



P-Channel 60-V (D-S) MOSFET

PRODUCT SUMMARY			
V_{DS} (V)	$R_{DS(on)}$ (Ω)	I_D (A) ^d	Q_g (Typ.)
- 60	0.345 at $V_{GS} = - 10$ V	- 1.6	2.7 nC
	0.450 at $V_{GS} = - 4.5$ V	- 1.4	

FEATURES

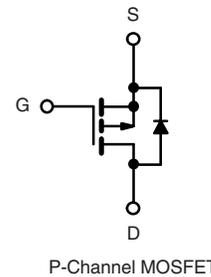
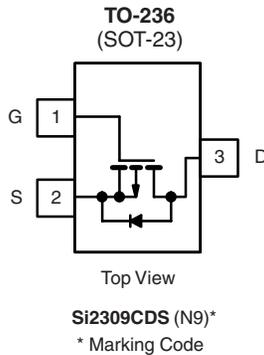
- Halogen-free Option Available
- TrenchFET[®] Power MOSFET



RoHS
COMPLIANT

APPLICATIONS

- Load Switch



Ordering Information: Si2309CDS-T1-E3 (Lead (Pb)-free)
Si2309CDS-T1-GE3 (Lead (Pb)-free and Halogen-free)

ABSOLUTE MAXIMUM RATINGS $T_A = 25$ °C, unless otherwise noted				
Parameter	Symbol	Limit	Unit	
Drain-Source Voltage	V_{DS}	- 60	V	
Gate-Source Voltage	V_{GS}	± 20		
Continuous Drain Current ($T_J = 150$ °C) ^{a, b}	$T_C = 25$ °C	- 1.6	A	
	$T_C = 70$ °C	- 1.3		
	$T_A = 25$ °C	- 1.2 ^{a, b}		
	$T_A = 70$ °C	- 1.0 ^{a, b}		
Pulsed Drain Current (10 μ s Pulse Width)	I_{DM}	- 8	A	
Single Pulse Avalanche Current	$L = 0.1$ mH I_{AS}	- 5		
Continuous Source-Drain Diode Current	$T_C = 25$ °C	- 1.4	A	
	$T_A = 25$ °C	- 0.9 ^{a, b}		
Maximum Power Dissipation	$T_C = 25$ °C	1.7	W	
	$T_C = 70$ °C	1.1		
	$T_A = 25$ °C	1.0 ^{a, b}		
	$T_A = 70$ °C	0.67 ^{a, b}		
Operating Junction and Storage Temperature Range	T_J, T_{stg}	- 55 to 150	°C	
Soldering Recommendations (Peak Temperature) ^c		260		

THERMAL RESISTANCE RATINGS					
Parameter	Symbol	Typical	Maximum	Unit	
Maximum Junction-to-Ambient ^{a, c}	$t \leq 5$ s R_{thJA}	92	120	°C/W	
Maximum Junction-to-Foot (Drain)	Steady State R_{thJF}	58	73		

Notes:

a. Surface Mounted on 1" x 1" FR4 board.

b. $t = 5$ s.

c. Maximum under Steady State conditions is 166 °C/W.

d. When $T_C = 25$ °C.



SPECIFICATIONS $T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Static						
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$	- 60			V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = -250\text{ }\mu\text{A}$		- 65		mV/°C
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$		4.5			
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	- 1		- 3	V
Gate-Source Leakage	I_{GSS}	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			- 100	nA
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = -60\text{ V}, V_{GS} = 0\text{ V}$			- 1	μA
		$V_{DS} = -60\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$			- 10	
On-State Drain Current ^a	$I_{D(on)}$	$V_{DS} \leq 5\text{ V}, V_{GS} = -10\text{ V}$	- 6			A
Drain-Source On-State Resistance ^a	$R_{DS(on)}$	$V_{GS} = -10\text{ V}, I_D = -1.25\text{ A}$		0.285	0.345	Ω
		$V_{GS} = -4.5\text{ V}, I_D = -1.0\text{ A}$		0.360	0.450	
Forward Transconductance ^a	g_{fs}	$V_{DS} = -10\text{ V}, I_D = -1.0\text{ A}$		2.8		S
Dynamic^b						
Input Capacitance	C_{iss}	$V_{DS} = -30\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		210		pF
Output Capacitance	C_{oss}		28			
Reverse Transfer Capacitance	C_{rss}		20			
Total Gate Charge	Q_g	$V_{DS} = -30\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -1.25\text{ A}$		2.7	4.1	nC
Gate-Source Charge	Q_{gs}		0.8			
Gate-Drain Charge	Q_{gd}		1.2			
Gate Resistance	R_g	$f = 1\text{ MHz}$		7		Ω
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -30\text{ V}, R_L = 30\text{ }\Omega$ $I_D \cong -1\text{ A}, V_{GEN} = -4.5\text{ V}, R_g = 1\text{ }\Omega$		40	60	ns
Rise Time	t_r		35	55		
Turn-Off Delay Time	$t_{d(off)}$		15	25		
Fall Time	t_f		10	20		
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -30\text{ V}, R_L = 30\text{ }\Omega$ $I_D \cong -1\text{ A}, V_{GEN} = -10\text{ V}, R_g = 1\text{ }\Omega$		5	10	
Rise Time	t_r		10	20		
Turn-Off Delay Time	$t_{d(off)}$		15	25		
Fall Time	t_f		10	20		
Drain-Source Body Diode Characteristics						
Continuous Source-Drain Diode Current	I_S	$T_C = 25\text{ }^\circ\text{C}$			- 1.4	A
Pulse Diode Forward Current	I_{SM}				- 8	
Body Diode Voltage	V_{SD}	$I_S = -0.75\text{ A}, V_{GS} = 0\text{ V}$		- 0.8	- 1.2	V
Body Diode Reverse Recovery Time	t_{rr}	$I_F = -1.25\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$		30	60	ns
Body Diode Reverse Recovery Charge	Q_{rr}		33	60	nC	
Reverse Recovery Fall Time	t_a		18		ns	
Reverse Recovery Rise Time	t_b		12			

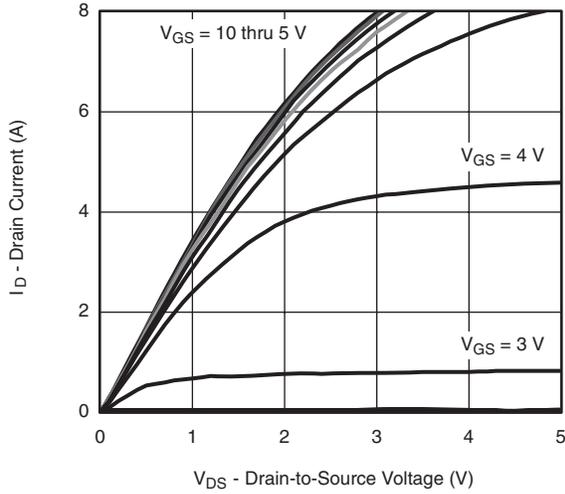
Notes:

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

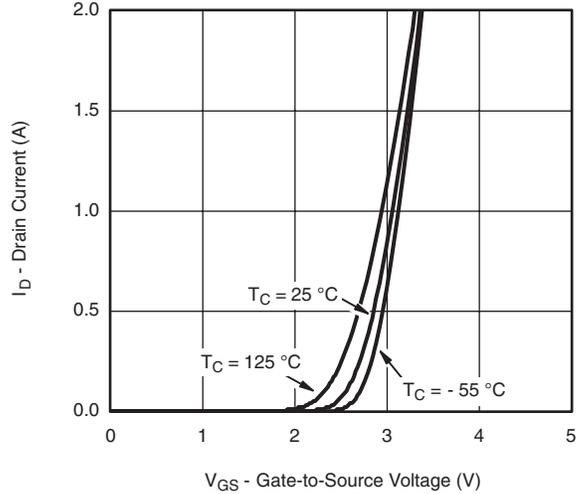
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



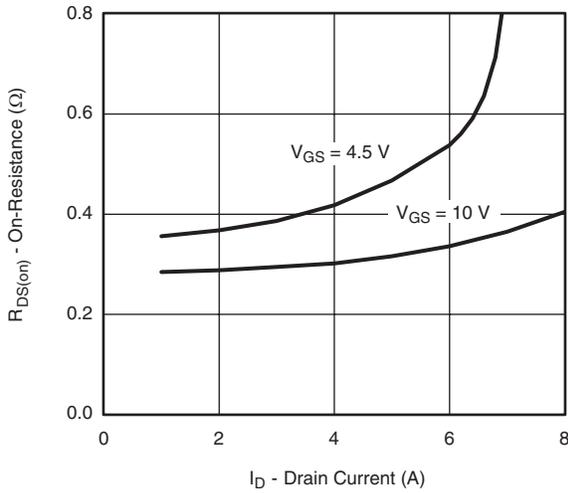
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



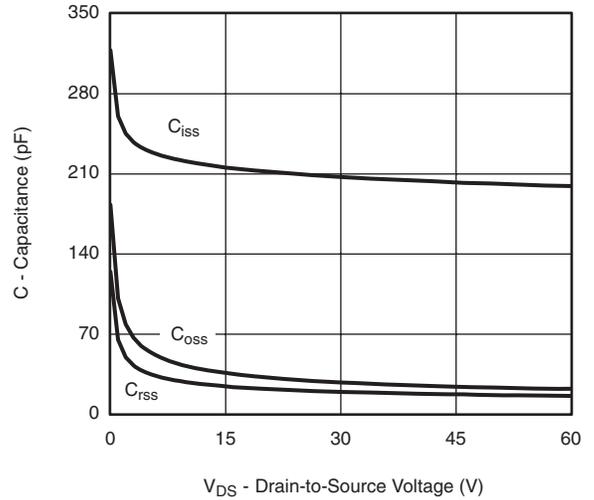
Output Characteristics



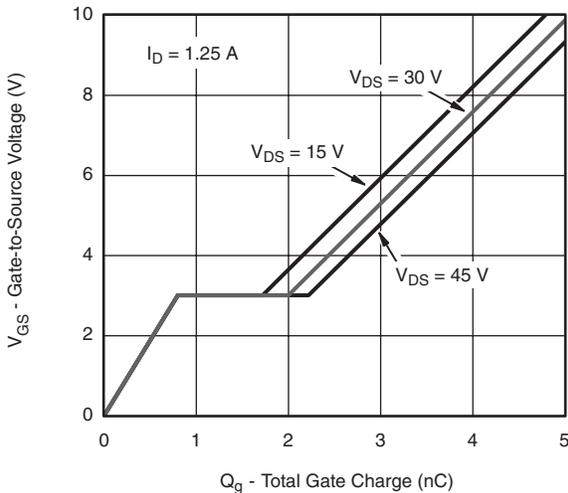
Transfer Characteristics



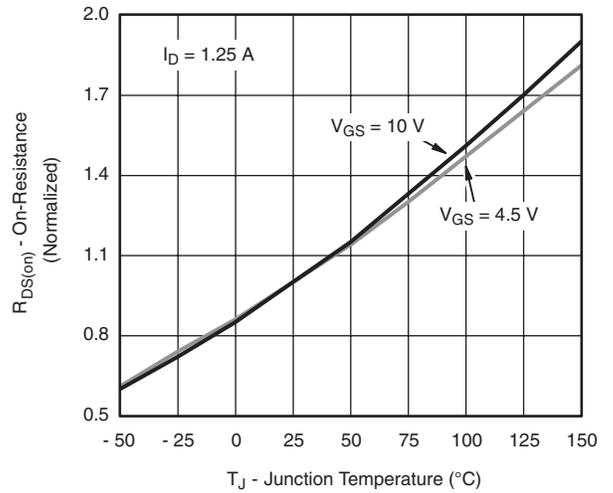
On-Resistance vs. Drain Current and Gate Voltage



Capacitance



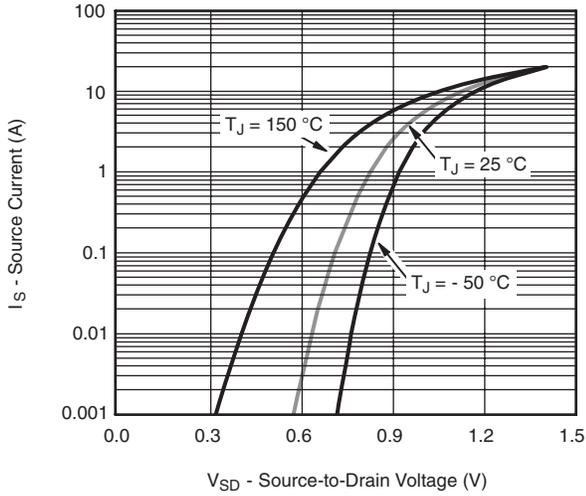
Gate Charge



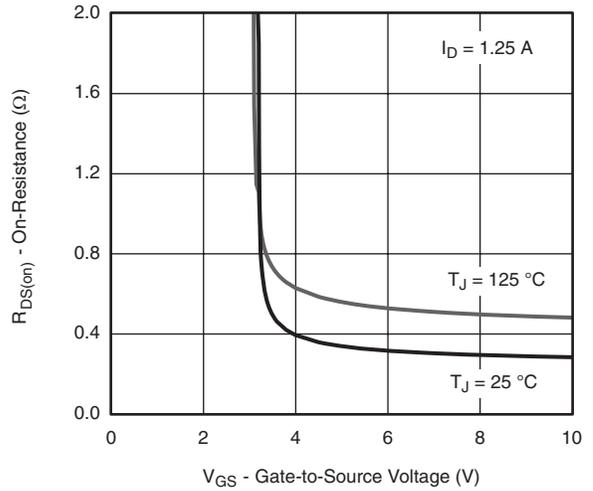
On-Resistance vs. Junction Temperature



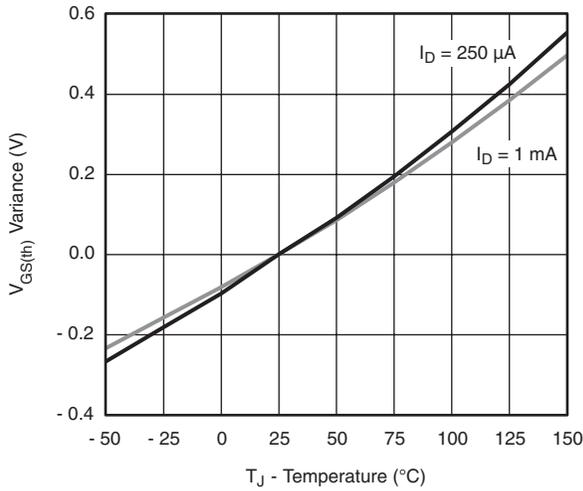
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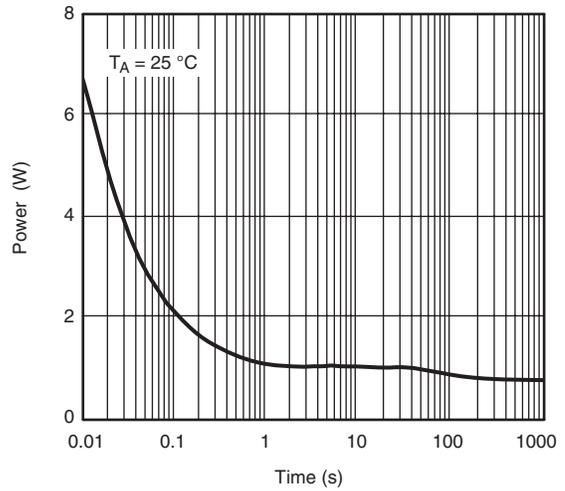
Source-Drain Diode Forward Voltage



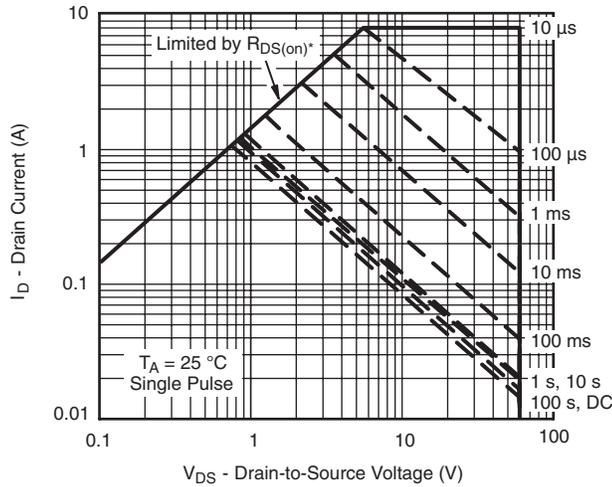
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



Single Pulse Power, Junction-to-Ambient

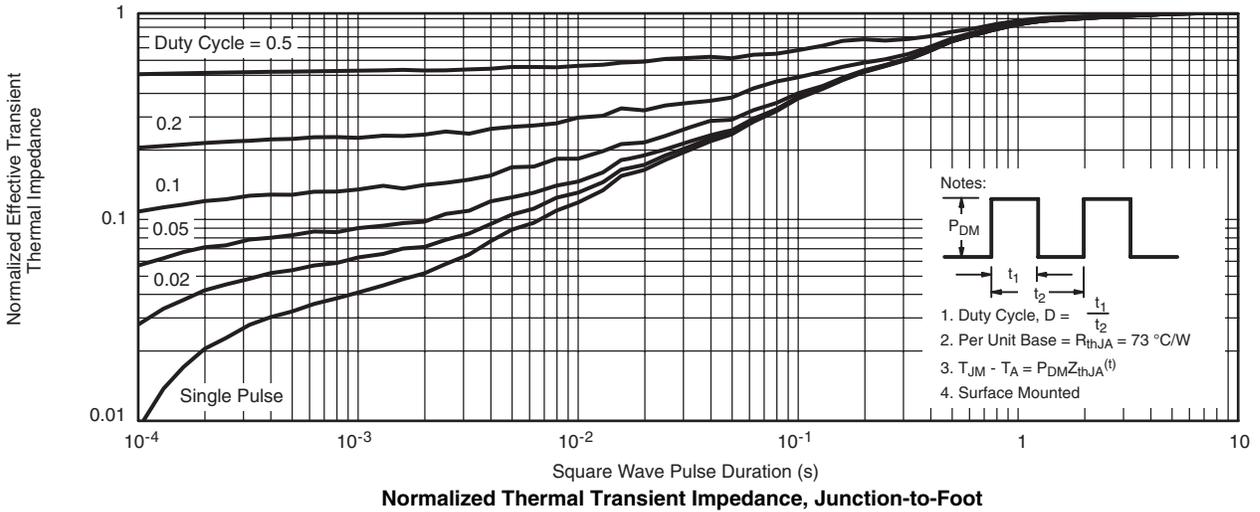
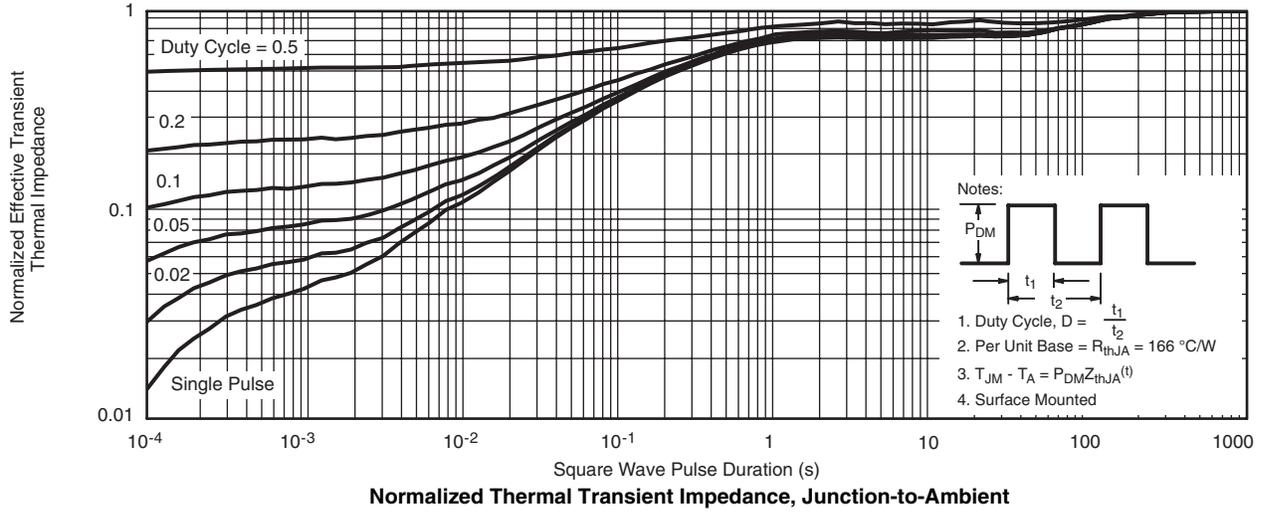


* $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified

Safe Operating Area, Junction-to-Ambient

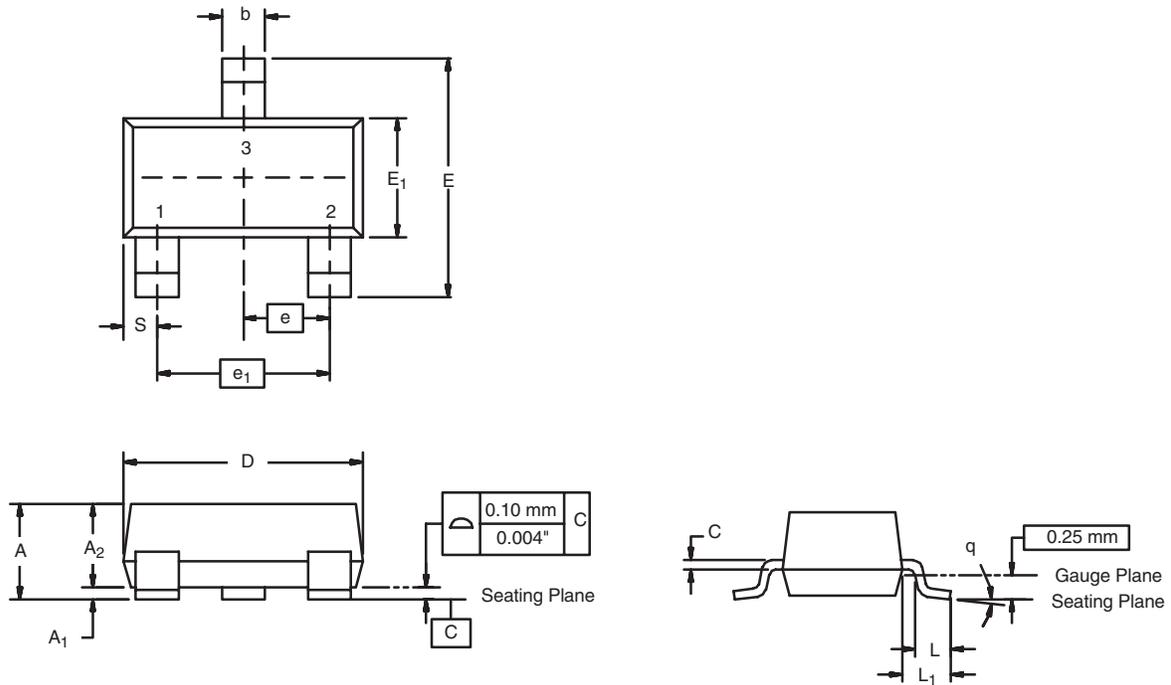


TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



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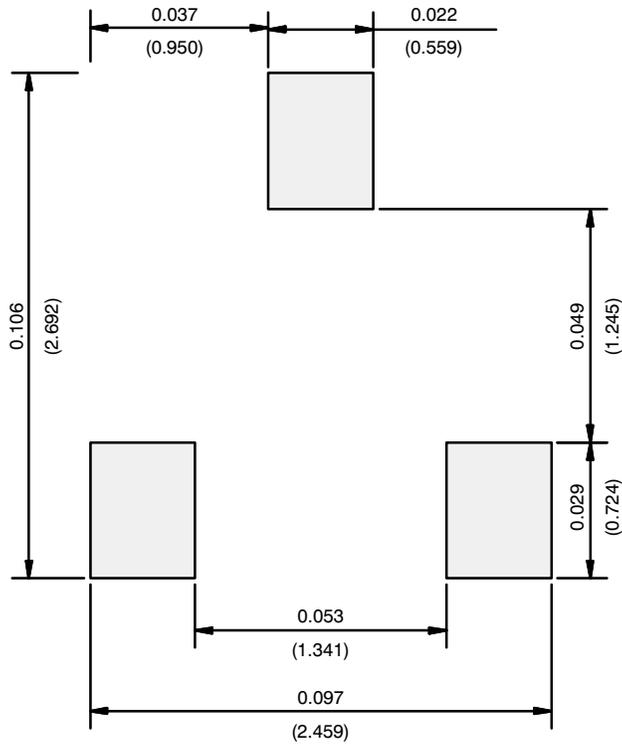
SOT-23 (TO-236): 3-LEAD



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)

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