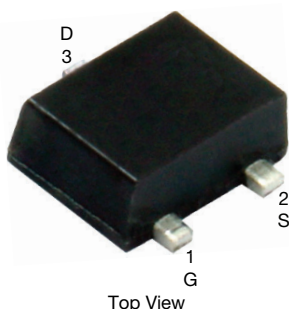


## P-Channel 20 V (D-S) MOSFET

### PRODUCT SUMMARY

$V_{DS}$ (V)	$R_{DS(on)}$ ( $\Omega$ )	$I_D$ (A)	$Q_g$ (TYP.) (nC)
-20	0.760 at $V_{GS} = -4.5$ V	-0.45	1
	1.040 at $V_{GS} = -2.5$ V	-0.40	
	1.500 at $V_{GS} = -1.8$ V	-0.32	

SC-89 (3 leads)



### FEATURES

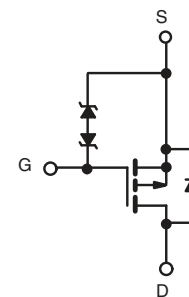
- TrenchFET® power MOSFET
- 100 %  $R_g$  tested
- Typical ESD protection: 1000 V (HBM)
- Fast switching speed
- Material categorization:  
for definitions of compliance please see  
[www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



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

### APPLICATIONS

- Load / power switch for portable devices
- Drivers: relays, solenoids, displays
- Battery operated systems



P-Channel MOSFET

**Marking Code:** 6

### Ordering Information:

Si1013CX-T1-GE3 (Lead (Pb)-free and Halogen-free)

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

PARAMETER		SYMBOL	LIMIT	UNIT
Drain-Source Voltage		$V_{DS}$	-20	V
Gate-Source Voltage		$V_{GS}$	$\pm 8$	
Continuous Drain Current ( $T_J = 150$ °C)	$T_A = 25$ °C	$I_D$	-0.45 <sup>b, c</sup>	A
	$T_A = 70$ °C		-0.36 <sup>b, c</sup>	
Pulsed Drain Current ( $t = 300$ $\mu$ s)		$I_{DM}$	-1.5	
Continuous Source-Drain Diode Current	$T_A = 25$ °C	$I_S$	-0.16 <sup>b, c</sup>	
Maximum Power Dissipation	$T_A = 25$ °C	$P_D$	0.19 <sup>b, c</sup>	W
	$T_A = 70$ °C		0.12 <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>a, b</sup>	$t \leq 5$ s	$R_{thJA}$	440	530	°C/W
	Steady State		540	650	

### Notes

- Maximum under steady state conditions is 650 °C/W.
- Surface mounted on 1" x 1" FR4 board.
- $t = 5$  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, 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	-	-12	-	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	-0.4	-	-1	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> = -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> = 85 °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	-1.5	-	-	A	
Drain-Source On-State Resistance <sup>a</sup>	R <sub>DS(on)</sub>	V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -0.4 A	-	0.630	0.760	Ω	
		V <sub>GS</sub> = -2.5 V, I <sub>D</sub> = -0.2 A	-	0.865	1.040		
		V <sub>GS</sub> = -1.8 V, I <sub>D</sub> = -0.1 A	-	1.200	1.500		
Forward Transconductance	g <sub>fs</sub>	V <sub>DS</sub> = -10 V, I <sub>D</sub> = 0.4 A	-	1	-	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	-	45	-	pF	
Output Capacitance	C <sub>oss</sub>		-	15	-		
Reverse Transfer Capacitance	C <sub>rss</sub>		-	10	-		
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> = -10 V, V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -0.4 A	-	1.65	2.50	nC	
		V <sub>DS</sub> = -0 V, V <sub>GS</sub> = -2.5 V, I <sub>D</sub> = -0.4	-	1	2		
Gate-Source Charge	Q <sub>gs</sub>		-	0.2	-		
Gate-Drain Charge	Q <sub>gd</sub>		-	0.26	-		
Gate Resistance	R <sub>g</sub>	f = 1 MHz	2.4	12	24	Ω	
Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = -10 V, R <sub>L</sub> = 33.3 Ω I <sub>D</sub> ≅ -0.3 A, V <sub>GEN</sub> = -4.5 V, R <sub>g</sub> = 1 Ω	-	9	18	ns	
Rise Time	t <sub>r</sub>		-	10	20		
Turn-Off DelayTime	t <sub>d(off)</sub>		-	10	20		
Fall Time	t <sub>f</sub>		-	8	16		
Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = -10 V, R <sub>L</sub> = 33.3 Ω I <sub>D</sub> ≅ -0.3 A, V <sub>GEN</sub> = -8 V, R <sub>g</sub> = 1 Ω	-	1	2		
Rise Time	t <sub>r</sub>		-	8	16		
Turn-Off DelayTime	t <sub>d(off)</sub>		-	9	18		
Fall Time	t <sub>f</sub>		-	5	10		
Drain-Source Body Diode Characteristics							
Pulse Diode Forward Current <sup>a</sup>	I <sub>SM</sub>		-	-	-1.5	A	
Body Diode Voltage	V <sub>SD</sub>	I <sub>S</sub> = -0.3 A	-	-0.8	-1.2	V	
Body Diode Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> = -0.3 A, dI/dt = 100 A/μs	-	16	24	ns	
Body Diode Reverse Recovery Charge	Q <sub>rr</sub>		-	8	16	nC	
Reverse Recovery Fall Time	t <sub>a</sub>		-	11	-	ns	
Reverse Recovery Rise Time	t <sub>b</sub>		-	5	-		

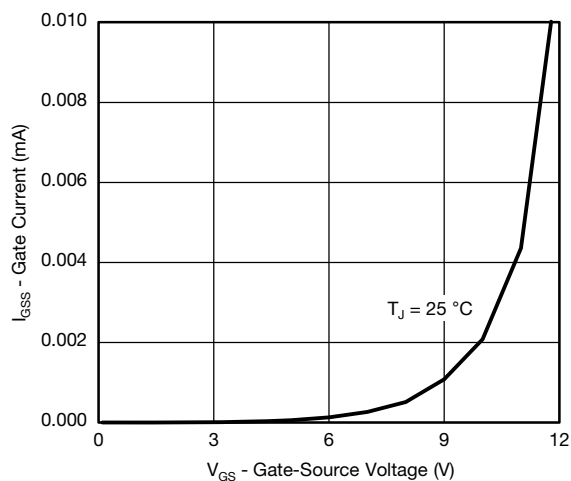
**Notes**

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

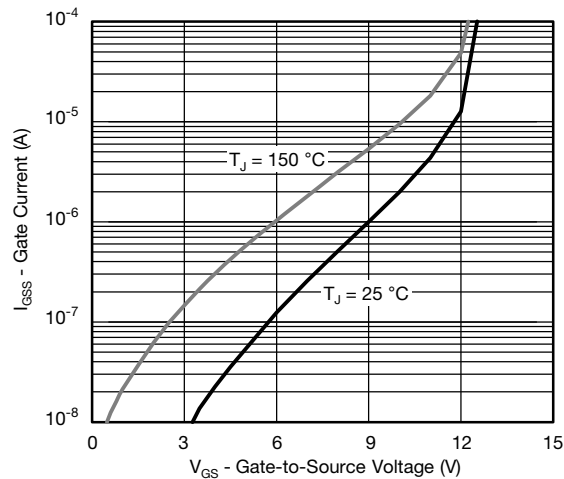
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



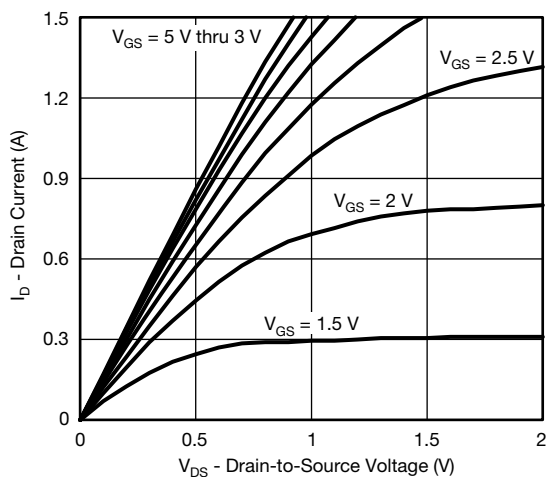
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



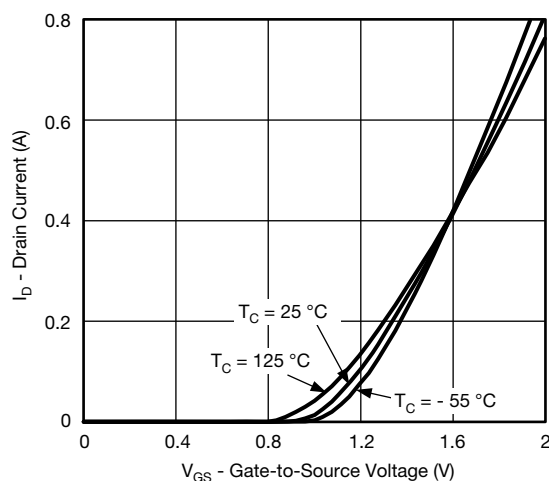
**Gate Current vs. Gate-Source Voltage**



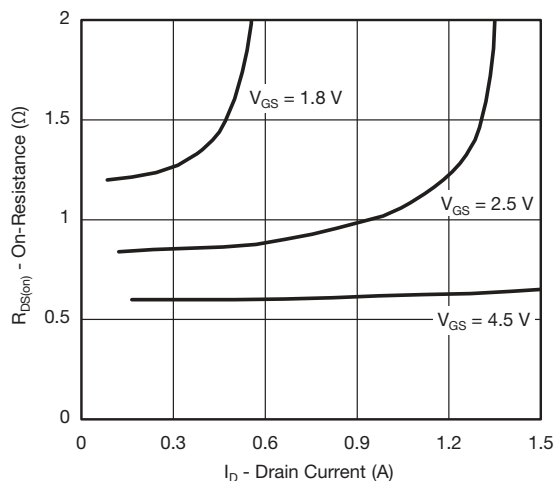
**Gate Current vs. Gate-Source Voltage**



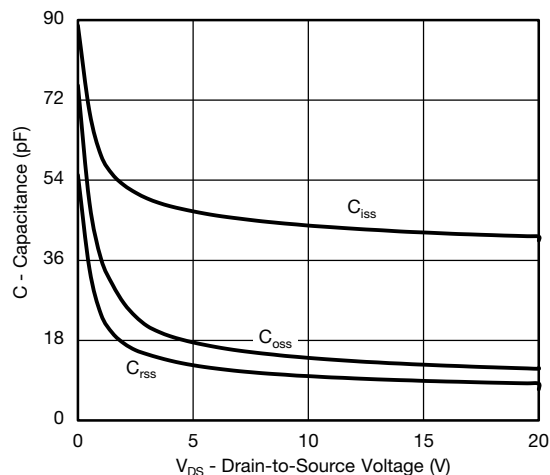
**Output Characteristics**



**Transfer Characteristics**



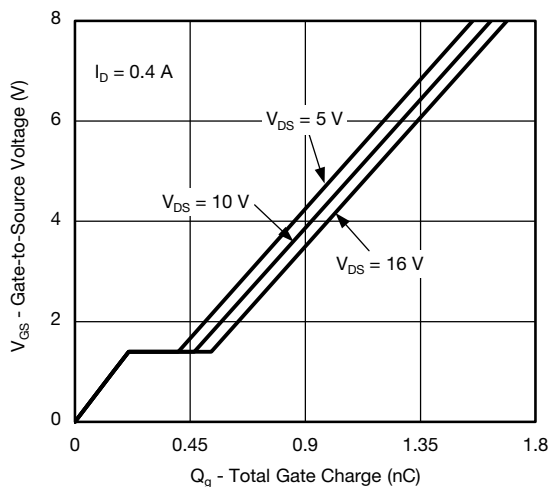
**On-Resistance vs. Drain Current**



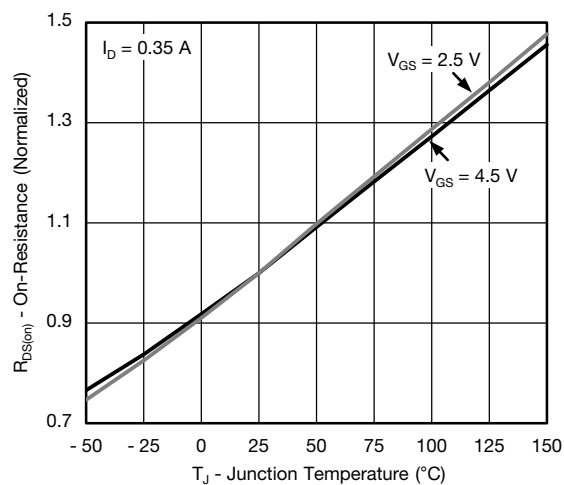
**Capacitance**



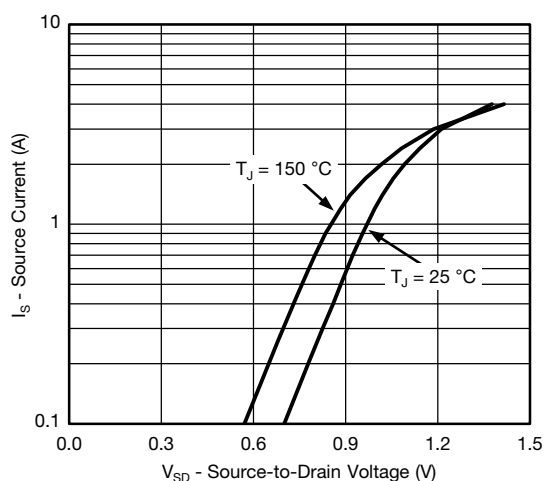
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



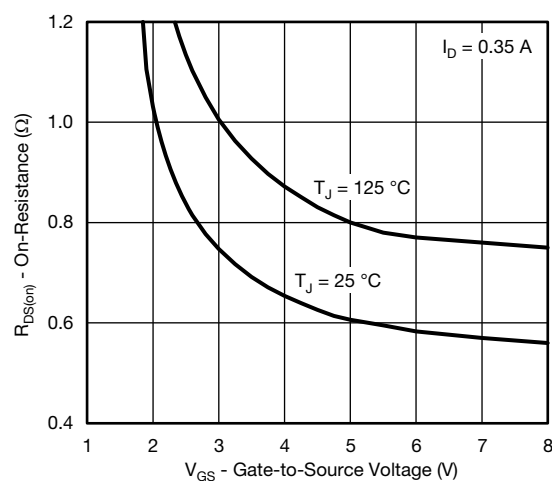
**Gate Charge**



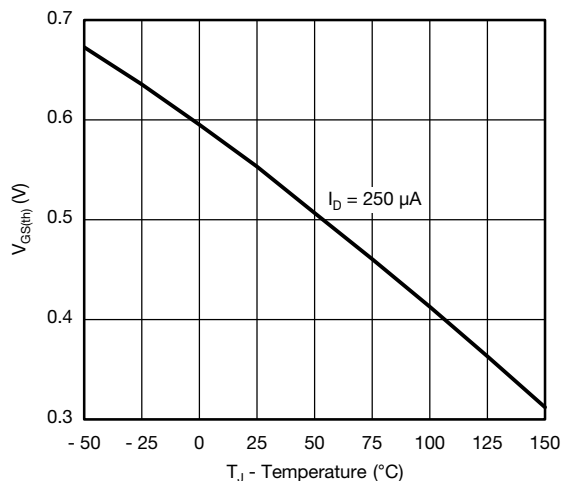
**On-Resistance vs. Junction Temperature**



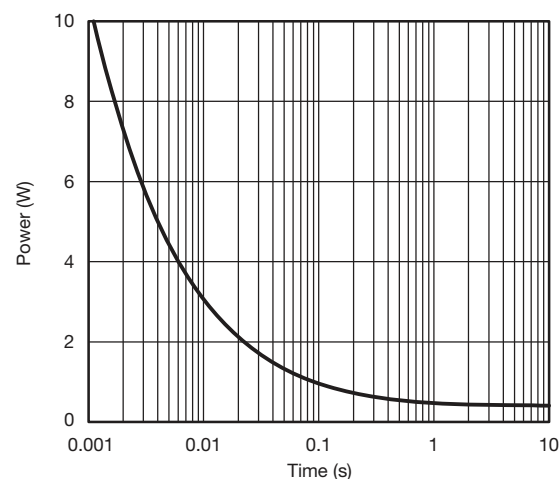
**Source-Drain Diode Forward Voltage**



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



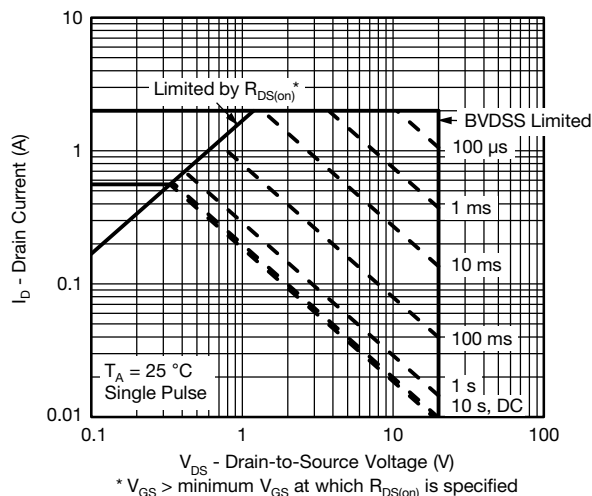
**Threshold Voltage**



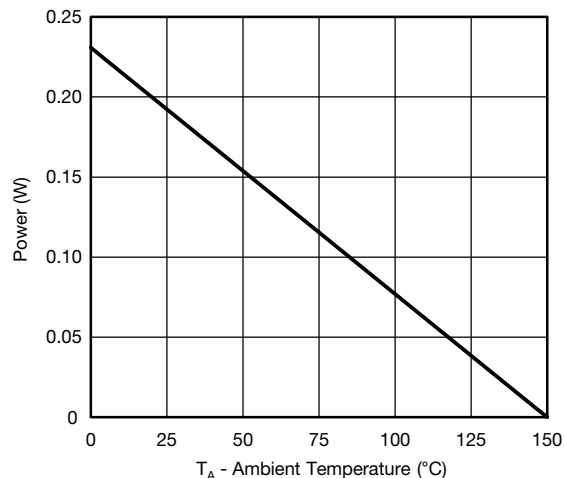
**Single Pulse Power, Junction-to-Ambient**



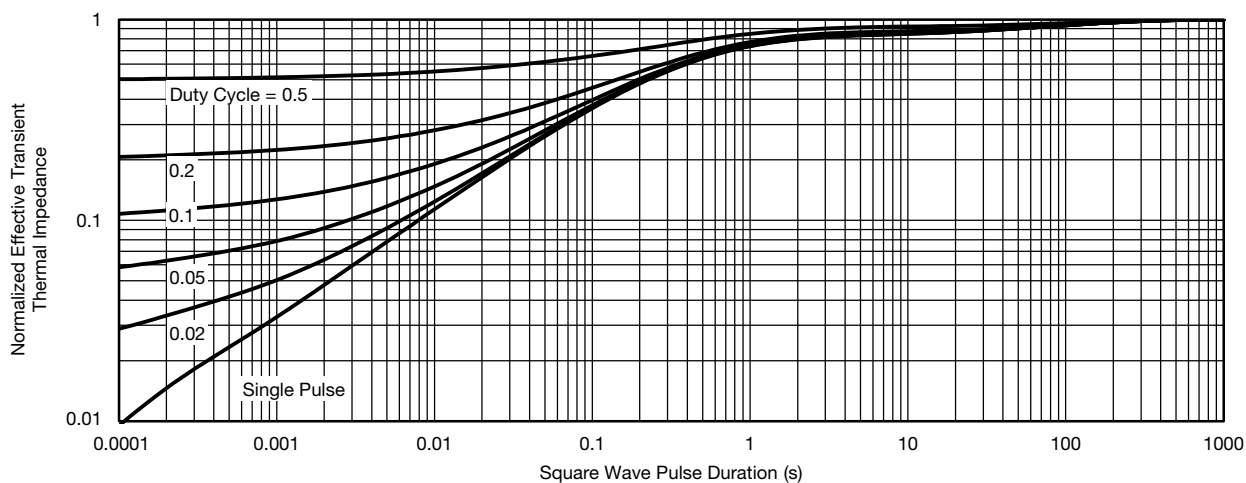
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



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



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

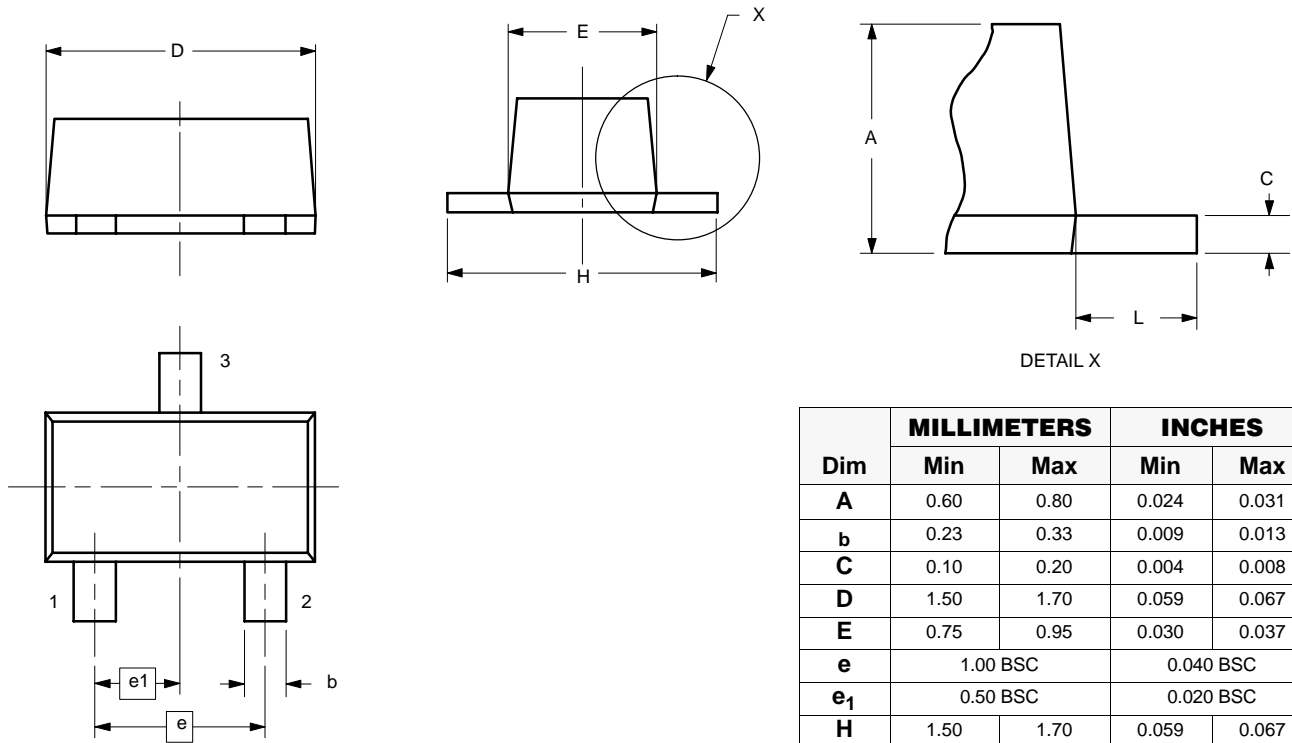


**Normalized Thermal Transient Impedance, Junction-to-Ambient**

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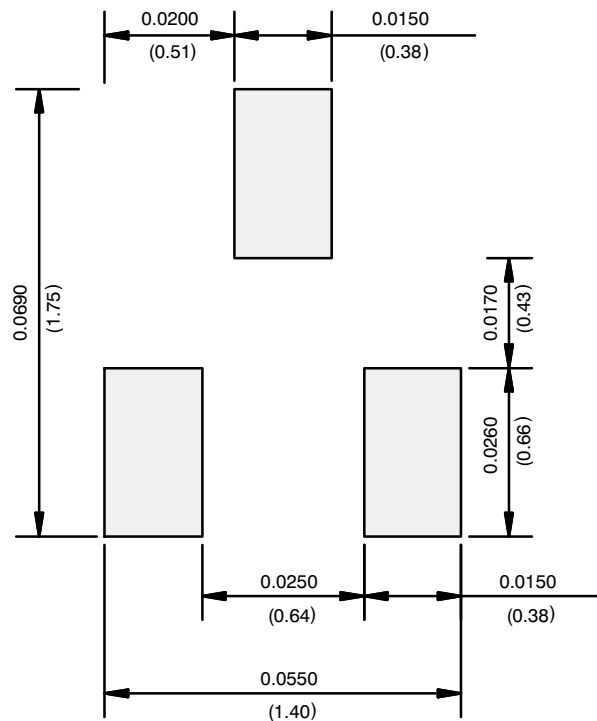
SC89-3



Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
<b>A</b>	0.60	0.80	0.024	0.031
<b>b</b>	0.23	0.33	0.009	0.013
<b>C</b>	0.10	0.20	0.004	0.008
<b>D</b>	1.50	1.70	0.059	0.067
<b>E</b>	0.75	0.95	0.030	0.037
<b>e</b>	1.00 BSC		0.040 BSC	
<b>e<sub>1</sub></b>	0.50 BSC		0.020 BSC	
<b>H</b>	1.50	1.70	0.059	0.067
<b>L</b>	0.30	0.50	0.012	0.020

ECN: S-03946—Rev. B, 09-Jul-01  
DWG: 5869

## RECOMMENDED MINIMUM PADS FOR SC-89: 3-Lead



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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