MCR08B, MCR08M

Preferred Device

Sensitive Gate Silicon Controlled Rectifiers

Reverse Blocking Thyristors

PNPN devices designed for line powered consumer applications such as relay and lamp drivers, small motor controls, gate drivers for larger thyristors, and sensing and detection circuits. Supplied in surface mount package for use in automated manufacturing.

- Sensitive Gate Trigger Current
- Blocking Voltage to 600 Volts
- Glass Passivated Surface for Reliability and Uniformity
- Surface Mount Package
- Device Marking: MCR08BT1: CR08B; MCR08MT1: CR08M, and Date Code

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

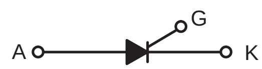
Rating	Symbol	Value	Unit
Peak Repetitive Off–State Voltage(1) (Sine Wave, R_{GK} = 1000 Ω, T_J = 25 to 110°C) MCR08BT1 / MCR08MT1	V_{DRM}, V_{RRM}	200 / 600	Volts
On-State Current RMS (All Conduction Angles; T_C = 80°C)	$I_{T(RMS)}$	0.8	Amps
Peak Non-repetitive Surge Current (1/2 Cycle Sine Wave, 60 Hz, T_C = 25°C)	I_{TSM}	8.0	Amps
Circuit Fusing Considerations (t = 8.3 ms)	I^2t	0.4	A^2s
Forward Peak Gate Power (T_C = 80°C, t = 1.0 μs)	P_{GM}	0.1	Watts
Average Gate Power (T_C = 80°C, t = 8.3 ms)	$P_{G(AV)}$	0.01	Watts
Operating Junction Temperature Range	T_J	–40 to +110	°C
Storage Temperature Range	T_{stg}	–40 to +150	°C

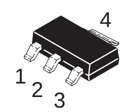
(1) V_{DRM} and V_{RRM} for all types can be applied on a continuous basis. Ratings apply for zero or negative gate voltage; however, positive gate voltage shall not be applied concurrent with negative potential on the anode. Blocking voltages shall not be tested with a constant source such that the voltage ratings of the devices are exceeded.

KERSEMI

www.kersemi.com

SCRs
0.8 AMPERES RMS
200 thru 600 VOLTS





SOT–223
CASE 318E
STYLE 10

PIN ASSIGNMENT	
1	Cathode
2	Anode
3	Gate
4	Anode

ORDERING INFORMATION

Device	Package	Shipping
MCR08BT1	SOT223	16mm Tape and Reel (1K/Reel)
MCR08MT1	SOT223	16mm Tape and Reel (1K/Reel)

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

THERMAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction to Ambient PCB Mounted per Figure 1	$R_{\theta JA}$	156	°C/W
Thermal Resistance, Junction to Tab Measured on Anode Tab Adjacent to Epoxy	$R_{\theta JT}$	25	°C/W
Maximum Device Temperature for Soldering Purposes (for 10 Seconds Maximum)	T_L	260	°C

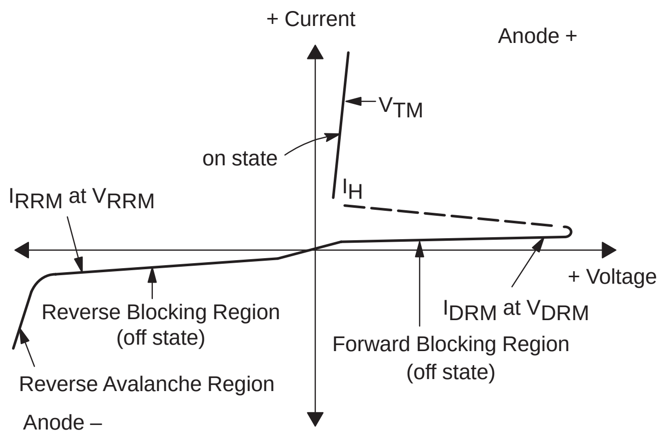
ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

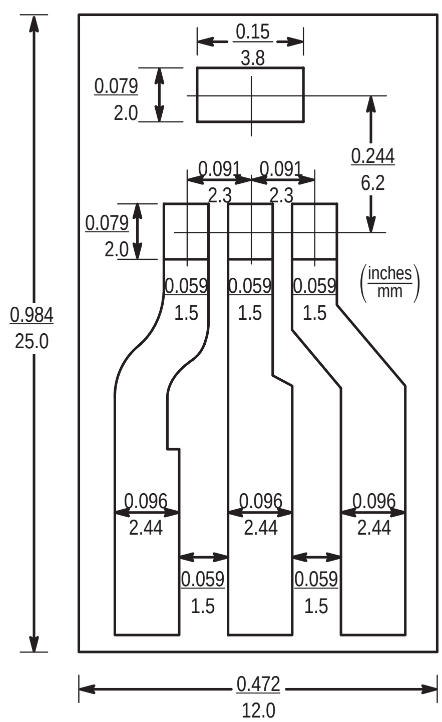
Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Peak Repetitive Forward or Reverse Blocking Current(2) (V_{AK} = Rated V_{DRM} or V_{RRM}, R_{GK} = 1000 Ω) T_J = 25°C T_J = 110°C	I_{DRM}, I_{RRM}	— —	— —	10 200	μA μA
ON CHARACTERISTICS					
Peak Forward On-State Voltage(1) (I_T = 1.0 A Peak)	V_{TM}	—	—	1.7	Volts
Gate Trigger Current (Continuous dc)(3) (V_{AK} = 12 Vdc, R_L = 100 Ω)	I_{GT}	—	—	200	μA
Holding Current(3) (V_{AK} = 12 Vdc, Initiating Current = 20 mA)	I_H	—	—	5.0	mA
Gate Trigger Voltage (Continuous dc)(3) (V_{AK} = 12 Vdc, R_L = 100 Ω)	V_{GT}	—	—	0.8	Volts
DYNAMIC CHARACTERISTICS					
Critical Rate-of-Rise of Off State Voltage (V_{pk} = Rated V_{DRM}, T_C = 110°C, R_{GK} = 1000 Ω, Exponential Method)	dv/dt	10	—	—	V/μs

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.
(2) R_{GK} = 1000 Ω is included in measurement.
(3) R_{GK} is not included in measurement.

Voltage Current Characteristic of SCR

Symbol	Parameter
V_{DRM}	Peak Repetitive Off State Forward Voltage
I_{DRM}	Peak Forward Blocking Current
V_{RRM}	Peak Repetitive Off State Reverse Voltage
I_{RRM}	Peak Reverse Blocking Current
V_{TM}	Peak On State Voltage
I_H	Holding Current





BOARD MOUNTED VERTICALLY IN CINCH 8840 EDGE CONNECTOR.
BOARD THICKNESS = 65 MIL., FOIL THICKNESS = 2.5 MIL.
MATERIAL: G10 FIBERGLASS BASE EPOXY

Figure 1. PCB for Thermal Impedance and Power Testing of SOT-223

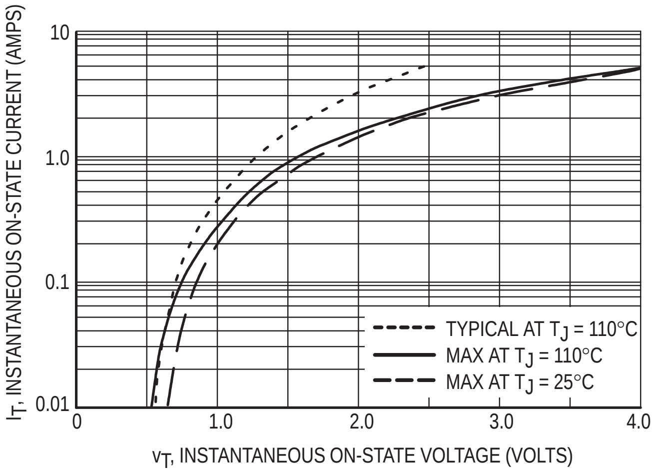


Figure 2. On-State Characteristics

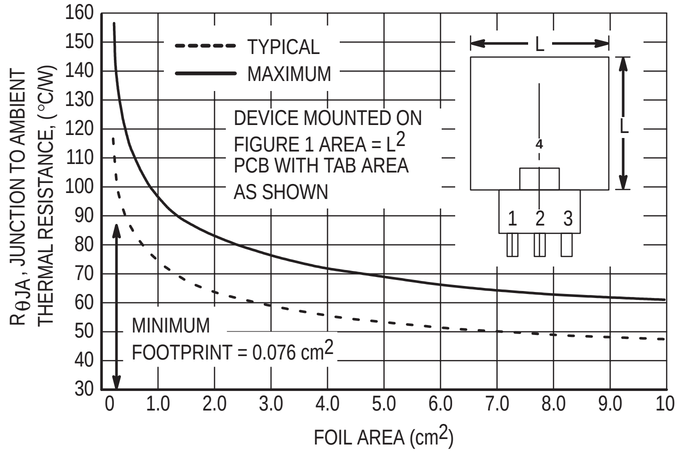


Figure 3. Junction to Ambient Thermal Resistance versus Copper Tab Area

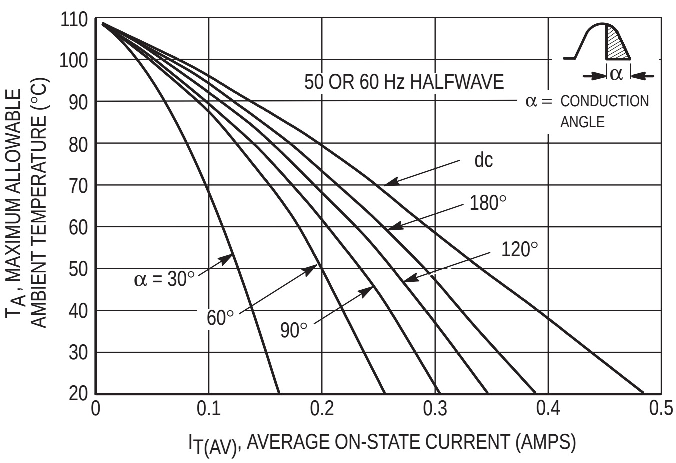


Figure 4. Current Derating, Minimum Pad Size Reference: Ambient Temperature

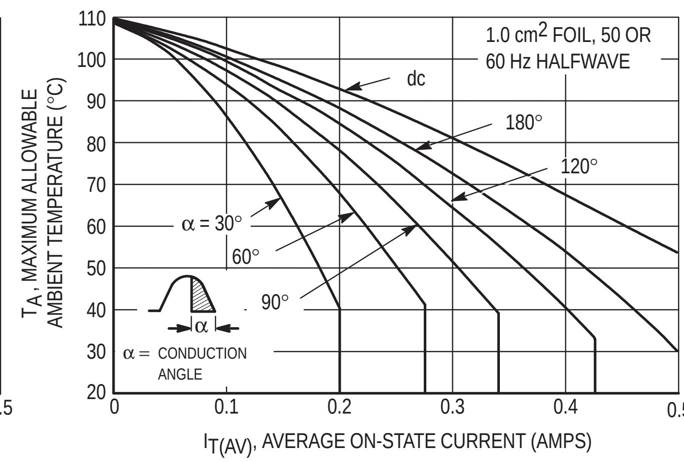


Figure 5. Current Derating, 1.0 cm Square Pad Reference: Ambient Temperature

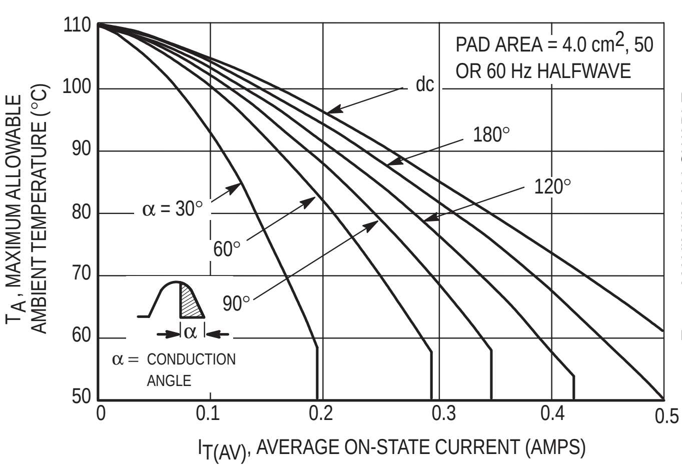


Figure 6. Current Derating, 2.0 cm Square Pad Reference: Ambient Temperature

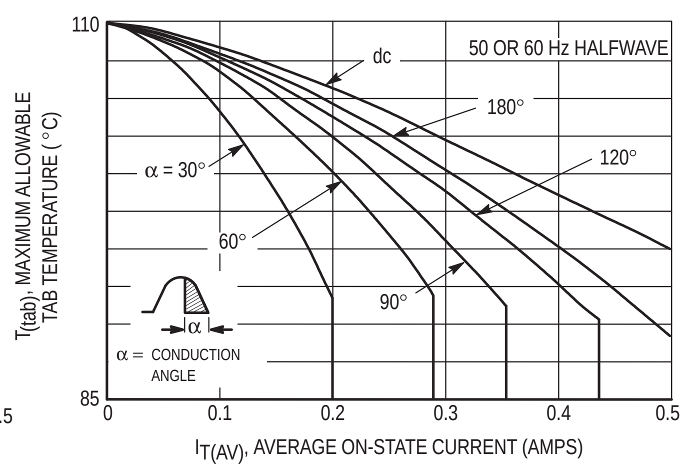


Figure 7. Current Derating Reference: Anode Tab

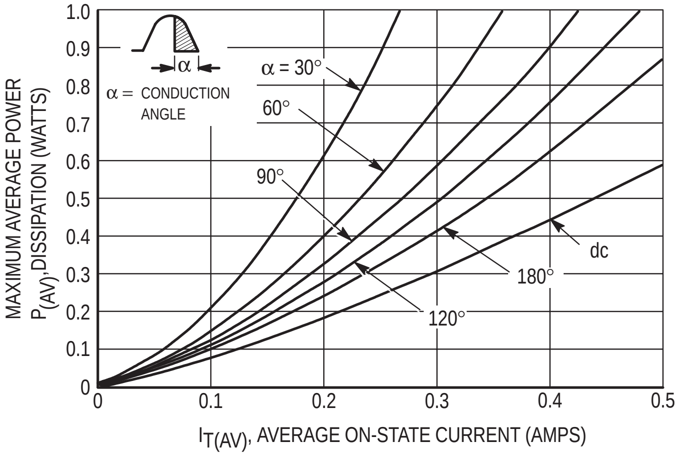


Figure 8. Power Dissipation

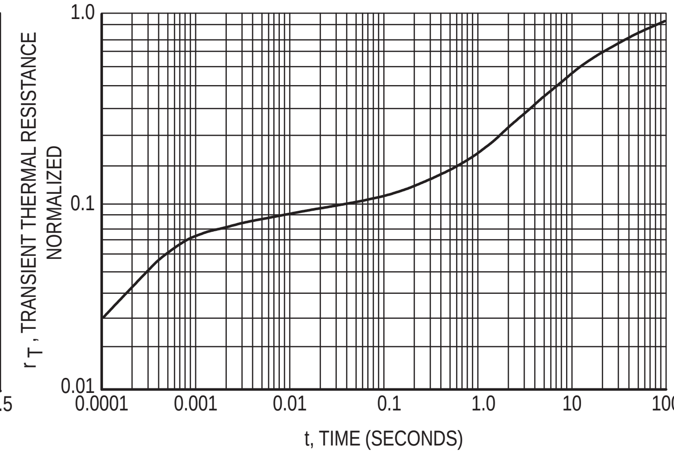


Figure 9. Thermal Response Device Mounted on Figure 1 Printed Circuit Board

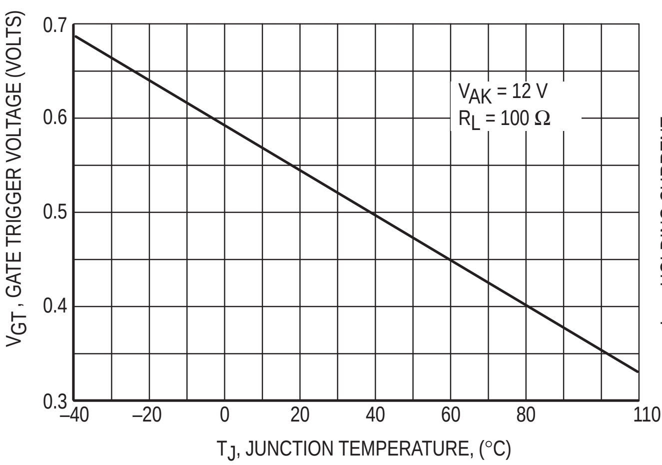


Figure 10. Typical Gate Trigger Voltage versus Junction Temperature

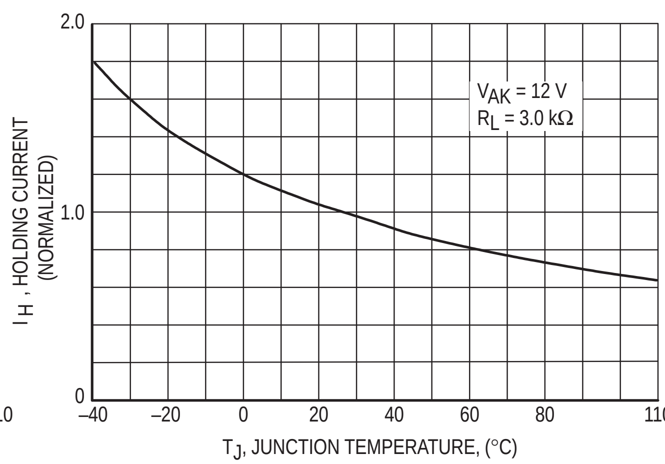


Figure 11. Typical Normalized Holding Current versus Junction Temperature

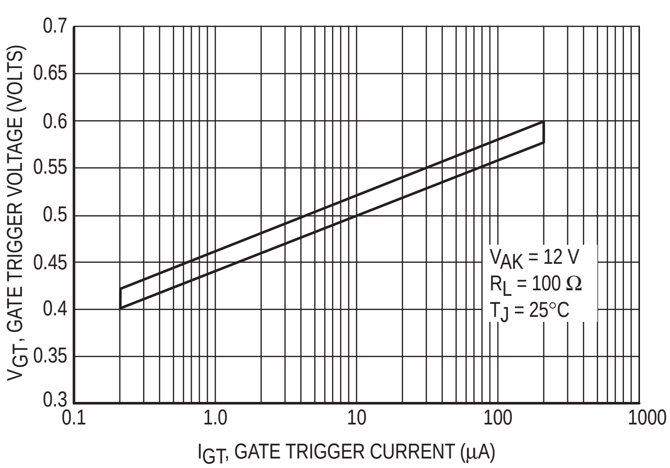


Figure 12. Typical Range of V_{GT} versus Measured I_{GT}

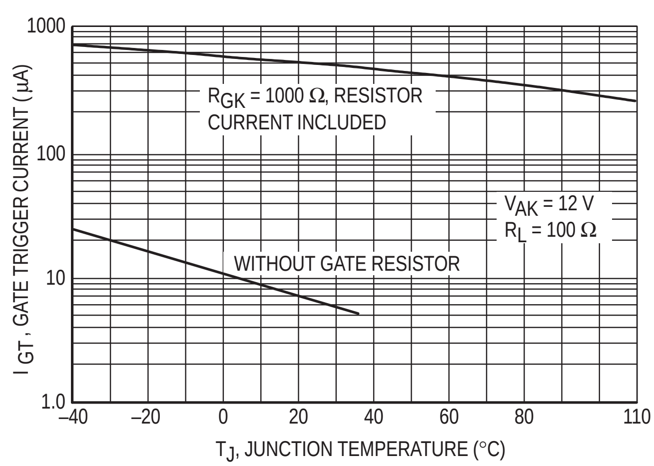


Figure 13. Typical Gate Trigger Current versus Junction Temperature

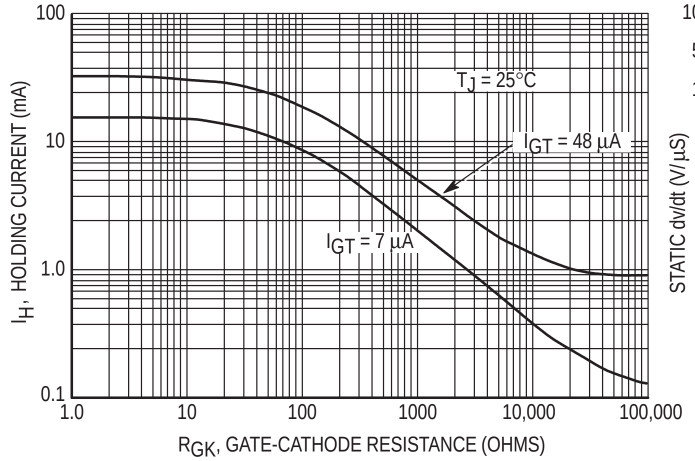


Figure 14. Holding Current Range versus Gate-Cathode Resistance

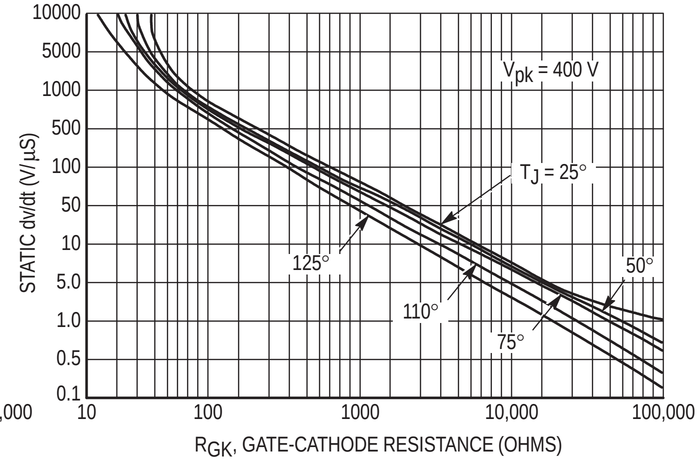


Figure 15. Exponential Static dv/dt versus Junction Temperature and Gate-Cathode Termination Resistance

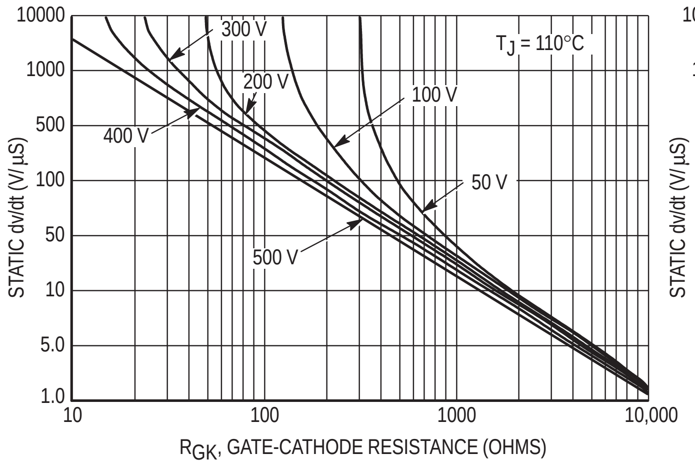


Figure 16. Exponential Static dv/dt versus Peak Voltage and Gate-Cathode Termination Resistance

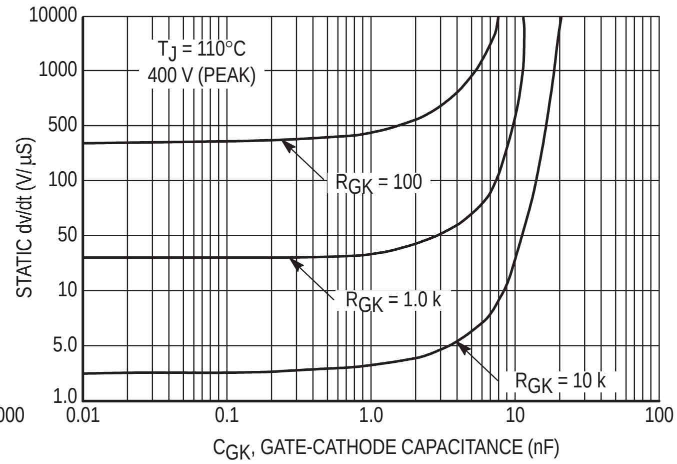


Figure 17. Exponential Static dv/dt versus Gate-Cathode Capacitance and Resistance

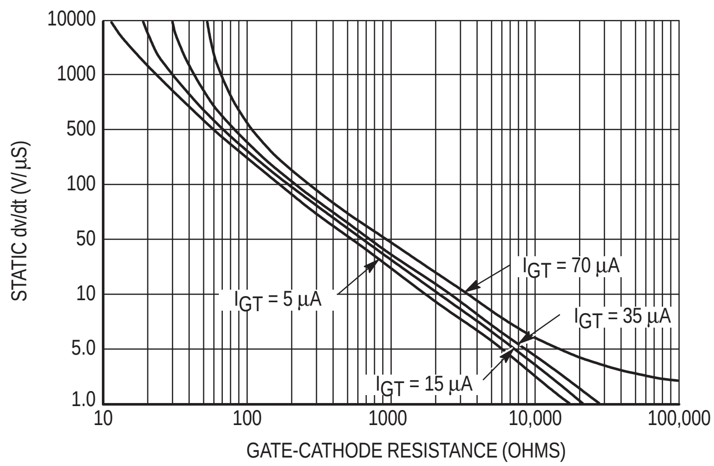
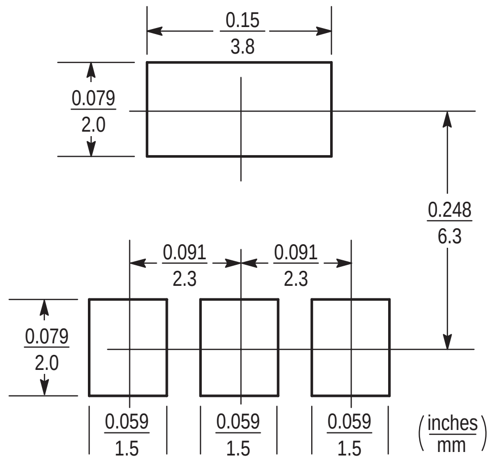


Figure 18. Exponential Static dv/dt versus Gate-Cathode Termination Resistance and Product Trigger Current Sensitivity

INFORMATION FOR USING THE SOT-223 SURFACE MOUNT PACKAGE

MINIMUM RECOMMENDED FOOTPRINT FOR SURFACE MOUNTED APPLICATIONS

Surface mount board layout is a critical portion of the total design. The footprint for the semiconductor packages must be the correct size to insure proper solder connection interface between the board and the package. With the correct pad geometry, the packages will self align when subjected to a solder reflow process.



SOT-223

SOT-223 POWER DISSIPATION

The power dissipation of the SOT-223 is a function of the anode pad size. This can vary from the minimum pad size for soldering to a pad size given for maximum power dissipation. Power dissipation for a surface mount device is determined by $T_{J(max)}$, the maximum rated junction temperature of the die, $R_{\theta JA}$, the thermal resistance from the device junction to ambient, and the operating temperature, T_A. Using the values provided on the data sheet for the SOT-223 package, P_D can be calculated as follows:

$$P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$$

The values for the equation are found in the maximum ratings table on the data sheet. Substituting these values into the equation for an ambient temperature T_A of 25°C, one can calculate the power dissipation of the device which in this case is 550 milliwatts.

$$P_D = \frac{110°C - 25°C}{156°C/W} = 550 \text{ milliwatts}$$

The 156°C/W for the SOT-223 package assumes the use of the recommended footprint on a glass epoxy printed circuit board to achieve a power dissipation of 550 milliwatts. There are other alternatives to achieving higher power dissipation from the SOT-223 package. One is to increase the area of the anode pad. By increasing the area of the anode pad, the power dissipation can be increased. Although one can almost double the power dissipation with this method, one will be giving up area on the printed circuit board which can defeat the purpose of using surface mount technology. A graph of $R_{\theta JA}$ versus anode pad area is shown in Figure 3.

Another alternative would be to use a ceramic substrate or an aluminum core board such as Thermal Clad™. Using a board material such as Thermal Clad, an aluminum core board, the power dissipation can be doubled using the same footprint.

SOLDER STENCIL GUIDELINES

Prior to placing surface mount components onto a printed circuit board, solder paste must be applied to the pads. A solder stencil is required to screen the optimum amount of solder paste onto the footprint. The stencil is made of brass or stainless steel with a typical thickness of 0.008 inches. The stencil opening size for the SOT-223 package should be the same as the pad size on the printed circuit board, i.e., a 1:1 registration.

SOLDERING PRECAUTIONS

The melting temperature of solder is higher than the rated temperature of the device. When the entire device is heated to a high temperature, failure to complete soldering within a short time could result in device failure. Therefore, the following items should always be observed in order to minimize the thermal stress to which the devices are subjected.

- Always preheat the device.
- The delta temperature between the preheat and soldering should be 100°C or less.*
- When preheating and soldering, the temperature of the leads and the case must not exceed the maximum temperature ratings as shown on the data sheet. When using infrared heating with the reflow soldering method, the difference should be a maximum of 10°C.
- The soldering temperature and time should not exceed 260°C for more than 10 seconds.
- When shifting from preheating to soldering, the maximum temperature gradient should be 5°C or less.
- After soldering has been completed, the device should be allowed to cool naturally for at least three minutes. Gradual cooling should be used as the use of forced cooling will increase the temperature gradient and result in latent failure due to mechanical stress.
- Mechanical stress or shock should not be applied during cooling.

* Soldering a device without preheating can cause excessive thermal shock and stress which can result in damage to the device.

TYPICAL SOLDER HEATING PROFILE

For any given circuit board, there will be a group of control settings that will give the desired heat pattern. The operator must set temperatures for several heating zones, and a figure for belt speed. Taken together, these control settings make up a heating "profile" for that particular circuit board. On machines controlled by a computer, the computer remembers these profiles from one operating session to the next. Figure 19 shows a typical heating profile for use when soldering a surface mount device to a printed circuit board. This profile will vary among soldering systems but it is a good starting point. Factors that can affect the profile include the type of soldering system in use, density and types of components on the board, type of solder used, and the type of board or substrate material being used. This profile shows temperature versus time. The line on the graph shows the actual temperature that might be experienced on the surface of a test board at or near a central solder joint. The two profiles are based on a high density and a low density board. The Vitronics SMD310 convection/infrared reflow soldering system was used to generate this profile. The type of solder used was 62/36/2 Tin Lead Silver with a melting point between 177–189°C. When this type of furnace is used for solder reflow work, the circuit boards and solder joints tend to heat first. The components on the board are then heated by conduction. The circuit board, because it has a large surface area, absorbs the thermal energy more efficiently, then distributes this energy to the components. Because of this effect, the main body of a component may be up to 30 degrees cooler than the adjacent solder joints.

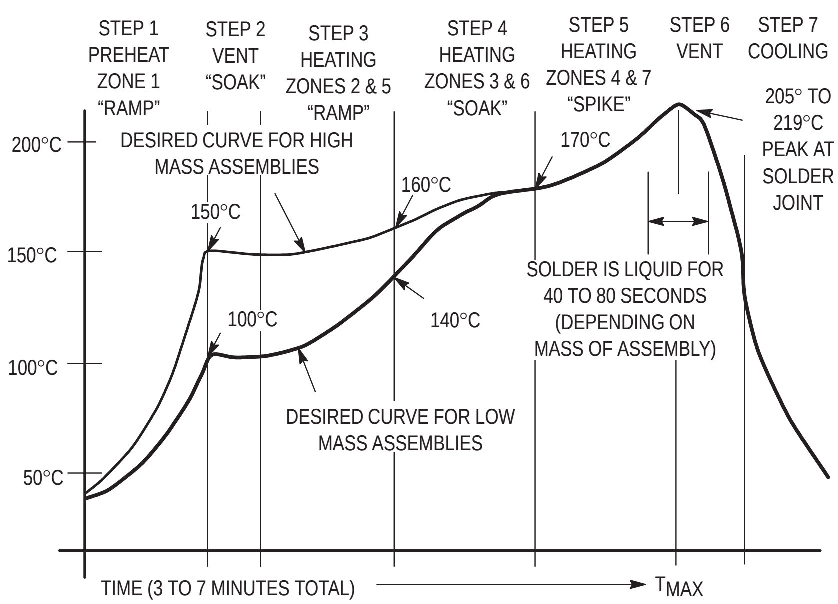
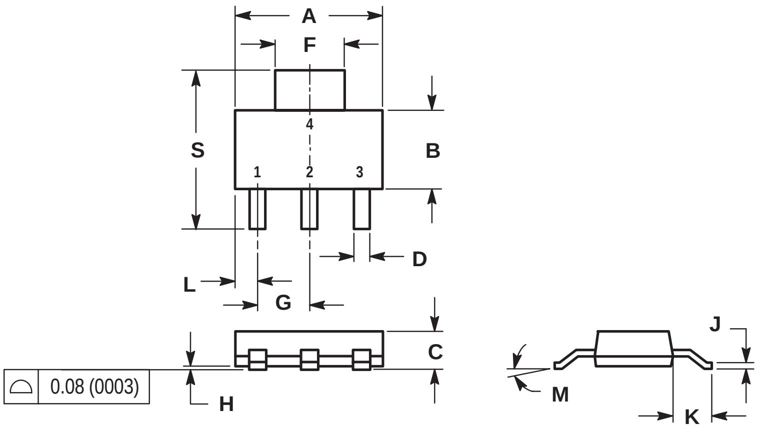


Figure 19. Typical Solder Heating Profile

PACKAGE DIMENSIONS

SOT–223
CASE 318E–04
ISSUE J



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

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.249	0.263	6.30	6.70
B	0.130	0.145	3.30	3.70
C	0.060	0.068	1.50	1.75
D	0.024	0.035	0.60	0.89
F	0.115	0.126	2.90	3.20
G	0.087	0.094	2.20	2.40
H	0.0008	0.0040	0.020	0.100
J	0.009	0.014	0.24	0.35
K	0.060	0.078	1.50	2.00
L	0.033	0.041	0.85	1.05
M	0 °	10 °	0 °	10 °
S	0.264	0.287	6.70	7.30

STYLE 10:
PIN 1. CATHODE
2. ANODE
3. GATE
4. ANODE