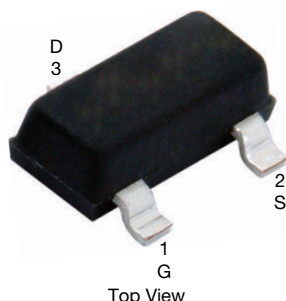


Automotive P-Channel 60 V (D-S) 175 °C MOSFET

SOT-23 (TO-236)



Marking code: 9NYXX

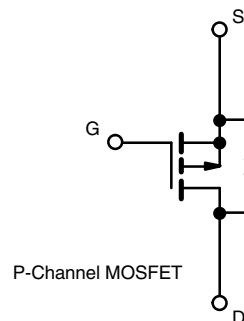
PRODUCT SUMMARY

V_{DS} (V)	-60
$R_{DS(on)}$ max. (Ω) at $V_{GS} = -10$ V	0.335
$R_{DS(on)}$ max. (Ω) at $V_{GS} = -4.5$ V	0.500
I_D (A)	-1.7
Configuration	Single

FEATURES

- TrenchFET® power MOSFET
- AEC-Q101 qualified
- 100 % R_g and UIS tested
- Material categorization:
for definitions of compliance please see
www.vishay.com/doc?99912

AUTOMOTIVE
GRADE

RoHS
COMPLIANT
HALOGEN
FREE


P-Channel MOSFET

ORDERING INFORMATION

Package	SOT-23
Lead (Pb)-free and halogen-free	SQ2309CES (for detailed order number please see www.vishay.com/doc?79771)

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	I_D	$T_C = 25$ °C	A
		$T_C = 125$ °C	
Continuous source current (diode conduction)	I_S	-2.6	
Pulsed drain current ^a	I_{DM}	-6.8	
Single pulse avalanche current	I_{AS}	-6.8	
Single pulse avalanche energy	E_{AS}	2.3	mJ
Maximum power dissipation	P_D	$T_C = 25$ °C	W
		$T_C = 125$ °C	
Operating junction and storage temperature range	T_J, T_{stg}	-55 to +175	°C

THERMAL RESISTANCE RATINGS

PARAMETER	SYMBOL	LIMIT	UNIT
Junction-to-ambient	R_{thJA}	166	°C/W
Junction-to-foot (drain)	R_{thJF}	73	

Notes

- Pulse test; pulse width ≤ 300 μ s, duty cycle ≤ 2 %
- When mounted on 1" square PCB (FR4 material)



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 V, I _D = -250 μA		-60	-	-	V
Gate-source threshold voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = -250 μA		-1.5	-2.0	-2.5	
Gate-source leakage	I _{GSS}	V _{DS} = 0 V, V _{GS} = ± 20 V		-	-	± 100	nA
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	-5	-	-	A
Drain-source on-state resistance ^a	R _{DS(on)}	V _{GS} = -10 V	I _D = -1.25 A	-	0.268	0.370	Ω
		V _{GS} = -10 V	I _D = -1.25 A, T _J = 125 °C	-	-	0.567	
		V _{GS} = -10 V	I _D = -1.25 A, T _J = 175 °C	-	-	0.704	
		V _{GS} = -4.5 V	I _D = -1 A	-	0.354	0.500	
Forward transconductance ^b	g _{fs}	V _{DS} = -5 V, I _D = -1 A		-	1.8	-	S
Dynamic ^b							
Input capacitance	C _{iss}	V _{GS} = 0 V	V _{DS} = -25 V, f = 1 MHz	-	211	265	pF
Output capacitance	C _{oss}			-	30	40	
Reverse transfer capacitance	C _{rss}			-	21	30	
Total gate charge ^c	Q _g	V _{GS} = -10 V	V _{DS} = -30 V, I _D = -1 A	-	5.5	8.5	nC
Gate-source charge ^c	Q _{gs}			-	0.8	-	
Gate-drain charge ^c	Q _{gd}			-	1.3	-	
Gate resistance	R _g	f = 1 MHz		2.7	5.40	14.80	Ω
Turn-on delay time ^c	t _{d(on)}	V _{DD} = -30 V, R _L = 30 Ω I _D ≅ -3 A, V _{GEN} = -10 V, R _g = 1 Ω		-	5	8	ns
Rise time ^c	t _r			-	9	14	
Turn-off delay time ^c	t _{d(off)}			-	12	18	
Fall time ^c	t _f			-	9	14	
Source-Drain Diode Ratings and Characteristics ^b							
Pulsed current ^a	I _{SM}			-	-	-6.8	A
Forward voltage	V _{SD}	I _F = -1.5 A, V _{GS} = 0 V		-	-0.85	-1.2	V
Body diode reverse recovery time	t _{rr}	I _F = -1.2 A, di/dt = 100 A/μs		-	23	46	ns
Body diode reverse recovery charge	Q _{rr}			-	24	48	nC
Reverse recovery fall time	t _a			-	20	-	ns
Reverse recovery rise time	t _b			-	3	-	
Body diode peak reverse recovery current	I _{RM(REC)}			-	-3.1	-	A

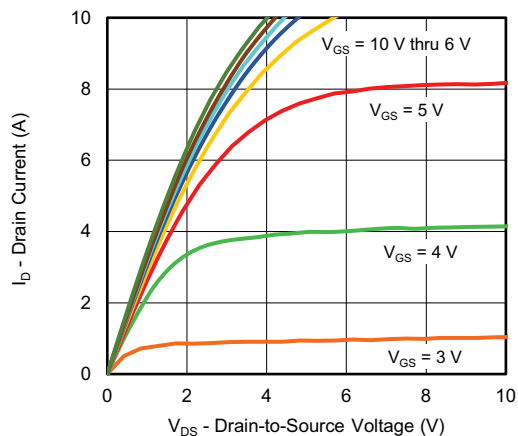
Notes

- 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

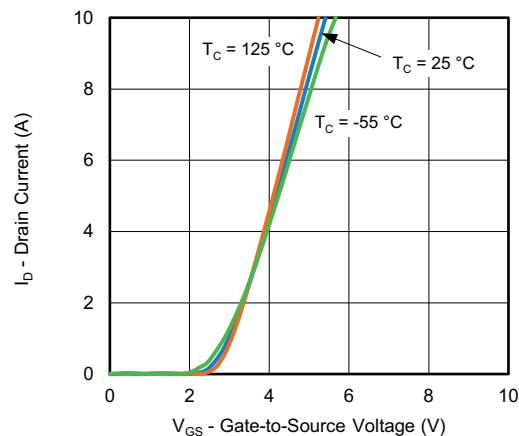
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



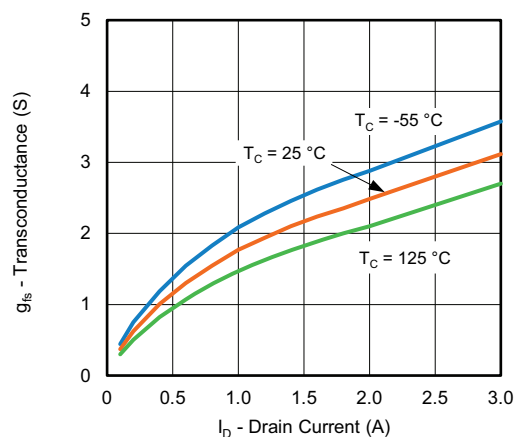
TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)



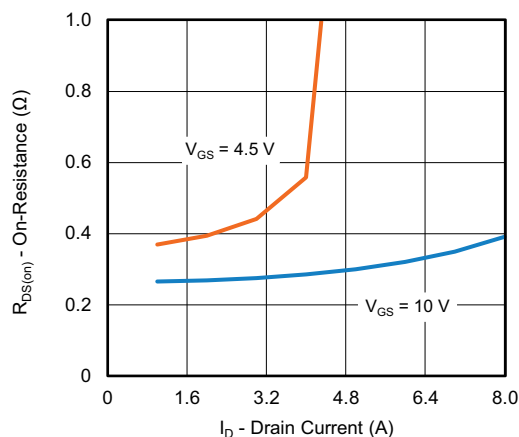
Output Characteristics



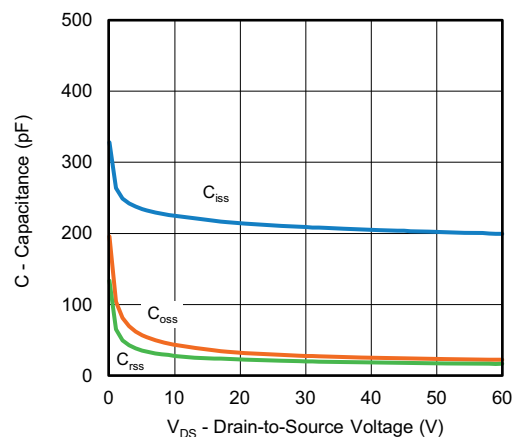
Transfer Characteristics



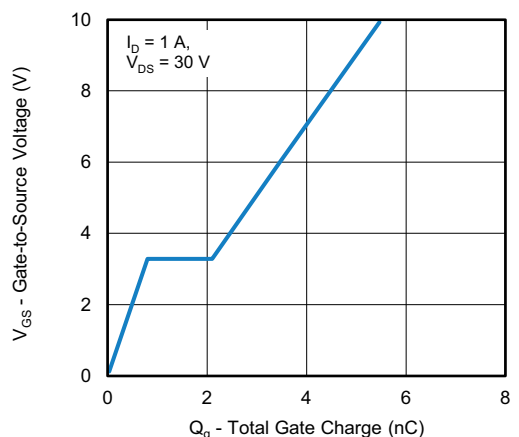
Transconductance



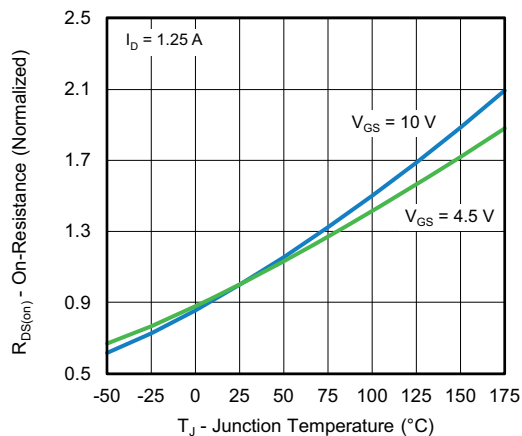
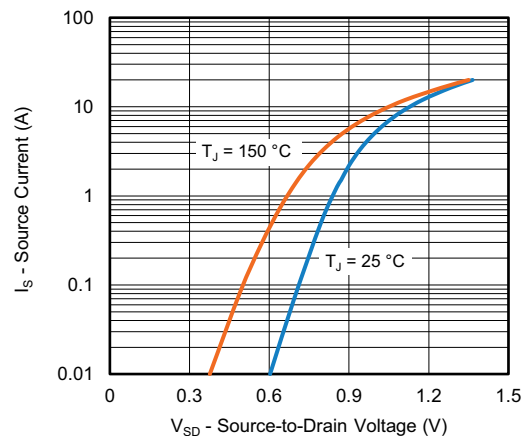
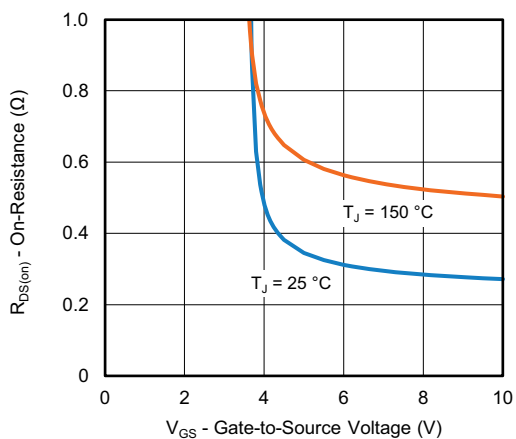
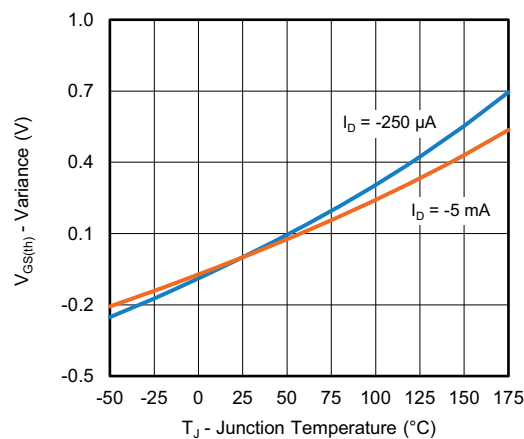
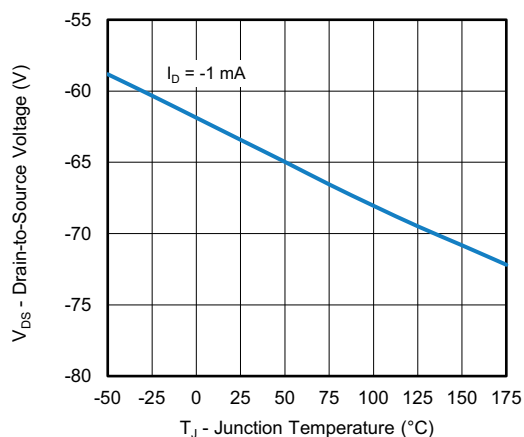
On-Resistance vs. Drain Current



Capacitance

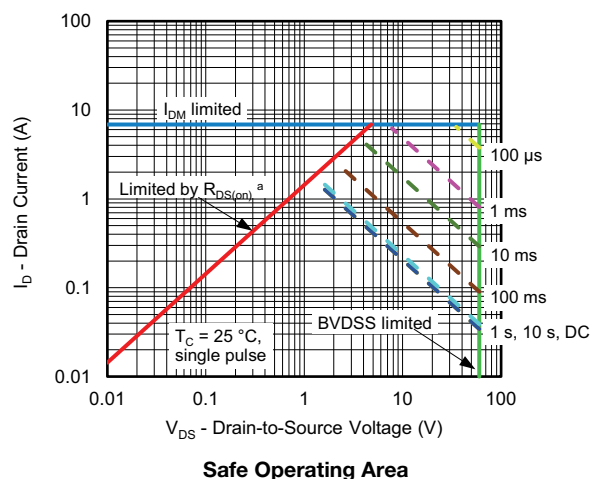


Gate Charge

TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

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

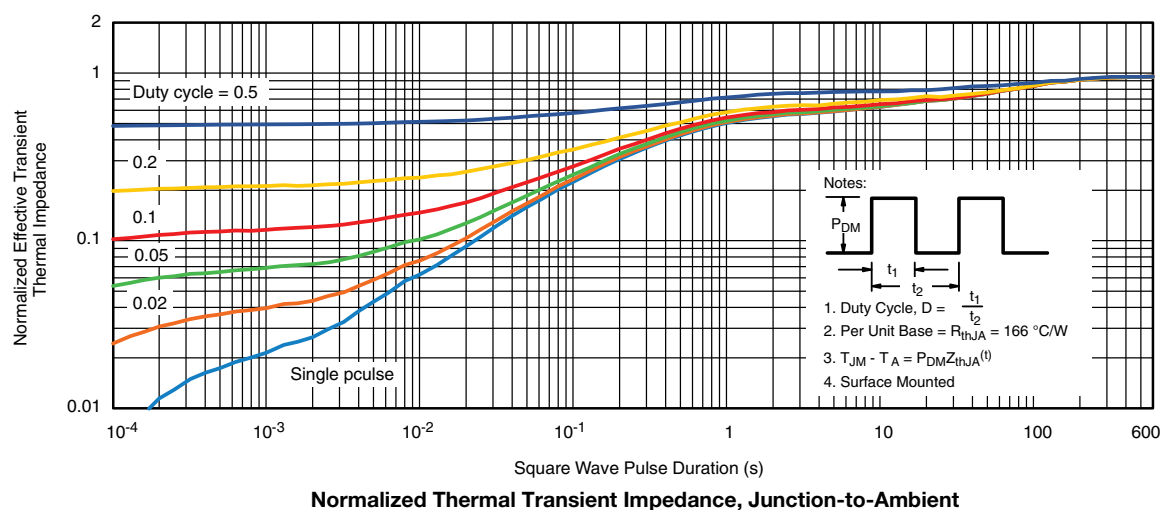


THERMAL RATINGS ($T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)



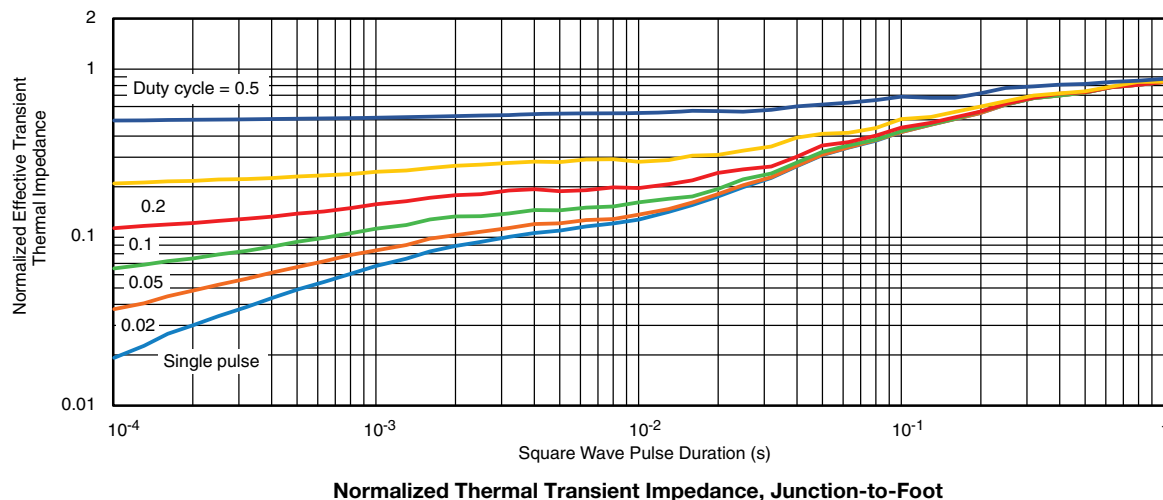
Note

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





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

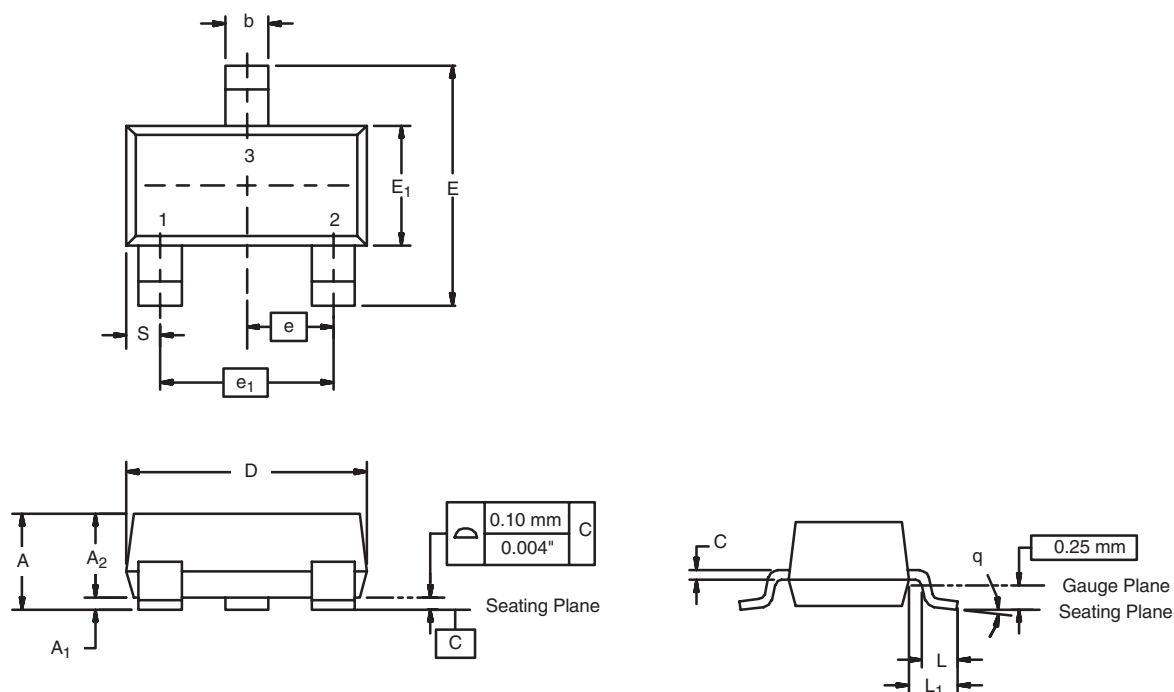


Notes

- The characteristics shown in the two graphs
 - Normalized Transient Thermal Impedance Junction-to-Ambient ($25\text{ }^{\circ}\text{C}$)
 - Normalized Transient Thermal Impedance Junction-to-Foot ($25\text{ }^{\circ}\text{C}$)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

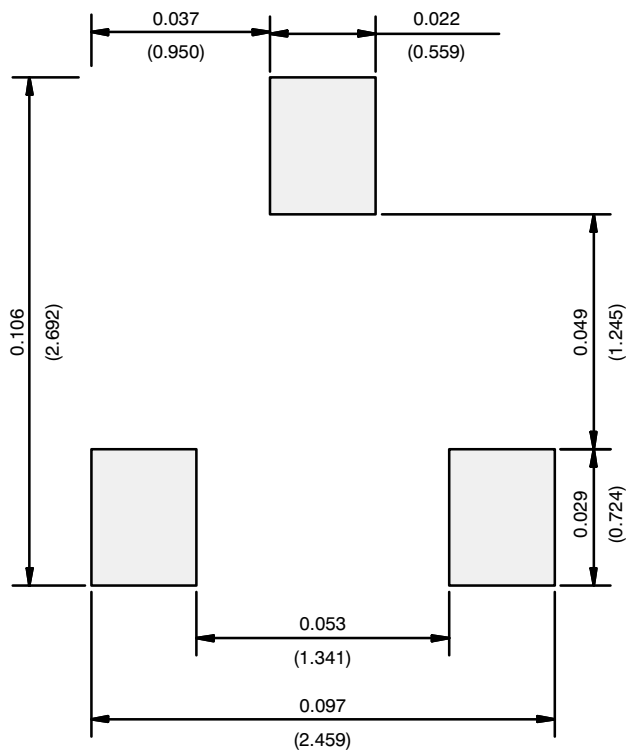
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SOT-23 (TO-236): 3-LEAD



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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