N- and P-Channel 40 V (D-S) MOSFET

PRODUCT SUMMARY

	V_{DS} (V)	$R_{DS(on)}$ (Ω)	I_D (A)[a]	Q_g (Typ.)
N-Channel	40	0.010 at V_{GS} = 10 V	12	13.3
		0.012 at V_{GS} = 4.5 V	11	
P-Channel	- 40	0.013 at V_{GS} = - 10 V	- 10	13
		0.015 at V_{GS} = - 4.5 V	- 9	

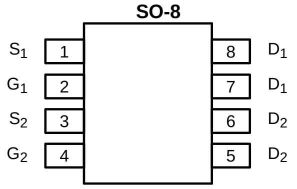
FEATURES

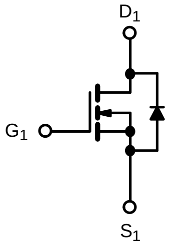
- **Halogen-free According to IEC 61249-2-21 Definition**
- TrenchFET® Power MOSFET
- 100 % R_g and UIS Tested
- Compliant to RoHS Directive 2002/95/EC

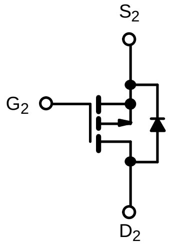
Pb-free
RoHS
COMPLIANT
HALOGEN
FREE

APPLICATIONS

- Motor Drive







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

Parameter		Symbol	N-Channel	P-Channel	Unit
Drain-Source Voltage		V_{DS}	40	- 40	V
Gate-Source Voltage		V_{GS}	± 20	± 20	
Continuous Drain Current (T_J = 150 °C)	T_C = 25 °C	I_D	12	-10	A
	T_C = 70 °C		10	- 8	
	T_A = 25 °C		8.8[b, c]	-7.6[b, c]	
	T_A = 70 °C		7.4[b, c]	- 6.3[b, c]	
Pulsed Drain Current (10 µs Pulse Width)		I_{DM}	36	- 30	
Source-Drain Current Diode Current	T_C = 25 °C	I_S	3.6	- 3.6	
	T_A = 25 °C		1.6[b, c]	- 1.6[b, c]	
Pulsed Source-Drain Current		I_{SM}	60	- 60	
Single Pulse Avalanche Current	L = 0.1 mH	I_{AS}	20	- 20	
Single Pulse Avalanche Energy		E_{AS}	5	20	mJ
Maximum Power Dissipation	T_C = 25 °C	P_D	6.1	5.2	W
	T_C = 70 °C		3	3.1	
	T_A = 25 °C		3[b, c]	3[b, c]	
	T_A = 70 °C		2.28[b, c]	2.28[b, c]	
Operating Junction and Storage Temperature Range		T_J, T_{stg}	- 55 to 150		°C

THERMAL RESISTANCE RATINGS

Parameter		Symbol	N-Channel		P-Channel		Unit
			Typ.	Max.	Typ.	Max.	
Maximum Junction-to-Ambient[b, d]	t ≤ 10 s	R_{thJA}	20	32.5	27	32.5	°C/W
Maximum Junction-to-Foot (Drain)	Steady State	R_{thJF}	10	20	19	28	

Notes:
a. Based on T_C = 25 °C.
b. Surface mounted on 1" x 1" FR4 board.
c. t = 10 s.
d. Maximum under steady state conditions is 120 °C/W (n-channel) and 110 °C/W (p-channel).
e. Package limited.

SPECIFICATIONS (T_J = 25 °C, unless otherwise noted)

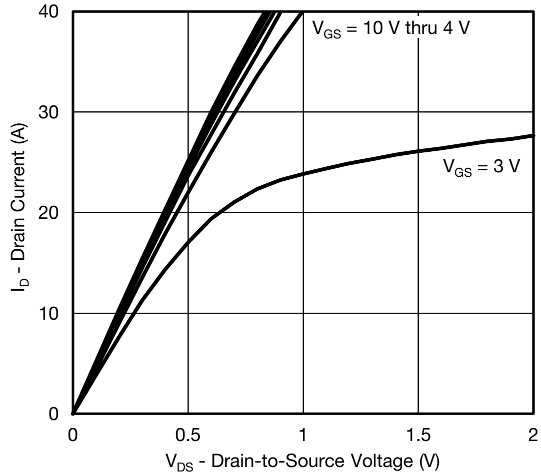
Parameter	Symbol	Test Conditions		Min.	Typ.[a]	Max.	Unit
Static							
Drain-Source Breakdown Voltage	V_{DS}	V_{GS} = 0 V, I_D = 250 µA	N-Ch	40			V
		V_{GS} = 0 V, I_D = - 250 µA	P-Ch	- 40			
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	I_D = 250 µA	N-Ch		30		mV/°C
		I_D = - 250 µA	P-Ch		- 24		
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$	I_D = 250 µA	N-Ch		- 4.1		
		I_D = - 250 µA	P-Ch		5		
Gate Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 µA	N-Ch	1		2.2	V
		V_{DS} = V_{GS}, I_D = - 250 µA	P-Ch	- 0.9		- 2.5	
Gate-Body Leakage	I_{GSS}	V_{DS} = 0 V, V_{GS} = ± 20 V	N-Ch			± 100	nA
		V_{DS} = 0 V, V_{GS} = ± 20 V	P-Ch			± 100	
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 30 V, V_{GS} = 0 V	N-Ch			1	µA
		V_{DS} = - 30 V, V_{GS} = 0 V	P-Ch			- 1	
		V_{DS} = 30 V, V_{GS} = 0 V, T_J = 55 °C	N-Ch			10	
		V_{DS} = - 30 V, V_{GS} = 0 V, T_J = 55 °C	P-Ch			- 10	
On-State Drain Current[b]	$I_{D(on)}$	V_{DS} = 5 V, V_{GS} = 10 V	N-Ch	40			A
		V_{DS} = - 5 V, V_{GS} = - 10 V	P-Ch	-40			
Drain-Source On-State Resistance[b]	$R_{DS(on)}$	V_{GS} = 10 V, I_D = 6.8 A	N-Ch		0.010	0.012	Ω
		V_{GS} = - 10 V, I_D = - 8 A	P-Ch		0.013	0.017	
		V_{GS} = 8 V, I_D = 6.7 A	N-Ch			0.014	
		V_{GS} = - 8 V, I_D = - 6.5 A	P-Ch			0.019	
		V_{GS} = 4.5 V, I_D = 6.6 A	N-Ch		0.012	0.016	
		V_{GS} = - 4.5 V, I_D = - 5 A	P-Ch		0.015	0.021	
Forward Transconductance[b]	g_{fs}	V_{DS} = 15 V, I_D = 6.8 A	N-Ch		37		S
		V_{DS} = - 15 V, I_D = - 6.7 A	P-Ch		35		
Dynamic[a]							
Input Capacitance	C_{iss}	N-Channel V_{DS} = 20 V, V_{GS} = 0 V, f = 1 MHz P-Channel V_{DS} = - 20 V, V_{GS} = 0 V, f = 1 MHz	N-Ch		1321		pF
			P-Ch		1345		
Output Capacitance	C_{oss}		N-Ch		745		
			P-Ch		792		
Reverse Transfer Capacitance	C_{rss}		N-Ch		214		
			P-Ch		245		
Total Gate Charge	Q_g	V_{DS} = 20 V, V_{GS} = 10 V, I_D = 10 A	N-Ch		13.3	20	nC
		V_{DS} = - 20 V, V_{GS} = - 10 V, I_D = - 10 A	P-Ch		13	20	
		N-Channel V_{DS} = 20 V, V_{GS} = 4.5 V, I_D = 10 A P-Channel V_{DS} = - 20 V, V_{GS} = - 4.5 V, I_D = - 10 A	N-Ch		6.5	10	
			P-Ch		21.7	33	
Gate-Source Charge	Q_{gs}		N-Ch		2.3		
			P-Ch		5.6		
Gate-Drain Charge	Q_{gd}		N-Ch		1.7		
			P-Ch		9.8		
Gate Resistance	R_g	f = 1 MHz	N-Ch	0.3	1.3	2.6	Ω
			P-Ch	1.3	6.4	12.8	

SPECIFICATIONS (T_J = 25 °C, unless otherwise noted)							
Parameter	**Symbol**	**Test Conditions**		**Min.**	**Typ.**[a]	**Max.**	**Unit**
Dynamic[a]							
Turn-On Delay Time	$t_{d(on)}$	N-Channel V_{DD} = 20 V, R_L = 3.7 Ω I_D ≅ 5.4 A, V_{GEN} = 10 V, R_g = 1 Ω P-Channel V_{DD} = - 20 V, R_L = 2 Ω I_D ≅ - 10 A, V_{GEN} = - 10 V, R_g = 1 Ω	N-Ch		5	10	ns
			P-Ch		10	20	
Rise Time	t_r		N-Ch		10	20	
			P-Ch		9	18	
Turn-Off Delay Time	$t_{d(off)}$		N-Ch		16	25	
			P-Ch		50	90	
Fall Time	t_f		N-Ch		7	14	
			P-Ch		13	26	
Turn-On Delay Time	$t_{d(on)}$	N-Channel V_{DD} = 20 V, R_L = 3.7 Ω I_D ≅ 5.4 A, V_{GEN} = 4.5 V, R_g = 1 Ω P-Channel V_{DD} = - 20 V, R_L = 2 Ω I_D ≅ - 10 A, V_{GEN} = - 4.5 V, R_g = 1 Ω	N-Ch		11	22	
			P-Ch		42	75	
Rise Time	t_r		N-Ch		12	22	
			P-Ch		40	70	
Turn-Off Delay Time	$t_{d(off)}$		N-Ch		17	26	
			P-Ch		40	70	
Fall Time	t_f		N-Ch		7	14	
			P-Ch		18	35	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I_S	T_C = 25 °C	N-Ch			5.6	A
			P-Ch			- 5.6	
Pulse Diode Forward Current[a]	I_{SM}		N-Ch			40	
			P-Ch			- 40	
Body Diode Voltage	V_{SD}	I_S = 5.4 A	N-Ch		0.81	1.2	V
		I_S = - 2 A	P-Ch		- 0.77	- 1.2	
Body Diode Reverse Recovery Time	t_{rr}	N-Channel I_F = 5 A, dI/dt = 100 A/µs, T_J = 25 °C P-Channel I_F = - 5 A, dI/dt = - 100 A/µs, T_J = 25 °C	N-Ch		17	34	ns
			P-Ch		41	80	
Body Diode Reverse Recovery Charge	Q_{rr}		N-Ch		10	20	nC
			P-Ch		32	65	
Reverse Recovery Fall Time	t_a		N-Ch		10		ns
			P-Ch		15		
Reverse Recovery Rise Time	t_b		N-Ch		7		
			P-Ch		26		

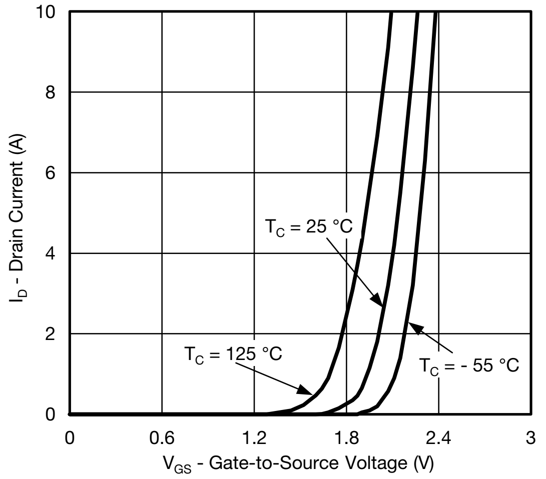
Notes:
a. Guaranteed by design, not subject to production testing.
b. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.

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.

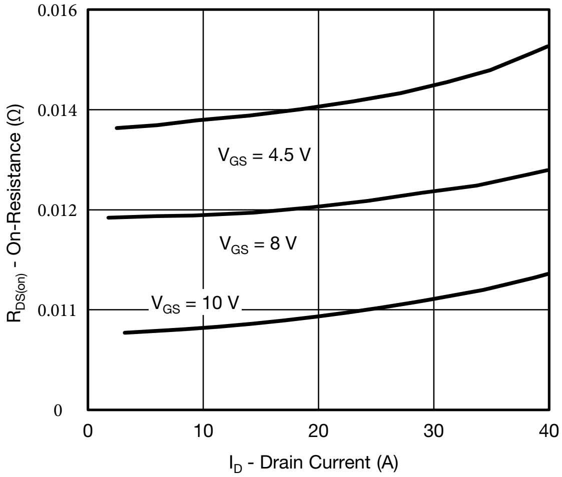
N-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



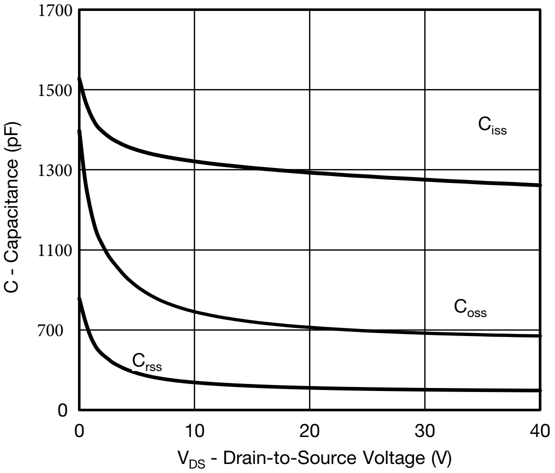
Output Characteristics



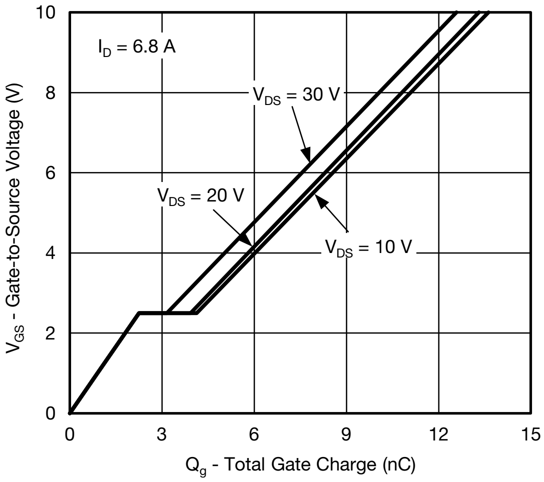
Transfer Characteristics



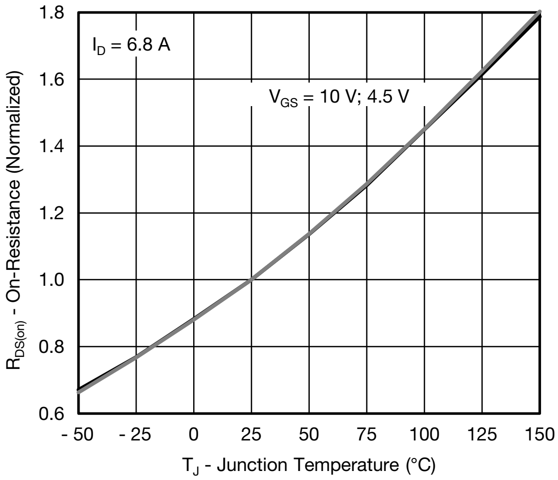
On-Resistance vs. Drain Current and Gate Voltage



Capacitance

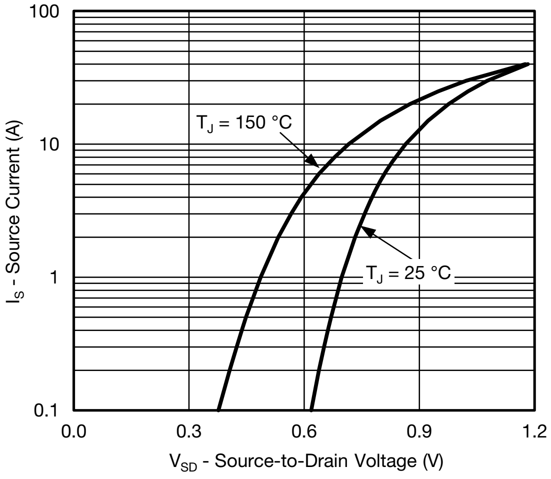


Gate Charge

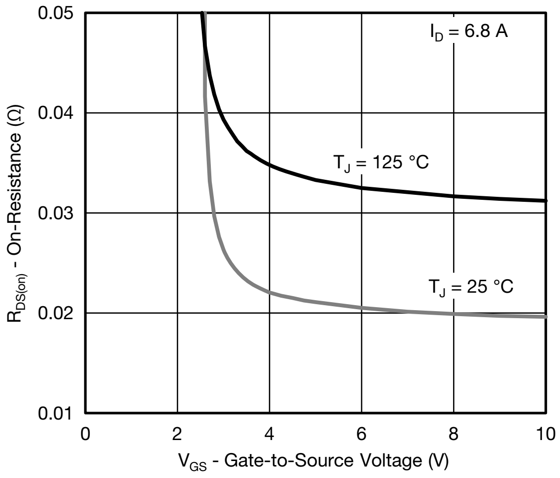


On-Resistance vs. Junction Temperature

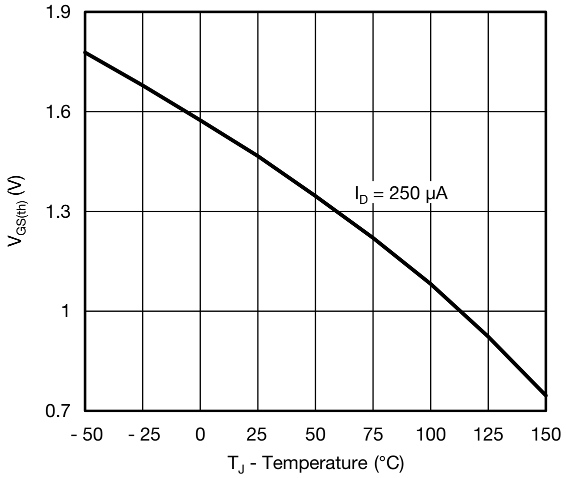
N-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



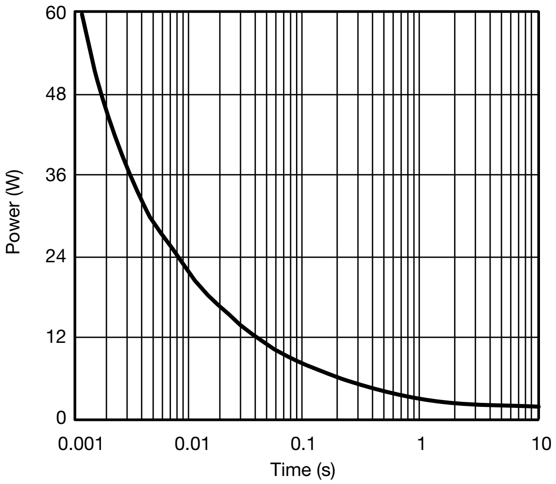
Source-Drain Diode Forward Voltage



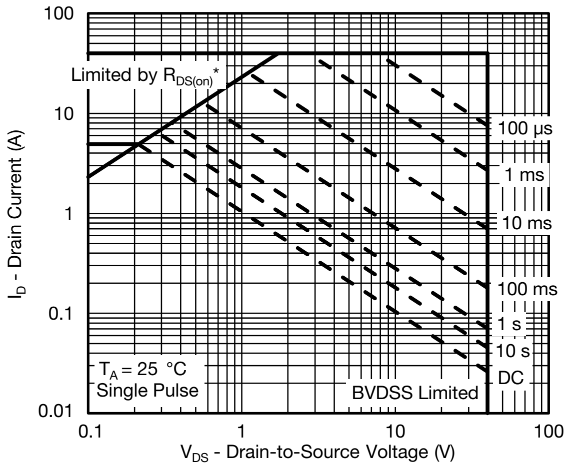
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



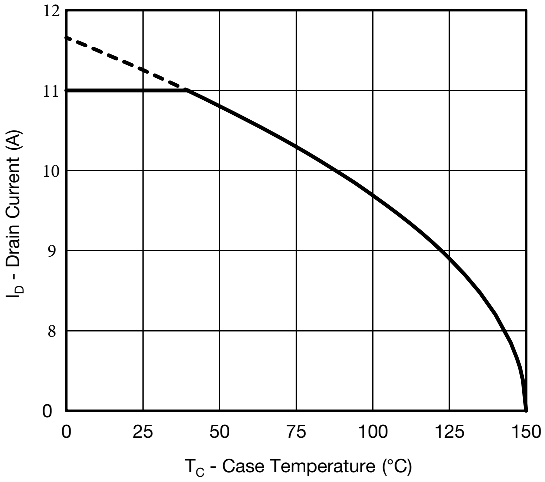
Single Pulse Power, Junction-to-Ambient



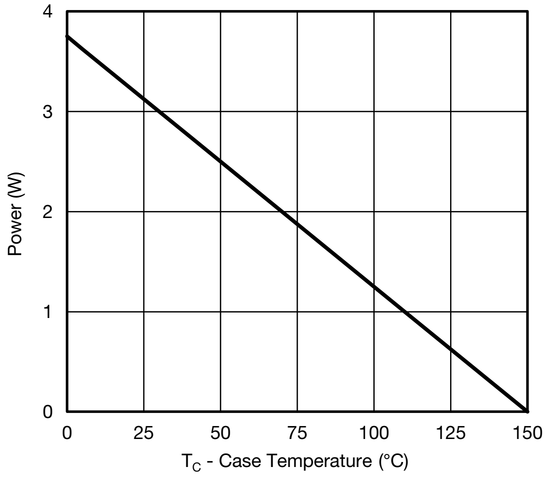
* V_{GS} > minimum V_{GS} at which $R_{DS(on)}$ is specified

Safe Operating Area, Junction-to-Ambient

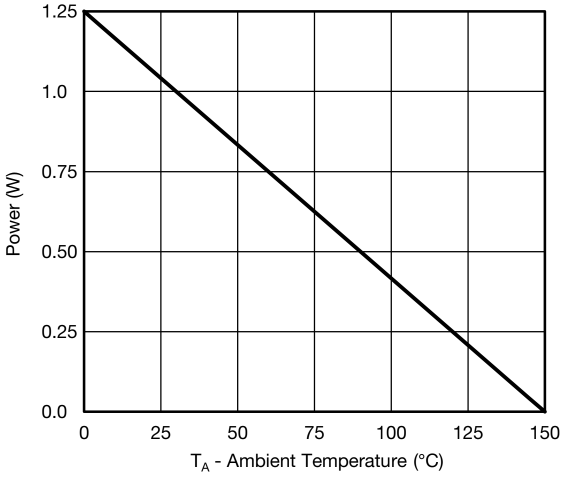
N-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Current Derating*



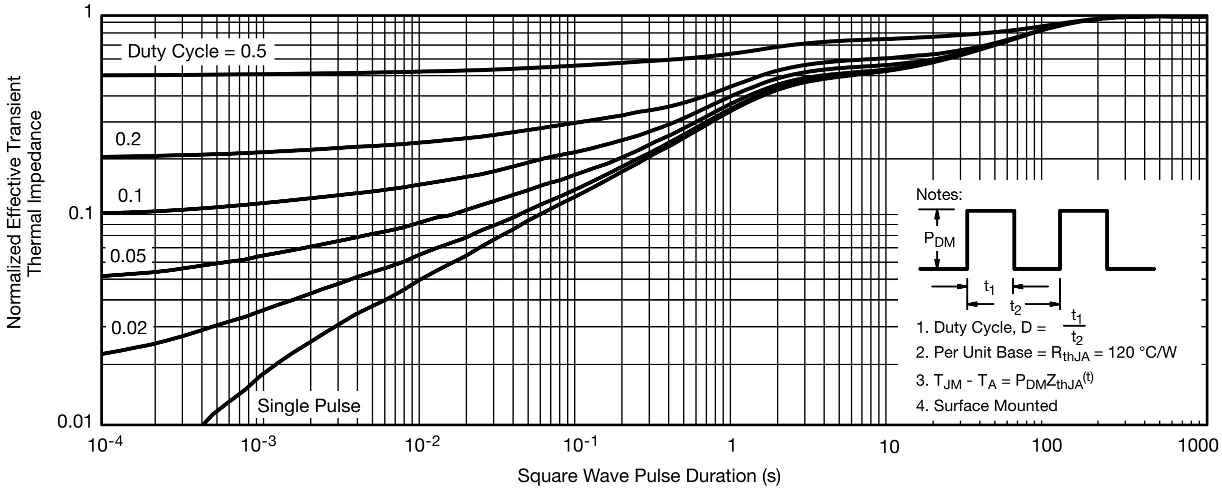
Power Derating, Junction-to-Foot



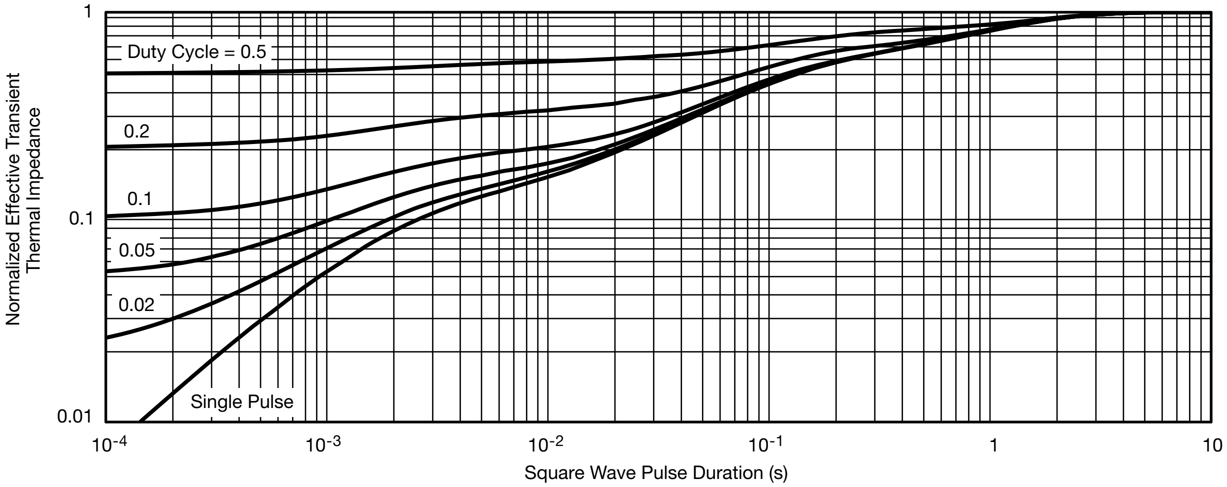
Power Derating, Junction-to-Ambient

* 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.

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

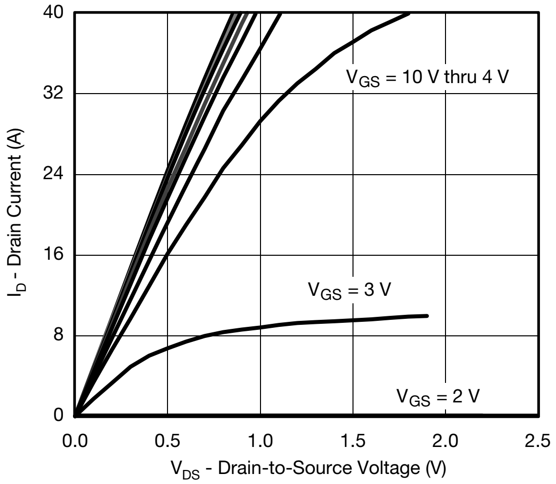


Normalized Thermal Transient Impedance, Junction-to-Ambient

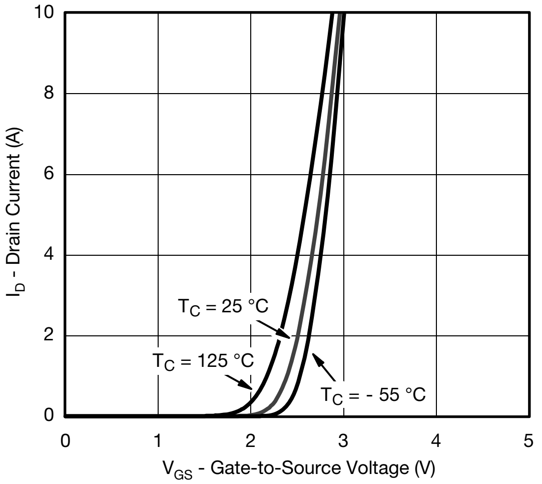


Normalized Thermal Transient Impedance, Junction-to-Foot

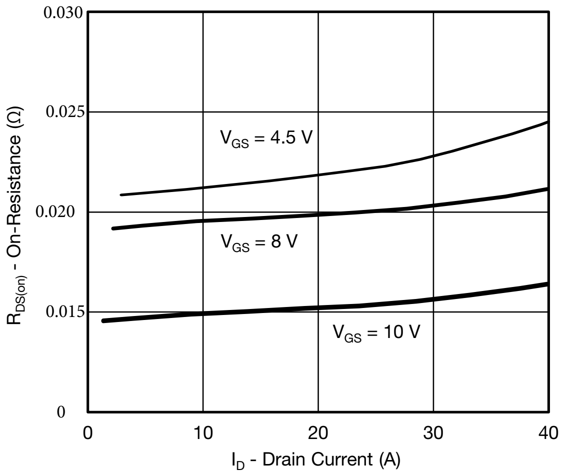
P-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



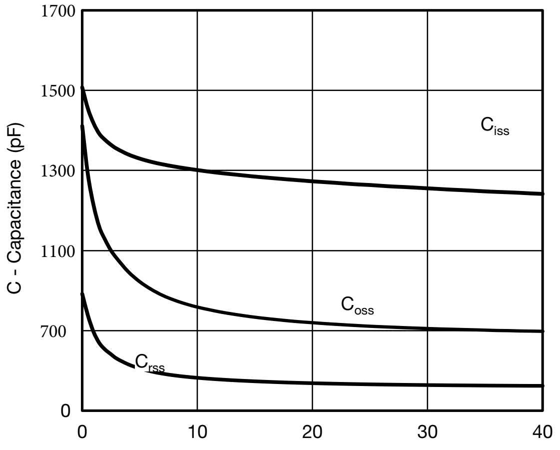
Output Characteristics



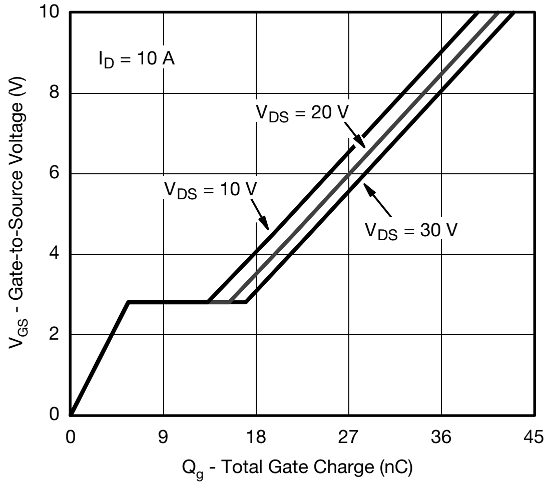
Transfer Characteristics



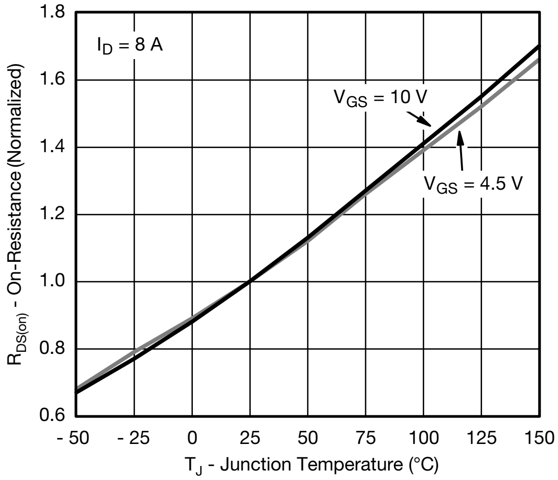
On-Resistance vs. Drain Current and Gate Voltage



Capacitance

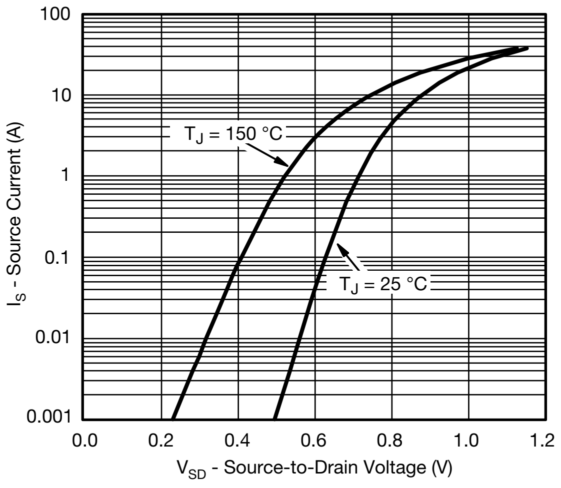


Gate Charge

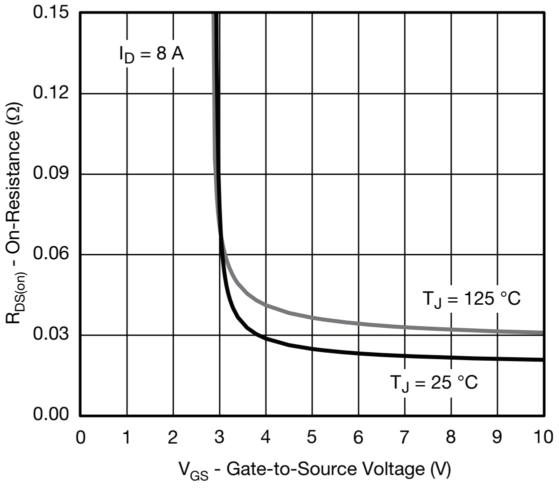


On-Resistance vs. Junction Temperature

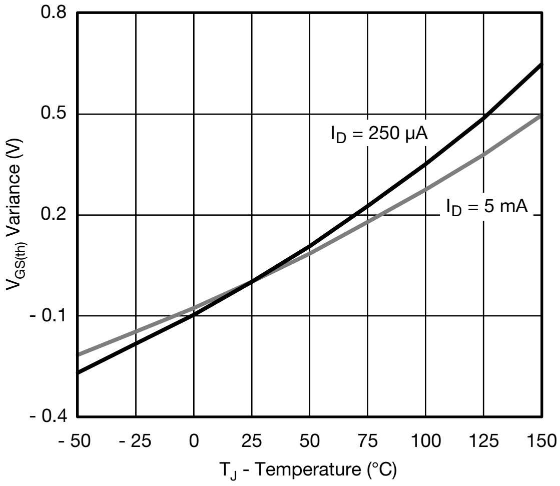
P-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



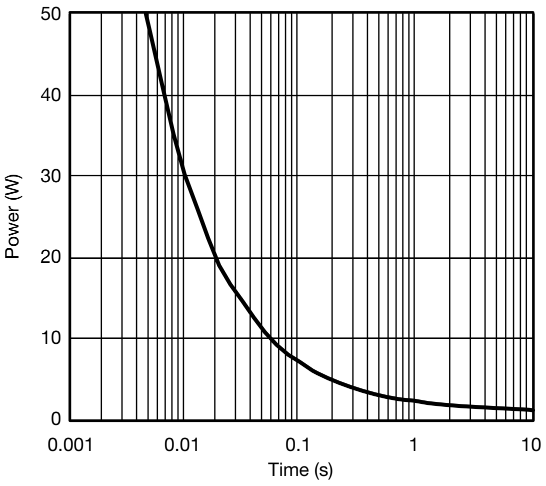
Source-Drain Diode Forward Voltage



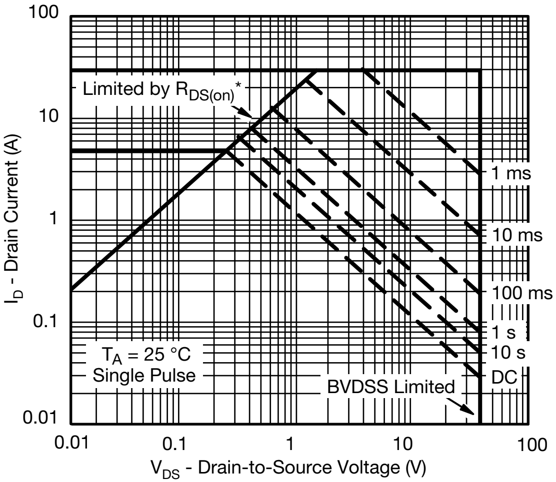
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



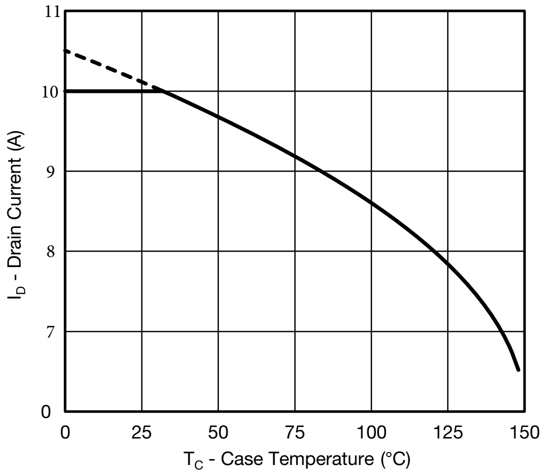
Single Pulse Power, Junction-to-Ambient



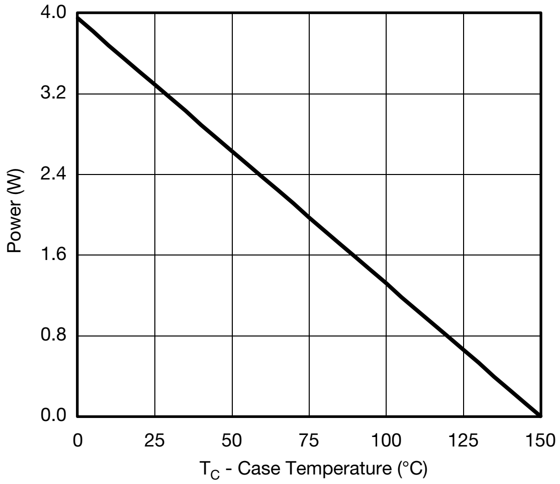
* V_{GS} > minimum V_{GS} at which $R_{DS(on)}$ is specified

Safe Operating Area, Junction-to-Ambient

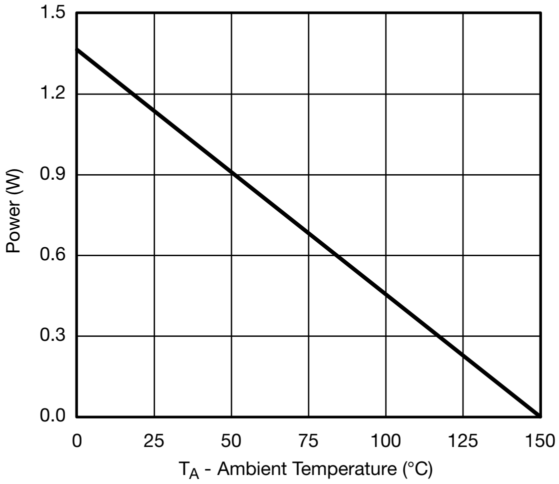
P-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Current Derating*



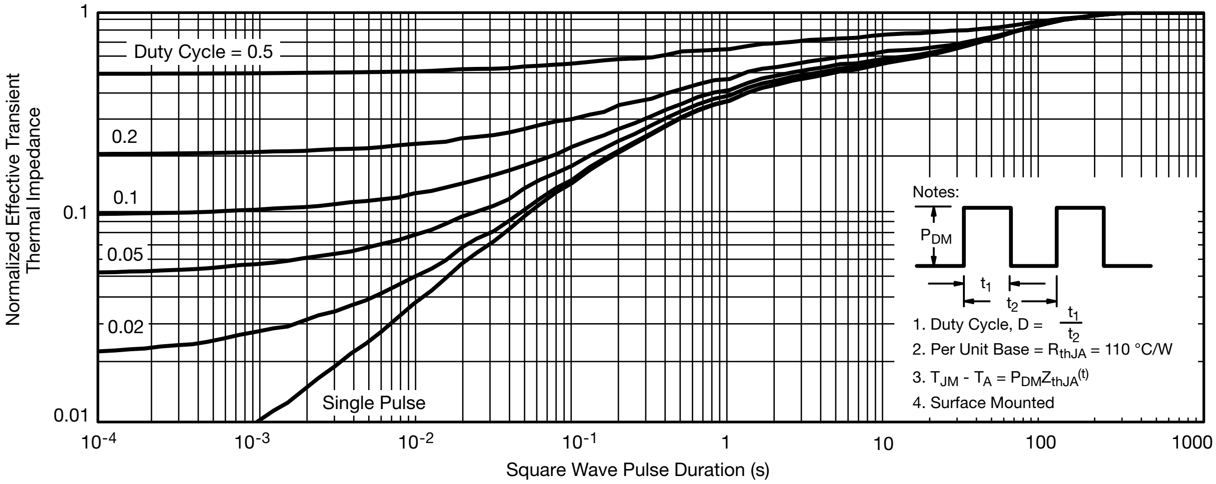
Power Derating, Junction-to-Foot



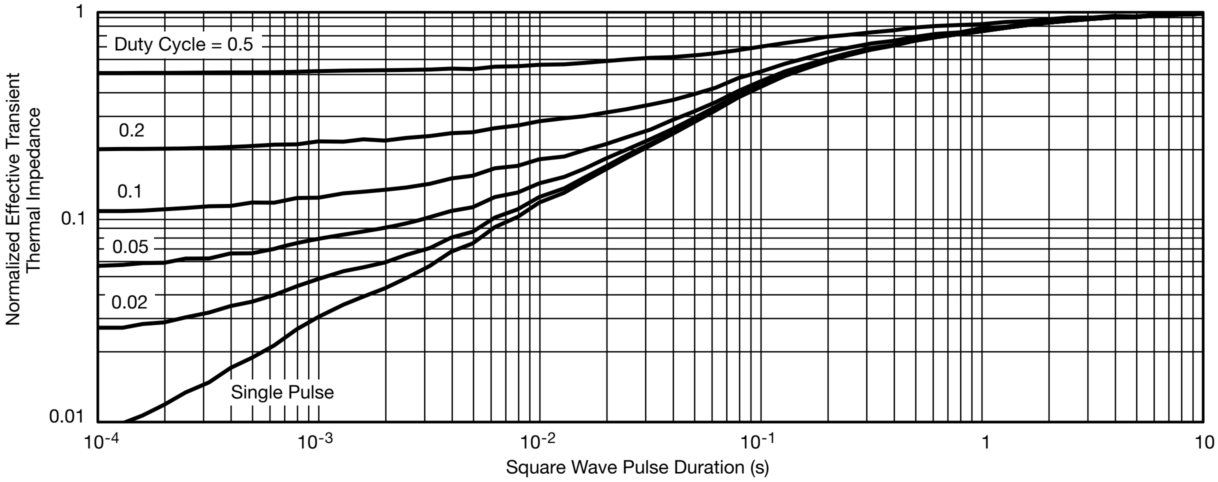
Power Derating, Junction-to-Ambient

* 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)



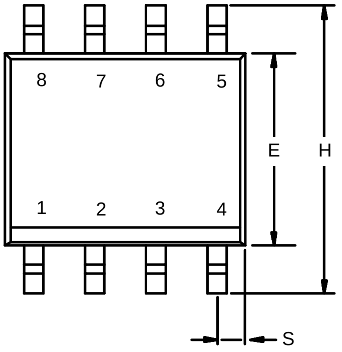
Normalized Thermal Transient Impedance, Junction-to-Ambient

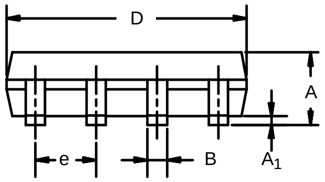


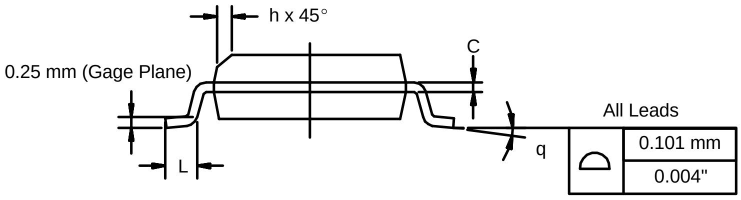
Normalized Thermal Transient Impedance, Junction-to-Foot

SOIC (NARROW): 8-LEAD

JEDEC Part Number: MS-012

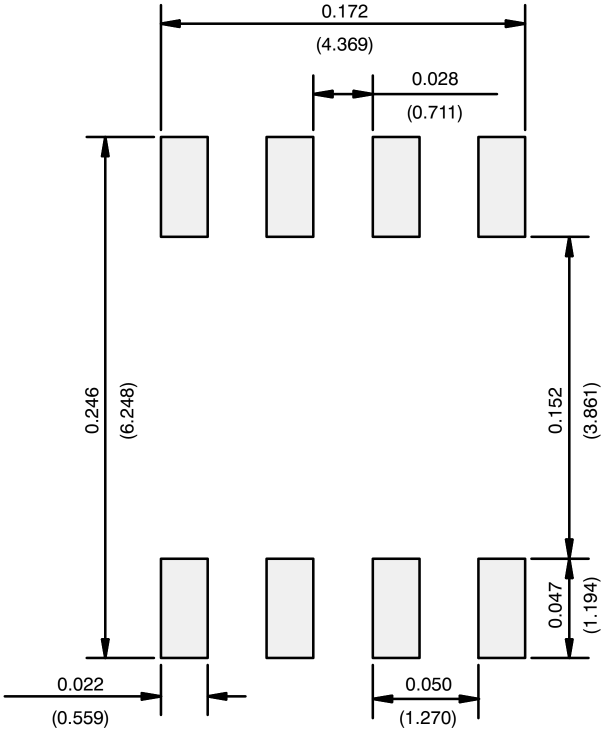






DIM	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	1.35	1.75	0.053	0.069
A_1	0.10	0.20	0.004	0.008
B	0.35	0.51	0.014	0.020
C	0.19	0.25	0.0075	0.010
D	4.80	5.00	0.189	0.196
E	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
H	5.80	6.20	0.228	0.244
h	0.25	0.50	0.010	0.020
L	0.50	0.93	0.020	0.037
q	0°	8°	0°	8°
S	0.44	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)