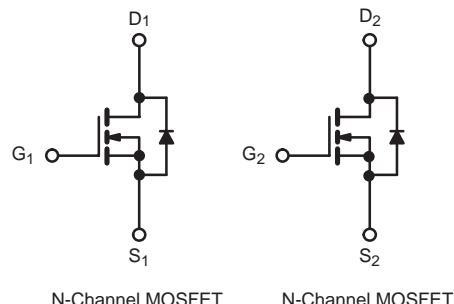
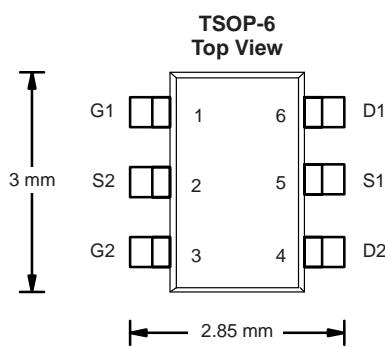


# 2N7002BKS-VB Datasheet

## Dual N-Channel 60 V (D-S) MOSFET

PRODUCT SUMMARY		
$V_{DS}$ (V)	$R_{DS(on)}$ ( $\Omega$ )	$I_D$ (mA)
60	1.8 at $V_{GS} = 10$ V	350



### FEATURES

- Halogen-free According to IEC 61249-2-21
- **Definition**
- Low On-Resistance: 1.8  $\Omega$
- Low Threshold: 2 V (typ.)
- Low Input Capacitance: 30 pF
- Fast Switching Speed: 25 ns
- Low Input and Output Leakage
- Trench Power MOSFET
- Compliant to RoHS Directive 2002/95/EC



### BENEFITS

- Low Offset Voltage
- Low-Voltage Operation
- Easily Driven Without Buffer
- High-Speed Circuits
- Low Error Voltage

### APPLICATIONS

- Direct Logic-Level Interface: TTL/CMOS
- Drivers: Relays, Solenoids, Lamps, Hammers, Display, Memories, Transistors, etc.
- Battery Operated Systems
- Solid-State Relays

### ABSOLUTE MAXIMUM RATINGS $T_A = 25$ °C, unless otherwise noted

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DS}$	60	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	
Continuous Drain Current ( $T_J = 150$ °C) <sup>b</sup>	$I_D$	350	mA
		230	
Pulsed Drain Current <sup>a</sup>	$I_{DM}$	900	
Power Dissipation <sup>b</sup>	$P_D$	0.45	W
		0.24	
Maximum Junction-to-Ambient <sup>b</sup>	$R_{thJA}$	350	°C/W
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to 150	°C

Notes:

a. Pulse width limited by maximum junction temperature.  
 b. Surface Mounted on FR4 board.

\* Pb containing terminations are not RoHS compliant, exemptions may apply.

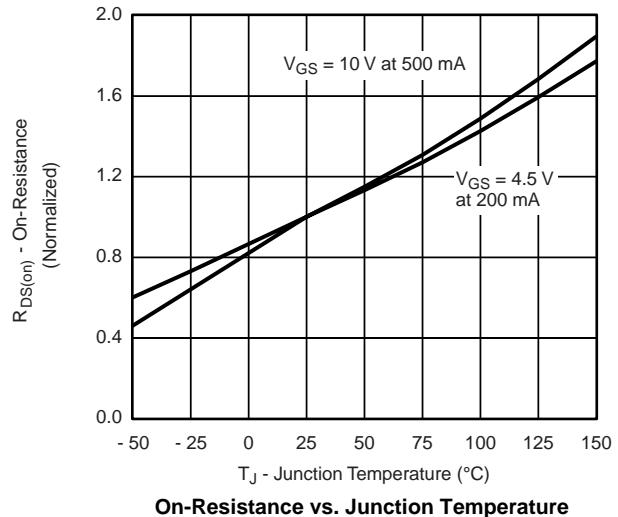
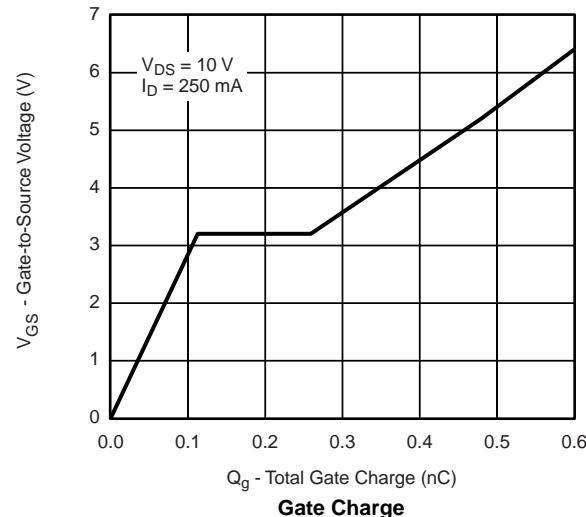
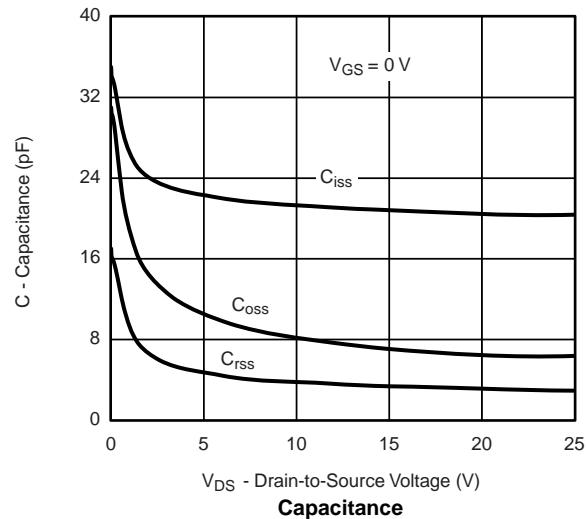
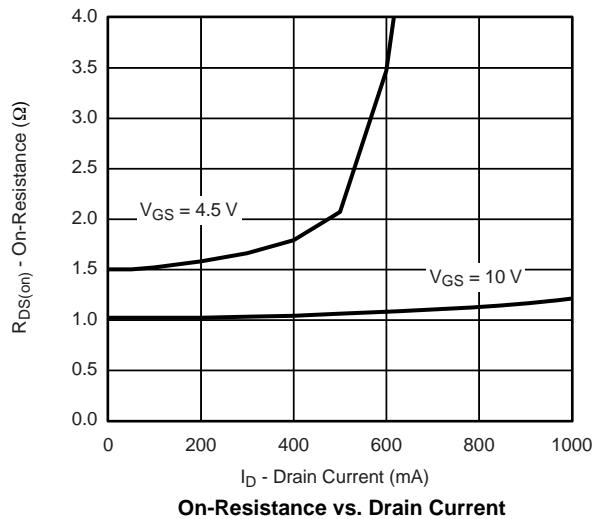
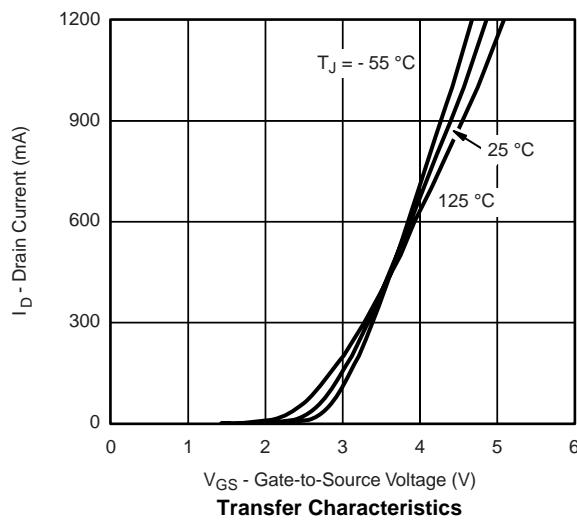
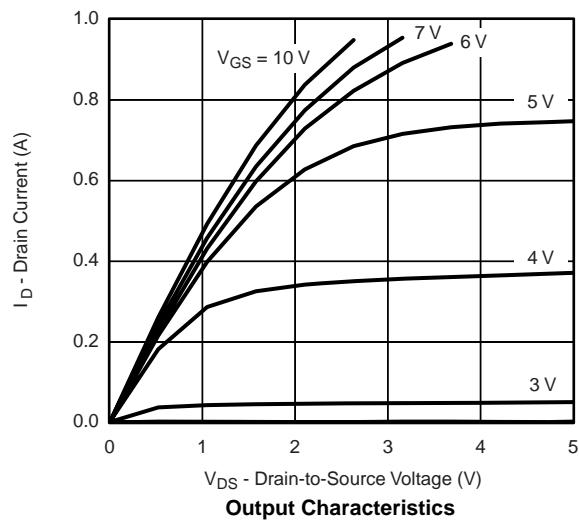
**SPECIFICATIONS**  $T_A = 25^\circ\text{C}$ , unless otherwise noted

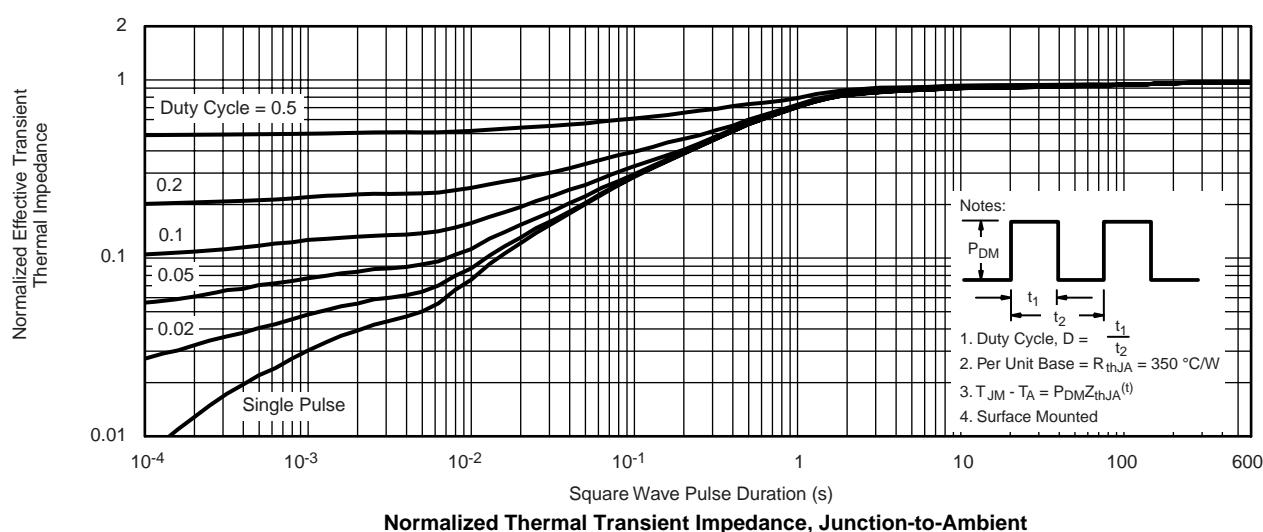
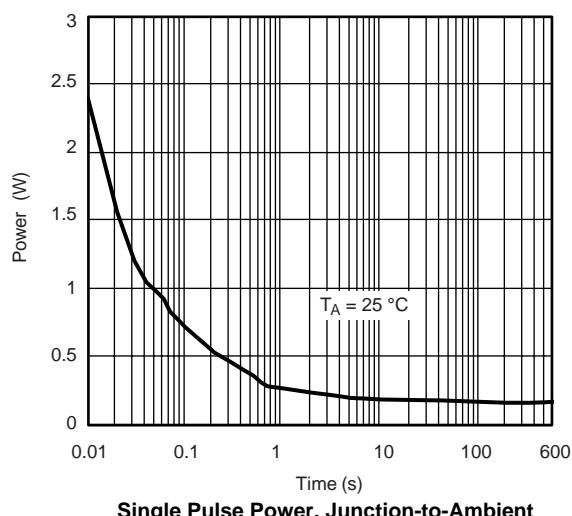
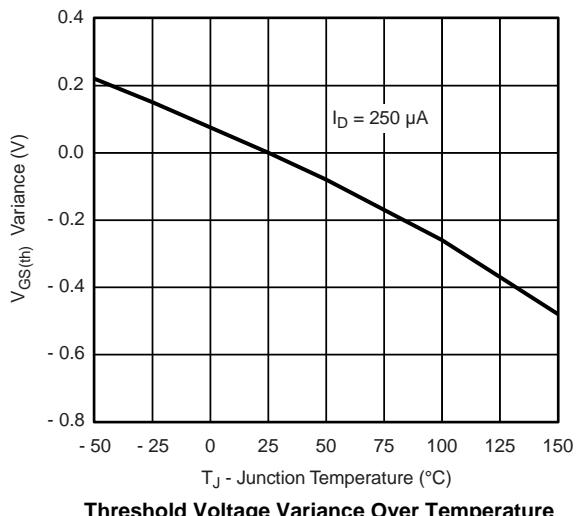
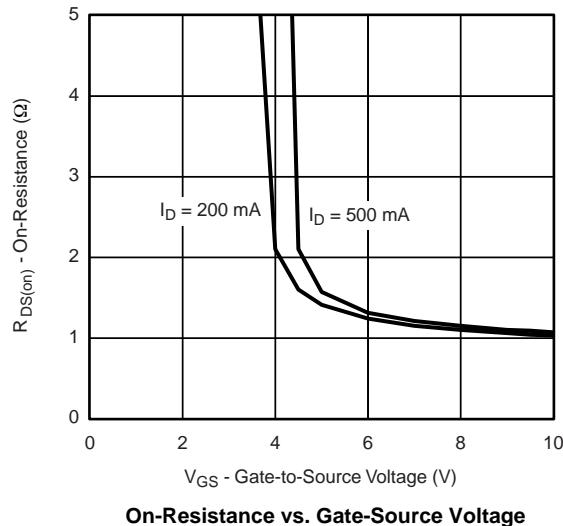
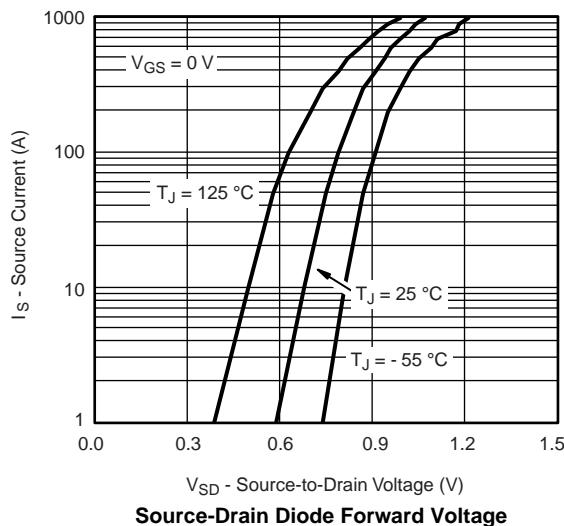
Parameter	Symbol	Test Conditions	Limits			Unit
			Min.	Typ. <sup>a</sup>	Max.	
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0 \text{ V}, I_D = 10 \mu\text{A}$	60			V
Gate-Threshold Voltage	$V_{GS(\text{th})}$	$V_{DS} = V_{GS}, I_D = 250 \mu\text{A}$	1		2.5	
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0 \text{ V}, V_{GS} = \pm 20 \text{ V}$			$\pm 10$	$\mu\text{A}$
		$V_{DS} = 0 \text{ V}, V_{GS} = \pm 15 \text{ V}$			1	
		$V_{DS} = 0 \text{ V}, V_{GS} = \pm 10 \text{ V}$			$\pm 150$	nA
		$V_{DS} = 0 \text{ V}, V_{GS} = \pm 10 \text{ V}, T_J = 85^\circ\text{C}$			$\pm 1000$	
		$V_{DS} = 0 \text{ V}, V_{GS} = \pm 5 \text{ V}$			$\pm 100$	
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 60 \text{ V}, V_{GS} = 0 \text{ V}$			1	$\mu\text{A}$
		$V_{DS} = 60 \text{ V}, V_{GS} = 0 \text{ V}, T_J = 125^\circ\text{C}$			500	
On-State Drain Current <sup>a</sup>	$I_{D(\text{on})}$	$V_{GS} = 10 \text{ V}, V_{DS} = 7.5 \text{ V}$	800			$\text{mA}$
		$V_{GS} = 4.5 \text{ V}, V_{DS} = 10 \text{ V}$	500			
Drain-Source On-Resistance <sup>a</sup>	$R_{DS(\text{on})}$	$V_{GS} = 10 \text{ V}, I_D = 500 \text{ mA}$		1.8		$\Omega$
		$V_{GS} = 4.5 \text{ V}, I_D = 200 \text{ mA}$		3		
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = 10 \text{ V}, I_D = 200 \text{ mA}$	100			$\text{mS}$
Diode Forward Voltage	$V_{SD}$	$I_S = 200 \text{ mA}, V_{GS} = 0 \text{ V}$			1.3	V
<b>Dynamic<sup>a</sup></b>						
Total Gate Charge	$Q_g$	$V_{DS} = 10 \text{ V}, V_{GS} = 4.5 \text{ V}$ $I_D \geq 250 \text{ mA}$		0.6	0.8	nC
Input Capacitance	$C_{iss}$	$V_{DS} = 25 \text{ V}, V_{GS} = 0 \text{ V}$ $f = 1 \text{ MHz}$		30		$\text{pF}$
Output Capacitance	$C_{oss}$			6		
Reverse Transfer Capacitance	$C_{rss}$			2.5		
<b>Switching<sup>a, b, c</sup></b>						
Turn-On Time	$t_{d(\text{on})}$	$V_{DD} = 30 \text{ V}, R_L = 150 \Omega$ $I_D \geq 200 \text{ mA}, V_{GEN} = 10 \text{ V}, R_G = 10 \Omega$			25	$\text{ns}$
Turn-Off Time	$t_{d(\text{off})}$				35	

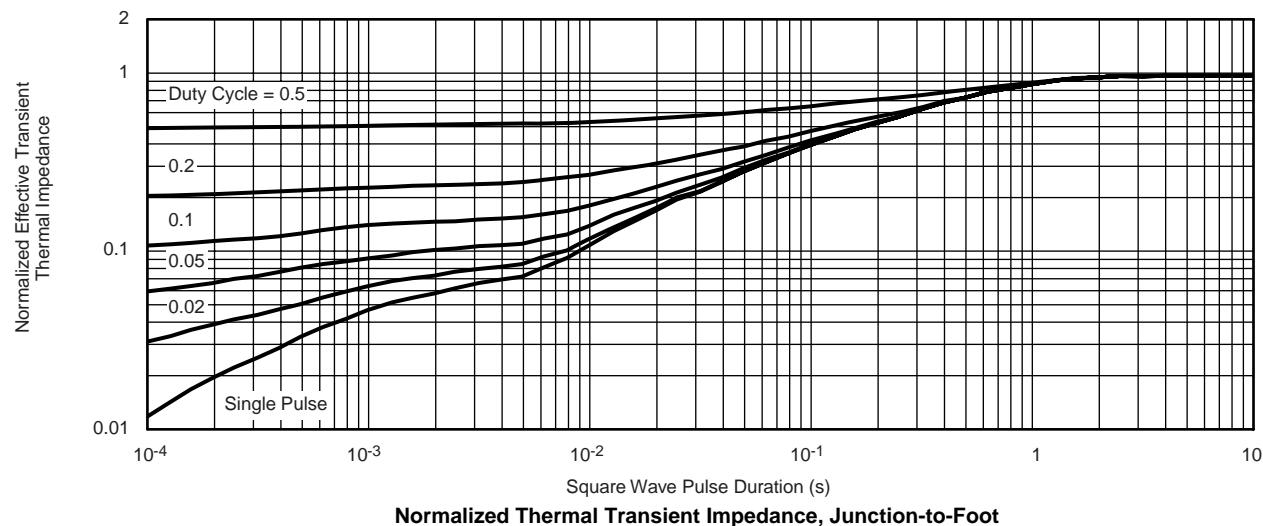
## Notes:

- a. For DESIGN AID ONLY, not subject to production testing.
- b. Pulse test: PW  $\leq 300 \mu\text{s}$  duty cycle  $\leq 2\%$ .
- c. Switching time is essentially 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** 25 °C, unless otherwise noted


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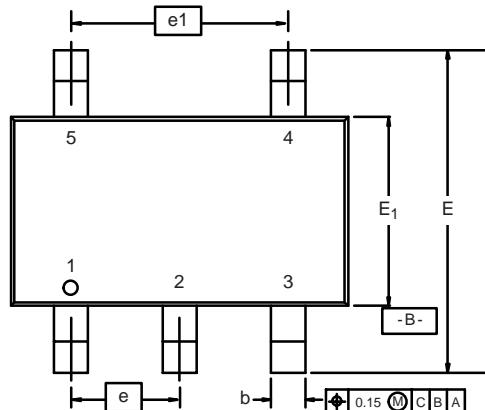
**THERMAL RATINGS** ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)

**Note**

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

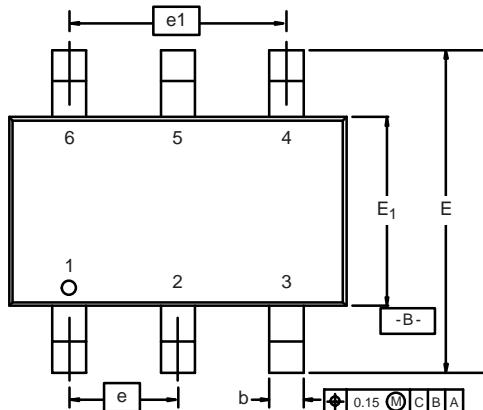
are given for general guidelines only to enable the user to get a "ball park" indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit 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.

## TSOP: 5/6-LEAD

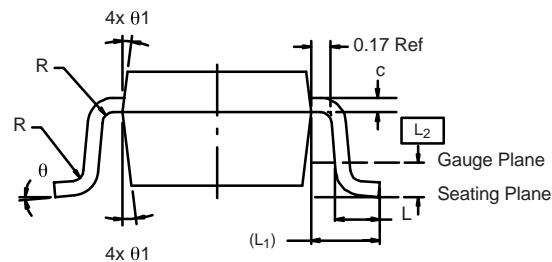
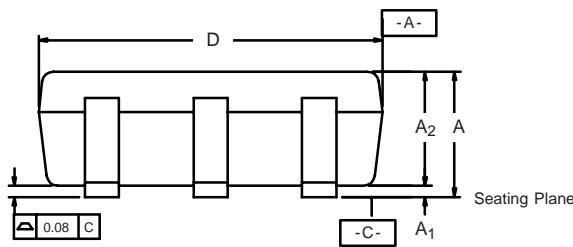
JEDEC Part Number: MO-193C



5-LEAD TSOP



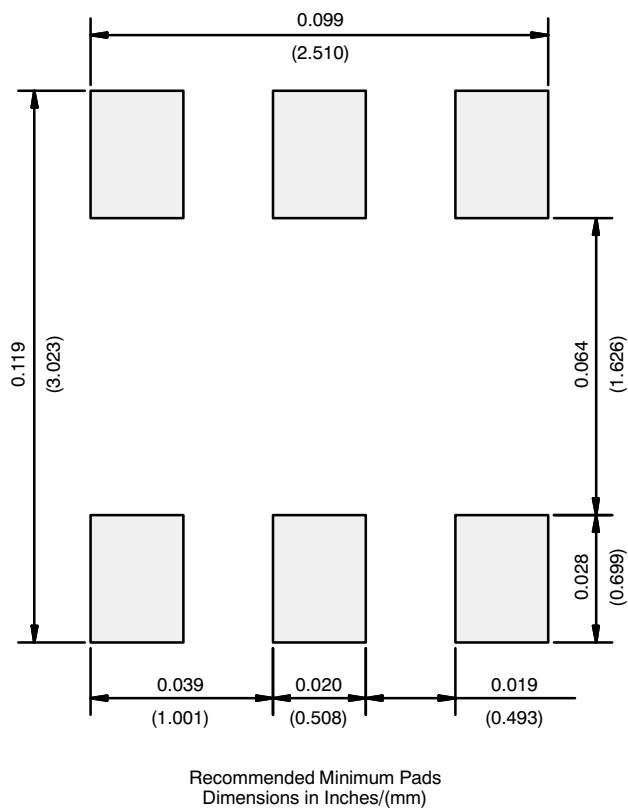
6-LEAD TSOP



Dim	MILLIMETERS			INCHES		
	Min	Nom	Max	Min	Nom	Max
<b>A</b>	0.91	-	1.10	0.036	-	0.043
<b>A<sub>1</sub></b>	0.01	-	0.10	0.0004	-	0.004
<b>A<sub>2</sub></b>	0.90	-	1.00	0.035	0.038	0.039
<b>b</b>	0.30	0.32	0.45	0.012	0.013	0.018
<b>c</b>	0.10	0.15	0.20	0.004	0.006	0.008
<b>D</b>	2.95	3.05	3.10	0.116	0.120	0.122
<b>E</b>	2.70	2.85	2.98	0.106	0.112	0.117
<b>E<sub>1</sub></b>	1.55	1.65	1.70	0.061	0.065	0.067
<b>e</b>	0.95 BSC			0.0374 BSC		
<b>e<sub>1</sub></b>	1.80	1.90	2.00	0.071	0.075	0.079
<b>L</b>	0.32	-	0.50	0.012	-	0.020
<b>L<sub>1</sub></b>	0.60 Ref			0.024 Ref		
<b>L<sub>2</sub></b>	0.25 BSC			0.010 BSC		
<b>R</b>	0.10	-	-	0.004	-	-
<b>θ</b>	0°	4°	8°	0°	4°	8°
<b>θ<sub>1</sub></b>	7° Nom			7° Nom		

ECN: C-06593-Rev. I, 18-Dec-06  
 DWG: 5540

## RECOMMENDED MINIMUM PADS FOR TSOP-6



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