

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

| PRODUCT SUMMARY | | | |
|-----------------|---------------------------|------------------------|--------------|
| V_{DS} (V) | $R_{DS(on)}$ (Ω) | I_D (A) ^a | Q_g (Typ.) |
| 60 | 0.031 at $V_{GS} = 10$ V | 9.1 | 6.5 nC |
| | 0.045 at $V_{GS} = 4.5$ V | 7.6 | |

FEATURES

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

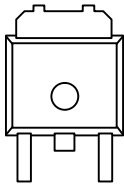


RoHS
COMPLIANT
HALOGEN
FREE

APPLICATIONS

- DC/DC Converters

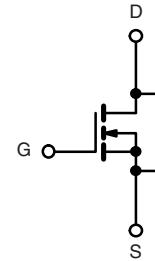
TO-252



G D S

Top View

Drain Connected to Tab



N-Channel MOSFET

Ordering Information: SUD23N06-31-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) | $T_C = 25$ °C | 21.4 | A | |
| | $T_C = 70$ °C | 17.1 | | |
| | $T_A = 25$ °C | 9.1 ^a | | |
| | $T_A = 70$ °C | 7.6 ^a | | |
| Pulsed Drain Current | I_{DM} | 50 | A | |
| Continuous Source-Drain Diode Current | $T_C = 25$ °C | 20.8 | | |
| | $T_A = 25$ °C | 3.8 ^a | | |
| Single Pulse Avalanche Current | $L = 0.1$ mH | I_{AS} | 20 | mJ |
| Avalanche Energy | | E_{AS} | 20 | |
| Maximum Power Dissipation | $T_C = 25$ °C | P_D | 31.25 | W |
| | $T_C = 70$ °C | | 20 | |
| | $T_A = 25$ °C | | 5.7 ^a | |
| | $T_A = 70$ °C | | 3.6 ^a | |
| Operating Junction and Storage Temperature Range | T_J, T_{stg} | - 55 to 150 | °C | |

THERMAL RESISTANCE RATINGS

| Parameter | Symbol | Typical | Maximum | Unit |
|--|------------|---------|---------|------|
| Maximum Junction-to-Ambient ^a | R_{thJA} | 18 | 22 | °C/W |
| Maximum Junction-to-Case | R_{thJC} | 3.2 | 4.0 | |

Notes:

a. Surface mounted on 1" x 1" FR4 board, $t \leq 10$ s.

| 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/ $^\circ\text{C}$ |
| $V_{GS(th)}$ Temperature Coefficient | $\Delta V_{GS(th)}/T_J$ | | -6.3 | | | |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$ | 1.0 | | 3.0 | 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 |
| | | $V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}, T_J = 70\text{ }^\circ\text{C}$ | | | 20 | |
| On-State Drain Current ^a | $I_{D(on)}$ | $V_{DS} \geq 5\text{ V}, V_{GS} = 10\text{ V}$ | 50 | | | A |
| Drain-Source On-State Resistance ^a | $R_{DS(on)}$ | $V_{GS} = 10\text{ V}, I_D = 15\text{ A}$ | | 0.025 | 0.031 | Ω |
| | | $V_{GS} = 4.5\text{ V}, I_D = 10\text{ A}$ | | 0.037 | 0.045 | |
| Forward Transconductance ^a | g_{fs} | $V_{DS} = 15\text{ V}, I_D = 15\text{ A}$ | | 20 | | S |
| Dynamic^b | | | | | | |
| Input Capacitance | C_{ISS} | $V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$ | | 670 | | μF |
| Output Capacitance | C_{OSS} | | 140 | | | |
| Reverse Transfer Capacitance | C_{RSS} | | 60 | | | |
| Total Gate Charge | Q_g | $V_{DS} = 30\text{ V}, V_{GS} = 10\text{ V}, I_D = 23\text{ A}$ | | 11 | 17 | nC |
| | | | $V_{DS} = 30\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 23\text{ A}$ | | 6.5 | |
| Gate-Source Charge | Q_{gs} | | | 3.0 | | |
| Gate-Drain Charge | Q_{gd} | | 3.0 | | | |
| Gate Resistance | R_g | $f = 1\text{ MHz}$ | | 1.6 | 3.2 | Ω |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = 30\text{ V}, R_L = 1.3\text{ }\Omega$ $I_D \cong 23\text{ A}, V_{GEN} = 4.5\text{ V}, R_g = 1\text{ }\Omega$ | | 18 | 30 | ns |
| Rise Time | t_r | | | 250 | 400 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 35 | 55 | |
| Fall Time | t_f | | | 68 | 110 | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = 30\text{ V}, R_L = 1.3\text{ }\Omega$ $I_D \cong 23\text{ A}, V_{GEN} = 10\text{ V}, R_g = 1\text{ }\Omega$ | | 8 | 15 | |
| Rise Time | t_r | | | 15 | 25 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 30 | 45 | |
| Fall Time | t_f | | | 25 | 40 | |
| Drain-Source Body Diode Characteristics | | | | | | |
| Continuous Source-Drain Diode Current | I_S | $T_C = 25\text{ }^\circ\text{C}$ | | | 20.8 | A |
| Pulse Diode Forward Current ^a | I_{SM} | | | | 50 | |
| Body Diode Voltage | V_{SD} | $I_S = 15\text{ A}$ | | 1.0 | 1.5 | V |
| Body Diode Reverse Recovery Time | t_{rr} | $I_F = 15\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$ | | 30 | 60 | ns |
| Body Diode Reverse Recovery Charge | Q_{rr} | | | 35 | 70 | nC |
| Reverse Recovery Fall Time | t_a | | | 20 | | ns |
| Reverse Recovery Rise Time | t_b | | | 10 | | |

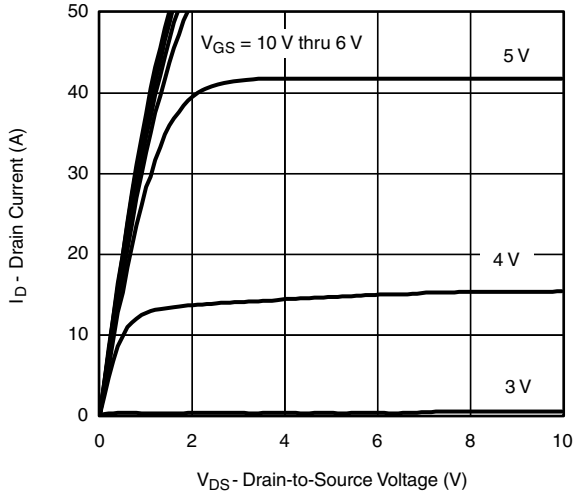
Notes:

a. Pulse test; pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$.

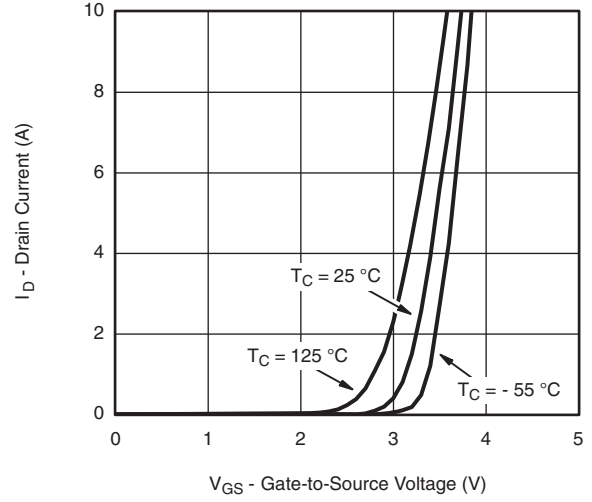
b. Guaranteed by design, not subject to production testing.

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.

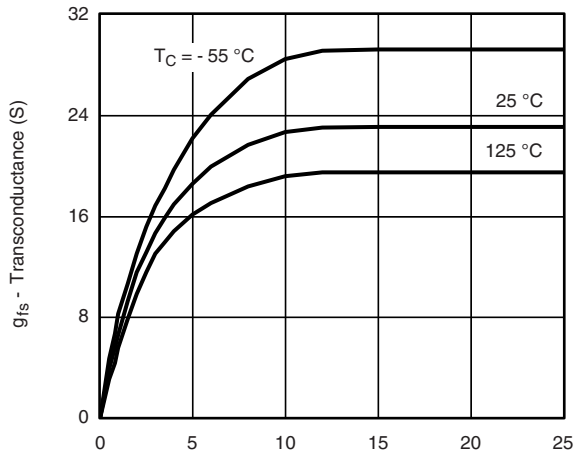
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



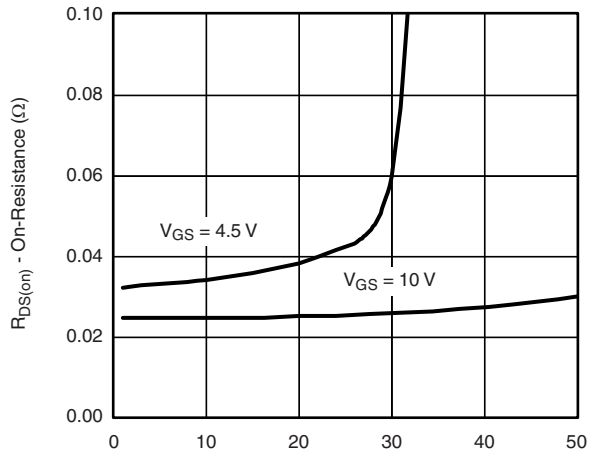
Output Characteristics



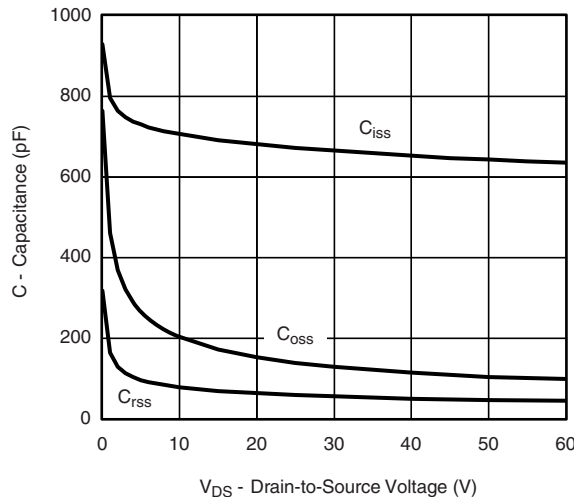
Transfer Characteristics



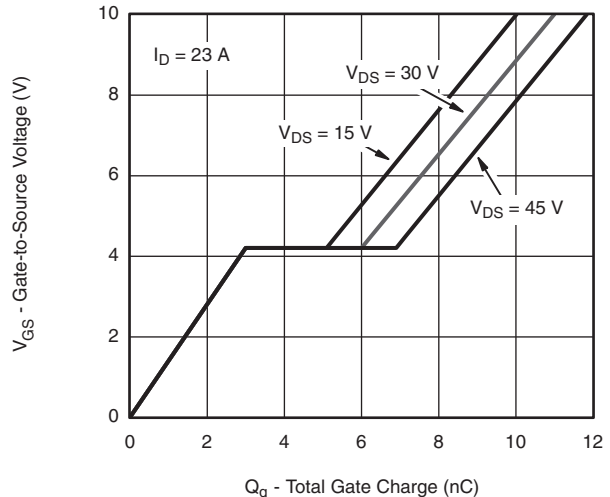
Transconductance



On-Resistance vs. Drain Current

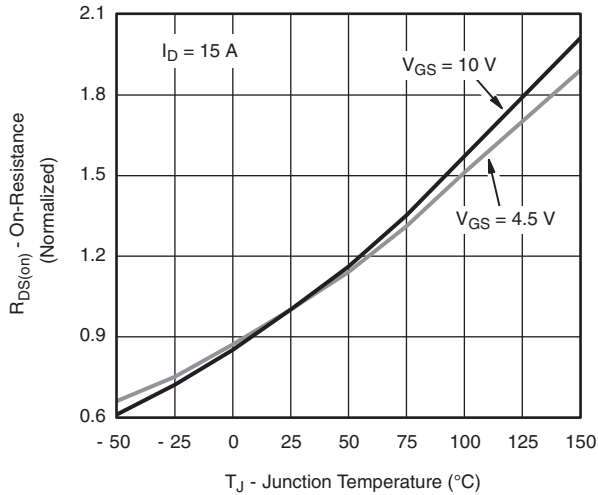


Capacitance

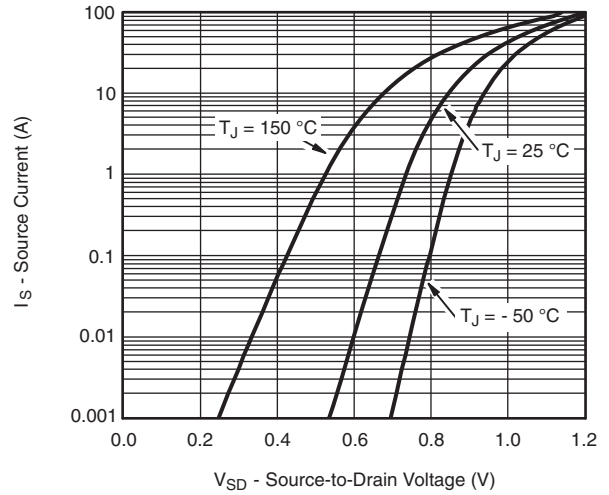


Gate Charge

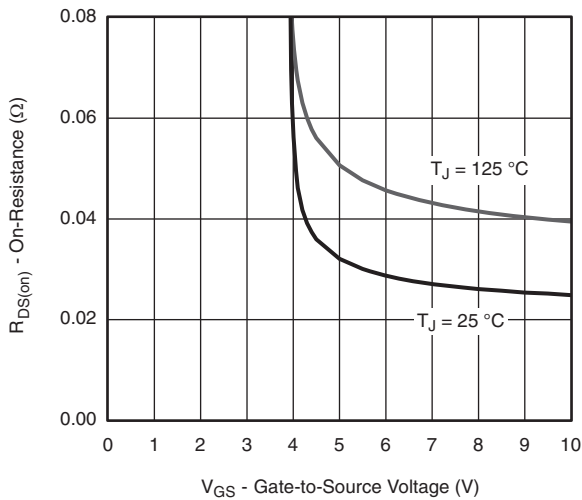
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



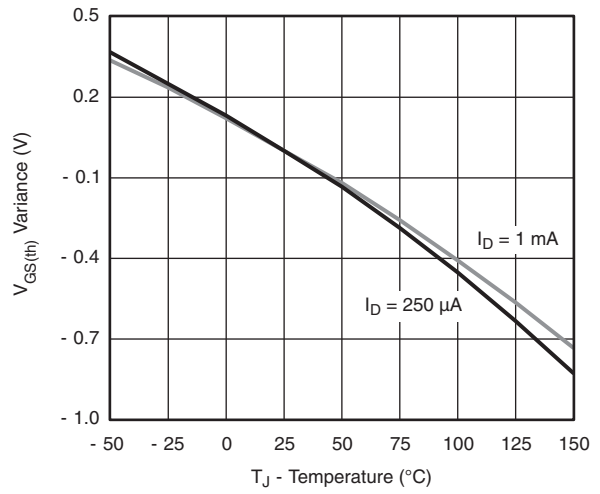
On-Resistance vs. Junction Temperature



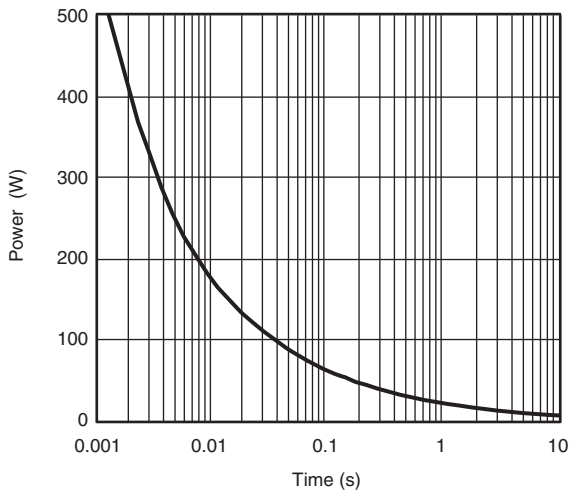
Source-Drain Diode Forward Voltage



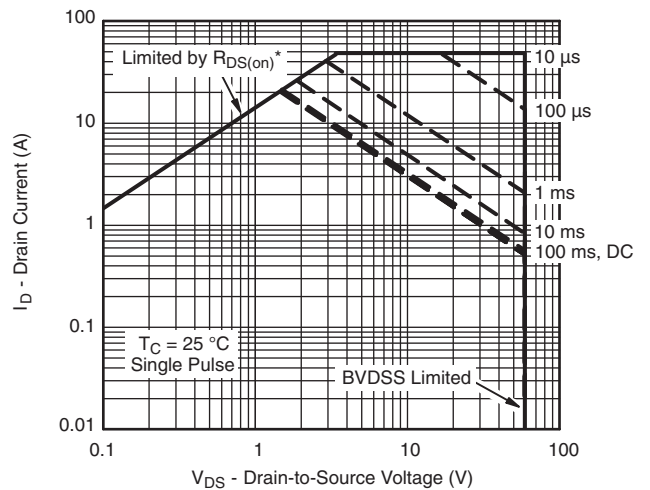
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



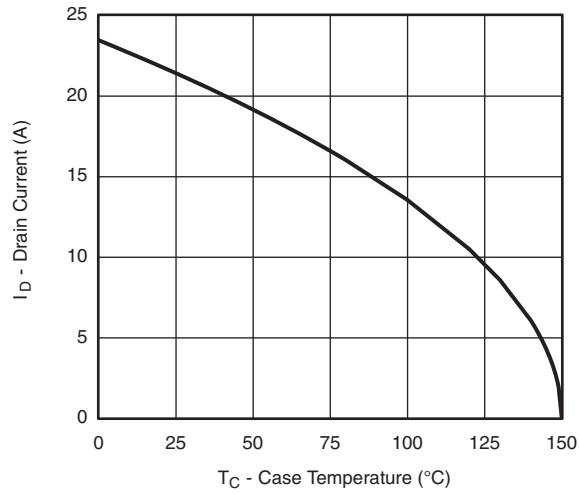
Single Pulse Power, Junction-to-Ambient



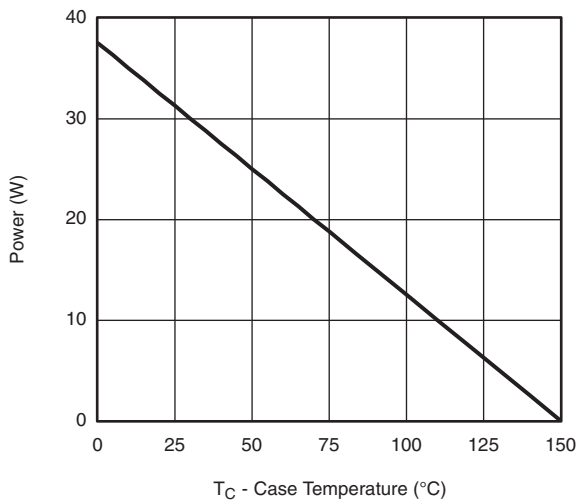
* $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified

Single Pulse Power, Junction-to-Case

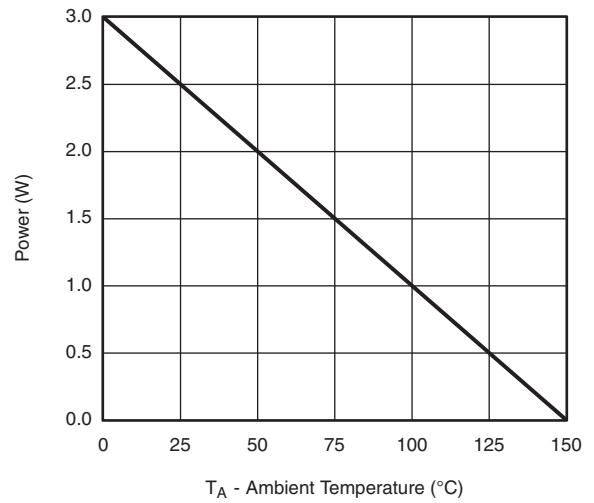
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Current Derating*, Junction-to-Case



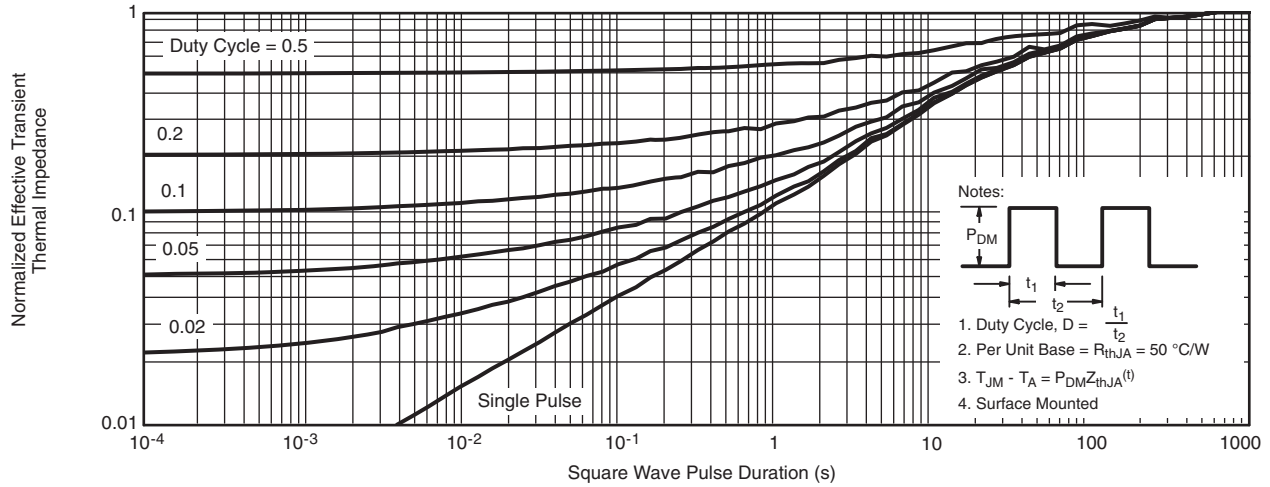
Power, Junction-to-Case



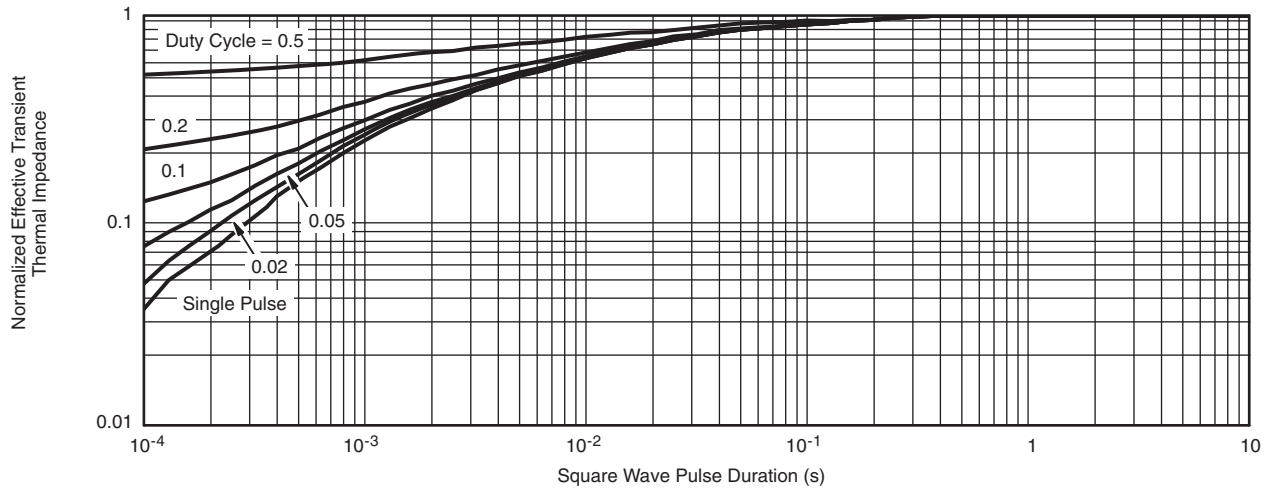
Power, Junction-to-Ambient

* 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-Case

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TO-252AA CASE OUTLINE



| DIM. | MILLIMETERS | | INCHES | |
|--|-------------|-------|-----------|-------|
| | MIN. | MAX. | MIN. | MAX. |
| A | 2.18 | 2.38 | 0.086 | 0.094 |
| A1 | - | 0.127 | - | 0.005 |
| b | 0.64 | 0.88 | 0.025 | 0.035 |
| b2 | 0.76 | 1.14 | 0.030 | 0.045 |
| b3 | 4.95 | 5.46 | 0.195 | 0.215 |
| C | 0.46 | 0.61 | 0.018 | 0.024 |
| C2 | 0.46 | 0.89 | 0.018 | 0.035 |
| D | 5.97 | 6.22 | 0.235 | 0.245 |
| D1 | 5.21 | - | 0.205 | - |
| E | 6.35 | 6.73 | 0.250 | 0.265 |
| E1 | 4.32 | - | 0.170 | - |
| H | 9.40 | 10.41 | 0.370 | 0.410 |
| e | 2.28 BSC | | 0.090 BSC | |
| e1 | 4.56 BSC | | 0.180 BSC | |
| L | 1.40 | 1.78 | 0.055 | 0.070 |
| L3 | 0.89 | 1.27 | 0.035 | 0.050 |
| L4 | - | 1.02 | - | 0.040 |
| L5 | 1.14 | 1.52 | 0.045 | 0.060 |
| ECN: X12-0247-Rev. M, 24-Dec-12 DWG: 5347 | | | | |

Note

- Dimension L3 is for reference only.

RECOMMENDED MINIMUM PADS FOR DPAK (TO-252)



Recommended Minimum Pads
Dimensions in Inches/(mm)

[Return to Index](#)



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