

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

PRODUCT SUMMARY			
V _{DS} (V)	R _{DS(on)} (Ω)	I _D (A) ^{a, e}	Q _g (Typ.)
- 20	0.058 at V _{GS} = - 4.5 V	- 4	8
	0.094 at V _{GS} = - 2.5 V	- 4	

FEATURES

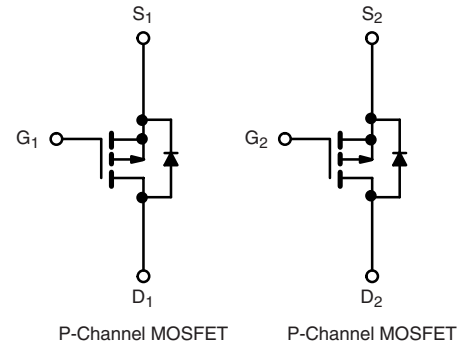
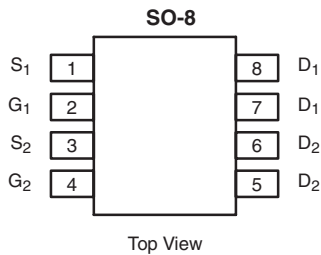
- Halogen-free Option Available
- TrenchFET[®] Power MOSFET
- 100 % R_g and UIS Tested



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 _A = 25 °C, unless otherwise noted						
Parameter	Symbol	Limit	Unit			
Drain-Source Voltage	V _{DS}	- 20	V			
Gate-Source Voltage	V _{GS}	± 12				
Continuous Drain Current (T _J = 150 °C)	I _D	T _C = 25 °C	- 4 ^e			
		T _C = 70 °C	- 4 ^e			
		T _A = 25 °C	- 4 ^{b, c, e}			
		T _A = 70 °C	- 3.8 ^{b, c}			
Pulsed Drain Current (10 μs Pulse Width)	I _{DM}	- 20	A			
Source-Drain Current Diode Current	I _S	T _C = 25 °C			- 2.5	
		T _A = 25 °C			- 1.7 ^{b, c}	
Single Pulse Avalanche Current	I _{AS}	- 6	mJ			
Single-Pulse Avalanche Energy	E _{AS}	1.8				
Maximum Power Dissipation	P _D	T _C = 25 °C	3.1			
		T _C = 70 °C	2			
		T _A = 25 °C	2 ^{b, c}			
		T _A = 70 °C	1.28 ^{b, c}			
Operating Junction and Storage Temperature Range	T _J , T _{stg}	- 50 to 150	°C			

THERMAL RESISTANCE RATINGS				
Parameter	Symbol	Limit	Unit	
			Typical	Maximum
Maximum Junction-to-Ambient ^{b, d}	R _{thJA}	52	62.5	°C/W
Maximum Junction-to-Foot (Drain)	R _{thJF}	32	40	

Notes:

- Based on T_C = 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. ^a	Max.	Unit	
Static							
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/ $^\circ\text{C}$	
$V_{GS(th)}$ 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	μA	
		$V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$			- 10		
On-State Drain Current ^b	$I_{D(on)}$	$V_{DS} \leq -5\text{ V}, V_{GS} = -10\text{ V}$	- 20			A	
Drain-Source On-State Resistance ^b	$R_{DS(on)}$	$V_{GS} = -4.5\text{ V}, I_D = -4.8\text{ A}$		0.048	0.058	Ω	
		$V_{GS} = -2.5\text{ V}, I_D = -1\text{ A}$		0.075	0.094		
Forward Transconductance ^b	g_{fs}	$V_{DS} = -10\text{ V}, I_D = -4.8\text{ A}$		11		S	
Dynamic^a							
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			
Gate-Drain Charge	Q_{gd}			3			
Gate Resistance	R_g	$f = 1\text{ MHz}$	1.2	6	12	Ω	
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	$t_{d(on)}$		$V_{DD} = -10\text{ V}, R_L = 2.6\text{ }\Omega$ $I_D \cong -3.8\text{ A}, V_{GEN} = -4.5\text{ V}, R_g = 1\text{ }\Omega$		21		32
Rise Time	t_r				50		75
Turn-Off Delay Time	$t_{d(off)}$			29	44		
Fall Time	t_f			13	20		
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I_S	$T_C = 25\text{ }^\circ\text{C}$			- 2.5	A	
Pulse Diode Forward Current ^a	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:

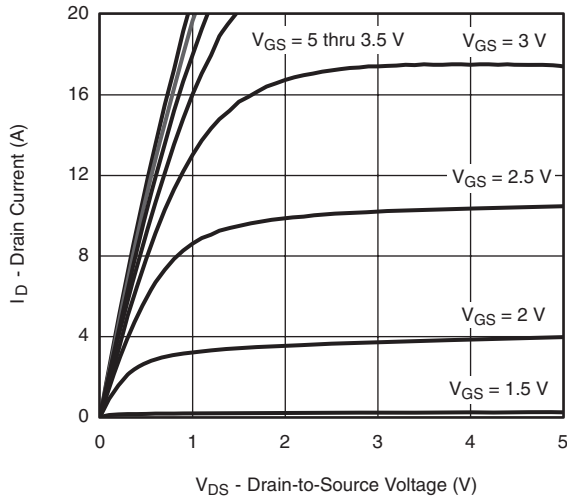
a. Guaranteed by design, not subject to production testing.

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

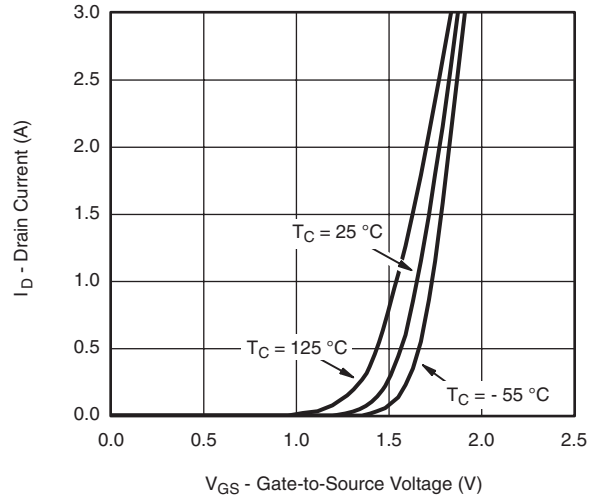
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



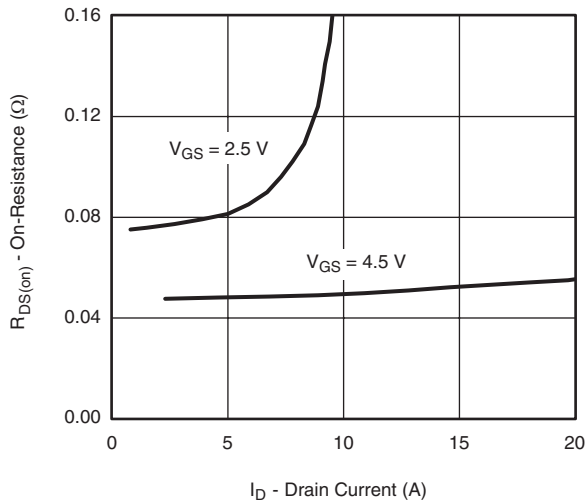
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



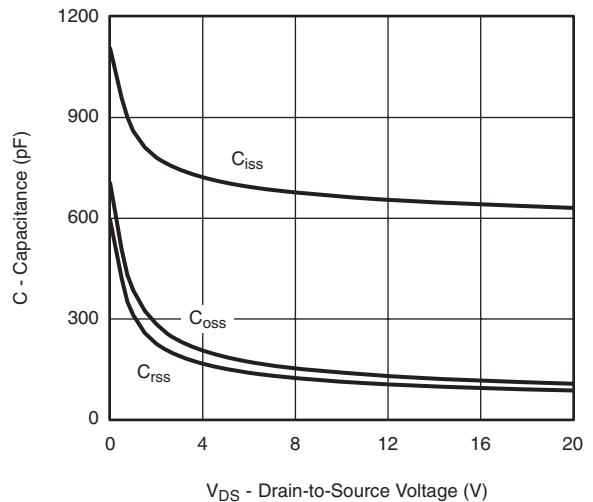
Output Characteristics



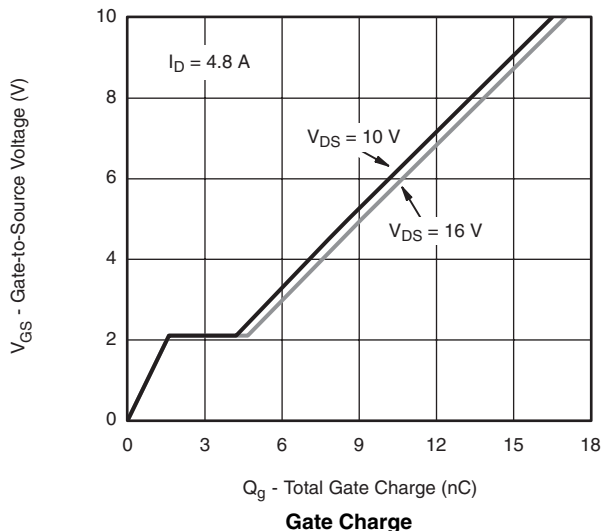
Transfer Characteristics



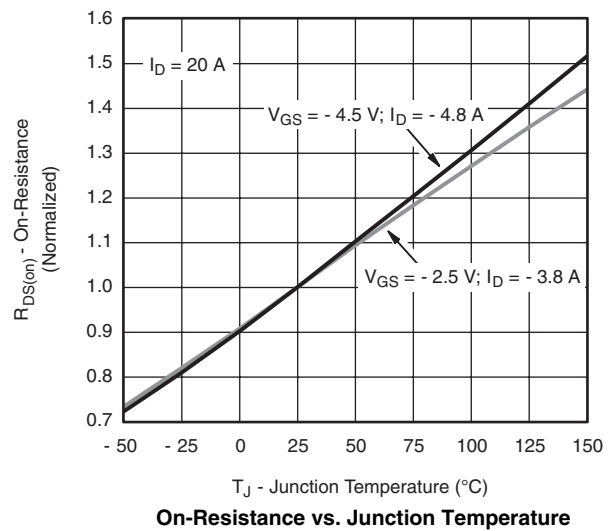
On-Resistance vs. Drain Current and Gate Voltage



Capacitance



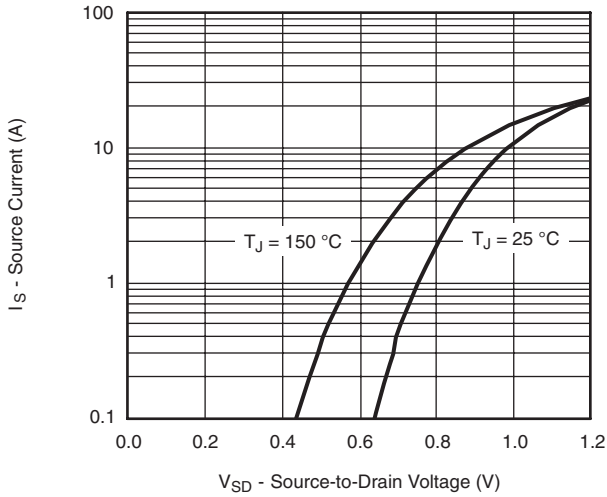
Gate Charge



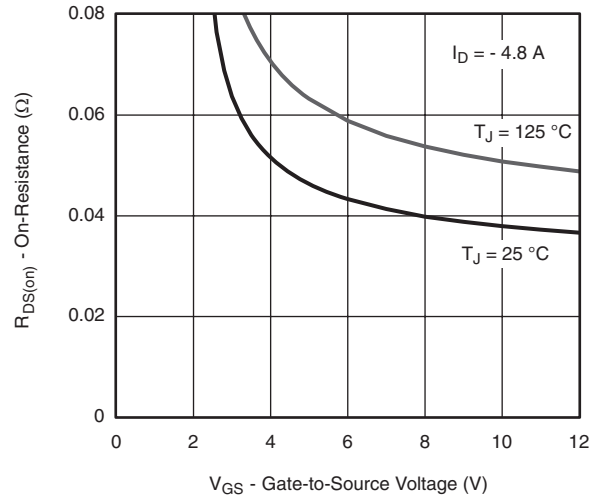
On-Resistance vs. Junction Temperature



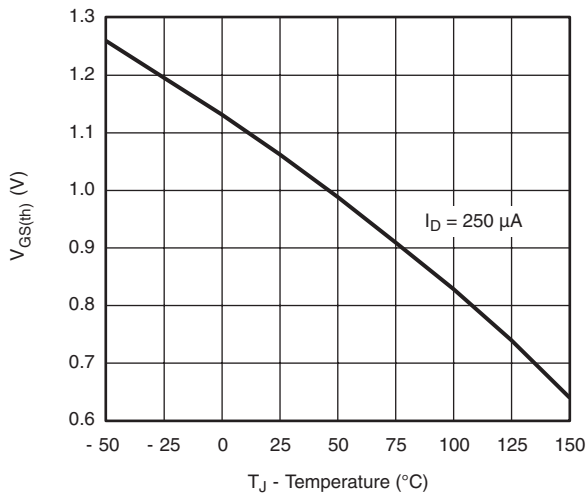
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



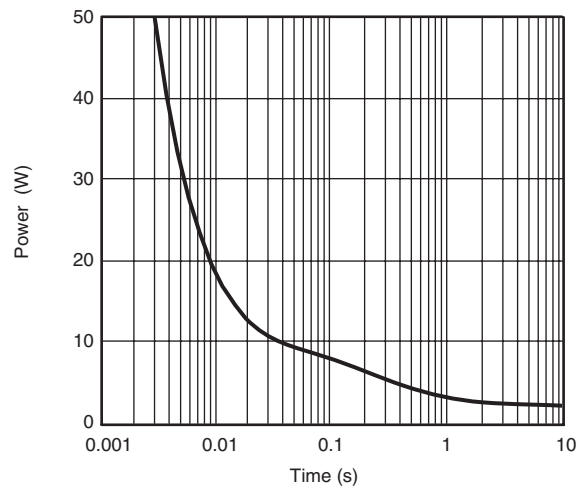
Source-Drain Diode Forward Voltage



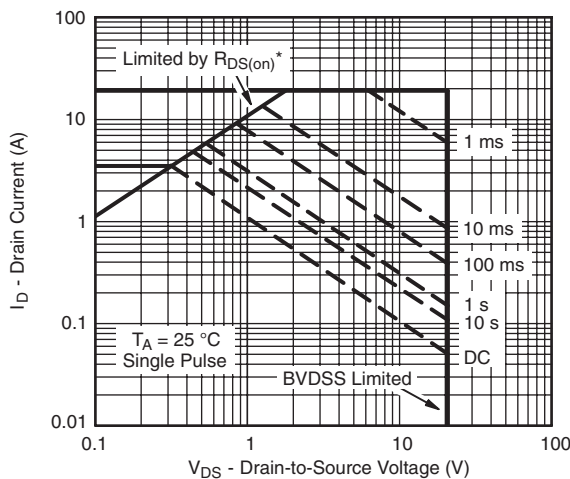
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



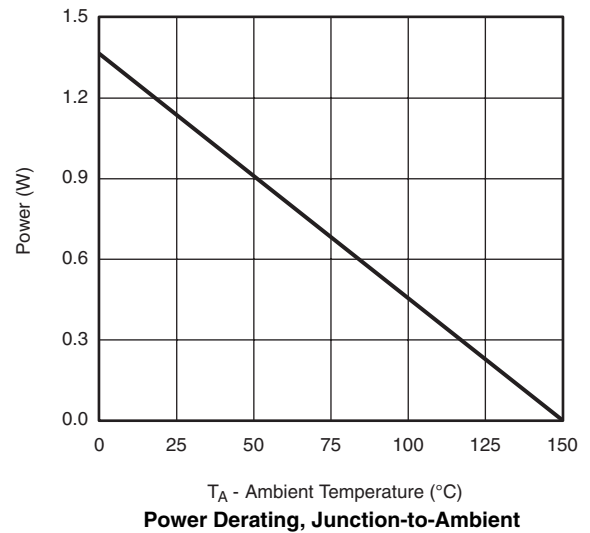
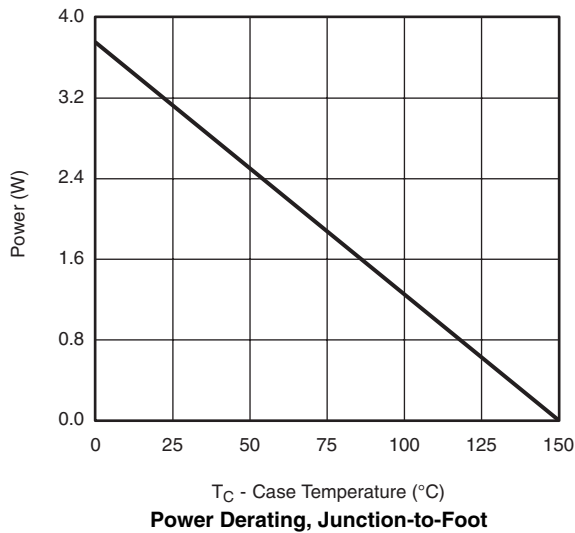
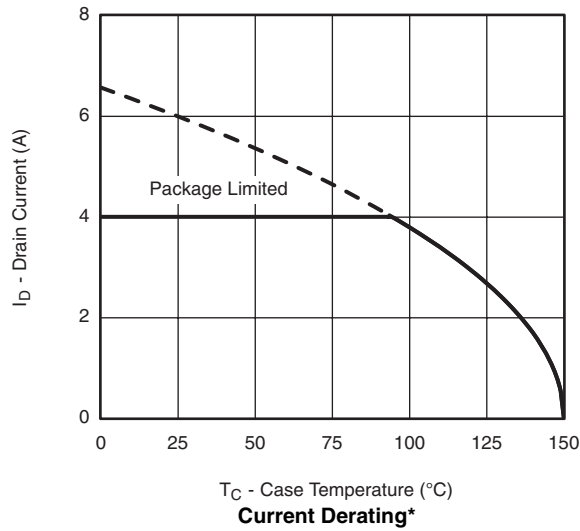
Single Pulse Power, Junction-to-Ambient



* $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified
Safe Operating Area, Junction-to-Ambient



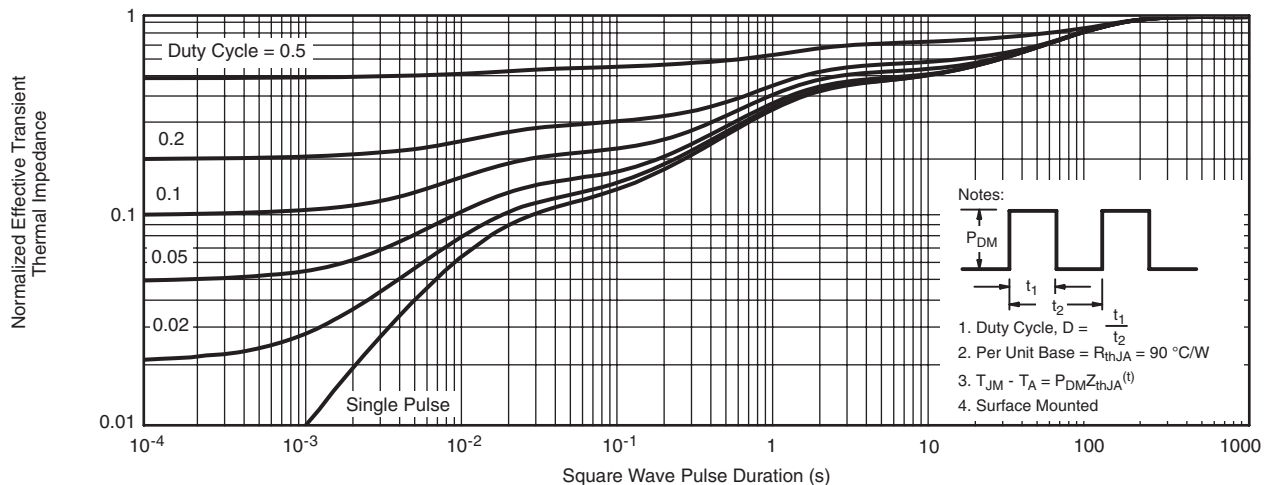
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



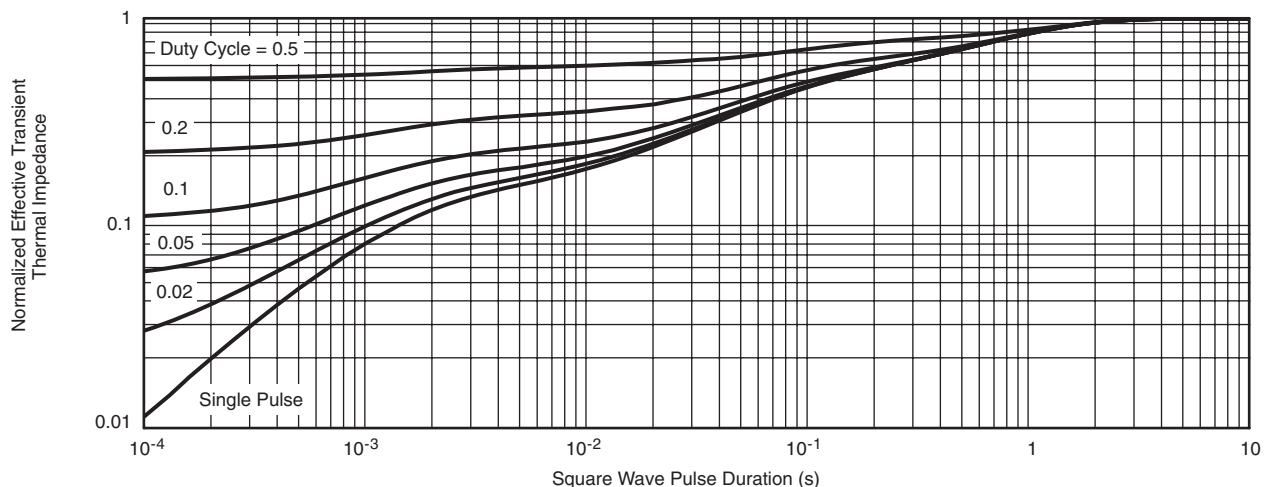
* The power dissipation P_D is based on $T_{J(max)} = 150$ °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.



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 ₁	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)

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