



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

PRODUCT SUMMARY			
V <sub>DS</sub> (V)	R <sub>DS(on)</sub> (Ω)	I <sub>D</sub> (A) <sup>a, e</sup>	Q <sub>g</sub> (Typ.)
- 20	0.058 at V <sub>GS</sub> = - 4.5 V	- 4	8
	0.094 at V <sub>GS</sub> = - 2.5 V	- 4	

### FEATURES

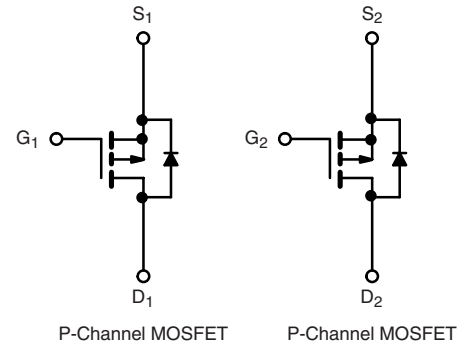
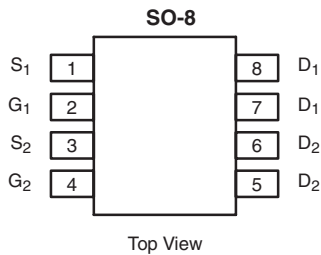
- Halogen-free Option Available
- TrenchFET<sup>®</sup> Power MOSFET
- 100 % R<sub>g</sub> and UIS Tested



**RoHS**  
COMPLIANT

### APPLICATIONS

- Load Switch
- DC/DC Converter



Ordering Information: Si9933CDY-T1-E3 (Lead (Pb)-free)  
Si9933CDY-T1-GE3 (Lead (Pb)-free and Halogen-free)

ABSOLUTE MAXIMUM RATINGS T <sub>A</sub> = 25 °C, unless otherwise noted						
Parameter	Symbol	Limit	Unit			
Drain-Source Voltage	V <sub>DS</sub>	- 20	V			
Gate-Source Voltage	V <sub>GS</sub>	± 12				
Continuous Drain Current (T <sub>J</sub> = 150 °C)	I <sub>D</sub>	T <sub>C</sub> = 25 °C	A			
		T <sub>C</sub> = 70 °C				
		T <sub>A</sub> = 25 °C				
		T <sub>A</sub> = 70 °C				
Pulsed Drain Current (10 μs Pulse Width)	I <sub>DM</sub>	- 20	A			
Source-Drain Current Diode Current	I <sub>S</sub>	T <sub>C</sub> = 25 °C			- 2.5	
		T <sub>A</sub> = 25 °C	- 1.7 <sup>b, c</sup>			
Single Pulse Avalanche Current	L = 0.1 mH	I <sub>AS</sub>			- 6	
Single-Pulse Avalanche Energy		E <sub>AS</sub>	1.8			
Maximum Power Dissipation	P <sub>D</sub>	T <sub>C</sub> = 25 °C			W	
		T <sub>C</sub> = 70 °C				
		T <sub>A</sub> = 25 °C	2 <sup>b, c</sup>			
		T <sub>A</sub> = 70 °C				
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	- 50 to 150	°C			

THERMAL RESISTANCE RATINGS					
Parameter	Symbol	Limit	Unit		
			Typical	Maximum	
Maximum Junction-to-Ambient <sup>b, d</sup>	t ≤ 10 s	R <sub>thJA</sub>	52	62.5	°C/W
Maximum Junction-to-Foot (Drain)	Steady State	R <sub>thJF</sub>	32	40	

Notes:

- Based on T<sub>C</sub> = 25 °C.
- Surface Mounted on 1" x 1" FR4 board.
- t = 10 s.
- Maximum under Steady State conditions is 110 °C/W.
- Package Limited.



SPECIFICATIONS $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Min.	Typ. <sup>a</sup>	Max.	Unit
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$	- 20			V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = -250\text{ }\mu\text{A}$		- 19		mV/°C
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$		3.1			
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	- 0.6		- 1.4	V
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 12\text{ V}$			- 100	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}$			- 1	$\mu\text{A}$
		$V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$			- 10	
On-State Drain Current <sup>b</sup>	$I_{D(on)}$	$V_{DS} \leq -5\text{ V}, V_{GS} = -10\text{ V}$	- 20			A
Drain-Source On-State Resistance <sup>b</sup>	$R_{DS(on)}$	$V_{GS} = -4.5\text{ V}, I_D = -4.8\text{ A}$		0.048	0.058	$\Omega$
		$V_{GS} = -2.5\text{ V}, I_D = -1\text{ A}$		0.075	0.094	
Forward Transconductance <sup>b</sup>	$g_{fs}$	$V_{DS} = -10\text{ V}, I_D = -4.8\text{ A}$		11		S
<b>Dynamic<sup>a</sup></b>						
Input Capacitance	$C_{iss}$	$V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		665		pF
Output Capacitance	$C_{oss}$		140			
Reverse Transfer Capacitance	$C_{rss}$		115			
Total Gate Charge	$Q_g$	$V_{DS} = -10\text{ V}, V_{GS} = -10\text{ V}, I_D = -4.8\text{ A}$		17	26	nC
		$V_{DS} = -10\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -4.8\text{ A}$		8	12	
Gate-Source Charge	$Q_{gs}$	$V_{DS} = -10\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -4.8\text{ A}$		2		nC
Gate-Drain Charge	$Q_{gd}$		3			
Gate Resistance	$R_g$	$f = 1\text{ MHz}$	1.2	6	12	$\Omega$
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -10\text{ V}, R_L = 2.6\text{ }\Omega$ $I_D \cong -3.8\text{ A}, V_{GEN} = -10\text{ V}, R_g = 1\text{ }\Omega$		6	12	ns
Rise Time	$t_r$		15	23		
Turn-Off Delay Time	$t_{d(off)}$		26	39		
Fall Time	$t_f$		9	18		
Turn-On Delay Time	$t_{d(on)}$		21	32		
Rise Time	$t_r$		50	75		
Turn-Off Delay Time	$t_{d(off)}$	$V_{DD} = -10\text{ V}, R_L = 2.6\text{ }\Omega$ $I_D \cong -3.8\text{ A}, V_{GEN} = -4.5\text{ V}, R_g = 1\text{ }\Omega$		29	44	
				13	20	
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Source-Drain Diode Current	$I_S$	$T_C = 25\text{ }^\circ\text{C}$			- 2.5	A
Pulse Diode Forward Current <sup>a</sup>	$I_{SM}$				- 20	
Body Diode Voltage	$V_{SD}$	$I_S = -3.8\text{ A}$		- 0.77	- 1.2	V
Body Diode Reverse Recovery Time	$t_{rr}$	$I_F = -3.8\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$		30	45	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$		17	26	nC	
Reverse Recovery Fall Time	$t_a$		16		ns	
Reverse Recovery Rise Time	$t_b$		14			

Notes:

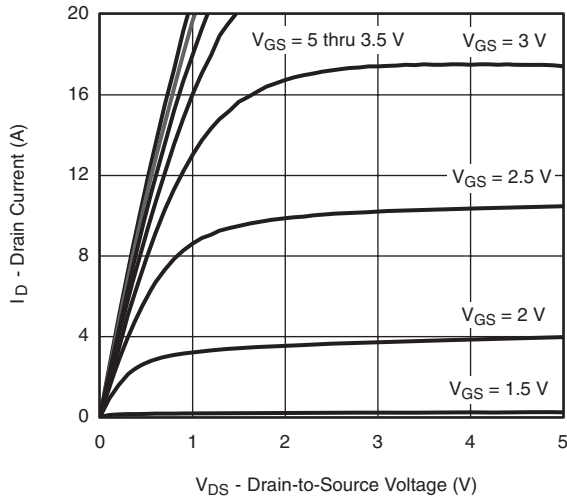
a. Guaranteed by design, not subject to production testing.

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

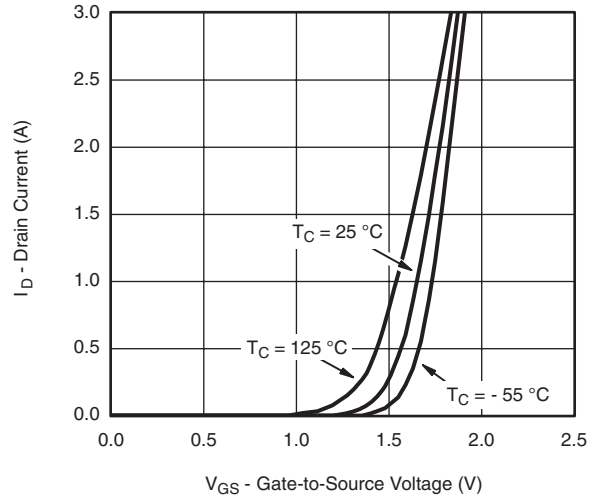
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



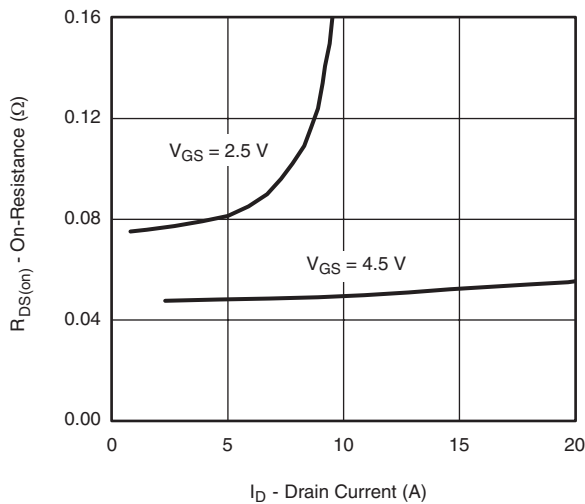
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



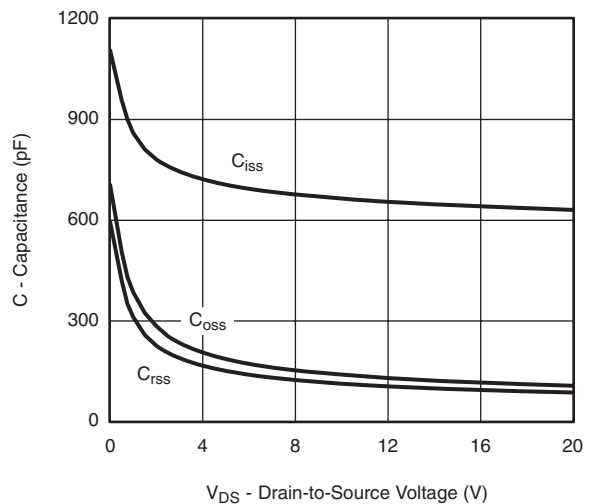
**Output Characteristics**



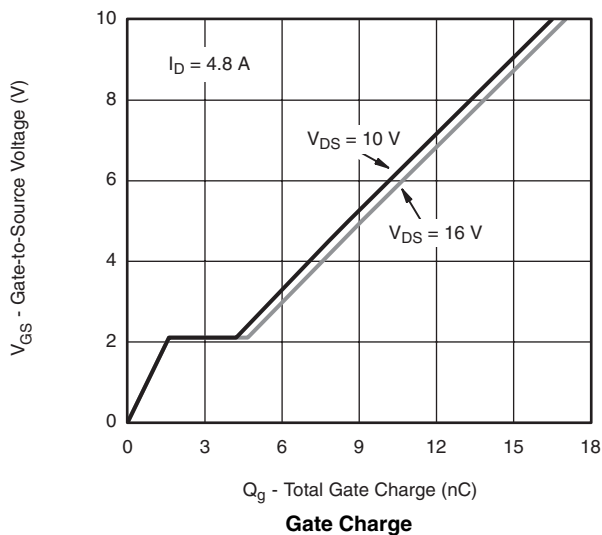
**Transfer Characteristics**



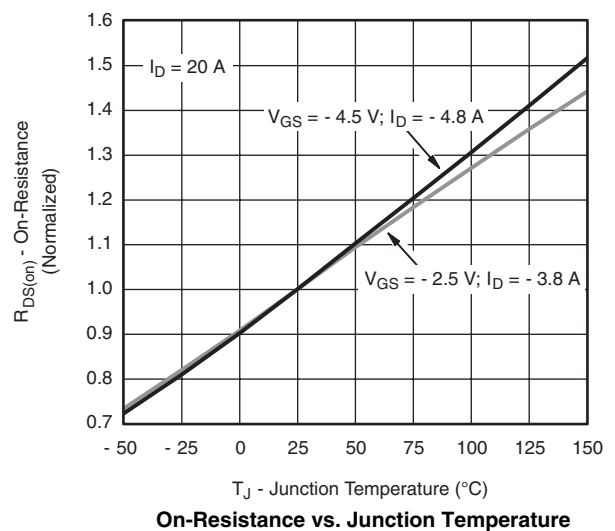
**On-Resistance vs. Drain Current and Gate Voltage**



**Capacitance**



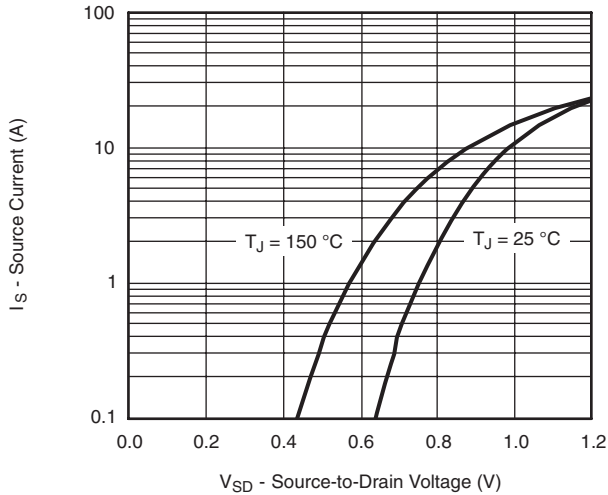
**Gate Charge**



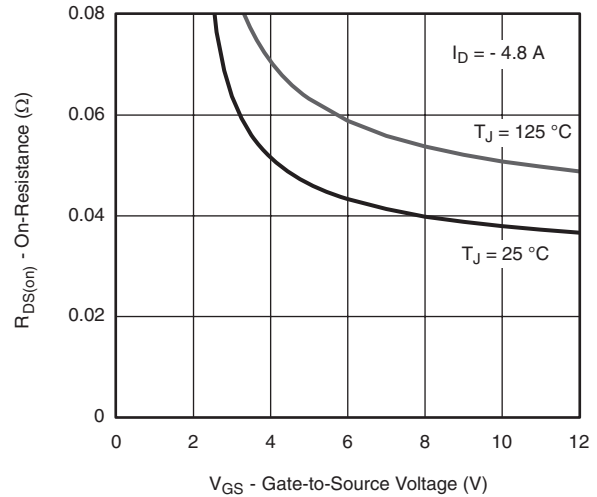
**On-Resistance vs. Junction Temperature**



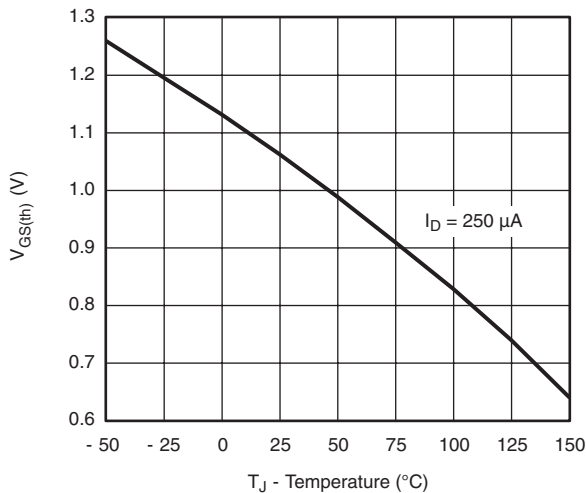
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



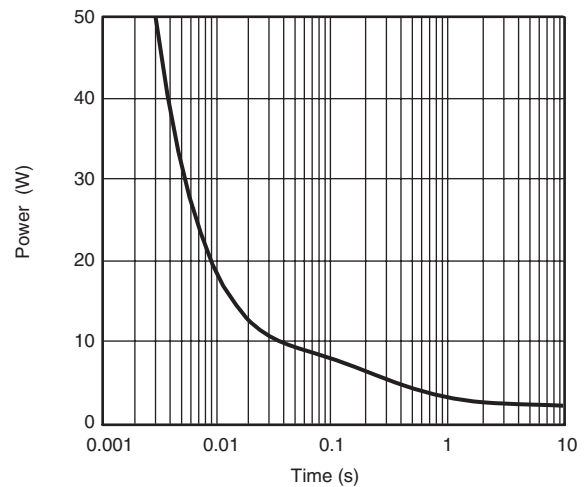
Source-Drain Diode Forward Voltage



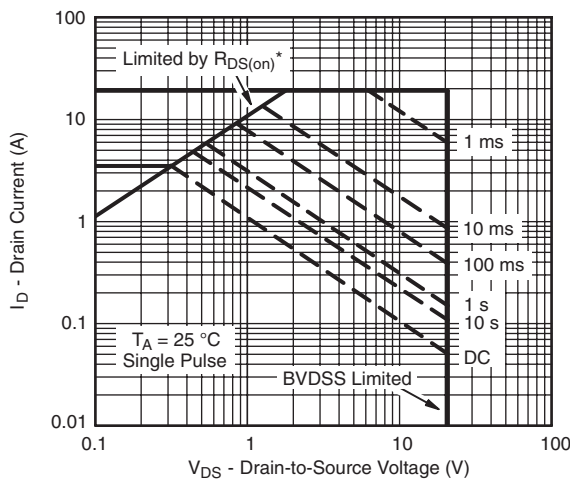
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



Single Pulse Power, Junction-to-Ambient

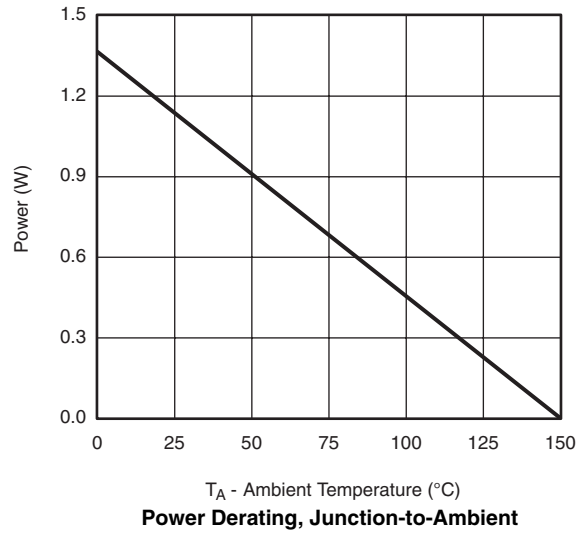
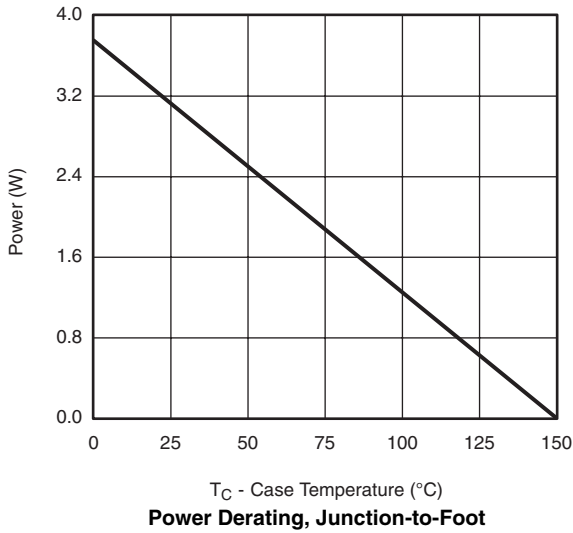
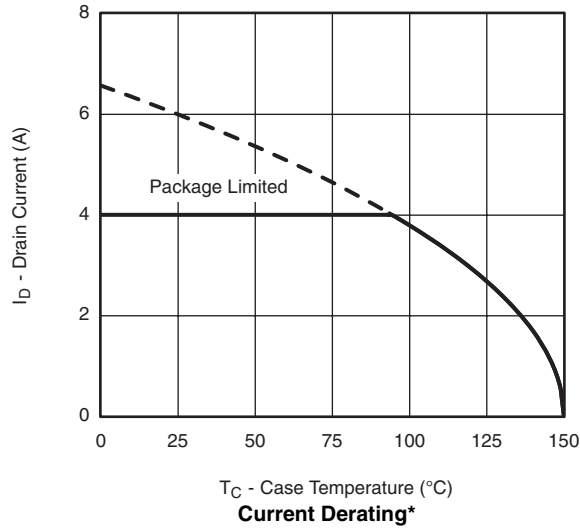


\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

Safe Operating Area, Junction-to-Ambient



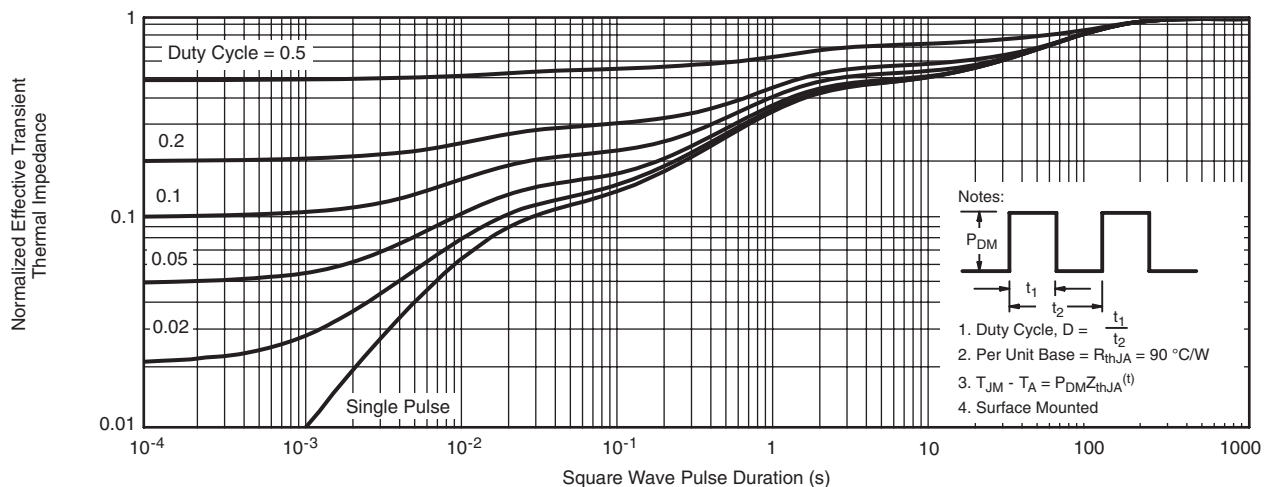
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



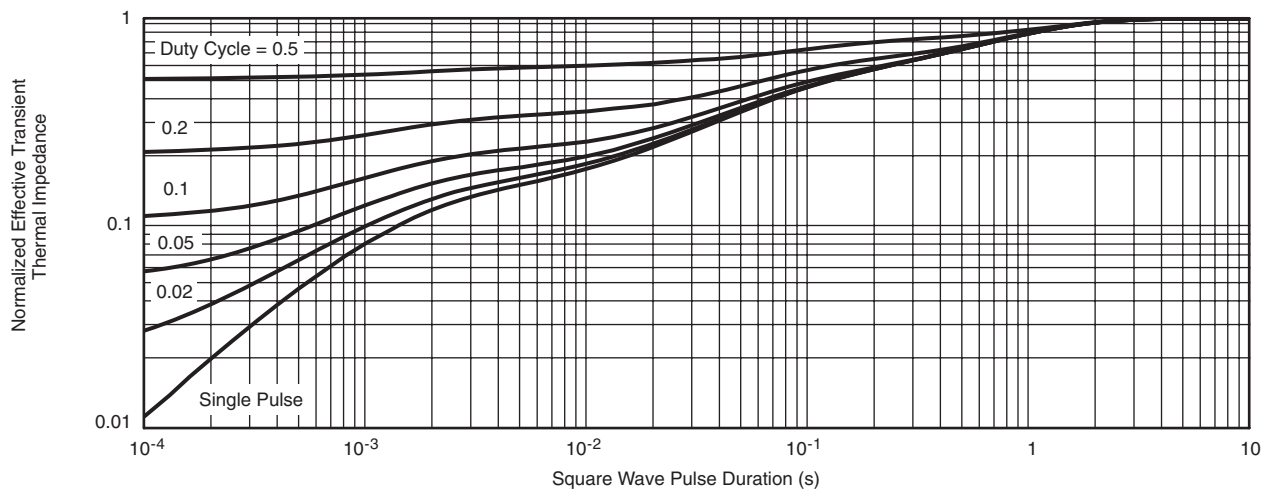
\* The power dissipation  $P_D$  is based on  $T_{J(max)} = 150$  °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package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



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



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



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

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## SOIC (NARROW): 8-LEAD

JEDEC Part Number: MS-012



DIM	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	1.35	1.75	0.053	0.069
A <sub>1</sub>	0.10	0.20	0.004	0.008
B	0.35	0.51	0.014	0.020
C	0.19	0.25	0.0075	0.010
D	4.80	5.00	0.189	0.196
E	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
H	5.80	6.20	0.228	0.244
h	0.25	0.50	0.010	0.020
L	0.50	0.93	0.020	0.037
q	0°	8°	0°	8°
S	0.44	0.64	0.018	0.026
ECN: C-06527-Rev. I, 11-Sep-06				
DWG: 5498				

## RECOMMENDED MINIMUM PADS FOR SO-8



Recommended Minimum Pads  
Dimensions in Inches/(mm)

[Return to Index](#)





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