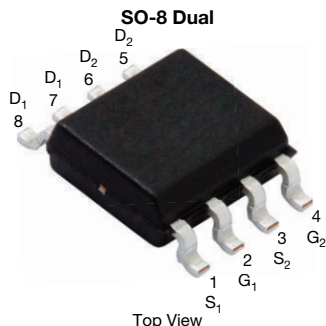


# N- and P-Channel 60 V (D-S) MOSFET



## FEATURES

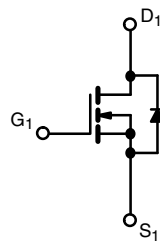
- TrenchFET® power MOSFET
- 100 %  $R_g$  and UIS tested
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



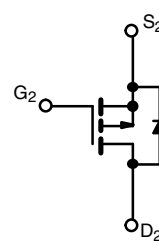
**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**  
Available

## APPLICATIONS

- CCFL Inverter



N-Channel MOSFET



P-Channel MOSFET

## PRODUCT SUMMARY

	N-CHANNEL	P-CHANNEL
$V_{DS}$ (V)	60	-60
$R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = \pm 10$ V	0.058	0.120
$R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = \pm 4.5$ V	0.072	0.150
$Q_g$ typ. (nC)	6	8
$I_D$ (A) <sup>a</sup>	5.3	-3.9
Configuration	N- and p-pair	

## ORDERING INFORMATION

Package	SO-8
Lead (Pb)-free	Si4559ADY-T1-E3
Lead (Pb)-free and halogen-free	Si4559ADY-T1-GE3

## ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)

PARAMETER	SYMBOL	N-CHANNEL	P-CHANNEL	UNIT
Drain-source voltage	$V_{DS}$	60	-60	V
Gate-source voltage	$V_{GS}$	$\pm 20$	$\pm 20$	
Continuous drain current ( $T_J = 150^\circ\text{C}$ )	$I_D$	5.3	-3.9	A
		4.3	-3.2	
		4.3 <sup>b, c</sup>	-3 <sup>b, c</sup>	
		3.4 <sup>b, c</sup>	-2.4 <sup>b, c</sup>	
Pulsed drain current (10 $\mu\text{s}$ pulse width)	$I_{DM}$	20	-25	
Source drain current diode current	$I_S$	2.6	-2.8	
		1.7 <sup>b, c</sup>	-1.7 <sup>b, c</sup>	
Pulsed source-drain current	$I_{SM}$	20	-25	
Single pulse avalanche current	$I_{AS}$	11	15	
Single pulse avalanche energy	$E_{AS}$	6.1	11	mJ
Maximum power dissipation	$P_D$	3.1	3.4	W
		2	2.2	
		2 <sup>b, c</sup>	2 <sup>b, c</sup>	
		1.3 <sup>b, c</sup>	1.3 <sup>b, c</sup>	
Operating junction and storage temperature range	$T_J, T_{stg}$	-55 to +150		$^\circ\text{C}$

## THERMAL RESISTANCE RATINGS

PARAMETER		SYMBOL	N-CHANNEL		P-CHANNEL		UNIT
			TYP.	MAX.	TYP.	MAX.	
Maximum junction-to-ambient <sup>b, d</sup>	t ≤ 10 s	R <sub>thJA</sub>	55	62.5	53	62.5	°C/W
Maximum junction-to-foot (drain)	Steady state	R <sub>thJF</sub>	33	40	30	37	

### Notes

- Based on  $T_C = 25^\circ\text{C}$
- Surface mounted on 1" x 1" FR4 board
- $t = 10$  s
- Maximum under steady state conditions is 110  $^\circ\text{C/W}$  for N-channel and P-channel



SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP. <sup>a</sup>	MAX.	UNIT
Static							
Drain-source breakdown voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	N-Ch	60	-	-	V
		V <sub>GS</sub> = 0 V, I <sub>D</sub> = -250 μA	P-Ch	-60	-	-	
V <sub>DS</sub> temperature coefficient	ΔV <sub>DS</sub> /T <sub>J</sub>	I <sub>D</sub> = 250 μA	N-Ch	-	55	-	mV
		I <sub>D</sub> = -250 μA	P-Ch	-	-50	-	
V <sub>GS(th)</sub> temperature coefficient	ΔV <sub>GS(th)</sub> /T <sub>J</sub>	I <sub>D</sub> = 250 μA	N-Ch	-	-6	-	
		I <sub>D</sub> = -250 μA	P-Ch	-	4	-	
Gate threshold voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	N-Ch	1	-	3	V
		V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μA	P-Ch	-1	-	-3	
Gate-body leakage	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 20 V	N-Ch	-	-	100	nA
			P-Ch	-	-	-100	
Zero gate voltage drain current	I <sub>DSS</sub>	V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V	N-Ch	-	-	1	μA
		V <sub>DS</sub> = -60 V, V <sub>GS</sub> = 0 V	P-Ch	-	-	-1	
		V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 55 °C	N-Ch	-	-	10	
		V <sub>DS</sub> = -60 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 55 °C	P-Ch	-	-	-10	
On-state drain current <sup>b</sup>	I <sub>D(on)</sub>	V <sub>DS</sub> ≥ 5 V, V <sub>GS</sub> = 10 V	N-Ch	20	-	-	A
		V <sub>DS</sub> ≤ -5 V, V <sub>GS</sub> = -10 V	P-Ch	-25	-	-	
Drain-source on-state resistance <sup>b</sup>	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 4.3 A	N-Ch	-	0.046	0.058	Ω
		V <sub>GS</sub> = -10 V, I <sub>D</sub> = -3.1 A	P-Ch	-	0.100	0.120	
		V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 3.9 A	N-Ch	-	0.059	0.072	
		V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -0.2 A	P-Ch	-	0.126	0.150	
Forward transconductance <sup>b</sup>	g <sub>fs</sub>	V <sub>DS</sub> = 15 V, I <sub>D</sub> = 4.3 A	N-Ch	-	15	-	S
		V <sub>DS</sub> = -15 V, I <sub>D</sub> = -3.1 A	P-Ch	-	8.5	-	
Dynamic <sup>a</sup>							
Input capacitance	C <sub>iss</sub>	N-Channel V <sub>DS</sub> = 15 V, V <sub>GS</sub> = 0 V, f = 1 MHz  P-Channel V <sub>DS</sub> = -15 V, V <sub>GS</sub> = 0 V, f = 1 MHz	N-Ch	-	665	-	pF
Output capacitance	C <sub>oss</sub>		P-Ch	-	650	-	
			N-Ch	-	75	-	
Reverse transfer capacitance	C <sub>rss</sub>		P-Ch	-	95	-	
			N-Ch	-	40	-	
			P-Ch	-	60	-	
Total gate charge	Q <sub>g</sub>	V <sub>DS</sub> = 30 V, V <sub>GS</sub> = 10 V, I <sub>D</sub> = 4.3 A	N-Ch	-	13	20	nC
		V <sub>DS</sub> = -30 V, V <sub>GS</sub> = -10 V, I <sub>D</sub> = -3.1 A	P-Ch	-	14.5	22	
		N-Channel V <sub>DS</sub> = 30 V, V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 4.3 A	N-Ch	-	6	9	
			P-Ch	-	8	12	
Gate-source charge	Q <sub>gs</sub>	P-Channel V <sub>DS</sub> = -30 V, V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -3.1 A	N-Ch	-	2.3	-	
			P-Ch	-	2.2	-	
Gate-drain charge	Q <sub>gd</sub>		N-Ch	-	2.6	-	
			P-Ch	-	3.7	-	
Gate resistance	R <sub>g</sub>	f = 1 MHz	N-Ch	-	2	3	Ω
			P-Ch	-	14	20	



SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP. <sup>a</sup>	MAX.	UNIT	
Dynamic <sup>a</sup>							
Turn-on delay time	t <sub>d(on)</sub>	N-Channel V <sub>DD</sub> = 30 V, R <sub>L</sub> = 8.8 Ω I <sub>D</sub> ≅ 3.4 A, V <sub>GEN</sub> = 4.5 V, R <sub>g</sub> = 1 Ω	N-Ch	-	15	25	ns
			P-Ch	-	30	45	
Rise time	t <sub>r</sub>		N-Ch	-	65	100	
			P-Ch	-	70	105	
Turn-off delay time	t <sub>d(off)</sub>	P-Channel V <sub>DD</sub> = -30 V, R <sub>L</sub> = 12.5 Ω I <sub>D</sub> ≅ -2.4 A, V <sub>GEN</sub> = -4.5 V, R <sub>g</sub> = 1 Ω	N-Ch	-	15	25	
			P-Ch	-	40	60	
Fall time	t <sub>f</sub>		N-Ch	-	10	15	
			P-Ch	-	30	45	
Turn-on delay time	t <sub>d(on)</sub>	N-Channel V <sub>DD</sub> = 30 V, R <sub>L</sub> = 8.8 Ω I <sub>D</sub> ≅ 3.4 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 1 Ω	N-Ch	-	10	15	
			P-Ch	-	10	15	
Rise time	t <sub>r</sub>		N-Ch	-	15	25	
			P-Ch	-	13	20	
Turn-off delay time	t <sub>d(off)</sub>		N-Ch	-	20	30	
			P-Ch	-	35	55	
Fall time	t <sub>f</sub>		N-Ch	-	10	15	
			P-Ch	-	30	45	
Drain-Source Body Diode Characteristics							
Continuous source-drain diode current	I <sub>S</sub>	T <sub>C</sub> = 25 °C	N-Ch	-	-	2.6	A
			P-Ch	-	-	-2.8	
Pulse diode forward current <sup>a</sup>	I <sub>SM</sub>		N-Ch	-	-	20	
			P-Ch	-	-	-25	
Body diode voltage	V <sub>SD</sub>	I <sub>S</sub> = 1.7 A	N-Ch	-	0.8	1.2	V
		I <sub>S</sub> = -2 A	P-Ch	-	-0.8	-1.2	
Body diode reverse recovery time	t <sub>rr</sub>	N-Channel I <sub>F</sub> = 1.7 A, di/dt = 100 A/μs, T <sub>J</sub> = 25 °C	N-Ch	-	30	60	ns
			P-Ch	-	30	50	
Body diode reverse recovery charge	Q <sub>rr</sub>		N-Ch	-	32	50	nC
			P-Ch	-	35	60	
Reverse recovery fall time	t <sub>a</sub>	P-Channel I <sub>F</sub> = -2 A, di/dt = -100 A/μs, T <sub>J</sub> = 25 °C	N-Ch	-	25	-	ns
			P-Ch	-	16	-	
Reverse recovery rise time	t <sub>b</sub>		N-Ch	-	5	-	
			P-Ch	-	14	-	

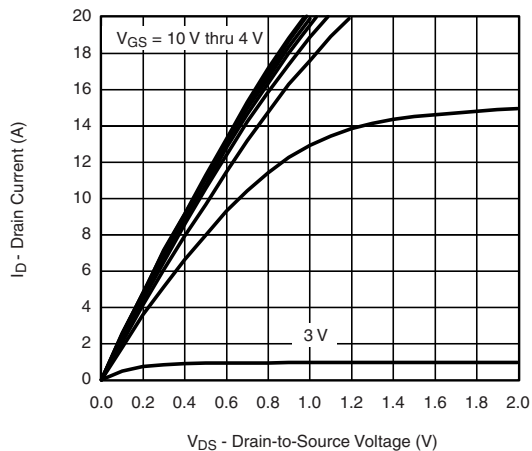
**Notes**

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

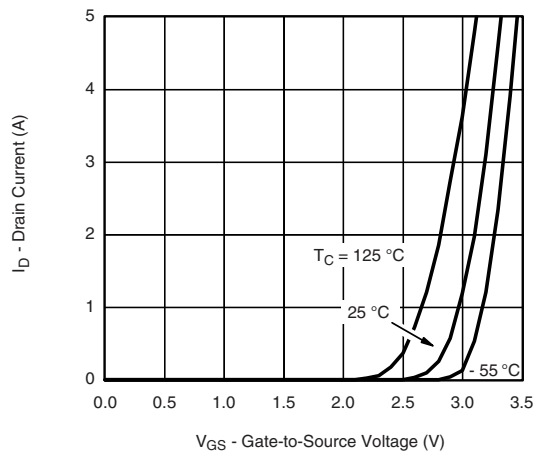
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



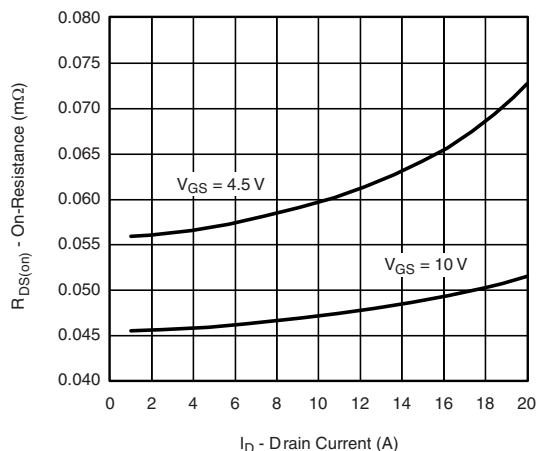
**N-CHANNEL TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



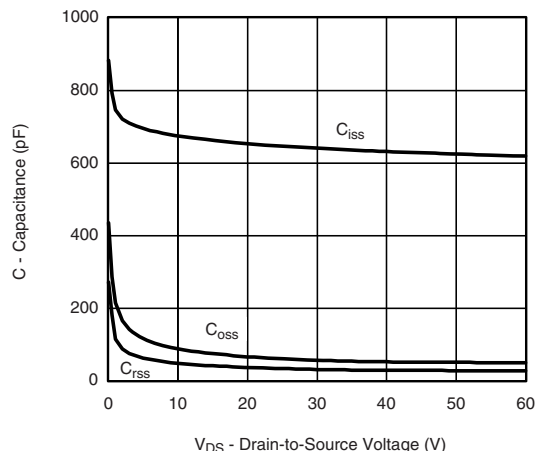
**Output Characteristics**



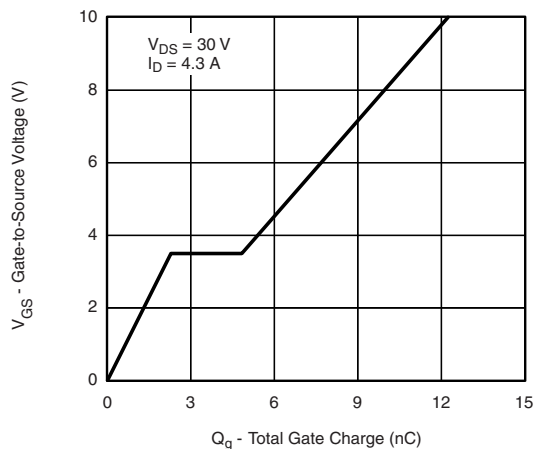
**Transfer Characteristics**



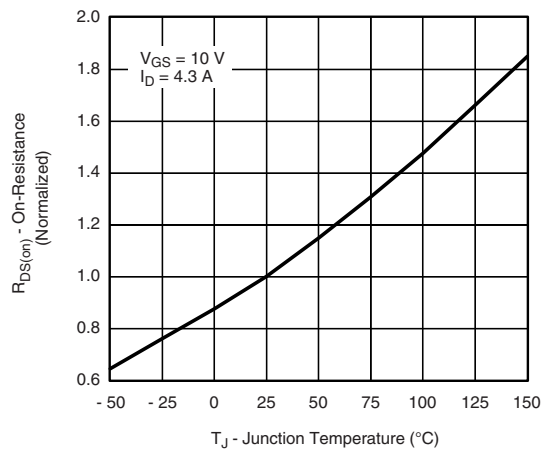
**On-Resistance vs. Drain Current and Gate Voltage**



**Capacitance**



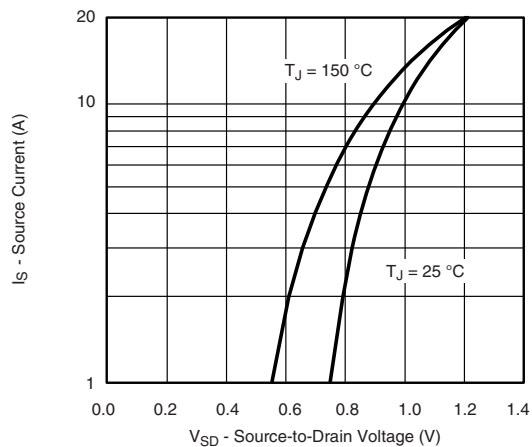
**Gate Charge**



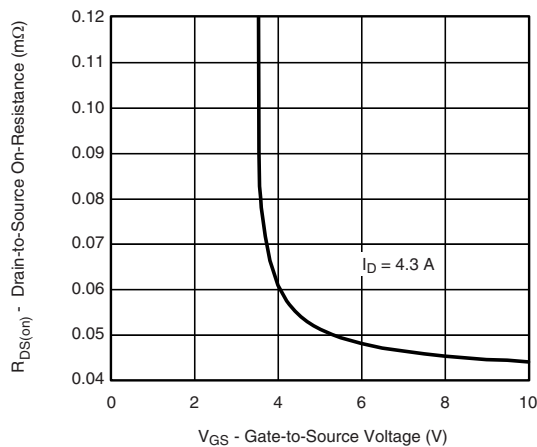
**On-Resistance vs. Junction Temperature**



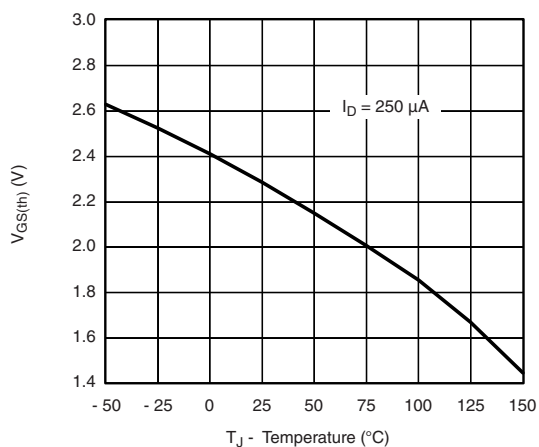
**N-CHANNEL TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



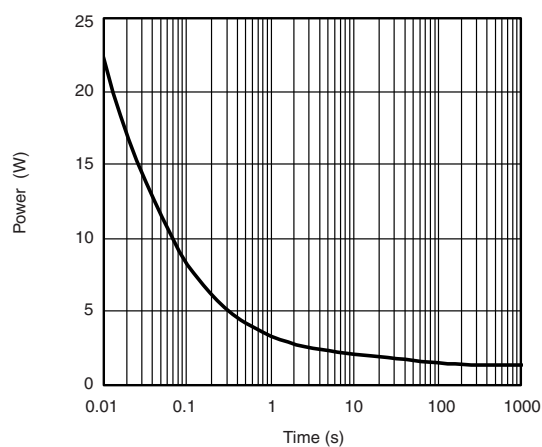
**Source-Drain Diode Forward Voltage**



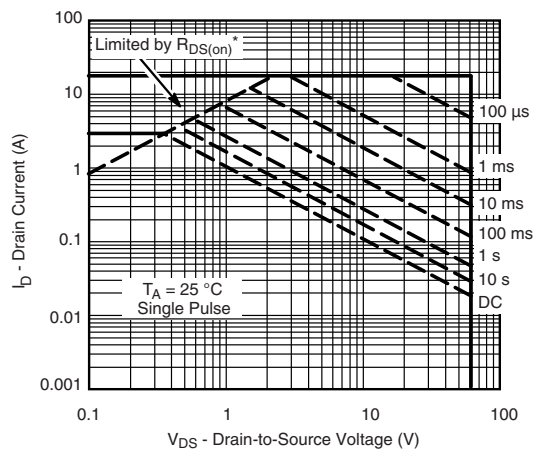
**On-Resistance vs. Gate-to-Source Voltage**



**Threshold Voltage**



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

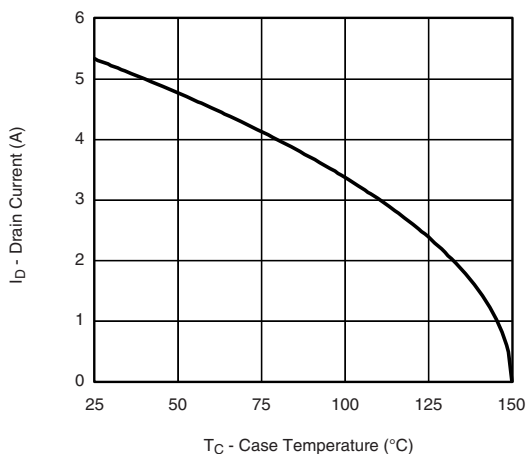


\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

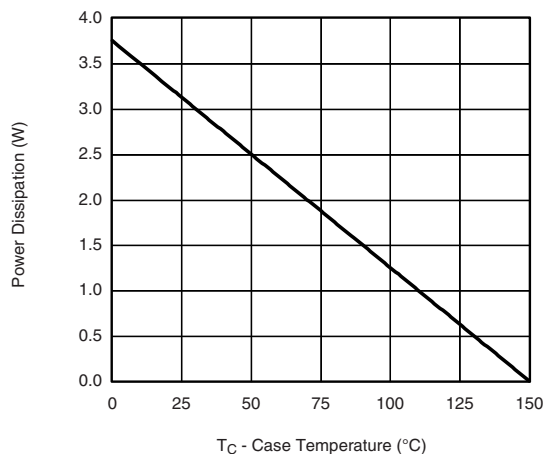
**Safe Operating Area**



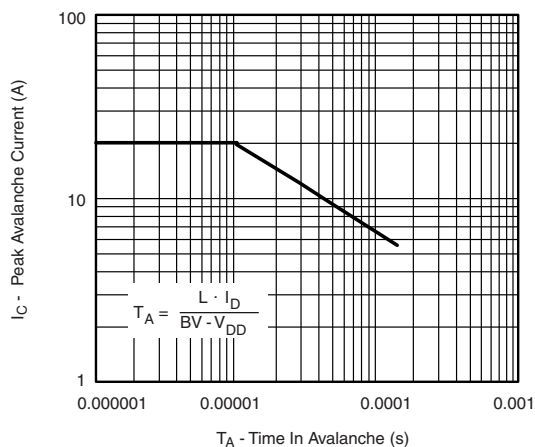
**N-CHANNEL TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



**Current Derating <sup>a</sup>**



**Power Derating**



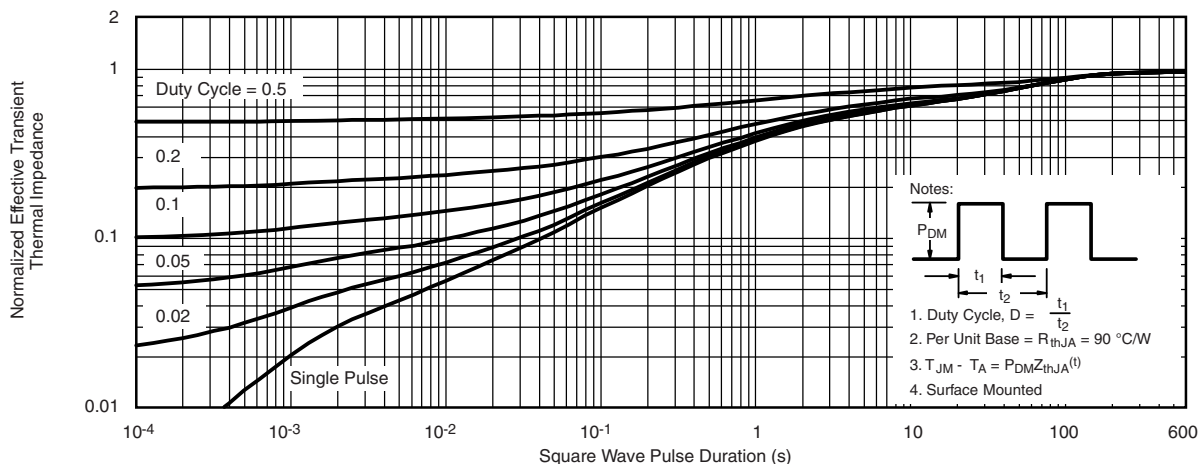
**Single Pulse Avalanche Capability**

**Note**

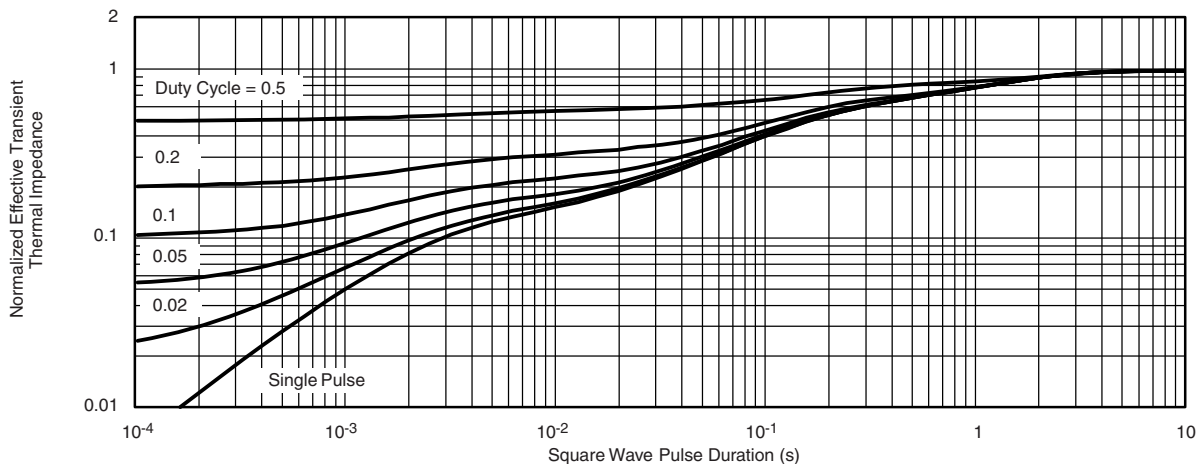
- a. The power dissipation  $P_D$  is based on  $T_J \text{ max} = 150^\circ\text{C}$ , using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls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



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



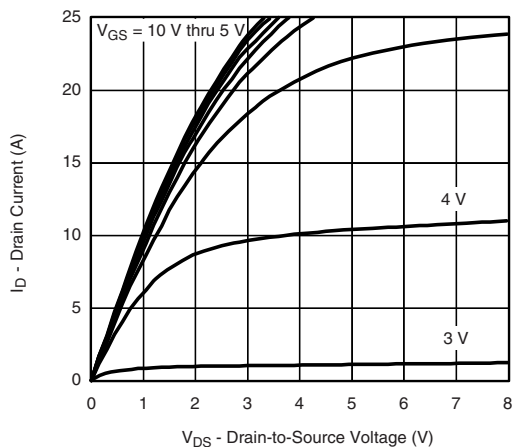
**Normalized Thermal Transient Impedance, Junction-to-Ambient**



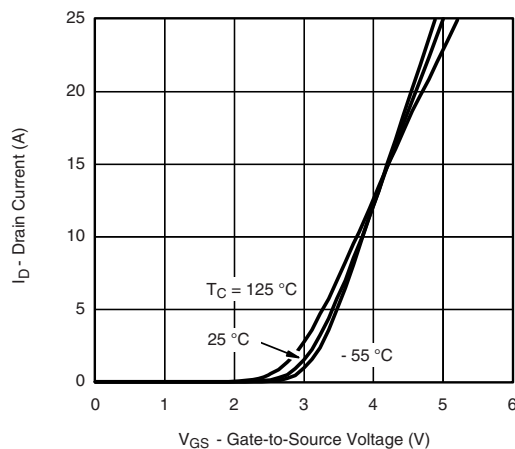
**Normalized Thermal Transient Impedance, Junction-to-Case**



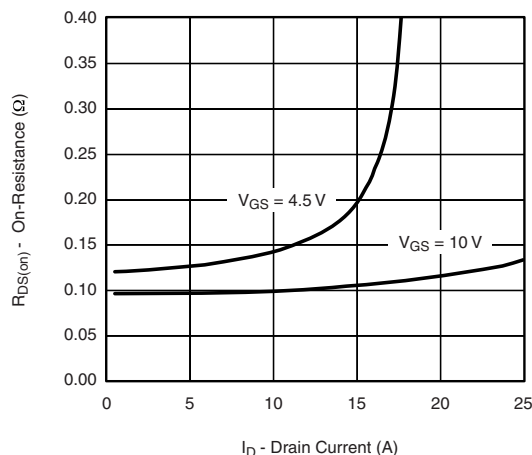
**P-CHANNEL TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



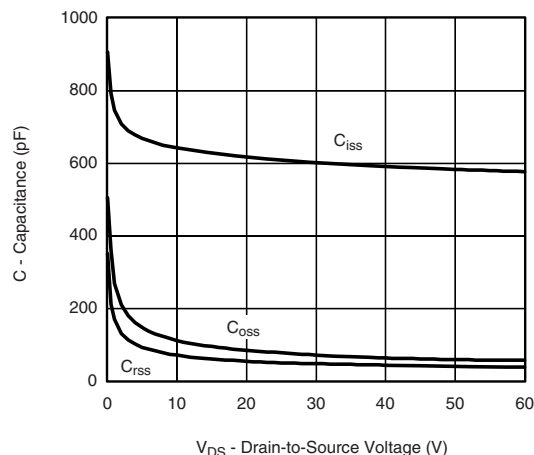
**Output Characteristics**



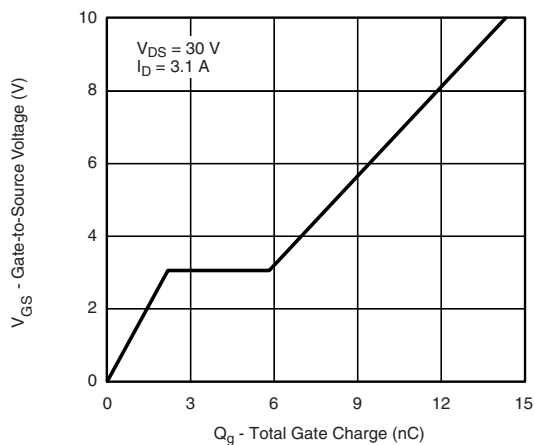
**Transfer Characteristics**



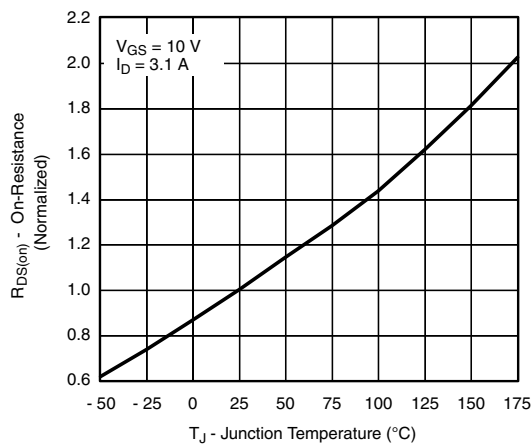
**On-Resistance vs. Drain Current**



**Capacitance**



**Gate Charge**

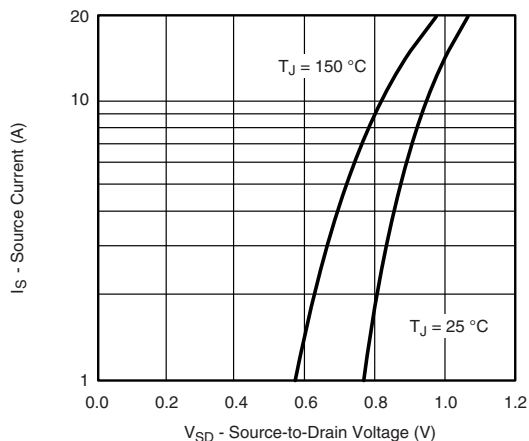


**On-Resistance vs. Junction Temperature**

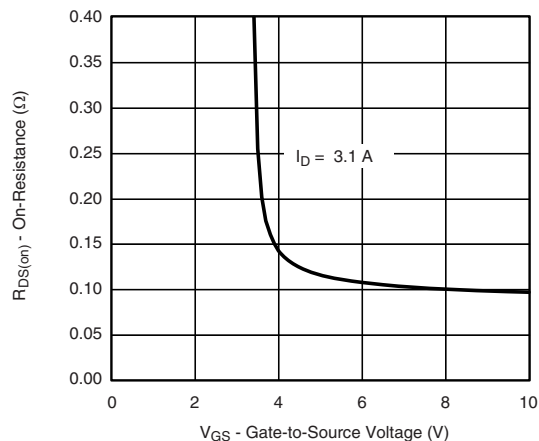




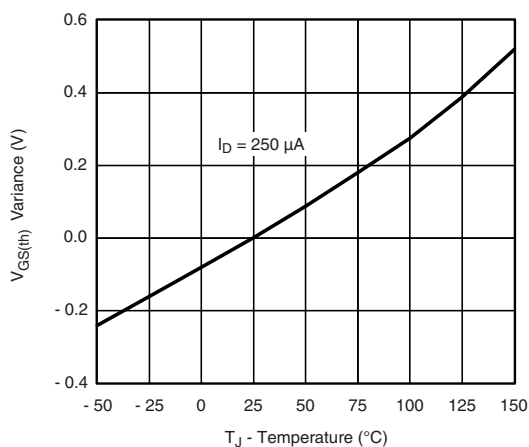
**P-CHANNEL TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



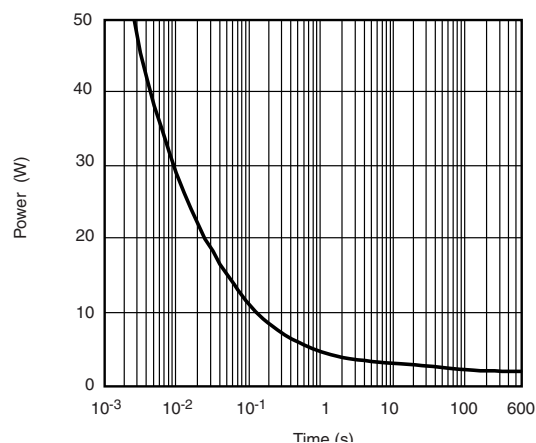
**Source-Drain Diode Forward Voltage**



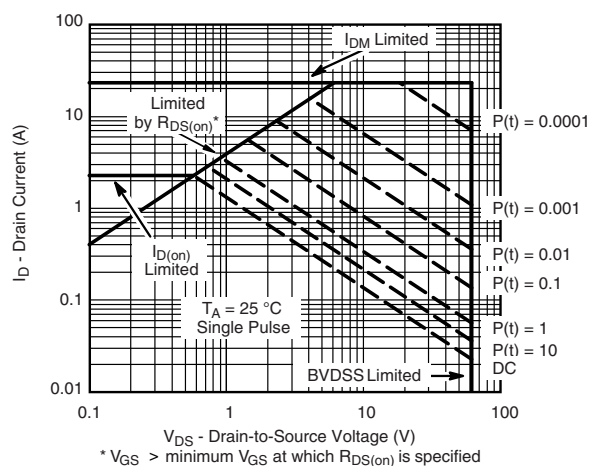
**On-Resistance vs. Gate-to-Source Voltage**



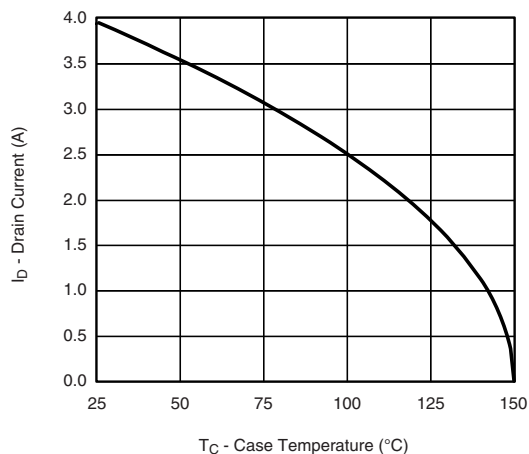
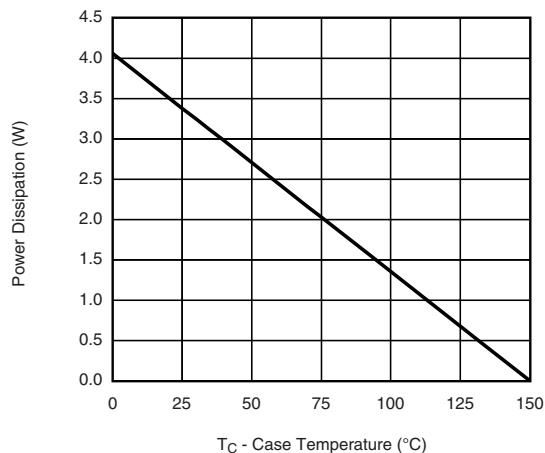
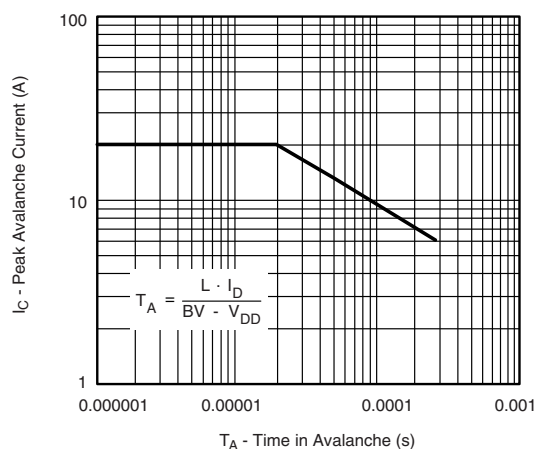
**Threshold Voltage**



**Single Pulse Power**



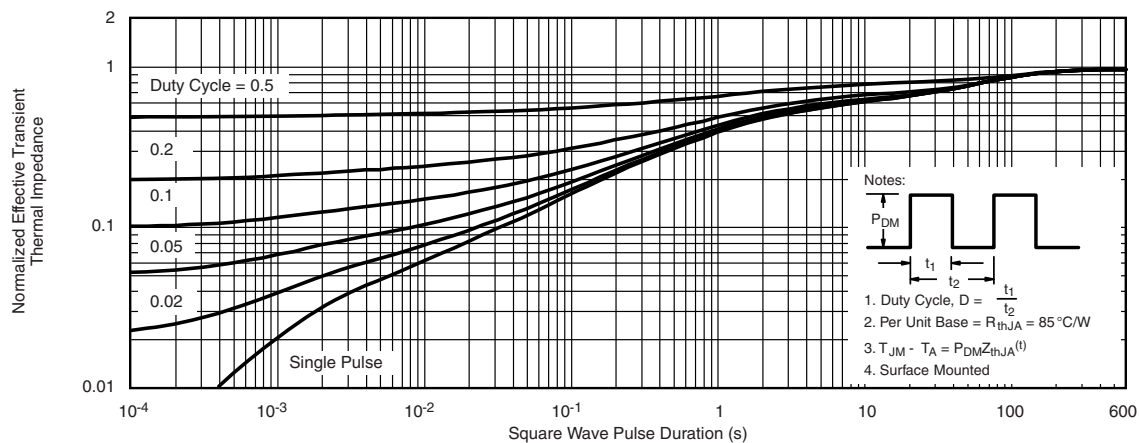
**Safe Operating Area, Junction-to-Case**

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

**Current Derating <sup>a</sup>**

**Power Derating, Junction-to-Foot**

**Single Pulse Avalanche Capability**
**Note**

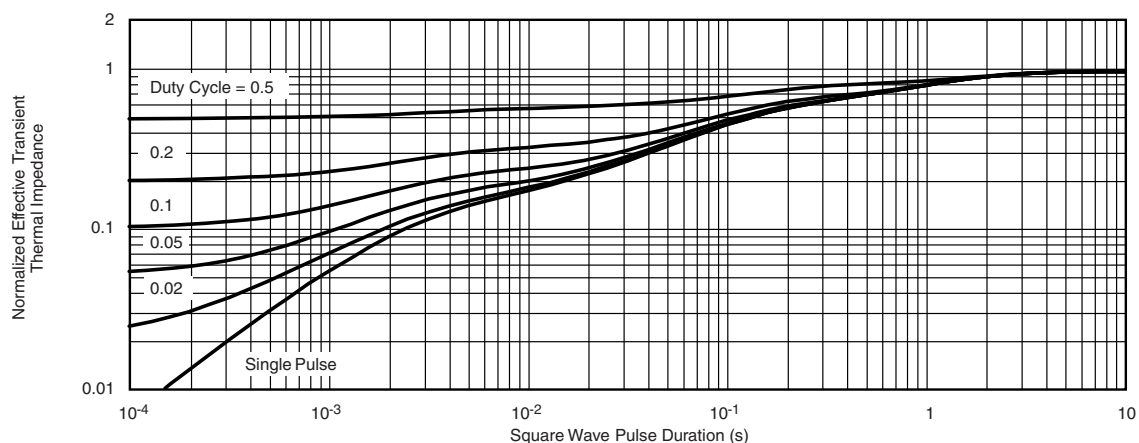
- a. The power dissipation  $P_D$  is based on  $T_J$  max = 150 °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package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



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



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

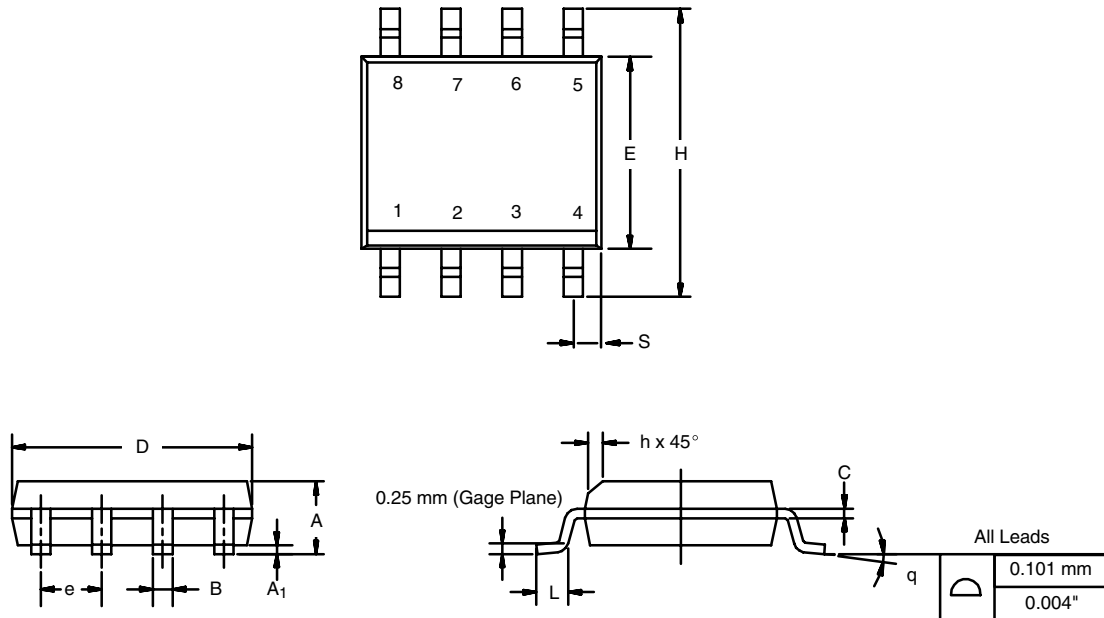


**Normalized Thermal Transient Impedance, Junction-to-Foot**

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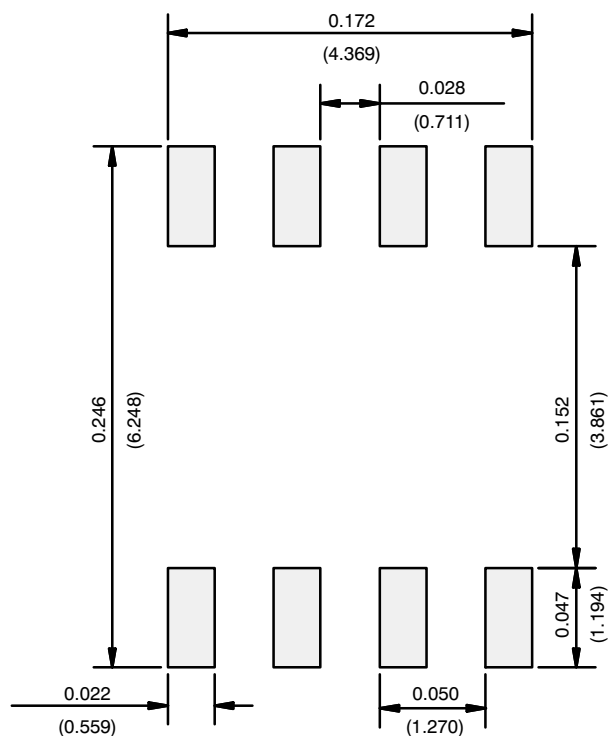
## SOIC (NARROW): 8-LEAD

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)

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