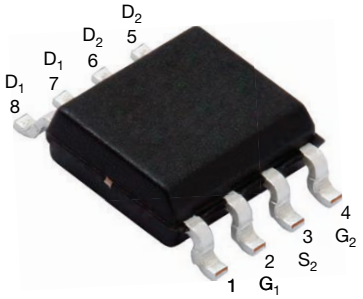
# APM9948KC-TRL-VB Datasheet
# Dual N-Channel 60 V (D-S) 175 °C MOSFET

| PRODUCT SUMMARY | |
|---|---|
| $V_{DS}$ (V) | 60 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 10 V | 0.028 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 4.5 V | 0.030 |
| $I_D$ (A) per leg | 7 |
| Configuration | Dual |

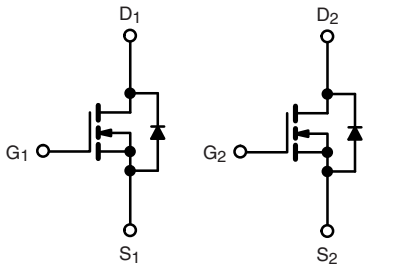
## FEATURES
- Trench power MOSFET
- 100 % $R_g$ and UIS tested

Pb-free
RoHS COMPLIANT
HALOGEN FREE

**SO-8 Dual**




Top View




N-Channel MOSFET N-Channel MOSFET

| 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) [a] | | $I_S$ | 3.6 | |
| Pulsed Drain Current [b] | | $I_{DM}$ | 28 | |
| Single Pulse Avalanche Current | L = 0.1 mH | $I_{AS}$ | 18 | |
| Single Pulse Avalanche Energy | | $E_{AS}$ | 16.2 | mJ |
| Maximum Power Dissipation [b] | $T_C$ = 25 °C | $P_D$ | 4 | W |
| | $T_C$ = 125 °C | | 1.3 | |
| 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 [c] | $R_{thJA}$ | 110 | °C/W |
| Junction-to-Foot (Drain) | | $R_{thJF}$ | 34 | |

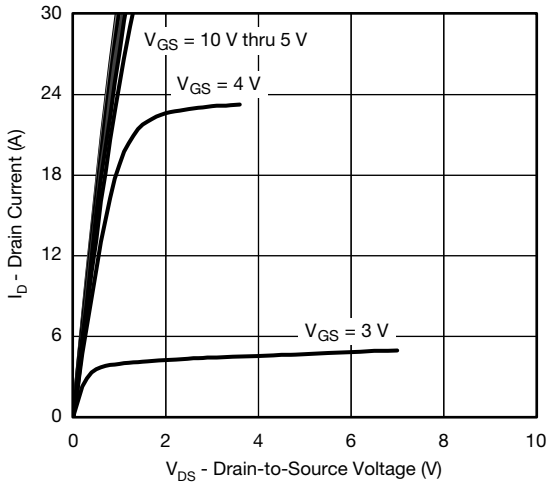
**Notes**
a. Package limited.
b. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
c. When mounted on 1" square PCB (FR4 material).

| **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 V, $I_D$ = 250 µA | | 60 | - | - | V |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | | 1.5 | 2.0 | 2.5 | |
| Gate-Source Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | | - | - | ± 100 | nA |
| 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 | 20 | - | - | A |
| Drain-Source On-State Resistance [a] | $R_{DS(on)}$ | $V_{GS}$ = 10 V | $I_D$ = 4.5 A- | - | 0.028 | - | Ω |
| | | $V_{GS}$ = 10 V | $I_D$ = 4.5 A, $T_J$ = 125 °C | - | 0.066 | - | |
| | | $V_{GS}$ = 10 V | $I_D$ = 4.5 A, $T_J$ = 175 °C | - | 0.081 | - | |
| | | $V_{GS}$ = 4.5 V | $I_D$ = 4 A- | - | 0.030 | - | |
| Forward Transconductance [f] | $g_{fs}$ | $V_{DS}$ = 15 V, $I_D$ = 4.5 A | | - | 15 | - | S |
| **Dynamic [b]** | | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 25 V, f = 1 MHz | - | 600 | 750 | pF |
| Output Capacitance | $C_{oss}$ | | | - | 110 | 140 | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | - | 50 | 62 | |
| Total Gate Charge [c] | $Q_g$ | $V_{GS}$ = 10 V | $V_{DS}$ = 30 V, $I_D$ = 5.3 A | - | 11.7 | 18 | nC |
| Gate-Source Charge [c] | $Q_{gs}$ | | | - | 1.8 | 2.7 | |
| Gate-Drain Charge [c] | $Q_{gd}$ | | | - | 2.8 | 4.2 | |
| Gate Resistance | $R_g$ | f = 1 MHz | | 1.3 | - | 6 | Ω |
| Turn-On Delay Time [c] | $t_{d(on)}$ | $V_{DD}$ = 30 V, $R_L$ = 6.8 Ω<br>$I_D$ ≅ 4.4 A, $V_{GEN}$ = 10 V, $R_g$ = 1 Ω | | - | 7 | 11 | ns |
| Rise Time [c] | $t_r$ | | | - | 3.3 | 5 | |
| Turn-Off Delay Time [c] | $t_{d(off)}$ | | | - | 22.4 | 33.5 | |
| Fall Time [c] | $t_f$ | | | - | 2.1 | 3.2 | |
| **Source-Drain Diode Ratings and Characteristics [b]** | | | | | | | |
| Pulsed Current [a] | $I_{SM}$ | | | - | - | 28 | A |
| Forward Voltage | $V_{SD}$ | $I_F$ = 2 A, $V_{GS}$ = 0 V | | - | 0.75 | 1.1 | V |

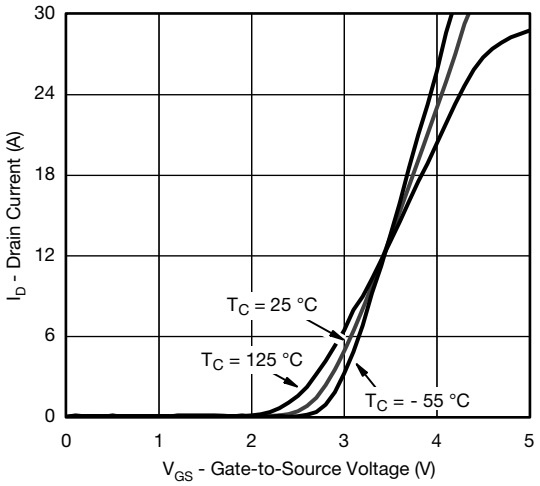
**Notes**

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

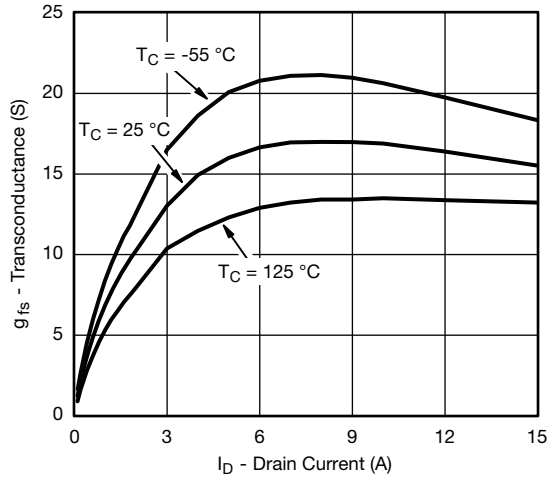
## TYPICAL CHARACTERISTICS ($T_A$ = 25 °C, unless otherwise noted)



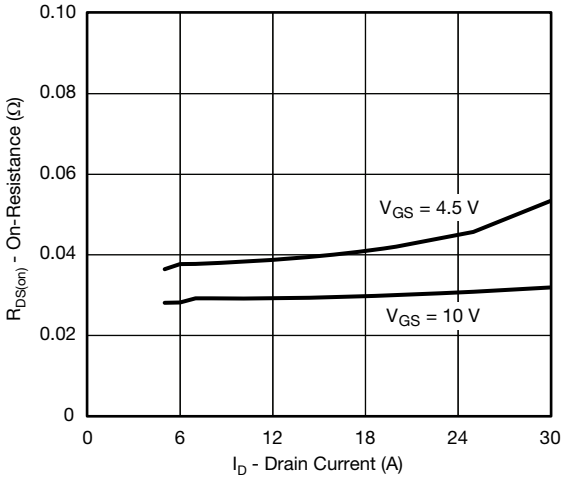

**Output Characteristics**



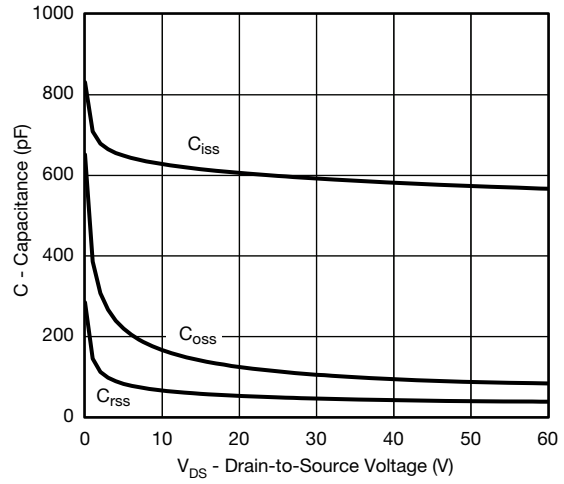

**Transfer Characteristics**



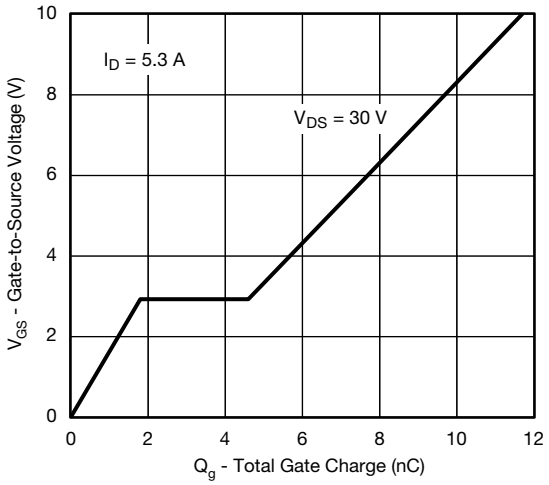

**Transconductance**




**On-Resistance vs. Drain Current**

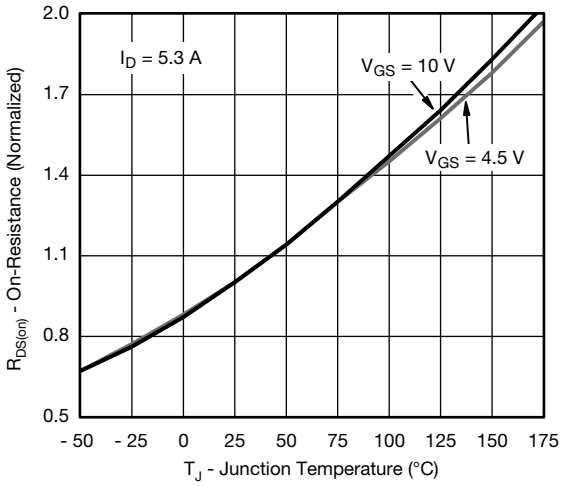



**Capacitance**

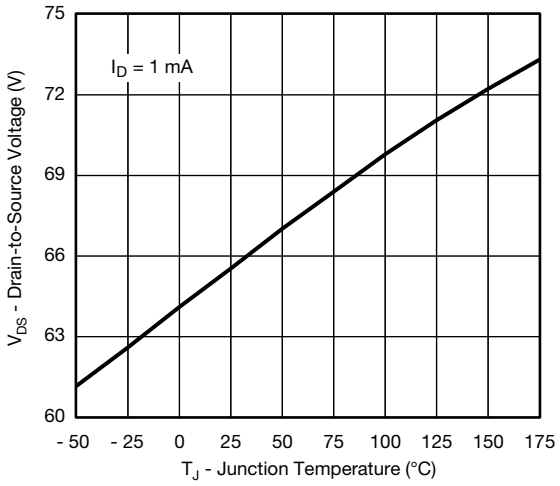



**Gate Charge**

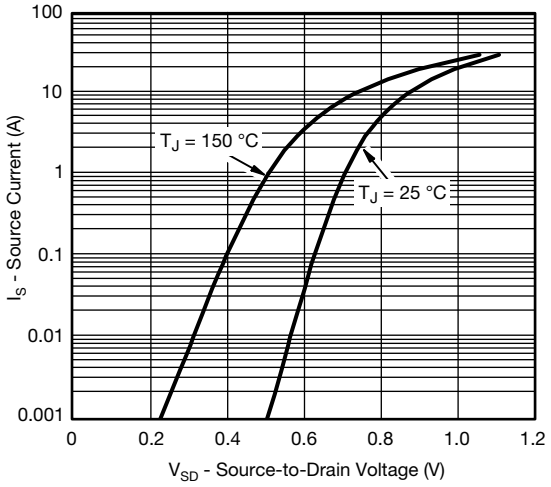
**TYPICAL CHARACTERISTICS** ($T_A$ = 25 °C, unless otherwise noted)



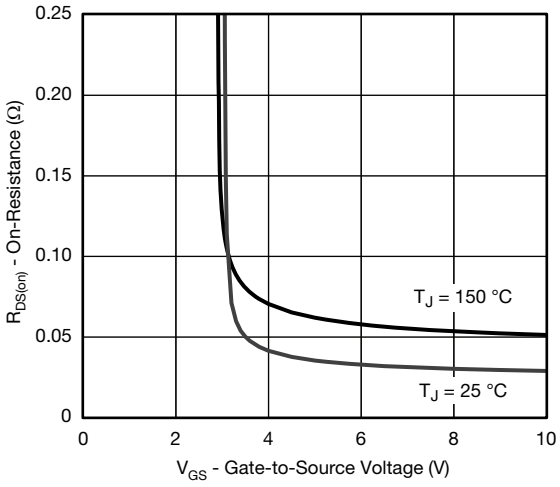

**On-Resistance vs. Junction Temperature**



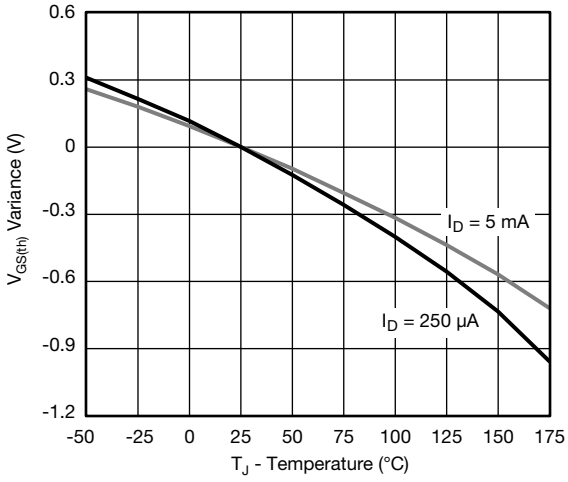

**Drain Source Breakdown vs. Junction Temperature**




**Source Drain Diode Forward Voltage**

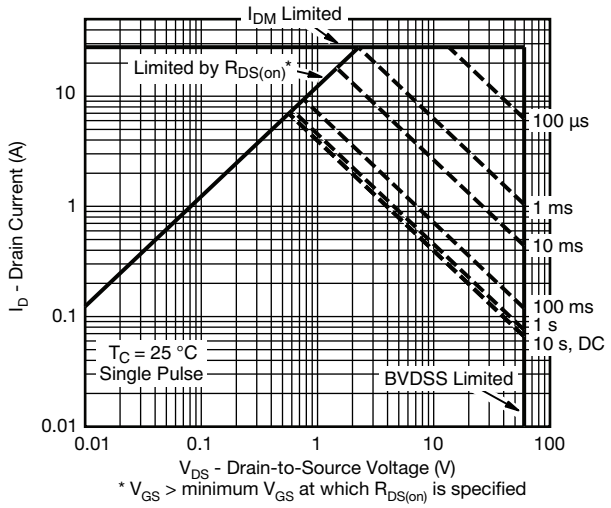



**On-Resistance vs. Gate-to-Source Voltage**

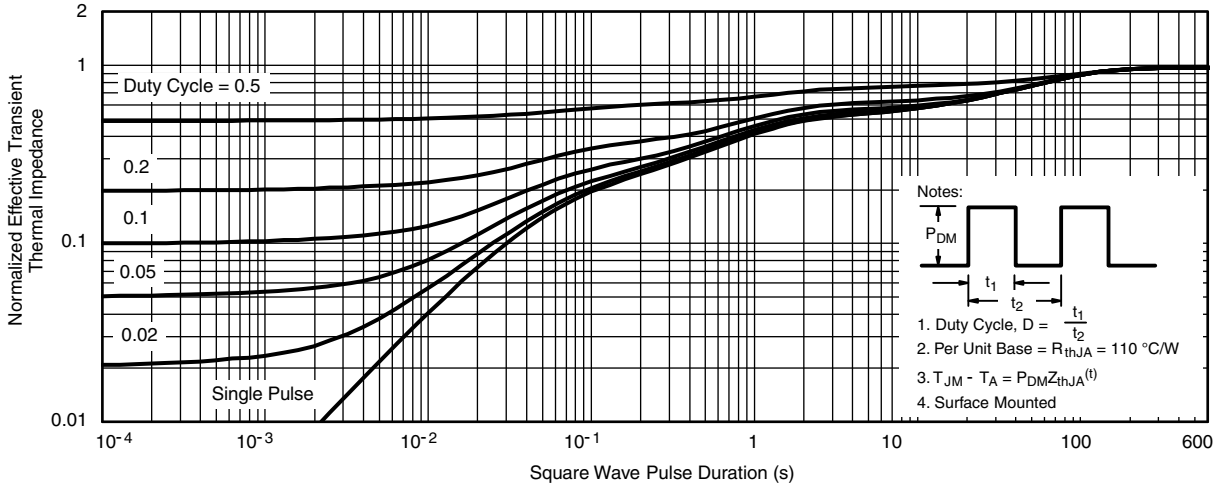



**Threshold Voltage**

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

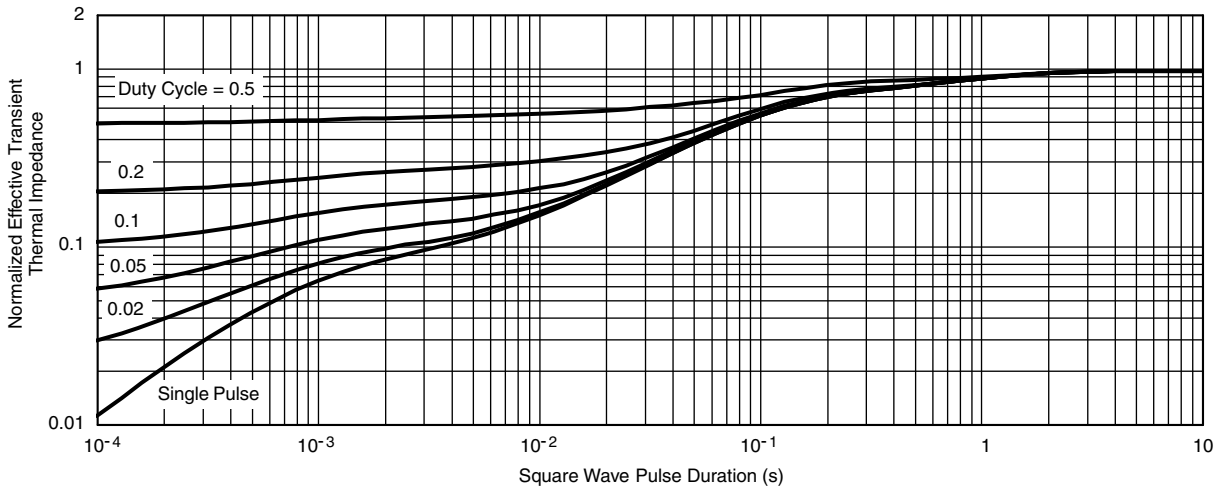



**Safe Operating Area**



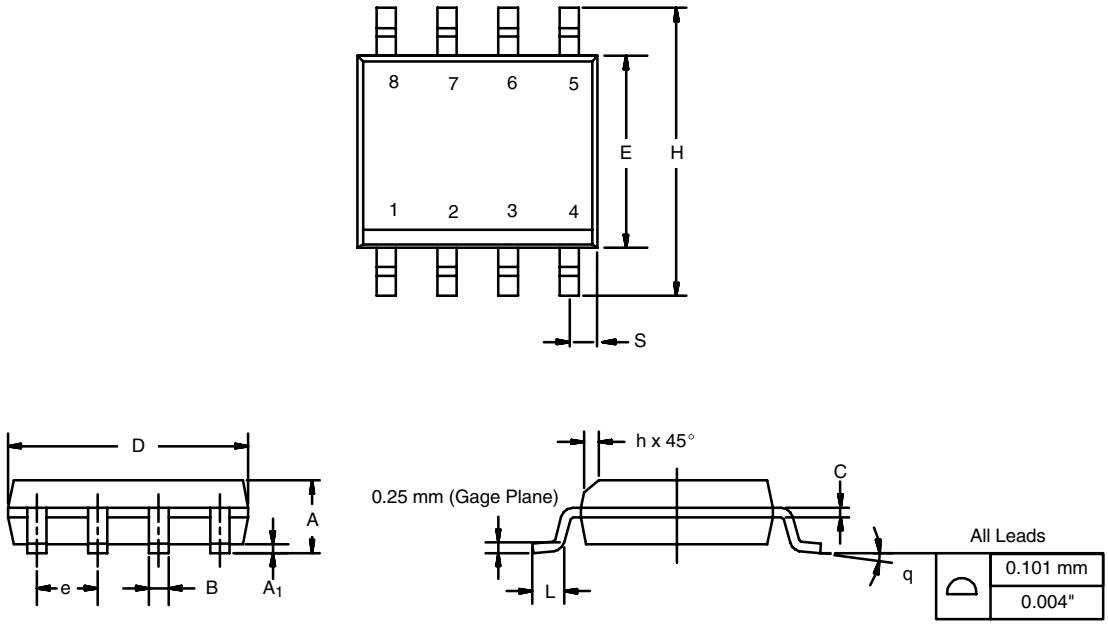

**Normalized Thermal Transient Impedance, Junction-to-Ambient**

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



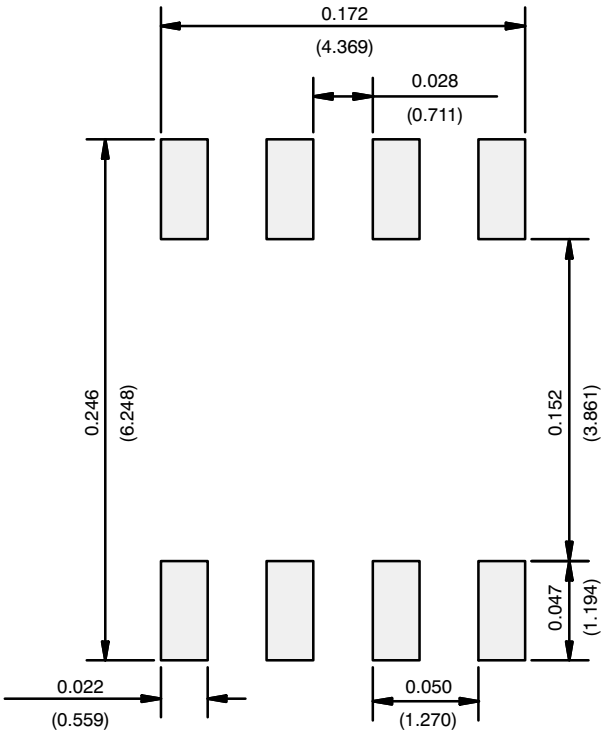

**Normalized Thermal Transient Impedance, Junction-to-Foot**

**SOIC (NARROW): 8-LEAD**
JEDEC Part Number: MS-012




| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 1.35 | 1.75 | 0.053 | 0.069 |
| $A_1$ | 0.10 | 0.20 | 0.004 | 0.008 |
| B | 0.35 | 0.51 | 0.014 | 0.020 |
| C | 0.19 | 0.25 | 0.0075 | 0.010 |
| D | 4.80 | 5.00 | 0.189 | 0.196 |
| E | 3.80 | 4.00 | 0.150 | 0.157 |
| e | 1.27 BSC | | 0.050 BSC | |
| H | 5.80 | 6.20 | 0.228 | 0.244 |
| h | 0.25 | 0.50 | 0.010 | 0.020 |
| L | 0.50 | 0.93 | 0.020 | 0.037 |
| q | 0° | 8° | 0° | 8° |
| S | 0.44 | 0.64 | 0.018 | 0.026 |
| ECN: C-06527-Rev. I, 11-Sep-06<br>DWG: 5498 | | | | |

## RECOMMENDED MINIMUM PADS FOR SO-8




Recommended Minimum Pads
Dimensions in Inches/(mm)

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