



**THE DATASHEET OF  
DMN2056U-13**



## Product Summary

| $BV_{DSS}$ | $R_{DS(on)}$ max                      | $I_D$ max<br>$T_A = +25^\circ\text{C}$ |
|------------|---------------------------------------|----------------------------------------|
| 20V        | 38m $\Omega$ @ $V_{GS} = 4.5\text{V}$ | 4.0A                                   |
|            | 45m $\Omega$ @ $V_{GS} = 2.5\text{V}$ | 3.7A                                   |

## 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)**
- **For automotive applications requiring specific change control (i.e.: parts qualified to AEC-Q100/101/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please refer to the related automotive grade (Q-suffix) part. A listing can be found at <https://www.diodes.com/products/automotive/automotive-products/>.**
- **This part is qualified to JEDEC standards (as references in AEC-Q) for High Reliability. <https://www.diodes.com/quality/product-definitions/>**

## Description and Applications

This MOSFET is designed to minimize the on-state resistance ( $R_{DS(on)}$ ) and yet maintain superior switching performance, making it ideal for high-efficiency power management applications.

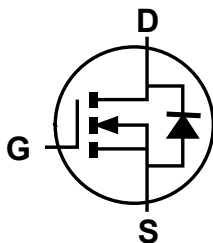
- Battery Charging
- Power Management Functions
- DC-DC Converters
- Portable Power Adaptors

## Mechanical Data

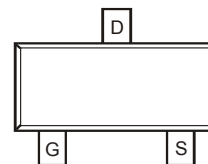
- Case: SOT23 (Standard)
- Case Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish—Matte Tin Annealed over Copper Leadframe. Solderable per MIL-STD-202, Method 208
- Terminals Connections: See Diagram Below
- Weight: 0.009 grams (Approximate)



Top View



Internal Schematic



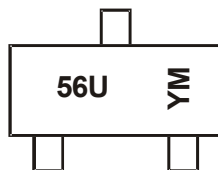
Top View

## Ordering Information (Note 4)

| Part Number | Case             | Packaging         |
|-------------|------------------|-------------------|
| DMN2056U-7  | SOT23 (Standard) | 3000/Tape & Reel  |
| DMN2056U-13 | SOT23 (Standard) | 10000/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



56U = Product Type Marking Code  
 YM = Date Code Marking  
 Y or Y = Year (ex: 1 = 2021)  
 M = Month (ex: 9 = September)

### Date Code Key

| Year  | 2016 | ..... | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|-------|------|-------|------|------|------|------|------|------|------|------|------|------|
| Code  | D    | ..... | I    | J    | K    | L    | M    | N    | O    | P    | R    | S    |
| Month | Jan  | Feb   | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov  | Dec  |
| Code  | 1    | 2     | 3    | 4    | 5    | 6    | 7    | 8    | 9    | O    | N    | D    |

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

| Characteristic                                           |              |                        | Symbol           | Value | Units |
|----------------------------------------------------------|--------------|------------------------|------------------|-------|-------|
| Drain-Source Voltage                                     |              |                        | V <sub>DSS</sub> | 20    | V     |
| Gate-Source Voltage                                      |              |                        | V <sub>GSS</sub> | ±8    | V     |
| Continuous Drain Current (Note 6) V <sub>GS</sub> = 4.5V | Steady State | T <sub>A</sub> = +25°C | I <sub>D</sub>   | 4.0   | A     |
|                                                          |              | T <sub>A</sub> = +70°C |                  | 3.2   |       |
| Maximum Body Diode Forward Current (Note 6)              |              |                        | I <sub>S</sub>   | 1.0   | A     |
| Pulsed Drain Current (10µs pulse, duty cycle = 1%)       |              |                        | I <sub>DM</sub>  | 22    | A     |

## Thermal Characteristics

| Characteristic                                   |  |              | Symbol                            | Value       | Unit |
|--------------------------------------------------|--|--------------|-----------------------------------|-------------|------|
| Power Dissipation (Note 5)                       |  |              | P <sub>D</sub>                    | 0.66        | W    |
| Thermal Resistance, Junction to Ambient (Note 5) |  | Steady State | R <sub>θJA</sub>                  | 192         | °C/W |
| Power Dissipation (Note 6)                       |  |              | P <sub>D</sub>                    | 0.94        | W    |
| Thermal Resistance, Junction to Ambient (Note 6) |  | Steady State | R <sub>θJA</sub>                  | 136         | °C/W |
| Operating and Storage Temperature Range          |  |              | T <sub>J</sub> , T <sub>STG</sub> | -55 to +150 | °C   |

**Electrical Characteristics** (@  $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

| Characteristic                          | Symbol       | Min | Typ | Max       | Unit       | Test Condition                                                |
|-----------------------------------------|--------------|-----|-----|-----------|------------|---------------------------------------------------------------|
| <b>OFF CHARACTERISTICS (Note 7)</b>     |              |     |     |           |            |                                                               |
| Drain-Source Breakdown Voltage          | $BV_{DSS}$   | 20  | —   | —         | V          | $V_{GS} = 0V, I_D = 250\mu A$                                 |
| Zero Gate Voltage Drain Current         | $I_{DSS}$    | —   | —   | 1         | $\mu A$    | $V_{DS} = 20V, V_{GS} = 0V$                                   |
| Gate-Source Leakage                     | $I_{GSS}$    | —   | —   | $\pm 100$ | nA         | $V_{GS} = \pm 8V, V_{DS} = 0V$                                |
| <b>ON CHARACTERISTICS (Note 7)</b>      |              |     |     |           |            |                                                               |
| Gate Threshold Voltage                  | $V_{GS(th)}$ | 0.4 | 0.6 | 1.0       | V          | $V_{DS} = V_{GS}, I_D = 250\mu A$                             |
| Static Drain-Source On-Resistance       | $R_{DS(on)}$ | —   | 30  | 38        | m $\Omega$ | $V_{GS} = 4.5V, I_D = 3.6A$                                   |
|                                         |              | —   | 34  | 45        |            | $V_{GS} = 2.5V, I_D = 3.1A$                                   |
|                                         |              | —   | 52  | 85        |            | $V_{GS} = 1.5V, I_D = 2.0A$                                   |
| Diode Forward Voltage                   | $V_{SD}$     | —   | 0.7 | 1.2       | V          | $V_{GS} = 0V, I_S = 1A$                                       |
| <b>DYNAMIC CHARACTERISTICS (Note 8)</b> |              |     |     |           |            |                                                               |
| Input Capacitance                       | $C_{iss}$    | —   | 339 | —         | pF         | $V_{DS} = 10V, V_{GS} = 0V$<br>$f = 1.0MHz$                   |
| Output Capacitance                      | $C_{oss}$    | —   | 47  | —         |            |                                                               |
| Reverse Transfer Capacitance            | $C_{rss}$    | —   | 34  | —         |            |                                                               |
| Gate Resistance                         | $R_G$        | —   | 2.6 | —         | $\Omega$   | $V_{DS} = 0V, V_{GS} = 0V, f = 1.0MHz$                        |
| Total Gate Charge                       | $Q_g$        | —   | 4.3 | —         | nC         | $V_{DS} = 10V, V_{GS} = 4.5V, I_D = 3.6A$                     |
| Gate-Source Charge                      | $Q_{gs}$     | —   | 0.5 | —         |            |                                                               |
| Gate-Drain Charge                       | $Q_{gd}$     | —   | 0.8 | —         |            |                                                               |
| Turn-On Delay Time                      | $t_{D(on)}$  | —   | 1.8 | —         | ns         | $V_{GS} = 4.5V, V_{DD} = 10V, R_G = 1\Omega,$<br>$I_D = 3.6A$ |
| Turn-On Rise Time                       | $t_R$        | —   | 2.8 | —         |            |                                                               |
| Turn-Off Delay Time                     | $t_{D(off)}$ | —   | 8.5 | —         |            |                                                               |
| Turn-Off Fall Time                      | $t_F$        | —   | 1.7 | —         |            |                                                               |
| Body Diode Reverse Recovery Time        | $t_{RR}$     | —   | 4.7 | —         | ns         | $I_F = 3.6A, dI/dt = 100A/\mu s$                              |
| Body Diode Reverse Recovery Charge      | $Q_{RR}$     | —   | 0.7 | —         | nC         | $I_F = 3.6A, dI/dt = 100A/\mu s$                              |

- Notes:
5. Device mounted on FR-4 substrate PC board, 2oz copper, with minimum recommended pad layout.
  6. Device mounted on FR-4 substrate PC board, 2oz copper, with thermal bias to bottom layer 1inch square copper plate.
  7. Short duration pulse test used to minimize self-heating effect.
  8. Guaranteed by design. Not subject to product testing.

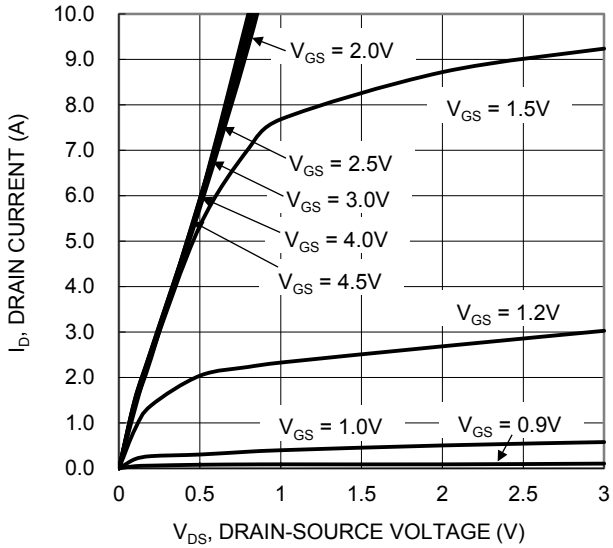


Figure 1. Typical Output Characteristic

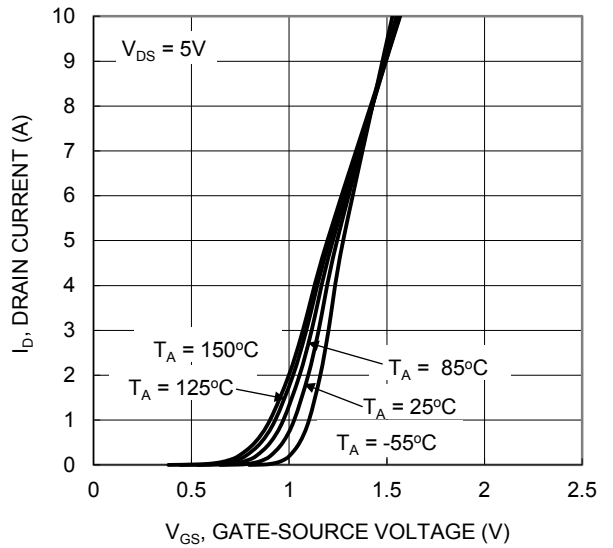


Figure 2. Typical Transfer Characteristic

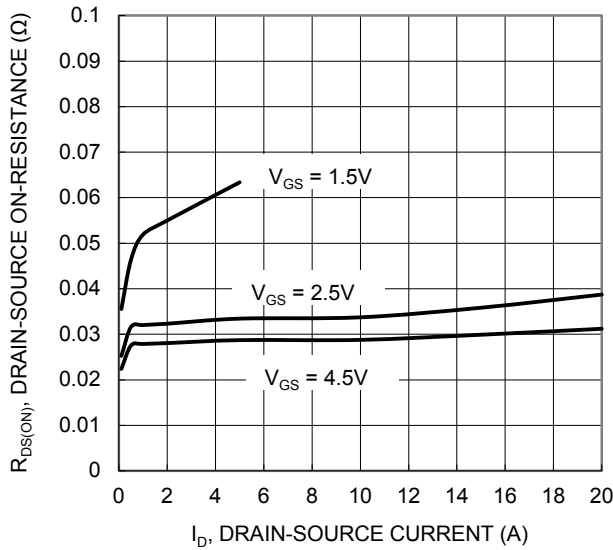


Figure 3. Typical On-Resistance vs Drain Current and Gate Voltage

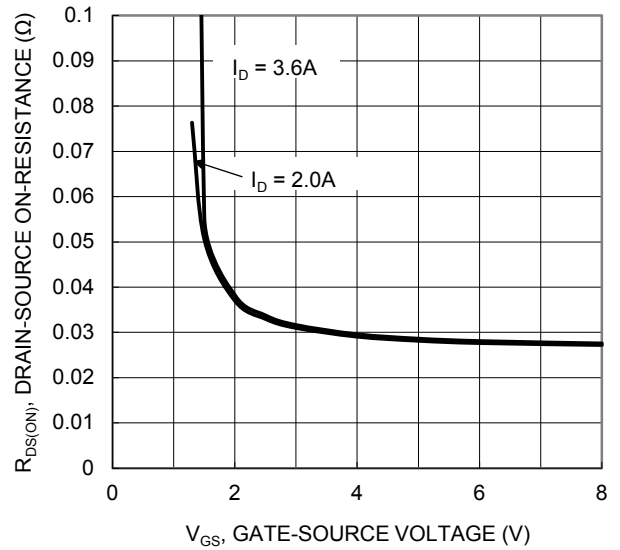


Figure 4. Typical Transfer Characteristic

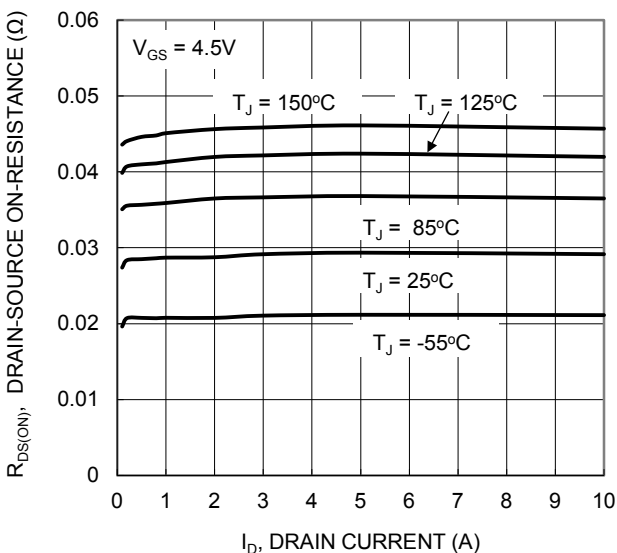


Figure 5. Typical On-Resistance vs Drain Current and Junction Temperature

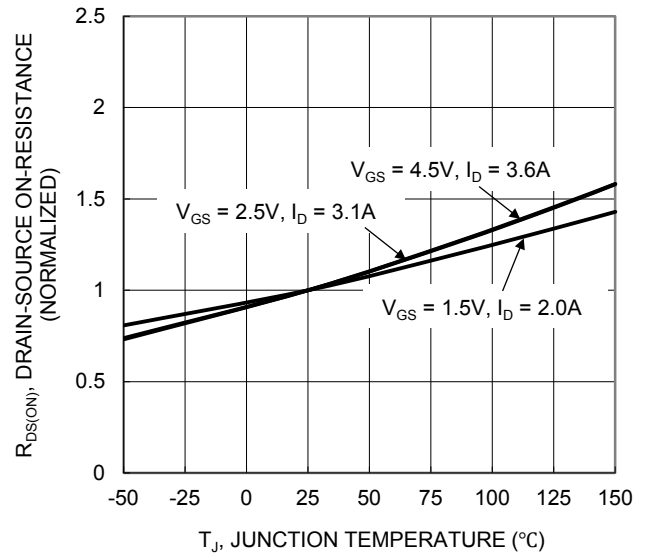


Figure 6. On-Resistance Variation with Junction Temperature

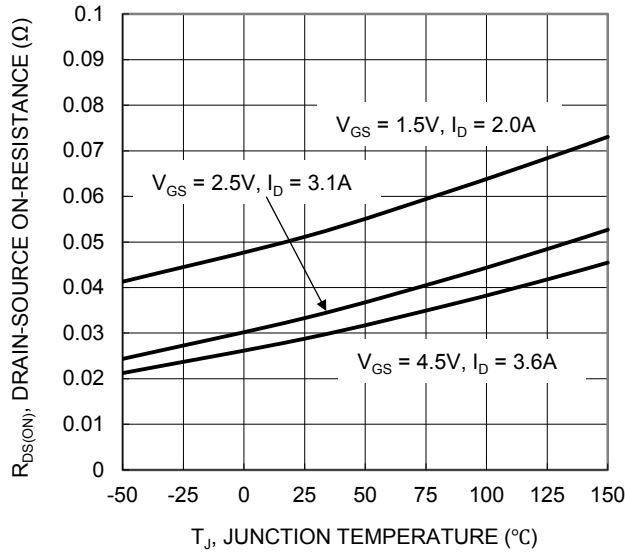


Figure 7. On-Resistance Variation with Junction Temperature

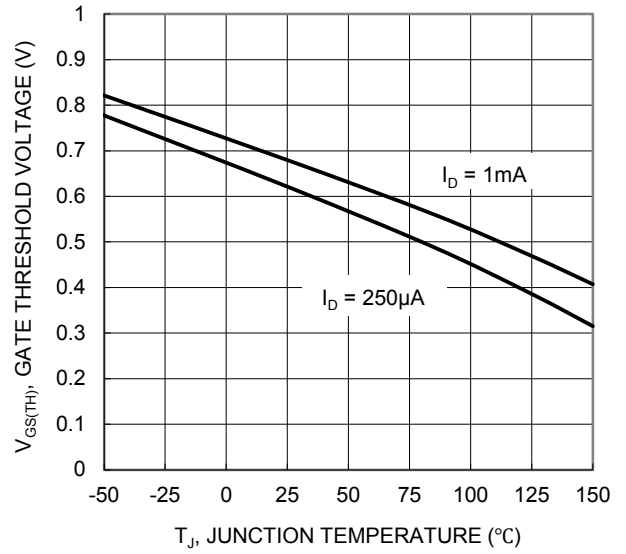


Figure 8. Gate Threshold Variation vs Junction Temperature

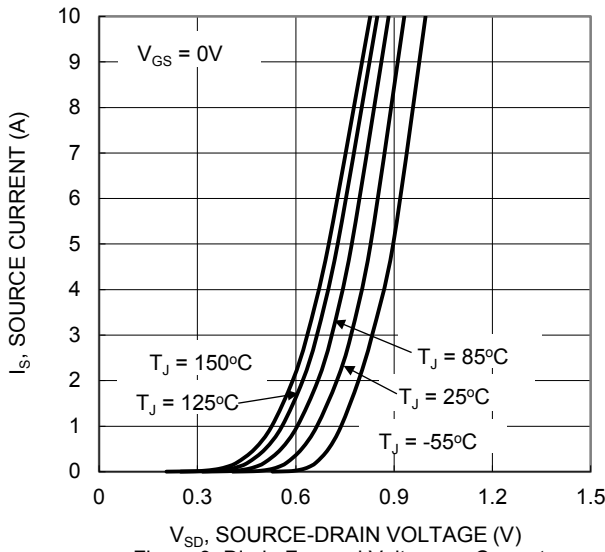


Figure 9. Diode Forward Voltage vs Current

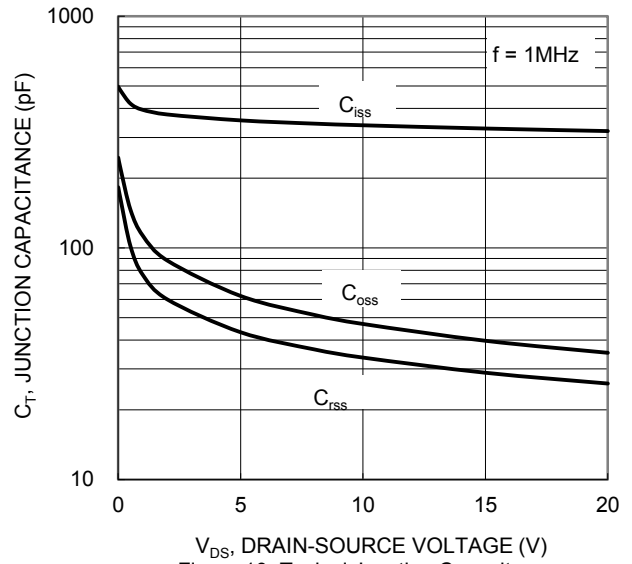


Figure 10. Typical Junction Capacitance

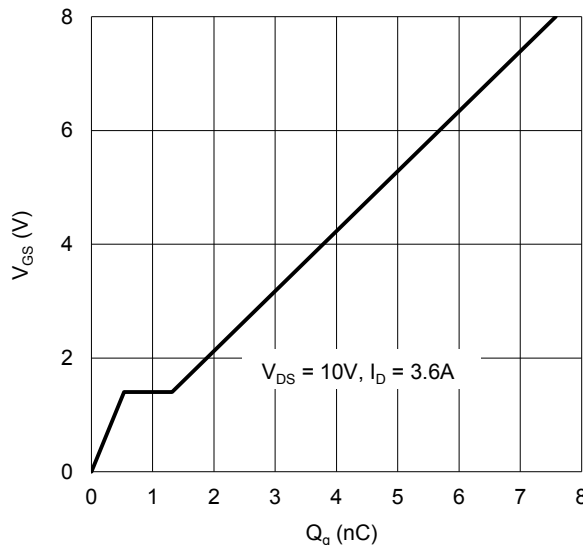


Figure 11. Gate Charge

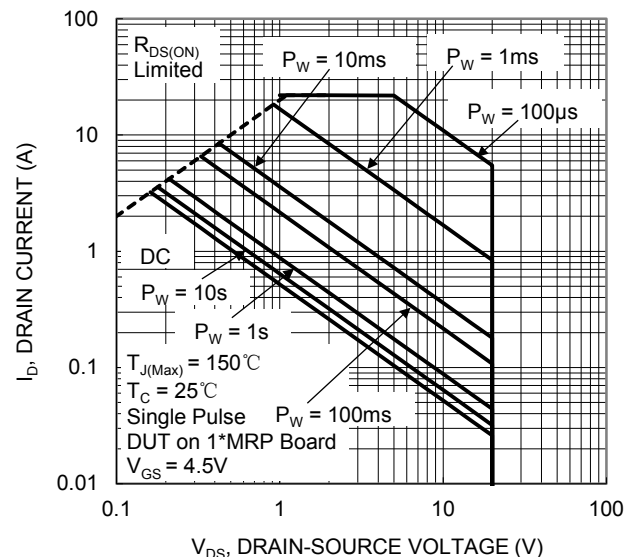
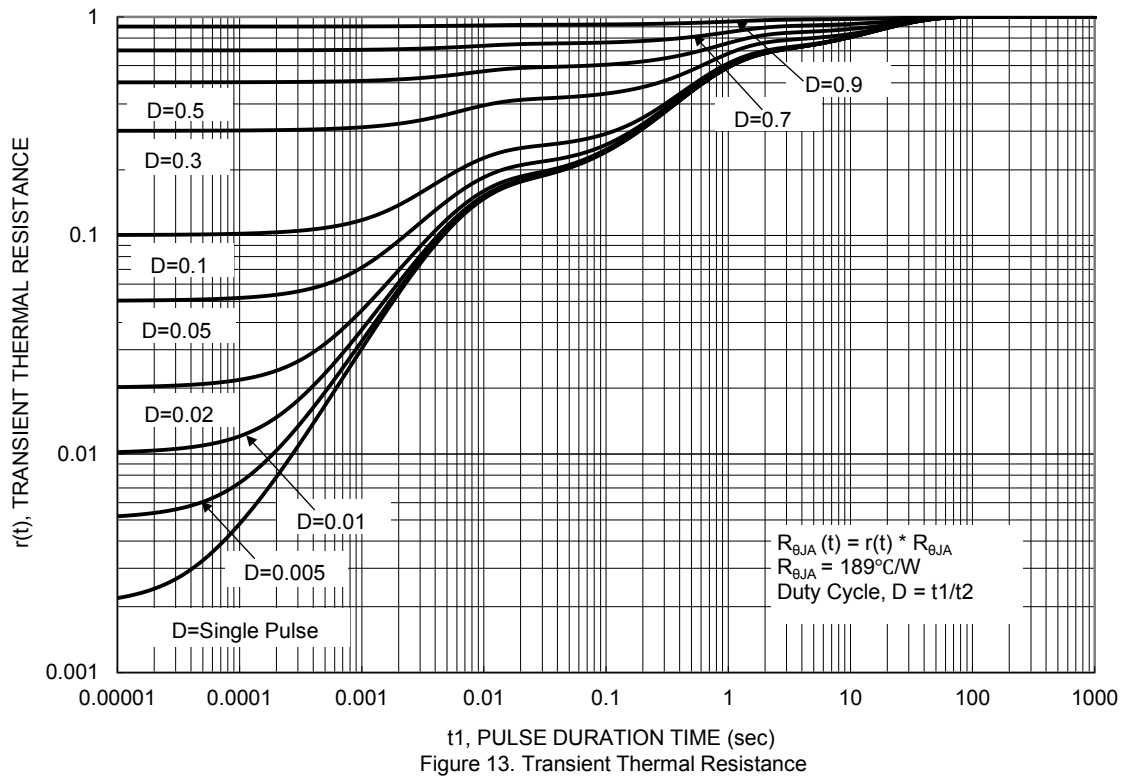


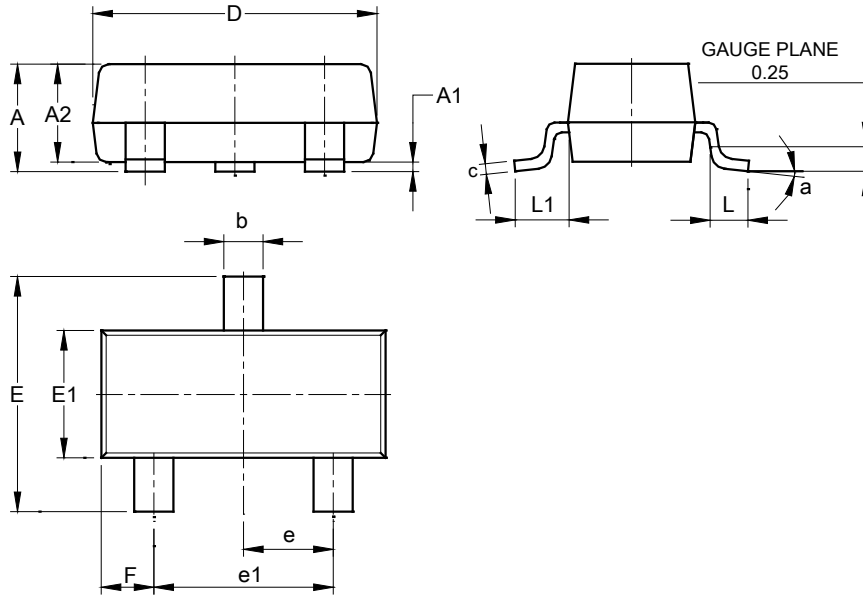
Figure 12. SOA, Safe Operation Area



## Package Outline Dimensions

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

### SOT23 (Standard)

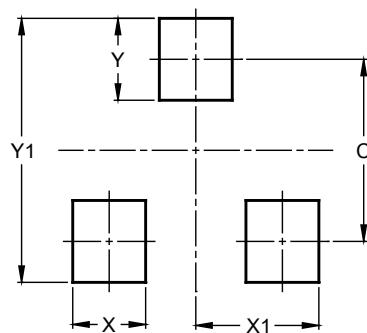


| SOT23 (Standard)     |       |       |       |
|----------------------|-------|-------|-------|
| Dim                  | Min   | Max   | Typ   |
| A                    | 0.90  | 1.15  | 1.025 |
| A1                   | 0.00  | 0.10  | 0.05  |
| A2                   | 0.85  | 1.10  | 0.975 |
| b                    | 0.30  | 0.51  | 0.40  |
| c                    | 0.080 | 0.202 | 0.11  |
| D                    | 2.80  | 3.00  | 2.90  |
| E                    | 2.25  | 2.55  | 2.40  |
| E1                   | 1.20  | 1.40  | 1.30  |
| e                    | 0.89  | 1.03  | 0.915 |
| e1                   | 1.78  | 2.05  | 1.83  |
| F                    | 0.40  | 0.60  | 0.535 |
| L1                   | 0.45  | 0.61  | 0.55  |
| L                    | 0.25  | 0.55  | 0.40  |
| a                    | 0°    | 8°    | --    |
| All Dimensions in mm |       |       |       |

## Suggested Pad Layout

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

### SOT23 (Standard)



| Dimensions | Value (in mm) |
|------------|---------------|
| C          | 2.0           |
| X          | 0.8           |
| X1         | 1.35          |
| Y          | 0.9           |
| Y1         | 2.9           |

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