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

| PRODUCT SUMMARY | |
|---|---|
| $V_{DS}$ (V) | 60 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 10 V | 0.030 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 4.5 V | 0.035 |
| $I_D$ (A) | 7 |
| Configuration | Single |

## FEATURES

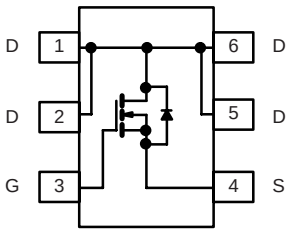
- **Halogen-free According to IEC 61249-2-21 Definition**
- TrenchFET® Power MOSFET
- Low On-Resistance
- 100 % $R_g$ Tested
- Compliant to RoHS Directive 2002/95/EC

Pb-free
RoHS COMPLIANT

## APPLICATIONS

- DC/DC Converters, High Speed Switching

**TSOP-6**




Top View

| 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 | $I_D$ | 7 | A |
| | $T_C$ = 125 °C | | 4 | |
| Continuous Source Current (Diode Conduction) | | $I_S$ | 6 | |
| Pulsed Drain Current [a] | | $I_{DM}$ | 29 | |
| Single Pulse Avalanche Current | L = 0.1 mH | $I_{AS}$ | 10 | |
| Single Pulse Avalanche Energy | | $E_{AS}$ | 5 | mJ |
| Maximum Power Dissipation [a] | $T_C$ = 25 °C | $P_D$ | 5 | W |
| | $T_C$ = 125 °C | | 1.6 | |
| 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] | $R_{thJA}$ | 110 | °C/W |
| Junction-to-Foot (Drain) | | $R_{thJF}$ | 30 | |

**Notes**

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

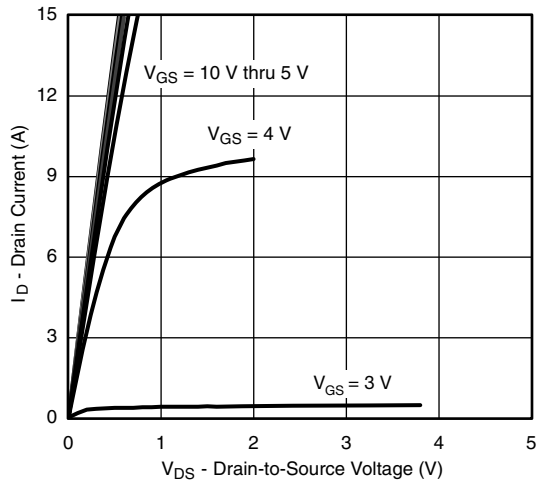
| **SPECIFICATIONS** ($T_C$ = 25 °C, unless otherwise noted) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **Static** | | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0, $I_D$ = 250 µA | | 60 | - | - | V |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | | 1.0 | - | 2.5 | |
| Gate-Source Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 12 V | | - | - | ± 500 | nA |
| | | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | | - | - | ± 1 | mA |
| 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 | $I_D$ = 5 A | - | 0.030 | - | Ω |
| | | $V_{GS}$ = 10 V | $I_D$ = 5 A, $T_J$ = 125 °C | - | 0.050 | - | |
| | | $V_{GS}$ = 10 V | $I_D$ = 5 A, $T_J$ = 175 °C | - | 0.070 | - | |
| | | $V_{GS}$ = 4.5 V | $I_D$ = 4 A | - | 0.035 | - | |
| Forward Transconductance [a] | $g_{fs}$ | $V_{DS}$ = 15 V, $I_D$ = 4 A | | - | 12 | - | S |
| **Dynamic** [b] | | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 30 V, f = 1 MHz | - | 560 | 700 | pF |
| Output Capacitance | $C_{oss}$ | | | - | 85 | 105 | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | - | 55 | 70 | |
| Total Gate Charge [c] | $Q_g$ | $V_{GS}$ = 4.5 V | $V_{DS}$ = 30 V, $I_D$ = 4 A | - | 7.6 | 12 | nC |
| Gate-Source Charge [c] | $Q_{gs}$ | | | - | 2.1 | - | |
| Gate-Drain Charge [c] | $Q_{gd}$ | | | - | 4.1 | - | |
| Gate Resistance | $R_g$ | f = 1 MHz | | 1.2 | 2.4 | 3.6 | Ω |
| Turn-On Delay Time [c] | $t_{d(on)}$ | $V_{DD}$ = 30 V, $R_L$ = 7.5 Ω<br>$I_D$ ≅ 4 A, $V_{GEN}$ = 10 V, $R_g$ = 1 Ω | | - | 9 | 14 | ns |
| Rise Time [c] | $t_r$ | | | - | 12 | 18 | |
| Turn-Off Delay Time [c] | $t_{d(off)}$ | | | - | 19 | 29 | |
| Fall Time [c] | $t_f$ | | | - | 7 | 11 | |
| Source-Drain Diode Ratings and Characteristics [b] | | | | | | | |
| Pulsed Current [a] | $I_{SM}$ | | | - | - | 29 | A |
| Forward Voltage | $V_{SD}$ | $I_F$ = 1.6 A, $V_{GS}$ = 0 | | - | 0.75 | 1.2 | V |

**Notes**

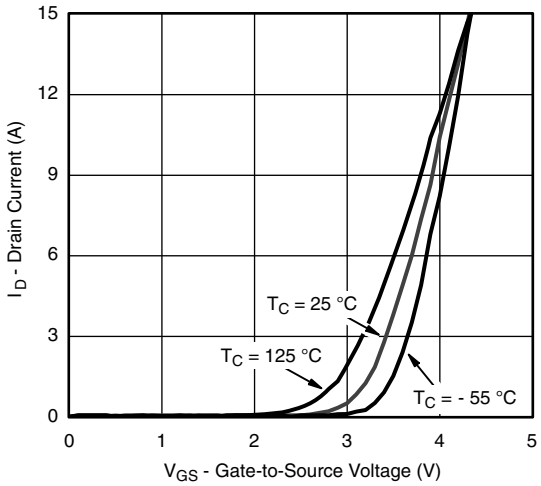
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.
c. Independent of operating temperature.

*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.*

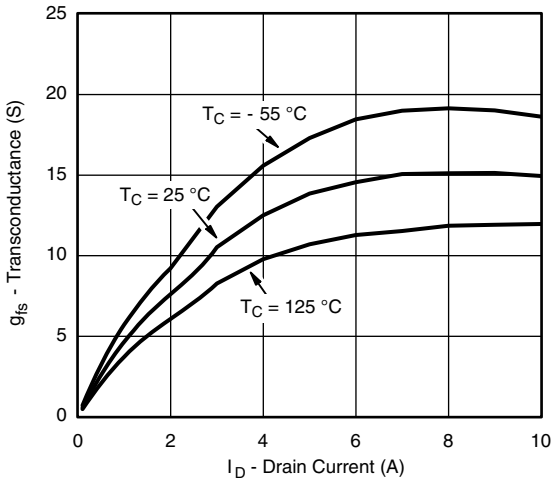
## TYPICAL CHARACTERISTICS ($T_A$ = 25 °C, unless otherwise noted)



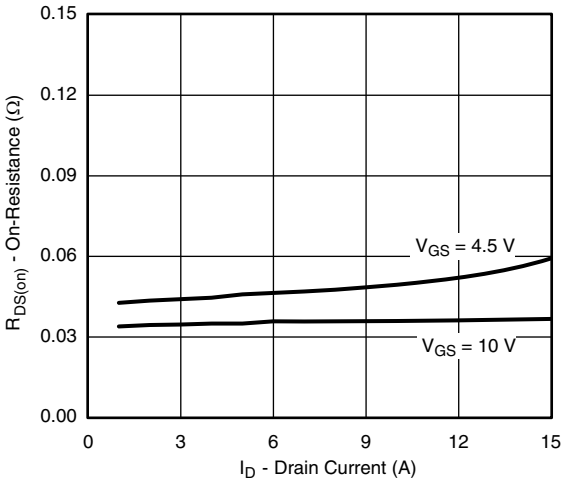

**Output Characteristics**



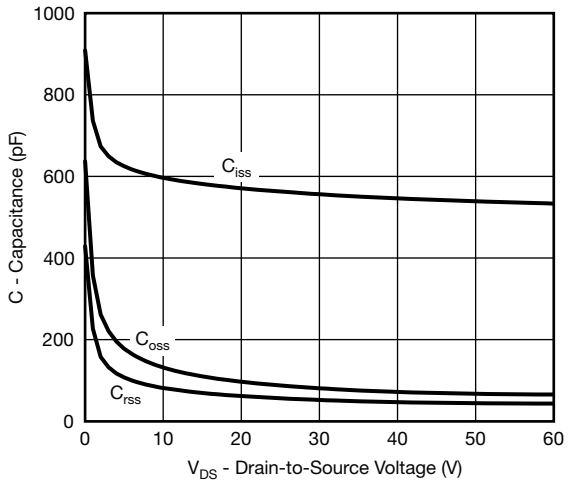

**Transfer Characteristics**



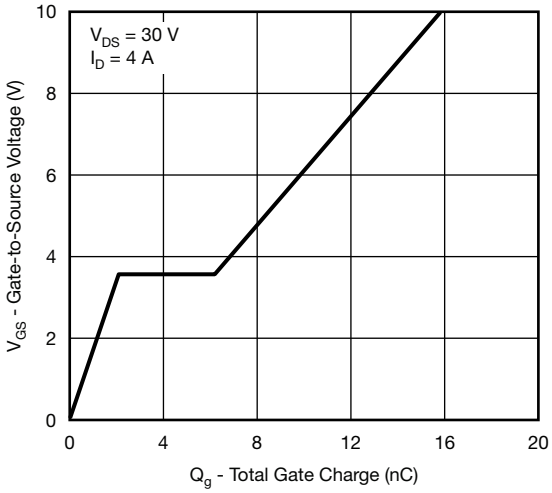

**Transconductance**




**On-Resistance vs. Drain Current**

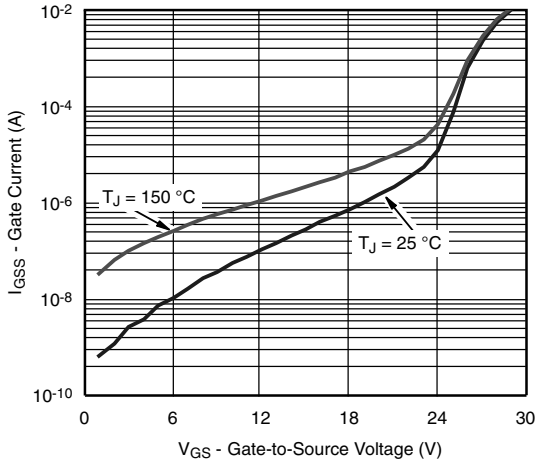



**Capacitance**

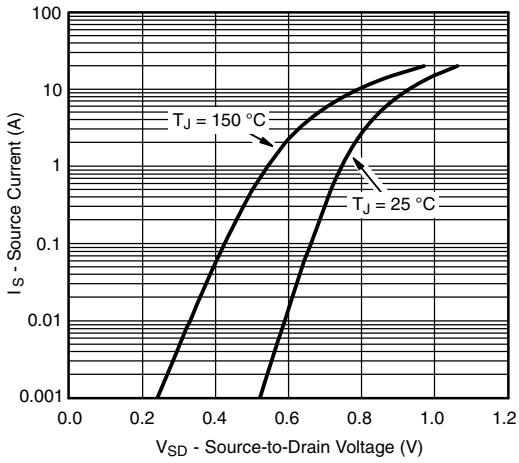



**Gate Charge**

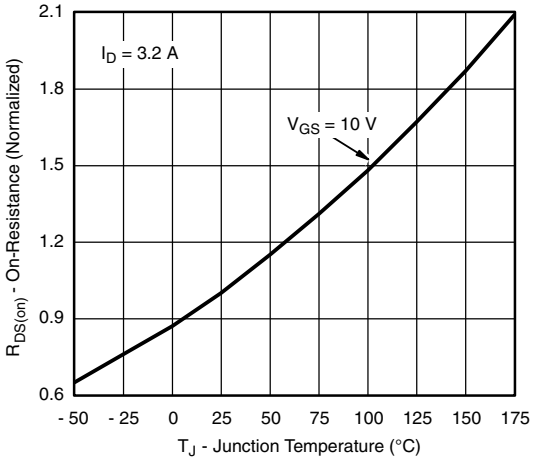
## TYPICAL CHARACTERISTICS ($T_A$ = 25 °C, unless otherwise noted)



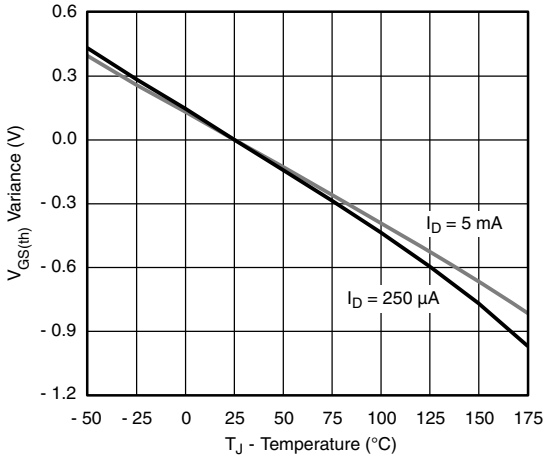

**Gate Current vs. Gate-Source Voltage**



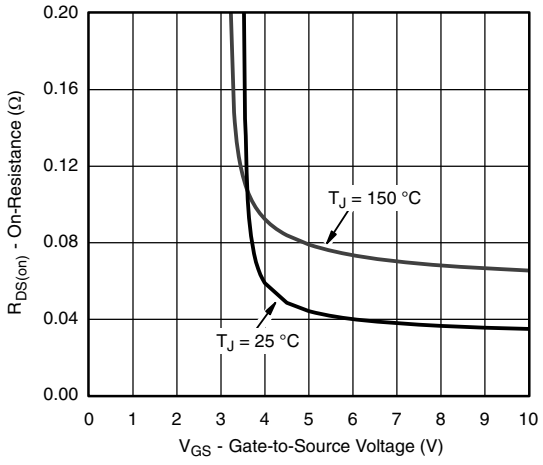

**Source-Drain Diode Forward Voltage**



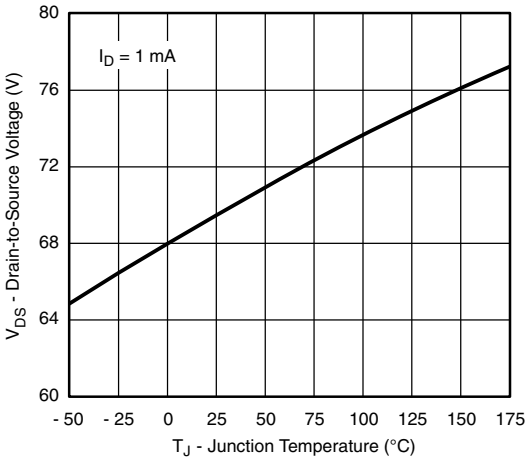

**On-Resistance vs. Junction Temperature**




**Threshold Voltage**

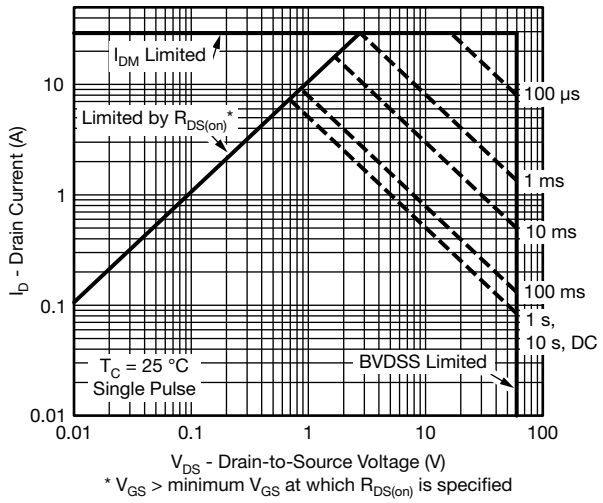



**On-Resistance vs. Gate-Source Voltage**

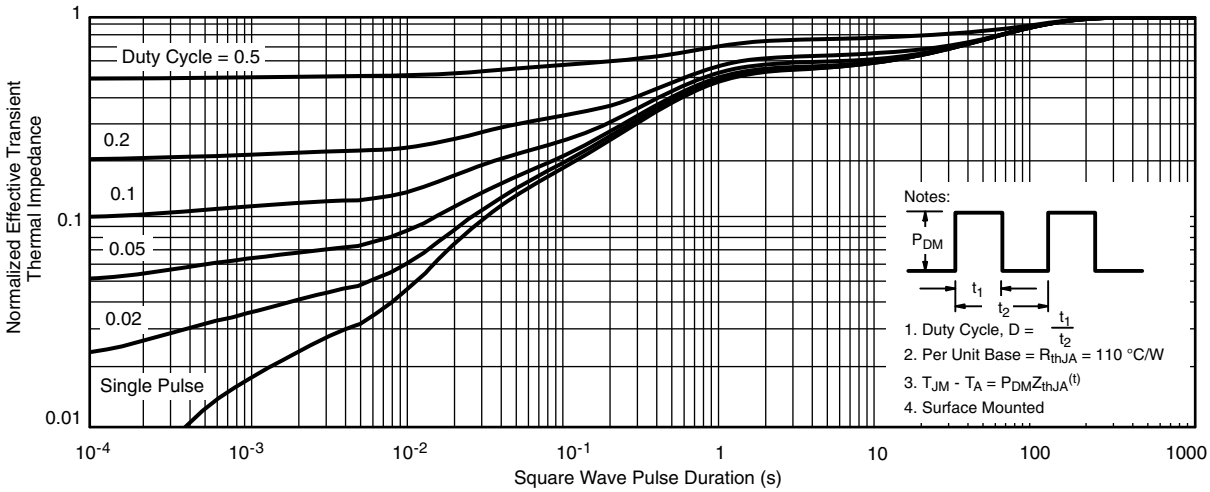



**Drain-Source Breakdown vs. Junction Temperature**

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

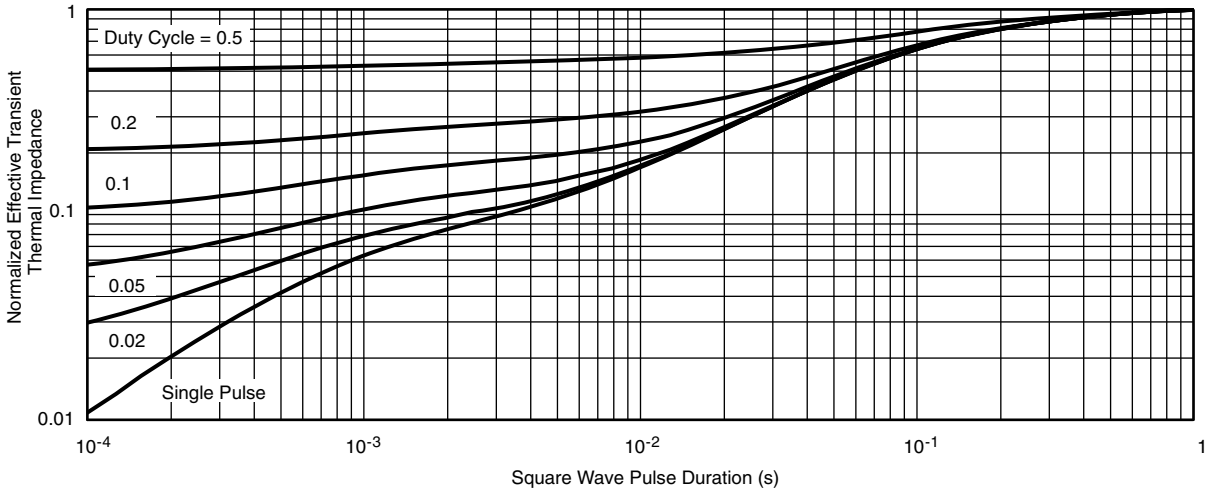



**Safe Operating Area**




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

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



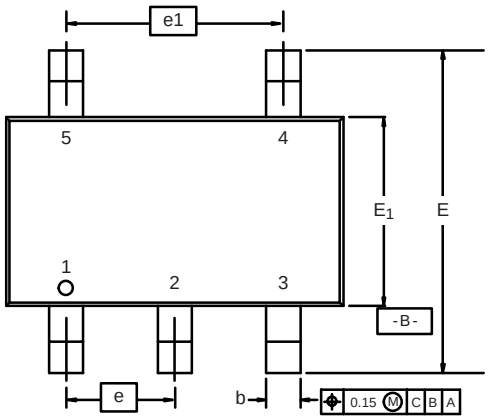

**Normalized thermal Transient Impedance, Junction-to-Foot**

**Note**

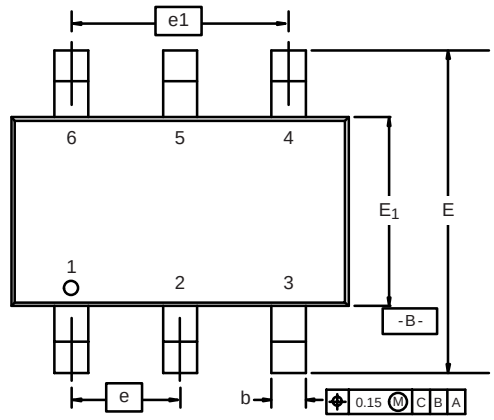
- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction to Ambient (25 °C)
  - Normalized Transient Thermal Impedance Junction to Foot (25 °C)

  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.

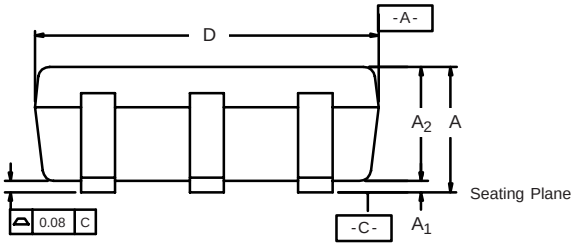
## TSOP: 5/6−LEAD
**JEDEC Part Number: MO-193C**

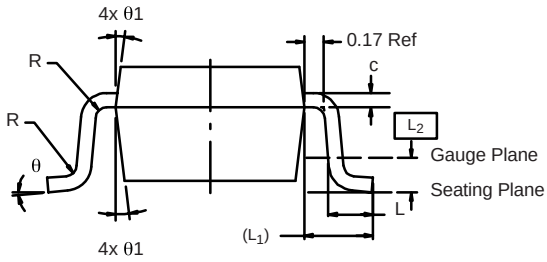



**5-LEAD TSOP**



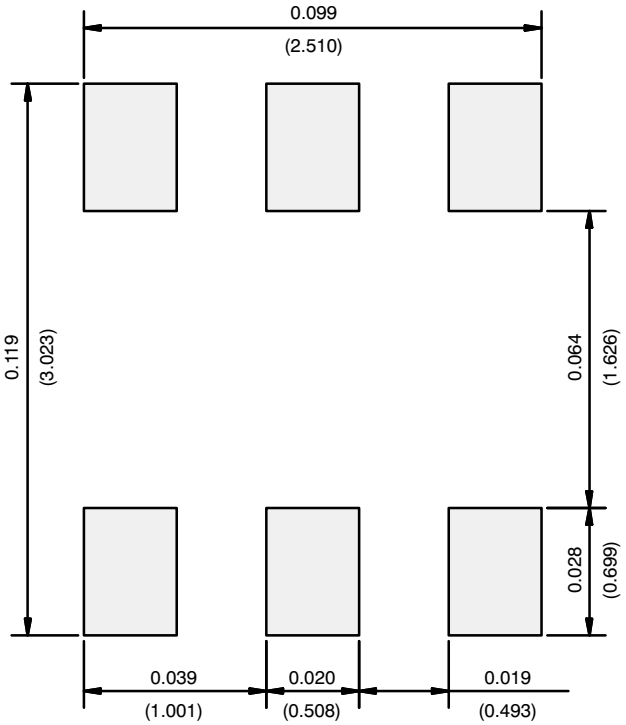

**6-LEAD TSOP**




| Dim | MILLIMETERS | | | INCHES | | |
|---|---|---|---|---|---|---|
| | Min | Nom | Max | Min | Nom | Max |
| A | 0.91 | - | 1.10 | 0.036 | - | 0.043 |
| $A_1$ | 0.01 | - | 0.10 | 0.0004 | - | 0.004 |
| $A_2$ | 0.90 | - | 1.00 | 0.035 | 0.038 | 0.039 |
| b | 0.30 | 0.32 | 0.45 | 0.012 | 0.013 | 0.018 |
| c | 0.10 | 0.15 | 0.20 | 0.004 | 0.006 | 0.008 |
| D | 2.95 | 3.05 | 3.10 | 0.116 | 0.120 | 0.122 |
| E | 2.70 | 2.85 | 2.98 | 0.106 | 0.112 | 0.117 |
| $E_1$ | 1.55 | 1.65 | 1.70 | 0.061 | 0.065 | 0.067 |
| e | 0.95 BSC | | | 0.0374 BSC | | |
| $e_1$ | 1.80 | 1.90 | 2.00 | 0.071 | 0.075 | 0.079 |
| L | 0.32 | - | 0.50 | 0.012 | - | 0.020 |
| $L_1$ | 0.60 Ref | | | 0.024 Ref | | |
| $L_2$ | 0.25 BSC | | | 0.010 BSC | | |
| R | 0.10 | - | - | 0.004 | - | - |
| θ | 0° | 4° | 8° | 0° | 4° | 8° |
| $θ_1$ | 7° Nom | | | 7° Nom | | |
| ECN: C-06593-Rev. I, 18-Dec-06<br>DWG: 5540 | | | | | | |

## RECOMMENDED MINIMUM PADS FOR TSOP-6




Recommended Minimum Pads
Dimensions in Inches/(mm)

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