

## APM1402AS-TRL-VB Datasheet

### N-Channel 20 V (D-S) MOSFET

#### PRODUCT SUMMARY

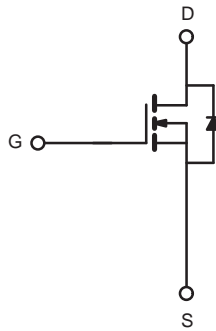
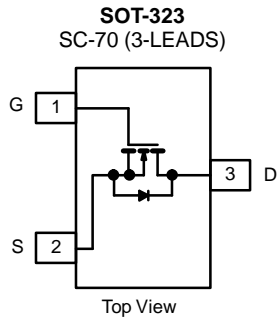
$V_{DS}$ (V)	$R_{DS(on)}$ ( $\Omega$ )	$I_D$ (A) <sup>a</sup>	$Q_g$ (Typ.)
20	0.036 at $V_{GS} = 10$ V	4	4 nC
	0.040 at $V_{GS} = 4.5$ V	3.8	
	0.048 at $V_{GS} = 2.5$ V	3.6	

#### FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET<sup>®</sup> Power MOSFET
- 100 %  $R_g$  Tested
- Compliant to RoHS Directive 2002/95/EC



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**



#### APPLICATIONS

- Portable Devices
  - Load Switch
  - Battery Switch
- Load Switch for Motors, Relays and Solenoids

#### ABSOLUTE MAXIMUM RATINGS ( $T_A = 25$ °C, unless otherwise noted)

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DS}$	20	V
Gate-Source Voltage	$V_{GS}$	$\pm 12$	
Continuous Drain Current ( $T_J = 150$ °C)	$I_D$	$T_C = 25$ °C	4 <sup>a</sup>
		$T_C = 70$ °C	3.6 <sup>a</sup>
		$T_A = 25$ °C	4 <sup>a, b, c</sup>
		$T_A = 70$ °C	3.7 <sup>b, c</sup>
Pulsed Drain Current ( $t = 300$ $\mu$ s)	$I_{DM}$	20	
Continuous Source-Drain Diode Current	$I_S$	$T_C = 25$ °C	2.3 <sup>a</sup>
		$T_A = 25$ °C	1.3 <sup>b, c</sup>
Maximum Power Dissipation	$P_D$	$T_C = 25$ °C	2.8
		$T_C = 70$ °C	1.8
		$T_A = 25$ °C	1.56 <sup>b, c</sup>
		$T_A = 70$ °C	1.0 <sup>b, c</sup>
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to 150	°C

#### THERMAL RESISTANCE RATINGS

Parameter	Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient <sup>b, d</sup>	$R_{thJA}$	60	80	°C/W
Maximum Junction-to-Foot (Drain)	$R_{thJF}$	34	45	

#### Notes:

- Package limited,  $T_C = 25$  °C.
- Surface mounted on 1" x 1" FR4 board.
- $t = 5$  s.
- Maximum under steady state conditions is 125 °C/W.

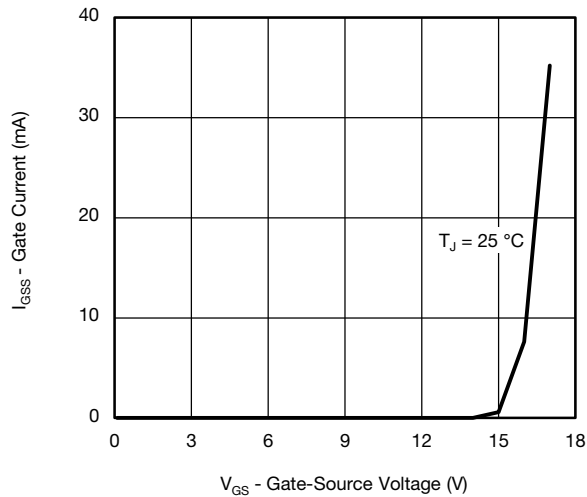
SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted)						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Static						
Drain-Source Breakdown Voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	20			V
V <sub>DS</sub> Temperature Coefficient	ΔV <sub>DS</sub> /T <sub>J</sub>	I <sub>D</sub> = 250 μA		23		mV/°C
V <sub>GS(th)</sub> Temperature Coefficient	ΔV <sub>GS(th)</sub> /T <sub>J</sub>			- 3.2		
Gate-Source Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	0.6		1.3	V
Gate-Source Leakage	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 4.5 V			± 0.5	μA
		V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 12 V			± 25	
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 20 V, V <sub>GS</sub> = 0 V			1	
		V <sub>DS</sub> = 20 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 55 °C			10	
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	15			A
Drain-Source On-State Resistance <sup>a</sup>	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 3.7 A		0.036		Ω
		V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 3.6 A		0.040		
		V <sub>GS</sub> = 2.5 V, I <sub>D</sub> = 1.5 A		0.048		
Forward Transconductance <sup>a</sup>	g <sub>fs</sub>	V <sub>DS</sub> = 15 V, I <sub>D</sub> = 3.7 A		17		S
Dynamic <sup>b</sup>						
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> = 15 V, V <sub>GS</sub> = 10 V, I <sub>D</sub> = 3.7 A		8.8	13.5	nC
		V <sub>DS</sub> = 15 V, V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 3.7 A		4	6	
Gate-Source Charge	Q <sub>gs</sub>			0.9		
Gate-Drain Charge	Q <sub>gd</sub>			1.1		
Gate Resistance	R <sub>g</sub>	f = 1 MHz	0.4	2	4	kΩ
Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = 15 V, R <sub>L</sub> = 4.1 Ω I <sub>D</sub> ≈ 3.7 A, V <sub>GEN</sub> = 4.5 V, R <sub>g</sub> = 1 Ω		0.29	0.58	μs
Rise Time	t <sub>r</sub>			0.4	0.8	
Turn-Off DelayTime	t <sub>d(off)</sub>			1.9	3.8	
Fall Time	t <sub>f</sub>			0.75	1.5	
Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = 15 V, R <sub>L</sub> = 4.1 Ω I <sub>D</sub> ≈ 3.7 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 1 Ω		0.1	0.2	
Rise Time	t <sub>r</sub>			0.15	0.3	
Turn-Off DelayTime	t <sub>d(off)</sub>			3	6	
Fall Time	t <sub>f</sub>			0.75	1.5	
Drain-Source Body Diode Characteristics						
Continuous Source-Drain Diode Current	I <sub>S</sub>	T <sub>C</sub> = 25 °C			2.3	A
Pulse Diode Forward Current	I <sub>SM</sub>				20	
Body Diode Voltage	V <sub>SD</sub>	I <sub>S</sub> = 3.7 A, V <sub>GS</sub> = 0 V		0.85	1.2	V
Body Diode Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> = 3.7 A, dI/dt = 100 A/μs, T <sub>J</sub> = 25 °C		12	25	ns
Body Diode Reverse Recovery Charge	Q <sub>rr</sub>			5	10	nC
Reverse Recovery Fall Time	t <sub>a</sub>			6.5		ns
Reverse Recovery Rise Time	t <sub>b</sub>			5.5		

**Notes:**

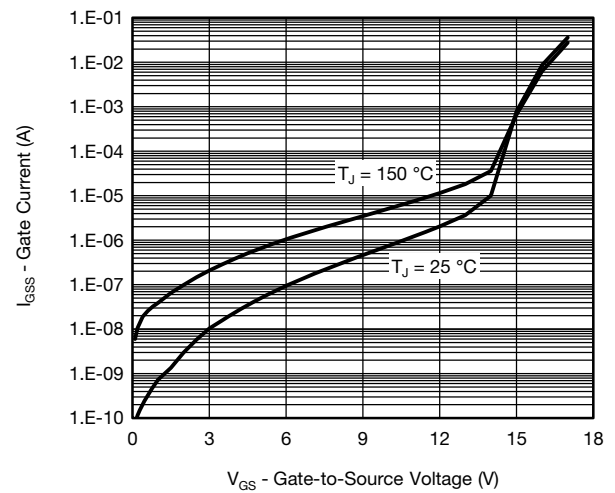
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
 b. Guaranteed by design, not subject to production testing.

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.

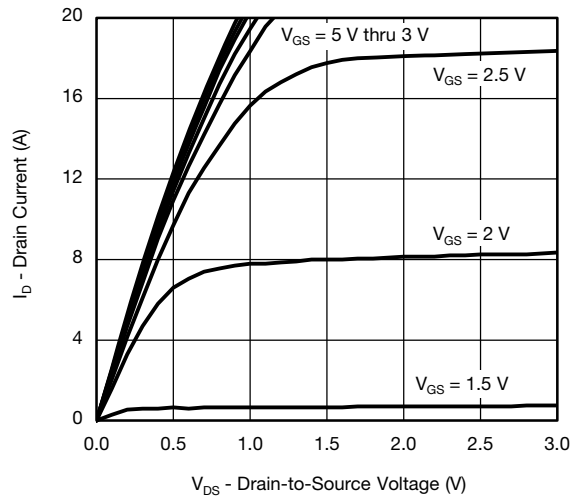
**TYPICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)



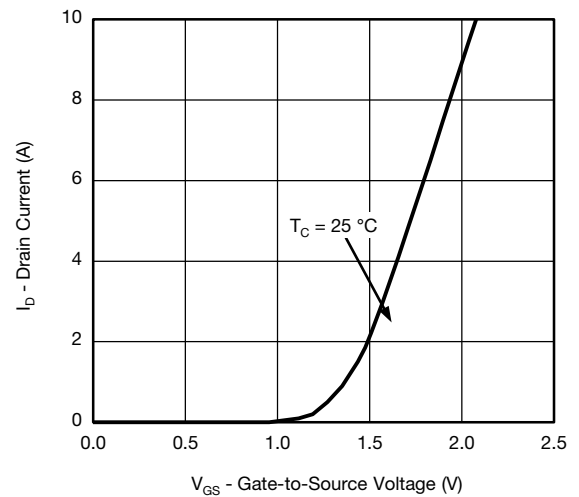
Gate Current vs. Gate-to-Source Voltage



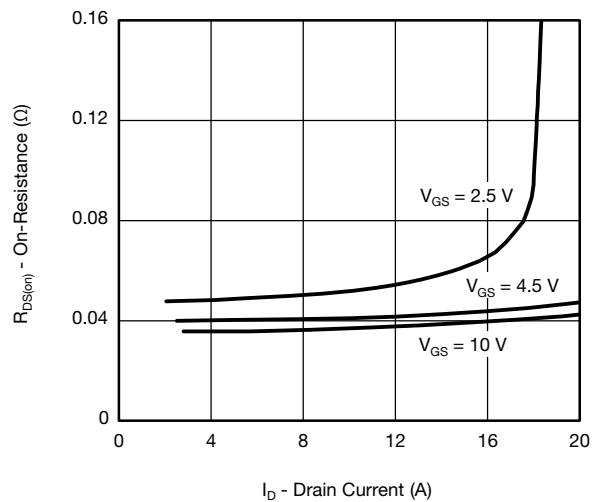
Gate Current vs. Gate-to-Source Voltage



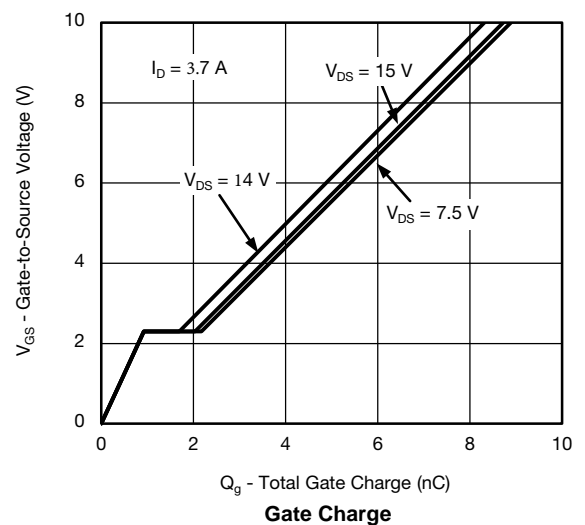
Output Characteristics



Transfer Characteristics

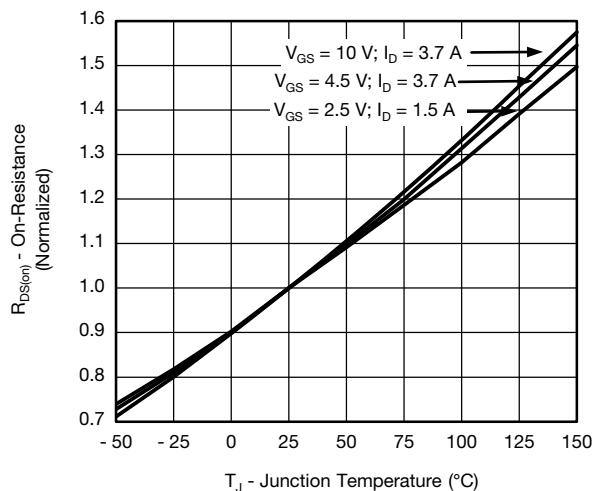


On-Resistance vs. Drain Current

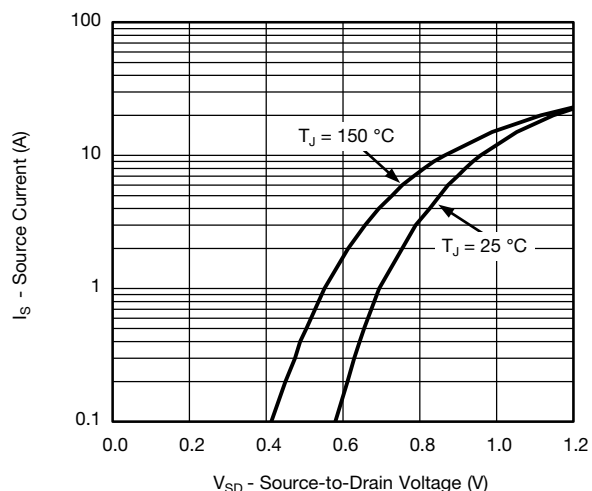


Gate Charge

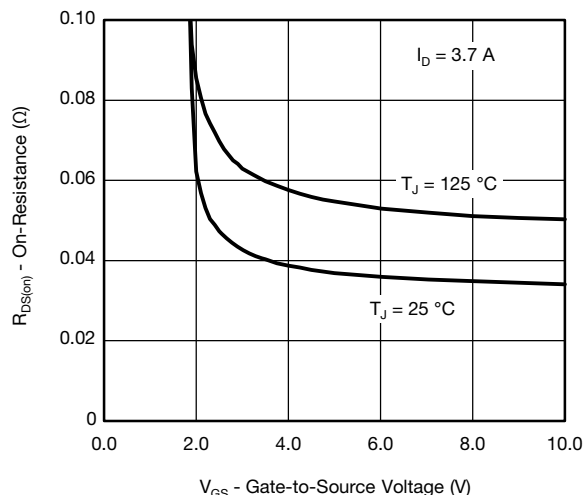
**TYPICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)



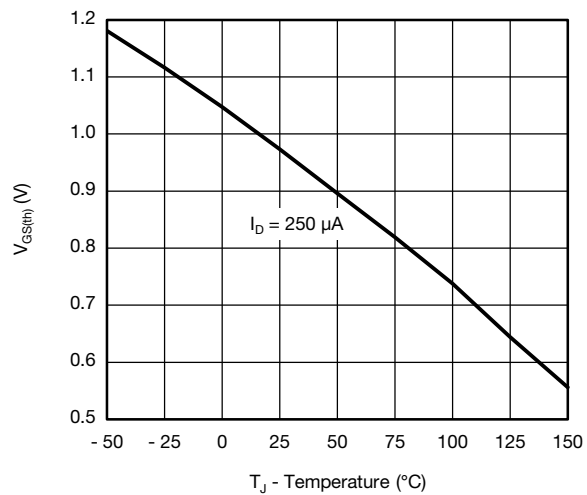
**Normalized On-Resistance vs. Junction Temperature**



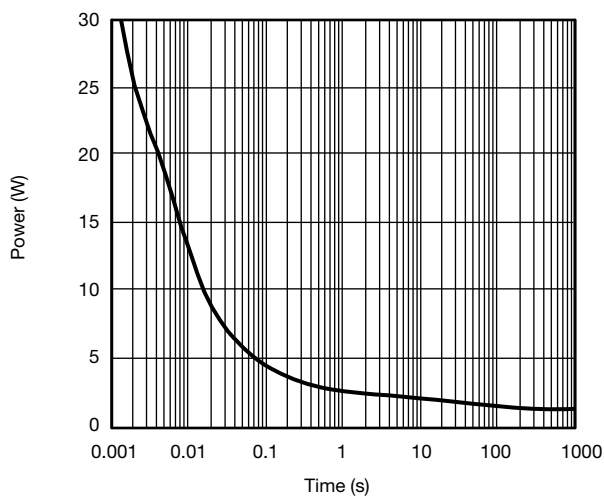
**Source-Drain Diode Forward Voltage**



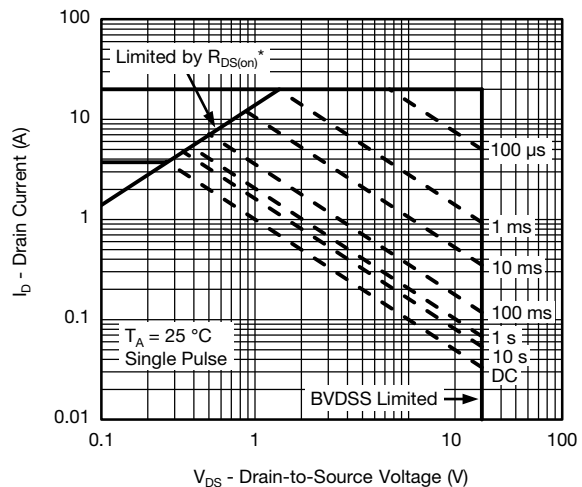
**On-Resistance vs. Gate-to-Source Voltage**



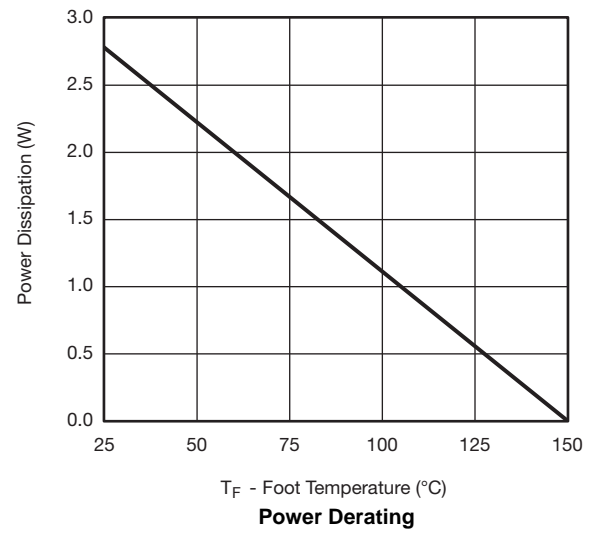
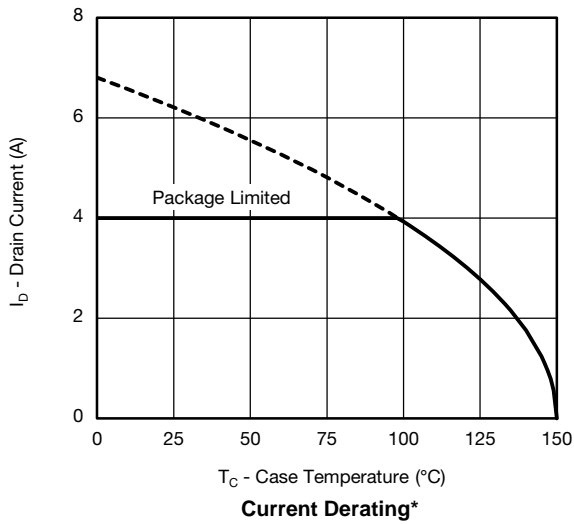
**Threshold Voltage**



**Single Pulse Power, Junction-to-Ambient**

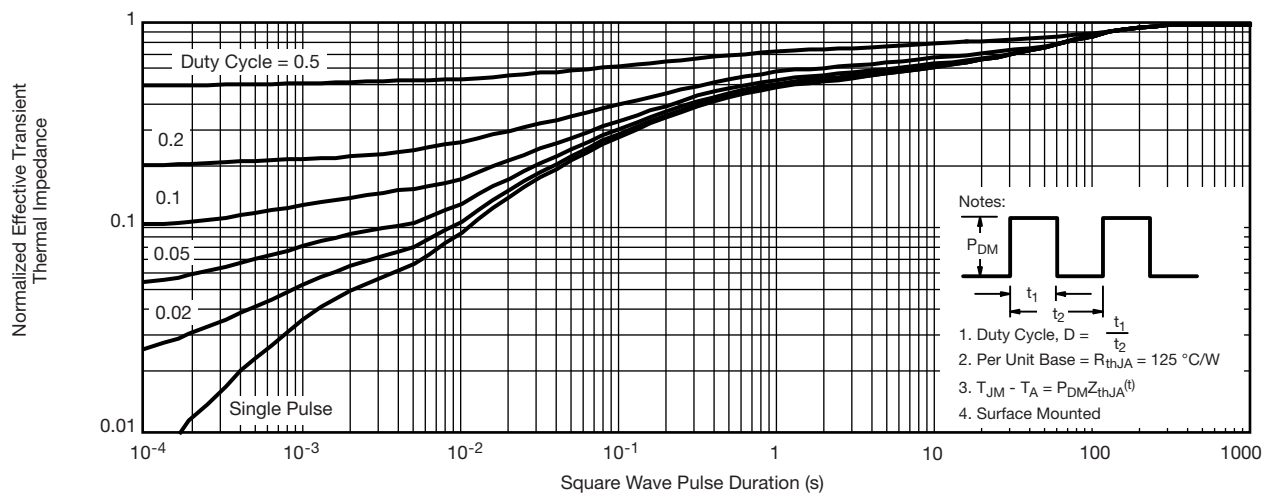


**Safe Operating Area, Junction-to-Ambient**

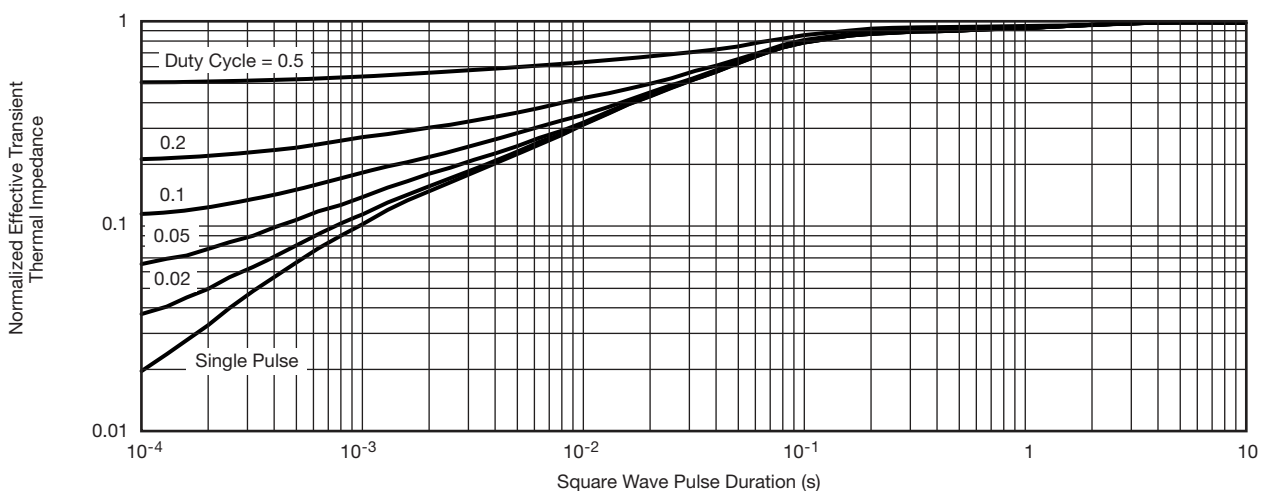
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

\* The power dissipation  $P_D$  is based on  $T_{J(max)} = 150\text{ }^{\circ}\text{C}$ , using junction-to-case thermal resistance, and is more useful in settling the upper 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.

**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

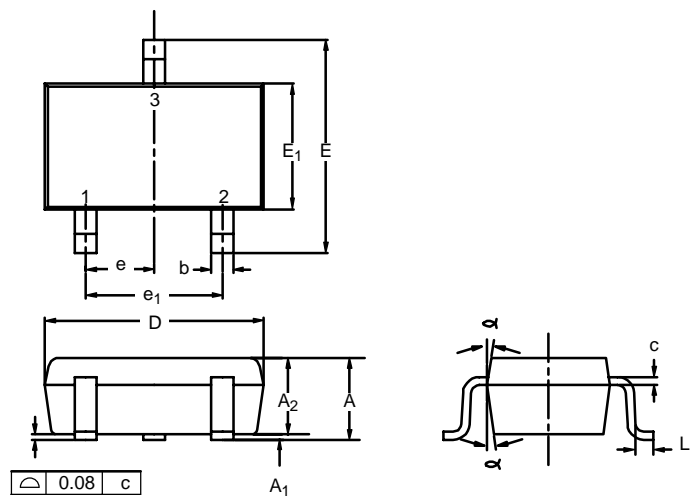


**Normalized Thermal Transient Impedance, Junction-to-Ambient**



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

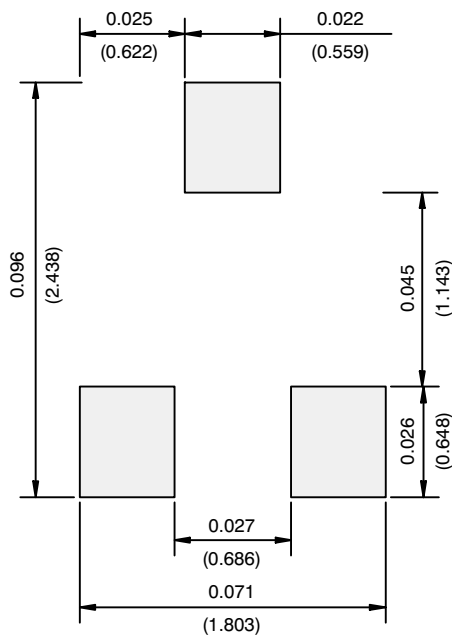
SC-70: 3-LEADS



Dim	MILLIMETERS			INCHES		
	Min	Nom	Max	Min	Nom	Max
A	0.90	—	1.10	0.035	—	0.043
A <sub>1</sub>	—	—	0.10	—	—	0.004
A <sub>2</sub>	0.80	—	1.00	0.031	—	0.039
b	0.25	—	0.40	0.010	—	0.016
c	0.10	—	0.25	0.004	—	0.010
D	1.80	2.00	2.20	0.071	0.079	0.087
E	1.80	2.10	2.40	0.071	0.083	0.094
E <sub>1</sub>	1.15	1.25	1.35	0.045	0.049	0.053
e	0.65BSC			0.026BSC		
e <sub>1</sub>	1.20	1.30	1.40	0.047	0.051	0.055
L	0.10	0.20	0.30	0.004	0.008	0.012
α	7°Nom			7°Nom		

ECN: S-03946—Rev. C, 09-Jul-01  
DWG: 5549

RECOMMENDED MINIMUM PADS FOR SC-70: 3-Lead



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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