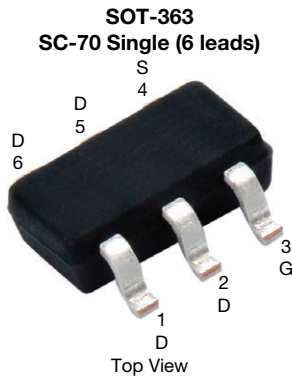


## Automotive P-Channel 60 V (D-S) MOSFET



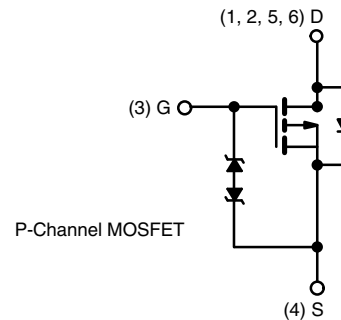
Marking Code: 9D

PRODUCT SUMMARY	
$V_{DS}$ (V)	-60
$R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = -10$ V	0.290
$R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = -4.5$ V	0.395
$I_D$ (A)	-1.6
Configuration	Single
Package	SC-70

### FEATURES

- TrenchFET® power MOSFET
- AEC-Q101 qualified
- 100 %  $R_g$  and UIS tested
- Typical ESD protection: 800 V
- Material categorization:  
for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

 AUTOMOTIVE  
GRADE

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


ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted)				
PARAMETER		SYMBOL	LIMIT	UNIT
Drain-source voltage		$V_{DS}$	-60	V
Gate-source voltage		$V_{GS}$	$\pm 20$	
Continuous drain current	$T_C = 25$ °C <sup>a</sup>	$I_D$	-1.6	A
	$T_C = 125$ °C		-1	
Continuous source current (diode conduction) <sup>a</sup>		$I_S$	-1.6	
Pulsed drain current <sup>b</sup>		$I_{DM}$	-6.7	
Single pulse avalanche current	L = 0.1 mH	$I_{AS}$	-8	
Single pulse avalanche energy		$E_{AS}$	3.2	
Maximum power dissipation <sup>b</sup>	$T_C = 25$ °C	$P_D$	2.7	W
	$T_C = 125$ °C		0.5	
Operating junction and storage temperature range		$T_J, T_{stg}$	-55 to +150	°C

THERMAL RESISTANCE RATINGS				
PARAMETER		SYMBOL	LIMIT	UNIT
Junction-to-ambient	PCB mount <sup>c</sup>	$R_{thJA}$	125	°C/W
Junction-to-foot (drain)		$R_{thJF}$	45	

### Notes

- Package limited
- Pulse test; pulse width  $\leq 300$   $\mu$ s, duty cycle  $\leq 2$  %
- When mounted on 1" square PCB (FR4 material)



SPECIFICATIONS (T <sub>C</sub> = 25 °C, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
<b>Static</b>							
Drain-source breakdown voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = -250 μA		-60	-	-	V
Gate-source threshold voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μA		-1.5	-2.0	-2.5	
Gate-source leakage	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 12 V		-	-	± 5	μA
		V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 20 V		-	-	± 5	mA
Zero gate voltage drain current	I <sub>DSS</sub>	V <sub>GS</sub> = 0 V	V <sub>DS</sub> = -60 V	-	-	-1	μA
		V <sub>GS</sub> = 0 V	V <sub>DS</sub> = -60 V, T <sub>J</sub> = 125 °C	-	-	-50	
		V <sub>GS</sub> = 0 V	V <sub>DS</sub> = -60 V, T <sub>J</sub> = 150 °C	-	-	-150	
On-state drain current <sup>a</sup>	I <sub>D(on)</sub>	V <sub>GS</sub> = -10 V	V <sub>DS</sub> ≤ -5 V	-5	-	-	A
Drain-source on-state resistance <sup>a</sup>	R <sub>DS(on)</sub>	V <sub>GS</sub> = -10 V	I <sub>D</sub> = -2 A	-	0.230	0.290	Ω
		V <sub>GS</sub> = -10 V	I <sub>D</sub> = -2 A, T <sub>J</sub> = 125 °C	-	-	0.470	
		V <sub>GS</sub> = -10 V	I <sub>D</sub> = -2 A, T <sub>J</sub> = 150 °C	-	-	0.566	
		V <sub>GS</sub> = -4.5 V	I <sub>D</sub> = -1 A	-	0.305	0.395	
Forward transconductance <sup>b</sup>	g <sub>fs</sub>	V <sub>DS</sub> = -10 V, I <sub>D</sub> = -1.5 A		-	3	-	S
<b>Dynamic <sup>b</sup></b>							
Input capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0 V	V <sub>DS</sub> = -25 V, f = 1 MHz	-	284	355	pF
Output capacitance	C <sub>oss</sub>			-	36	45	
Reverse transfer capacitance	C <sub>rss</sub>			-	28	35	
Total gate charge <sup>c</sup>	Q <sub>g</sub>	V <sub>GS</sub> = -4.5 V	V <sub>DS</sub> = -30 V, I <sub>D</sub> = -1 A	-	3.6	5.4	nC
Gate-source charge <sup>c</sup>	Q <sub>gs</sub>			-	1.2	-	
Gate-drain charge <sup>c</sup>	Q <sub>gd</sub>			-	1.7	-	
Gate resistance	R <sub>g</sub>	f = 1 MHz		3.1	6.05	9	Ω
Turn-on delay time <sup>c</sup>	t <sub>d(on)</sub>	V <sub>DD</sub> = -30 V, R <sub>L</sub> = 30 Ω I <sub>D</sub> ≅ -1 A, V <sub>GEN</sub> = -4.5 V, R <sub>g</sub> = 1 Ω		-	44	66	ns
Rise time <sup>c</sup>	t <sub>r</sub>			-	25	38	
Turn-off delay time <sup>c</sup>	t <sub>d(off)</sub>			-	13	20	
Fall time <sup>c</sup>	t <sub>f</sub>			-	9	14	
<b>Source-Drain Diode Ratings and Characteristics <sup>b</sup></b>							
Pulsed current <sup>a</sup>	I <sub>SM</sub>			-	-	-6.7	A
Forward voltage	V <sub>SD</sub>	I <sub>F</sub> = -0.5 A, V <sub>GS</sub> = 0 V		-	-0.8	-1.2	V

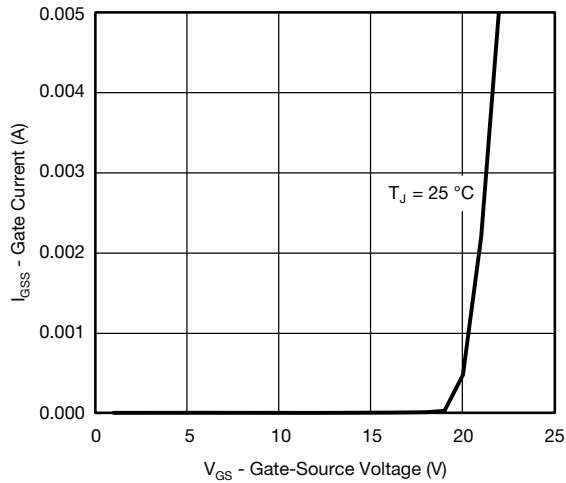
**Notes**

- Pulse test; pulse width ≤ 300 μs, duty cycle ≤ 2 %
- Guaranteed by design, not subject to production testing
- Independent of operating temperature

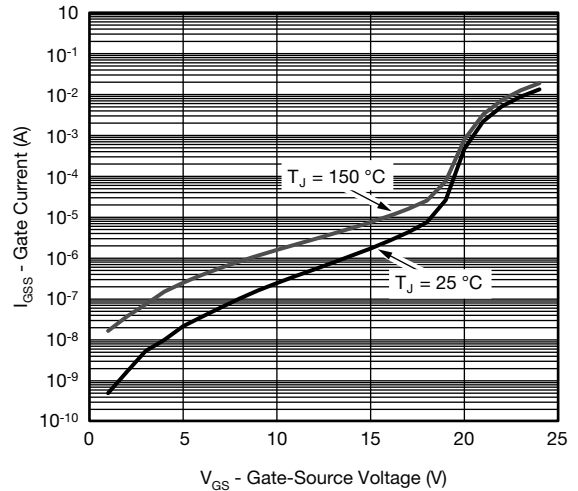
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



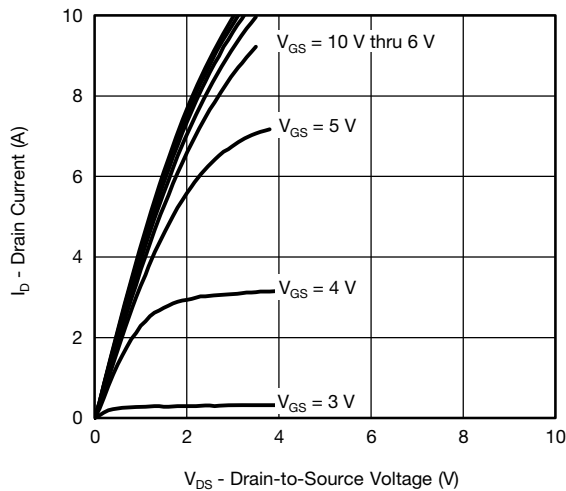
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



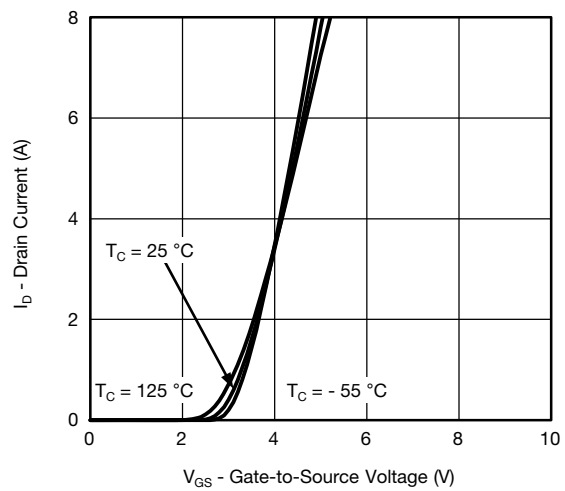
Gate Current vs. Gate-Source Voltage



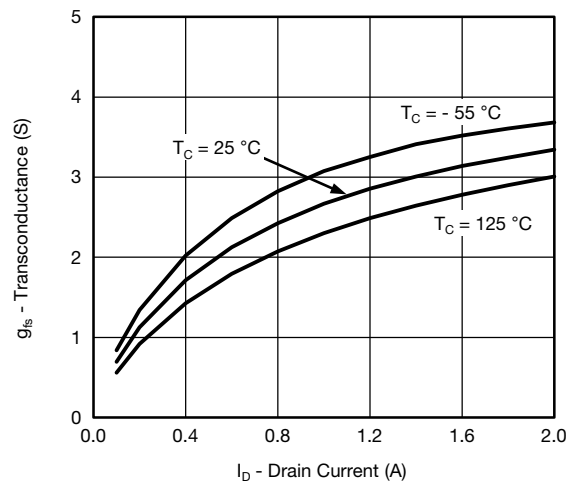
Gate Current vs. Gate-Source Voltage



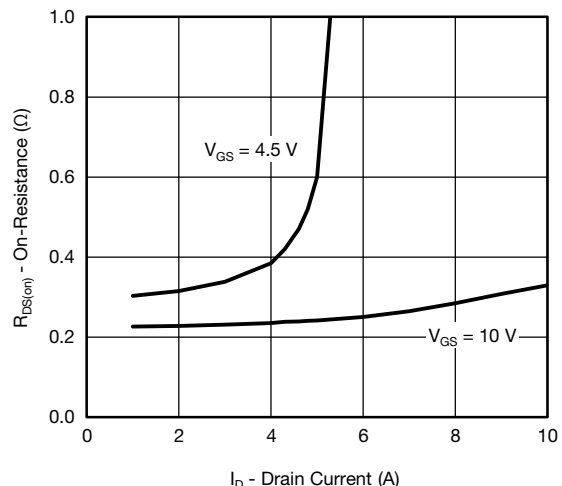
Output Characteristics



Transfer Characteristics



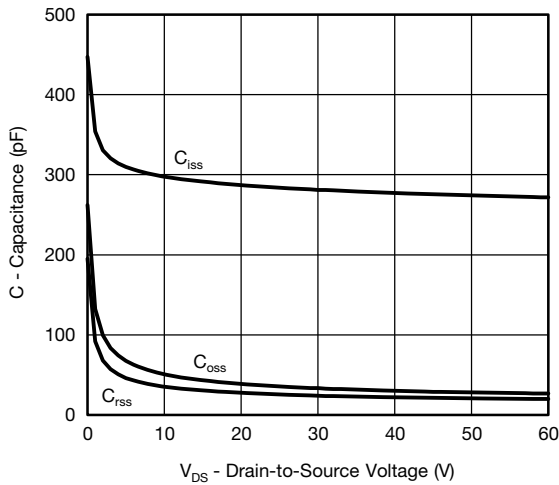
Transconductance



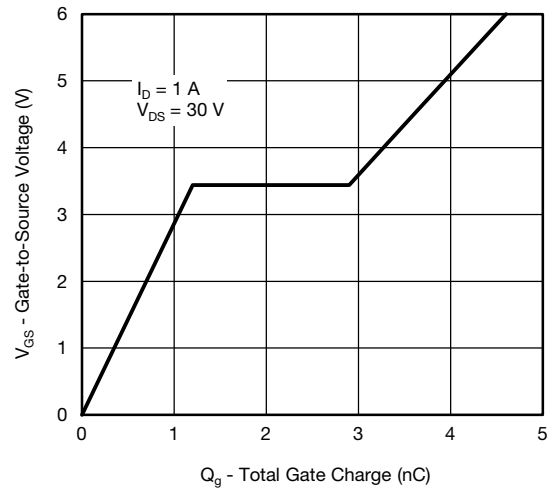
On-Resistance vs. Drain Current



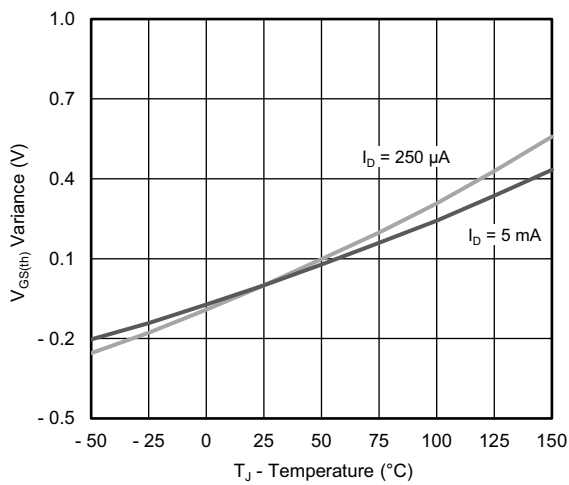
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



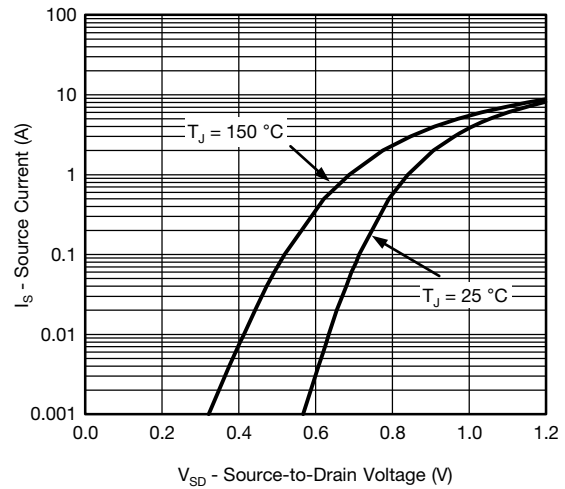
Capacitance



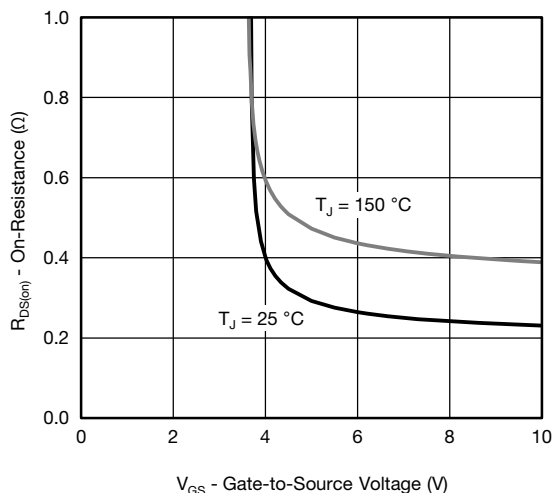
Gate Charge



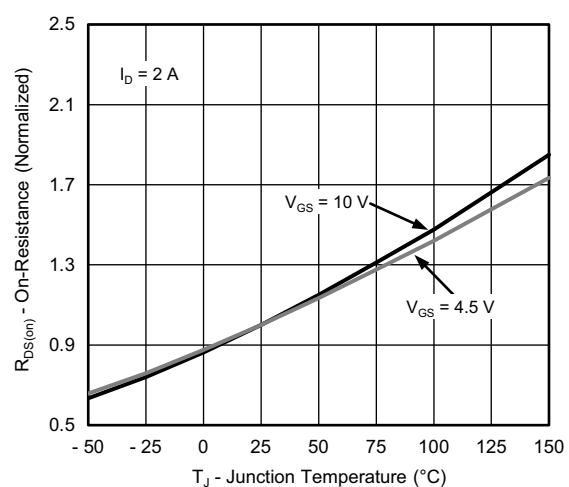
Threshold Voltage



Source Drain Diode Forward Voltage



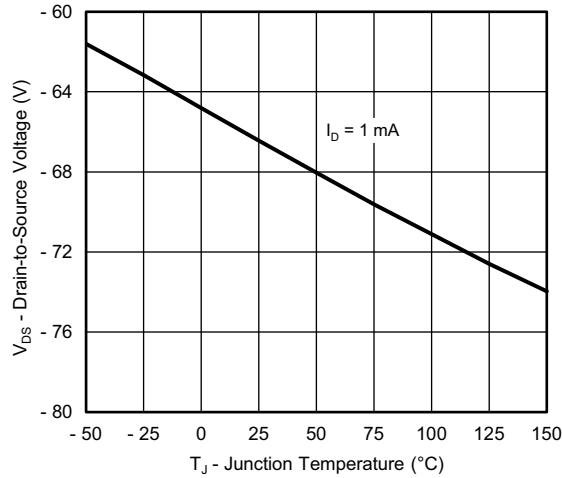
On-Resistance vs. Gate-to-Source Voltage



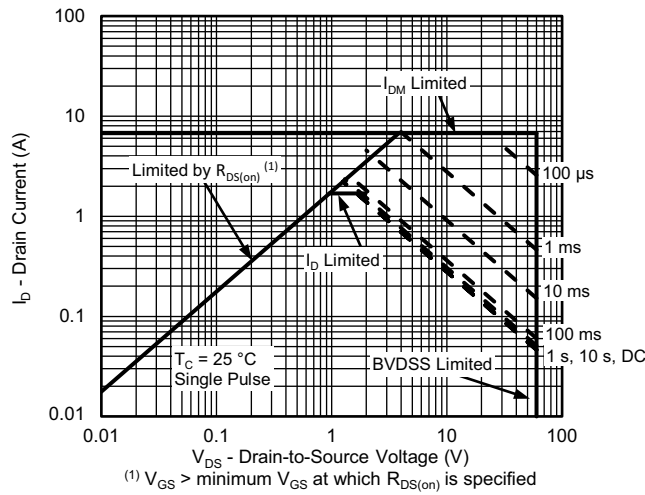
On-Resistance vs. Junction Temperature



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



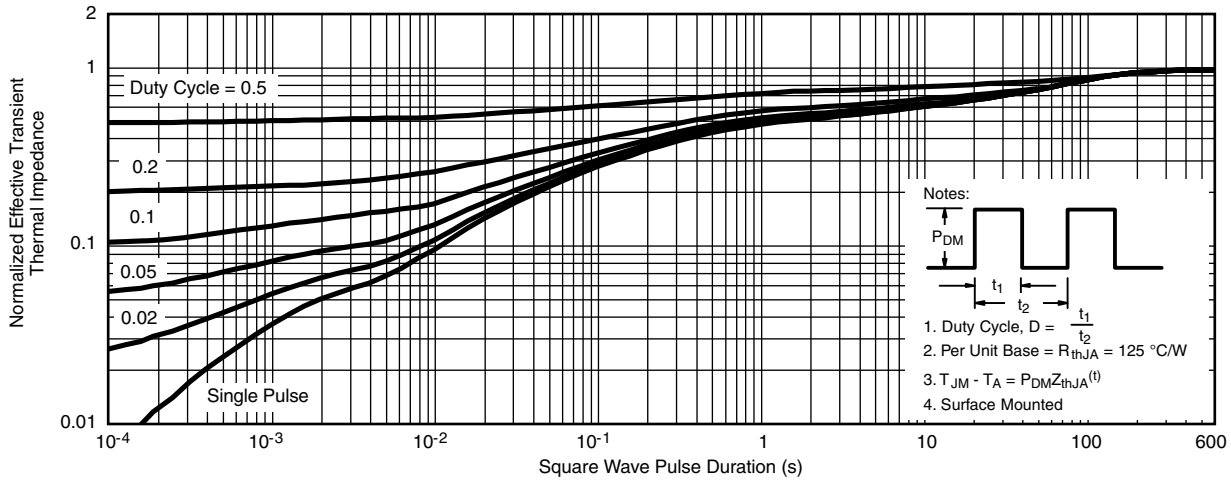
**Drain Source Breakdown vs. Junction Temperature**



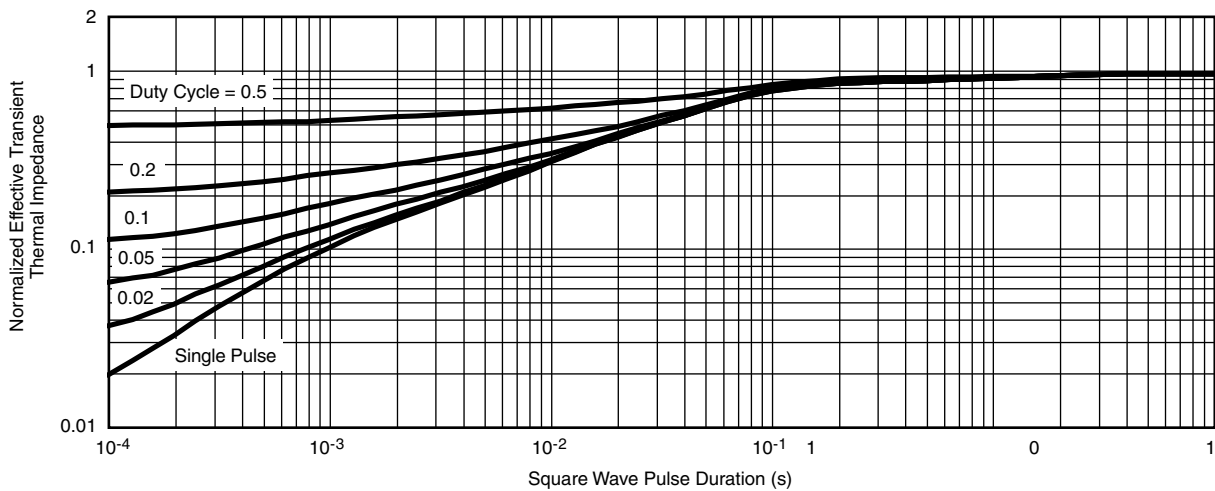
**Safe Operating Area**



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



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



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

**Note**

- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient ( $25\text{ }^\circ\text{C}$ )
  - Normalized Transient Thermal Impedance Junction-to-Foot ( $25\text{ }^\circ\text{C}$ )
 are given for general guidelines only to enable the user to get a “ball park” indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions

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## SC-70

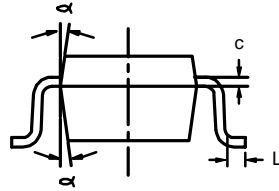
Ordering codes for the SQ rugged series power MOSFETs in the SC-70 package:

DATASHEET PART NUMBER	OLD ORDERING CODE <sup>a</sup>	NEW ORDERING CODE
SQ1421EDH	-	<b>SQ1421EDH-T1_GE3</b>
SQ1431EH	SQ1431EH-T1-GE3	<b>SQ1431EH-T1_GE3</b>
SQ1440EH	-	<b>SQ1440EH-T1_GE3</b>
SQ1470AEH	-	<b>SQ1470AEH-T1_GE3</b>
SQ1539EH	-	<b>SQ1539EH-T1_GE3</b>
SQ1563AEH	-	<b>SQ1563AEH-T1_GE3</b>
SQ1902AEL	-	<b>SQ1902AEL-T1_GE3</b>
SQ1912AEEH	-	<b>SQ1912AEEH-T1_GE3</b>
SQ1912EH	-	<b>SQ1912EH-T1_GE3</b>

**Note**

a. Old ordering code is obsolete and no longer valid for new orders

### SC-70: 6-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	0.15	-	0.30	0.006	-	0.012
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. B, 09-Jul-01  
DWG: 5550



## RECOMMENDED MINIMUM PADS FOR SC-70: 6-Lead



Recommended Minimum Pads  
Dimensions in Inches/(mm)

[Return to Index](#)



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