

## N-Channel 20 V (D-S) MOSFET

### PRODUCT SUMMARY

| $V_{DS}$ (V) | $R_{DS(on)}$ ( $\Omega$ ) | $I_D$ (A) <sup>e</sup> | $Q_g$ (Typ.) |
|--------------|---------------------------|------------------------|--------------|
| 20           | 0.028 at $V_{GS} = 4.5$ V | 6 <sup>a</sup>         | 8.8 nC       |
|              | 0.042 at $V_{GS} = 2.5$ V | 6 <sup>a</sup>         |              |
|              | 0.050 at $V_{GS} = 1.8$ V | 5.6                    |              |

### FEATURES

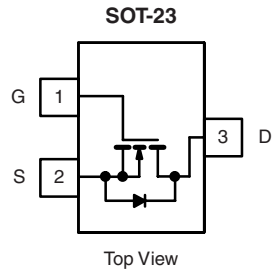
- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET® Power MOSFET
- 100 %  $R_g$  Tested
- Compliant to RoHS Directive 2002/95/EC



**RoHS**  
COMPLIANT  
HALOGEN  
FREE

### APPLICATIONS

- DC/DC Converters
- Load Switch for Portable Applications



### ABSOLUTE MAXIMUM RATINGS $T_A = 25^\circ\text{C}$ , unless otherwise noted

| Parameter                                              | Symbol                   | Limit                | Unit             |
|--------------------------------------------------------|--------------------------|----------------------|------------------|
| Drain-Source Voltage                                   | $V_{DS}$                 | 20                   | V                |
| Gate-Source Voltage                                    | $V_{GS}$                 | $\pm 12$             |                  |
| Continuous Drain Current ( $T_J = 150^\circ\text{C}$ ) | $T_C = 25^\circ\text{C}$ | 6 <sup>a</sup>       | A                |
|                                                        | $T_C = 70^\circ\text{C}$ | 5.1                  |                  |
|                                                        | $T_A = 25^\circ\text{C}$ | 5 <sup>b, c</sup>    |                  |
|                                                        | $T_A = 70^\circ\text{C}$ | 4 <sup>b, c</sup>    |                  |
| Pulsed Drain Current                                   | $I_{DM}$                 | 20                   |                  |
| Continuous Source-Drain Diode Current                  | $T_C = 25^\circ\text{C}$ | 1.75                 |                  |
|                                                        | $T_A = 25^\circ\text{C}$ | 1.04 <sup>b, c</sup> |                  |
| Maximum Power Dissipation                              | $T_C = 25^\circ\text{C}$ | 2.1                  | W                |
|                                                        | $T_C = 70^\circ\text{C}$ | 1.3                  |                  |
|                                                        | $T_A = 25^\circ\text{C}$ | 1.25 <sup>b, c</sup> |                  |
|                                                        | $T_A = 70^\circ\text{C}$ | 0.8 <sup>b, c</sup>  |                  |
| Operating Junction and Storage Temperature Range       | $T_J, T_{stg}$           | - 55 to 150          | $^\circ\text{C}$ |
| Soldering Recommendations (Peak Temperature)           |                          | 260                  |                  |

### THERMAL RESISTANCE RATINGS

| Parameter                                   | Symbol     | Typical | Maximum | Unit               |
|---------------------------------------------|------------|---------|---------|--------------------|
| Maximum Junction-to-Ambient <sup>b, d</sup> | $R_{thJA}$ | 80      | 100     | $^\circ\text{C/W}$ |
| Maximum Junction-to-Foot (Drain)            | $R_{thJF}$ | 40      | 60      |                    |

Notes:

- Package limited
- Surface Mounted on 1" x 1" FR4 board.
- $t = 5$  s.
- Maximum under steady state conditions is 125  $^\circ\text{C/W}$ .
- Based on  $T_C = 25^\circ\text{C}$ .

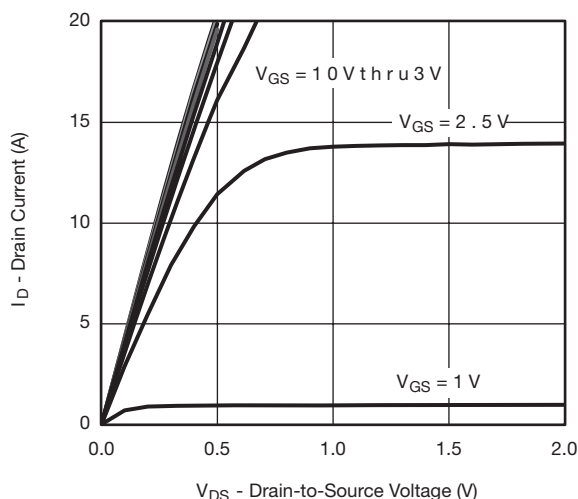
| SPECIFICATIONS $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted |                         |                                                                                                                          |      |       |           |                        |
|----------------------------------------------------------------------------|-------------------------|--------------------------------------------------------------------------------------------------------------------------|------|-------|-----------|------------------------|
| Parameter                                                                  | Symbol                  | Test Conditions                                                                                                          | Min. | Typ.  | Max.      | Unit                   |
| Static                                                                     |                         |                                                                                                                          |      |       |           |                        |
| Drain-Source Breakdown Voltage                                             | $V_{DS}$                | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$                                                                      | 20   |       |           | V                      |
| $V_{DS}$ Temperature Coefficient                                           | $\Delta V_{DS}/T_J$     | $I_D = 250\text{ }\mu\text{A}$                                                                                           |      | 25    |           | mV/ $^{\circ}\text{C}$ |
| $V_{GS(th)}$ Temperature Coefficient                                       | $\Delta V_{GS(th)}/T_J$ |                                                                                                                          |      | - 2.6 |           |                        |
| Gate-Source Threshold Voltage                                              | $V_{GS(th)}$            | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$                                                                          | 0.45 |       | 1.0       | V                      |
| Gate-Source Leakage                                                        | $I_{GSS}$               | $V_{DS} = 0\text{ V}, V_{GS} = \pm 8\text{ V}$                                                                           |      |       | $\pm 100$ | nA                     |
| Zero Gate Voltage Drain Current                                            | $I_{DSS}$               | $V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$                                                                              |      |       | 1         | $\mu\text{A}$          |
|                                                                            |                         | $V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}, T_J = 70\text{ }^{\circ}\text{C}$                                            |      |       | 10        |                        |
| On-State Drain Current <sup>a</sup>                                        | $I_{D(on)}$             | $V_{DS} \leq 5\text{ V}, V_{GS} = 4.5\text{ V}$                                                                          | 20   |       |           | A                      |
| Drain-Source On-State Resistance <sup>a</sup>                              | $R_{DS(on)}$            | $V_{GS} = 4.5\text{ V}, I_D = 5.0\text{ A}$                                                                              |      | 0.028 |           | $\Omega$               |
|                                                                            |                         | $V_{GS} = 2.5\text{ V}, I_D = 4.7\text{ A}$                                                                              |      | 0.042 |           |                        |
|                                                                            |                         | $V_{GS} = 1.8\text{ V}, I_D = 4.3\text{ A}$                                                                              |      | 0.050 |           |                        |
| Forward Transconductance <sup>a</sup>                                      | $g_{fs}$                | $V_{DS} = 10\text{ V}, I_D = 5.0\text{ A}$                                                                               |      | 24    |           | S                      |
| Dynamic <sup>b</sup>                                                       |                         |                                                                                                                          |      |       |           |                        |
| Input Capacitance                                                          | $C_{iss}$               | $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$                                                            |      | 865   |           | pF                     |
| Output Capacitance                                                         | $C_{oss}$               |                                                                                                                          |      | 105   |           |                        |
| Reverse Transfer Capacitance                                               | $C_{rss}$               |                                                                                                                          |      | 55    |           |                        |
| Total Gate Charge                                                          | $Q_g$                   | $V_{DS} = 10\text{ V}, V_{GS} = 5\text{ V}, I_D = 5.0\text{ A}$                                                          |      | 12    | 18        | nC                     |
| Gate-Source Charge                                                         | $Q_{gs}$                | $V_{DS} = 10\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 5.0\text{ A}$                                                        |      | 8.8   | 14        |                        |
| Gate-Drain Charge                                                          | $Q_{gd}$                |                                                                                                                          |      | 1.1   |           |                        |
| Gate Resistance                                                            | $R_g$                   | $f = 1\text{ MHz}$                                                                                                       | 0.5  | 2.4   | 4.8       |                        |
| Turn-On Delay Time                                                         | $t_{d(on)}$             | $V_{DD} = 10\text{ V}, R_L = 2.2\text{ }\Omega$<br>$I_D \cong 4\text{ A}, V_{GEN} = 4.5\text{ V}, R_g = 1\text{ }\Omega$ |      | 8     | 16        | ns                     |
| Rise Time                                                                  | $t_r$                   |                                                                                                                          |      | 17    | 26        |                        |
| Turn-Off Delay Time                                                        | $t_{d(off)}$            |                                                                                                                          |      | 31    | 47        |                        |
| Fall Time                                                                  | $t_f$                   |                                                                                                                          |      | 8     | 16        |                        |
| Turn-On Delay Time                                                         | $t_{d(on)}$             | $V_{DD} = 10\text{ V}, R_L = 2.2\text{ }\Omega$<br>$I_D \cong 4\text{ A}, V_{GEN} = 5\text{ V}, R_g = 1\text{ }\Omega$   |      | 5     | 10        |                        |
| Rise Time                                                                  | $t_r$                   |                                                                                                                          |      | 13    | 20        |                        |
| Turn-Off Delay Time                                                        | $t_{d(off)}$            |                                                                                                                          |      | 21    | 32        |                        |
| Fall Time                                                                  | $t_f$                   |                                                                                                                          |      | 6     | 12        |                        |
| Drain-Source Body Diode Characteristics                                    |                         |                                                                                                                          |      |       |           |                        |
| Continuous Source-Drain Diode Current                                      | $I_S$                   | $T_C = 25\text{ }^{\circ}\text{C}$                                                                                       |      |       | 1.75      | A                      |
| Pulse Diode Forward Current                                                | $I_{SM}$                |                                                                                                                          |      |       | 20        |                        |
| Body Diode Voltage                                                         | $V_{SD}$                | $I_S = 4\text{ A}, V_{GS} = 0\text{ V}$                                                                                  |      | 0.75  | 1.2       | V                      |
| Body Diode Reverse Recovery Time                                           | $t_{rr}$                | $I_F = 4\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^{\circ}\text{C}$                                   |      | 12    | 20        | ns                     |
| Body Diode Reverse Recovery Charge                                         | $Q_{rr}$                |                                                                                                                          |      | 5     | 10        | nC                     |
| Reverse Recovery Fall Time                                                 | $t_a$                   |                                                                                                                          |      | 7     |           | ns                     |
| Reverse Recovery Rise Time                                                 | $t_b$                   |                                                                                                                          |      | 5     |           |                        |

Notes:

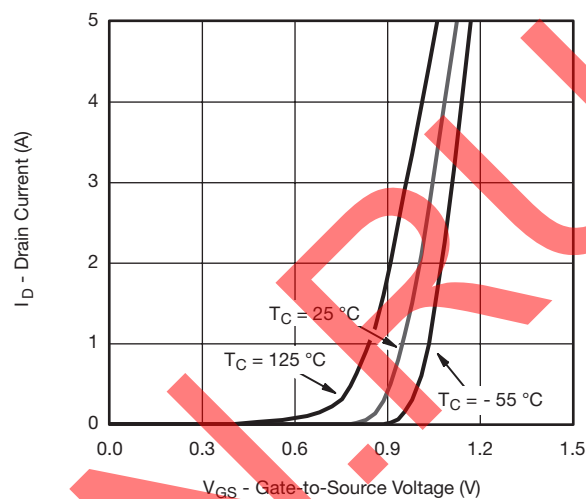
- Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$
- Guaranteed by design, not subject to production testing.

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.

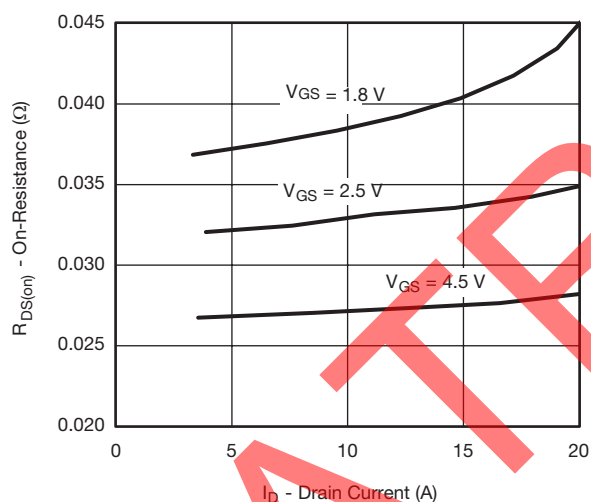
°C, unless otherwise noted



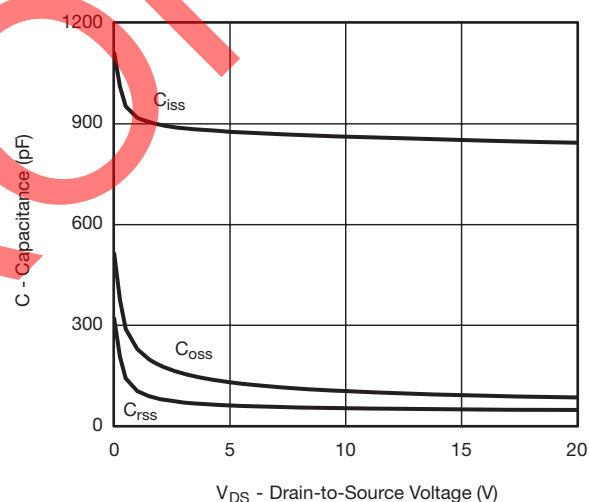
Output Characteristics



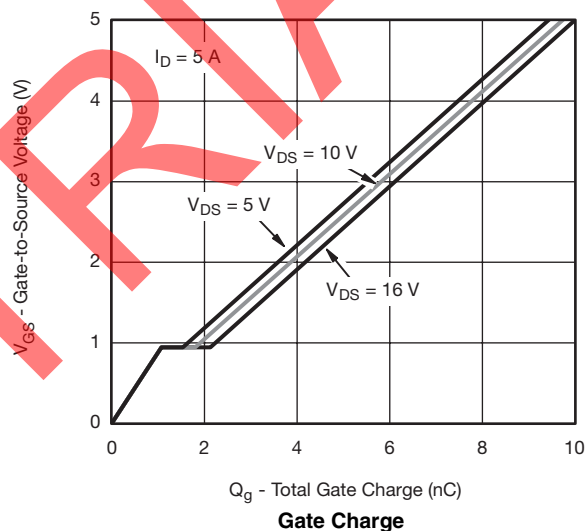
Transfer Characteristics



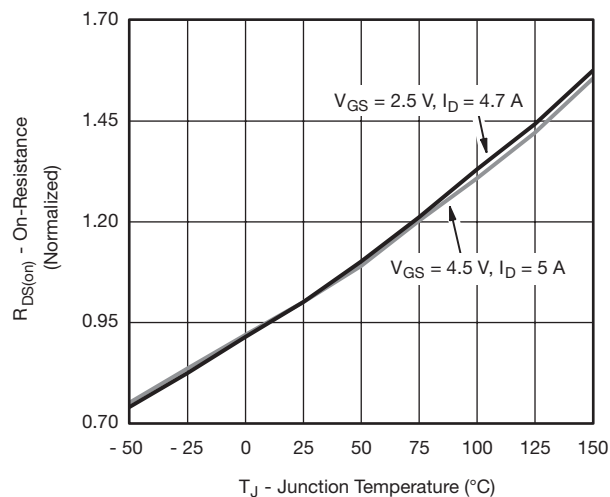
On-Resistance vs. Drain Current and Gate Voltage



Capacitance

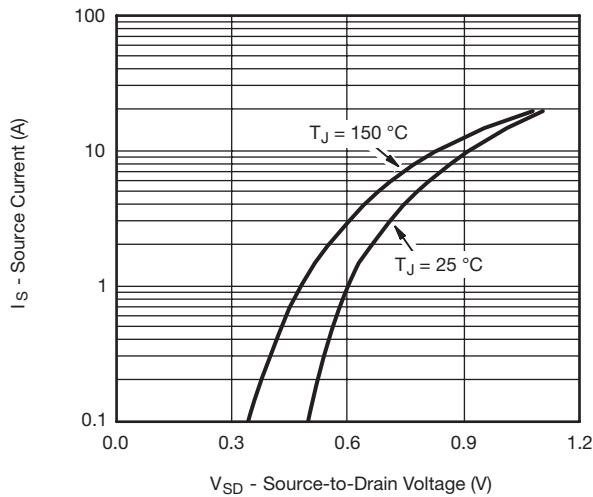


Gate Charge

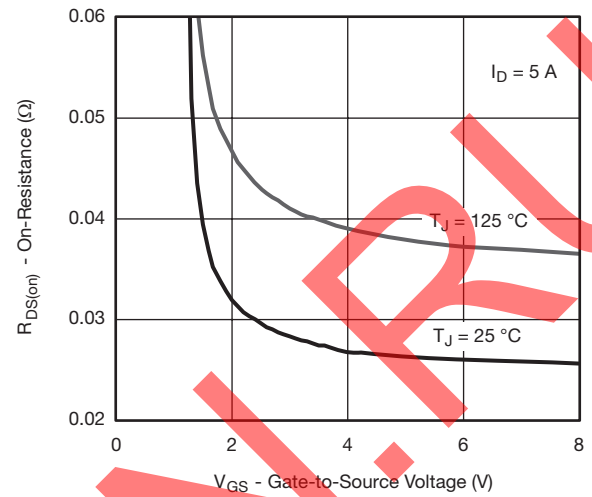


On-Resistance vs. Junction Temperature

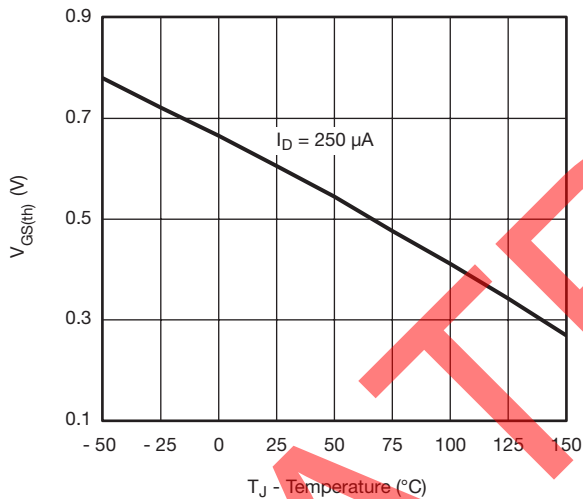
## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



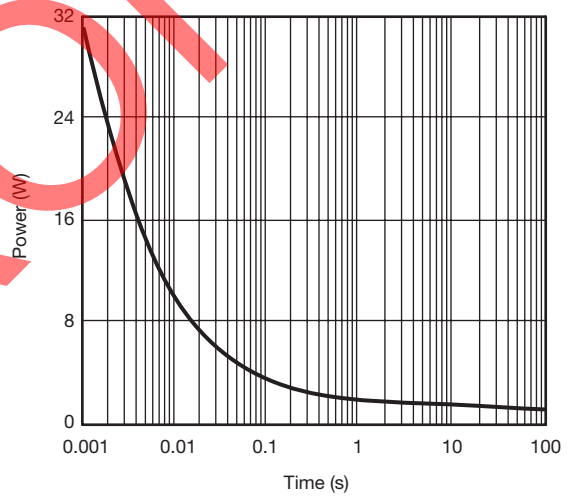
Source-Drain Diode Forward Voltage



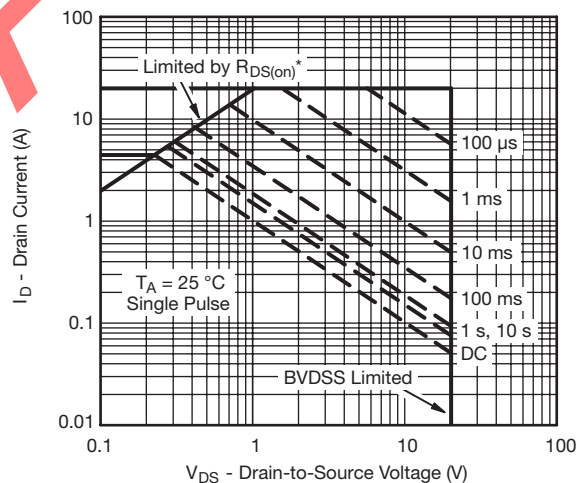
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



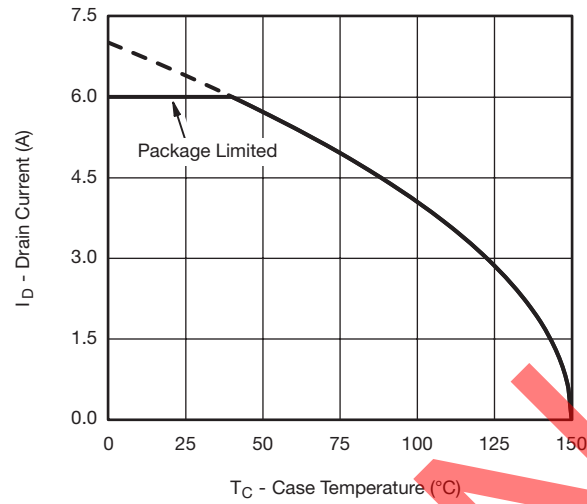
Single Pulse Power (Junction-to-Ambient)



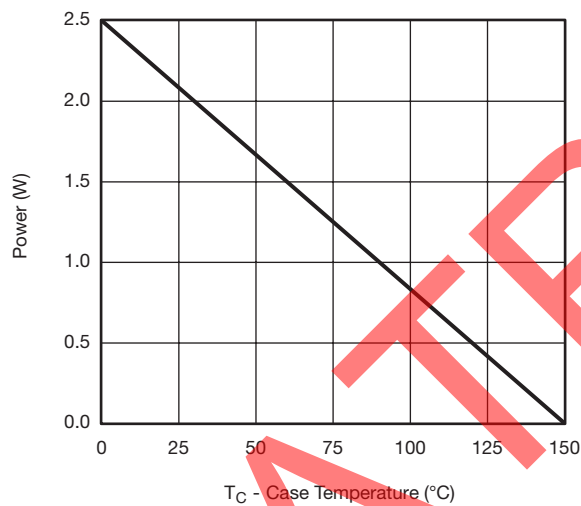
\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

Safe Operating Area, Junction-to-Ambient

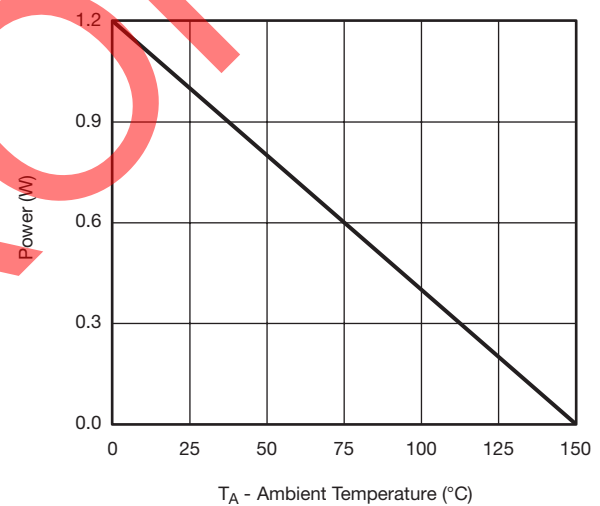
## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



Current Derating\*



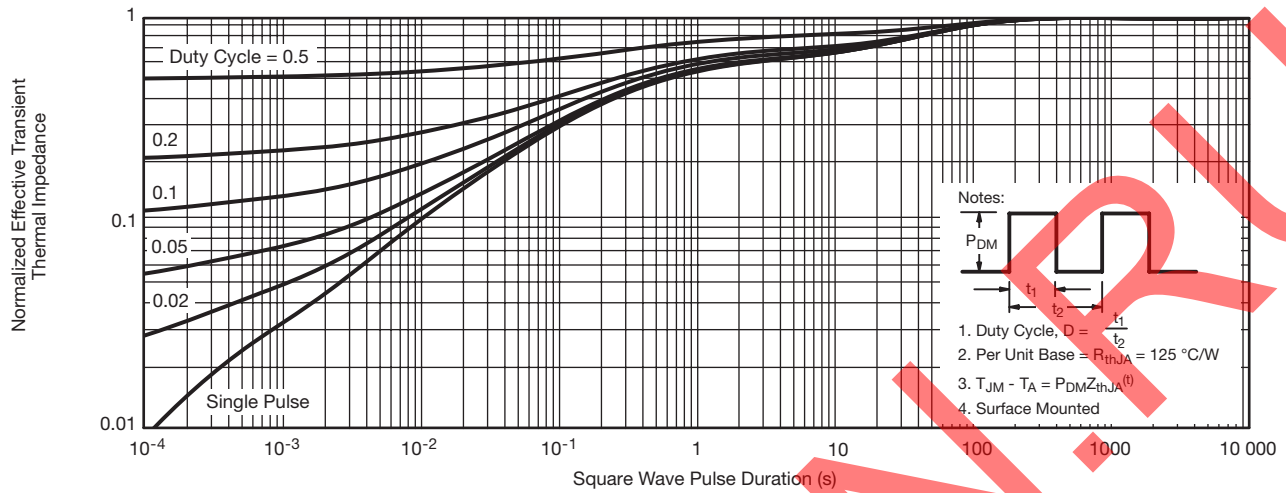
Power Derating, Junction-to-Foot



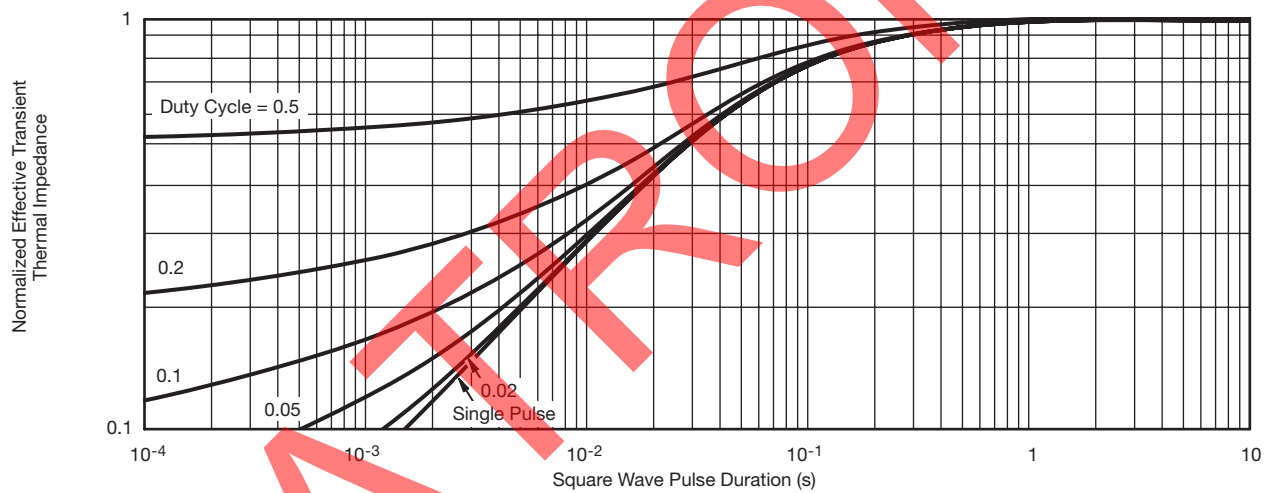
Power Derating, Junction-to-Ambient

\* The power dissipation  $P_D$  is based on  $T_{J(max)} = 150$  °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

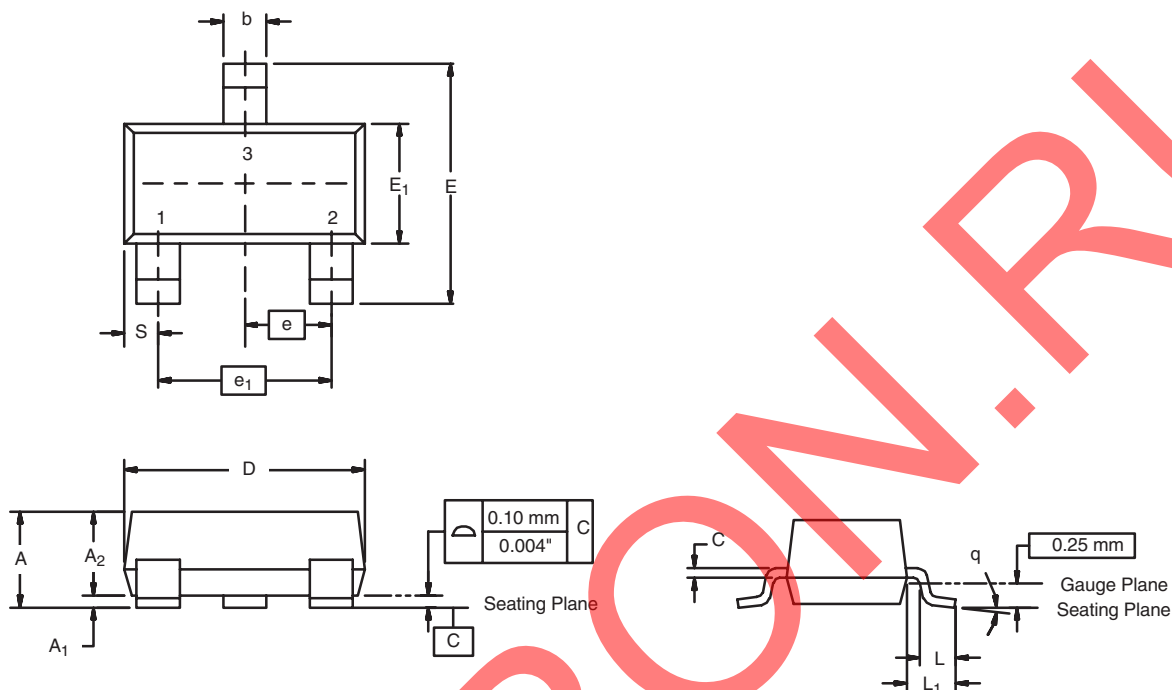


Normalized Thermal Transient Impedance, Junction-to-Ambient



Normalized Thermal Transient Impedance, Junction-to-Foot

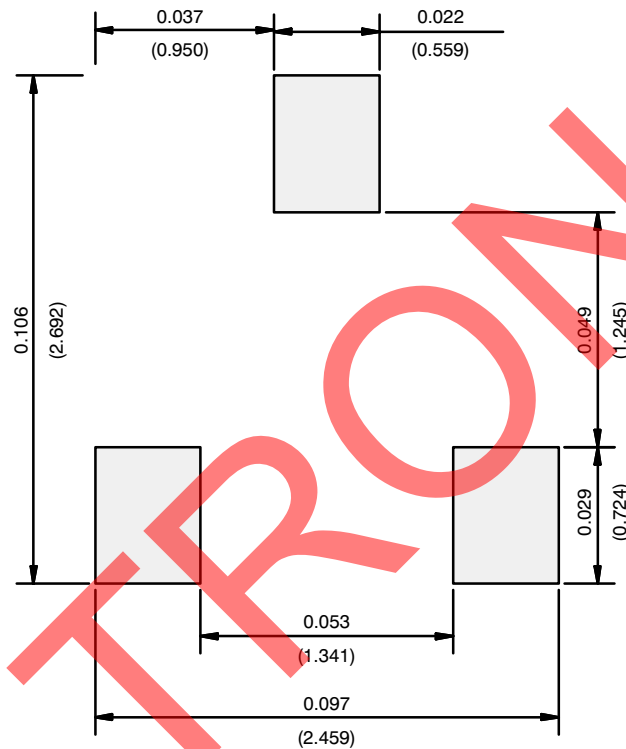
## SOT-23 (TO-236): 3-LEAD



| Dim            | MILLIMETERS |      | INCHES     |       |
|----------------|-------------|------|------------|-------|
|                | Min         | Max  | Min        | Max   |
| A              | 0.89        | 1.12 | 0.035      | 0.044 |
| A <sub>1</sub> | 0.01        | 0.10 | 0.0004     | 0.004 |
| A <sub>2</sub> | 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 <sub>1</sub> | 1.20        | 1.40 | 0.047      | 0.055 |
| e              | 0.95 BSC    |      | 0.0374 Ref |       |
| e <sub>1</sub> | 1.90 BSC    |      | 0.0748 Ref |       |
| L              | 0.40        | 0.60 | 0.016      | 0.024 |
| L <sub>1</sub> | 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)