

## Product Summary

| BV <sub>DSS</sub> | R <sub>DS(ON)</sub> Max        | I <sub>D</sub> Max<br>T <sub>A</sub> = +25°C |
|-------------------|--------------------------------|--|
| -20V              | 33mΩ @ V <sub>GS</sub> = -4.5V | -7.0A  |
|                   | 52mΩ @ V <sub>GS</sub> = -2.5V | -5.5A  |

## Features and Benefits

- Low On-Resistance
- Low Gate Threshold Voltage
- Low Input Capacitance
- Fast Switching Speed
- Low Input/Output Leakage
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

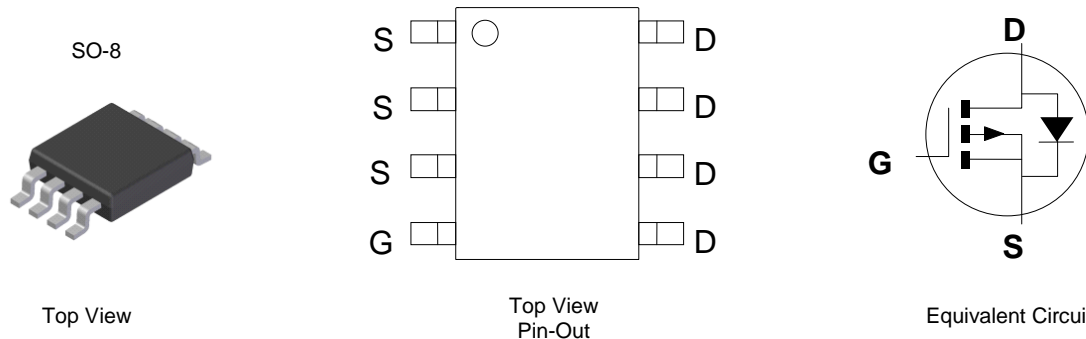
## Description and Applications

This MOSFET is designed to minimize the on-state resistance (R<sub>DS(ON)</sub>) and yet maintain superior switching performance, making it ideal for high efficiency power management applications.

- Backlighting
- Power Management Functions
- DC-DC Converters

## Mechanical Data

- Case: SO-8
- Case Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals Connections: See Diagram
- Terminals: Finish - Matte Tin Annealed over Copper Lead Frame. Solderable per MIL-STD-202, Method 208 (E3)
- Weight: 0.072g (Approximate)

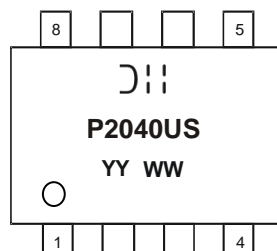


## Ordering Information (Note 4)

| Part Number   | Case | Packaging        |
|---------------|------|------------------|
| DMP2040USS-13 | SO-8 | 2500/Tape & Reel |

- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
  2. See <https://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
  3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
  4. For packaging details, go to our website at <https://www.diodes.com/design/support/packaging/diodes-packaging/>.

## Marking Information



⌋|| = Manufacturer's Marking  
 P2040US = Product Type Marking Code  
 YYWW = Date Code Marking  
 YY or YY= Year (ex: 19 = 2019)  
 WW = Week (01 to 53)

**Maximum Ratings** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Characteristic  |              | Symbol                 | Value | Unit |
|---|--------------|------------------------|-------|------|
| Drain-Source Voltage                                      |              | V <sub>DSS</sub>       | -20   | V    |
| Gate-Source Voltage                                       |              | V <sub>GSS</sub>       | ±12   | V    |
| Continuous Drain Current (Note 6) V <sub>GS</sub> = -4.5V | Steady State | T <sub>A</sub> = +25°C | -7.0  | A    |
|   |              | T <sub>A</sub> = +70°C | -5.5  |      |
| Continuous Drain Current (Note 7) V <sub>GS</sub> = -4.5V | Steady State | T <sub>C</sub> = +25°C | -15   | A    |
|   |              | T <sub>C</sub> = +70°C | -12   |      |
| Pulsed Drain Current (10µs Pulse, Duty Cycle = 1%)        |              | I <sub>DM</sub>        | -30   | A    |
| Continuous Source-Drain Diode Current (Note 6)            |              | I <sub>S</sub>         | -2.2  | A    |
| Avalanche Current (Note 8) L = 0.1mH                      |              | I <sub>AS</sub>        | -16   | A    |
| Avalanche Energy (Note 8) L = 0.1mH                       |              | E <sub>AS</sub>        | 13.5  | mJ   |

**Thermal Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Characteristic                                   |                        | Symbol                            | Value       | Unit |
|--|------------------------|-----------------------------------|-------------|------|
| Total Power Dissipation (Note 5)                 | T <sub>A</sub> = +25°C | P <sub>D</sub>                    | 1.4         | W    |
| Thermal Resistance, Junction to Ambient (Note 5) | Steady State           | R <sub>θJA</sub>                  | 91          | °C/W |
| Total Power Dissipation (Note 6)                 | T <sub>A</sub> = +25°C | P <sub>D</sub>                    | 1.9         | W    |
| Thermal Resistance, Junction to Ambient (Note 6) | Steady State           | R <sub>θJA</sub>                  | 64          | °C/W |
| Thermal Resistance, Junction to Case (Note 7)    | Steady State           | R <sub>θJC</sub>                  | 13.5        | °C/W |
| Operating and Storage Temperature Range          |                        | T <sub>J</sub> , T <sub>STG</sub> | -55 to +150 | °C   |

**Electrical Characteristics** (T<sub>A</sub> = +25°C, unless otherwise specified.)

| Characteristic                              | Symbol              | Min  | Typ  | Max  | Unit | Test Condition   |
|---|---------------------|------|------|------|------|--|
| <b>OFF CHARACTERISTICS (Note 9)</b>         |                     |      |      |      |      |  |
| Drain-Source Breakdown Voltage              | BV <sub>DSS</sub>   | -20  | —    | —    | V    | V <sub>GS</sub> = 0V, I <sub>D</sub> = -250µA  |
| Zero Gate Voltage Drain Current             | I <sub>DSS</sub>    | —    | —    | -1   | µA   | V <sub>DS</sub> = -16V, V <sub>GS</sub> = 0V   |
| Gate-Source Leakage                         | I <sub>GSS</sub>    | —    | —    | ±100 | nA   | V <sub>GS</sub> = ±12V, V <sub>DS</sub> = 0V   |
| <b>ON CHARACTERISTICS (Note 9)</b>          |                     |      |      |      |      |  |
| Gate Threshold Voltage                      | V <sub>GS(TH)</sub> | -0.6 | —    | -1.5 | V    | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250µA  |
| Static Drain-Source On-Resistance           | R <sub>DS(ON)</sub> | —    | 26   | 33   | mΩ   | V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -8.9A  |
|   |                     | —    | 37.5 | 52   |      | V <sub>GS</sub> = -2.5V, I <sub>D</sub> = -6.9A  |
| Diode Forward Voltage                       | V <sub>SD</sub>     | —    | -0.7 | -1.2 | V    | V <sub>GS</sub> = 0V, I <sub>S</sub> = -2.9A   |
| <b>DYNAMIC CHARACTERISTICS (Note 10)</b>    |                     |      |      |      |      |  |
| Input Capacitance                           | C <sub>ISS</sub>    | —    | 834  | —    | pF   | V <sub>DS</sub> = -10V, V <sub>GS</sub> = 0V, f = 1.0MHz   |
| Output Capacitance                          | C <sub>OSS</sub>    | —    | 133  | —    |      |  |
| Reverse Transfer Capacitance                | C <sub>RSS</sub>    | —    | 105  | —    |      |  |
| Gate Resistance                             | R <sub>g</sub>      | —    | 4.9  | —    | Ω    | V <sub>DS</sub> = 0V, V <sub>GS</sub> = 0V, f = 1.0MHz   |
| Total Gate Charge (V <sub>GS</sub> = -4.5V) | Q <sub>g</sub>      | —    | 8.6  | —    | nC   | V <sub>DS</sub> = -6V, I <sub>D</sub> = -8.9A  |
| Total Gate Charge (V <sub>GS</sub> = -8V)   | Q <sub>g</sub>      | —    | 19   | —    |      |  |
| Gate-Source Charge                          | Q <sub>gs</sub>     | —    | 1.5  | —    |      |  |
| Gate-Drain Charge                           | Q <sub>gd</sub>     | —    | 2.5  | —    |      |  |
| Turn-On Delay Time                          | t <sub>D(ON)</sub>  | —    | 5.8  | —    | ns   | V <sub>DD</sub> = -6V, R <sub>L</sub> = 6Ω<br>V <sub>GS</sub> = -4.5V, R <sub>g</sub> = 6Ω, I <sub>D</sub> = -1A |
| Turn-On Rise Time                           | t <sub>r</sub>      | —    | 7.7  | —    |      |  |
| Turn-Off Delay Time                         | t <sub>D(OFF)</sub> | —    | 28.1 | —    |      |  |
| Turn-Off Fall Time                          | t <sub>f</sub>      | —    | 14.6 | —    |      |  |
| Body Diode Reverse Recovery Time            | t <sub>RR</sub>     | —    | 9.8  | —    | ns   | I <sub>F</sub> = -8.9A, di/dt = -100A/µs   |
| Body Diode Reverse Recovery Charge          | Q <sub>RR</sub>     | —    | 2.7  | —    | nC   | I <sub>F</sub> = -8.9A, di/dt = -100A/µs   |

- Notes:
- Device mounted on FR-4 PC board, with minimum recommended pad layout, single sided.
  - Device mounted on FR-4 substrate PC board, 2oz copper, with thermal bias to bottom layer 1inch square copper plate.
  - Thermal resistance from junction to soldering point (on the exposed drain pad).
  - I<sub>AS</sub> and E<sub>AS</sub> ratings are based on low frequency and duty cycles to keep T<sub>J</sub> = +25°C.
  - Short duration pulse test used to minimize self-heating effect.
  - Guaranteed by design. Not subject to product testing.

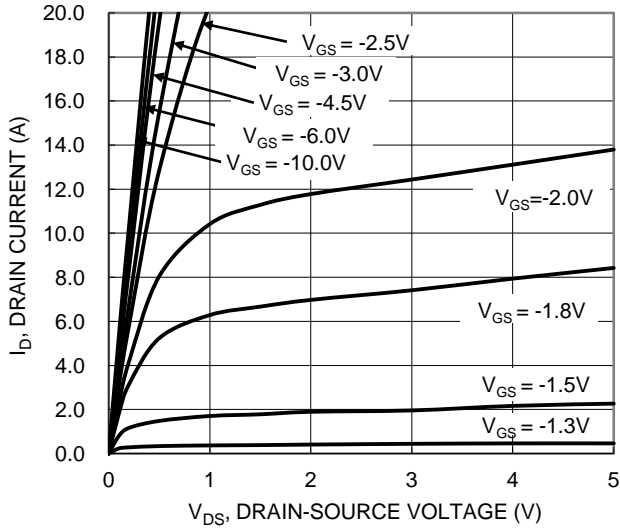


Figure 1. Typical Output Characteristic

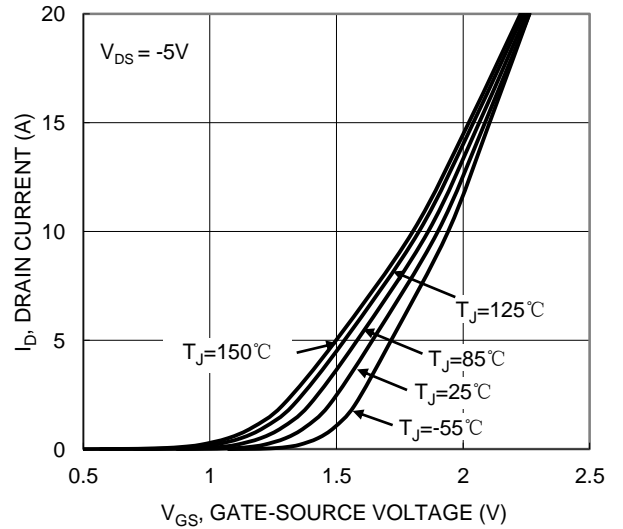


Figure 2. Typical Transfer Characteristic

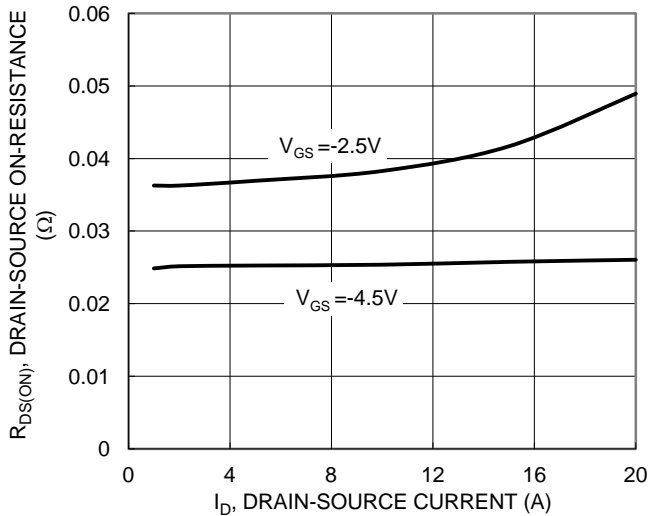


Figure 3. Typical On-Resistance vs. Drain Current and Gate Voltage

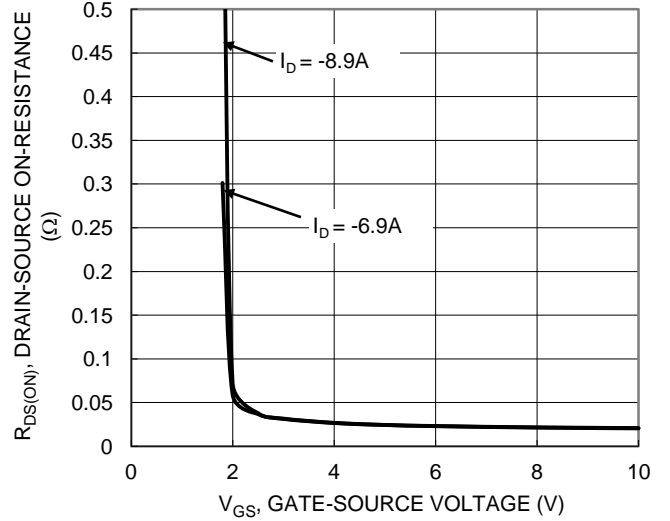


Figure 4. Typical Transfer Characteristic

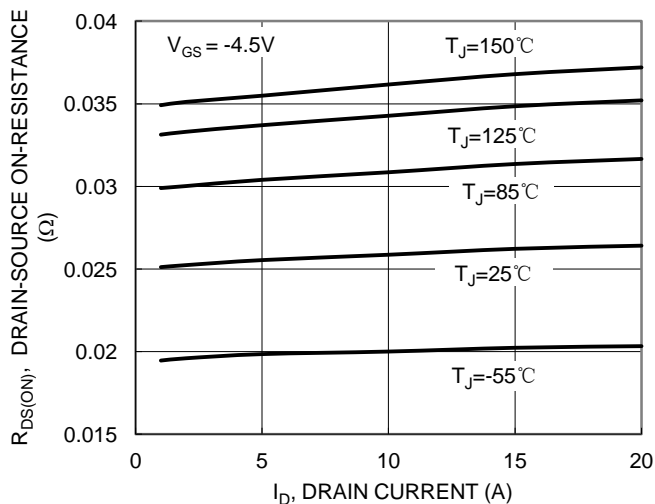


Figure 5. Typical On-Resistance vs. Drain Current and Junction Temperature

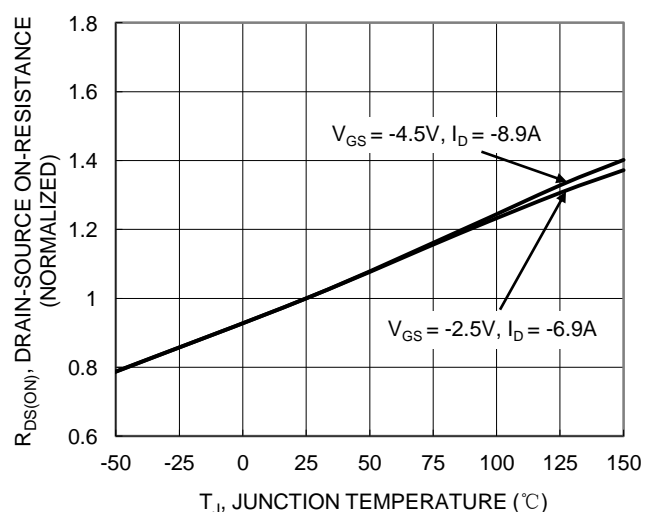


Figure 6. On-Resistance Variation with Junction Temperature

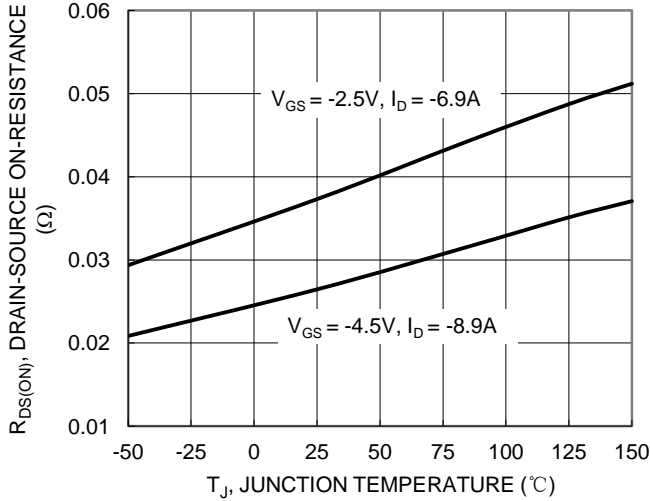


Figure 7. On-Resistance Variation with Junction Temperature

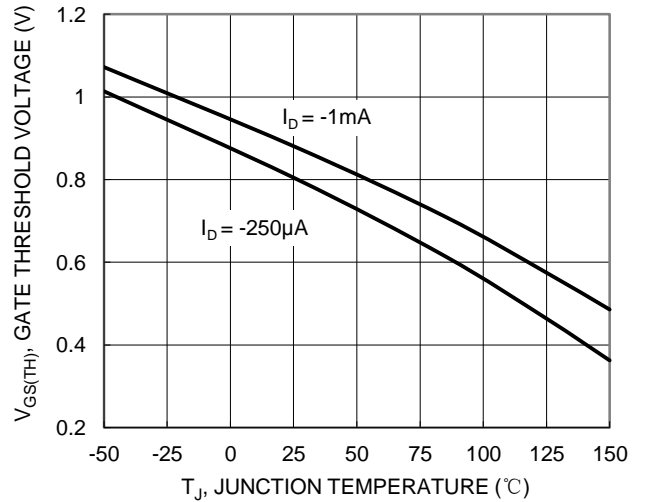


Figure 8. Gate Threshold Variation vs. Junction Temperature

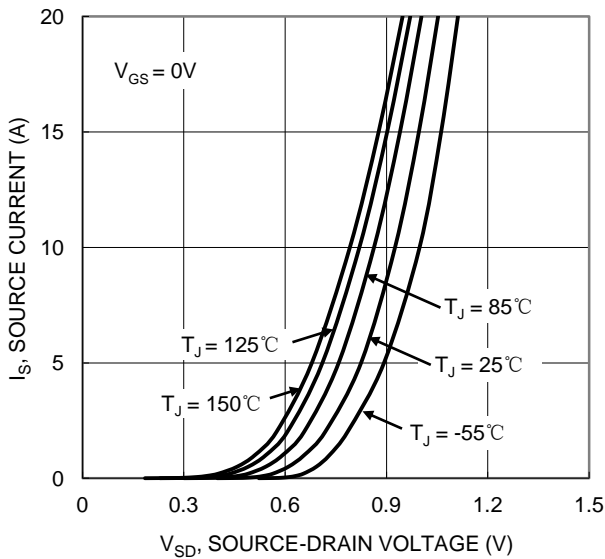


Figure 9. Diode Forward Voltage vs. Current

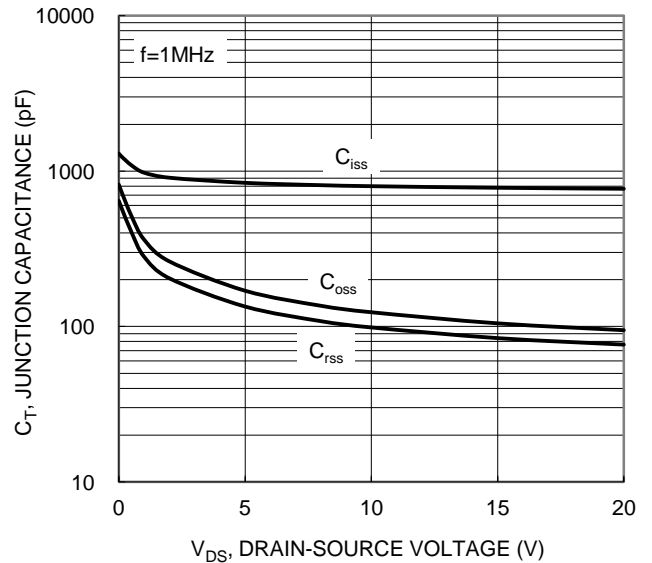


Figure 10. Typical Junction Capacitance

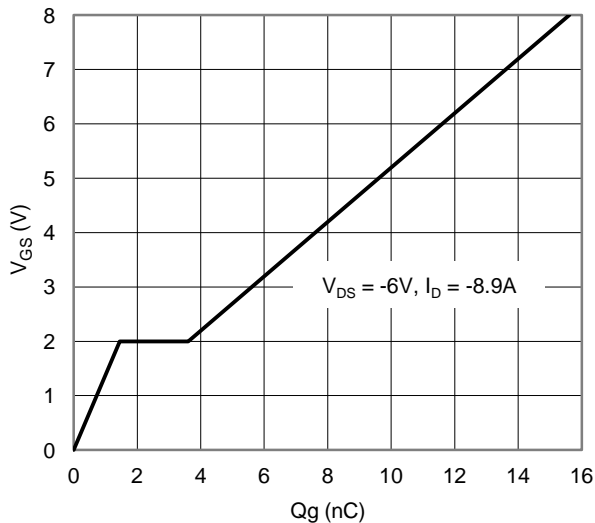


Figure 11. Gate Charge

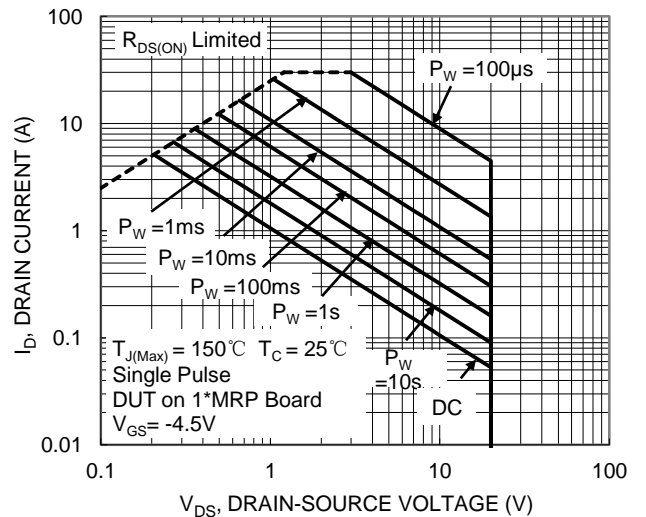


Figure 12. SOA, Safe Operation Area

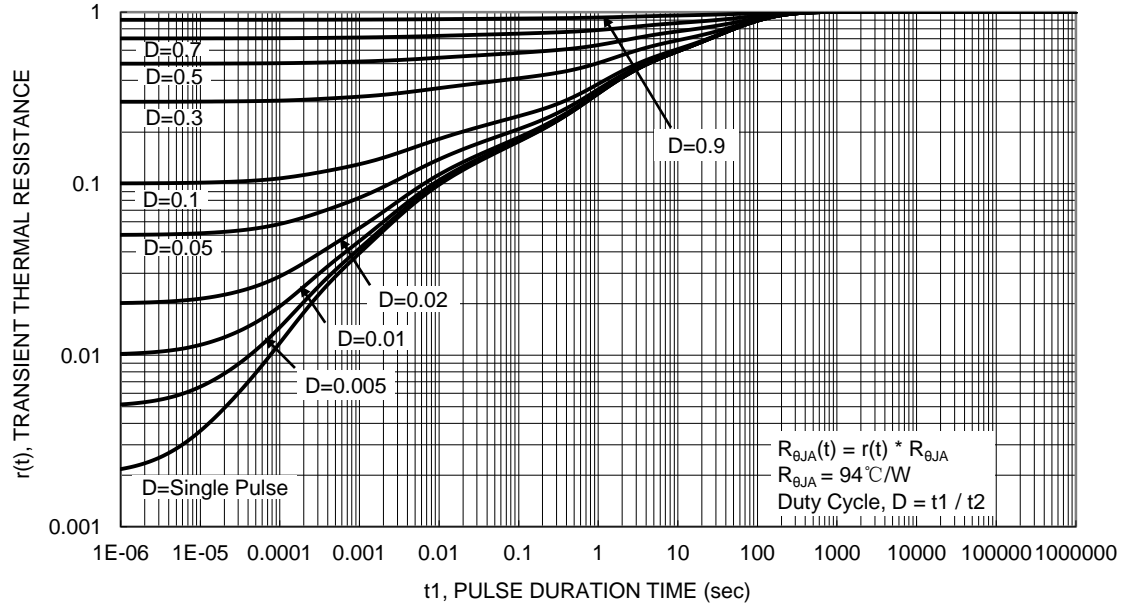
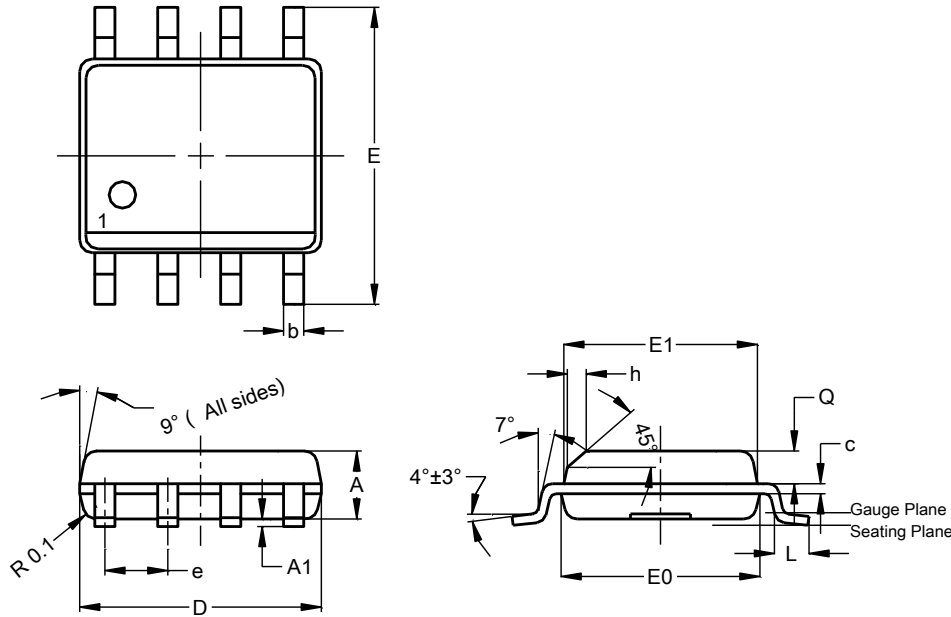


Figure 13. Transient Thermal Resistance

**Package Outline Dimensions**

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

SO-8

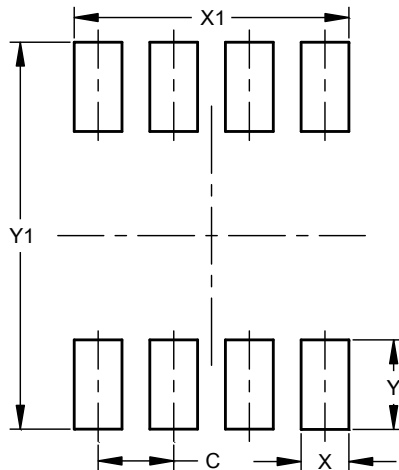


| SO-8                 |      |      |      |
|----------------------|------|------|------|
| Dim                  | Min  | Max  | Typ. |
| A                    | 1.40 | 1.50 | 1.45 |
| A1                   | 0.10 | 0.20 | 0.15 |
| b                    | 0.30 | 0.50 | 0.40 |
| c                    | 0.15 | 0.25 | 0.20 |
| D                    | 4.85 | 4.95 | 4.90 |
| E                    | 5.90 | 6.10 | 6.00 |
| E1                   | 3.80 | 3.90 | 3.85 |
| E0                   | 3.85 | 3.95 | 3.90 |
| e                    | --   | --   | 1.27 |
| h                    | --   | --   | 0.35 |
| L                    | 0.62 | 0.82 | 0.72 |
| Q                    | 0.60 | 0.70 | 0.65 |
| All Dimensions in mm |      |      |      |

**Suggested Pad Layout**

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

SO-8



| Dimensions | Value (in mm) |
|------------|---------------|
| C          | 1.27          |
| X          | 0.802         |
| X1         | 4.612         |
| Y          | 1.505         |
| Y1         | 6.50          |

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