

## 2N7002V-VB Datasheet

### Dual N-Channel 60 V (D-S) MOSFET

#### PRODUCT SUMMARY

$V_{DS}$ (V)	$R_{DS(on)}$ ( $\Omega$ )	$I_D$ (A)	$Q_g$ (Typ.)
60	1.200 at $V_{GS} = 10$ V	0.3	0.75
	1.300 at $V_{GS} = 8$ V	0.28	
	1.500 at $V_{GS} = 4.5$ V	0.25	
	1.650 at $V_{GS} = 2.5$ V	0.15	

#### FEATURES

- Trench Power MOSFET
- 100 %  $R_g$  Tested


**RoHS**  
 COMPLIANT

#### APPLICATIONS

- Load/Power Switching for Portable Devices
- Drivers: Relays, Solenoids, Lamps, Hammers, Displays, Memories
- Battery Operated Systems
- Power Supply Converter Circuits



#### ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DS}$	60	V
Gate-Source Voltage	$V_{GS}$	$\pm 12$	
Continuous Drain Current ( $T_J = 150^\circ\text{C}$ ) <sup>a</sup>	$I_D$	$T_A = 25^\circ\text{C}$	A
		$T_A = 70^\circ\text{C}$	
Pulsed Drain Current	$I_{DM}$	2	
Continuous Source-Drain Diode Current	$I_S$	$0.18^{\text{a, b}}$	A
Maximum Power Dissipation <sup>a</sup>	$P_D$	$T_A = 25^\circ\text{C}$	W
		$T_A = 70^\circ\text{C}$	
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to 150	$^\circ\text{C}$

#### THERMAL RESISTANCE RATINGS

Parameter	Symbol	Typ.	Max.	Unit
Maximum Junction-to-Ambient <sup>b</sup>	$R_{thJA}$	$t \leq 5$ s	470	$^\circ\text{C/W}$
		Steady State	560	

Notes:

a. Surface mounted on 1" x 1" FR4 board.

 b.  $t = 5$  s.

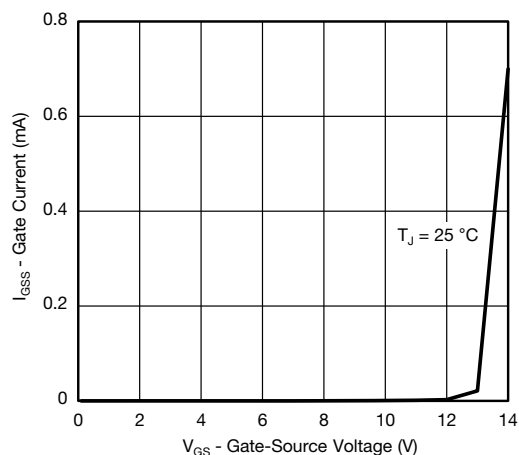
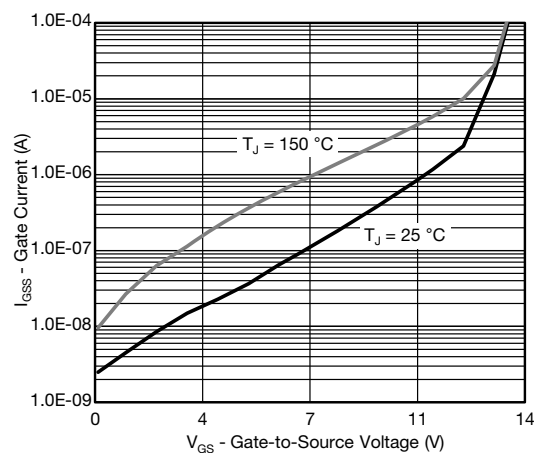
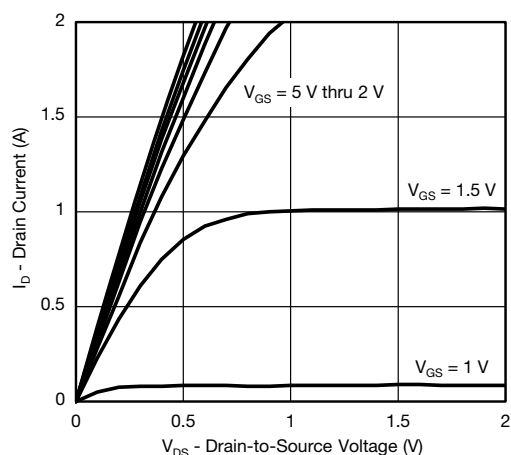
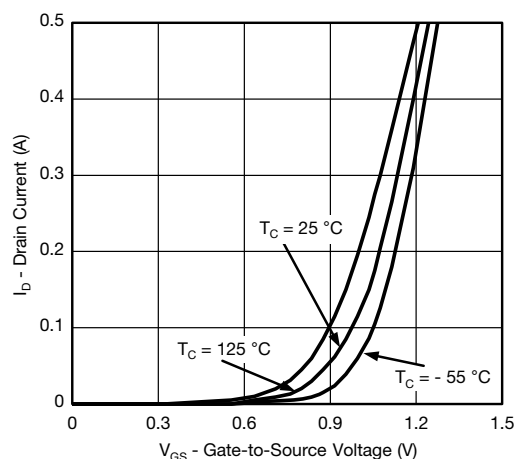
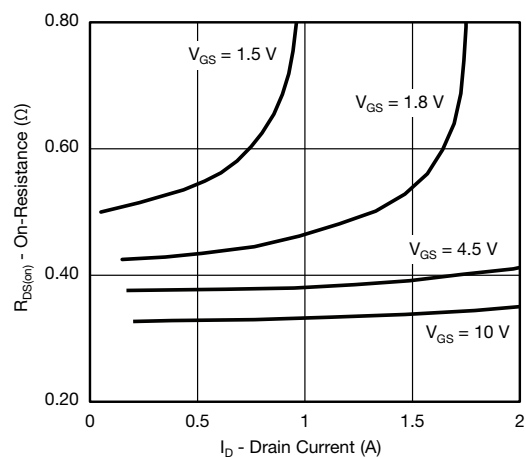
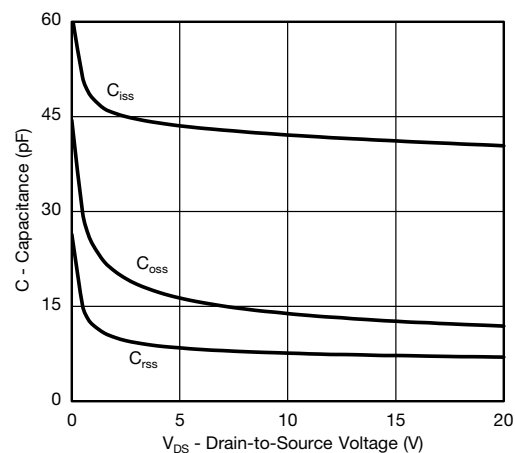
SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted)						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Static						
Drain-Source Breakdown Voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	60			V
V <sub>DS</sub> Temperature Coefficient	ΔV <sub>DS</sub> /T <sub>J</sub>	I <sub>D</sub> = 250 μA		17		mV/°C
V <sub>GS(th)</sub> Temperature Coefficient	ΔV <sub>GS(th)</sub> /T <sub>J</sub>			- 1.8		
Gate-Source Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA		1.6		V
Gate-Source Leakage	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 8 V			± 30	μA
		V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 4.5 V			± 1	
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V			1	
		V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 85 °C			3	
On-State Drain Current <sup>a</sup>	I <sub>D(on)</sub>	V <sub>DS</sub> ≥ 5 V, V <sub>GS</sub> = 4.5 V	2			A
Drain-Source On-State Resistance <sup>a</sup>	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 0.3A		1.200		Ω
		V <sub>GS</sub> = 8 V, I <sub>D</sub> = 0.2 A		1.300		
		V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 0.2 A		1.500		
		V <sub>GS</sub> = 2.5 V, I <sub>D</sub> = 0.15A		1.650		
Forward Transconductance	g <sub>fs</sub>	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 0.5 A		7.5		S
Dynamic <sup>b</sup>						
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 0 V, f = 1 MHz		40		pF
Output Capacitance	C <sub>oss</sub>			14		
Reverse Transfer Capacitance	C <sub>rss</sub>			8		
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 8 V, I <sub>D</sub> = 0.6 A		1.3	2	nC
		V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 0.6 A		0.75	1.2	
Gate-Source Charge	Q <sub>gs</sub>			0.15		
Gate-Drain Charge	Q <sub>gd</sub>			0.13		
Gate Resistance	R <sub>g</sub>	f = 1 MHz	2.4	12.2	24.4	Ω
Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = 10 V, R <sub>L</sub> = 20 Ω I <sub>D</sub> ≅ 0.5 A, V <sub>GEN</sub> = 4.5 V, R <sub>g</sub> = 1 Ω		11	20	ns
Rise Time	t <sub>r</sub>			16	24	
Turn-Off Delay Time	t <sub>d(off)</sub>			26	39	
Fall Time	t <sub>f</sub>			11	20	
Drain-Source Body Diode Characteristics						
Pulse Diode Forward Current <sup>a</sup>	I <sub>SM</sub>				2	A
Body Diode Voltage	V <sub>SD</sub>	I <sub>S</sub> = 0.5 A		0.8	1.2	V
Body Diode Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> = 0.5 A, dI/dt = 100 A/μs		10	15	ns
Body Diode Reverse Recovery Charge	Q <sub>rr</sub>			2	4	nC
Reverse Recovery Fall Time	t <sub>a</sub>			5		ns
Reverse Recovery Rise Time	t <sub>b</sub>			5		

Notes:

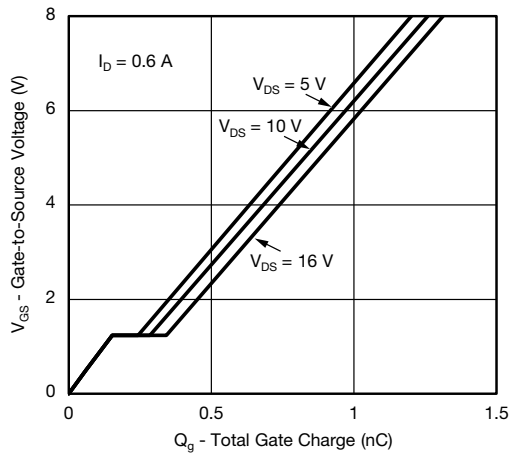
a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .

b. Guaranteed by design, not subject to production testing.

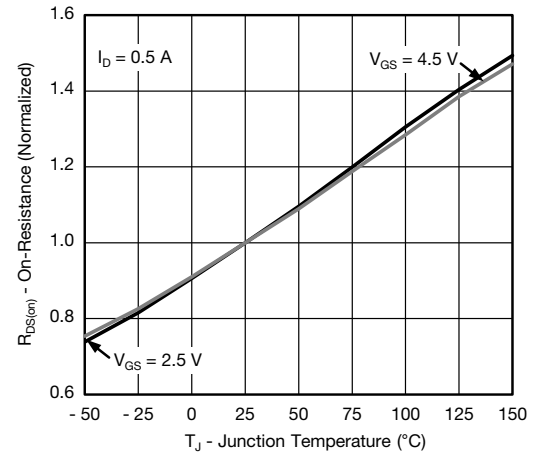
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Gate Current vs. Gate-Source Voltage**

**Gate Current vs. Gate-Source Voltage**

**Output Characteristics**

**Transfer Characteristics**

**On-Resistance vs. Drain Current**

**Capacitance**

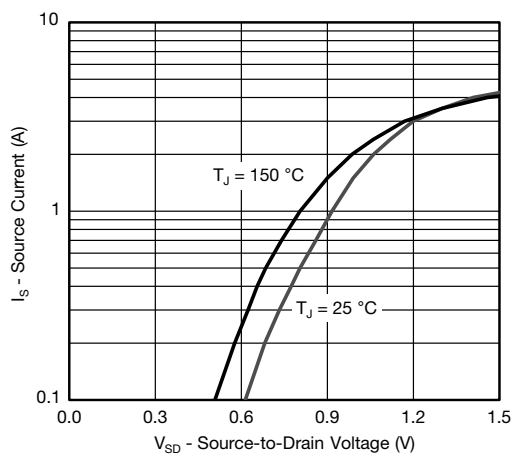
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



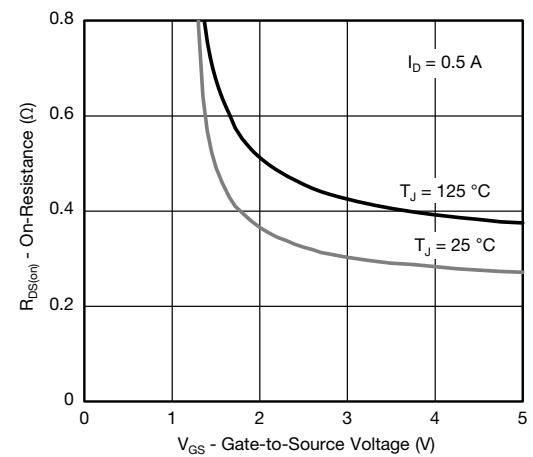
Gate Charge



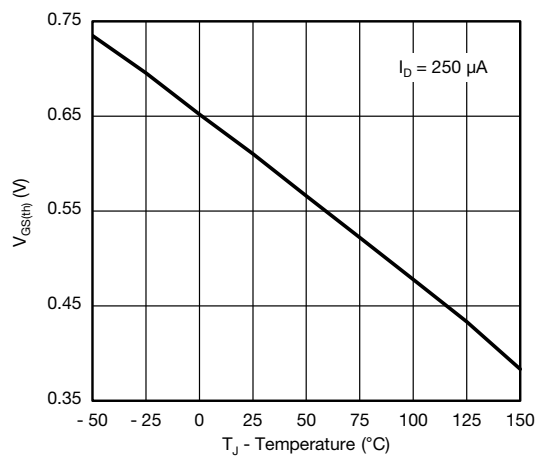
On-Resistance vs. Junction Temperature



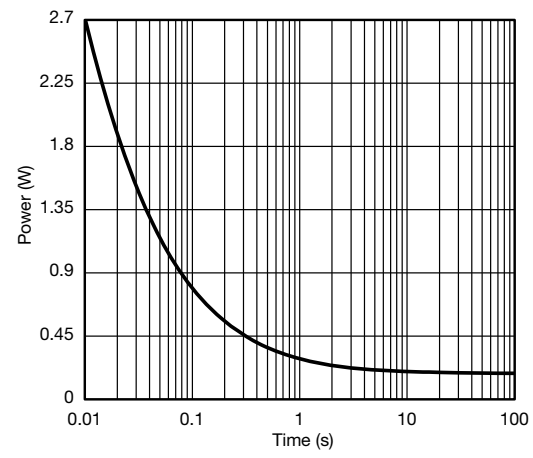
Source-Drain Diode Forward Voltage



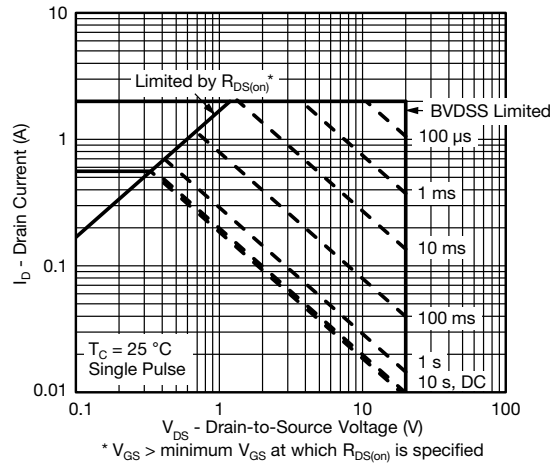
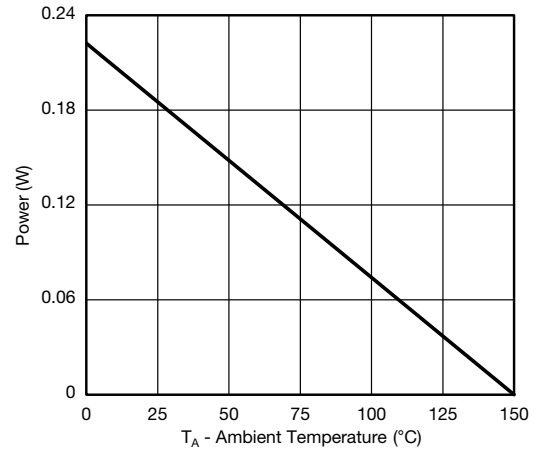
On-Resistance vs. Gate-to-Source Voltage



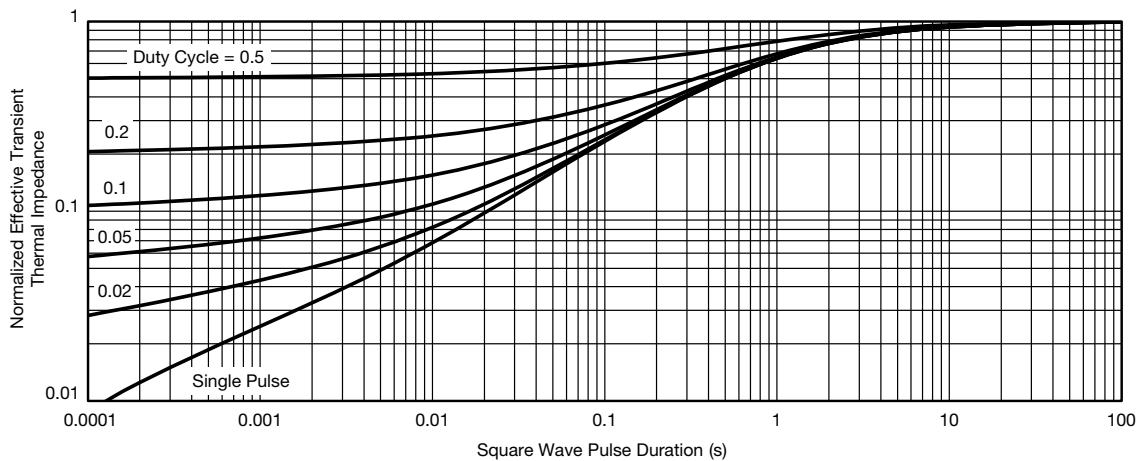
Threshold Voltage



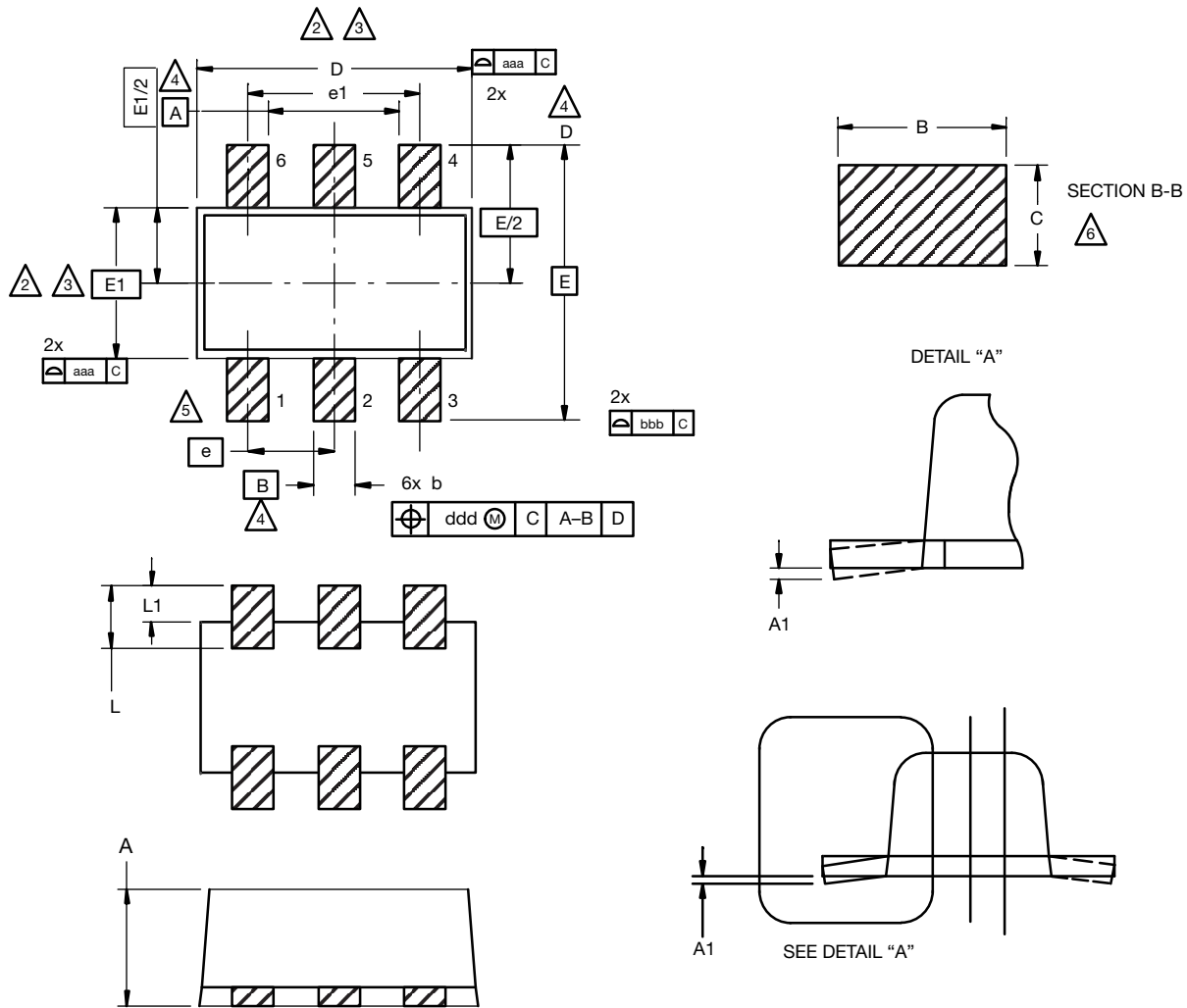
Single Pulse Power, Junction-to-Ambient

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Safe Operating Area, Junction-to-Ambient**

**Power Derating, Junction-to-Ambient**

\* The power dissipation  $P_D$  is based on  $T_{J(max)} = 150^\circ\text{C}$ , using junction-to-case thermal resistance, and is more useful in settling the upper power dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.


**Normalized Thermal Transient Impedance, Junction-to-Ambient**

## SC-89 6-Leads (SOT-563F)

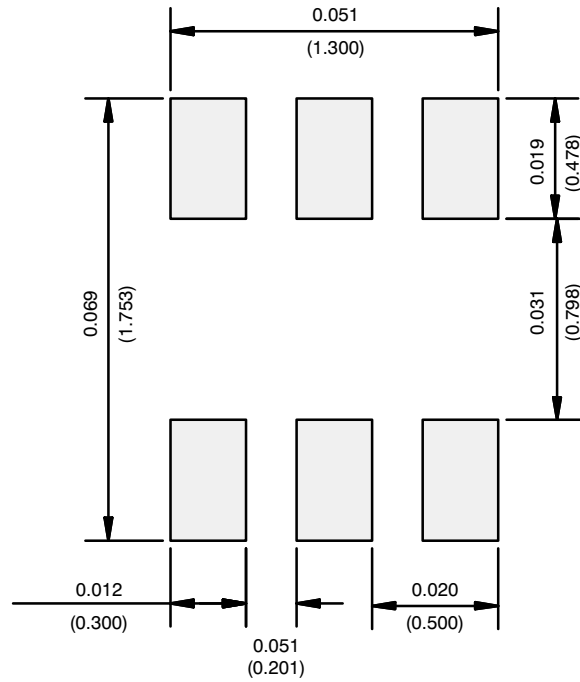


## Notes

1. Dimensions in millimeters.
2. Dimension D does not include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15 mm per dimension E1 does not include interlead flash or protrusion shall not exceed 0.15 mm per side.
3. Dimensions D and E1 are determined at the outmost extremes of the plastic body exclusive of mold flash, the bar burrs, gate burrs and interlead flash, but including any mismatch between the top and the bottom of the plastic body.
4. Datums A, B and D to be determined 0.10 mm from the lead tip.
5. Terminal numbers are shown for reference only.
6. These dimensions apply to the flat section of the lead between 0.08 mm and 0.15 mm from the lead tip.

DIM.	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.56	0.58	0.60
A1	0	0.02	0.10
b	0.15	0.22	0.30
c	0.10	0.14	0.18
D	1.50	1.60	1.70
E	1.50	1.60	1.70
E1	1.15	1.20	1.25
e	0.45	0.50	0.55
e1	0.95	1.00	1.05
L	0.25	0.35	0.50
L1	0.10	0.20	0.30

RECOMMENDED MINIMUM PADS FOR SC-89: 6-Lead



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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