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

| PRODUCT SUMMARY | | | |
|---|---|---|---|
| $V_{DS}$ (V) | $R_{DS(on)max}$ (Ω) | $I_D$ (A) | $Q_g$ (Typ.) |
| 20 | 0.300 at $V_{GS}$ = 4.5 V | 0.6 | 0.75 |
| | 0.350 at $V_{GS}$ = 2.5 V | 0.4 | |
| | 0.420 at $V_{GS}$ = 1.8 V | 0.2 | |
| | 0.500 at $V_{GS}$ = 1.5 V | 0.05 | |

## FEATURES

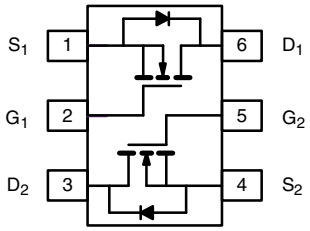
- Trench Power MOSFET
- 100 % $R_g$ Tested

Pb-free
RoHS COMPLIAN

## APPLICATIONS

- Load/Power Switching for Portable Devices
- Drivers: Relays, Solenoids, Lamps, Hammers, Displays, Memories
- Battery Operated Systems
- Power Supply Converter Circuits

SC-89




Top View

| ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25 °C, unless otherwise noted) | | | | |
|---|---|---|---|---|
| Parameter | | Symbol | Limit | Unit |
| Drain-Source Voltage | | $V_{DS}$ | 20 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 12 | |
| Continuous Drain Current ($T_J$ = 150 °C)[a] | $T_A$ = 25 °C | $I_D$ | 0.60[a, b] | A |
| | $T_A$ = 70 °C | | 0.49[a, b] | |
| Pulsed Drain Current | | $I_{DM}$ | 2 | |
| Continuous Source-Drain Diode Current | $T_A$ = 25 °C | $I_S$ | 0.18[a, b] | A |
| Maximum Power Dissipation[a] | $T_A$ = 25 °C | $P_D$ | 0.22[a, b] | W |
| | $T_A$ = 70 °C | | 0.14[a, b] | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | - 55 to 150 | °C |

| THERMAL RESISTANCE RATINGS | | | | | |
|---|---|---|---|---|---|
| Parameter | | Symbol | Typ. | Max. | Unit |
| Maximum Junction-to-Ambient[b] | t ≤ 5 s | $R_{thJA}$ | 470 | 565 | °C/W |
| | Steady State | | 560 | 675 | |

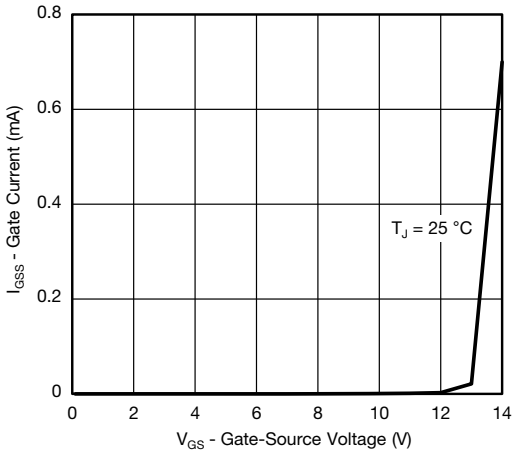
Notes:
a. Surface mounted on 1" x 1" FR4 board.
b. t = 5 s.

| **SPECIFICATIONS** ($T_J$ = 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 | 20 | | | V |
| $V_{DS}$ Temperature Coefficient | $\Delta V_{DS}/T_J$ | $I_D$ = 250 µA | | 17 | | mV/°C |
| $V_{GS(th)}$ Temperature Coefficient | $\Delta V_{GS(th)}/T_J$ | | | - 1.8 | | |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 0.4 | | 1 | V |
| Gate-Source Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 8 V | | | ± 30 | µA |
| | | $V_{DS}$ = 0 V, $V_{GS}$ = ± 4.5 V | | | ± 1 | |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 20 V, $V_{GS}$ = 0 V | | | 1 | |
| | | $V_{DS}$ = 20 V, $V_{GS}$ = 0 V, $T_J$ = 85 °C | | | 3 | |
| On-State Drain Current[a] | $I_{D(on)}$ | $V_{DS}$ = ≥ 5 V, $V_{GS}$ = 4.5 V | 2 | | | A |
| Drain-Source On-State Resistance[a] | $R_{DS(on)}$ | $V_{GS}$ = 4.5 V, $I_D$ = 0.5 A | | 0.300 | | Ω |
| | | $V_{GS}$ = 2.5 V, $I_D$ = 0.2 A | | 0.350 | | |
| | | $V_{GS}$ = 1.8 V, $I_D$ = 0.2 A | | 0.420 | | |
| | | $V_{GS}$ = 1.5 V, $I_D$ = 0.05 A | | 0.500 | | |
| Forward Transconductance | $g_{fs}$ | $V_{DS}$ = 10 V, $I_D$ = 0.5 A | | 7.5 | | S |
| **Dynamic[b]** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{DS}$ = 10 V, $V_{GS}$ = 0 V, f = 1 MHz | | 43 | | pF |
| Output Capacitance | $C_{oss}$ | | | 14 | | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 8 | | |
| Total Gate Charge | $Q_g$ | $V_{DS}$ = 10 V, $V_{GS}$ = 8 V, $I_D$ = 0.6 A | | 1.3 | 2 | nC |
| | | $V_{DS}$ = 10 V, $V_{GS}$ = 4.5 V, $I_D$ = 0.6 A | | 0.75 | 1.2 | |
| Gate-Source Charge | $Q_{gs}$ | | | 0.15 | | |
| Gate-Drain Charge | $Q_{gd}$ | | | 0.13 | | |
| Gate Resistance | $R_g$ | f = 1 MHz | 2.4 | 12.2 | 24.4 | Ω |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD}$ = 10 V, $R_L$ = 20 Ω<br>$I_D$ ≅ 0.5 A, $V_{GEN}$ = 4.5 V, $R_g$ = 1 Ω | | 11 | 20 | ns |
| Rise Time | $t_r$ | | | 16 | 24 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 26 | 39 | |
| Fall Time | $t_f$ | | | 11 | 20 | |
| **Drain-Source Body Diode Characteristics** | | | | | | |
| Pulse Diode Forward Current[a] | $I_{SM}$ | | | | 2 | A |
| Body Diode Voltage | $V_{SD}$ | $I_S$ = 0.5 A | | 0.8 | 1.2 | V |
| Body Diode Reverse Recovery Time | $t_{rr}$ | $I_F$ = 0.5 A, dI/dt = 100 A/µs | | 10 | 15 | ns |
| Body Diode Reverse Recovery Charge | $Q_{rr}$ | | | 2 | 4 | nC |
| Reverse Recovery Fall Time | $t_a$ | | | 5 | | ns |
| Reverse Recovery Rise Time | $t_b$ | | | 5 | | |

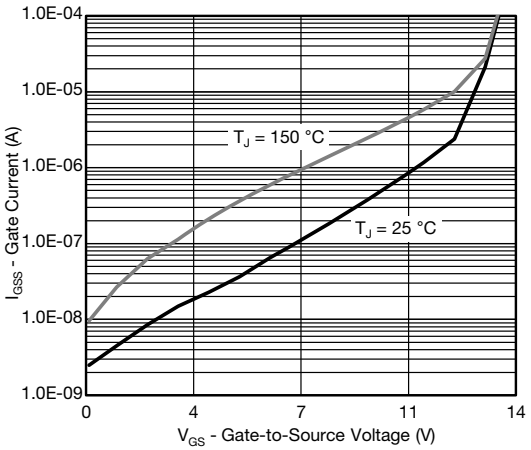
Notes:
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.

*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.*

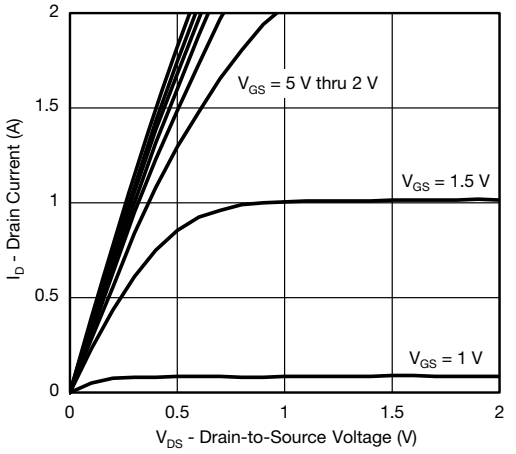
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



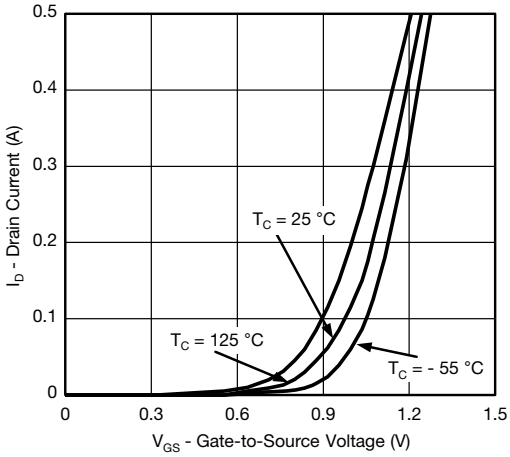

**Gate Current vs. Gate-Source Voltage**



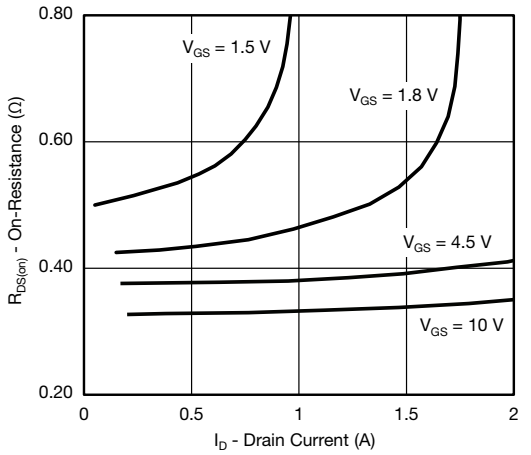

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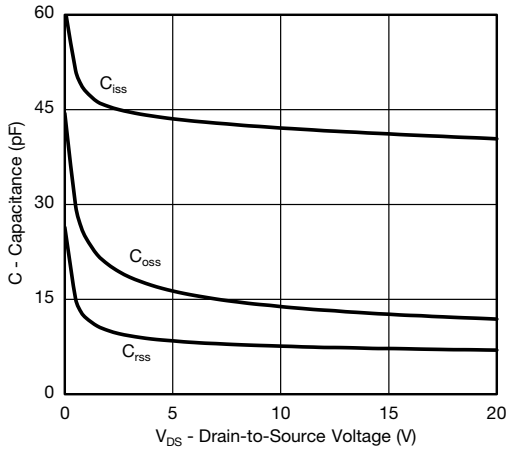

**Output Characteristics**




**Transfer Characteristics**

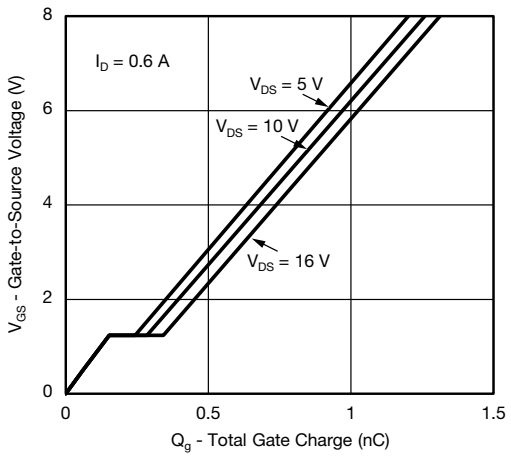



**On-Resistance vs. Drain Current**

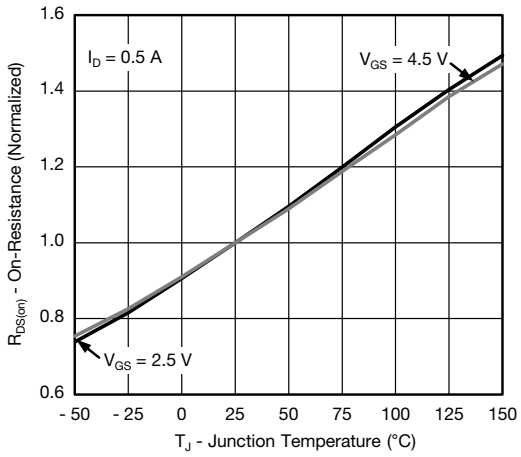



**Capacitance**

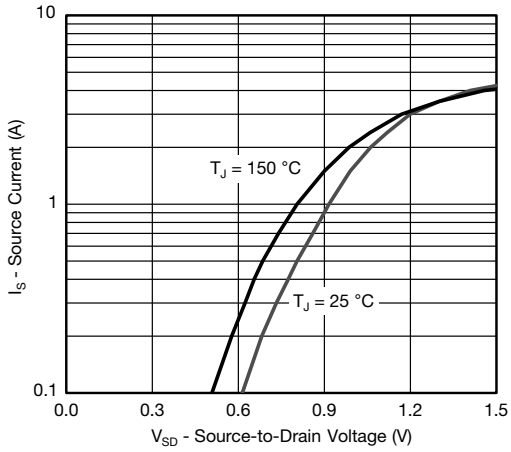
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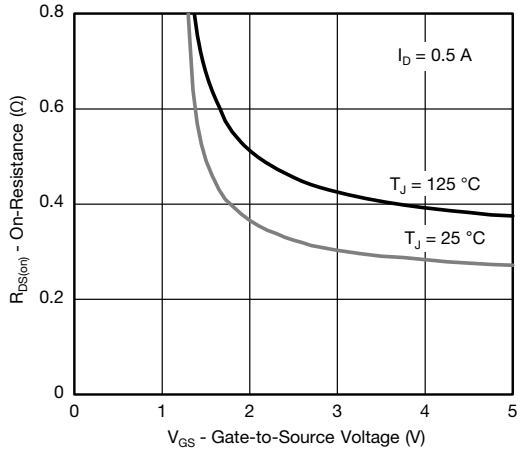

**Gate Charge**



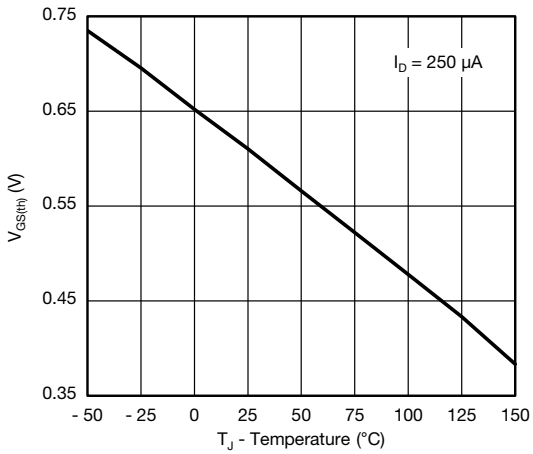

**On-Resistance vs. Junction Temperature**



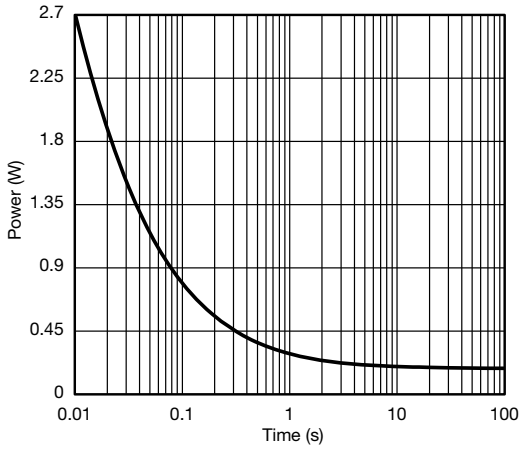

**Soure-Drain Diode Forward Voltage**




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

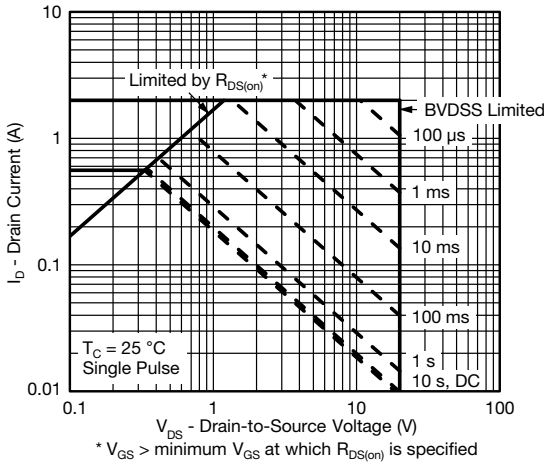



**Threshold Voltage**

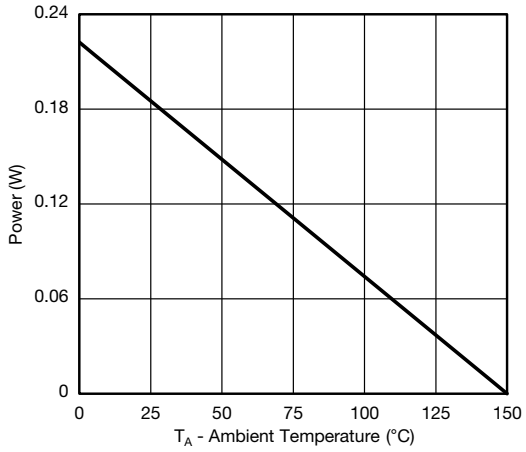



**Single Pulse Power, Junction-to-Ambient**

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

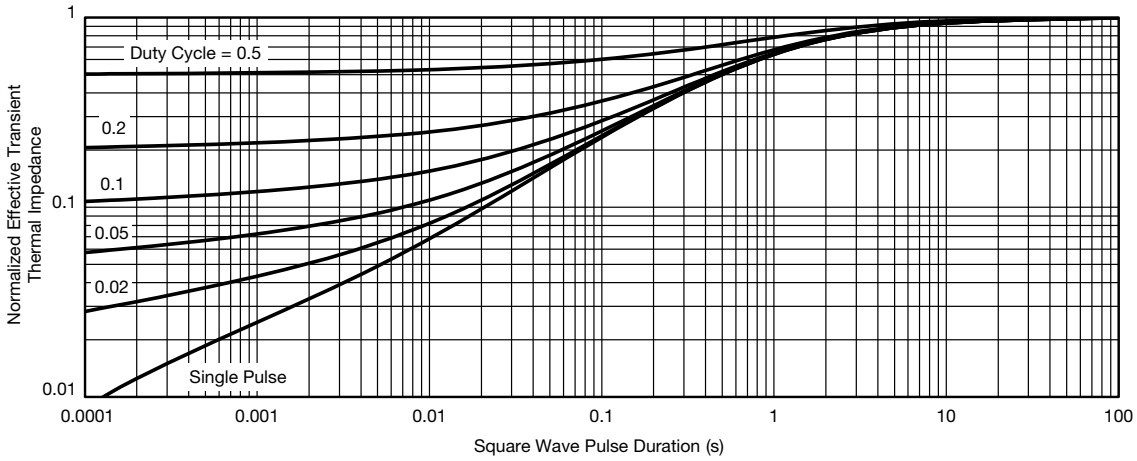



**Safe Operating Area, Junction-to-Ambient**



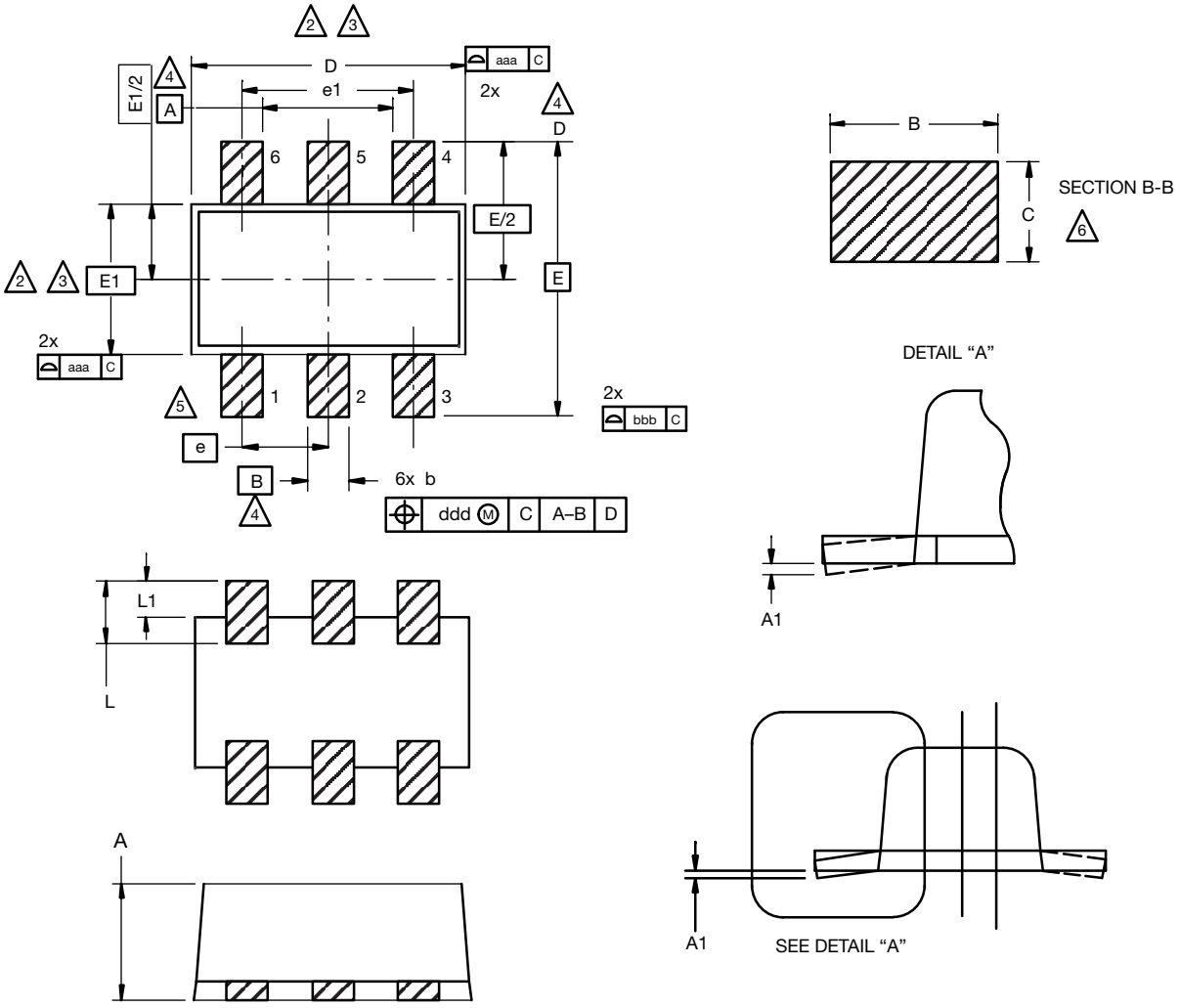

**Power Derating, Junction-to-Ambient**

* 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.




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

# SC-89 6-Leads (SOT-563F)

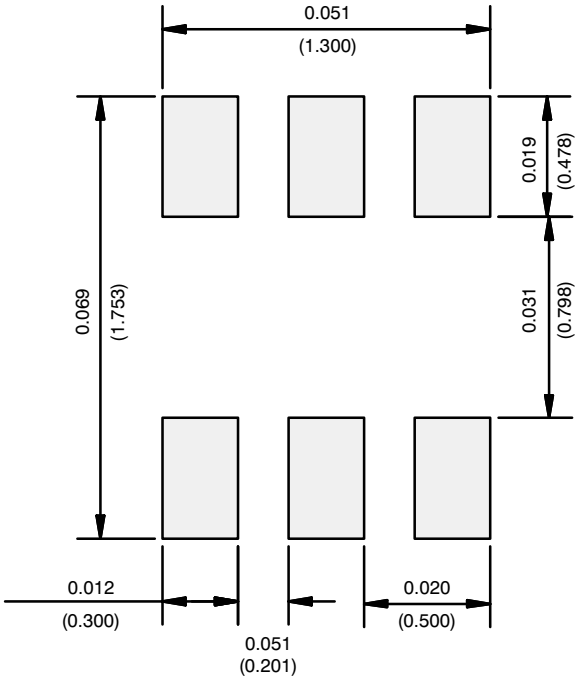



**Notes**

1. Dimensions in millimeters.
2. Dimension D does not include mold flash, protrusions or gate burrs. Mold flush, protrusions or gate burrs shall not exceed 0.15 mm per dimension E1 does not include interlead flash or protrusion, interlead flash or protrusion shall not exceed 0.15 mm per side.
3. Dimensions D and E1 are determined at the outmost extremes of the plastic body exclusive of mold flash, the bar burrs, gate burrs and interlead flash, but including any mismatch between the top and the bottom of the plastic body.
4. Datums A, B and D to be determined 0.10 mm from the lead tip.
5. Terminal numbers are shown for reference only.
6. These dimensions apply to the flat section of the lead between 0.08 mm and 0.15 mm from the lead tip.

| DIM. | MILLIMETERS | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | 0.56 | 0.58 | 0.60 |
| A1 | 0 | 0.02 | 0.10 |
| b | 0.15 | 0.22 | 0.30 |
| c | 0.10 | 0.14 | 0.18 |
| D | 1.50 | 1.60 | 1.70 |
| E | 1.50 | 1.60 | 1.70 |
| E1 | 1.15 | 1.20 | 1.25 |
| e | 0.45 | 0.50 | 0.55 |
| e1 | 0.95 | 1.00 | 1.05 |
| L | 0.25 | 0.35 | 0.50 |
| L1 | 0.10 | 0.20 | 0.30 |

## RECOMMENDED MINIMUM PADS FOR SC-89: 6-Lead




Recommended Minimum Pads
Dimensions in Inches/(mm)

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