

# APM9946KC-TRL-VB Datasheet Dual N-Channel 60 V (D-S) 175 °C MOSFET

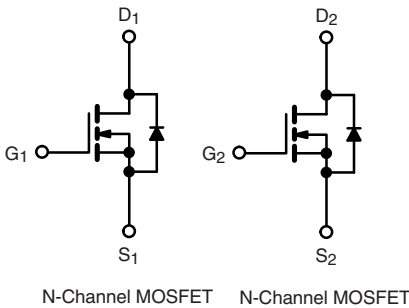
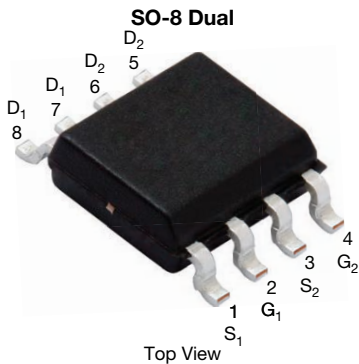
| PRODUCT SUMMARY                               |       |
|-----------------------------------------------|-------|
| $V_{DS}$ (V)                                  | 60    |
| $R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = 10$ V  | 0.028 |
| $R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = 4.5$ V | 0.030 |
| $I_D$ (A)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

### FEATURES

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



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**



| ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted) |                |                |             |      |
|-------------------------------------------------------------------|----------------|----------------|-------------|------|
| PARAMETER                                                         |                | SYMBOL         | LIMIT       | UNIT |
| Drain-Source Voltage                                              |                | $V_{DS}$       | 60          | V    |
| Gate-Source Voltage                                               |                | $V_{GS}$       | $\pm 20$    |      |
| Continuous Drain Current                                          | $T_C = 25$ °C  | $I_D$          | 7           | A    |
|                                                                   | $T_C = 125$ °C |                | 4           |      |
| Continuous Source Current (Diode Conduction) <sup>a</sup>         |                | $I_S$          | 3.6         |      |
| Pulsed Drain Current <sup>b</sup>                                 |                | $I_{DM}$       | 28          |      |
| Single Pulse Avalanche Current                                    | L = 0.1 mH     | $I_{AS}$       | 18          | mJ   |
| Single Pulse Avalanche Energy                                     |                | $E_{AS}$       | 16.2        |      |
| Maximum Power Dissipation <sup>b</sup>                            | $T_C = 25$ °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 <sup>c</sup> | $R_{thJA}$ | 110   | °C/W |
| Junction-to-Foot (Drain)   |                        | $R_{thJF}$ | 34    |      |

### Notes

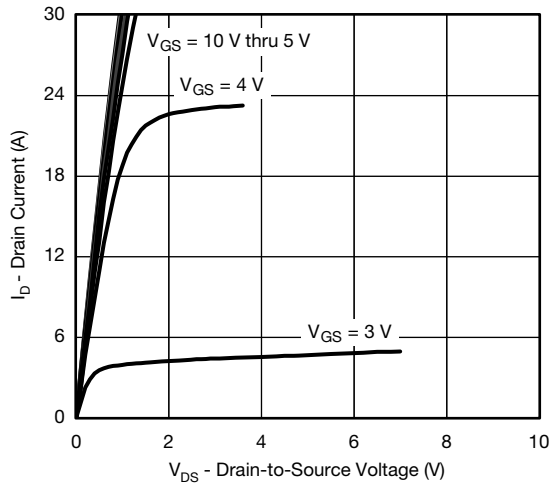
- Package limited.
- Pulse test; pulse width  $\leq 300$   $\mu$ s, duty cycle  $\leq 2$  %.
- When mounted on 1" square PCB (FR4 material).

| SPECIFICATIONS (T <sub>C</sub> = 25 °C, unless otherwise noted) |                     |                                                                                                                         |                                                 |      |       |       |      |
|-----------------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|------|-------|-------|------|
| PARAMETER                                                       | SYMBOL              | TEST CONDITIONS                                                                                                         |                                                 | MIN. | TYP.  | MAX.  | UNIT |
| Static                                                          |                     |                                                                                                                         |                                                 |      |       |       |      |
| Drain-Source Breakdown Voltage                                  | V <sub>DS</sub>     | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA                                                                          |                                                 | 60   | -     | -     | V    |
| Gate-Source Threshold Voltage                                   | V <sub>GS(th)</sub> | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA                                                             |                                                 | 1.5  | 2.0   | 2.5   |      |
| Gate-Source Leakage                                             | I <sub>GSS</sub>    | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 20 V                                                                         |                                                 | -    | -     | ± 100 | nA   |
| Zero Gate Voltage Drain Current                                 | I <sub>DSS</sub>    | V <sub>GS</sub> = 0 V                                                                                                   | V <sub>DS</sub> = 60 V                          | -    | -     | 1     | μA   |
|                                                                 |                     | V <sub>GS</sub> = 0 V                                                                                                   | V <sub>DS</sub> = 60 V, T <sub>J</sub> = 125 °C | -    | -     | 50    |      |
|                                                                 |                     | V <sub>GS</sub> = 0 V                                                                                                   | V <sub>DS</sub> = 60 V, T <sub>J</sub> = 175 °C | -    | -     | 150   |      |
| On-State Drain Current <sup>a</sup>                             | I <sub>D(on)</sub>  | V <sub>GS</sub> = 10 V                                                                                                  | V <sub>DS</sub> ≥ 5 V                           | 20   | -     | -     | A    |
| Drain-Source On-State Resistance <sup>a</sup>                   | R <sub>DS(on)</sub> | V <sub>GS</sub> = 10 V                                                                                                  | I <sub>D</sub> = 4.5 A-                         | -    | 0.028 | -     | Ω    |
|                                                                 |                     | V <sub>GS</sub> = 10 V                                                                                                  | I <sub>D</sub> = 4.5 A, T <sub>J</sub> = 125 °C | -    | 0.066 | -     |      |
|                                                                 |                     | V <sub>GS</sub> = 10 V                                                                                                  | I <sub>D</sub> = 4.5 A, T <sub>J</sub> = 175 °C | -    | 0.081 | -     |      |
|                                                                 |                     | V <sub>GS</sub> = 4.5 V                                                                                                 | I <sub>D</sub> = 4 A-                           | -    | 0.030 | -     |      |
| Forward Transconductance <sup>f</sup>                           | g <sub>fs</sub>     | V <sub>DS</sub> = 15 V, I <sub>D</sub> = 4.5 A                                                                          |                                                 | -    | 15    | -     | S    |
| Dynamic <sup>b</sup>                                            |                     |                                                                                                                         |                                                 |      |       |       |      |
| Input Capacitance                                               | C <sub>iss</sub>    | V <sub>GS</sub> = 0 V                                                                                                   | V <sub>DS</sub> = 25 V, f = 1 MHz               | -    | 600   | 750   | pF   |
| Output Capacitance                                              | C <sub>oss</sub>    |                                                                                                                         |                                                 | -    | 110   | 140   |      |
| Reverse Transfer Capacitance                                    | C <sub>rss</sub>    |                                                                                                                         |                                                 | -    | 50    | 62    |      |
| Total Gate Charge <sup>c</sup>                                  | Q <sub>g</sub>      | V <sub>GS</sub> = 10 V                                                                                                  | V <sub>DS</sub> = 30 V, I <sub>D</sub> = 5.3 A  | -    | 11.7  | 18    | nC   |
| Gate-Source Charge <sup>c</sup>                                 | Q <sub>gs</sub>     |                                                                                                                         |                                                 | -    | 1.8   | 2.7   |      |
| Gate-Drain Charge <sup>c</sup>                                  | Q <sub>gd</sub>     |                                                                                                                         |                                                 | -    | 2.8   | 4.2   |      |
| Gate Resistance                                                 | R <sub>g</sub>      | f = 1 MHz                                                                                                               |                                                 | 1.3  | -     | 6     | Ω    |
| Turn-On Delay Time <sup>c</sup>                                 | t <sub>d(on)</sub>  | V <sub>DD</sub> = 30 V, R <sub>L</sub> = 6.8 Ω<br>I <sub>D</sub> ≅ 4.4 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 1 Ω |                                                 | -    | 7     | 11    | ns   |
| Rise Time <sup>c</sup>                                          | t <sub>r</sub>      |                                                                                                                         |                                                 | -    | 3.3   | 5     |      |
| Turn-Off Delay Time <sup>c</sup>                                | t <sub>d(off)</sub> |                                                                                                                         |                                                 | -    | 22.4  | 33.5  |      |
| Fall Time <sup>c</sup>                                          | t <sub>f</sub>      |                                                                                                                         |                                                 | -    | 2.1   | 3.2   |      |
| Source-Drain Diode Ratings and Characteristics <sup>b</sup>     |                     |                                                                                                                         |                                                 |      |       |       |      |
| Pulsed Current <sup>a</sup>                                     | I <sub>SM</sub>     |                                                                                                                         |                                                 | -    | -     | 28    | A    |
| Forward Voltage                                                 | V <sub>SD</sub>     | I <sub>F</sub> = 2 A, V <sub>GS</sub> = 0 V                                                                             |                                                 | -    | 0.75  | 1.1   | V    |

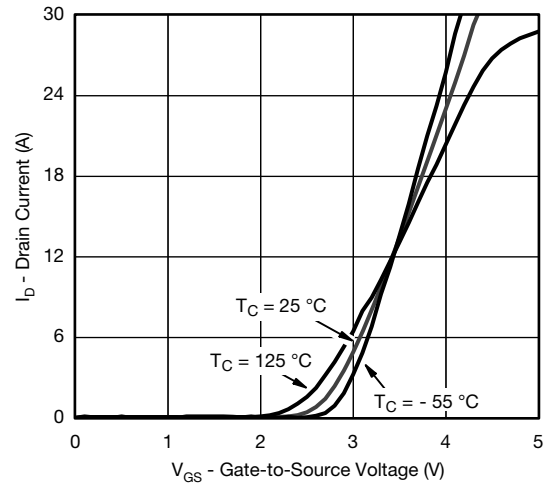
**Notes**

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

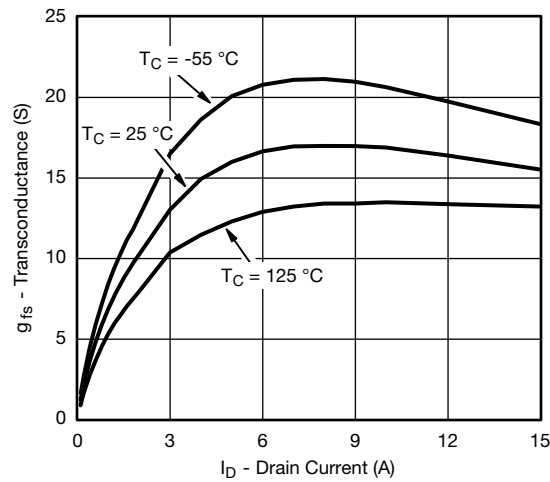
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)



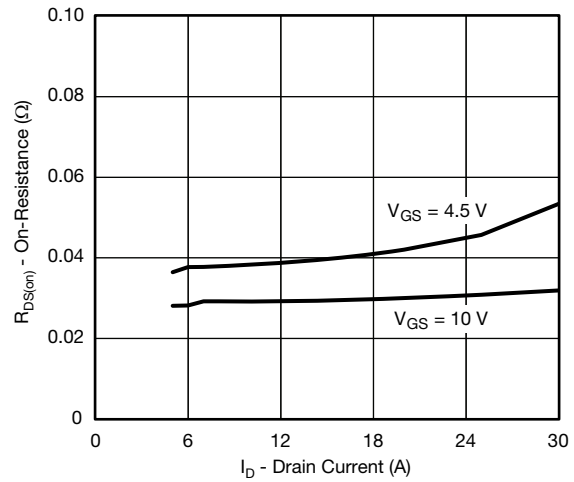
**Output Characteristics**



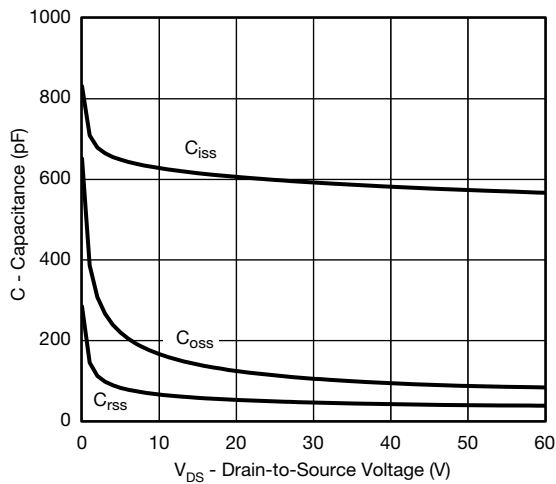
**Transfer Characteristics**



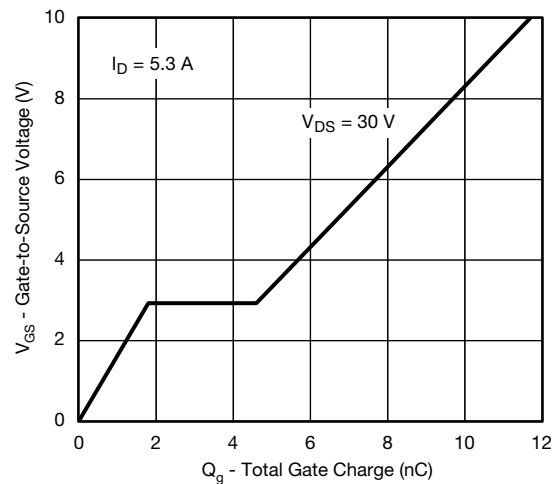
**Transconductance**



**On-Resistance vs. Drain Current**

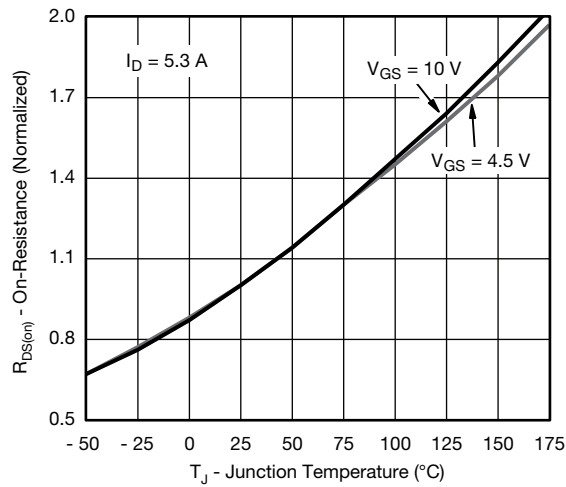


**Capacitance**

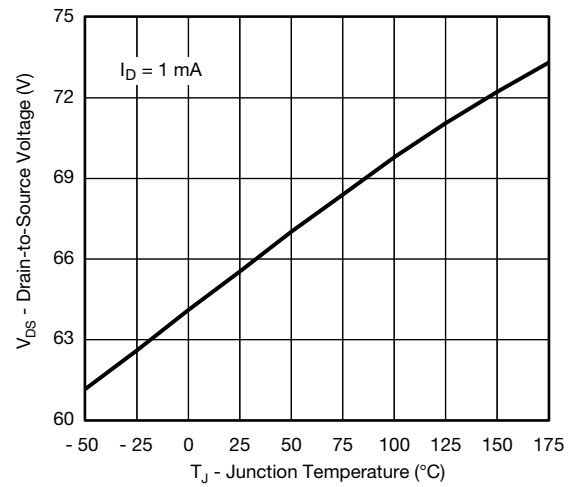


**Gate Charge**

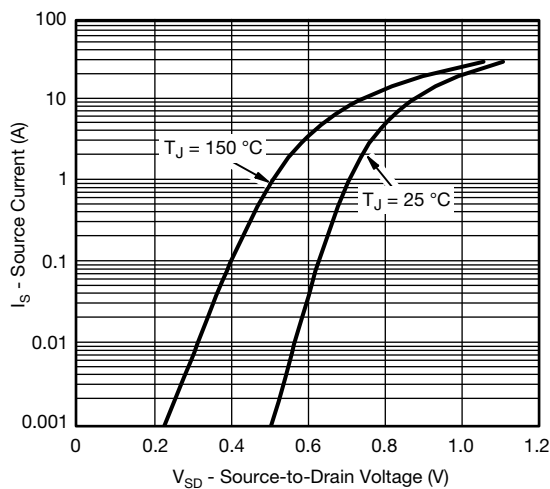
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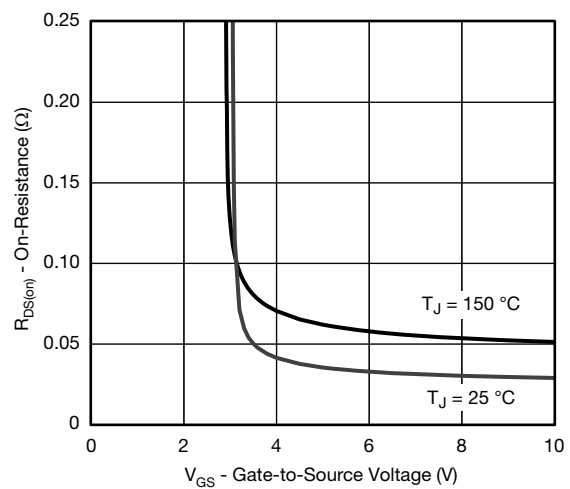
**On-Resistance vs. Junction Temperature**



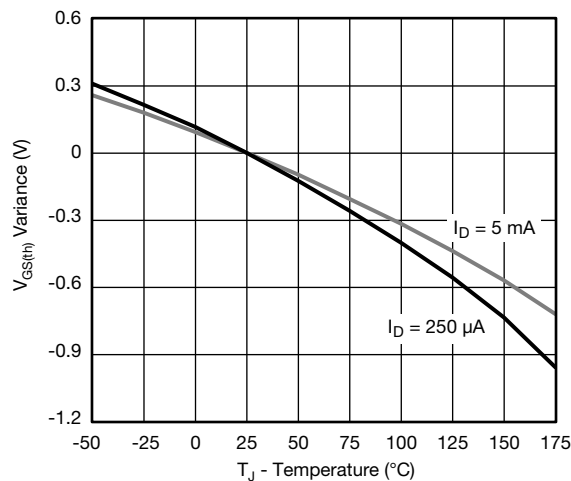
**Drain Source Breakdown vs. Junction Temperature**



**Source Drain Diode Forward Voltage**

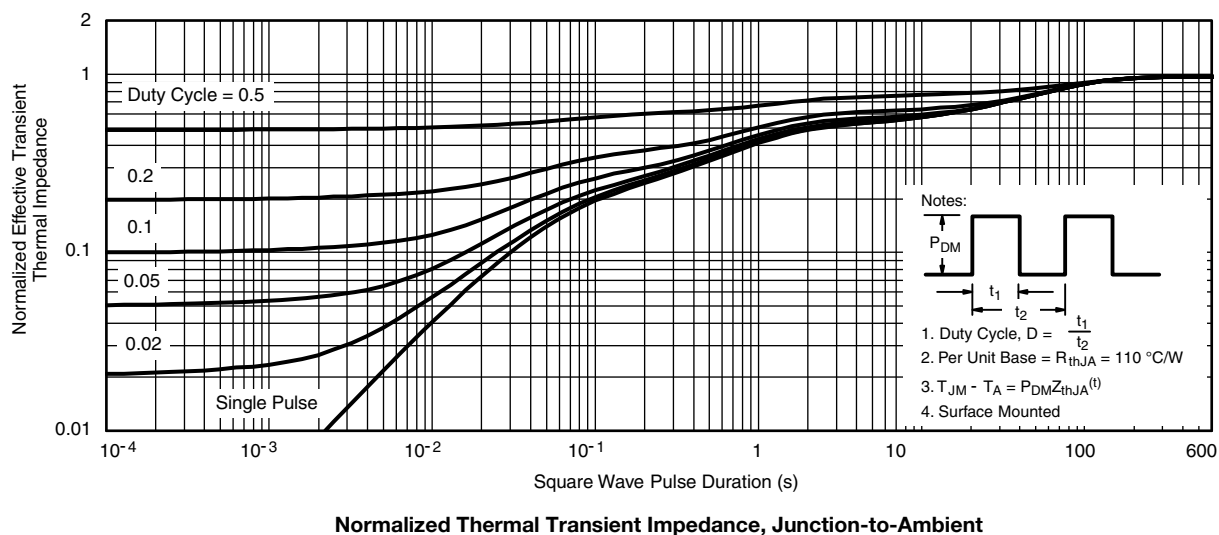
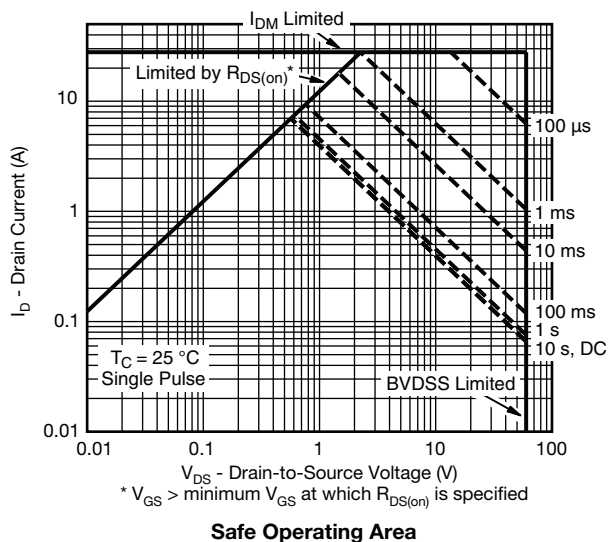


**On-Resistance vs. Gate-to-Source Voltage**

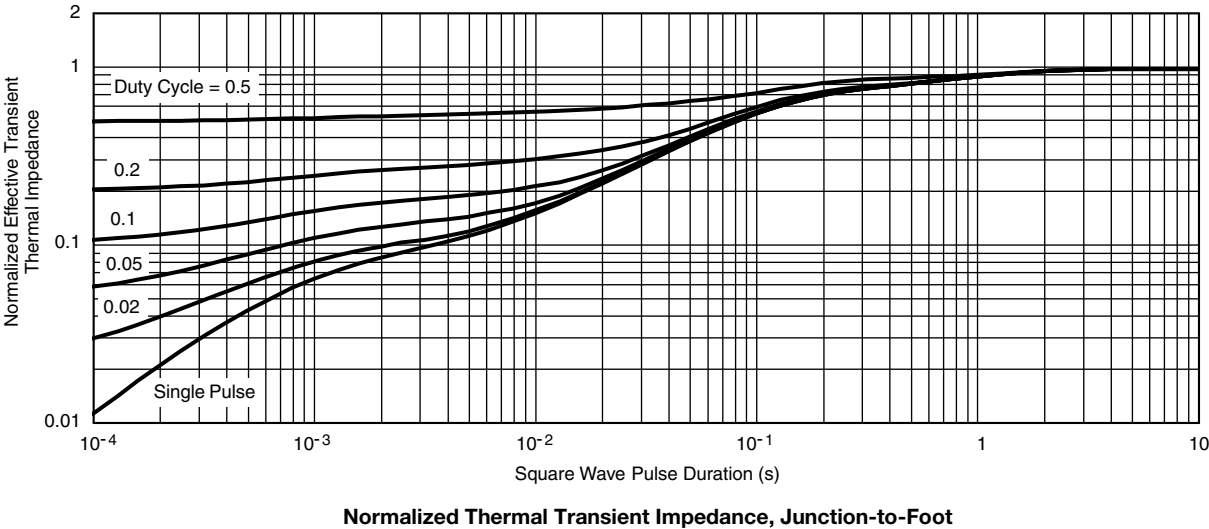


**Threshold Voltage**

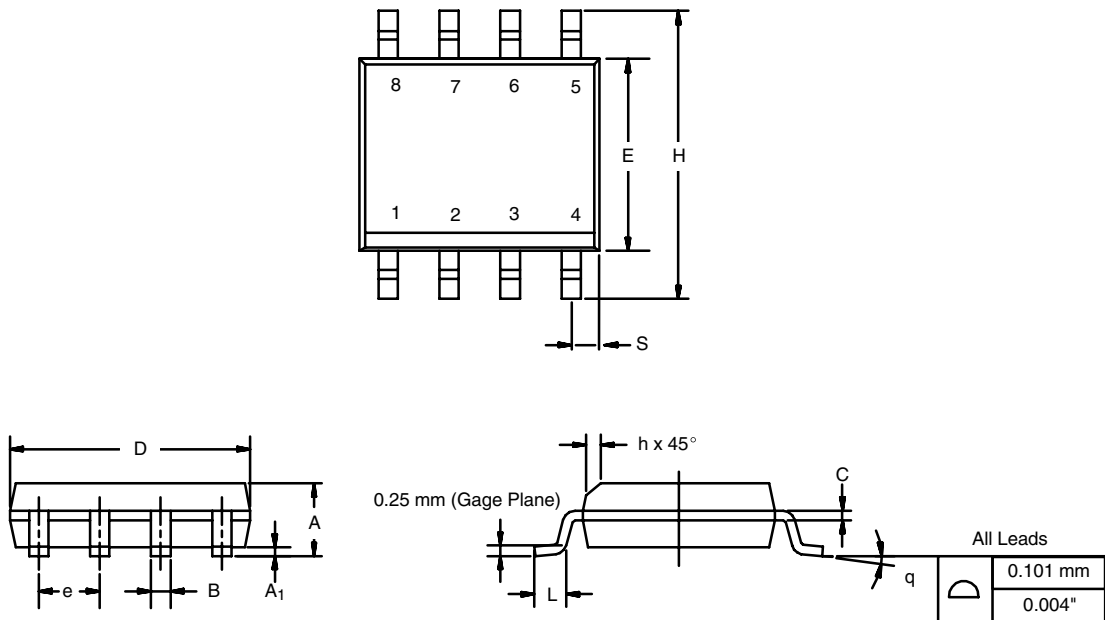
**THERMAL RATINGS** ( $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)



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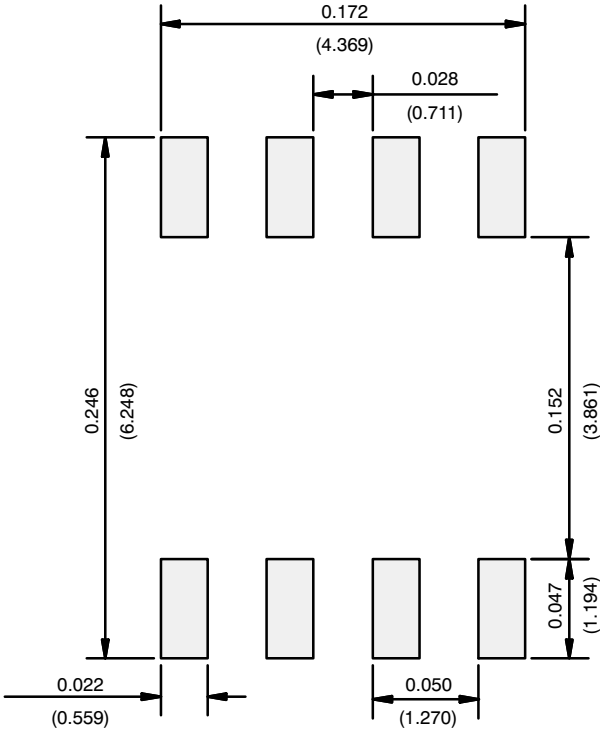


**SOIC (NARROW): 8-LEAD**  
JEDEC Part Number: MS-012



| DIM                            | MILLIMETERS |      | INCHES    |       |
|--------------------------------|-------------|------|-----------|-------|
|                                | Min         | Max  | Min       | Max   |
| A                              | 1.35        | 1.75 | 0.053     | 0.069 |
| A <sub>1</sub>                 | 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 |             |      |           |       |
| DWG: 5498                      |             |      |           |       |

RECOMMENDED MINIMUM PADS FOR SO-8



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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