond pads

POLARITY: Cathode indicated by polarity band

MOUNTING POSITION: Any

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (Note 1.) @ T_L = 25°C, Pulse Width = 1 ms	P_{PK}	600	W
DC Power Dissipation @ T_L = 75°C Measured Zero Lead Length (Note 2.) Derate Above 75°C Thermal Resistance from Junction to Lead	P_D $R_{\theta JL}$	3.0 40 25	W mW/°C °C/W
DC Power Dissipation (Note 3.) @ T_A = 25°C Derate Above 25°C Thermal Resistance from Junction to Ambient	P_D $R_{\theta JA}$	0.55 4.4 226	W mW/°C °C/W
Operating and Storage Temperature Range	T_J, T_{stg}	–65 to +150	°C

1. 10 X 1000 μs, non–repetitive
2. 1″ square copper pad, FR–4 board
3. FR–4 board, using ON Semiconductor minimum recommended footprint, as shown in 403B case outline dimensions spec.

*Please see P6SMB11CAT3 to P6SMB91CAT3 for Bidirectional devices.

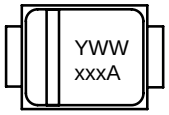
ON Semiconductor™

http://onsemi.com

PLASTIC SURFACE MOUNT ZENER OVERVOLTAGE TRANSIENT SUPPRESSORS 6.8–200 VOLTS 600 WATT PEAK POWER

SMB
CASE 403A
PLASTIC

MARKING DIAGRAM



Y = Year
WW = Work Week
xxxA = Specific Device Code
(See Table Next Page)

ORDERING INFORMATION

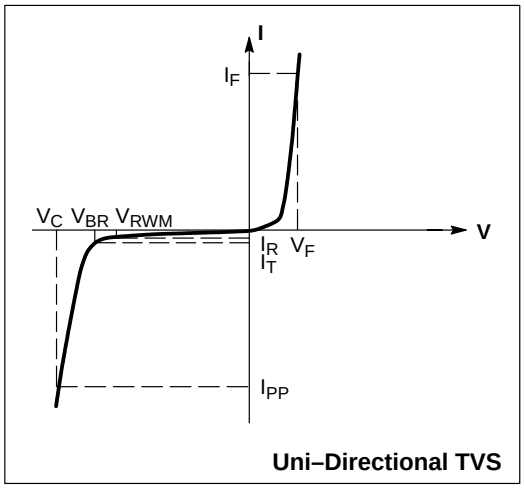
Device †	Package	Shipping
P6SMBxxxAT3	SMB	2500/Tape & Reel

Devices listed in ***bold, italic*** are ON Semiconductor **Preferred** devices. **Preferred** devices are recommended choices for future use and best overall value.

†The "T3" suffix refers to a 13 inch reel.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted, V_F = 3.5 V Max. @ I_F (Note 4) = 50 A)

Symbol	Parameter
I_{PP}	Maximum Reverse Peak Pulse Current
V_C	Clamping Voltage @ I_{PP}
V_{RWM}	Working Peak Reverse Voltage
I_R	Maximum Reverse Leakage Current @ V_{RWM}
V_{BR}	Breakdown Voltage @ I_T
I_T	Test Current
ΘV_{BR}	Maximum Temperature Coefficient of V_{BR}
I_F	Forward Current
V_F	Forward Voltage @ I_F



ELECTRICAL CHARACTERISTICS (Devices listed in bold, italic are ON Semiconductor Preferred devices.)

Device	Device Marking	V_{RWM}	I_R @ V_{RWM}	Breakdown Voltage V_{BR} (Note 5)			@ I_T	V_C @ I_{PP} (Note 6.)		ΘV_{BR}
		Volts	μA	Min	Nom	Max	mA	Volts	Amps	%/°C
P6SMB6.8AT3	***6V8A***	***5.8***	***1000***	***6.45***	***6.8***	***7.14***	***10***	***10.5***	***57***	***0.057***
P6SMB7.5AT3	***7V5A***	***6.4***	***500***	***7.13***	***7.51***	***7.88***	***10***	***11.3***	***53***	***0.061***
P6SMB8.2AT3	8V2A	7.02	200	7.79	8.2	8.61	10	12.1	50	0.065
P6SMB9.1AT3	9V1A	7.78	50	8.65	9.1	9.55	1	13.4	45	0.068
P6SMB10AT3	***10A***	***8.55***	***10***	***9.5***	***10***	***10.5***	***1***	***14.5***	***41***	***0.073***
P6SMB11AT3	11A	9.4	5	10.5	11.05	11.6	1	15.6	38	0.075
P6SMB12AT3	12A	10.2	5	11.4	12	12.6	1	16.7	36	0.078
P6SMB13AT3	***13A***	***11.1***	***5***	***12.4***	***13.05***	***13.7***	***1***	***18.2***	***33***	***0.081***
P6SMB15AT3	**15A**	**12.8**	**5**	**14.3**	**15.05**	**15.8**	**1**	**21.2**	**28**	**0.084**
P6SMB16AT3	**16A**	**13.6**	**5**	**15.2**	**16**	**16.8**	**1**	**22.5**	**27**	**0.086**
P6SMB18AT3	**18A**	**15.3**	**5**	**17.1**	**18**	**18.9**	**1**	**25.2**	**24**	**0.088**
P6SMB20AT3	**20A**	**17.1**	**5**	**19**	**20**	**21**	**1**	**27.7**	**22**	**0.09**
P6SMB22AT3	***22A***	***18.8***	***5***	***20.9***	***22***	***23.1***	***1***	***30.6***	***20***	***0.092***
P6SMB24AT3	24A	20.5	5	22.8	24	25.2	1	33.2	18	0.094
P6SMB27AT3	***27A***	***23.1***	***5***	***25.7***	***27.05***	***28.4***	***1***	***37.5***	***16***	***0.096***
P6SMB30AT3	***30A***	***25.6***	***5***	***28.5***	***30***	***31.5***	***1***	***41.4***	***14.4***	***0.097***
P6SMB33AT3	33A	28.2	5	31.4	33.*05*	34.7	1	45.7	13.2	0.098
P6SMB36AT3	***36A***	***30.8***	***5***	***34.2***	***36***	***37.8***	***1***	***49.9***	***12***	***0.099***
P6SMB39AT3	***39A***	***33.3***	***5***	***37.1***	***39.05***	***41***	***1***	***53.9***	***11.2***	***0.1***
P6SMB43AT3	43A	36.8	5	40.9	43.05	45.2	1	59.3	10.1	0.101
P6SMB47AT3	47A	40.2	5	44.7	47.05	49.4	1	64.8	9.3	0.101
P6SMB51AT3	***51A***	***43.6***	***5***	***48.5***	***51.05***	***53.6***	***1***	***70.1***	***8.6***	***0.102***
P6SMB56AT3	56A	47.8	5	53.2	56	58.8	1	77	7.8	0.103
P6SMB62AT3	62A	53	5	58.9	62	65.1	1	85	7.1	0.104
P6SMB68AT3	68A	58.1	5	64.6	68	71.4	1	92	6.5	0.104
P6SMB75AT3	75A	64.1	5	71.3	75.05	78.8	1	103	5.8	0.105
P6SMB82AT3	82A	70.1	5	77.9	82	86.1	1	113	5.3	0.105
P6SMB91AT3	91A	77.8	5	86.5	91	95.5	1	125	4.8	0.106
P6SMB100AT3	100A	85.5	5	95	100	105	1	137	4.4	0.106
P6SMB110AT3	110A	94	5	105	110.5	116	1	152	4.0	0.107
P6SMB120AT3	120A	102	5	114	120	126	1	165	3.6	0.107
P6SMB130AT3	130A	111	5	124	130.5	137	1	179	3.3	0.107
P6SMB150AT3	150A	128	5	143	150.5	158	1	207	2.9	0.108
P6SMB160AT3	***160A***	***136***	***5***	***152***	***160***	***168***	***1***	***219***	***2.7***	***0.108***
P6SMB170AT3	170A	145	5	162	170	179	1	234	2.6	0.108
P6SMB180AT3	180A	154	5	171	180	189	1	246	2.4	0.108
P6SMB200AT3	200A	171	5	190	200	210	1	274	2.2	0.108

4. 1/2 sine wave (or equivalent square wave), PW = 8.3 ms, duty cycle = 4 pulses per minute maximum.
5. V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C.
6. Surge current waveform per Figure 2 and derate per Figure 3.

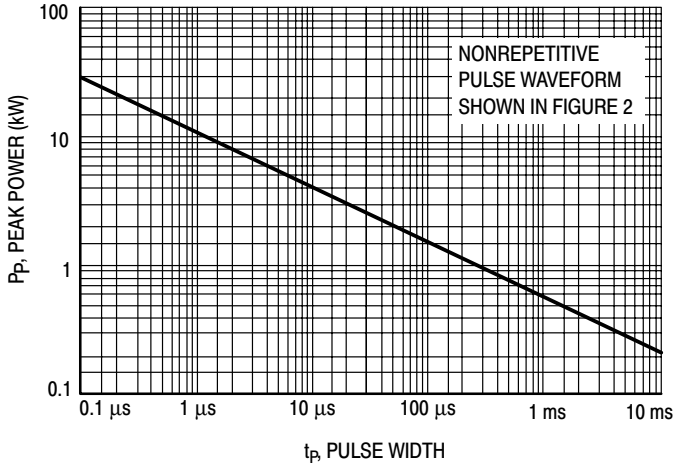


Figure 1. Pulse Rating Curve

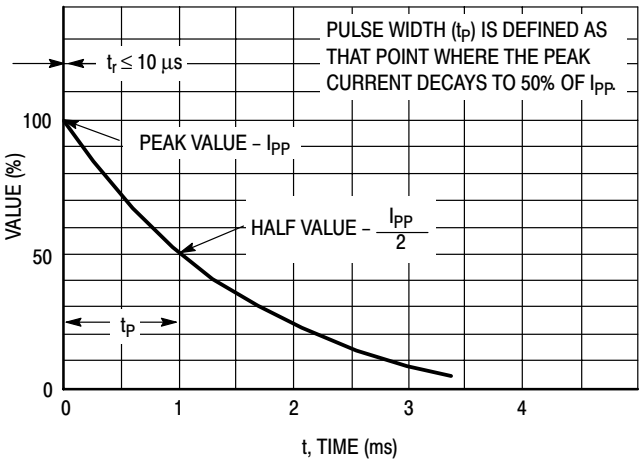


Figure 2. Pulse Waveform

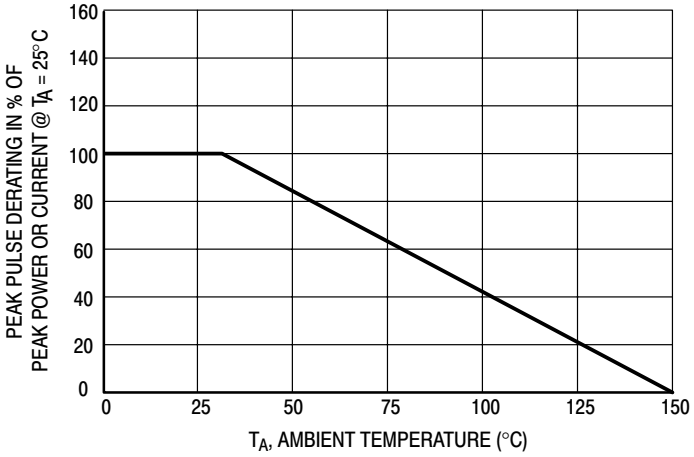
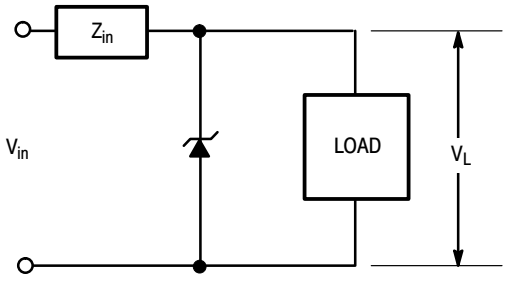


Figure 3. Pulse Derating Curve

TYPICAL PROTECTION CIRCUIT



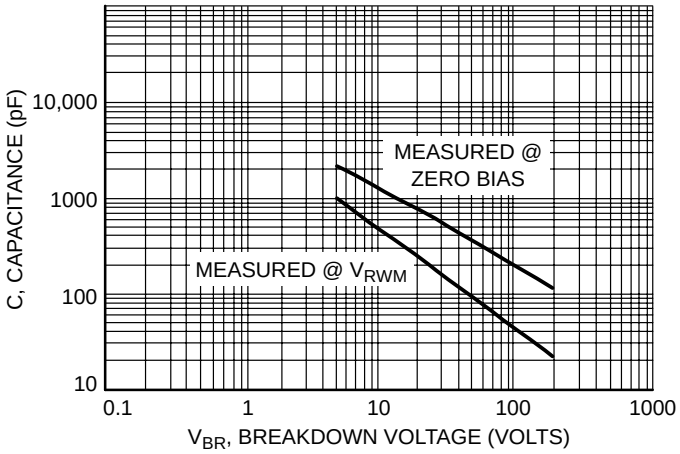


Figure 4. Capacitance versus Breakdown Voltage

APPLICATION NOTES

RESPONSE TIME

In most applications, the transient suppressor device is placed in parallel with the equipment or component to be protected. In this situation, there is a time delay associated with the capacitance of the device and an overshoot condition associated with the inductance of the device and the inductance of the connection method. The capacitive effect is of minor importance in the parallel protection scheme because it only produces a time delay in the transition from the operating voltage to the clamp voltage as shown in Figure 5.

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Some input impedance represented by Z_{in} is essential to prevent overstress of the protection device. This impedance should be as high as possible, without restricting the circuit operation.

DUTY CYCLE DERATING

The data of Figure 1 applies for non-repetitive conditions and at a lead temperature of 25°C. If the duty cycle increases, the peak power must be reduced as indicated by the curves of Figure 7. Average power must be derated as the lead or ambient temperature rises above 25°C. The average power derating curve normally given on data sheets may be normalized and used for this purpose.

At first glance the derating curves of Figure 7 appear to be in error as the 10 ms pulse has a higher derating factor than the 10 μs pulse. However, when the derating factor for a given pulse of Figure 7 is multiplied by the peak power value of Figure 1 for the same pulse, the results follow the expected trend.

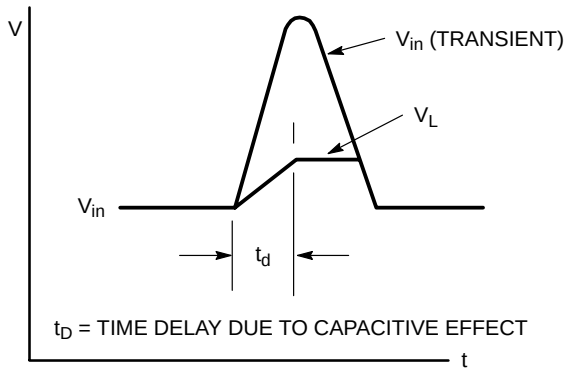

Figure 5.

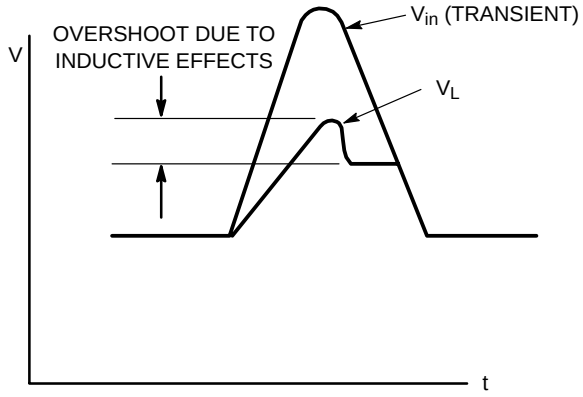

Figure 6.

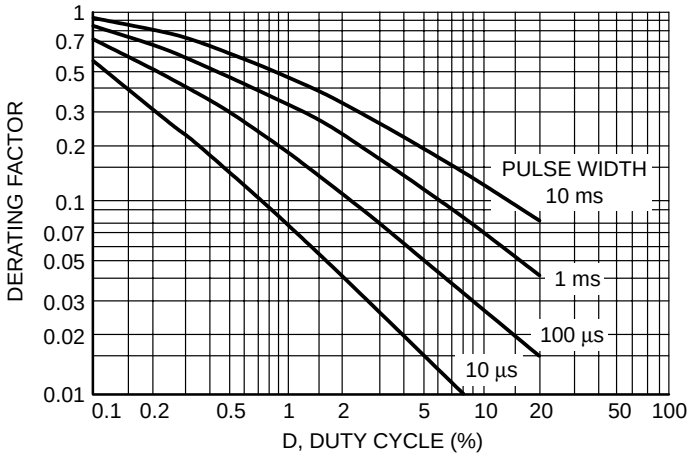

Figure 7. Typical Derating Factor for Duty Cycle

UL RECOGNITION

The entire series has *Underwriters Laboratory Recognition* for the classification of protectors (QVGV2) under the UL standard for safety 497B and File #116110. Many competitors only have one or two devices recognized or have recognition in a non-protective category. Some competitors have no recognition at all. With the UL497B recognition, our parts successfully passed several tests including Strike Voltage Breakdown test, Endurance Conditioning, Temperature test, Dielectric Voltage-Withstand test, Discharge test and several more.

Whereas, some competitors have only passed a flammability test for the package material, we have been recognized for much more to be included in their Protector category.

P6SMB11CAT3 Series

600 Watt Peak Power Zener Transient Voltage Suppressors

Bidirectional*

The SMB series is designed to protect voltage sensitive components from high voltage, high energy transients. They have excellent clamping capability, high surge capability, low zener impedance and fast response time. The SMB series is supplied in ON Semiconductor's exclusive, cost-effective, highly reliable Surmetic™ package and is ideally suited for use in communication systems, automotive, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/consumer applications.

Specification Features:

- Working Peak Reverse Voltage Range – 9.4 to 77.8 V
- Standard Zener Breakdown Voltage Range – 11 to 91 V
- Peak Power – 600 Watts @ 1 ms
- ESD Rating of Class 3 (>16 KV) per Human Body Model
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5 μA Above 10 V
- UL 497B for Isolated Loop Circuit Protection
- Response Time is Typically < 1 ns

Mechanical Characteristics:

CASE: Void-free, transfer-molded, thermosetting plastic

FINISH: All external surfaces are corrosion resistant and leads are readily solderable

MAXIMUM CASE TEMPERATURE FOR SOLDERING PURPOSES: 260°C for 10 Seconds

LEADS: Modified L–Bend providing more contact area to bond pads

POLARITY: Polarity band will not be indicated

MOUNTING POSITION: Any

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (Note 1.) @ T_L = 25°C, Pulse Width = 1 ms	P_{PK}	600	W
DC Power Dissipation @ T_L = 75°C Measured Zero Lead Length (Note 2.) Derate Above 75°C Thermal Resistance from Junction to Lead	P_D $R_{\theta JL}$	3.0 40 25	W mW/°C °C/W
DC Power Dissipation (Note 3.) @ T_A = 25°C Derate Above 25°C Thermal Resistance from Junction to Ambient	P_D $R_{\theta JA}$	0.55 4.4 226	W mW/°C °C/W
Operating and Storage Temperature Range	T_J, T_{stg}	–65 to +150	°C

1. 10 X 1000 μs, non–repetitive
2. 1″ square copper pad, FR–4 board
3. FR–4 board, using ON Semiconductor minimum recommended footprint, as shown in 403B case outline dimensions spec.

*Please see P6SMB6.8AT3 to P6SMB200AT3 for Unidirectional devices.

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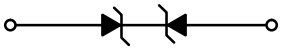
PLASTIC SURFACE MOUNT ZENER OVERVOLTAGE TRANSIENT SUPPRESSORS 11–91 VOLTS 600 WATT PEAK POWER



SMB
CASE 403A
PLASTIC

MARKING DIAGRAM

Y = Year
WW = Work Week
xxC = Specific Device Code (See Table Next Page)

ORDERING INFORMATION

Device †	Package	Shipping
P6SMBxxCAT3	SMB	2500/Tape & Reel

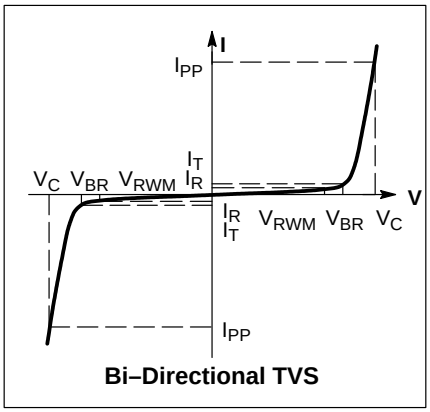
Devices listed in ***bold, italic*** are ON Semiconductor **Preferred** devices. **Preferred** devices are recommended choices for future use and best overall value.

†The "T3" suffix refers to a 13 inch reel.

ELECTRICAL CHARACTERISTICS

(T_A = 25°C unless otherwise noted)

Symbol	Parameter
I_{PP}	Maximum Reverse Peak Pulse Current
V_C	Clamping Voltage @ I_{PP}
V_{RWM}	Working Peak Reverse Voltage
I_R	Maximum Reverse Leakage Current @ V_{RWM}
V_{BR}	Breakdown Voltage @ I_T
I_T	Test Current
ΘV_{BR}	Maximum Temperature Coefficient of V_{BR}



Bi–Directional TVS

ELECTRICAL CHARACTERISTICS (Devices listed in bold, italic are ON Semiconductor Preferred devices.)

Device	Device Marking	V_{RWM}	I_R @ V_{RWM}	Breakdown Voltage V_{BR} (Note 4.) Volts			@ I_T	V_C @ I_{PP} (Note 5.) V_C	I_{PP}	ΘV_{BR}
		Volts	μA	Min	Nom	Max	mA	Volts	Amps	%/°C
P6SMB11CAT3	11C	9.4	5	10.5	11.05	11.6	1	15.6	38	0.075
P6SMB12CAT3	12C	10.2	5	11.4	12	12.6	1	16.7	36	0.078
P6SMB13CAT3	13C	11.1	5	12.4	13.05	13.7	1	18.2	33	0.081
P6SMB15CAT3	15C	12.8	5	14.3	15.05	15.8	1	21.2	28	0.084
P6SMB16CAT3	16C	13.6	5	15.2	16	16.8	1	22.5	27	0.086
P6SMB18CAT3	18C	15.3	5	17.1	18	18.9	1	25.2	24	0.088
P6SMB20CAT3	20C	17.1	5	19	20	21	1	27.7	22	0.09
P6SMB22CAT3	22C	18.8	5	20.9	22	23.1	1	30.6	20	0.09
P6SMB24CAT3	24C	20.5	5	22.8	24	25.2	1	33.2	18	0.094
P6SMB27CAT3	27C	23.1	5	25.7	27.05	28.4	1	37.5	16	0.096
P6SMB30CAT3	30C	25.6	5	28.5	30	31.5	1	41.4	14.4	0.097
P6SMB33CAT3	***33C***	***28.2***	***5***	***31.4***	***33.05***	***34.7***	***1***	***45.7***	***13.2***	***0.098***
P6SMB36CAT3	36C	30.8	5	34.2	36	37.8	1	49.9	12	0.099
P6SMB39CAT3	39C	33.3	5	37.1	39.05	41	1	53.9	11.2	0.1
P6SMB43CAT3	43C	36.8	5	40.9	43.05	45.2	1	59.3	10.1	0.101
P6SMB47CAT3	47C	40.2	5	44.7	47.05	49.4	1	64.8	9.3	0.101
P6SMB51CAT3	51C	43.6	5	48.5	51.05	53.6	1	70.1	8.6	0.102
P6SMB56CAT3	56C	47.8	5	53.2	56	58.8	1	77	7.8	0.103
P6SMB62CAT3	62C	53	5	58.9	62	65.1	1	85	7.1	0.104
P6SMB68CAT3	68C	58.1	5	64.6	68	71.4	1	92	6.5	0.104
P6SMB75CAT3	75C	64.1	5	71.3	75.05	78.8	1	103	5.8	0.105
P6SMB82CAT3	82C	70.1	5	77.9	82	86.1	1	113	5.3	0.105
P6SMB91CAT3	91C	77.8	5	86.5	91	95.5	1	125	4.8	0.106

4. V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C.
5. Surge current waveform per Figure 2 and derate per Figure 3 of the General Data – 600 Watt at the beginning of this group.

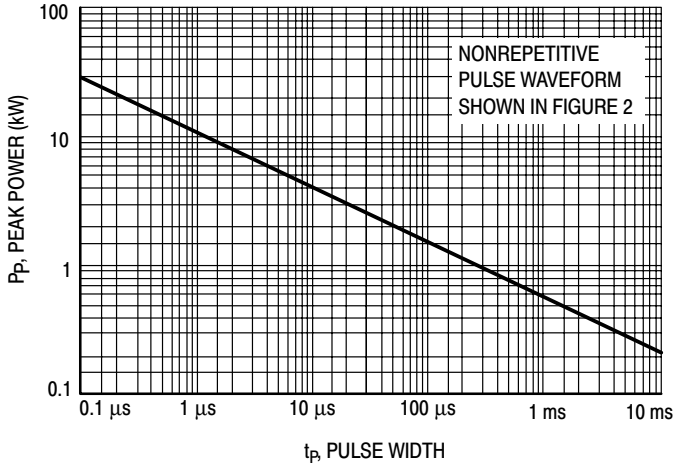


Figure 1. Pulse Rating Curve

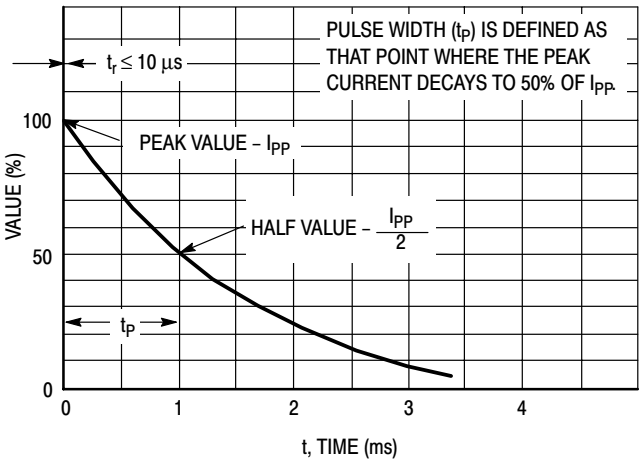


Figure 2. Pulse Waveform

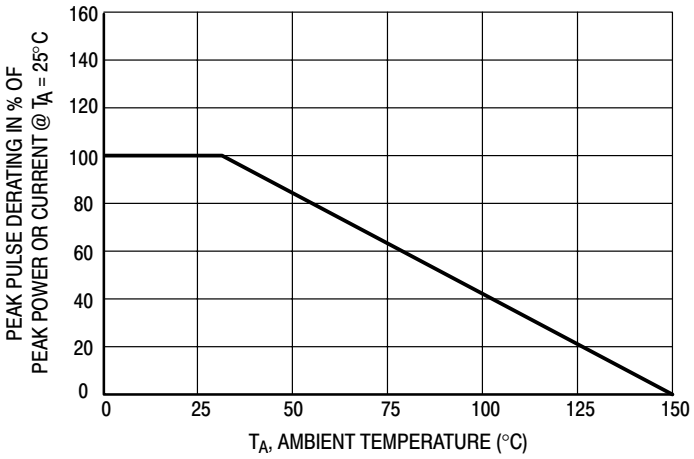
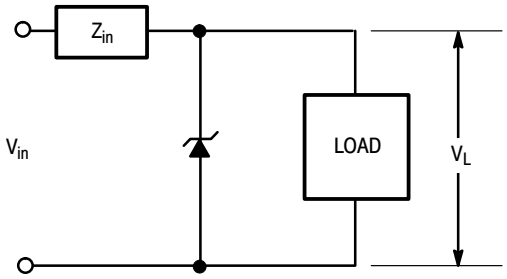


Figure 3. Pulse Derating Curve

TYPICAL PROTECTION CIRCUIT



APPLICATION NOTES

RESPONSE TIME

In most applications, the transient suppressor device is placed in parallel with the equipment or component to be protected. In this situation, there is a time delay associated with the capacitance of the device and an overshoot condition associated with the inductance of the device and the inductance of the connection method. The capacitive effect is of minor importance in the parallel protection scheme because it only produces a time delay in the transition from the operating voltage to the clamp voltage as shown in Figure 4.

The inductive effects in the device are due to actual turn-on time (time required for the device to go from zero current to full current) and lead inductance. This inductive effect produces an overshoot in the voltage across the equipment or component being protected as shown in Figure 5. Minimizing this overshoot is very important in the application, since the main purpose for adding a transient suppressor is to clamp voltage spikes. The SMB series have a very good response time, typically < 1 ns and negligible inductance. However, external inductive effects could produce unacceptable overshoot. Proper circuit layout, minimum lead lengths and placing the suppressor device as close as possible to the equipment or components to be protected will minimize this overshoot.

Some input impedance represented by Z_{in} is essential to prevent overstress of the protection device. This impedance should be as high as possible, without restricting the circuit operation.

DUTY CYCLE DERATING

The data of Figure 1 applies for non-repetitive conditions and at a lead temperature of 25°C. If the duty cycle increases, the peak power must be reduced as indicated by the curves of Figure 6. Average power must be derated as the lead or ambient temperature rises above 25°C. The average power derating curve normally given on data sheets may be normalized and used for this purpose.

At first glance the derating curves of Figure 6 appear to be in error as the 10 ms pulse has a higher derating factor than the 10 μs pulse. However, when the derating factor for a given pulse of Figure 6 is multiplied by the peak power value of Figure 1 for the same pulse, the results follow the expected trend.

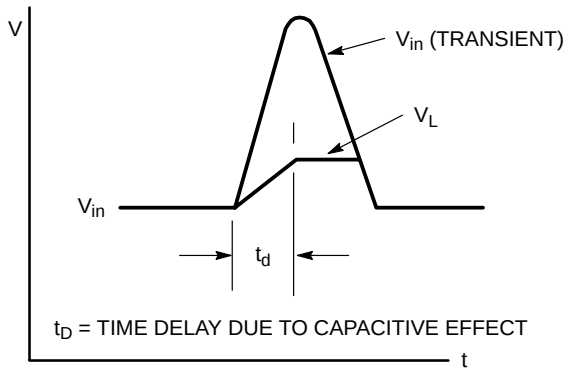


Figure 4.

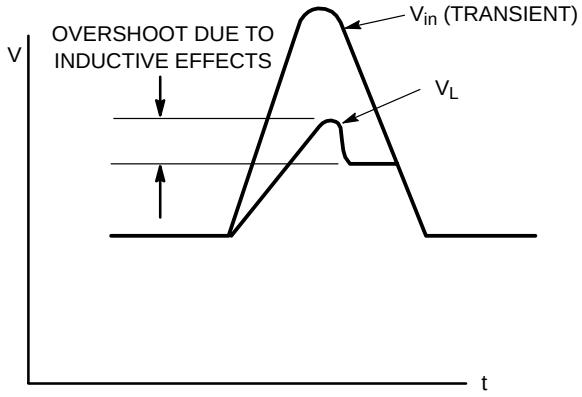


Figure 5.

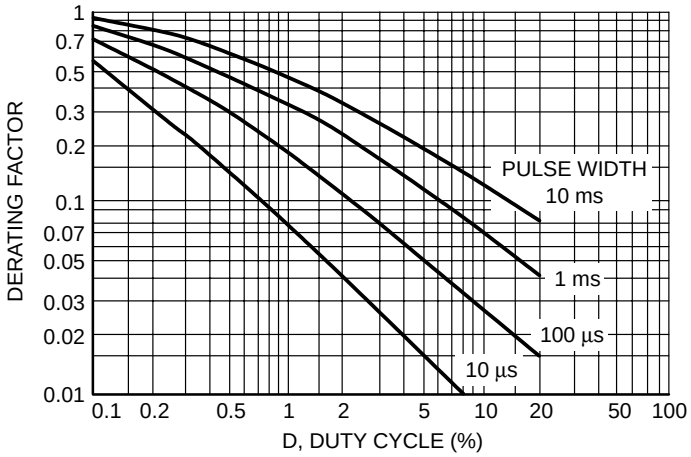


Figure 6. Typical Derating Factor for Duty Cycle

UL RECOGNITION

The entire series has *Underwriters Laboratory Recognition* for the classification of protectors (QVGV2) under the UL standard for safety 497B and File #116110. Many competitors only have one or two devices recognized or have recognition in a non-protective category. Some competitors have no recognition at all. With the UL497B recognition, our parts successfully passed several tests including Strike Voltage Breakdown test, Endurance Conditioning, Temperature test, Dielectric Voltage-Withstand test, Discharge test and several more.

Whereas, some competitors have only passed a flammability test for the package material, we have been recognized for much more to be included in their Protector category.

1.5SMC6.8AT3 Series

1500 Watt Peak Power Zener Transient Voltage Suppressors

Unidirectional*

The SMC series is designed to protect voltage sensitive components from high voltage, high energy transients. They have excellent clamping capability, high surge capability, low zener impedance and fast response time. The SMC series is supplied in ON Semiconductor's exclusive, cost-effective, highly reliable Surmetic™ package and is ideally suited for use in communication systems, automotive, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/consumer applications.

Specification Features:

- Working Peak Reverse Voltage Range – 5.8 to 77.8 V
- Standard Zener Breakdown Voltage Range – 6.8 to 91 V
- Peak Power – 1500 Watts @ 1 ms
- ESD Rating of Class 3 (>16 KV) per Human Body Model
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5 μA Above 10 V
- UL 497B for Isolated Loop Circuit Protection
- Maximum Temperature Coefficient Specified
- Response Time is Typically < 1 ns

Mechanical Characteristics:

CASE: Void-free, transfer-molded, thermosetting plastic

FINISH: All external surfaces are corrosion resistant and leads are readily solderable

MAXIMUM CASE TEMPERATURE FOR SOLDERING PURPOSES: 260°C for 10 Seconds

LEADS: Modified L–Bend providing more contact area to bond pads

POLARITY: Cathode indicated by molded polarity notch

MOUNTING POSITION: Any

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (Note 1.) @ T_L = 25°C, Pulse Width = 1 ms	P_{PK}	1500	W
DC Power Dissipation @ T_L = 75°C Measured Zero Lead Length (Note 2.)	P_D	4.0	W
Derate Above 75°C		54.6	mW/°C
Thermal Resistance from Junction to Lead	$R_{\theta JL}$	18.3	°C/W
DC Power Dissipation (Note 3.) @ T_A = 25°C	P_D	0.75	W
Derate Above 25°C		6.1	mW/°C
Thermal Resistance from Junction to Ambient	$R_{\theta JA}$	165	°C/W
Operating and Storage Temperature Range	T_J, T_{stg}	–65 to +150	°C

1. 10 X 1000 μs, non–repetitive
2. 1″ square copper pad, FR–4 board
3. FR–4 board, using ON Semiconductor minimum recommended footprint, as shown in 403B case outline dimensions spec.

ON Semiconductor™

http://onsemi.com

PLASTIC SURFACE MOUNT ZENER OVERVOLTAGE TRANSIENT SUPPRESSORS 5.8–78 VOLTS 1500 WATT PEAK POWER

SMC
CASE 403
PLASTIC

MARKING DIAGRAM

Y = Year
WW = Work Week
xxxA = Specific Device Code (See Table Next Page)

ORDERING INFORMATION

Device †	Package	Shipping
1.5SMCxxxAT3	SMC	2500/Tape & Reel

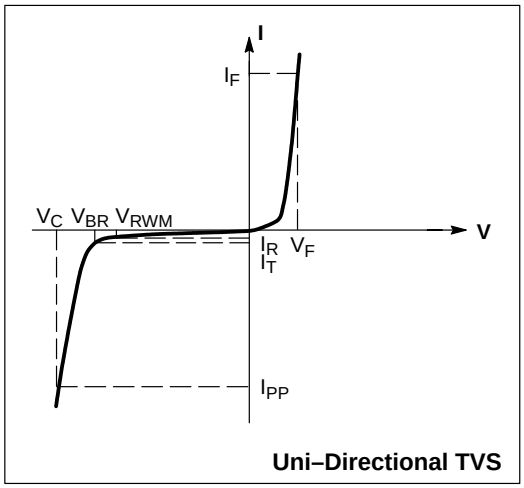
Devices listed in ***bold, italic*** are ON Semiconductor **Preferred** devices. **Preferred** devices are recommended choices for future use and best overall value.

*Bidirectional devices will not be available in this series.

†The "T3" suffix refers to a 13 inch reel.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted, V_F = 3.5 V Max. @ I_F (Note 4.) = 100 A)

Symbol	Parameter
I_{PP}	Maximum Reverse Peak Pulse Current
V_C	Clamping Voltage @ I_{PP}
V_{RWM}	Working Peak Reverse Voltage
I_R	Maximum Reverse Leakage Current @ V_{RWM}
V_{BR}	Breakdown Voltage @ I_T
I_T	Test Current
ΘV_{BR}	Maximum Temperature Coefficient of V_{BR}
I_F	Forward Current
V_F	Forward Voltage @ I_F



Uni–Directional TVS

ELECTRICAL CHARACTERISTICS (Devices listed in bold, italic are ON Semiconductor Preferred devices.)

Device	Device Marking	V_{RWM}	I_R @ V_{RWM}	Breakdown Voltage V_{BR} (Note 5.)			@ I_T	V_C @ I_{PP} (Note 6.)		ΘV_{BR}
				Min	Nom	Max		V_C	I_{PP}	
		Volts	μA				mA	Volts	Amps	%/°C
1.5SMC6.8AT3	6V8A	5.8	1000	6.45	6.8	7.14	10	10.5	143	0.057
1.5SMC7.5AT3	7V5A	6.4	500	7.13	7.5	7.88	10	11.3	132	0.061
1.5SMC8.2AT3	8V2A	7.02	200	7.79	8.2	8.61	10	12.1	124	0.065
1.5SMC9.1AT3	9V1A	7.78	50	8.65	9.1	9.55	1	13.4	112	0.068
1.5SMC10AT3	10A	8.55	10	9.5	10	10.5	1	14.5	103	0.073
1.5SMC11AT3	11A	9.4	5	10.5	11	11.6	1	15.6	96	0.075
1.5SMC12AT3	12A	10.2	5	11.4	12	12.6	1	16.7	90	0.078
1.5SMC13AT3	13A	11.1	5	12.4	13	13.7	1	18.2	82	0.081
1.5SMC15AT3	***15A***	***12.8***	***5***	***14.3***	***15***	***15.8***	***1***	***21.2***	***71***	***0.084***
1.5SMC16AT3	16A	13.6	5	15.2	16	16.8	1	22.5	67	0.086
1.5SMC18AT3	18A	15.3	5	17.1	18	18.9	1	25.2	59.5	0.088
1.5SMC20AT3	20A	17.1	5	19	20	21	1	27.7	54	0.09
1.5SMC22AT3	22A	18.8	5	20.9	22	23.1	1	30.6	49	0.092
1.5SMC24AT3	***24A***	***20.5***	***5***	***22.8***	***24***	***25.2***	***1***	***33.2***	***45***	***0.094***
1.5SMC27AT3	27A	23.1	5	25.7	27	28.4	1	37.5	40	0.096
1.5SMC30AT3	30A	25.6	5	28.5	30	31.5	1	41.4	36	0.097
1.5SMC33AT3	***33A***	***28.2***	***5***	***31.4***	***33***	***34.7***	***1***	***45.7***	***33***	***0.098***
1.5SMC36AT3	***36A***	***30.8***	***5***	***34.2***	***36***	***37.8***	***1***	***49.9***	***30***	***0.099***
1.5SMC39AT3	***39A***	***33.3***	***5***	***37.1***	***39***	***41***	***1***	***53.9***	***28***	***0.1***
1.5SMC43AT3	***43A***	***36.8***	***5***	***40.9***	***43***	***45.2***	***1***	***59.3***	***25.3***	***0.101***
1.5SMC47AT3	***47A***	***40.2***	***5***	***44.7***	***47***	***49.4***	***1***	***64.8***	***23.2***	***0.101***
1.5SMC51AT3	51A	43.6	5	48.5	51	53.6	1	70.1	21.4	0.102
1.5SMC56AT3	56A	47.8	5	53.2	56	58.8	1	77	19.5	0.103
1.5SMC62AT3	62A	53	5	58.9	62	65.1	1	85	17.7	0.104
1.5SMC68AT3	68A	58.1	5	64.6	68	71.4	1	92	16.3	0.104
1.5SMC75AT3	***75A***	***64.1***	***5***	***71.3***	***75***	***78.8***	***1***	***103***	***14.6***	***0.105***
1.5SMC82AT3	82A	70.1	5	77.9	82	86.1	1	113	13.3	0.105
1.5SMC91AT3	91A	77.8	5	86.5	91	95.5	1	125	12	0.106

4. 1/2 sine wave (or equivalent square wave), PW = 8.3 ms, duty cycle = 4 pulses per minute maximum.
5. V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C.
6. Surge current waveform per Figure 2 and derate per Figure 3 of the General Data – 1500 Watt at the beginning of this group.

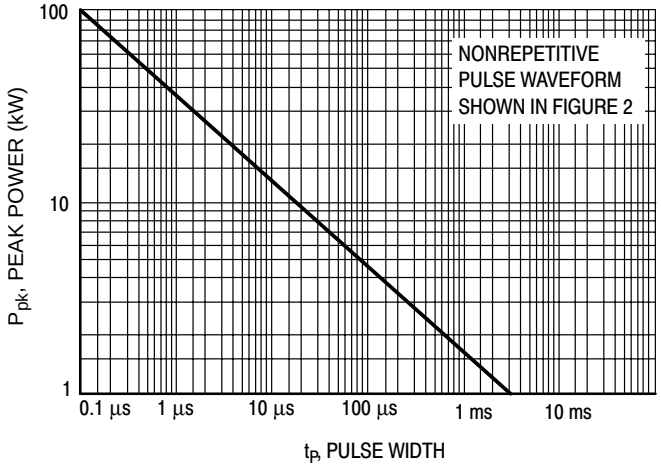


Figure 1. Pulse Rating Curve

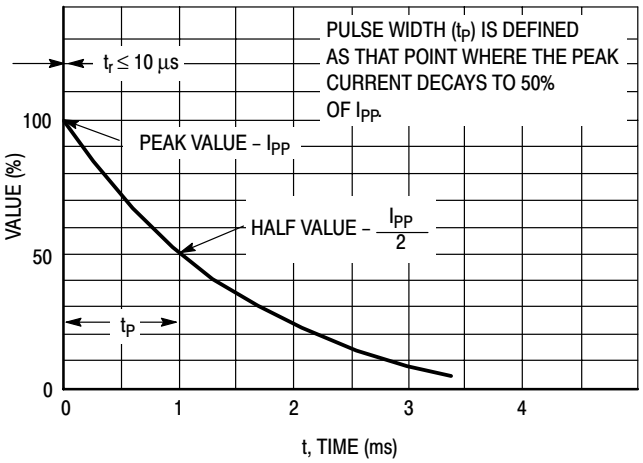


Figure 2. Pulse Waveform

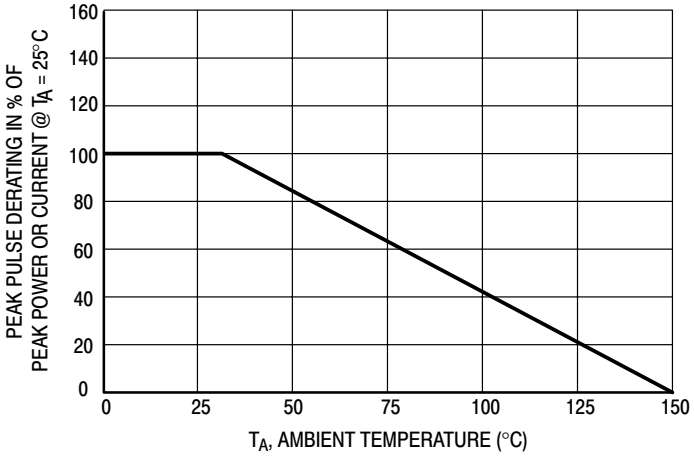


Figure 3. Pulse Derating Curve

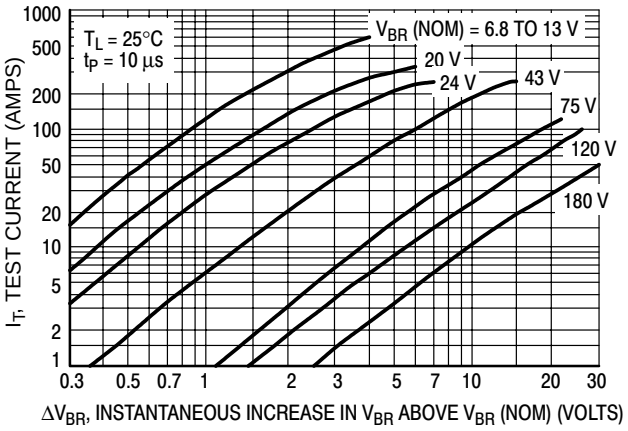


Figure 4. Dynamic Impedance

UL RECOGNITION

The entire series has *Underwriters Laboratory Recognition* for the classification of protectors (QVGV2) under the UL standard for safety 497B and File #116110. Many competitors only have one or two devices recognized or have recognition in a non-protective category. Some competitors have no recognition at all. With the UL497B recognition, our parts successfully passed several tests including Strike Voltage Breakdown test, Endurance Conditioning, Temperature test, Dielectric Voltage-Withstand test, Discharge test and several more.

Whereas, some competitors have only passed a flammability test for the package material, we have been recognized for much more to be included in their Protector category.

APPLICATION NOTES

RESPONSE TIME

In most applications, the transient suppressor device is placed in parallel with the equipment or component to be protected. In this situation, there is a time delay associated with the capacitance of the device and an overshoot condition associated with the inductance of the device and the inductance of the connection method. The capacitive effect is of minor importance in the parallel protection scheme because it only produces a time delay in the transition from the operating voltage to the clamp voltage as shown in Figure 5.

The inductive effects in the device are due to actual turn-on time (time required for the device to go from zero current to full current) and lead inductance. This inductive effect produces an overshoot in the voltage across the equipment or component being protected as shown in Figure 6. Minimizing this overshoot is very important in the application, since the main purpose for adding a transient suppressor is to clamp voltage spikes. The SMC series have a very good response time, typically < 1 ns and negligible inductance. However, external inductive effects could produce unacceptable overshoot. Proper circuit layout, minimum lead lengths and placing the suppressor device as close as possible to the equipment or components to be protected will minimize this overshoot.

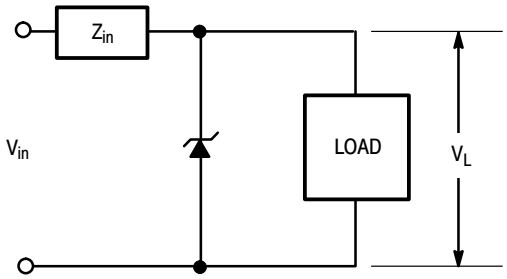
Some input impedance represented by Z_{in} is essential to prevent overstress of the protection device. This impedance should be as high as possible, without restricting the circuit operation.

DUTY CYCLE DERATING

The data of Figure 1 applies for non-repetitive conditions and at a lead temperature of 25°C. If the duty cycle increases, the peak power must be reduced as indicated by the curves of Figure 7. Average power must be derated as the lead or ambient temperature rises above 25°C. The average power derating curve normally given on data sheets may be normalized and used for this purpose.

At first glance the derating curves of Figure 7 appear to be in error as the 10 ms pulse has a higher derating factor than the 10 μs pulse. However, when the derating factor for a given pulse of Figure 7 is multiplied by the peak power value of Figure 1 for the same pulse, the results follow the expected trend.

TYPICAL PROTECTION CIRCUIT



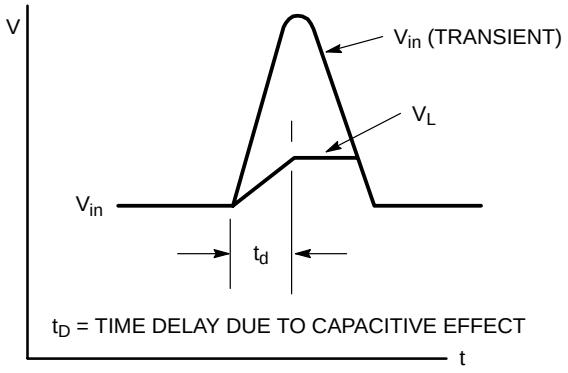


Figure 5.

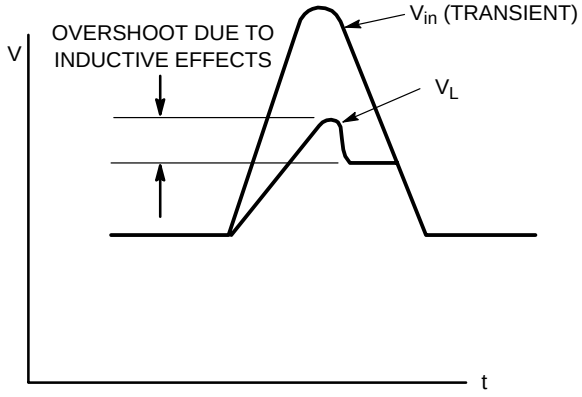


Figure 6.

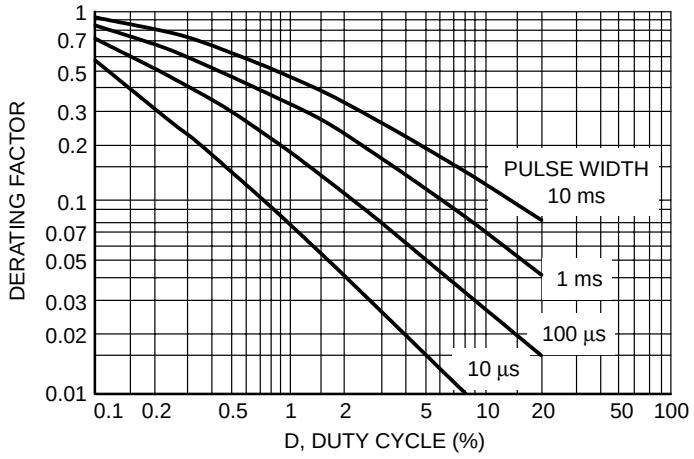


Figure 7. Typical Derating Factor for Duty Cycle

1SMC5.0AT3 Series

1500 Watt Peak Power Zener Transient Voltage Suppressors

Unidirectional*

The SMC series is designed to protect voltage sensitive components from high voltage, high energy transients. They have excellent clamping capability, high surge capability, low zener impedance and fast response time. The SMC series is supplied in ON Semiconductor's exclusive, cost-effective, highly reliable Surmetic™ package and is ideally suited for use in communication systems, automotive, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/consumer applications.

Specification Features:

- Working Peak Reverse Voltage Range – 5.0 V to 78 V
- Standard Zener Breakdown Voltage Range – 6.7 V to 91.25 V
- Peak Power – 1500 Watts @ 1 ms
- ESD Rating of Class 3 (>16 KV) per Human Body Model
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5 μA Above 10 V
- UL 497B for Isolated Loop Circuit Protection
- Maximum Temperature Coefficient Specified
- Response Time is Typically < 1 ns

Mechanical Characteristics:

CASE: Void-free, transfer-molded, thermosetting plastic
FINISH: All external surfaces are corrosion resistant and leads are readily solderable
MAXIMUM CASE TEMPERATURE FOR SOLDERING PURPOSES: 260°C for 10 Seconds
LEADS: Modified L–Bend providing more contact area to bond pads
POLARITY: Cathode indicated by molded polarity notch
MOUNTING POSITION: Any

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (Note 1.) @ T_L = 25°C, Pulse Width = 1 ms	P_{PK}	1500	W
DC Power Dissipation @ T_L = 75°C Measured Zero Lead Length (Note 2.) Derate Above 75°C Thermal Resistance from Junction to Lead	P_D $R_{\theta JL}$	4.0 54.6 18.3	W mW/°C °C/W
DC Power Dissipation (Note 3.) @ T_A = 25°C Derate Above 25°C Thermal Resistance from Junction to Ambient	P_D $R_{\theta JA}$	0.75 6.1 165	W mW/°C °C/W
Operating and Storage Temperature Range	T_J, T_{stg}	–65 to +150	°C

1. 10 X 1000 μs, non–repetitive
2. 1″ square copper pad, FR–4 board
3. FR–4 board, using ON Semiconductor minimum recommended footprint, as shown in 403B case outline dimensions spec.

ON Semiconductor™

http://onsemi.com

PLASTIC SURFACE MOUNT ZENER TRANSIENT VOLTAGE SUPPRESSORS 5.0–78 VOLTS 1500 WATT PEAK POWER

SMC
CASE 403
PLASTIC

MARKING DIAGRAM

Y = Year
WW = Work Week
Gxx = Specific Device Code
(See Table Next Page)

ORDERING INFORMATION

Device †	Package	Shipping
1SMCxxxAT3	SMC	2500/Tape & Reel

Devices listed in ***bold, italic*** are ON Semiconductor **Preferred** devices. **Preferred** devices are recommended choices for future use and best overall value.

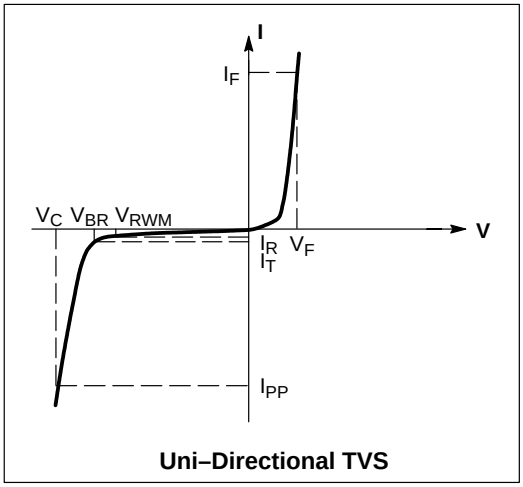
*Bidirectional devices will not be available in this series.

†The "T3" suffix refers to a 13 inch reel.

ELECTRICAL CHARACTERISTICS

(T_A = 25°C unless otherwise noted)

Symbol	Parameter
I_{PP}	Maximum Reverse Peak Pulse Current
V_C	Clamping Voltage @ I_{PP}
V_{RWM}	Working Peak Reverse Voltage
I_R	Maximum Reverse Leakage Current @ V_{RWM}
V_{BR}	Breakdown Voltage @ I_T
I_T	Test Current
I_F	Forward Current
V_F	Forward Voltage @ I_F



Uni–Directional TVS

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Device	Device Marking	V_{RWM} (Note 4.)	I_R @ V_{RWM}	Breakdown Voltage				V_C @ I_{PP} (Note 6.)	
				V_{BR} (Note 5.) Volts			@ I_T	V_C	I_{PP}
		Volts	μA	Min	Nom	Max	mA	Volts	Amps
1SMC5.0AT3	GDE	5.0	1000	6.4	6.7	7.0	10	9.2	163
1SMC6.0AT3	GDG	6.0	1000	6.67	7.02	7.37	10	10.3	145.6
1SMC6.5AT3	GDK	6.5	500	7.22	7.6	7.98	10	11.2	133.9
1SMC7.0AT3	GDM	7.0	200	7.78	8.19	8.6	10	12	125
1SMC7.5AT3	GDP	7.5	100	8.33	8.77	9.21	1	12.9	116.3
1SMC8.0AT3	GDR	8.0	50	8.89	9.36	9.83	1	13.6	110.3
1SMC8.5AT3	GDT	8.5	25	9.44	9.92	10.4	1	14.4	104.2
1SMC9.0AT3	GDV	9.0	10	10	10.55	11.1	1	15.4	97.4
1SMC10AT3	GDX	10	5	11.1	11.7	12.3	1	17	88.2
1SMC11AT3	GDZ	11	5	12.2	12.85	13.5	1	18.2	82.4
1SMC12AT3	GEE	12	5	13.3	14	14.7	1	19.9	75.3
1SMC13AT3	GEG	13	5	14.4	15.15	15.9	1	21.5	69.7
1SMC14AT3	GEK	14	5	15.6	16.4	17.2	1	23.2	64.7
1SMC15AT3	GEM	15	5	16.7	17.6	18.5	1	24.4	61.5
1SMC16AT3	GEP	16	5	17.8	18.75	19.7	1	26	57.7
1SMC17AT3	GER	17	5	18.9	19.9	20.9	1	27.6	53.3
1SMC18AT3	GET	18	5	20	21.05	22.1	1	29.2	51.4
1SMC20AT3	GEV	20	5	22.2	23.35	24.5	1	32.4	46.3
1SMC22AT3	GEX	22	5	24.4	25.65	26.9	1	35.5	42.2
1SMC24AT3	GEZ	24	5	26.7	28.1	29.5	1	38.9	38.6
1SMC26AT3	GFE	26	5	28.9	30.4	31.9	1	42.1	35.6
1SMC28AT3	GFG	28	5	31.1	32.75	34.4	1	45.4	33
1SMC30AT3	GFK	30	5	33.3	35.05	36.8	1	48.4	31
1SMC33AT3	GFM	33	5	36.7	38.65	40.6	1	53.3	28.1
1SMC36AT3	GFP	36	5	40	42.1	44.2	1	58.1	25.8
1SMC40AT3	GFR	40	5	44.4	46.75	49.1	1	64.5	32.2
1SMC43AT3	GFT	43	5	47.8	50.3	52.8	1	69.4	21.6
1SMC45AT3	GFV	45	5	50	52.65	55.3	1	72.2	20.6
1SMC48AT3	GFX	48	5	53.3	56.1	58.9	1	77.4	19.4
1SMC51AT3	GFZ	51	5	56.7	59.7	62.7	1	82.4	18.2
1SMC54AT3	GGE	54	5	60	63.15	66.3	1	87.1	17.2
1SMC58AT3	***GGG***	***58***	***5***	***64.4***	***67.8***	***71.2***	***1***	***93.6***	***16***
1SMC60AT3	GGK	60	5	66.7	70.2	73.7	1	96.8	15.5
1SMC64AT3	GGM	64	5	71.1	74.85	78.6	1	103	14.6
1SMC70AT3	GGP	70	5	77.8	81.9	86	1	113	13.3
1SMC75AT3	GGR	75	5	83.3	87.7	92.1	1	121	12.4
1SMC78AT3	GGT	78	5	86.7	91.25	95.8	1	126	11.4

4. A transient suppressor is normally selected according to the maximum working peak reverse voltage (V_{RWM}), which should be equal to or greater than the DC or continuous peak operating voltage level.
5. V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C.
6. Surge current waveform per Figure 2 and derate per Figure 3 of the General Data – 1500 Watt at the beginning of this group.

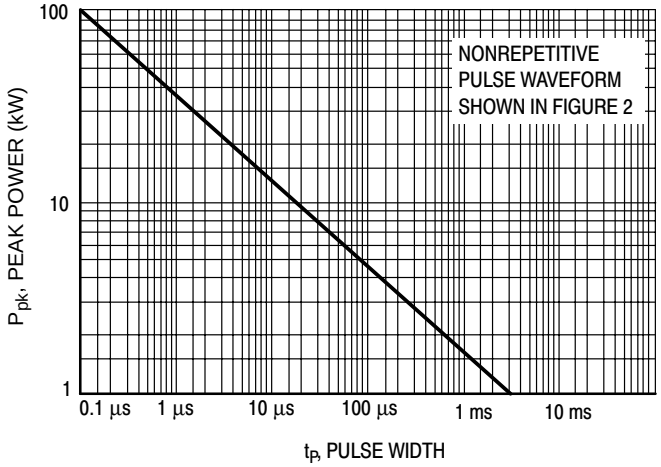


Figure 1. Pulse Rating Curve

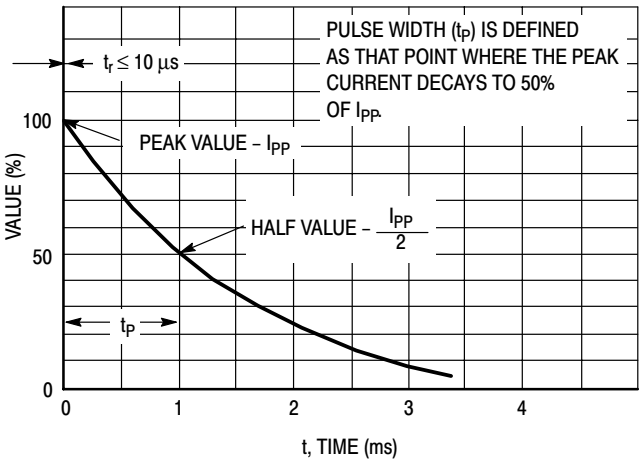


Figure 2. Pulse Waveform

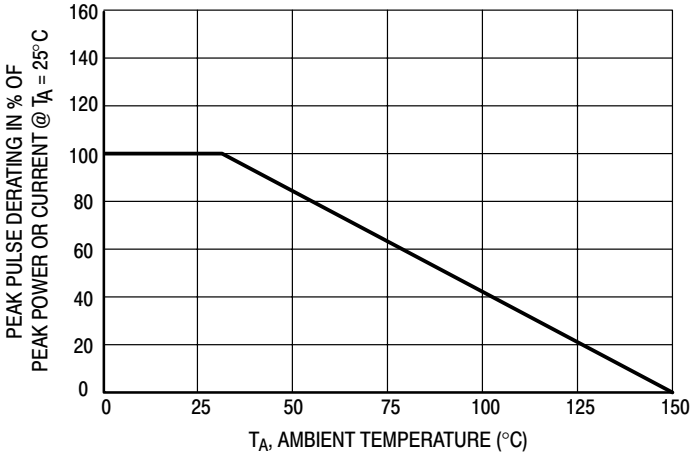


Figure 3. Pulse Derating Curve

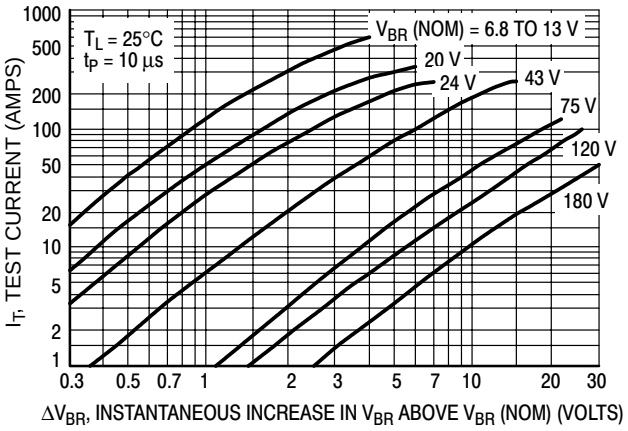


Figure 4. Dynamic Impedance

UL RECOGNITION

The entire series has *Underwriters Laboratory Recognition* for the classification of protectors (QVGV2) under the UL standard for safety 497B and File #116110. Many competitors only have one or two devices recognized or have recognition in a non-protective category. Some competitors have no recognition at all. With the UL497B recognition, our parts successfully passed several tests including Strike Voltage Breakdown test, Endurance Conditioning, Temperature test, Dielectric Voltage-Withstand test, Discharge test and several more.

Whereas, some competitors have only passed a flammability test for the package material, we have been recognized for much more to be included in their Protector category.

APPLICATION NOTES

RESPONSE TIME

In most applications, the transient suppressor device is placed in parallel with the equipment or component to be protected. In this situation, there is a time delay associated with the capacitance of the device and an overshoot condition associated with the inductance of the device and the inductance of the connection method. The capacitive effect is of minor importance in the parallel protection scheme because it only produces a time delay in the transition from the operating voltage to the clamp voltage as shown in Figure 5.

The inductive effects in the device are due to actual turn-on time (time required for the device to go from zero current to full current) and lead inductance. This inductive effect produces an overshoot in the voltage across the equipment or component being protected as shown in Figure 6. Minimizing this overshoot is very important in the application, since the main purpose for adding a transient suppressor is to clamp voltage spikes. The SMC series have a very good response time, typically < 1 ns and negligible inductance. However, external inductive effects could produce unacceptable overshoot. Proper circuit layout, minimum lead lengths and placing the suppressor device as close as possible to the equipment or components to be protected will minimize this overshoot.

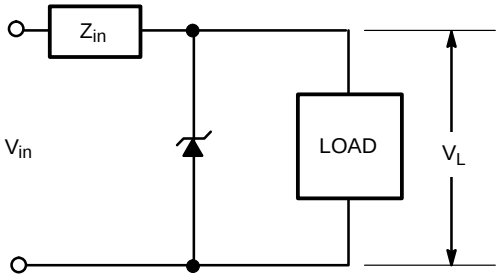
Some input impedance represented by Z_{in} is essential to prevent overstress of the protection device. This impedance should be as high as possible, without restricting the circuit operation.

DUTY CYCLE DERATING

The data of Figure 1 applies for non-repetitive conditions and at a lead temperature of 25°C. If the duty cycle increases, the peak power must be reduced as indicated by the curves of Figure 7. Average power must be derated as the lead or ambient temperature rises above 25°C. The average power derating curve normally given on data sheets may be normalized and used for this purpose.

At first glance the derating curves of Figure 7 appear to be in error as the 10 ms pulse has a higher derating factor than the 10 μs pulse. However, when the derating factor for a given pulse of Figure 7 is multiplied by the peak power value of Figure 1 for the same pulse, the results follow the expected trend.

TYPICAL PROTECTION CIRCUIT



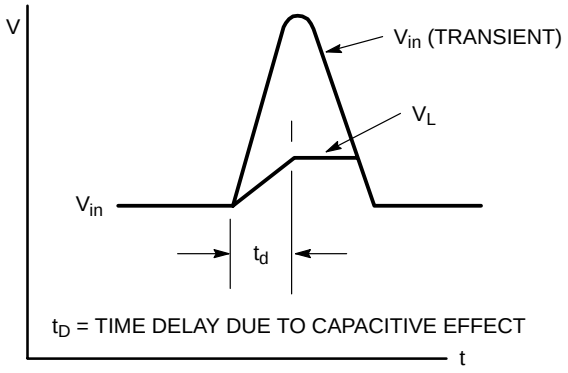


Figure 5.

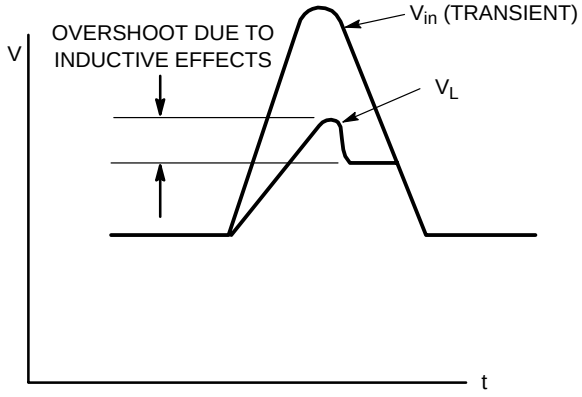


Figure 6.

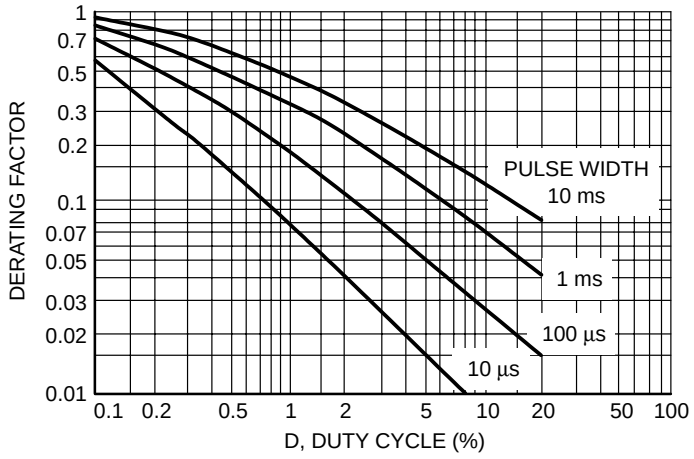


Figure 7. Typical Derating Factor for Duty Cycle

MSQA6V1W5T2

Quad Array for ESD Protection

This quad monolithic silicon voltage suppressor is designed for applications requiring transient overvoltage protection capability. It is intended for use in voltage and ESD sensitive equipment such as computers, printers, business machines, communication systems, medical equipment, and other applications. Its quad junction common anode design protects four separate lines using only one package. These devices are ideal for situations where board space is at a premium.

Specification Features

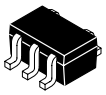
- SC88A Package Allows Four Separate Unidirectional Configurations
- Low Leakage < 1 μA @ 3 Volt
- Breakdown Voltage: 6.1 Volt – 7.2 Volt @ 1 mA
- Low Capacitance (90 pF typical)
- ESD Protection Meeting IEC1000–4–2

Mechanical Characteristics

- Void Free, Transfer–Molded, Thermosetting Plastic Case
- Corrosion Resistant Finish, Easily Solderable
- Package Designed for Optimal Automated Board Assembly
- Small Package Size for High Density Applications

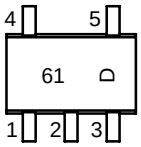
ON Semiconductor™

http://onsemi.com

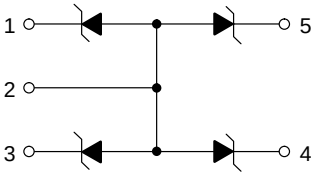


SC–88A/SOT–323
CASE 419A

MARKING DIAGRAM



61 = Device Marking
D = One Digit Date Code



ORDERING INFORMATION

Device	Package	Shipping
MSQA6V1W5T2	SC–88A	3000/Tape & Reel

NOTE: T2 Suffix Devices are Packaged with Pin 1 Opposing Sprocket Hole.

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Characteristic		Symbol	Value	Unit
Peak Power Dissipation @ 20 μs @$T_A \le$ 25°C (Note 1.)		P_{pk}	150	Watts
Steady State Power – 1 Diode (Note 2.)		P_D	385	mW
Thermal Resistance Junction to Ambient Above 25°C, Derate		$R_{\theta JA}$	325 3.1	°C/W mW/°C
Maximum Junction Temperature		T_{Jmax}	150	°C
Operating Junction and Storage Temperature Range		T_J T_{stg}	–55 to +150	°C
ESD Discharge	MIL STD 883C – Method 3015–6 IEC1000–4–2, Air Discharge IEC1000–4–2, Contact Discharge	V_{PP}	16 16 9	kV
Lead Solder Temperature (10 seconds duration)		T_L	260	°C

ELECTRICAL CHARACTERISTICS

	Breakdown Voltage V_{BR} @ 1 mA (Volts)			Leakage Current I_{RM} @ V_{RM} = 3 V	Capacitance @ 0 V Bias	Max V_F @ I_F = 200 mA
Device	**Min**	**Nom**	**Max**	**(μA)**	**(pF)**	**(V)**
MSQA6V1W5	6.1	6.6	7.2	1.0	90	1.25

1. Non–repetitive current per Figure 1. Derate per Figure 2.
2. Only 1 diode under power. For all 4 diodes under power, P_D will be 25%. Mounted on FR–4 board with min pad.

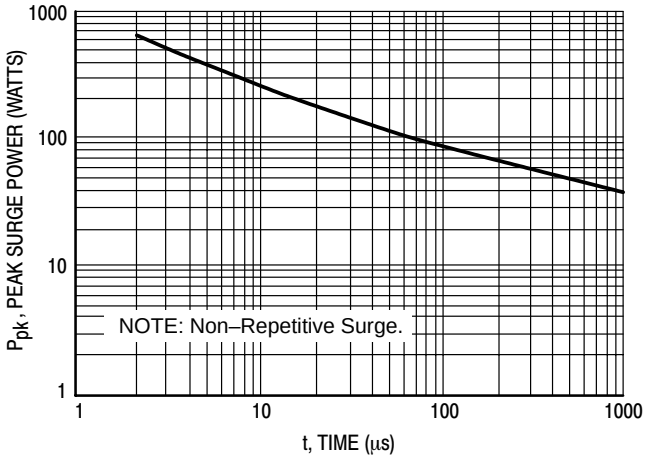


Figure 1. Pulse Width

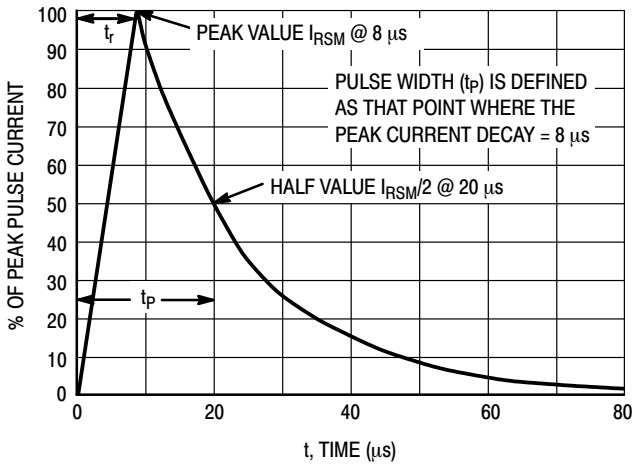


Figure 2. 8 × 20 μs Pulse Waveform

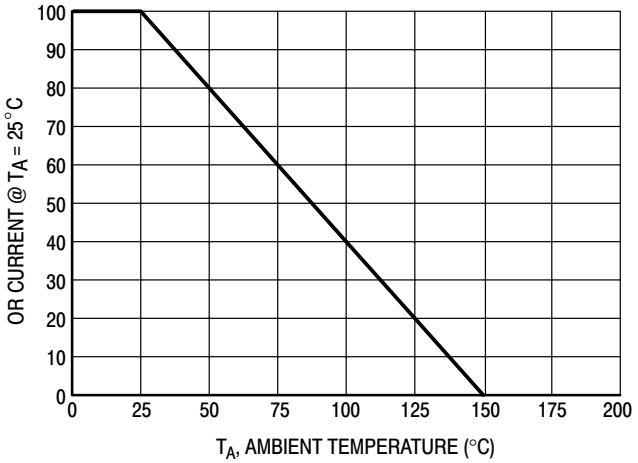


Figure 3. Pulse Derating Curve

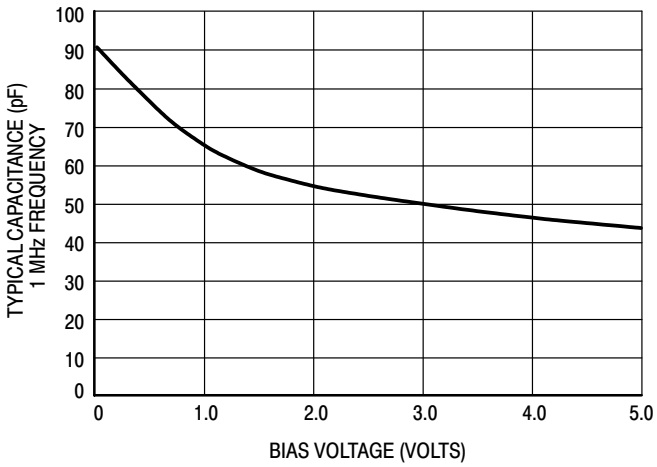


Figure 4. Capacitance

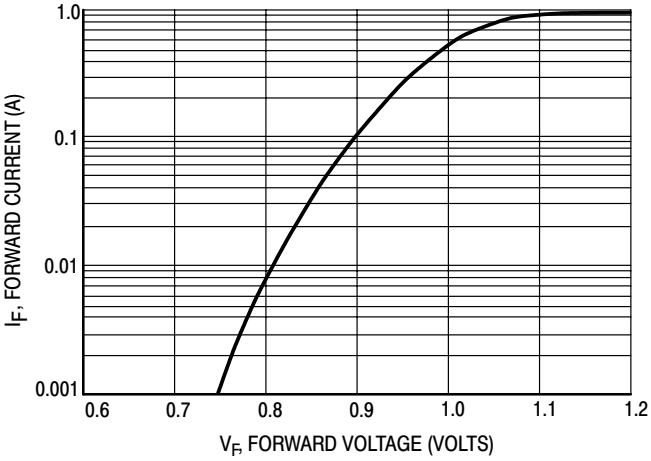


Figure 5. Forward Voltage

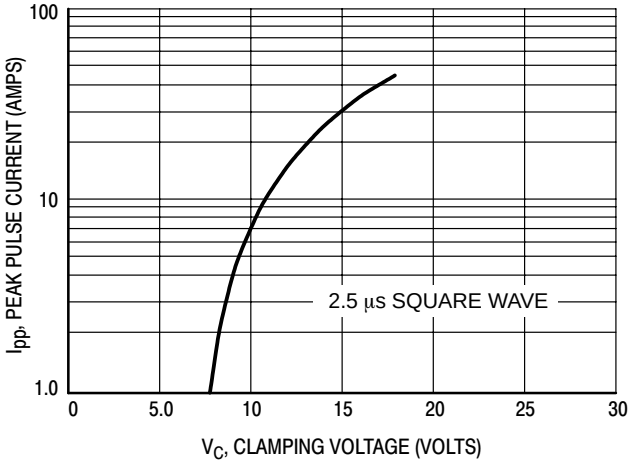


Figure 6. Clamping Voltage versus Peak Pulse Current (Reverse Direction)

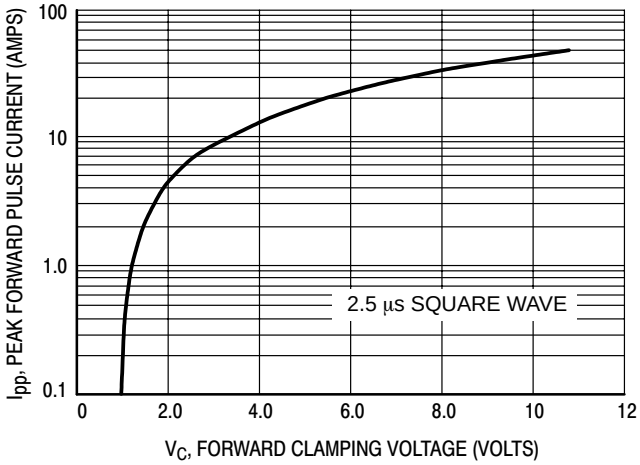


Figure 7. Clamping Voltage versus Peak Pulse Current (Forward Direction)

1PMT5.0AT3 Series

Zener Transient Voltage Suppressor POWERMITE® Package

The 1PMT5.0AT3 Series is designed to protect voltage sensitive components from high voltage, high energy transients. Excellent clamping capability, high surge capability, low zener impedance and fast response time. The advanced packaging technique provides for a highly efficient micro miniature, space saving surface mount with its unique heat sink design. The POWERMITE has the same thermal performance as the SMA while being 50% smaller in footprint area, and delivering one of the lowest height profiles (1.1 mm) in the industry. Because of its small size, it is ideal for use in cellular phones, portable devices, business machines, power supplies and many other industrial/consumer applications.

Specification Features:

- Stand–off Voltage: 5 – 58 Volts
- Peak Power – 175 Watts @ 1 ms
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage
- Response Time is Typically < 1 ns
- ESD Rating of Class 3 (> 16 kV) per Human Body Model
- Low Profile – Maximum Height of 1.1 mm
- Integral Heat Sink/Locking Tabs
- Full Metallic Bottom Eliminates Flux Entrapment
- Small Footprint – Footprint Area of 8.45 mm^2
- Supplied in 12 mm Tape and Reel – 12,000 Units per Reel
- POWERMITE is JEDEC Registered as DO–216AA

Mechanical Characteristics:

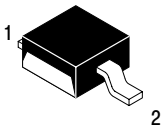
CASE: Void-free, transfer-molded, thermosetting plastic
FINISH: All external surfaces are corrosion resistant and leads are readily solderable
MOUNTING POSITION: Any
MAXIMUM CASE TEMPERATURE FOR SOLDERING PURPOSES: 260°C for 10 Seconds

ON Semiconductor™

http://onsemi.com

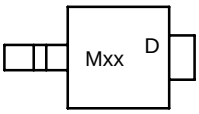
PLASTIC SURFACE MOUNT ZENER OVERVOLTAGE TRANSIENT SUPPRESSOR 5 – 58 VOLTS 175 WATT PEAK POWER

1: CATHODE
2: ANODE



POWERMITE
CASE 457
PLASTIC

MARKING DIAGRAM



Mxx = Specific Device Code
xx = 5 – 58
(See Table Next Page)
D = Date Code

ORDERING INFORMATION

Device	Package	Shipping
1PMTxxAT3	POWERMITE	12,000/Tape & Reel

LEAD ORIENTATION IN TAPE:
Cathode (Short) Lead to Sprocket Holes

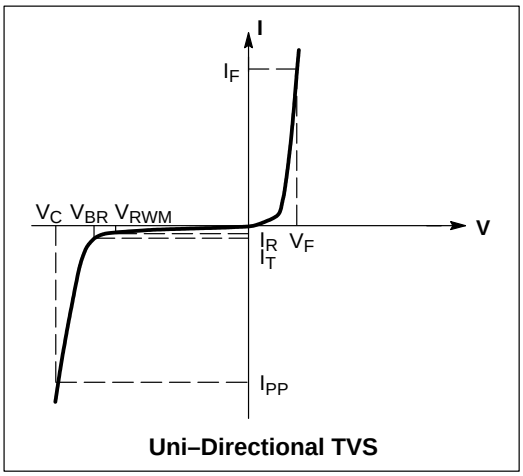
MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Maximum P_{pk} Dissipation @ T_A = 25°C, (PW–10/1000 μs) (Note 1.)	P_{pk}	175	W
Maximum P_{pk} Dissipation @ T_A = 25°C, (PW–8/20 μs) (Note 1.)	P_{pk}	1000	W
DC Power Dissipation @ T_A = 25°C (Note 2.) Derate above 25°C Thermal Resistance from Junction to Ambient	P_D $R_{\theta JA}$	500 4.0 248	mW mW/°C °C/W
Thermal Resistance from Junction to Lead (Anode)	$R_{\theta Janode}$	35	°C/W
Maximum DC Power Dissipation (Note 3.) Thermal Resistance from Junction to Tab (Cathode)	P_D $R_{\theta Jcathode}$	3.2 23	W °C/W
Operating and Storage Temperature Range	T_J, T_{stg}	–55 to +150	°C

1. Non–repetitive current pulse at T_A = 25°C.
2. Mounted with recommended minimum pad size, DC board FR–4.
3. At Tab (Cathode) temperature, T_{tab} = 75°C

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted, V_F = 3.5 V Max. @ I_F (Note 4.) = 35 A)

Symbol	Parameter
I_{PP}	Maximum Reverse Peak Pulse Current
V_C	Clamping Voltage @ I_{PP}
V_{RWM}	Working Peak Reverse Voltage
I_R	Maximum Reverse Leakage Current @ V_{RWM}
V_{BR}	Breakdown Voltage @ I_T
I_T	Test Current
I_F	Forward Current
V_F	Forward Voltage @ I_F



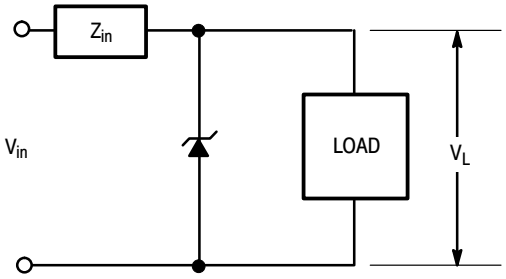
Uni–Directional TVS

ELECTRICAL CHARACTERISTICS (T_L = 30°C unless otherwise noted, V_F = 1.25 Volts @ 200 mA)

Device	Marking	V_R (V) (Note 5.)	V_{BR} @ I_T (V) (Note 6.) Min	Nom	Max	I_T (mA)	I_R @ V_{RWM} (μA)	V_C @ I_{PP} (V)	I_{PP} (A) (Note 7.)
1PMT5.0AT3	MKE	5.0	6.4	6.7	7.0	10	800	9.2	19
1PMT7.0AT3	MKM	7.0	7.78	8.2	8.6	10	500	12	14.6
1PMT12AT3	MLE	12	13.3	14.0	14.7	1.0	5.0	19.9	8.8
1PMT16AT3	MLP	16	17.8	18.75	19.7	1.0	5.0	26	7.0
1PMT18AT3	MLT	18	20.0	21.0	22.1	1.0	5.0	29.2	6.0
1PMT22AT3	MLX	22	24.4	25.6	26.9	1.0	5.0	35.5	4.9
1PMT24AT3	MLZ	24	26.7	28.1	29.5	1.0	5.0	38.9	4.5
1PMT26AT3	MME	26	28.9	30.4	31.9	1.0	5.0	42.1	4.2
1PMT28AT3	MMG	28	31.1	32.8	34.4	1.0	5.0	45.4	3.9
1PMT30AT3	MMK	30	33.3	35.1	36.8	1.0	5.0	48.4	3.6
1PMT33AT3	MMM	33	36.7	38.7	40.6	1.0	5.0	53.3	3.3
1PMT36AT3	MMP	36	40.0	42.1	44.2	1.0	5.0	58.1	3.0
1PMT40AT3	MMR	40	44.4	46.8	49.1	1.0	5.0	64.5	2.7
1PMT48AT3	MMX	48	53.3	56.1	58.9	1.0	5.0	77.4	2.3
1PMT51AT3	MMZ	51	56.7	59.7	62.7	1.0	5.0	82.4	2.1
1PMT58AT3	MNG	58	64.4	67.8	71.2	1.0	5.0	93.6	1.9

4. 1/2 sine wave (or equivalent square wave), PW = 8.3 ms, duty cycle = 4 pulses per minute maximum.
5. A transient suppressor is normally selected according to the Working Peak Reverse Voltage (V_{RWM}) which should be equal to or greater than the DC or continuous peak operating voltage level.
6. V_{BR} measured at pulse test current I_T at ambient temperature of 25°C.
7. Surge current waveform per Figure 2 and derate per Figure 4.

TYPICAL PROTECTION CIRCUIT



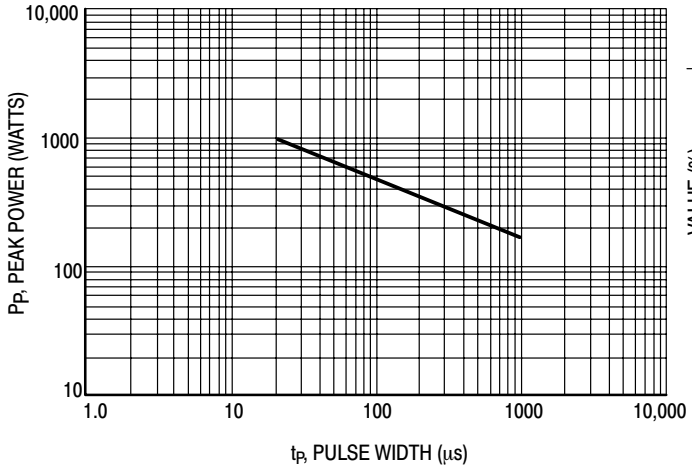


Figure 1. Pulse Rating Curve

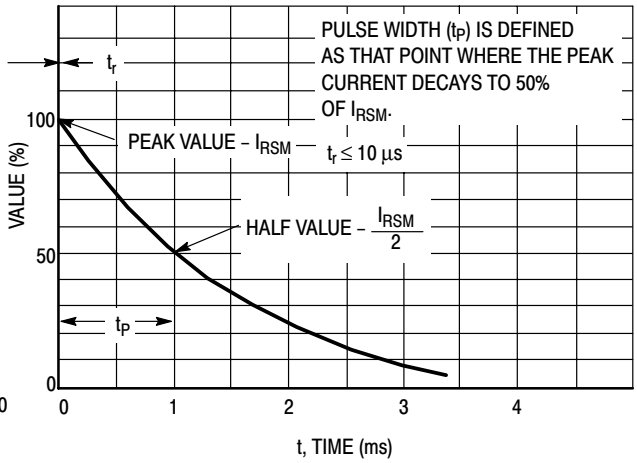


Figure 2. 10 X 1000 μs Pulse Waveform

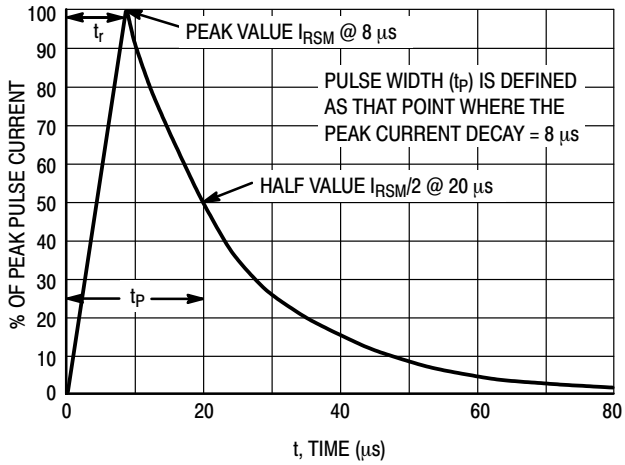


Figure 3. 8 X 20 μs Pulse Waveform

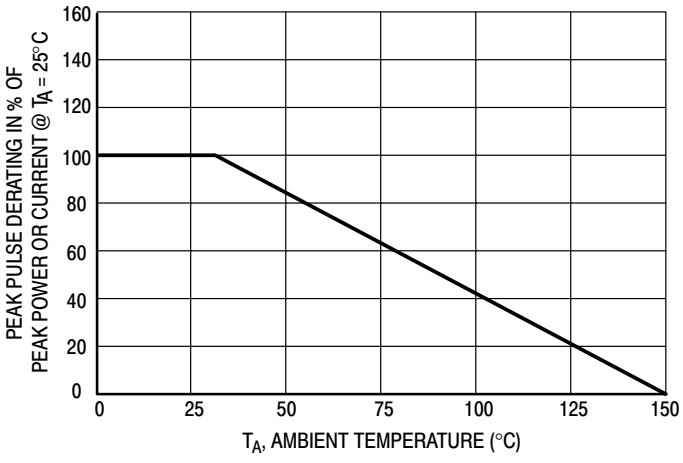


Figure 4. Pulse Derating Curve

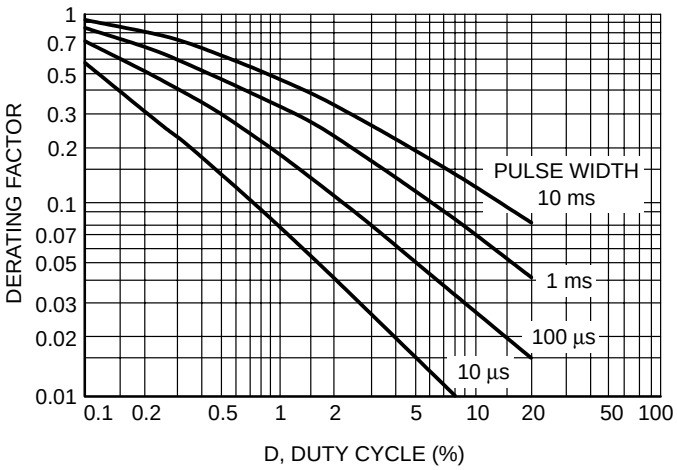


Figure 5. Typical Derating Factor for Duty Cycle

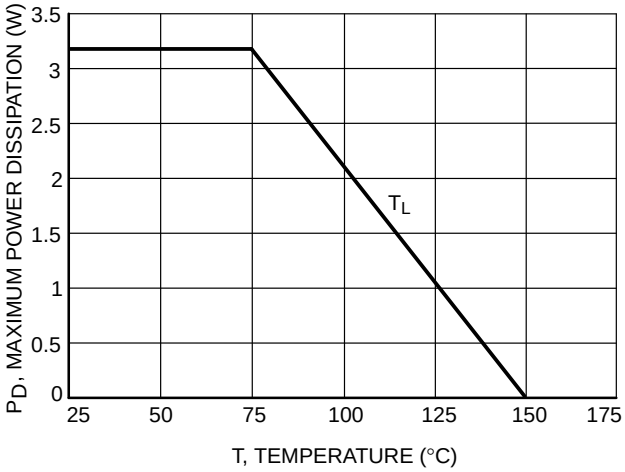


Figure 6. Steady State Power Derating

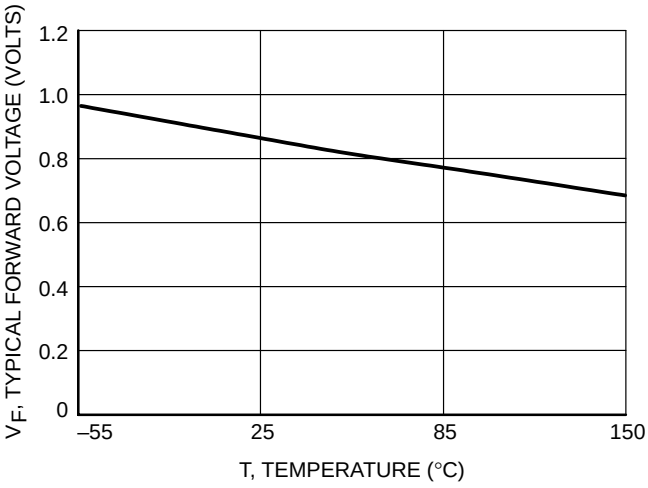


Figure 7. Forward Voltage

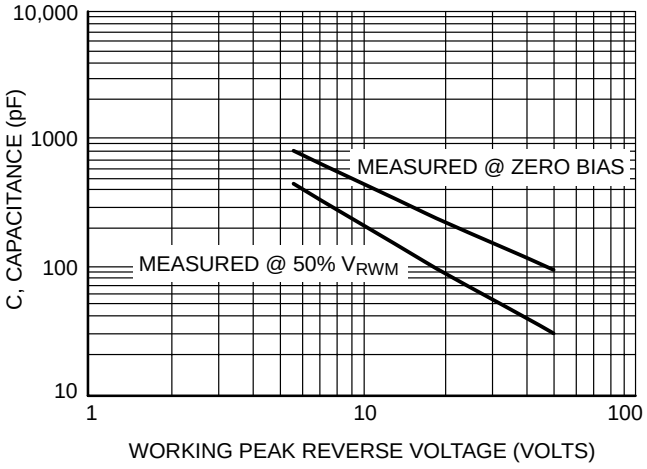


Figure 8. Capacitance versus Working Peak Reverse Voltage

SMS05T1

Advance Information

SC-74 Quad Transient Voltage Suppressor

for ESD Protection

This quad monolithic silicon voltage suppressor is designed for applications requiring transient overvoltage protection capability. It is intended for use in voltage and ESD sensitive equipment such as computers, printers, business machines, communication systems and other applications. This quad device provides superior surge protection over current quad Zener MMQA series by providing up to 350 watts peak power.

Features:

- SC-74 Package Allows Four Separate Unidirectional Configurations
- Peak Power – 350 Watts 8 x 20 μS
- ESD Rating of Class N (Exceeding 25 kV) per the Human Body Model
- ESD Rating:
  IEC 61000–4–2 (ESD) 15 kV (air) 8 kV (contact)
  IEC 61000–4–4 (EFT) 40 A (5/50 ns)
  IEC 61000–4–5 (lighting) 23 (8/20 μs)
- UL Flammability Rating of 94V–0

Typical Applications:

- Hand Held Portable Applications such as Cell Phones, Pagers, Notebooks and Notebook Computers

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation 8 x 20 μS @ T_A = 25°C (Note 1.)	P_{pk}	350	W
Total Power Dissipation on FR–5 Board @ T_A = 25°C (Note 2.)	P_D	225	mW
Derate Above 25°C		1.8	mW/°C
Thermal Resistance, Junction–to–Ambient	$R_{\theta JA}$	556	°C/W
Junction and Storage Temperature Range	T_J, T_{stg}	–55 to +150	°C
Lead Solder Temperature – Maximum 10 Seconds Duration	T_L	260	°C

1. Non–repetitive current pulse 8 x 20 μS exponential decay waveform
2. FR–5 = 1.0 x 0.75 x 0.62 in.

This document contains information on a new product. Specifications and information herein are subject to change without notice.

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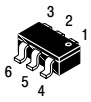
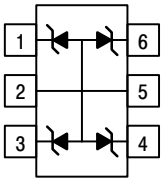
SC–74 QUAD TRANSIENT VOLTAGE SUPPRESSOR 350 WATTS PEAK POWER 5 VOLTS

PIN ASSIGNMENT

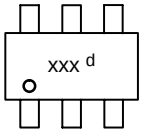


SC–74
CASE 318F
STYLE 1



PIN 1. CATHODE
2. ANODE
3. CATHODE
4. CATHODE
5. ANODE
6. CATHODE

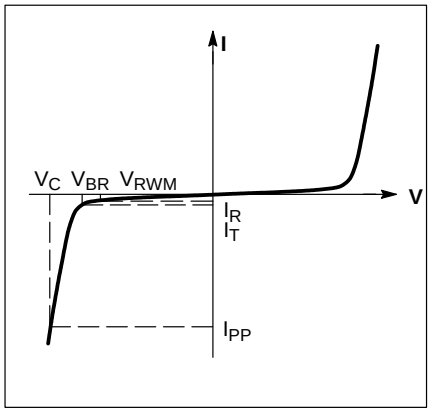
MARKING DIAGRAM



xxx = Device Code
d = Date Code

ORDERING INFORMATION

Device	Package	Shipping
SMS05T1	SC–74	3000/Tape & Reel
SMS05T3	SC–74	10,000/Tape & Reel



ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Reverse Breakdown Voltage @ I_t = 1.0 mA	V_{BR}	6.0	–	7.2	V
Reverse Leakage Current @ V_{RWN} = 5.0 Volts	I_R	N/A	–	20	μA
Maximum Clamping Voltage @ I_{PP} = 5.0 A, 8 x 20 μS	V_C	N/A	–	9.8	V
Maximum Clamping Voltage @ I_{PP} = 23 A, 8 x 20 μS	V_C	N/A	–	15.5	V
Between I/O Pins and Ground @ V_R = 0 Volts, 1.0 MHz	Capacitance	250	300	400	pF

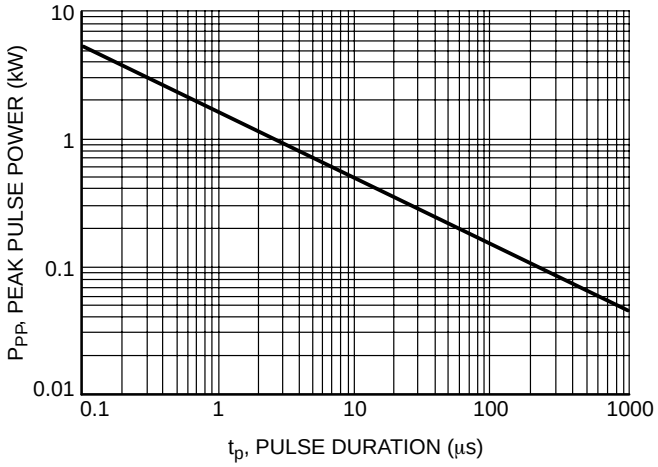


Figure 1. Non–Repetitive Peak Pulse Power versus Pulse Time

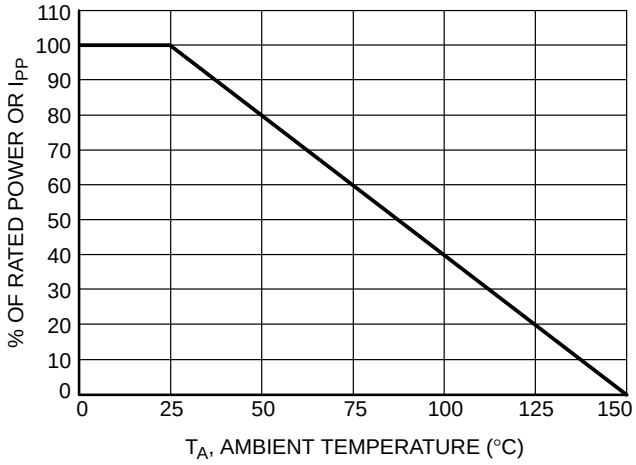


Figure 2. Power Derating Curve

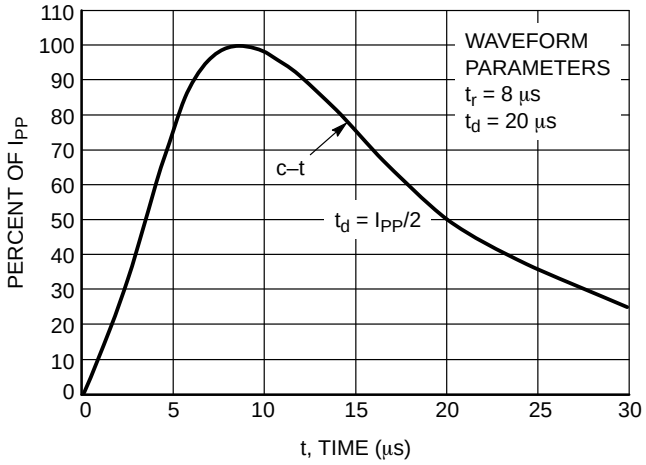


Figure 3. Pulse Waveform

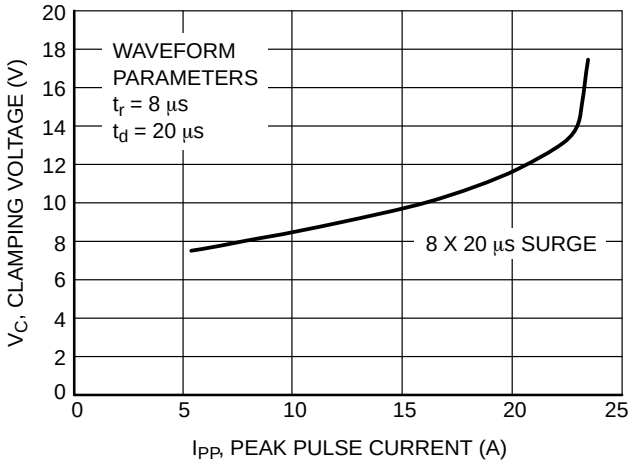


Figure 4. Clamping Voltage versus Peak Pulse Current

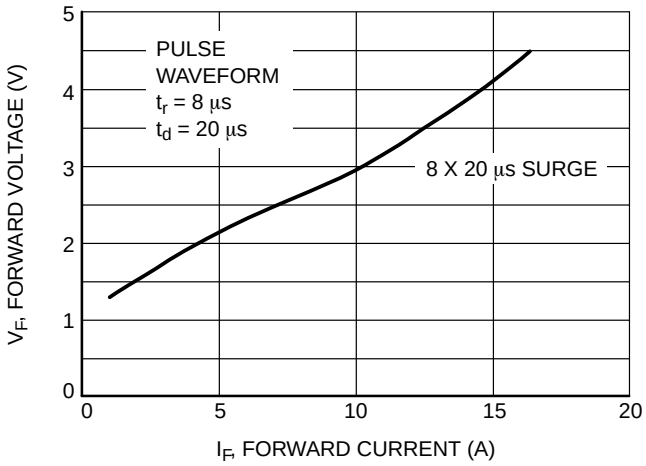


Figure 5. 8 x 20 μs V_F

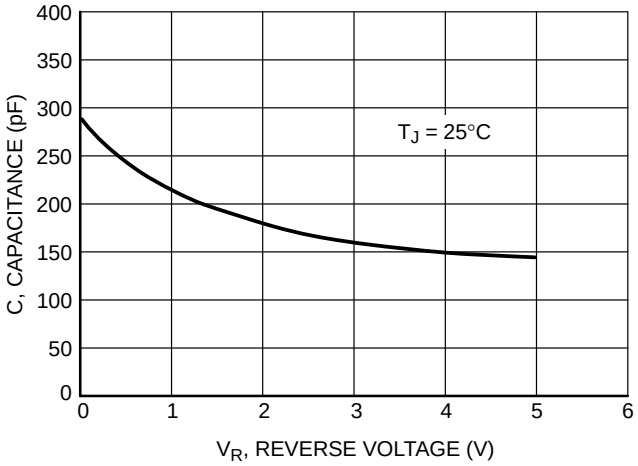


Figure 6. Typical Capacitance

NZMM7V0T4

EMI Filter with ESD Protection

This device is scheduled for availability in Q4 2000. Please contact your nearest ON Semiconductor sales representative for further information.

Features:

- 4 × 4 mm Lead Less MLF Surface Mount Package
- 9 EMI/RFI Bi–directional “Pi” Low–Pass Filters
- ESD Protection Meets IEC6000–4–2
- 50 Watt Peak Pulse Power, 8 × 20 μs (all diodes under power)
- Diode Capacitance: 7 – 10 pF
- “Pi” Filter Line Capacitance: 22 ±20% pF
- Low Zener Diode Leakage: 1 μA Maximum
- Zener Breakdown Voltage; 6 – 8 Volts
- Moisture Sensitivity Level 1

Benefits:

- Suppresses EMI/RFI Noise in Systems Subjected to Electromagnetic Interference
- Small Package Size Minimizes Parasitic Inductance, Thus a More “Ideal” Low Pass Filtering Response

Typical Applications:

- Cellular Phones
- Communication Systems
- Computers
- Portable Products with Input/Output Conductors

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (Note 1.) 8 × 20 μs Pulse	P_{PK}	50	Watts
IEC6000–4–2 Air Discharge	ESD	±25	kV
Contact Discharge		±8.0	
MIL STD 883C Method 3015–6		±16	
Maximum Junction Temperature	T_J	150	°C

1. All diodes under power

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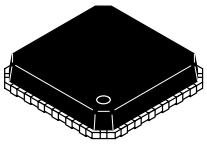
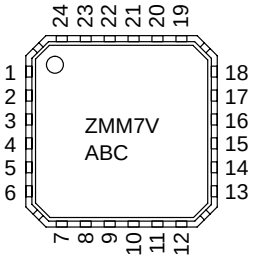


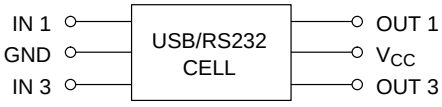
24 PIN MLF
CASE 488
PLASTIC

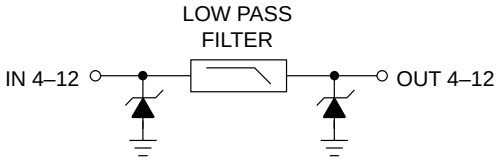
MARKING DIAGRAM



ZMM7V = Specific Device Code
ABC = Date Code

CIRCUIT DESCRIPTION





ORDERING INFORMATION

Device	Package	Shipping
NZMM7V0T4	24 PIN	4000/Tape & Reel

ELECTRICAL CHARACTERISTICS

Symbol	Characteristic	Min	Typ	Max	Unit
V_Z	Zener Breakdown Voltage, @ I_{ZT} = 1 mA	6.0	–	8.0	V
I_r	Zener Leakage Current, @ V_R = 3 V	N/A	–	1.0	μA
V_F	Zener Forward Voltage, @ I_F = 50 mA	N/A	–	1.25	V
Capacitance	Zener Internal Capacitance, @ 0 V Bias	7.0	–	10	pF
Capacitance	Zener/Resistor Array Line Capacitance	17.6	–	26.4	pF
Resistor	Resistance	90	–	110	Ω
F_C (Note 2.)	Cutoff Frequency	–	220	–	MHz

2. 50 Ω Source and 50 Ω Lead Termination per Figure 2

Frequency Response Specification

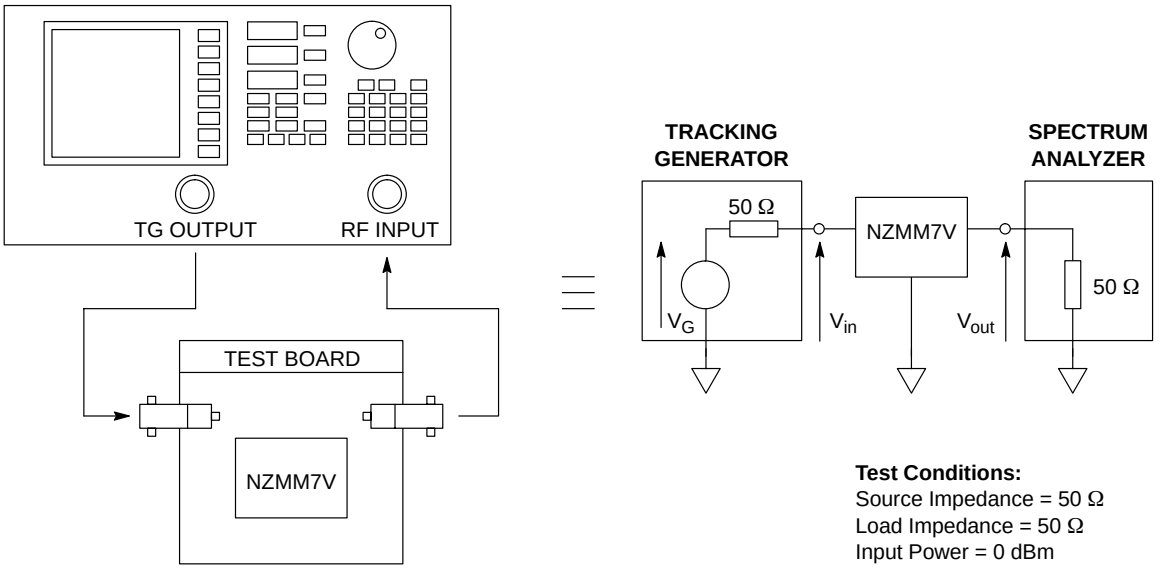


Figure 1. Measurement Conditions

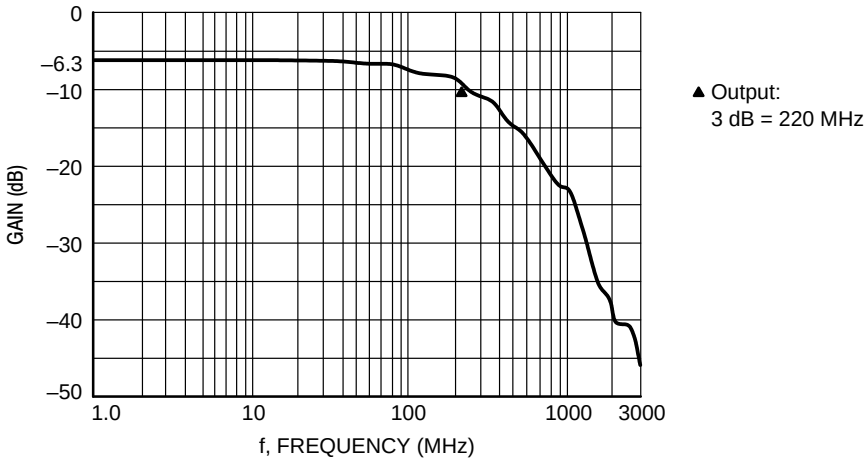
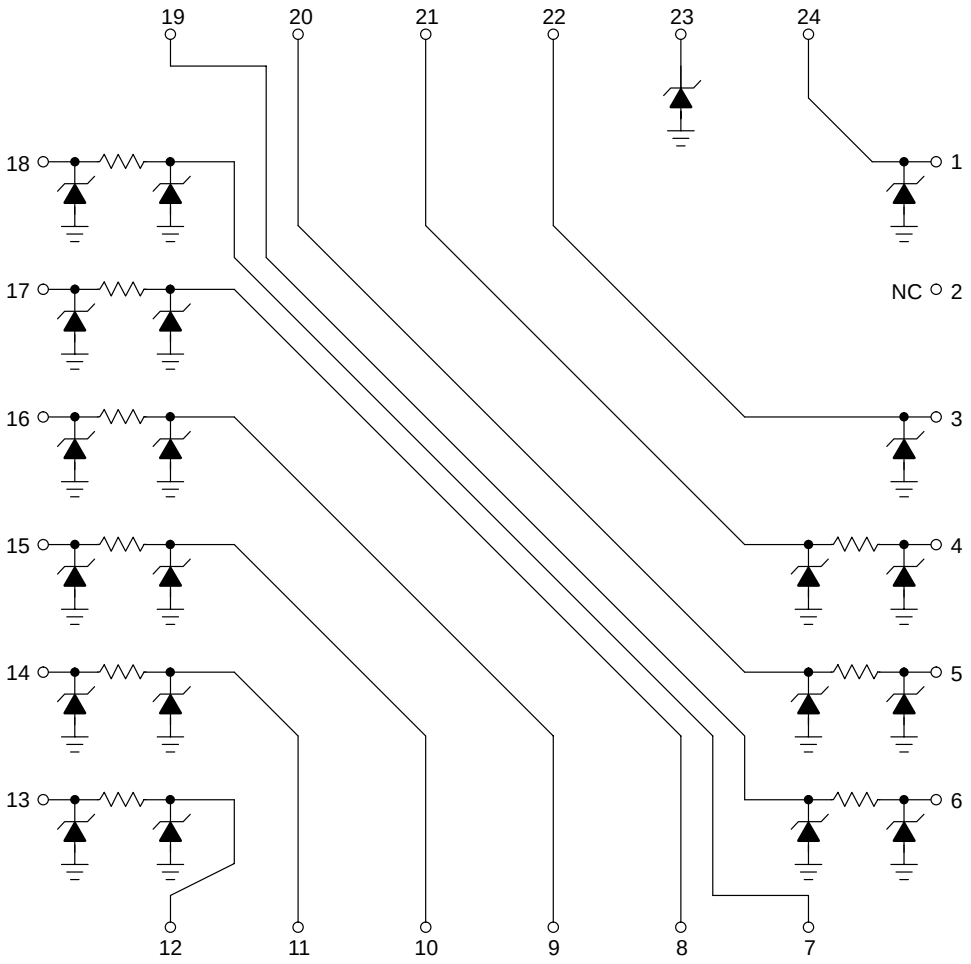


Figure 2. Typical EMI Filter Response (50 Ω Source and 50 Ω Lead Termination)

Detailed Device Schematic



Applications Information

Suppressing Noise at the Source

- Filter all I/O signals leaving the noisy environment
- Locate I/O driver circuits close to the connector
- Use the longest rise/fall times possible for all digital signals

Reducing Noise at the Receiver

- Filter all I/O signals entering the unit
- Locate the I/O filters as close as possible to the connector

Minimizing Noise Coupling

- Use multilayer PCBs to minimize power and ground inductance
- Keep clock circuits away from the I/O connector
- Ground planes should be used whenever possible
- Minimize the loop area for all high speed signals
- Provide for adequate power decoupling

ESD Protection

- Locate the suppression devices as close to the I/O connector as possible
- Minimize the PCB trace length to the suppression device
- Minimize the PCB trace length for the ground return for the suppression device

NZF220TT1

Advance Information

EMI Filter with ESD Protection

Features:

- EMI/RFI Bi–directional “Pi” Low–Pass Filters
- ESD Protection Meets IEC6000–4–2, up to 15 kV Air Discharge, or 8 kV Contact Discharge
- Diode Capacitance: 7 – 10 pF
- Zener/Resistor Line Capacitance: 22 ±20% pF
- Low Zener Diode Leakage: 1 μA Maximum
- Zener Breakdown Voltage; 6 – 8 Volts

Benefits:

- Designed to suppress EMI/RFI Noise in Systems Subjected to Electromagnetic Interference
- Small Package Size Minimizes Parasitic Inductance, Thus a More “Ideal” Low Pass Filtering Response

Typical Applications:

- Cellular Phones
- Communication Systems
- Computers
- Portable Products with Input/Output Conductors

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (Note 1.) 8 × 20 μs Pulse	P_{PK}	TBD	Watts
IEC6000–4–2 Air Discharge IEC6000402 Contact Discharge MIL STD 883C Method 3015–6	ESD	±25 ±8.0 ±16	kV
Maximum Junction Temperature	T_J	150	°C

1. All diodes under power

This document contains information on a new product. Specifications and information herein are subject to change without notice.

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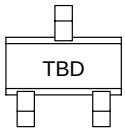
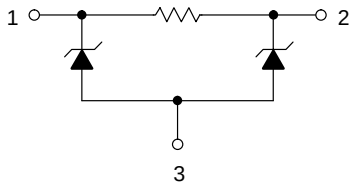
SC–75
CASE 463
PLASTIC

MARKING DIAGRAM



CIRCUIT DESCRIPTION



ORDERING INFORMATION

Device	Package	Shipping
NZF220TT1	SC–75	TBD

ELECTRICAL CHARACTERISTICS

Symbol	Characteristic	Min	Typ	Max	Unit
V_Z	Zener Breakdown Voltage, @ I_{ZT} = 1 mA	6.0	–	8.0	V
I_r	Zener Leakage Current, @ V_R = 3 V	N/A	–	1.0	μA
V_F	Zener Forward Voltage, @ I_F = 50 mA	N/A	–	1.25	V
Capacitance	Zener Internal Capacitance, @ 0 V Bias	7.0	–	10	pF
Capacitance	Zener/Resistor Array Line Capacitance	17.6	–	26.4	pF
Resistor	Resistance	90	–	110	Ω
F_C (Note 2.)	Cutoff Frequency	–	220	–	MHz

2. 50 Ω Source and 50 Ω Lead Termination per Figure 2

Applications Information

Suppressing Noise at the Source

- Filter all I/O signals leaving the noisy environment
- Locate I/O driver circuits close to the connector
- Use the longest rise/fall times possible for all digital signals

Reducing Noise at the Receiver

- Filter all I/O signals entering the unit
- Locate the I/O filters as close as possible to the connector

Minimizing Noise Coupling

- Use multilayer PCBs to minimize power and ground inductance
- Keep clock circuits away from the I/O connector
- Ground planes should be used whenever possible
- Minimize the loop area for all high speed signals
- Provide for adequate power decoupling

ESD Protection

- Locate the suppression devices as close to the I/O connector as possible
- Minimize the PCB trace length to the suppression device
- Minimize the PCB trace length for the ground return for the suppression device

Frequency Response Specification

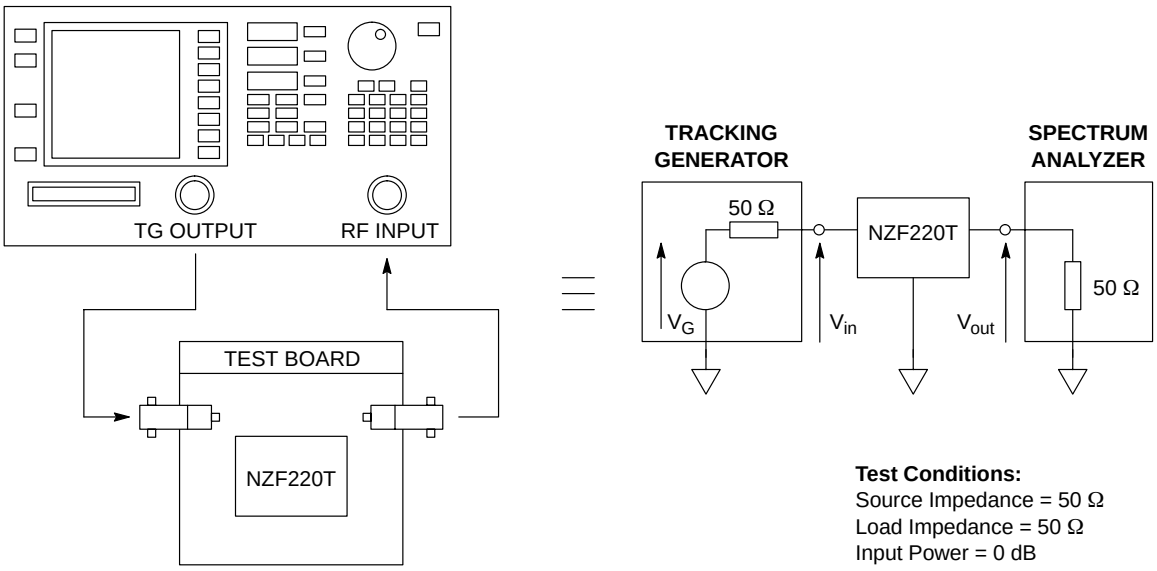


Figure 1. Measurement Conditions

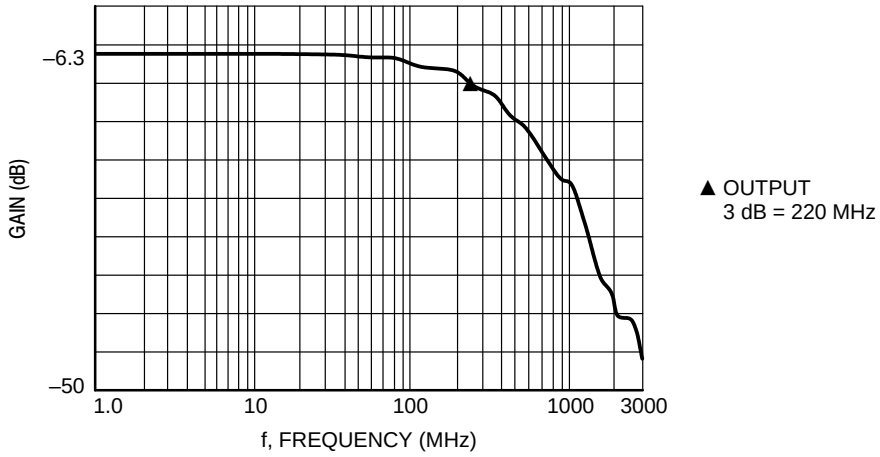


Figure 2. Typical EMI Filter Response (50 Ω Source and 50 Ω Lead Termination)

NZF220DFT1

Advance Information

EMI Filter with ESD Protection

Features:

- 2 EMI/RFI Bi–directional “Pi” Low–Pass Filters
- ESD Protection Meets IEC6000–4–2, up to 15 kV Air Discharge, or 8 kV Contact Discharge
- Diode Capacitance: 7 – 10 pF
- Zener/Resistor Line Capacitance: 22 ±20% pF
- Low Zener Diode Leakage: 1 μA Maximum
- Zener Breakdown Voltage; 6 – 8 Volts

Benefits:

- Designed to suppress EMI/RFI Noise in Systems Subjected to Electromagnetic Interference
- Nominal Cutoff Frequency of 220 MHz (per Figure 2)
- Small Package Size Minimizes Parasitic Inductance, Thus a More “Ideal” Low Pass Filtering Response

Typical Applications:

- Cellular Phones
- Communication Systems
- Computers
- Portable Products with Input/Output Conductors

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (Note 1.) 8 × 20 μs Pulse	P_{PK}	TBD	Watts
IEC6000–4–2 Air Discharge IEC6000402 Contact Discharge	ESD	±15 ±8.0	kV
Maximum Junction Temperature	T_J	150	°C

1. All diodes under power

This document contains information on a new product. Specifications and information herein are subject to change without notice.

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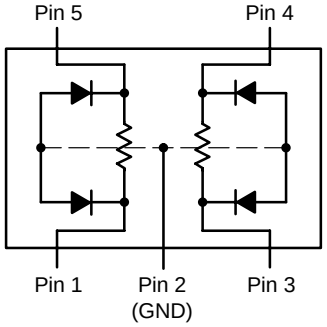
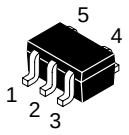
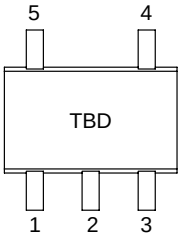
CIRCUIT DESCRIPTION





SC–88A
CASE 419A
DF SUFFIX

MARKING DIAGRAM



ORDERING INFORMATION

Device	Package	Shipping
NZF220DFT1	SC–88A	3000/Tape & Reel

ELECTRICAL CHARACTERISTICS

Symbol	Characteristic	Min	Typ	Max	Unit
V_Z	Zener Breakdown Voltage, @ I_{ZT} = 1 mA	6.0	–	8.0	V
I_r	Zener Leakage Current, @ V_R = 3 V	N/A	–	1.0	μA
V_F	Zener Forward Voltage, @ I_F = 50 mA	N/A	–	1.5	V
Capacitance	Zener Internal Capacitance, @ 0 V Bias	7.0	–	10	pF
Capacitance	Zener/Resistor Array Line Capacitance	17.6	–	26.4	pF
Resistor	Resistance	90	–	110	Ω
F_C (Note 2.)	Cutoff Frequency	–	220	–	MHz

2. 50 Ω Source and 50 Ω Lead Termination per Figure 2

Applications Information

Suppressing Noise at the Source

- Filter all I/O signals leaving the noisy environment
- Locate I/O driver circuits close to the connector
- Use the longest rise/fall times possible for all digital signals

Reducing Noise at the Receiver

- Filter all I/O signals entering the unit
- Locate the I/O filters as close as possible to the connector

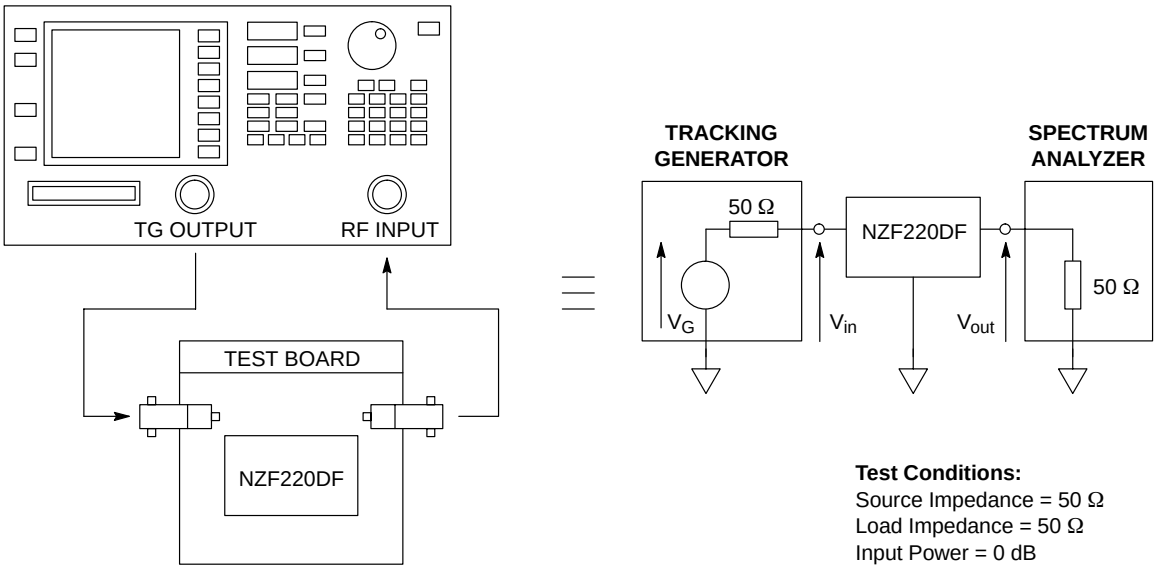
Minimizing Noise Coupling

- Use multilayer PCBs to minimize power and ground inductance
- Keep clock circuits away from the I/O connector
- Ground planes should be used whenever possible
- Minimize the loop area for all high speed signals
- Provide for adequate power decoupling

ESD Protection

- Locate the suppression devices as close to the I/O connector as possible
- Minimize the PCB trace length to the suppression device
- Minimize the PCB trace length for the ground return for the suppression device

Frequency Response Specification



Test Conditions:
Source Impedance = 50 Ω
Load Impedance = 50 Ω
Input Power = 0 dB

Figure 1. Measurement Conditions

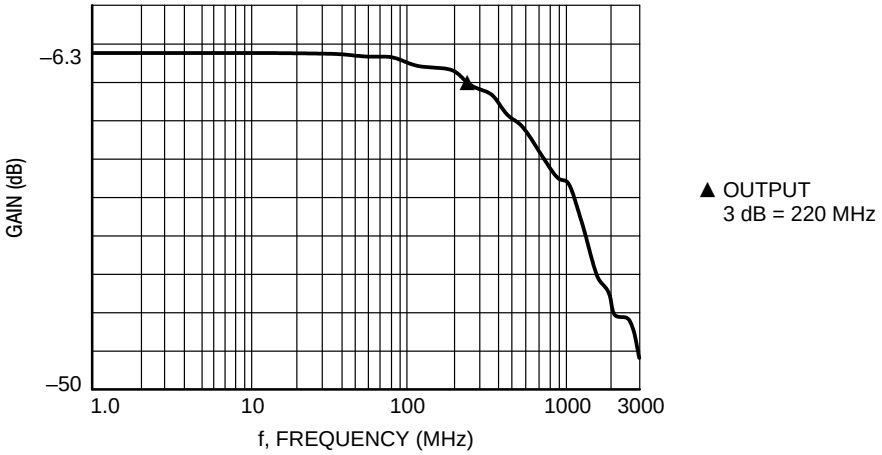
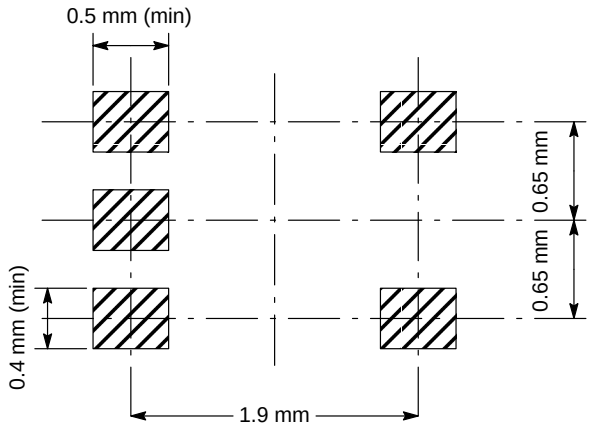


Figure 2. Typical EMI Filter Response
(50 Ω Source and 50 Ω Lead Termination)

Footprint



MMT05A230T3, MMT05A260T3, MMT05A310T3

Preferred Devices

Advance Information

Thyristor Surge Protectors

High Voltage Bidirectional TSPD

These Thyristor Surge Protective devices (TSPD) prevent overvoltage damage to sensitive circuits by lightning, induction and power line crossings. They are breakover–triggered crowbar protectors. Turn–off occurs when the surge current falls below the holding current value.

Secondary protection applications for electronic telecom equipment at customer premises.

- High Surge Current Capability: **50 Amps** 10 x 1000 μsec; Guaranteed at the extended temp range of –20°C to 65°C in the SMA package
- The MMT05A230T3 Series is used to help equipment meet various regulatory requirements including: Telcordia 1089, ITU K.20 & K.21, IEC 950 and FCC Part 68.
- Bidirectional Protection in a Single Device
- Little Change of Voltage Limit with Transient Amplitude or Rate
- Freedom from Wearout Mechanisms Present in Non–Semiconductor Devices
- Fail–Safe, Shorts When Overstressed, Preventing Continued Unprotected Operation.
- Surface Mount Technology (SMT)
- Device Marking: MMT05A230T3: TBD; MMT05A260T3: TBD; MMT05A310T3: TBD

MAXIMUM RATINGS (T_J = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Off–State Voltage – Maximum MMT05A230T3 MMT05A260T3 MMT05A310T3	V_{DM}	 ±170 ±200 ±270	Volts
Maximum Pulse Surge Short Circuit Current Non–Repetitive Double Exponential Decay Waveform (Notes 1. and 2.) 10 x 1000 μsec (–20°C to +65°C) 8 x 20 μsec 10 x 160 μsec 10 x 560 μsec	 I_{PPS1} I_{PPS2} I_{PPS3} I_{PPS4}	 ±50 ±150 ±100 ±70	A(pk)
Maximum Non–Repetitive Rate of Change of On–State Current Double Exponential Waveform, R = 1.0, L = 1.5 μH, C = 1.67 μF, I_{pk} = 110A	di/dt	±150	A/μs

1. Allow cooling before testing second polarity.
2. Measured under pulse conditions to reduce heating.

This document contains information on a new product. Specifications and information herein are subject to change without notice.

ON Semiconductor™

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BIDIRECTIONAL TSPD
50 AMP SURGE
265 thru 365 VOLTS

SMA
(No Polarity)
CASE 403D

MARKING DIAGRAM

xxxx = Specific Device Code
LL = Location Code
WW = Work Week
# = Die Fab Location

ORDERING INFORMATION

Device	Package	Shipping
MMT05A230T3	SMA	12mm Tape and Reel (2.5K/Reel)
MMT05A260T3	SMA	12mm Tape and Reel (2.5K/Reel)
MMT05A310T3	SMA	12mm Tape and Reel (2.5K/Reel)

Preferred devices are recommended choices for future use and best overall value.

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Operating Temperature Range Blocking or Conducting State	T_{J1}	–40 to +125	°C
Overload Junction Temperature – Maximum Conducting State Only	T_{J2}	+175	°C
Instantaneous Peak Power Dissipation (I_{pk} = 50A, 10x1000 μsec @ 25°C)	P_{PK}	2000	W
Maximum Lead Temperature for Soldering Purposes 1/8″ from Case for 10 Seconds	T_L	260	°C

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

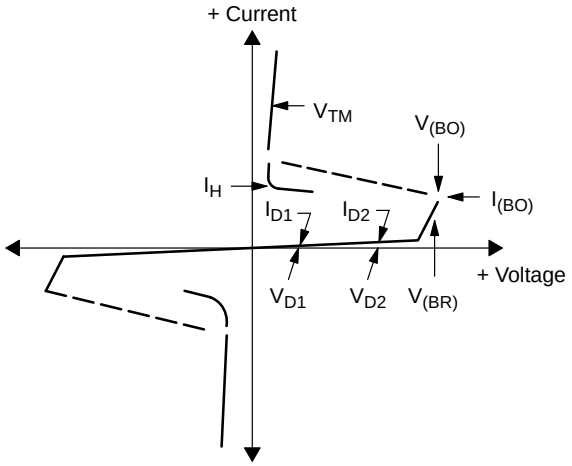
Devices are bidirectional. All electrical parameters apply to forward and reverse polarities.

Characteristics		Symbol	Min	Typ	Max	Unit
Breakover Voltage (Both polarities)		$V_{(BO)}$				Volts
(dv/dt = 100 V/μs, I_{SC} = 1.0 A, Vdc = 1000 V)	MMT05A230T3		–	–	265	
	MMT05A260T3		–	–	320	
	MMT05A310T3		–	–	365	
(+65°C)						
	MMT05A230T3		–	–	280	
	MMT05A260T3		–	–	340	
	MMT05A310T3		–	–	400	
Breakover Voltage (Both polarities)		$V_{(BO)}$				Volts
(f = 60 Hz, I_{SC} = 1.0 A(rms), V_{OC} = 1000 V(rms),	MMT05A230T3		–	–	265	
R_I = 1.0 kΩ, t = 0.5 cycle) (Note 3.)	MMT05A260T3		–	–	320	
	MMT05A310T3		–	–	365	
(+65°C)						
	MMT05A230T3		–	–	280	
	MMT05A260T3		–	–	340	
	MMT05A310T3		–	–	400	
Breakover Voltage Temperature Coefficient		$dV_{(BO)}/dT_J$	–	0.08	–	%/°C
Breakdown Voltage ($I_{(BR)}$ = 1.0 mA) Both polarities		$V_{(BR)}$				Volts
	MMT05A230T3		–	190	–	
	MMT05A260T3		–	240	–	
	MMT05A310T3		–	280	–	
Off State Current (V_{D1} = 50 V) Both polarities		I_{D1}	–	–	2.0	μA
(V_{D2} = V_{DM}) Both polarities		I_{D2}	–	–	5.0	
On–State Voltage (I_T = 1.0 A)		V_T	–	1.53	3.0	Volts
(PW ≤ 300 μs, Duty Cycle ≤ 2%) (Note 3.)						
Breakover Current (f = 60 Hz, V_{DM} = 1000 V(rms), R_S = 1.0 kΩ) Both polarities		I_{BO}	–	230	–	mA
Holding Current (Both polarities)	(Note 3.)	I_H	175	340	–	mA
V_S = 500 Volts; I_T (Initiating Current) = ±1.0 Amp	(+65°C)		130	–	–	
Critical Rate of Rise of Off–State Voltage		dv/dt	2000	–	–	V/μs
(Linear waveform, V_D = Rated V_{BR}, T_J = 25°C)						
Capacitance (f = 1.0 MHz, 50 Vdc, 1.0 V rms Signal)		C_O	–	22	–	pF
(f = 1.0 MHz, 2.0 Vdc, 15 mV rms Signal)			–	53	75	

3. Measured under pulse conditions to reduce heating.

Voltage Current Characteristic of TSPD (Bidirectional Device)

Symbol	Parameter
I_{D1}, I_{D2}	Off State Leakage Current
V_{D1}, V_{D2}	Off State Blocking Voltage
V_{BR}	Breakdown Voltage
V_{BO}	Breakover Voltage
I_{BO}	Breakover Current
I_H	Holding Current
V_{TM}	On State Voltage



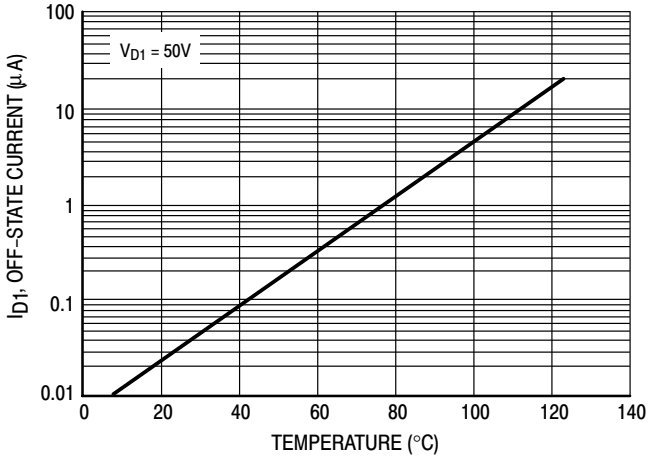


Figure 1. Off−State Current versus Temperature

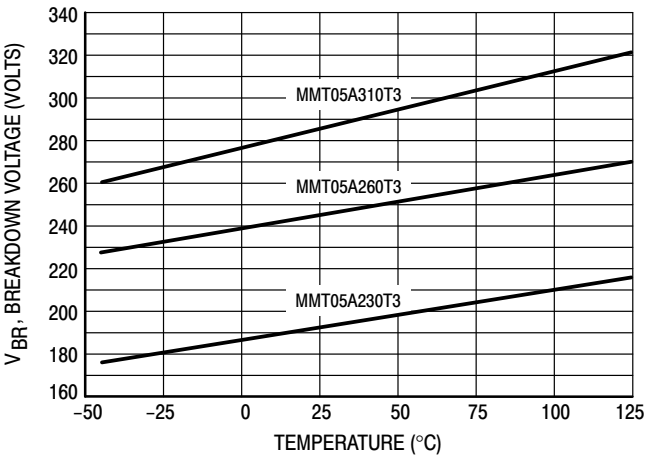


Figure 2. Breakdown Voltage versus Temperature

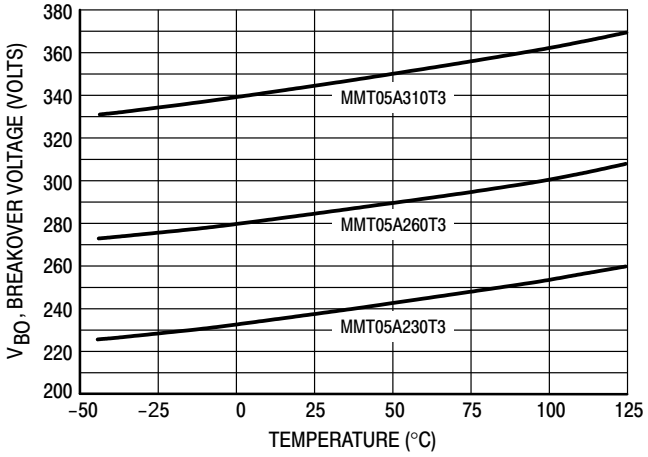


Figure 3. Breakover Voltage versus Temperature

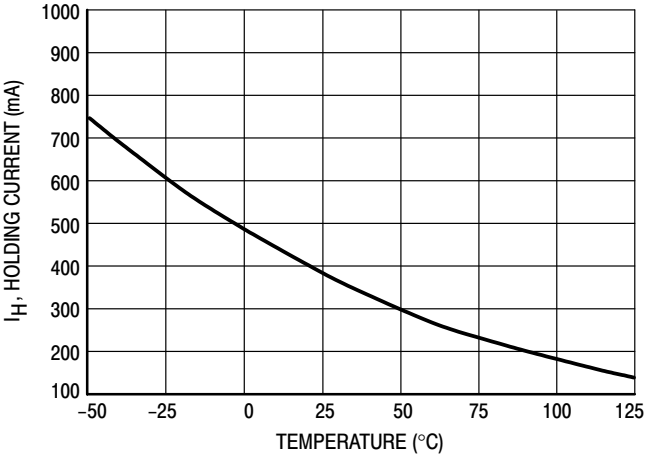


Figure 4. Holding Current versus Temperature

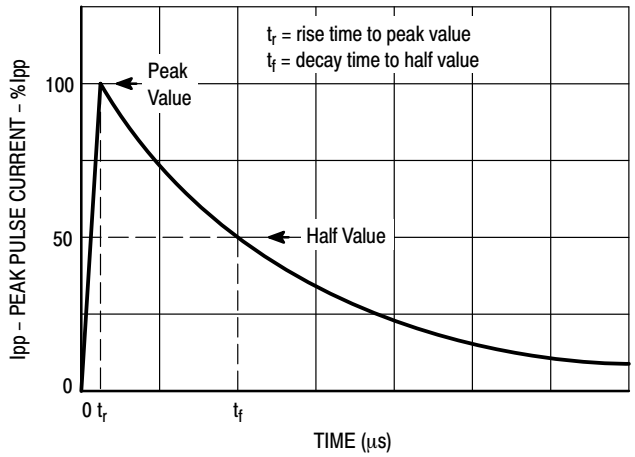


Figure 5. Exponential Decay Pulse Waveform

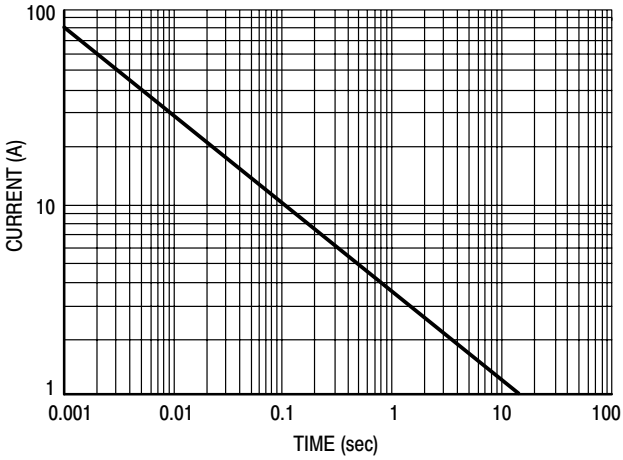
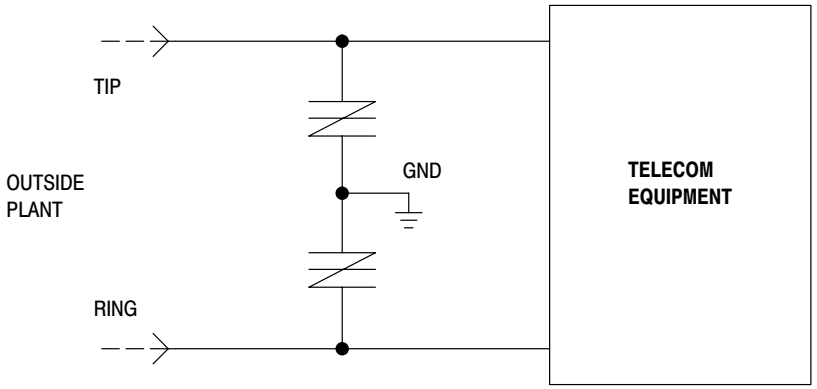
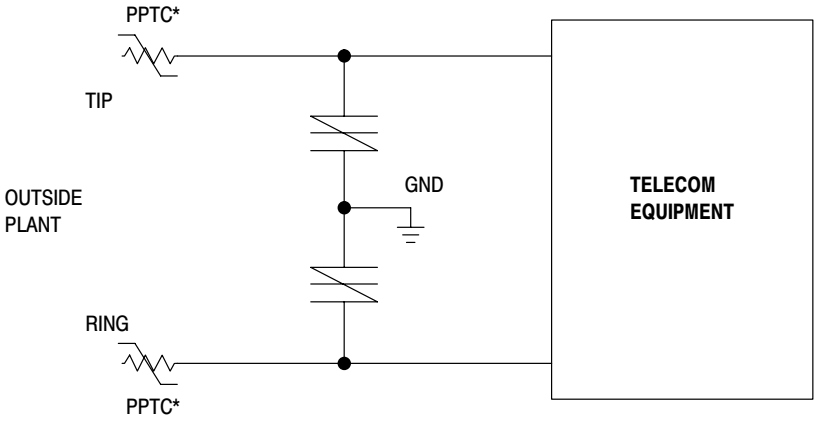
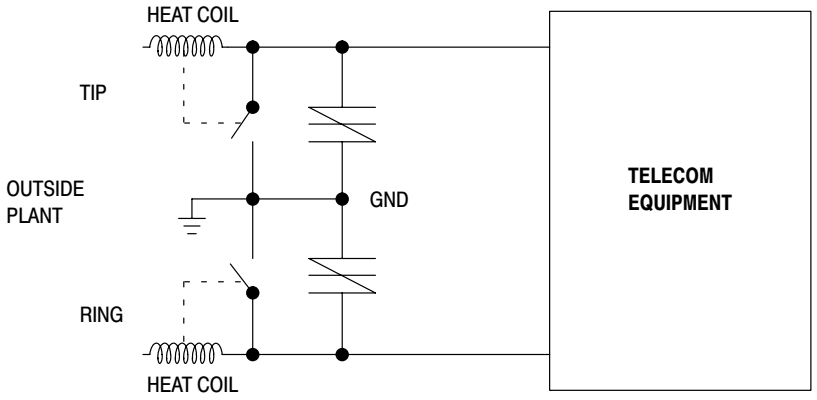


Figure 6. Peak Surge On–State Current versus Surge Current Duration, Sinusoidal Waveform

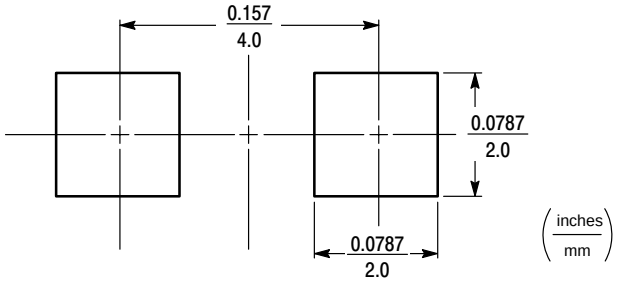




*Polymeric PTC (positive temperature coefficient) overcurrent protection device



MINIMUM RECOMMENDED FOOTPRINT FOR SURFACE MOUNTED APPLICATIONS



SMA

MMT05B230T3, MMT05B260T3, MMT05B310T3

Preferred Devices

Thyristor Surge Protectors

High Voltage Bidirectional TSPD

These Thyristor Surge Protective devices (TSPD) prevent overvoltage damage to sensitive circuits by lightning, induction and power line crossings. They are breakover–triggered crowbar protectors. Turn–off occurs when the surge current falls below the holding current value.

Secondary protection applications for electronic telecom equipment at customer premises.

- High Surge Current Capability: 50 Amps 10 x 1000 μsec Guaranteed at the extended temp range of –20°C to 65°C
- The MMT05B230T3 Series is used to help equipment meet various regulatory requirements including: Bellcore 1089, ITU K.20 & K.21, IEC 950, UL 1459 & 1950 and FCC Part 68.
- Bidirectional Protection in a Single Device
- Little Change of Voltage Limit with Transient Amplitude or Rate
- Freedom from Wearout Mechanisms Present in Non–Semiconductor Devices
- Fail–Safe, Shorts When Overstressed, Preventing Continued Unprotected Operation.
- Surface Mount Technology (SMT)
- Ⓤ Indicates UL Registered – File #E116110
- Device Marking: MMT05B230T3: RPBF; MMT05B260T3: RPBG; MMT05B310T3: RPBJ, and Date Code

MAXIMUM RATINGS (T_J = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Off–State Voltage – Maximum MMT05B230T3 MMT05B260T3 MMT05B310T3	V_{DM}	 ±170 ±200 ±270	Volts
Maximum Pulse Surge Short Circuit Current Non–Repetitive Double Exponential Decay Waveform (Notes 1. and 2.) 10 x 1000 μsec (–20°C to +65°C) 8 x 20 μsec 10 x 160 μsec 10 x 560 μsec	 I_{PPS1} I_{PPS2} I_{PPS3} I_{PPS4}	 ±50 ±150 ±100 ±70	A(pk)
Maximum Non–Repetitive Rate of Change of On–State Current Double Exponential Waveform, R = 1.0, L = 1.5 μH, C = 1.67 μF, I_{pk} = 110A	di/dt	±150	A/μs

1. Allow cooling before testing second polarity.
2. Measured under pulse conditions to reduce heating.

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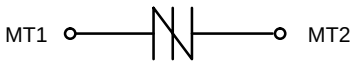
BIDIRECTIONAL TSPD (Ⓤ)
50 AMP SURGE
265 thru 365 VOLTS



SMB
(No Polarity)
(Essentially JEDEC DO–214AA)
CASE 403C

MARKING DIAGRAMS

RPBx = Specific Device Code
x = F, G or J
Y = Year
WW = Work Week

ORDERING INFORMATION

Device	Package	Shipping
MMT05B230T3	SMB	12mm Tape and Reel (2.5K/Reel)
MMT05B260T3	SMB	12mm Tape and Reel (2.5K/Reel)
MMT05B310T3	SMB	12mm Tape and Reel (2.5K/Reel)

Preferred devices are recommended choices for future use and best overall value.

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Operating Temperature Range Blocking or Conducting State	T_{J1}	–40 to +125	°C
Overload Junction Temperature – Maximum Conducting State Only	T_{J2}	+175	°C
Instantaneous Peak Power Dissipation (I_{pk} = 50 A, 10x1000 μsec @ 25°C)	P_{PK}	2000	W
Maximum Lead Temperature for Soldering Purposes 1/8″ from Case for 10 Seconds	T_L	260	°C

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

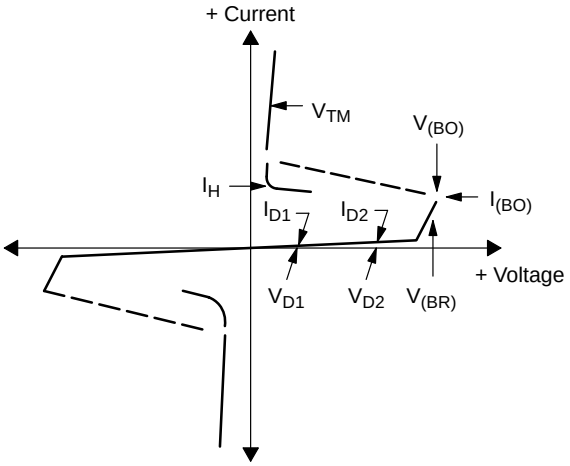
Devices are bidirectional. All electrical parameters apply to forward and reverse polarities.

Characteristics		Symbol	Min	Typ	Max	Unit
Breakover Voltage (Both polarities)		$V_{(BO)}$				Volts
(dv/dt = 100 V/μs, I_{SC} = 1.0 A, Vdc = 1000 V)	MMT05B230T3		–	–	265	
	MMT05B260T3		–	–	320	
	MMT05B310T3		–	–	365	
(+65°C)						
	MMT05B230T3		–	–	280	
	MMT05B260T3		–	–	340	
	MMT05B310T3		–	–	400	
Breakover Voltage (Both polarities)		$V_{(BO)}$				Volts
(f = 60 Hz, I_{SC} = 1.0 A(rms), V_{OC} = 1000 V(rms),	MMT05B230T3		–	–	265	
R_I = 1.0 kΩ, t = 0.5 cycle) (Note 3.)	MMT05B260T3		–	–	320	
	MMT05B310T3		–	–	365	
(+65°C)						
	MMT05B230T3		–	–	280	
	MMT05B260T3		–	–	340	
	MMT05B310T3		–	–	400	
Breakover Voltage Temperature Coefficient		$dV_{(BO)}/dT_J$	–	0.08	–	%/°C
Breakdown Voltage ($I_{(BR)}$ = 1.0 mA) Both polarities		$V_{(BR)}$				Volts
	MMT05B230T3		–	190	–	
	MMT05B260T3		–	240	–	
	MMT05B310T3		–	280	–	
Off State Current (V_{D1} = 50 V) Both polarities		I_{D1}	–	–	2.0	μA
(V_{D2} = V_{DM}) Both polarities		I_{D2}	–	–	5.0	
On–State Voltage (I_T = 1.0 A)		V_T	–	1.53	3.0	Volts
(PW ≤ 300 μs, Duty Cycle ≤ 2%) (Note 3.)						
Breakover Current (f = 60 Hz, V_{DM} = 1000 V(rms), R_S = 1.0 kΩ) Both polarities		I_{BO}	–	230	–	mA
Holding Current (Both polarities)	(Note 3.)	I_H	175	340	–	mA
V_S = 500 Volts; I_T (Initiating Current) = ±1.0 Amp	(+65°C)		130	–	–	
Critical Rate of Rise of Off–State Voltage (Linear waveform, V_D = Rated V_{BR}, T_J = 25°C)		dv/dt	2000	–	–	V/μs
Capacitance (f = 1.0 MHz, 50 Vdc, 1.0 V rms Signal)		C_O	–	22	–	pF
(f = 1.0 MHz, 2.0 Vdc, 15 mV rms Signal)			–	53	75	

3. Measured under pulse conditions to reduce heating.

Voltage Current Characteristic of TSPD (Bidirectional Device)

Symbol	Parameter
I_{D1}, I_{D2}	Off State Leakage Current
V_{D1}, V_{D2}	Off State Blocking Voltage
V_{BR}	Breakdown Voltage
V_{BO}	Breakover Voltage
I_{BO}	Breakover Current
I_H	Holding Current
V_{TM}	On State Voltage



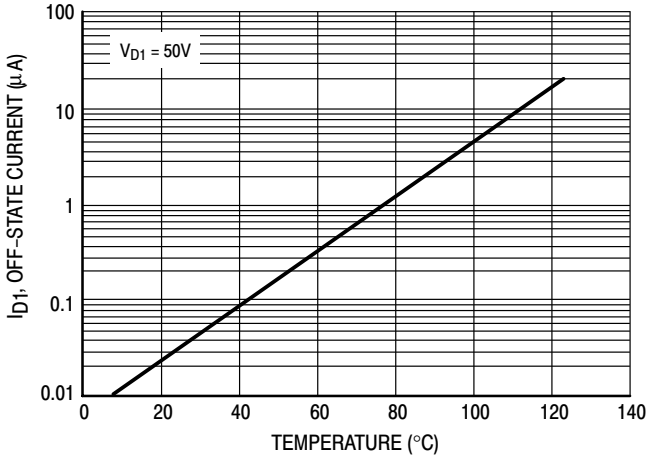


Figure 1. Off−State Current versus Temperature

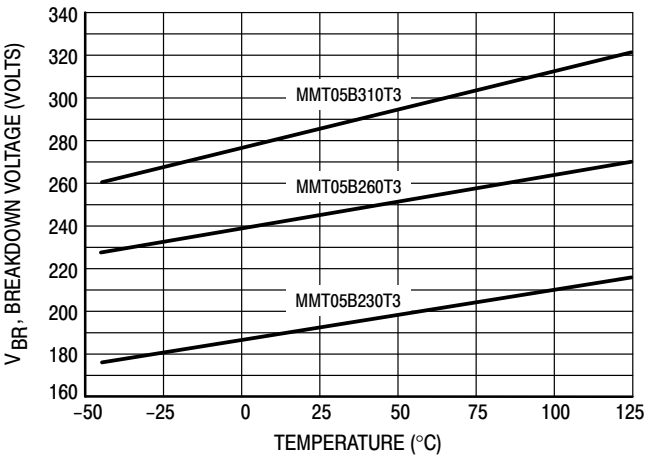


Figure 2. Breakdown Voltage versus Temperature

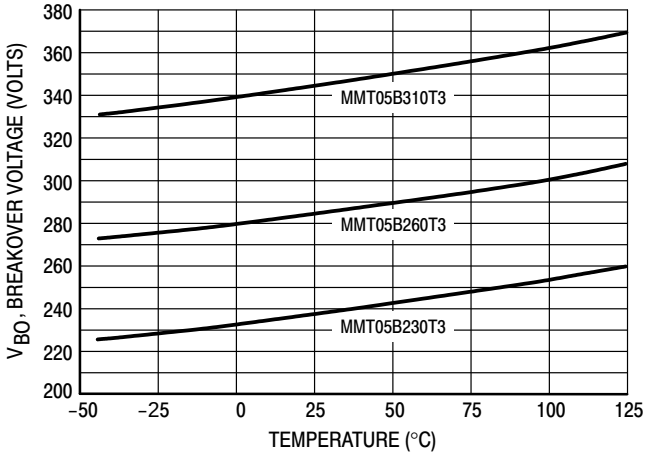


Figure 3. Breakover Voltage versus Temperature

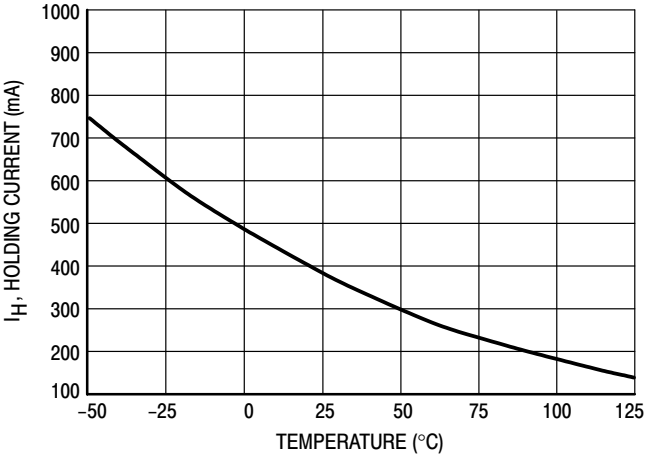


Figure 4. Holding Current versus Temperature

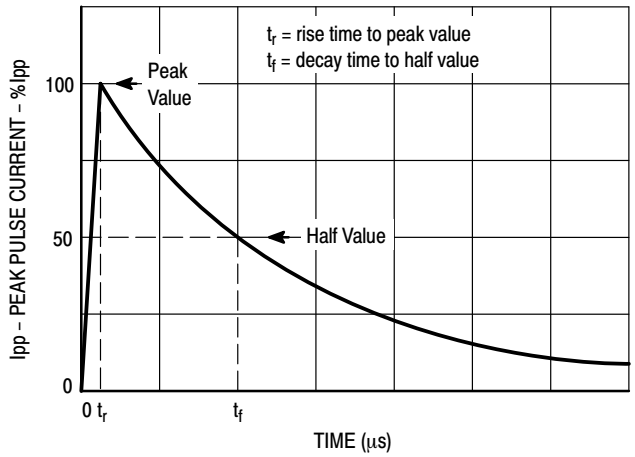


Figure 5. Exponential Decay Pulse Waveform

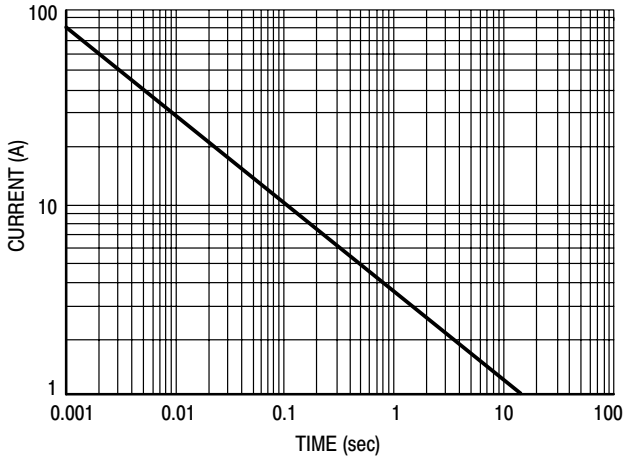
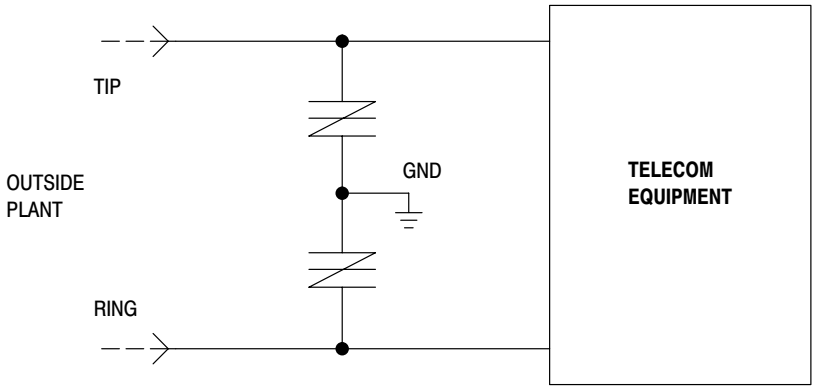
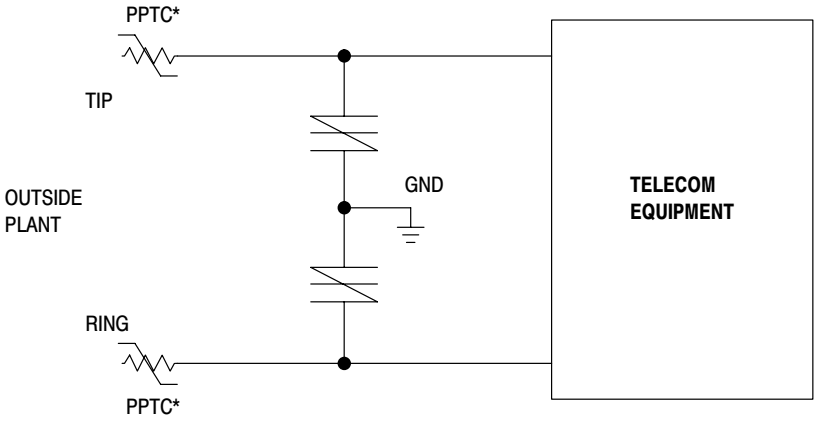
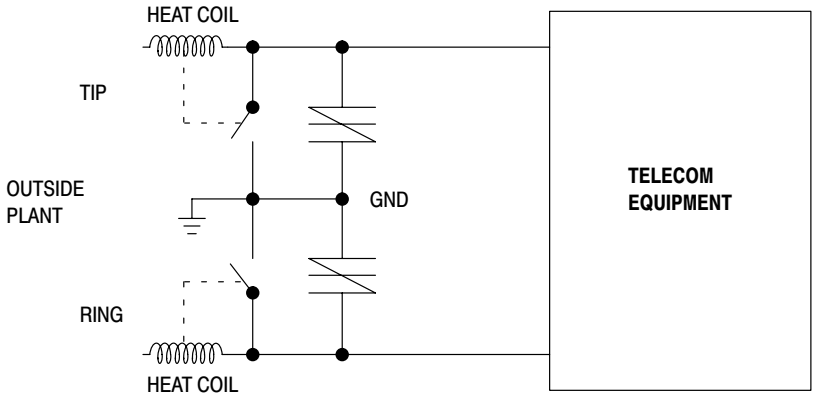


Figure 6. Peak Surge On−State Current versus Surge Current Duration, Sinusoidal Waveform





*Polymeric PTC (positive temperature coefficient) overcurrent protection device



MMT10B230T3, MMT10B260T3, MMT10B310T3

Preferred Device

Thyristor Surge Protectors

High Voltage Bidirectional TSPD

These Thyristor Surge Protective devices (TSPD) prevent overvoltage damage to sensitive circuits by lightning, induction and power line crossings. They are breakover–triggered crowbar protectors. Turn–off occurs when the surge current falls below the holding current value.

Secondary protection applications for electronic telecom equipment at customer premises.

- Outstanding High Surge Current Capability: 100 Amps 10x1000 μsec Guaranteed at the extended temp range of –20°C to 65°C
- The MMT10B230T3 Series is used to help equipment meet various regulatory requirements including: Bellcore 1089, ITU K.20 & K.21, IEC 950, UL 1459 & 1950 and FCC Part 68.
- Bidirectional Protection in a Single Device
- Little Change of Voltage Limit with Transient Amplitude or Rate
- Freedom from Wearout Mechanisms Present in Non–Semiconductor Devices
- Fail–Safe, Shorts When Overstressed, Preventing Continued Unprotected Operation.
- Surface Mount Technology (SMT)
- Complies with GR1089 Second Level Surge Spec at 500 Amps 2x10 μsec Waveforms
- Ⓤ Indicates UL Registered – File #E116110
- Device Marking: MMT10B230T3: RPDF; MMT10B260T3: RPDG; MMT10B310T3: RPDJ, and Date Code

MAXIMUM RATINGS (T_J = 25°C unless otherwise noted)

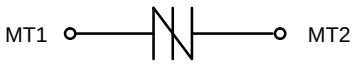
Rating	Symbol	Value	Unit
Off–State Voltage – Maximum MMT10B230T3 MMT10B260T3 MMT10B310T3	V_{DM}	 ±170 ±200 ±270	Volts
Maximum Pulse Surge Short Circuit Current Non–Repetitive Double Exponential Decay Waveform (Notes 1. and 2.) 10 x 1000 μsec (–20°C to +65°C) 2 x 10 μsec 10 x 700 μsec	 I_{PPS1} I_{PPS2} I_{PPS3}	 ±100 ±500 ±180	A(pk)
Maximum Non–Repetitive Rate of Change of On–State Current Double Exponential Waveform, R = 2.0, L = 1.5 μH, C = 1.67 μF, I_{pk} = 110A	di/dt	±100	A/μs

1. Allow cooling before testing second polarity.
2. Measured under pulse conditions to reduce heating.

ON Semiconductor™

http://onsemi.com

BIDIRECTIONAL TSPD (Ⓤ)
100 AMP SURGE
265 thru 365 VOLTS



SMB
(No Polarity)
(Essentially JEDEC DO–214AA)
CASE 403C

MARKING DIAGRAMS

RPDx = Specific Device Code
x = F, G or J
Y = Year
WW = Work Week

ORDERING INFORMATION

Device	Package	Shipping
MMT10B230T3	SMB	12mm Tape and Reel (2.5K/Reel)
MMT10B260T3	SMB	12mm Tape and Reel (2.5K/Reel)
MMT10B310T3	SMB	12mm Tape and Reel (2.5K/Reel)

Preferred devices are recommended choices for future use and best overall value.

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Operating Temperature Range Blocking or Conducting State	T_{J1}	–40 to +125	°C
Overload Junction Temperature – Maximum Conducting State Only	T_{J2}	+175	°C
Instantaneous Peak Power Dissipation (I_{pk} = 100 A, 10x1000 μsec @ 25°C)	P_{PK}	4000	W
Maximum Lead Temperature for Soldering Purposes 1/8″ from Case for 10 Seconds	T_L	260	°C

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

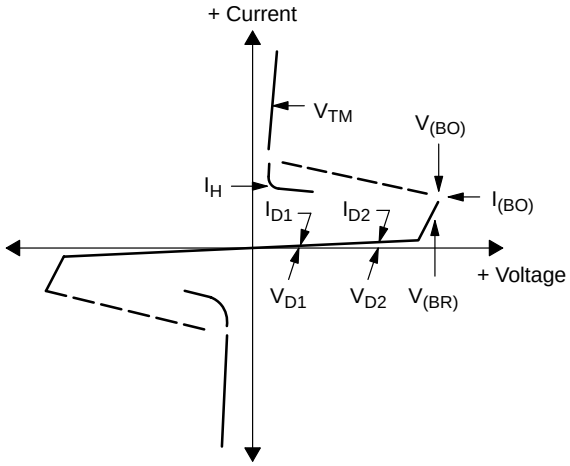
Devices are bidirectional. All electrical parameters apply to forward and reverse polarities.

Characteristic		Symbol	Min	Typ	Max	Unit
Breakover Voltage (Both polarities)		$V_{(BO)}$				Volts
(dv/dt = 100 V/μs, I_{SC} = 1.0 A, Vdc = 1000 V)	MMT10B230T3		–	–	265	
	MMT10B260T3		–	–	320	
	MMT10B310T3		–	–	365	
(+65°C)						
	MMT10B230T3		–	–	290	
	MMT10B260T3		–	–	340	
	MMT10B310T3		–	–	400	
Breakover Voltage (Both polarities)		$V_{(BO)}$				Volts
(f = 60 Hz, I_{SC} = 1.0 A(rms), V_{OC} = 1000 V(rms),	MMT10B230T3		–	–	265	
R_I = 1.0 kΩ, t = 0.5 cycle) (Note 3.)	MMT10B260T3		–	–	320	
	MMT10B310T3		–	–	365	
(+65°C)						
	MMT10B230T3		–	–	290	
	MMT10B260T3		–	–	340	
	MMT10B310T3		–	–	400	
Breakover Voltage Temperature Coefficient		$dV_{(BO)}/dT_J$	–	0.08	–	%/°C
Breakdown Voltage ($I_{(BR)}$ = 1.0 mA) Both polarities		$V_{(BR)}$				Volts
	MMT10B230T3		–	190	–	
	MMT10B260T3		–	240	–	
	MMT10B310T3		–	280	–	
Off State Current (V_{D1} = 50 V) Both polarities		I_{D1}	–	–	2.0	μA
(V_{D2} = V_{DM}) Both polarities		I_{D2}	–	–	5.0	
On–State Voltage (I_T = 1.0 A)		V_T	–	1.53	5.0	Volts
(PW ≤ 300 μs, Duty Cycle ≤ 2%) (Note 3.)						
Breakover Current (f = 60 Hz, V_{DM} = 1000 V(rms), R_S = 1.0 kΩ) Both polarities		I_{BO}	–	260	–	mA
Holding Current (Both polarities)	(Note 3.)	I_H	175	270	–	mA
V_S = 500 Volts; I_T (Initiating Current) = ±1.0 A	(+65°C)		130	–	–	
Critical Rate of Rise of Off–State Voltage (Linear waveform, V_D = Rated V_{BR}, T_J = 25°C)		dv/dt	2000	–	–	V/μs
Capacitance (f = 1.0 MHz, 50 Vdc, 1.0 V rms Signal)		C_O	–	65	–	pF
(f = 1.0 MHz, 2.0 Vdc, 15 mV rms Signal)			–	160	200	

3. Measured under pulse conditions to reduce heating.

Voltage Current Characteristic of TSPD (Bidirectional Device)

Symbol	Parameter
I_{D1}, I_{D2}	Off State Leakage Current
V_{D1}, V_{D2}	Off State Blocking Voltage
V_{BR}	Breakdown Voltage
V_{BO}	Breakover Voltage
I_{BO}	Breakover Current
I_H	Holding Current
V_{TM}	On State Voltage



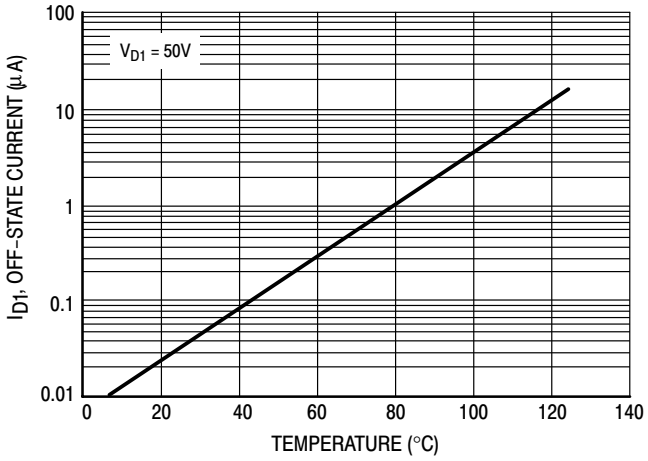


Figure 1. Off−State Current versus Temperature

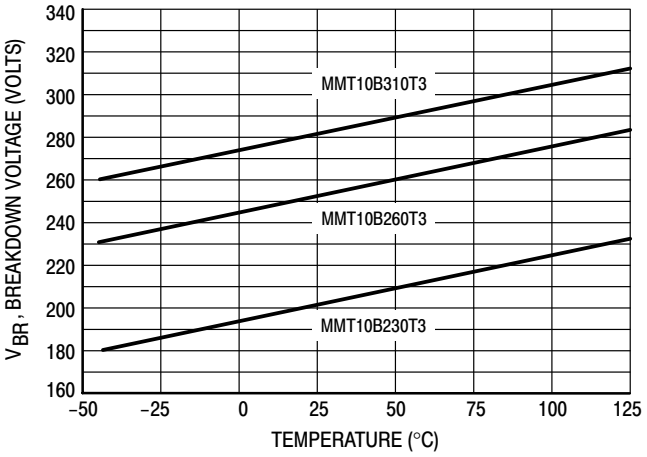


Figure 2. Breakdown Voltage versus Temperature

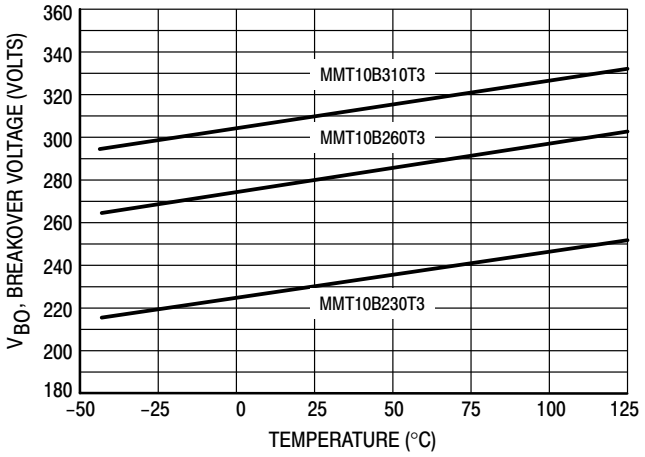


Figure 3. Breakover Voltage versus Temperature

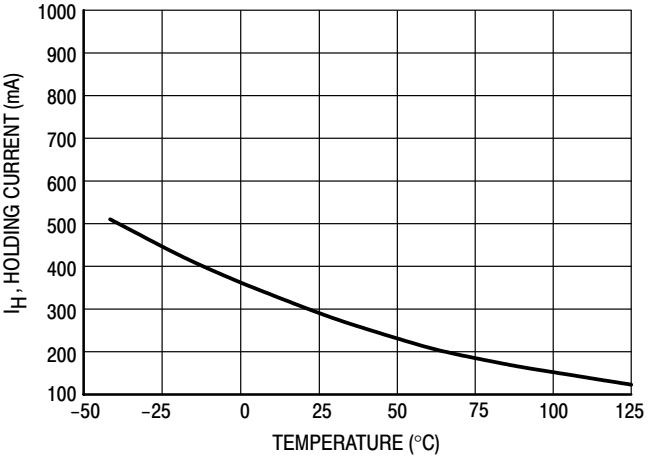


Figure 4. Holding Current versus Temperature

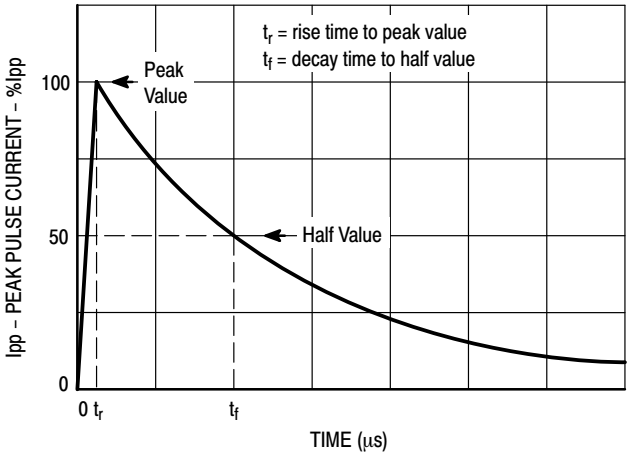


Figure 5. Exponential Decay Pulse Waveform

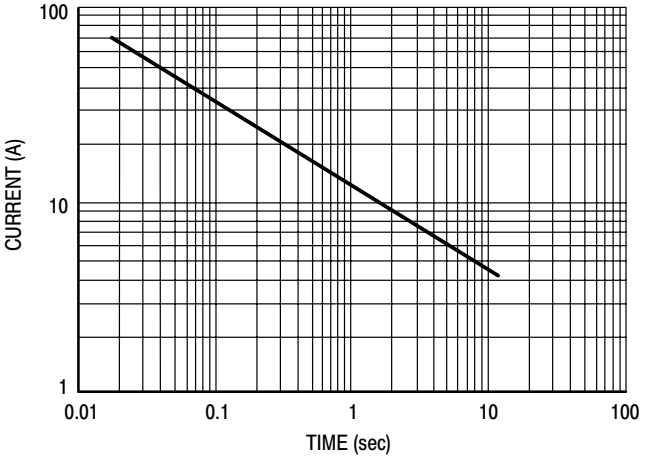
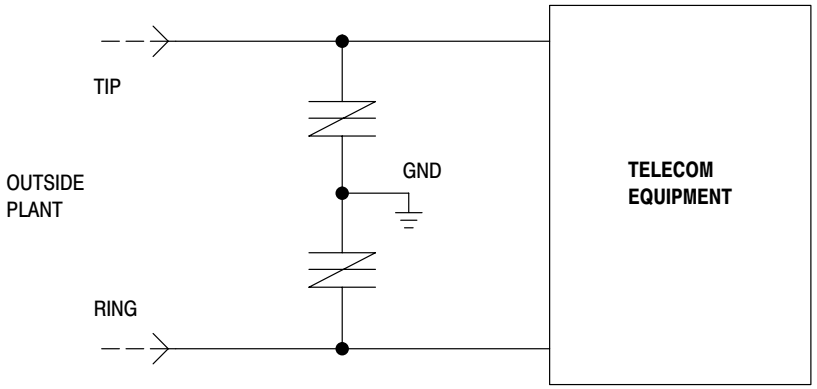
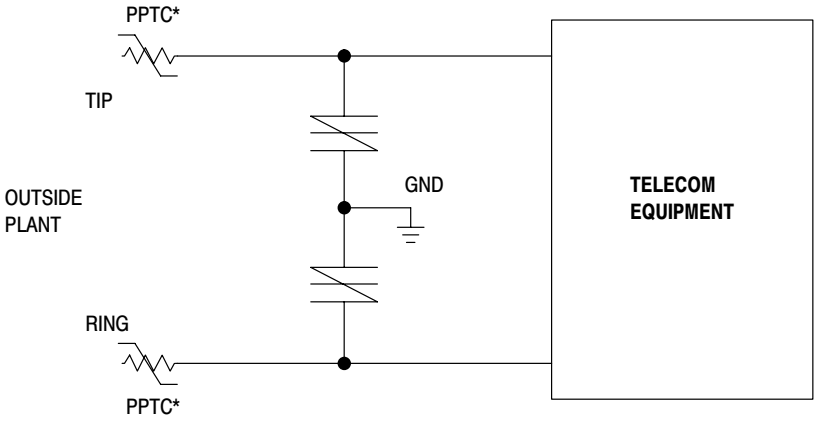
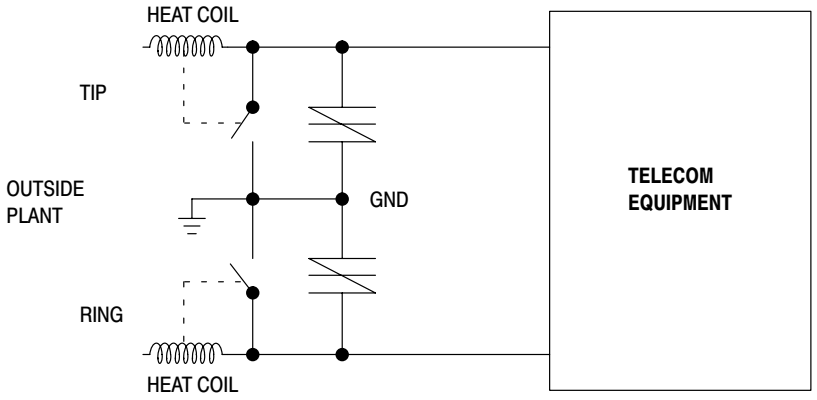


Figure 6. Peak Surge On−State Current versus Surge Current Duration, Sinusoidal Waveform



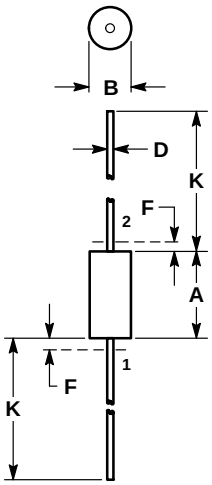


*Polymeric PTC (positive temperature coefficient) overcurrent protection device



Package Outline Dimensions

SURMETIC 40
CASE 17–02
ISSUE C

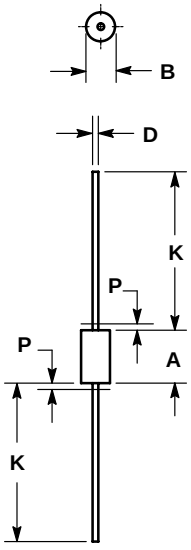


NOTE:
1. LEAD DIAMETER & FINISH NOT CONTROLLED WITHIN DIM F.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.330	0.350	8.38	8.89
B	0.130	0.145	3.30	3.68
D	0.037	0.043	0.94	1.09
F	—	0.050	—	1.27
K	1.000	1.250	25.40	31.75

STYLE 1:
PIN 1. ANODE
2. CATHODE

MOSORB
CASE 41A–02
ISSUE A

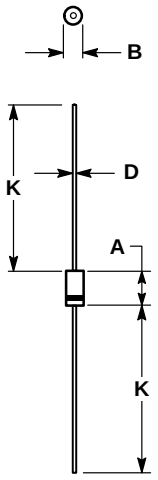


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. LEAD FINISH AND DIAMETER UNCONTROLLED IN DIMENSION P.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.360	0.375	9.14	9.52
B	0.190	0.205	4.83	5.21
D	0.038	0.042	0.97	1.07
K	1.00	---	25.40	---
P	---	0.050	---	1.27

Package Outline Dimensions (continued)

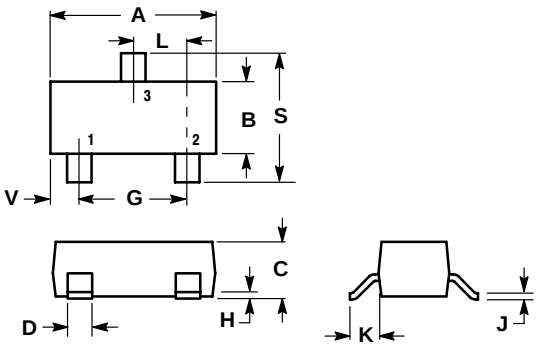
MINI MOSORB
CASE 59–04
ISSUE M



NOTES:
1. ALL RULES AND NOTES ASSOCIATED WITH JEDEC DO-41 OUTLINE SHALL APPLY.
2. POLARITY DENOTED BY CATHODE BAND.
3. LEAD DIAMETER NOT CONTROLLED WITHIN F DIMENSION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	5.97	6.60	0.235	0.260
B	2.79	3.05	0.110	0.120
D	0.76	0.86	0.030	0.034
K	27.94	—	1.100	—

SOT–23
CASE 318–08
ISSUE AF



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.

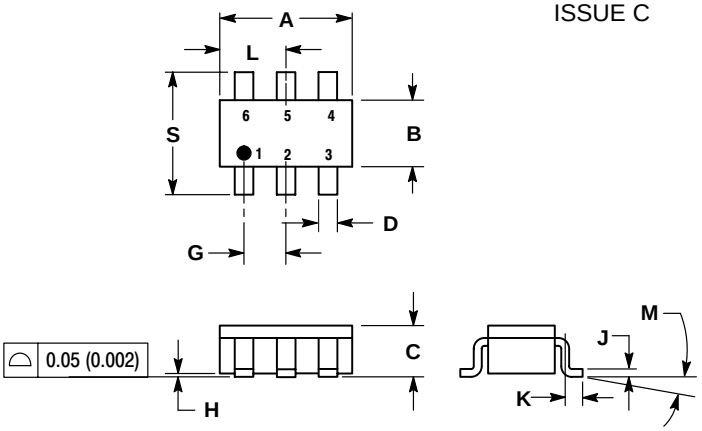
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.1102	0.1197	2.80	3.04
B	0.0472	0.0551	1.20	1.40
C	0.0350	0.0440	0.89	1.11
D	0.0150	0.0200	0.37	0.50
G	0.0701	0.0807	1.78	2.04
H	0.0005	0.0040	0.013	0.100
J	0.0034	0.0070	0.085	0.177
K	0.0140	0.0285	0.35	0.69
L	0.0350	0.0401	0.89	1.02
S	0.0830	0.1039	2.10	2.64
V	0.0177	0.0236	0.45	0.60

STYLE 9:
PIN 1. ANODE
2. ANODE
3. CATHODE

STYLE 12:
PIN 1. CATHODE
2. CATHODE
3. ANODE

Package Outline Dimensions (continued)

SC–74
CASE 318F–02
ISSUE C

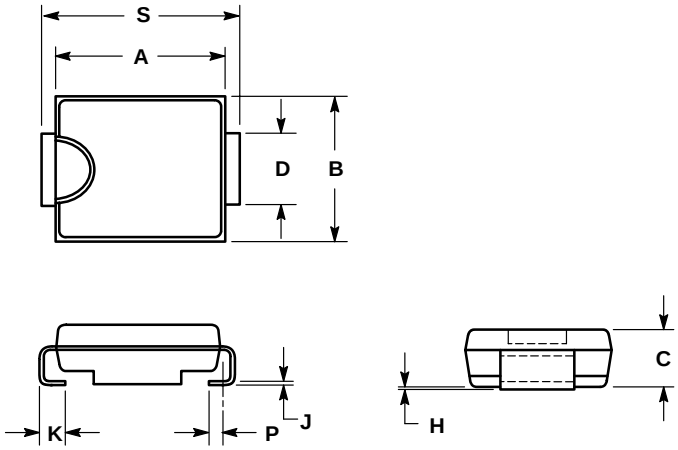


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.1063	0.1220	2.70	3.10
B	0.0512	0.0669	1.30	1.70
C	0.0394	0.0511	1.00	1.30
D	0.0098	0.0157	0.25	0.40
G	0.0335	0.0413	0.85	1.05
H	0.0005	0.0040	0.013	0.100
J	0.0040	0.0102	0.10	0.26
K	0.0079	0.0236	0.20	0.60
L	0.0493	0.0649	1.25	1.65
M	0 °	10 °	0 °	10 °
S	0.0985	0.1181	2.50	3.00

STYLE 1:
PIN 1. CATHODE
2. ANODE
3. CATHODE
4. CATHODE
5. ANODE
6. CATHODE

SMC
CASE 403–03
ISSUE B

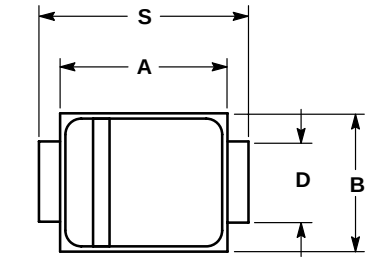


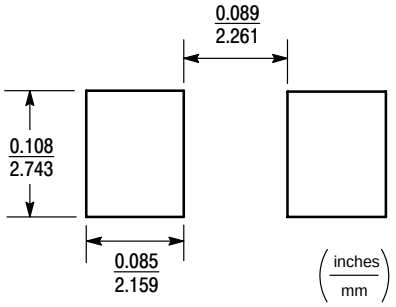
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. D DIMENSION SHALL BE MEASURED WITHIN DIMENSION P.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.260	0.280	6.60	7.11
B	0.220	0.240	5.59	6.10
C	0.075	0.095	1.90	2.41
D	0.115	0.121	2.92	3.07
H	0.0020	0.0060	0.051	0.152
J	0.006	0.012	0.15	0.30
K	0.030	0.050	0.76	1.27
P	0.020 REF		0.51 REF	
S	0.305	0.320	7.75	8.13

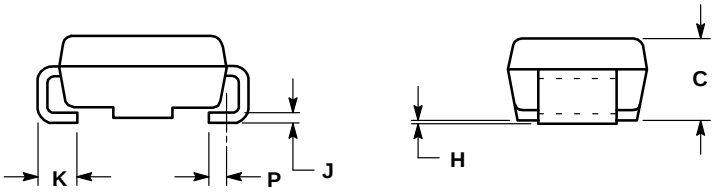
Package Outline Dimensions (continued)

SMB
CASE 403A–03
ISSUE D





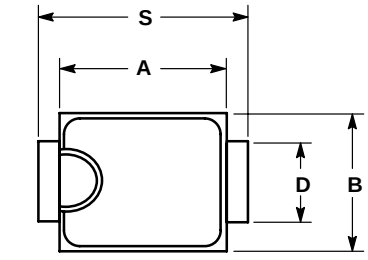
SMB Footprint

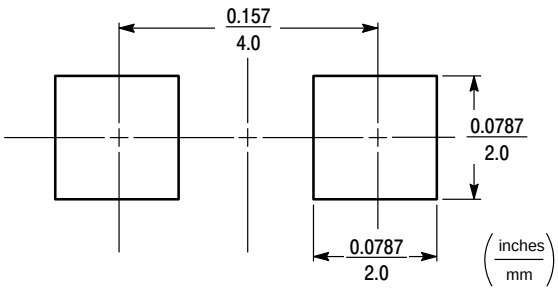


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. D DIMENSION SHALL BE MEASURED WITHIN DIMENSION P.

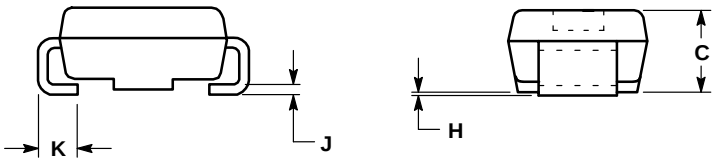
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.160	0.180	4.06	4.57
B	0.130	0.150	3.30	3.81
C	0.075	0.095	1.90	2.41
D	0.077	0.083	1.96	2.11
H	0.0020	0.0060	0.051	0.152
J	0.006	0.012	0.15	0.30
K	0.030	0.050	0.76	1.27
P	0.020 REF		0.51 REF	
S	0.205	0.220	5.21	5.59

SMA
CASE 403B–01
ISSUE O





SMA

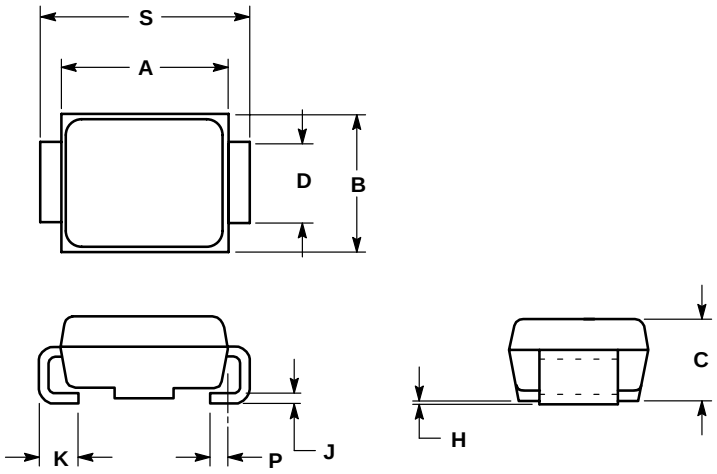


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.160	0.180	4.06	4.57
B	0.090	0.115	2.29	2.92
C	0.075	0.105	1.91	2.67
D	0.050	0.064	1.27	1.63
H	0.004	0.008	0.10	0.20
J	0.006	0.016	0.15	0.41
K	0.030	0.060	0.76	1.52
S	0.190	0.220	4.83	5.59

Package Outline Dimensions (continued)

SMB
CASE 403C–01
ISSUE O

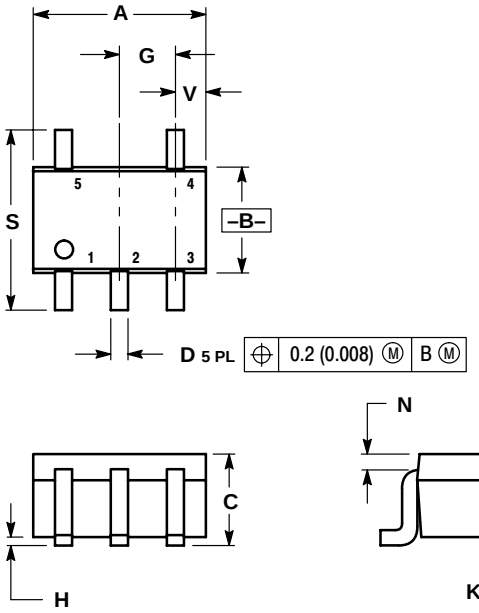


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. D DIMENSION SHALL BE MEASURED WITHIN DIMENSION P.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.160	0.180	4.06	4.57
B	0.130	0.150	3.30	3.81
C	0.075	0.095	1.90	2.41
D	0.077	0.083	1.96	2.11
H	0.0020	0.0060	0.051	0.152
J	0.006	0.012	0.15	0.30
K	0.030	0.050	0.76	1.27
P	0.020 REF		0.51 REF	
S	0.205	0.220	5.21	5.59

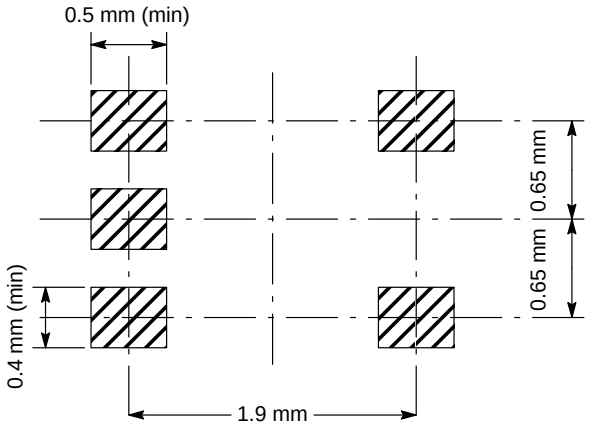
Package Outline Dimensions (continued)

SC−88A (SOT−323)
CASE 419A−01
ISSUE E



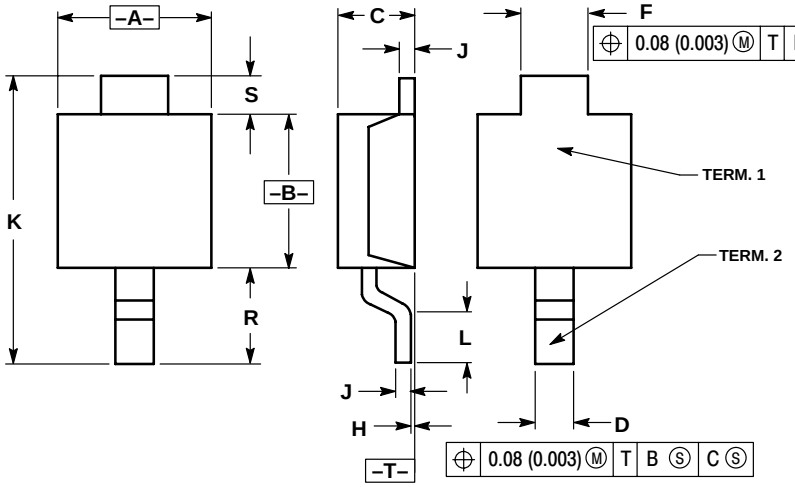
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.071	0.087	1.80	2.20
B	0.045	0.053	1.15	1.35
C	0.031	0.043	0.80	1.10
D	0.004	0.012	0.10	0.30
G	0.026 BSC		0.65 BSC	
H	---	0.004	---	0.10
J	0.004	0.010	0.10	0.25
K	0.004	0.012	0.10	0.30
N	0.008 REF		0.20 REF	
S	0.079	0.087	2.00	2.20
V	0.012	0.016	0.30	0.40



Package Outline Dimensions (continued)

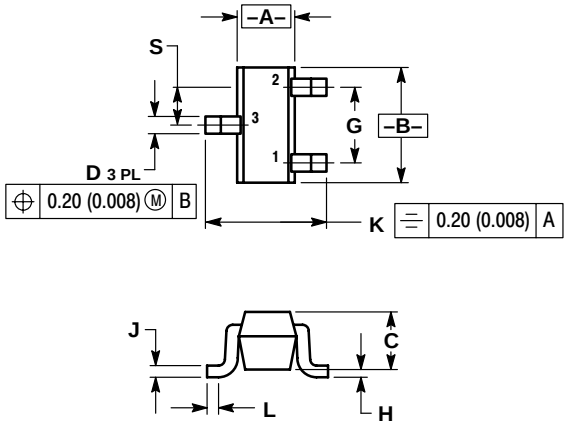
POWERMITE
CASE 457–04
ISSUE D



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	1.75	2.05	0.069	0.081
B	1.75	2.18	0.069	0.086
C	0.85	1.15	0.033	0.045
D	0.40	0.69	0.016	0.027
F	0.70	1.00	0.028	0.039
H	–0.05	+0.10	–0.002	+0.004
J	0.10	0.25	0.004	0.010
K	3.60	3.90	0.142	0.154
L	0.50	0.80	0.020	0.031
R	1.20	1.50	0.047	0.059
S	0.50 REF		0.019 REF	

SC–75/SOT–416
CASE 463–01
ISSUE B



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	0.70	0.80	0.028	0.031
B	1.40	1.80	0.055	0.071
C	0.60	0.90	0.024	0.035
D	0.15	0.30	0.006	0.012
G	1.00 BSC		0.039 BSC	
H	---	0.10	---	0.004
J	0.10	0.25	0.004	0.010
K	1.45	1.75	0.057	0.069
L	0.10	0.20	0.004	0.008
S	0.50 BSC		0.020 BSC	

STYLE 1:
PIN 1. BASE
2. EMITTER
3. COLLECTOR

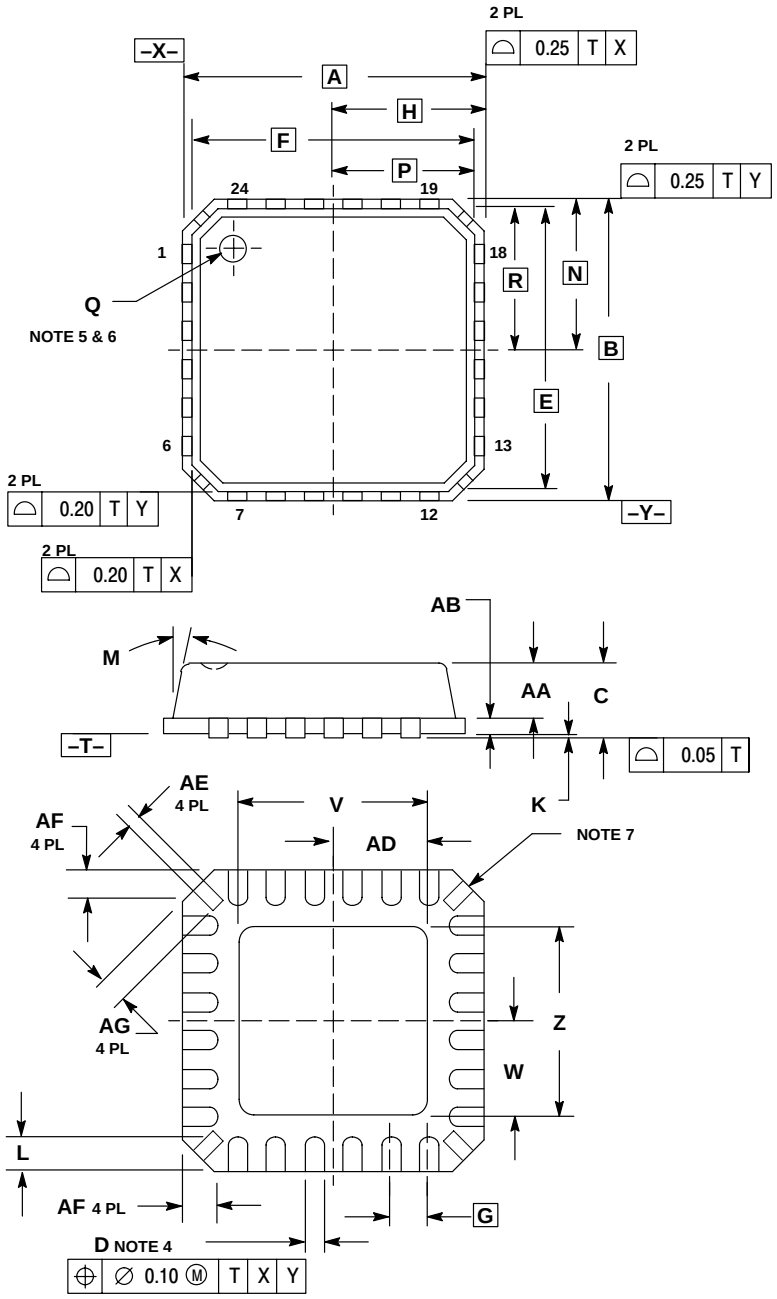
STYLE 2:
PIN 1. ANODE
2. N/C
3. CATHODE

STYLE 3:
PIN 1. ANODE
2. ANODE
3. CATHODE

STYLE 4:
PIN 1. CATHODE
2. CATHODE
3. ANODE

Package Outline Dimensions (continued)

24 PIN MLF
CASE 488–01
ISSUE O



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIE THICKNESS ALLOWABLE IS 0.305 MM MAXIMUM (0.012 INCHES MAXIMUM).
4. DIMENSION D APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.25 MM FROM TERMINAL.
5. THE PIN #1 IDENTIFIER MUST BE ON THE TOP SURFACE OF THE PACKAGE BY USING IDENTIFICATION MARK OR OTHER FEATURE OF PACKAGE BODY.
6. EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
7. THE SHAPE SHOWN ON FOUR CORNERS ARE NOT ACTUAL I/O.
8. PACKAGE WARPAGE MAX 0.05 MM.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.00 BSC		0.157 BSC	
B	4.00 BSC		0.157 BSC	
C	---	1.00	---	0.039
D	0.18	0.30	0.007	0.012
E	3.75 BSC		0.148 BSC	
F	3.75 BSC		0.148 BSC	
G	0.50 BSC		0.020 BSC	
H	2.00 BSC		0.79 BSC	
K	0.01	0.05	0.000	0.002
L	0.30	0.55	0.012	0.022
M	---	12 °	---	12 °
N	2.00 BSC		0.079 BSC	
P	1.88 BSC		0.074 BSC	
Q	0.50 DIA		0.020 DIA	
R	1.88 BSC		0.079 BSC	
V	2.50 BSC		0.098 BSC	
W	1.30 BSC		0.051 BSC	
Z	2.50 BSC		0.098 BSC	
AA	0.65	0.80	0.026	0.031
AB	0.20 REF		0.008 REF	
AD	1.30 BSC		0.051 BSC	
AE	0.13	0.23	0.005	0.009
AF	0.24	0.60	0.009	0.024
AG	0.30	0.45	0.012	0.018

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