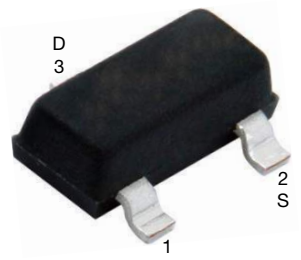
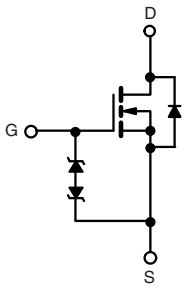
Automotive N-Channel 60 V (D-S) 175 °C MOSFET

PRODUCT SUMMARY	
V_{DS} (V)	60
$R_{DS(on)}$ (Ω) at V_{GS} = 10 V	0.085
$R_{DS(on)}$ (Ω) at V_{GS} = 4.5 V	0.130
I_D (A)	4
Configuration	Single

SOT-23 (TO-236)



Top View



N-Channel MOSFET

Marking Code: 8Mxxx

FEATURES

- TrenchFET® Power MOSFET
- AEC-Q101 Qualified[c]
- 100 % R_g and UIS Tested
- Typical ESD Protection 800 V
- Material categorization:
  For definitions of compliance please see www.vishay.com/doc?99912

AUTOMOTIVE GRADE

Pb-free

RoHS COMPLIANT

HALOGEN FREE

ORDERING INFORMATION	
Package	SOT-23
Lead (Pb)-free and Halogen-free	SQ2360EES-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}	± 20	
Continuous Drain Current	T_C = 25 °C	I_D	4	A
	T_C = 125 °C		2.3	
Continuous Source Current (Diode Conduction)		I_S	3.7	
Pulsed Drain Current [a]		I_{DM}	16	
Single Pulse Avalanche Current	L = 0.1 mH	I_{AS}	6	
Single Pulse Avalanche Energy		E_{AS}	1.8	mJ
Maximum Power Dissipation [a]	T_C = 25 °C	P_D	3	W
	T_C = 125 °C		1	
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 [b]	R_{thJA}	166	°C/W
Junction-to-Foot (Drain)		R_{thJF}	50	

Notes

a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. When mounted on 1" square PCB (FR-4 material).
c. Parametric verification ongoing.

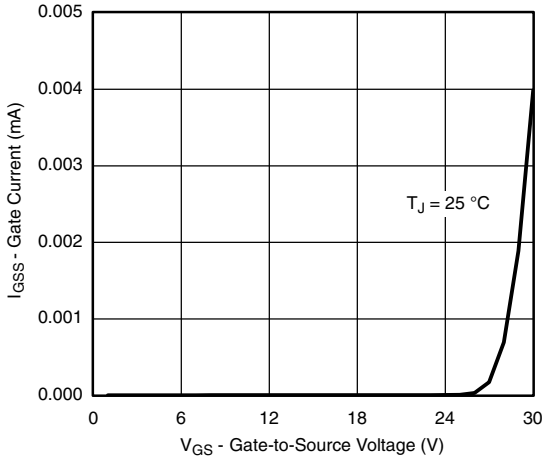
SPECIFICATIONS (T_C = 25 °C, unless otherwise noted)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS**		**MIN.**	**TYP.**	**MAX.**	**UNIT**
Static							
Drain-Source Breakdown Voltage	V_{DS}	V_{GS} = 0, I_D = 250 µA		60	-	-	V
Gate-Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 µA		1.5	-	2.5	
Gate-Source Leakage	I_{GSS}	V_{DS} = 0 V, V_{GS} = ± 20 V		-	-	± 5.5	µA
Zero Gate Voltage Drain Current	I_{DSS}	V_{GS} = 0 V	V_{DS} = 60 V	-	-	1	µA
		V_{GS} = 0 V	V_{DS} = 60 V, T_J = 125 °C	-	-	50	
		V_{GS} = 0 V	V_{DS} = 60 V, T_J = 175 °C	-	-	150	
On-State Drain Current [a]	$I_{D(on)}$	V_{GS} = 10 V	V_{DS} ≥ 5 V	10	-	-	A
Drain-Source On-State Resistance [a]	$R_{DS(on)}$	V_{GS} = 10 V	I_D = 6 A, T_J = 25 °C	-	0.058	0.085	Ω
		V_{GS} = 10 V	I_D = 6 A, T_J = 125 °C	-	-	0.197	
		V_{GS} = 10 V	I_D = 6 A, T_J = 175 °C	-	-	0.258	Ω
		V_{GS} = 4.5 V	I_D = 5 A	-	0.081	0.130	
Forward Transconductance [b]	g_{fs}	V_{DS} = -15 V, I_D = 1.9 A		-	5.8	-	S
Dynamic [b]							
Input Capacitance	C_{iss}	V_{GS} = 0 V	V_{DS} = 25 V, f = 1 MHz	-	295	370	pF
Output Capacitance	C_{oss}			-	55	70	
Reverse Transfer Capacitance	C_{rss}			-	35	55	
Total Gate Charge [c]	Q_g	V_{GS} = 10 V	V_{DS} = 30 V, I_D = 2 A	-	7.40	12	nC
Gate-Source Charge [c]	Q_{gs}			-	0.95	-	
Gate-Drain Charge [c]	Q_{gd}			-	1.94	-	
Gate Resistance	R_g	f = 1 MHz		1.24	2.46	3.68	Ω
Turn-On Delay Time [c]	$t_{d(on)}$	V_{DD} = 30 V, R_L = 15 Ω I_D ≅ 2 A, V_{GEN} = 10 V, R_g = 1 Ω		-	5	8	ns
Rise Time [c]	t_r			-	11	17	
Turn-Off Delay Time [c]	$t_{d(off)}$			-	10	15	
Fall Time [c]	t_f			-	8	12	
Source-Drain Diode Ratings and Characteristics [b]							
Pulsed Current [a]	I_{SM}			-	-	16	A
Forward Voltage	V_{SD}	I_F = 1.5 A, V_{GS} = 0		-	0.8	1.2	V

Notes

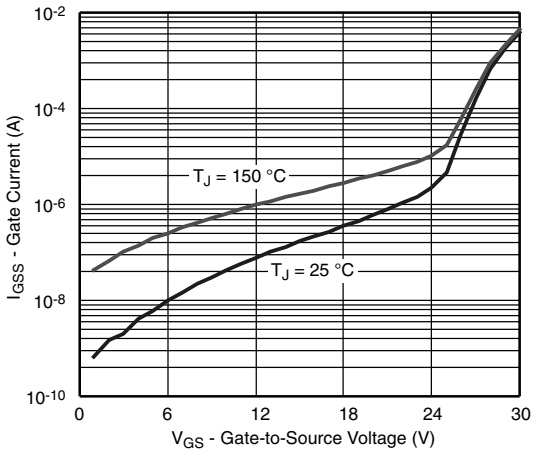
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.
c. Independent of operating temperature.

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.

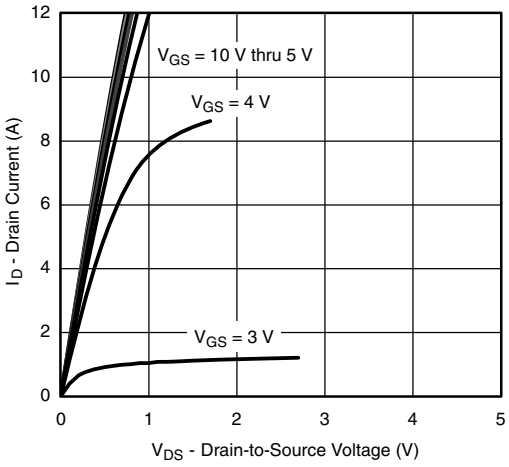
TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



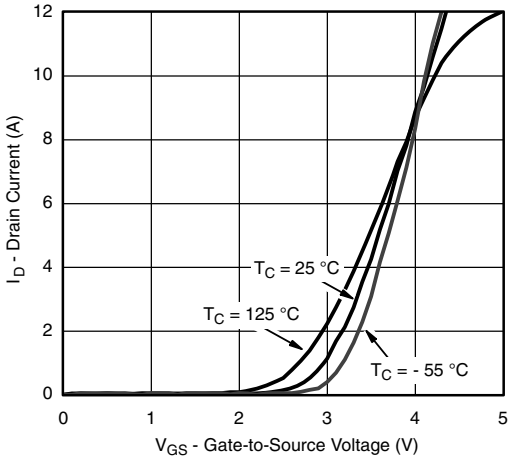
Gate Current vs. Gate-Source Voltage



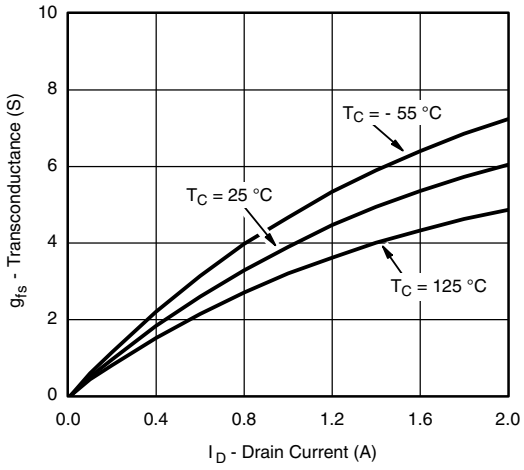
Gate Current vs. Gate-Source Voltage



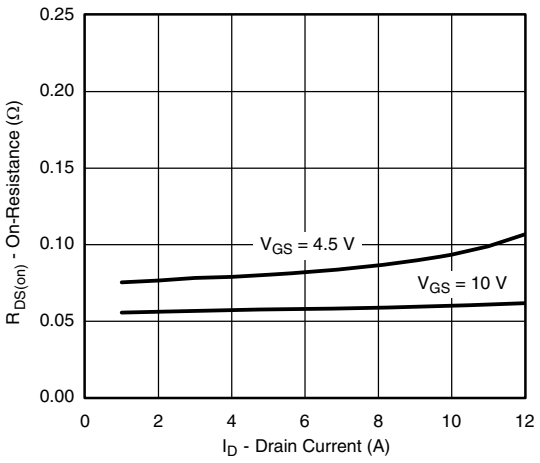
Output Characteristics



Transfer Characteristics

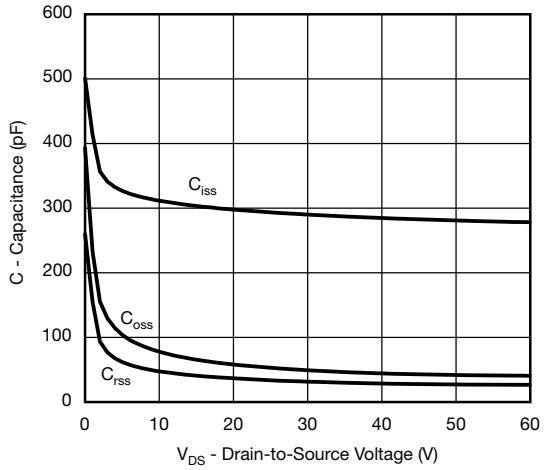


Transconductance

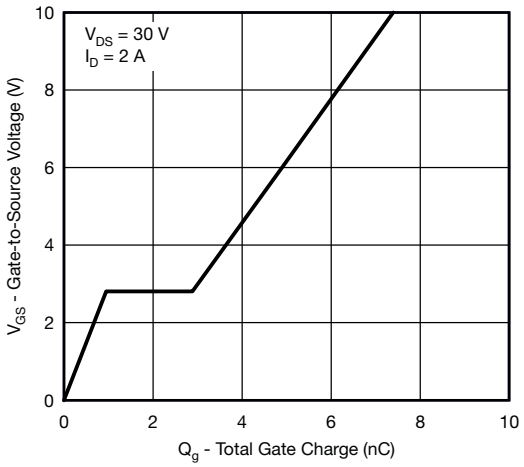


On-Resistance vs. Drain Current

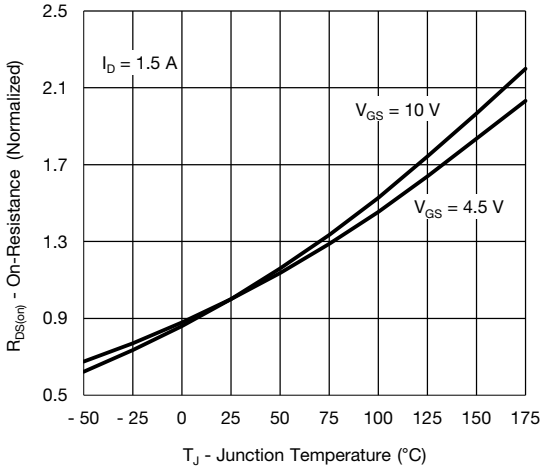
TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



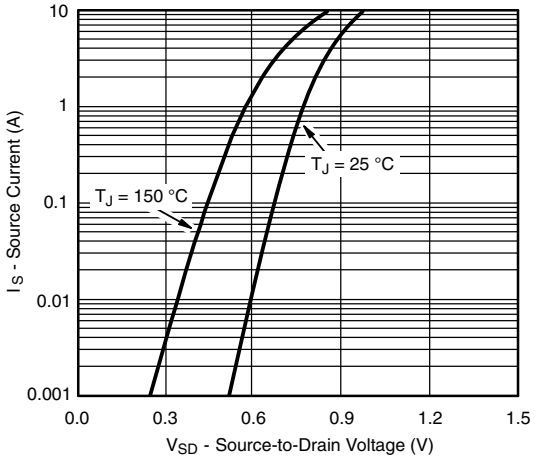
Capacitance



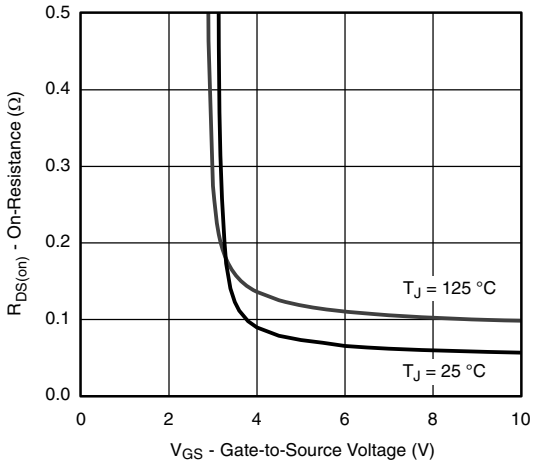
Gate Charge



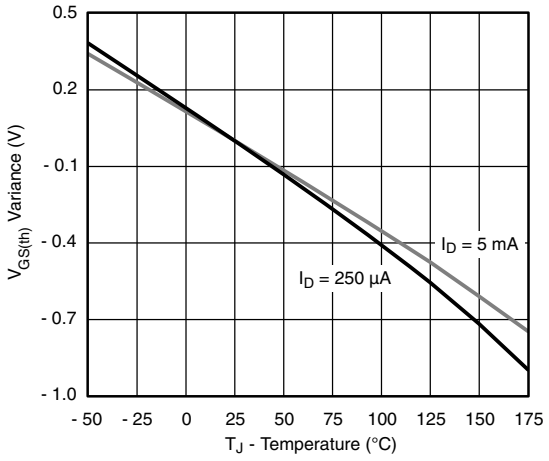
On-Resistance vs. Junction Temperature



Source-Drain Diode Forward Voltage

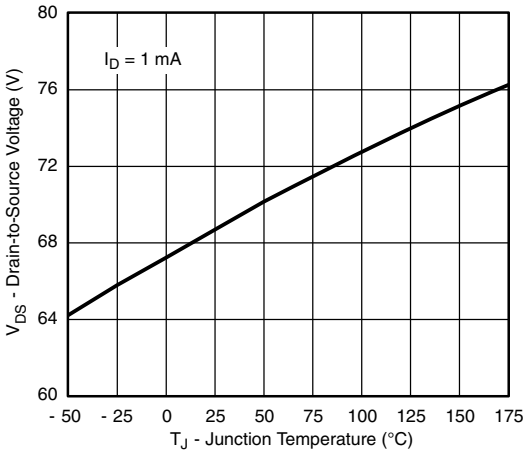


On-Resistance vs. Gate-Source Voltage

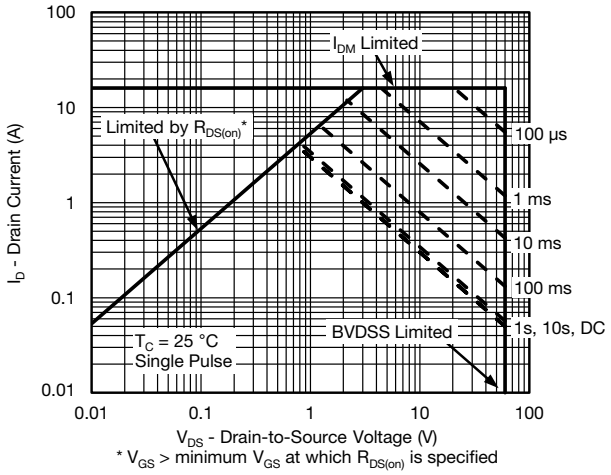


Threshold Voltage

TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)

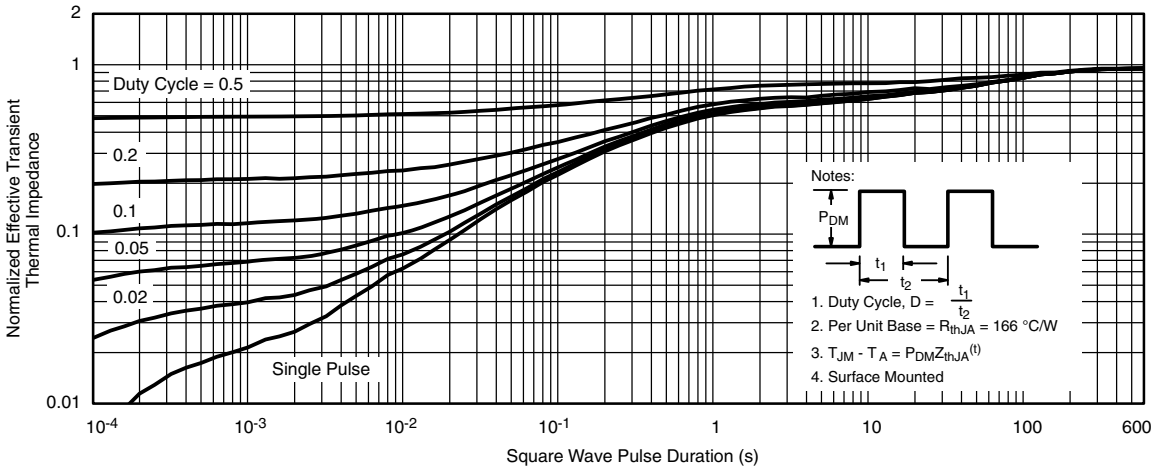


Drain-Source Breakdown vs. Junction Temperature



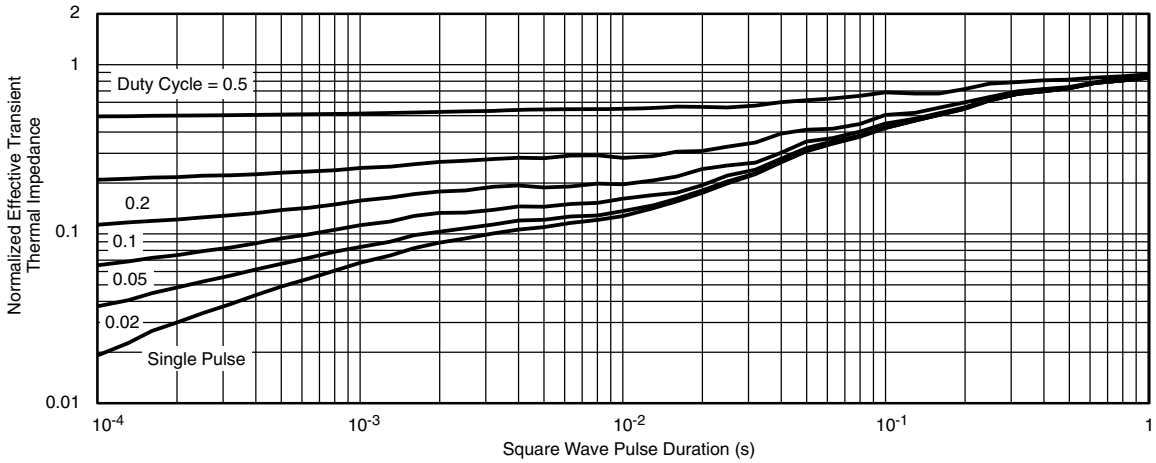
Safe Operating Area

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



Normalized Thermal Transient Impedance, Junction-to-Ambient

THERMAL RATINGS (T_A = 25 °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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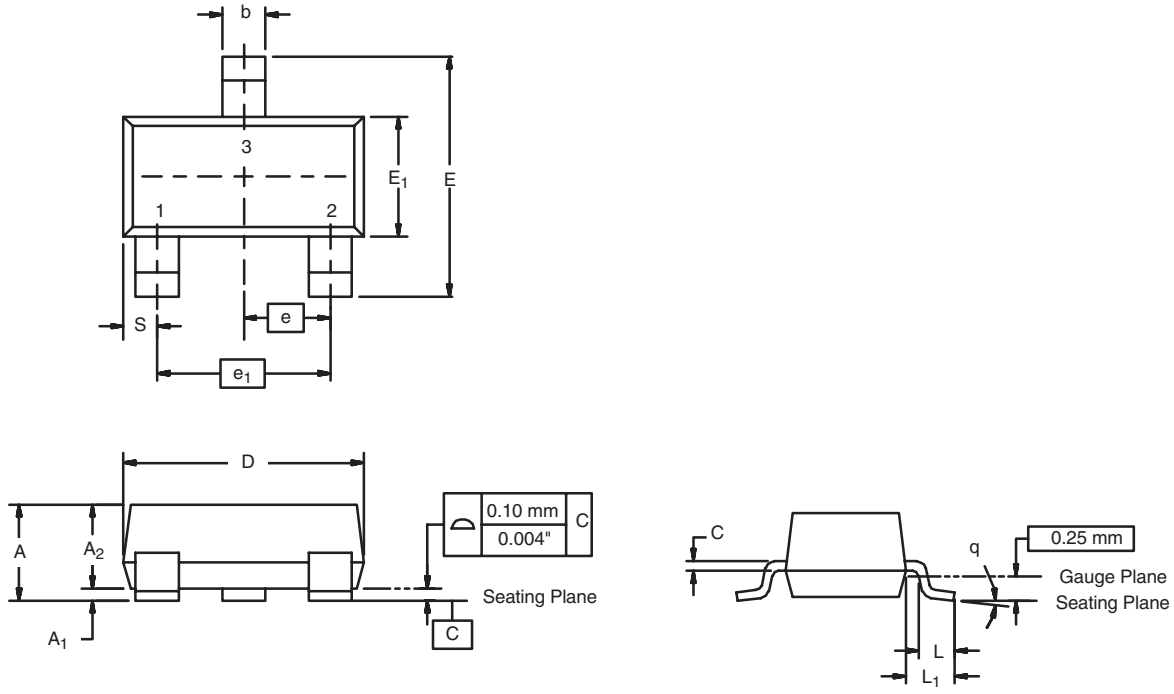
REVISION HISTORY [a]		
REVISION	**DATE**	**DESCRIPTION OF CHANGE**
F	04-Apr-14	• Correction of $R_{DS(on)}$ value used in calculation of maximum continuous drain current and safe operating area curve. • V_{GS} = 4.5 V curve added to on-resistance vs. junction temperature graph.

Note

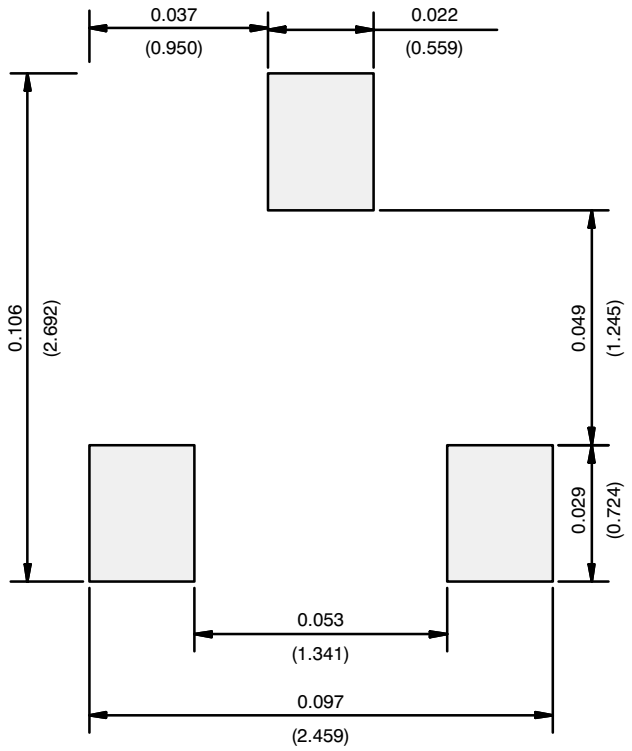
a. As of April 2014

SOT-23 (TO-236): 3-LEAD



Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	0.89	1.12	0.035	0.044
A_1	0.01	0.10	0.0004	0.004
A_2	0.88	1.02	0.0346	0.040
b	0.35	0.50	0.014	0.020
c	0.085	0.18	0.003	0.007
D	2.80	3.04	0.110	0.120
E	2.10	2.64	0.083	0.104
E_1	1.20	1.40	0.047	0.055
e	0.95 BSC		0.0374 Ref	
e_1	1.90 BSC		0.0748 Ref	
L	0.40	0.60	0.016	0.024
L_1	0.64 Ref		0.025 Ref	
S	0.50 Ref		0.020 Ref	
q	3°	8°	3°	8°
ECN: S-03946-Rev. K, 09-Jul-01 DWG: 5479				

RECOMMENDED MINIMUM PADS FOR SOT-23



Recommended Minimum Pads
Dimensions in Inches/(mm)

Return to Index

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