

## Automotive P-Channel 60 V (D-S) 175 °C MOSFET

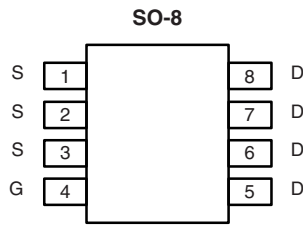
 AUTOMOTIVE  
GRADE

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

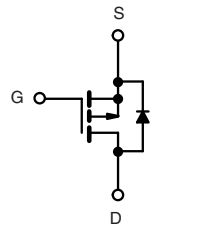
PRODUCT SUMMARY	
$V_{DS}$ (V)	- 60
$R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = -10$ V	0.085
$R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = -4.5$ V	0.115
$I_D$ (A)	- 4.6
Configuration	Single

### FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET® Power MOSFET
- AEC-Q101 Qualified<sup>c</sup>
- 100 %  $R_g$  and UIS Tested
- Compliant to RoHS Directive 2002/95/EC



Top View



P-Channel MOSFET

ORDERING INFORMATION	
Package	SO-8
Lead (Pb)-free and Halogen-free	SQ9407EY-T1-GE3

ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted)				
PARAMETER		SYMBOL	LIMIT	UNIT
Drain-Source Voltage		$V_{DS}$	- 60	V
Gate-Source Voltage		$V_{GS}$	$\pm 20$	
Continuous Drain Current	$T_C = 25$ °C	$I_D$	- 4.6	A
	$T_C = 125$ °C		- 2.6	
Continuous Source Current (Diode Conduction)		$I_S$	- 3.4	
Pulsed Drain Current <sup>a</sup>		$I_{DM}$	- 18.5	
Single Pulse Avalanche Current	L = 0.1 mH	$I_{AS}$	- 20	
Single Pulse Avalanche Energy		$E_{AS}$	20	
Maximum Power Dissipation <sup>a</sup>	$T_C = 25$ °C	$P_D$	3.75	W
	$T_C = 125$ °C		1.25	
Operating Junction and Storage Temperature Range		$T_J, T_{stg}$	- 55 to + 175	°C

THERMAL RESISTANCE RATINGS				
PARAMETER		SYMBOL	LIMIT	UNIT
Junction-to-Ambient	PCB Mount <sup>b</sup>	$R_{thJA}$	100	°C/W
Junction-to-Foot (Drain)		$R_{thJF}$	40	

### Notes

- Pulse test; pulse width  $\leq 300$   $\mu$ s, duty cycle  $\leq 2$  %.
- When mounted on 1" square PCB (FR-4 material).
- Parametric verification ongoing.



SPECIFICATIONS ( $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
<b>Static</b>							
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$		-60	-	-	V
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$		-1.5	-2.0	-2.5	
Gate-Source Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$		-	-	$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}$	$V_{DS} = -60\text{ V}$	-	-	-1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$	$V_{DS} = -60\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	-	-50	
		$V_{GS} = 0\text{ V}$	$V_{DS} = -60\text{ V}, T_J = 175\text{ }^\circ\text{C}$	-	-	-150	
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{GS} = -10\text{ V}$	$V_{DS} \leq -5\text{ V}$	-12	-	-	A
Drain-Source On-State Resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = -4.5\text{ V}$	$I_D = -2.5\text{ A}$	-	0.087	0.115	$\Omega$
		$V_{GS} = -10\text{ V}$	$I_D = -3.5\text{ A}$	-	0.067	0.085	
		$V_{GS} = -10\text{ V}$	$I_D = -3.5\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	-	0.143	
		$V_{GS} = -10\text{ V}$	$I_D = -3.5\text{ A}, T_J = 175\text{ }^\circ\text{C}$	-	-	0.176	
Forward Transconductance <sup>b</sup>	$g_{fs}$	$V_{DS} = -15\text{ V}, I_D = -3.5\text{ A}$		-	10	-	S
<b>Dynamic<sup>b</sup></b>							
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}$	$V_{DS} = -30\text{ V}, f = 1\text{ MHz}$	-	912	1140	$\mu\text{F}$
Output Capacitance	$C_{oss}$			-	100	125	
Reverse Transfer Capacitance	$C_{rss}$			-	60	75	
Total Gate Charge <sup>c</sup>	$Q_g$	$V_{GS} = -10\text{ V}$	$V_{DS} = -30\text{ V}, I_D = -4.3\text{ A}$	-	26.5	40	nC
Gate-Source Charge <sup>c</sup>	$Q_{gs}$			-	3.8	-	
Gate-Drain Charge <sup>c</sup>	$Q_{gd}$			-	5.8	-	
Gate Resistance	$R_g$	f = 1 MHz		3.5	7.1	10.7	$\Omega$
Turn-On Delay Time <sup>c</sup>	$t_{d(on)}$	$V_{DD} = -30\text{ V}, R_L = 8.8\text{ }\Omega$ $I_D \cong -3.4\text{ A}, V_{GEN} = -10\text{ V}, R_g = 1\text{ }\Omega$		-	11	17	ns
Rise Time <sup>c</sup>	$t_r$			-	13	20	
Turn-Off Delay Time <sup>c</sup>	$t_{d(off)}$			-	36	54	
Fall Time <sup>c</sup>	$t_f$			-	8	12	
<b>Source-Drain Diode Ratings and Characteristics<sup>b</sup></b>							
Pulsed Current <sup>a</sup>	$I_{SM}$			-	-	-18.5	A
Forward Voltage	$V_{SD}$	$I_F = -3\text{ A}, V_{GS} = 0\text{ V}$		-	-0.84	-1.1	V

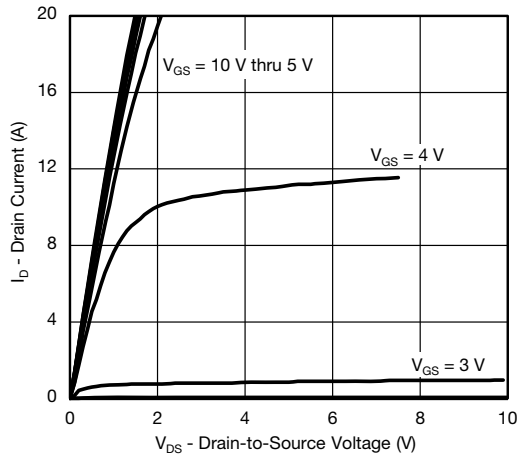
**Notes**

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

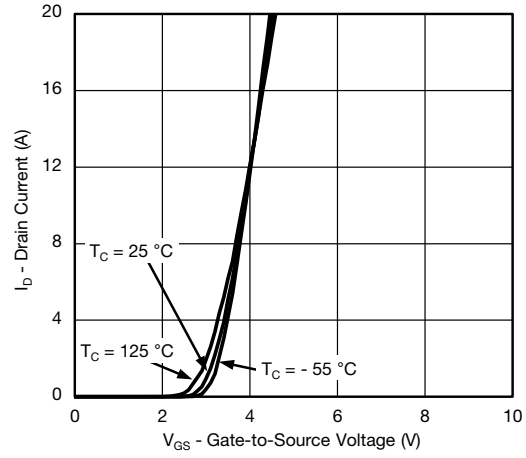
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



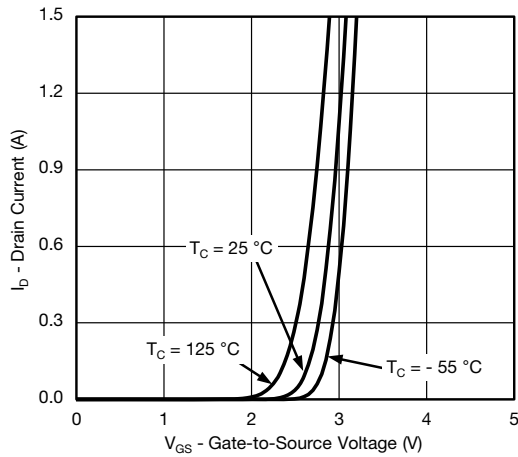
TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C, unless otherwise noted)



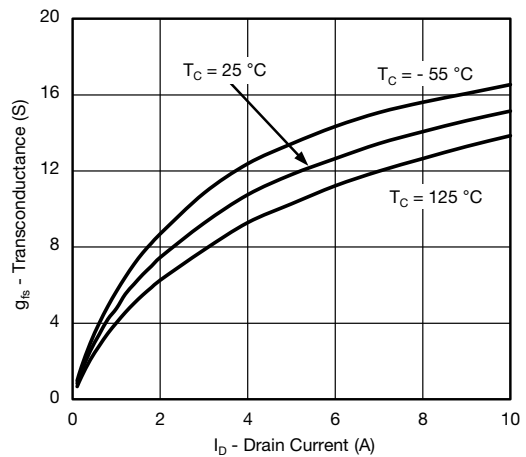
Output Characteristics



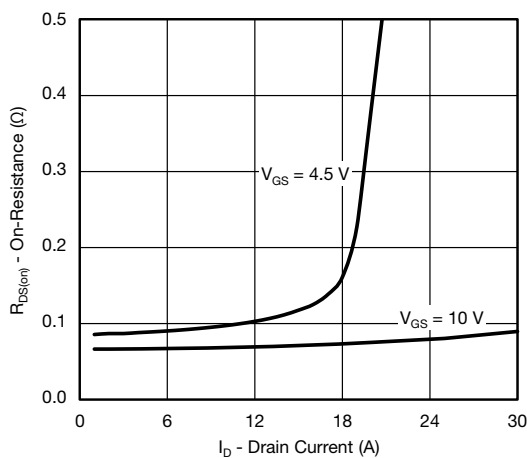
Transfer Characteristics



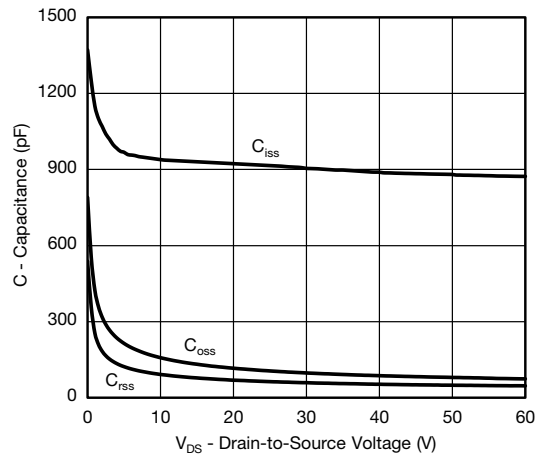
Transfer Characteristics



Transconductance



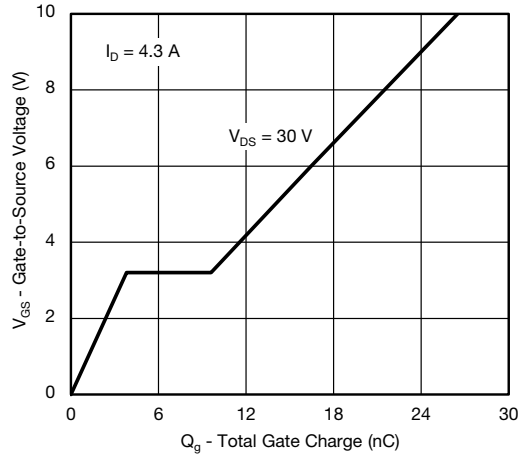
On-Resistance vs. Drain Current



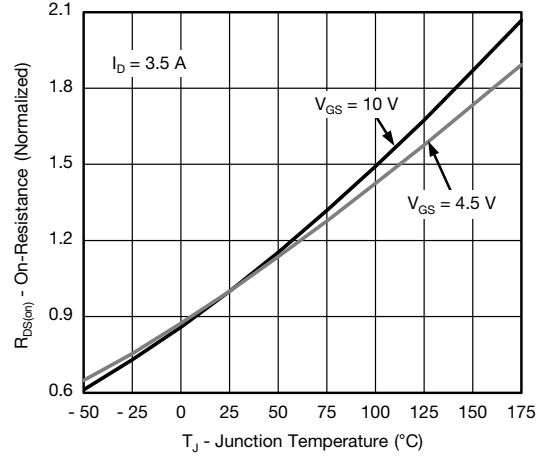
Capacitance



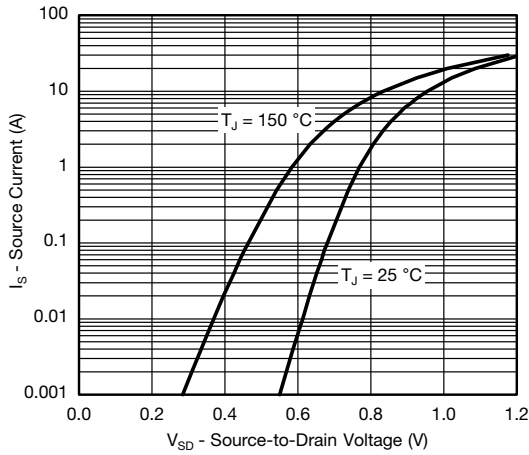
TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C, unless otherwise noted)



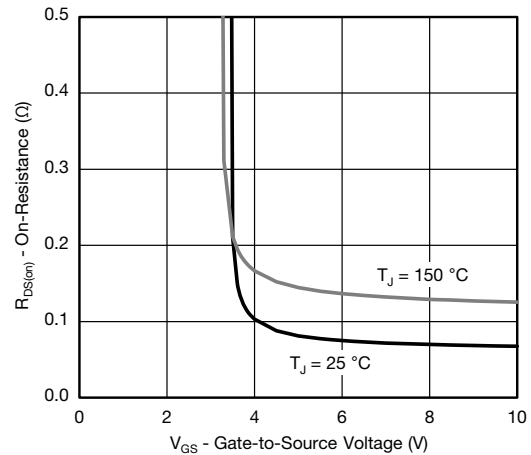
Gate Charge



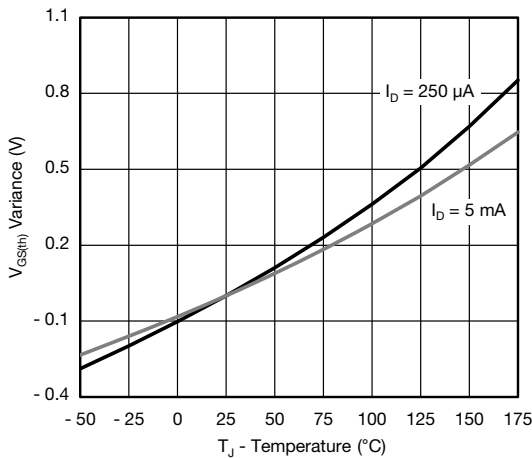
On-Resistance vs. Junction Temperature



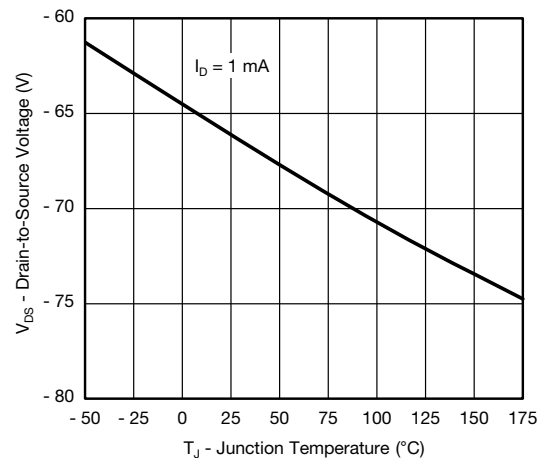
Source Drain Diode Forward Voltage



On-Resistance vs. Gate-to-Source Voltage

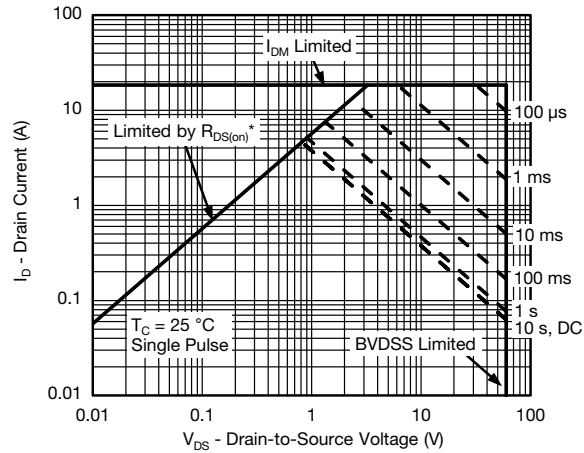


Threshold Voltage

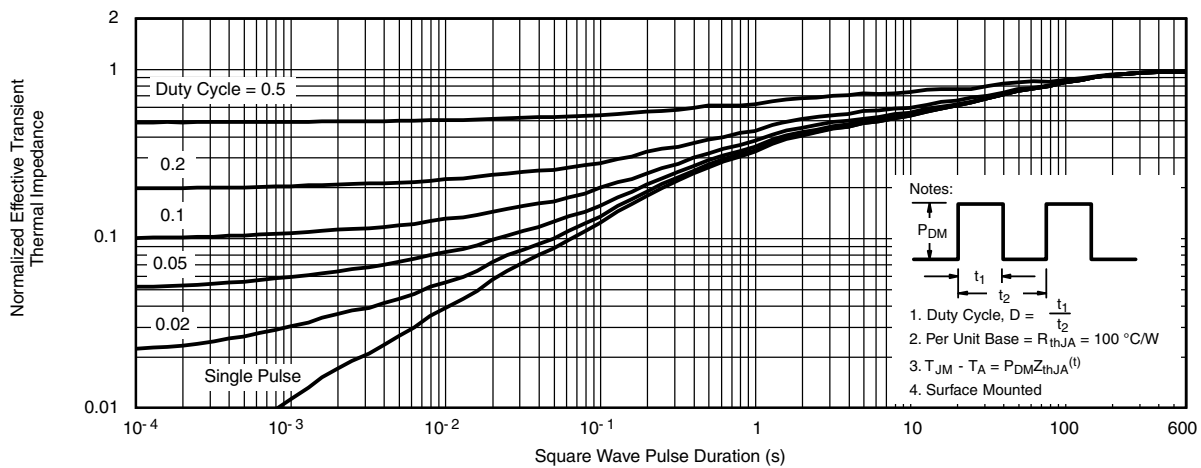


Drain Source Breakdown vs. Junction Temperature

**THERMAL RATINGS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



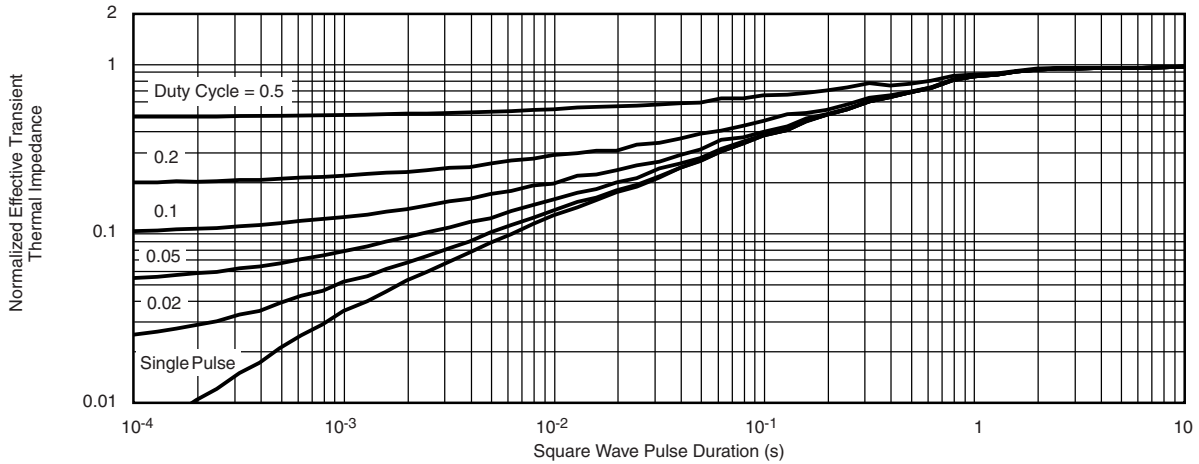
**Safe Operating Area**



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



**THERMAL RATINGS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



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

**Note**

- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient (25 °C)
  - Normalized Transient Thermal Impedance Junction-to-Foot (25 °C)
 are given for general guidelines only to enable the user to get a “ball park” indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions.

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## SO-8

Ordering codes for the SQ rugged series power MOSFETs in the SO-8 package:

DATASHEET PART NUMBER	OLD ORDERING CODE <sup>a</sup>	NEW ORDERING CODE
SQ4005EY	-	SQ4005EY-T1_GE3
SQ4050EY	SQ4050EY-T1-GE3	SQ4050EY-T1_GE3
SQ4182EY	SQ4182EY-T1-GE3	SQ4182EY-T1_GE3
SQ4184EY	SQ4184EY-T1-GE3	SQ4184EY-T1_GE3
SQ4282EY	SQ4282EY-T1-GE3	SQ4282EY-T1_GE3
SQ4284EY	SQ4284EY-T1-GE3	SQ4284EY-T1_GE3
SQ4401EY	SQ4401EY-T1-GE3	SQ4401EY-T1_GE3
SQ4410EY	SQ4410EY-T1-GE3	SQ4410EY-T1_GE3
SQ4425EY	SQ4425EY-T1-GE3	SQ4425EY-T1_GE3
SQ4431EY	SQ4431EY-T1-GE3	SQ4431EY-T1_GE3
SQ4435EY	SQ4435EY-T1-GE3	SQ4435EY-T1_GE3
SQ4470EY	SQ4470EY-T1-GE3	SQ4470EY-T1_GE3
SQ4483BEEY	SQ4483BEEY-T1-GE3	SQ4483BEEY-T1_GE3
SQ4483EY	-	SQ4483EY-T1_GE3
SQ4532AEY	-	SQ4532AEY-T1_GE3
SQ4840EY	SQ4840EY-T1-GE3	SQ4840EY-T1_GE3
SQ4850EY	SQ4850EY-T1-GE3	SQ4850EY-T1_GE3
SQ4917EY	SQ4917EY-T1-GE3	SQ4917EY-T1_GE3
SQ4920EY	SQ4920EY-T1-GE3	SQ4920EY-T1_GE3
SQ4937EY	SQ4937EY-T1-GE3	SQ4937EY-T1_GE3
SQ4940AEY	SQ4940AEY-T1-GE3	SQ4940AEY-T1_GE3
SQ4946AEY	SQ4946AEY-T1-GE3	SQ4946AEY-T1_GE3
SQ4949EY	SQ4949EY-T1-GE3	SQ4949EY-T1_GE3
SQ4961EY	SQ4961EY-T1-GE3	SQ4961EY-T1_GE3
SQ9407EY	SQ9407EY-T1-GE3	SQ9407EY-T1_GE3
SQ9945BEY	SQ9945BEY-T1-GE3	SQ9945BEY-T1_GE3

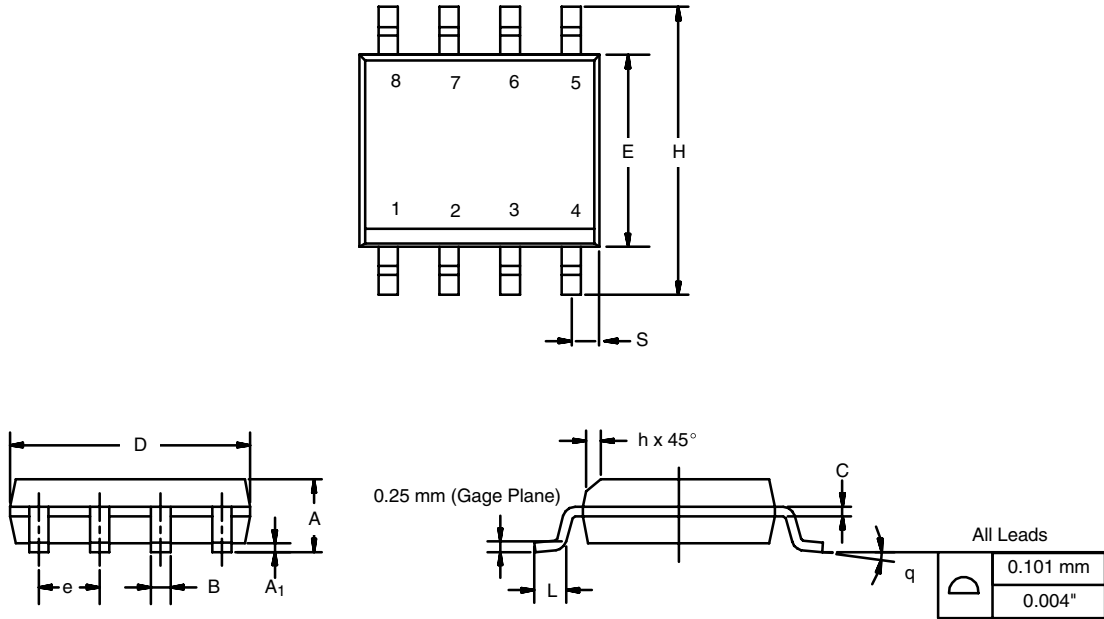
**Note**

a. Old ordering code is obsolete and no longer valid for new orders



**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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