

## N-Channel 40-V (D-S) MOSFET

PRODUCT SUMMARY			
V <sub>DS</sub> (V)	R <sub>DS(on)</sub> (Ω)	I <sub>D</sub> (A) <sup>a</sup>	Q <sub>g</sub> (Typ.)
40	0.0038 at V <sub>GS</sub> = 10 V	33	37.5 nC
	0.0045 at V <sub>GS</sub> = 4.5 V	31	

### FEATURES

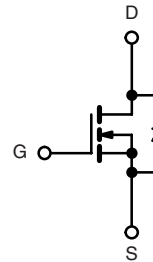
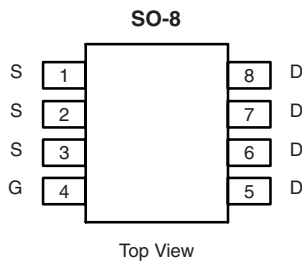
- Halogen-free According to IEC 61249-2-21 Available
- TrenchFET<sup>®</sup> Gen II Power MOSFET
- 100 % R<sub>g</sub> and UIS Tested



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

### APPLICATIONS

- Secondary Rectification
- Point of Load



Ordering Information: Si4456DY-T1-E3 (Lead (Pb)-free)  
Si4456DY-T1-GE3 (Lead (Pb)-free and Halogen-free)

N-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS T <sub>A</sub> = 25 °C, unless otherwise noted			
Parameter	Symbol	Limit	Unit
Drain-Source Voltage	V <sub>DS</sub>	40	V
Gate-Source Voltage	V <sub>GS</sub>	± 20	V
Continuous Drain Current (T <sub>J</sub> = 150 °C)	T <sub>C</sub> = 25 °C	33	A
	T <sub>C</sub> = 70 °C	27	
	T <sub>A</sub> = 25 °C	23 <sup>b, c</sup>	
	T <sub>A</sub> = 70 °C	18 <sup>b, c</sup>	
Pulsed Drain Current	I <sub>DM</sub>	70	A
Continuous Source-Drain Diode Current	T <sub>C</sub> = 25 °C	7.0	A
	T <sub>A</sub> = 25 °C	3.0 <sup>b, c</sup>	
Avalanche Current	I <sub>AS</sub>	40	A
Single Pulse Avalanche Energy	E <sub>AS</sub>	80	mJ
Maximum Power Dissipation	T <sub>C</sub> = 25 °C	7.8	W
	T <sub>C</sub> = 70 °C	5.0	
	T <sub>A</sub> = 25 °C	3.5 <sup>b, c</sup>	
	T <sub>A</sub> = 70 °C	2.2 <sup>b, c</sup>	
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	- 55 to 150	°C

THERMAL RESISTANCE RATINGS					
Parameter	Symbol	Typical	Maximum	Unit	
Maximum Junction-to-Ambient <sup>b, d</sup>	R <sub>thJA</sub>	29	35	°C/W	
Maximum Junction-to-Foot (Drain)	R <sub>thJF</sub>	13	16		

Notes:

- Based on T<sub>C</sub> = 25 °C.
- Surface Mounted on 1" x 1" FR4 board.
- t = 5 s.
- Maximum under steady state conditions is 80 °C/W.

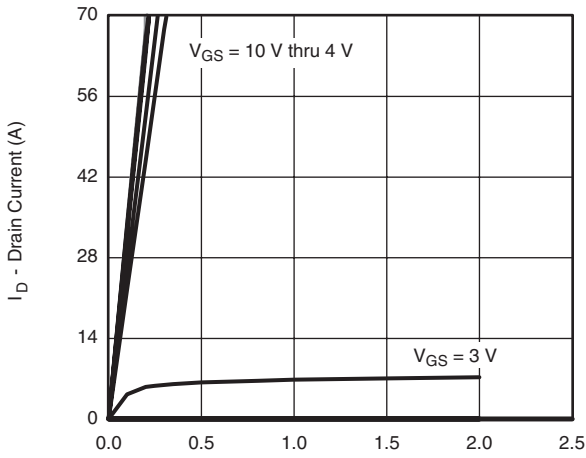
<b>SPECIFICATIONS</b> $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	40			V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = 250\text{ }\mu\text{A}$		54		mV/ $^\circ\text{C}$
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$			-7		
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	1.5		2.8	V
Gate-Source Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}$			1	$\mu\text{A}$
		$V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$			10	
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} \geq 5\text{ V}, V_{GS} = 10\text{ V}$	30			A
Drain-Source On-State Resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 20\text{ A}$		0.0031	0.0038	$\Omega$
		$V_{GS} = 4.5\text{ V}, I_D = 15\text{ A}$		0.0037	0.0045	
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = 15\text{ V}, I_D = 20\text{ A}$		110		S
<b>Dynamic<sup>b</sup></b>						
Input Capacitance	$C_{iss}$	$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		5670		pF
Output Capacitance	$C_{oss}$			621		
Reverse Transfer Capacitance	$C_{rss}$			287		
Total Gate Charge	$Q_g$	$V_{DS} = 20\text{ V}, V_{GS} = 10\text{ V}, I_D = 20\text{ A}$		81	122	nC
				37.5	57	
Gate-Source Charge	$Q_{gs}$	$V_{DS} = 20\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 20\text{ A}$		17		nC
Gate-Drain Charge	$Q_{gd}$			11		
Gate Resistance	$R_g$		$f = 1\text{ MHz}$		1.05	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 20\text{ V}, R_L = 2\text{ }\Omega$ $I_D \cong 10\text{ A}, V_{GEN} = 4.5\text{ V}, R_g = 1\text{ }\Omega$		145	220	ns
Rise Time	$t_r$			208	320	
Turn-Off Delay Time	$t_{d(off)}$			56	85	
Fall Time	$t_f$			15	23	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 20\text{ V}, R_L = 2\text{ }\Omega$ $I_D \cong 10\text{ A}, V_{GEN} = 10\text{ V}, R_g = 1\text{ }\Omega$		21	32	ns
Rise Time	$t_r$			58	90	
Turn-Off Delay Time	$t_{d(off)}$			55	85	
Fall Time	$t_f$			8	15	
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Source-Drain Diode Current	$I_S$	$T_C = 25\text{ }^\circ\text{C}$			7	A
Pulse Diode Forward Current <sup>a</sup>	$I_{SM}$				70	
Body Diode Voltage	$V_{SD}$	$I_S = 3\text{ A}$		0.71	1.1	V
Body Diode Reverse Recovery Time	$t_{rr}$	$I_F = 13\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$		38	60	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$			42	65	nC
Reverse Recovery Fall Time	$t_a$			21		ns
Reverse Recovery Rise Time	$t_b$			17		

## Notes:

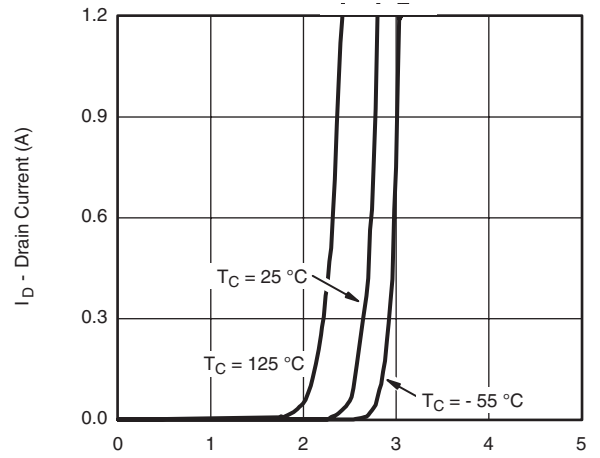
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
b. Guaranteed by design, not subject to production testing.

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.

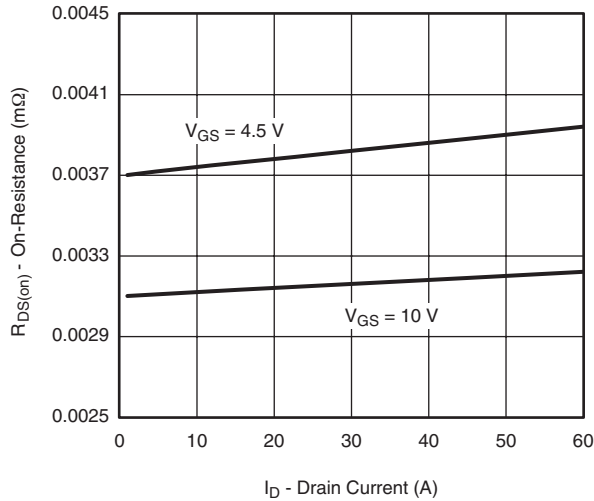
**TYPICAL CHARACTERISTICS**  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted



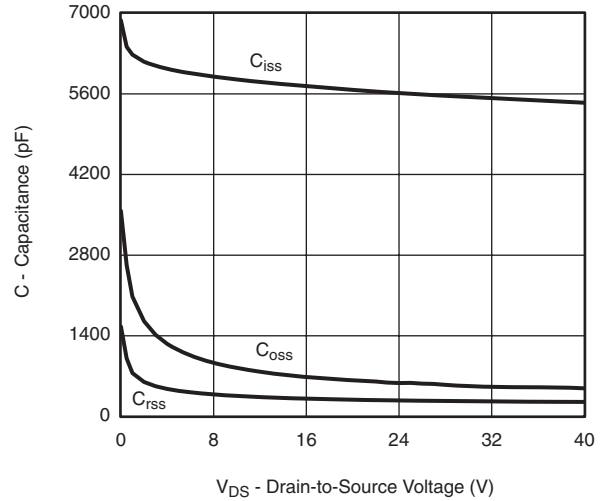
$V_{GS} = 10\text{ V thru } 4\text{ V}$   
 $V_{GS} = 3\text{ V}$   
**Output Characteristics**



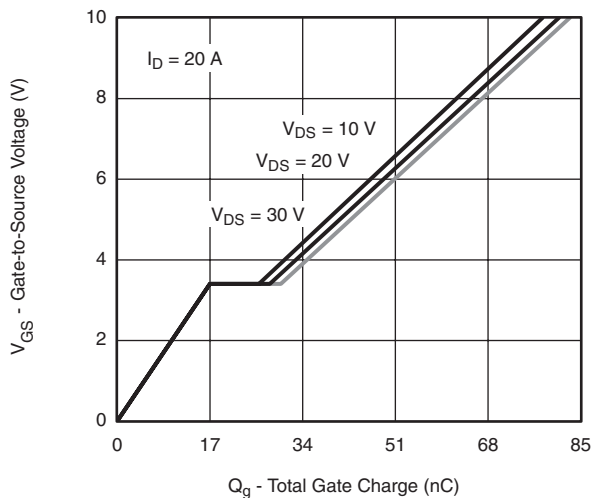
$T_C = 25\text{ }^\circ\text{C}$   
 $T_C = 125\text{ }^\circ\text{C}$   
 $T_C = -55\text{ }^\circ\text{C}$   
**Transfer Characteristics**



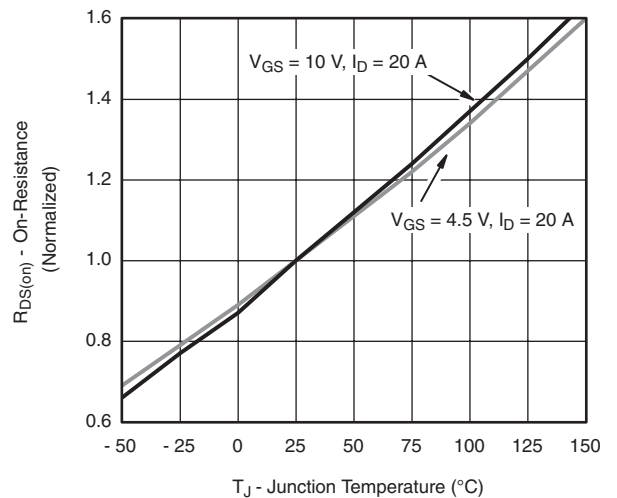
$V_{GS} = 4.5\text{ V}$   
 $V_{GS} = 10\text{ V}$   
**On-Resistance vs. Drain Current and Gate Voltage**



$C_{iss}$   
 $C_{oss}$   
 $C_{rss}$   
**Capacitance**

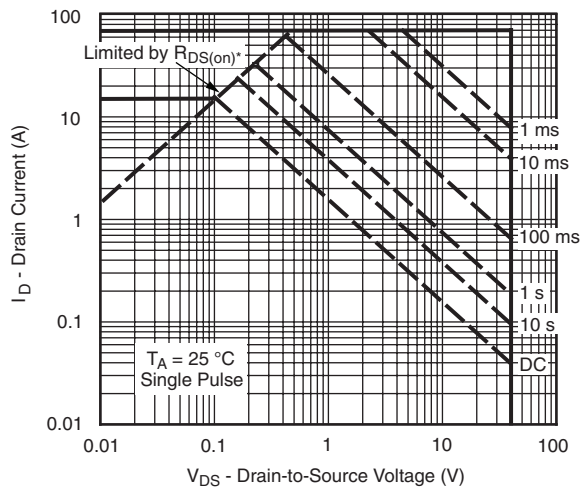
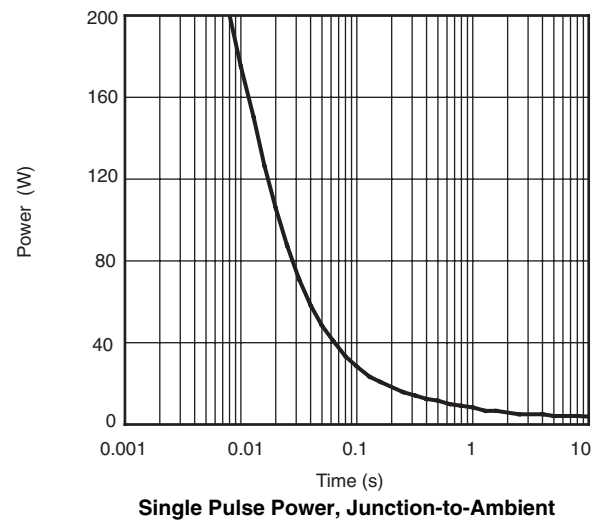
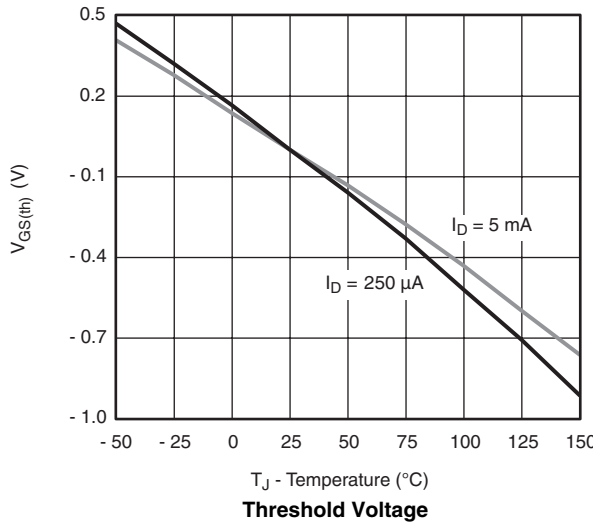
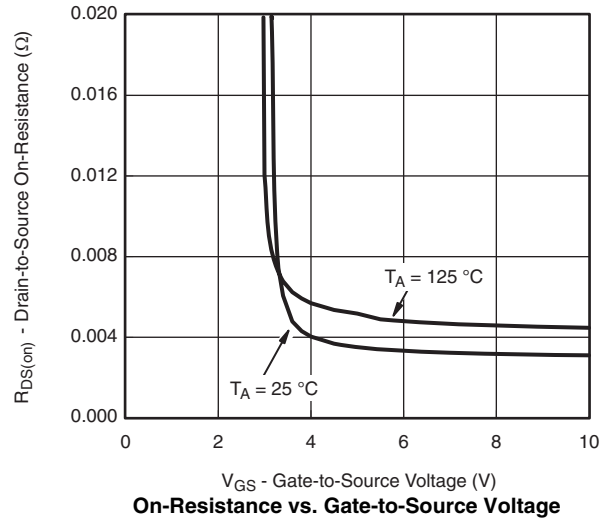
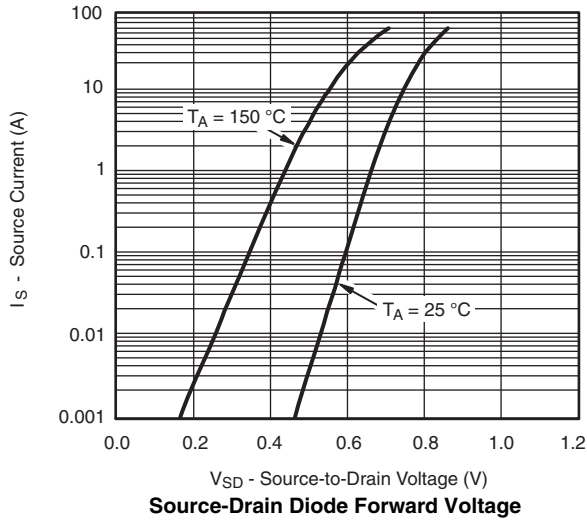


$I_D = 20\text{ A}$   
 $V_{DS} = 10\text{ V}$   
 $V_{DS} = 20\text{ V}$   
 $V_{DS} = 30\text{ V}$   
**Gate Charge**



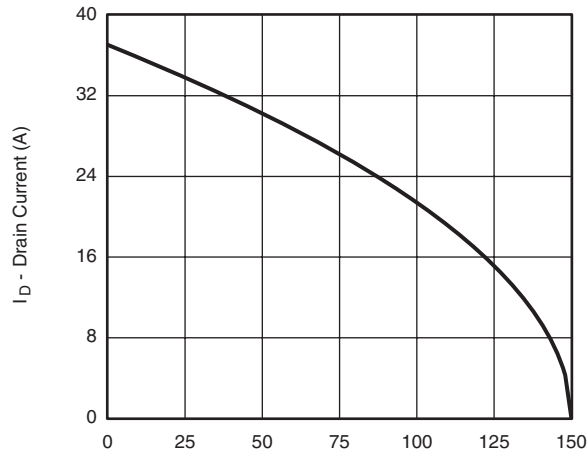
$V_{GS} = 10\text{ V}, I_D = 20\text{ A}$   
 $V_{GS} = 4.5\text{ V}, I_D = 20\text{ A}$   
**On-Resistance vs. Junction Temperature**

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



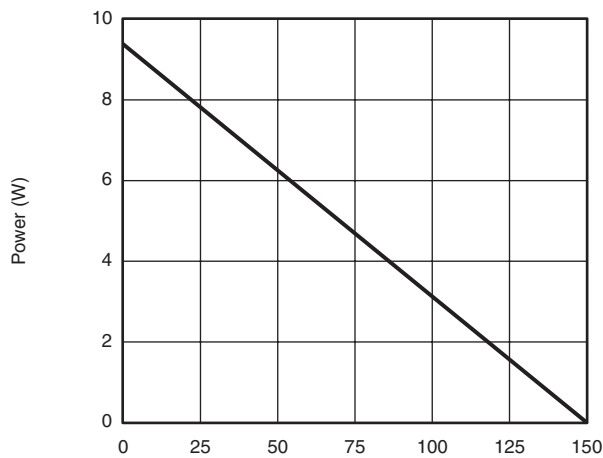
\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

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



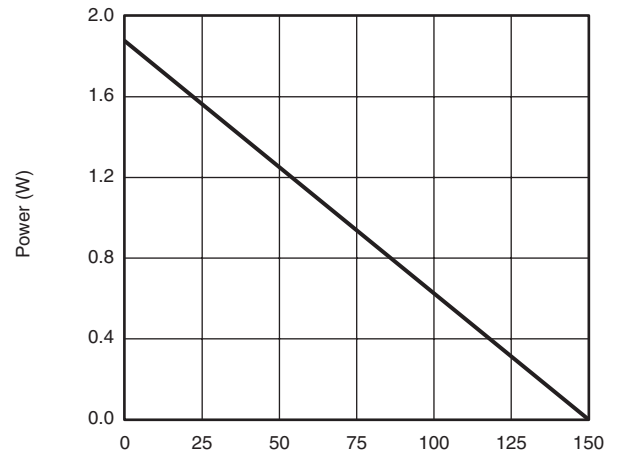
$T_C$  - Case Temperature (°C)

**Current Derating\***



$T_C$  - Case Temperature (°C)

**Power, Junction-to-Foot**

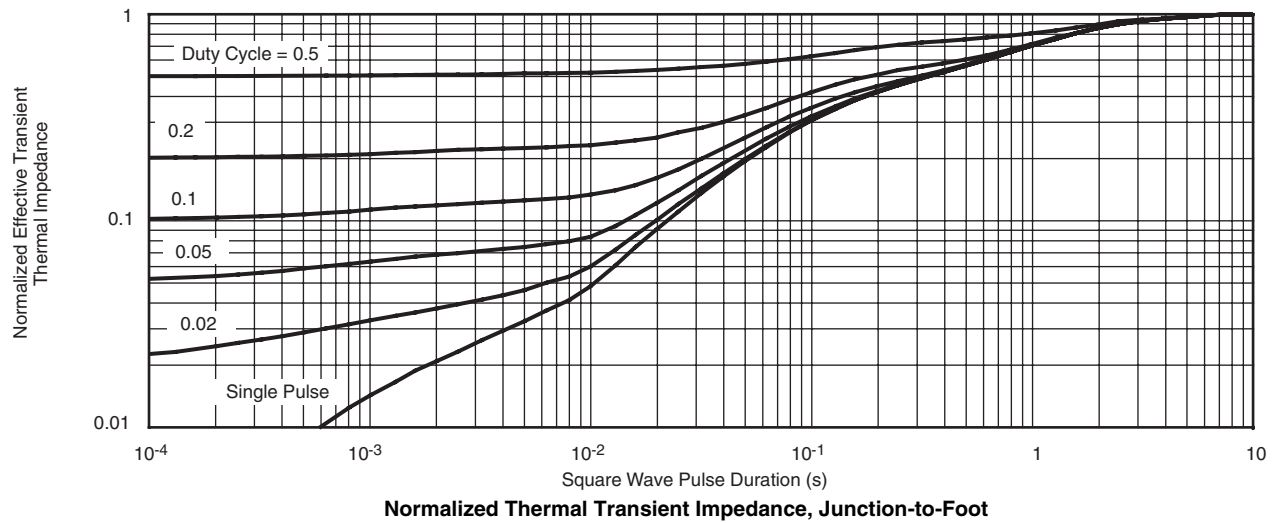
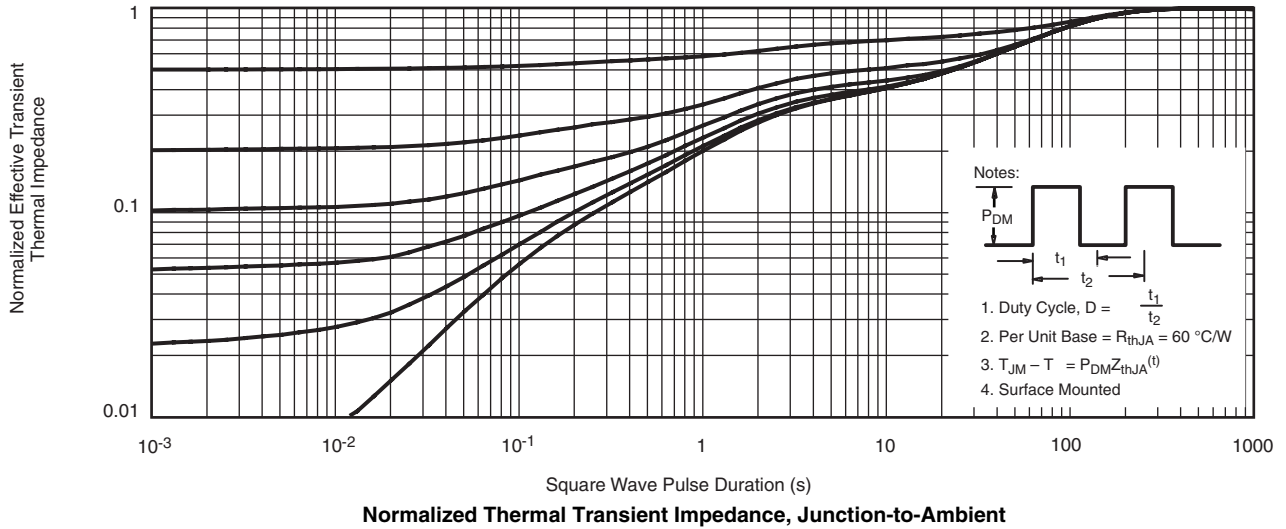


$T_A$  - Ambient Temperature (°C)

**Power, Junction-to-Ambient**

\* 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



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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)

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