# 20V N-CHANNEL ENHANCEMENT MODE MOSFET

## Product Summary

| $BV_{DSS}$ | $R_{DS(ON)}$ Max | $I_D$ Max $T_A$ = +25°C |
|---|---|---|
| 20V | 9mΩ @ $V_{GS}$ = 4.5V | 12.8A |
| | 13mΩ @ $V_{GS}$ = 2.5V | 10.7A |

## Description

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

## Applications

- General purpose interfacing switches
- Power management functions

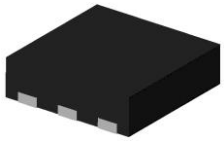
## Features

- 0.6mm Profile – Ideal for Low Profile Applications
- PCB Footprint of 4mm$^2$
- Low Gate Threshold Voltage
- Low On-Resistance
- **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-Q100/101/104/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please contact us or your local Diodes representative. https://www.diodes.com/quality/product-definitions/**

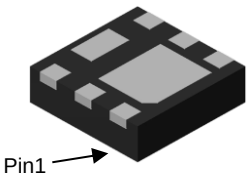
## Mechanical Data

- Package: U-DFN2020-6
- Package Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish – NiPdAu over Copper Lead-Frame. Solderable per MIL-STD-202, Method 208 e4
- Weight: 0.007 grams (Approximate)

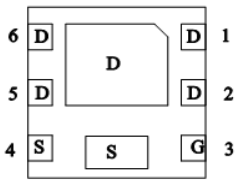
U-DFN2020-6 (Type F)



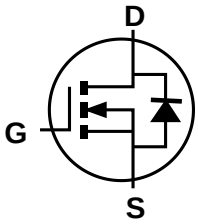
Top View




Bottom View




Pin Out
Bottom View




Equivalent Circuit

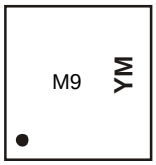
## Ordering Information (Note 4)

| Part Number | Package | Packing | |
|---|---|---|---|
| | | Qty. | Carrier |
| DMN2009UFDF-7 | U-DFN2020-6 (Type F) | 3,000 | Tape & Reel |
| DMN2009UFDF-13 | U-DFN2020-6 (Type F) | 10,000 | 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

Site 1



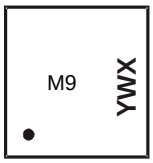

M9 = Product Type Marking Code
YM = Date Code Marking
Y = Year (ex: J = 2022)
M = Month (ex: 9 = September)

Date Code Key

| Year | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code | H | I | J | K | L | M | N | O | P | R | S | T |

| 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 |

Site 2




M9 = Product Type Marking Code
YWX = Date Code Marking
Y = Year (ex: 2 = 2022)
W = Week (ex: a = Week 27; z Represents Week 52 and 53)
X = Internal Code (ex: U = Monday)

Date Code Key

| Year | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 |

| Week | 1-26 | 27-52 | 53 |
|---|---|---|---|
| Code | A-Z | a-z | z |

| Internal Code | Sun | Mon | Tue | Wed | Thu | Fri | Sat |
|---|---|---|---|---|---|---|---|
| Code | T | U | V | W | X | Y | Z |

## Maximum Ratings (@ $T_A$ = +25°C, unless otherwise specified.)

| Characteristic | | | Symbol | Value | Unit |
|---|---|---|---|---|---|
| Drain-Source Voltage | | | $V_{DSS}$ | 20 | V |
| Gate-Source Voltage | | | $V_{GSS}$ | ±12 | V |
| Continuous Drain Current (Note 5) $V_{GS}$ = 4.5V | Steady State | $T_A$ = +25°C<br>$T_A$ = +70°C | $I_D$ | 12.8<br>10.3 | A |
| Maximum Body Diode Continuous Current (Note 5) | | | $I_S$ | 2.5 | A |
| Pulsed Drain Current (380µs Pulse, Duty Cycle = 1%) | | | $I_{DM}$ | 85 | A |
| Pulsed Body Diode Continuous Current (380µs Pulse, Duty Cycle = 1%) | | | $I_{SM}$ | 85 | A |
| Avalanche Current (Note 6) L = 0.1mH | | | $I_{AS}$ | 15.6 | A |
| Avalanche Energy (Note 6) L = 0.1mH | | | $E_{AS}$ | 12.1 | mJ |

## Thermal Characteristics

| Characteristic | | Symbol | Value | Unit |
|---|---|---|---|---|
| Total Power Dissipation (Note 7) | $T_A$ = +25°C | $P_D$ | 1.3 | W |
| Thermal Resistance, Junction to Ambient (Note 7) | Steady State | $R_{\theta JA}$ | 96.8 | °C/W |
| Total Power Dissipation (Note 5) | $T_A$ = +25°C | $P_D$ | 1.7 | W |
| Thermal Resistance, Junction to Ambient (Note 5) | Steady State | $R_{\theta JA}$ | 56 | °C/W |
| Thermal Resistance, Junction to Case (Note 5) | | $R_{\theta JC}$ | 9.6 | |
| Operating and Storage Temperature Range | | $T_J$, $T_{STG}$ | -55 to +150 | °C |

## Electrical Characteristics (@ $T_A$ = +25°C, unless otherwise specified.)

| Characteristic | Symbol | Min | Typ | Max | Unit | Test Condition |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS (Note 8)** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | 20 | — | — | V | $V_{GS}$ = 0V, $I_D$ = 250µA |
| Zero Gate Voltage Drain Current $T_J$ = +25°C | $I_{DSS}$ | — | — | 1 | µA | $V_{DS}$ = 16V, $V_{GS}$ = 0V |
| Gate-Source Leakage | $I_{GSS}$ | — | — | ±100 | nA | $V_{GS}$ = ±12V, $V_{DS}$ = 0V |
| **ON CHARACTERISTICS (Note 8)** | | | | | | |
| Gate Threshold Voltage | $V_{GS(TH)}$ | 0.5 | — | 1.4 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 250µA |
| Static Drain-Source On-Resistance | $R_{DS(ON)}$ | — | 7 | 9 | mΩ | $V_{GS}$ = 4.5V, $I_D$ = 8.5A |
| | | | 9.2 | 13 | | $V_{GS}$ = 2.5V, $I_D$ = 8.5A |
| Diode Forward Voltage | $V_{SD}$ | — | 0.7 | 1.2 | V | $V_{GS}$ = 0V, $I_S$ = 8.5A |
| **DYNAMIC CHARACTERISTICS (Note 9)** | | | | | | |
| Input Capacitance | $C_{iss}$ | — | 1083 | — | pF | $V_{DS}$ = 10V, $V_{GS}$ = 0V<br>f = 1.0MHz |
| Output Capacitance | $C_{oss}$ | — | 165 | — | pF | |
| Reverse Transfer Capacitance | $C_{rss}$ | — | 110 | — | pF | |
| Gate Resistance | $R_g$ | — | 5.5 | — | Ω | $V_{DS}$ = 0V, $V_{GS}$ = 0V, f = 1MHz |
| Total Gate Charge ($V_{GS}$ = 4.5V) | $Q_g$ | — | 12.7 | — | nC | $V_{DS}$ = 10V, $I_D$ = 8.5A |
| Total Gate Charge ($V_{GS}$ = 10V) | $Q_g$ | — | 27.9 | — | nC | |
| Gate-Source Charge | $Q_{gs}$ | — | 2.3 | — | nC | |
| Gate-Drain Charge | $Q_{gd}$ | — | 1.4 | — | nC | |
| Turn-On Delay Time | $t_{D(ON)}$ | — | 7 | — | ns | $V_{DS}$ = 10V, $I_D$ = 8.5A<br>$V_{GS}$ = 4.5V, $R_G$ = 1.8Ω |
| Turn-On Rise Time | $t_R$ | — | 2.7 | — | ns | |
| Turn-Off Delay Time | $t_{D(OFF)}$ | — | 31.9 | — | ns | |
| Turn-Off Fall Time | $t_F$ | — | 14.6 | — | ns | |

Notes:
5. Device mounted on FR-4 substrate PC board, 2oz copper, with thermal bias to bottom layer 1inch square copper plate.
6. $I_{AS}$ and $E_{AS}$ ratings are based on low frequency and duty cycles to keep $T_J$ = +25°C.
7. Device mounted on FR-4 PC board, with minimum recommended pad layout, single sided.
8. Short duration pulse test used to minimize self-heating effect.
9. Guaranteed by design. Not subject to product testing.

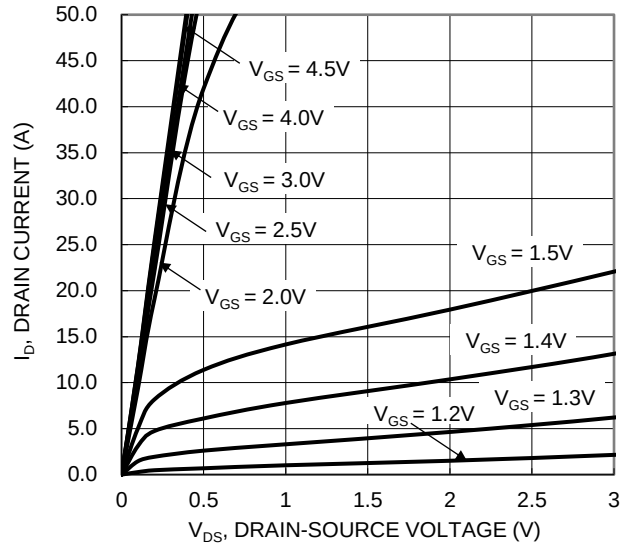



Figure 1. Typical Output Characteristic

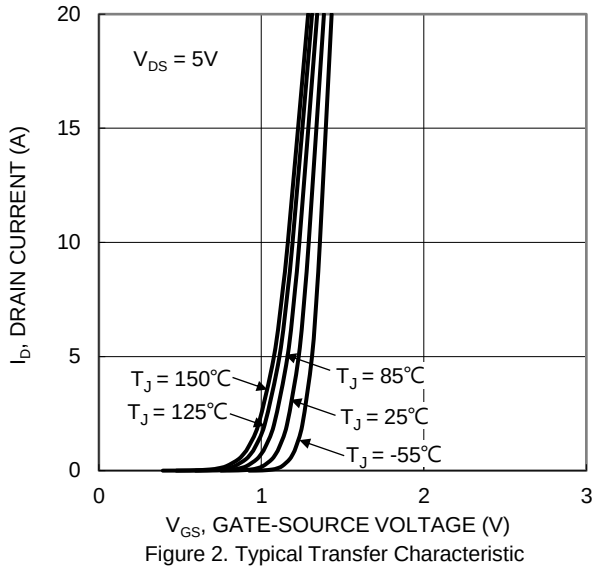



Figure 2. Typical Transfer Characteristic

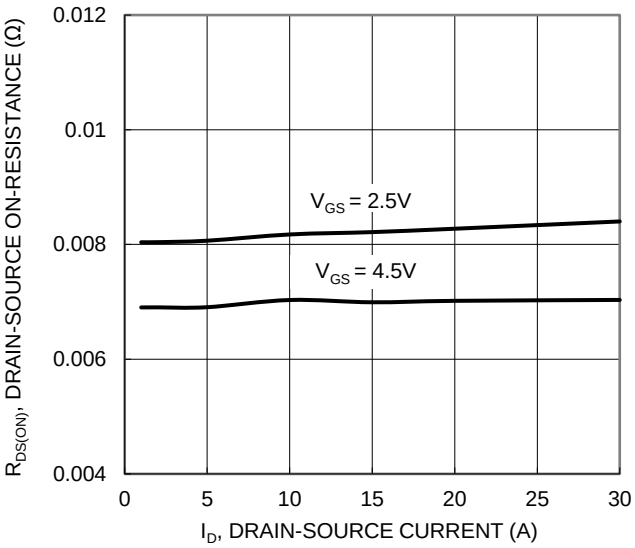



Figure 3. Typical On-Resistance vs. Drain Current and Gate Voltage

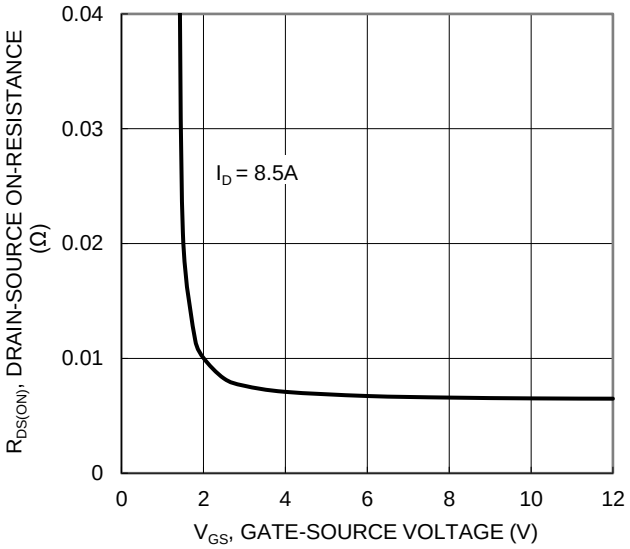



Figure 4. Typical Transfer Characteristic

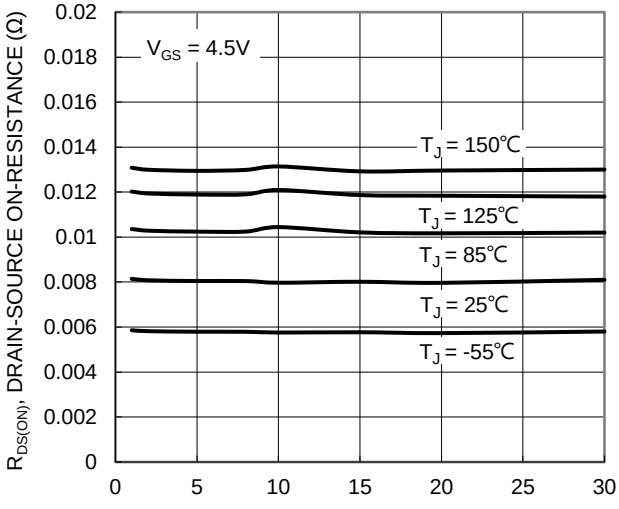



Figure 5. Typical On-Resistance vs. Drain Current and Temperature

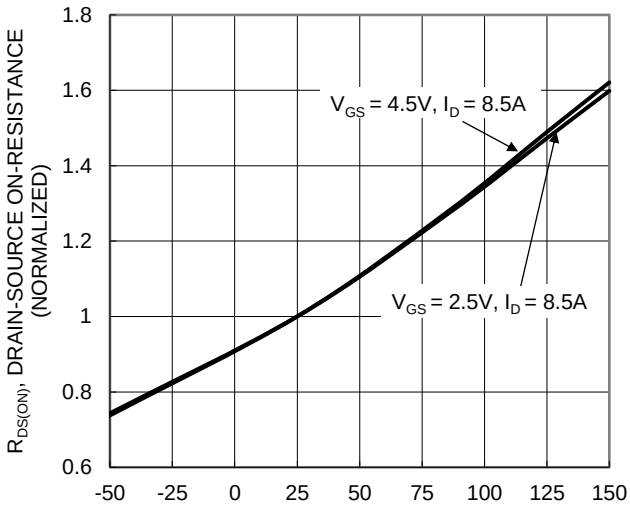



Figure 6. On-Resistance Variation with Temperature

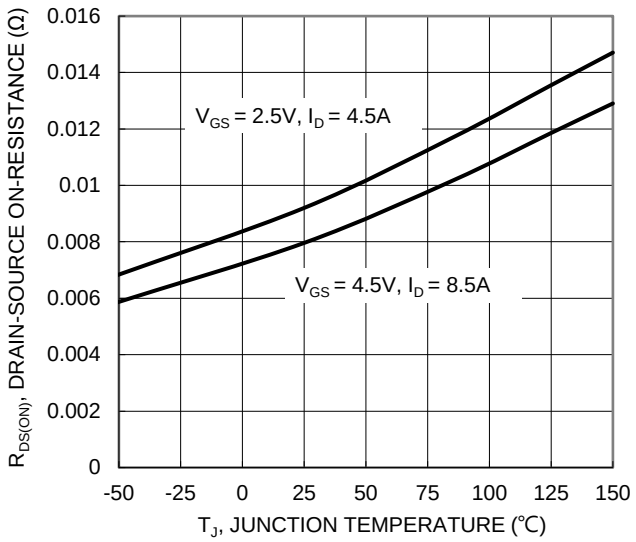



Figure 7. On-Resistance Variation with Temperature

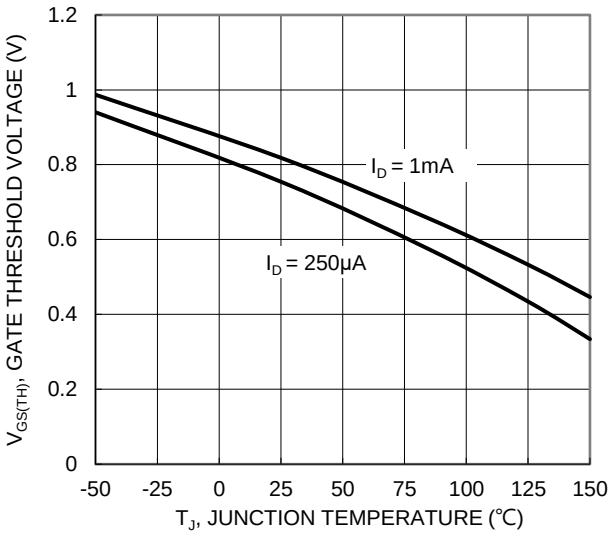



Figure 8. Gate Threshold Variation vs. Temperature

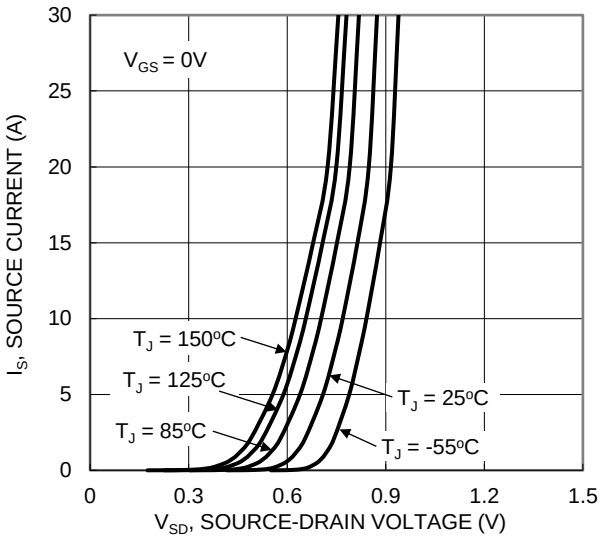



Figure 9. Diode Forward Voltage vs. Current

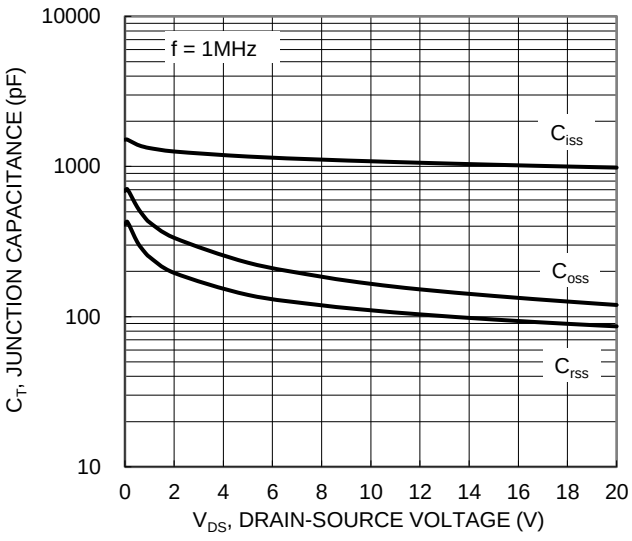



Figure 10. Typical Junction Capacitance

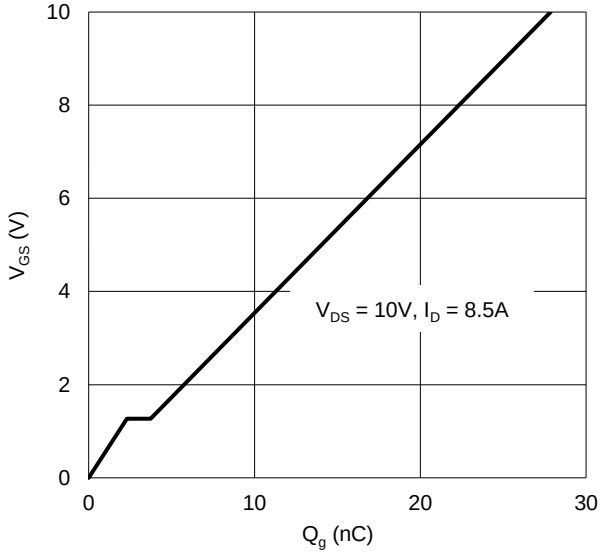



Figure 11. Gate Charge

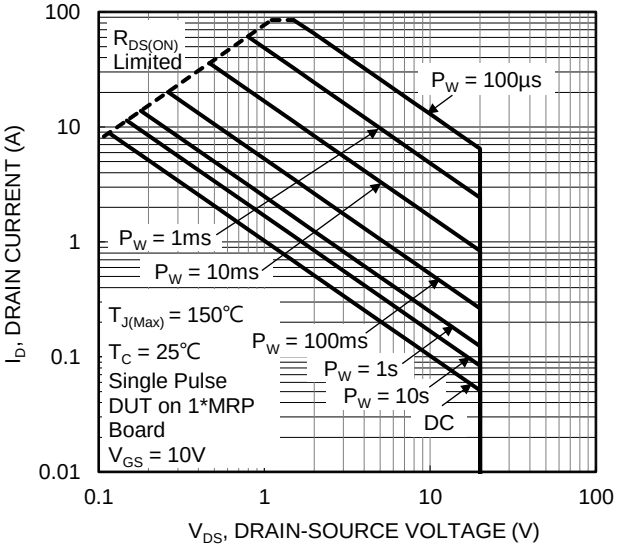



Figure 12. SOA, Safe Operation Area

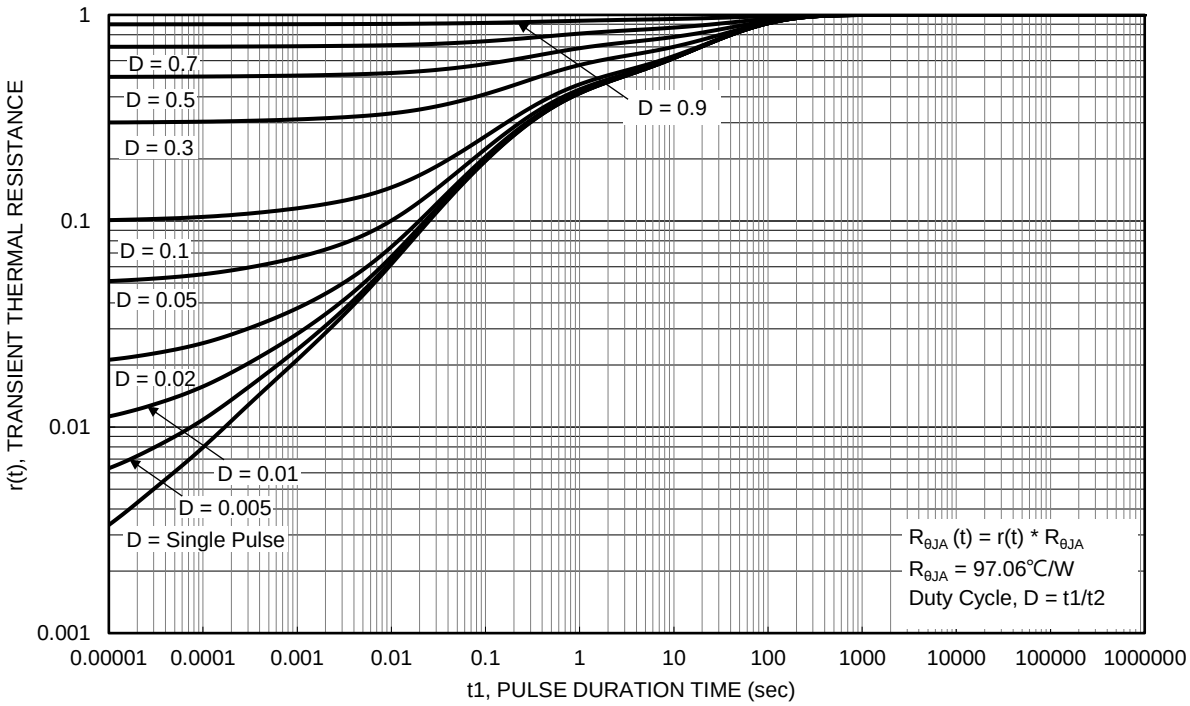
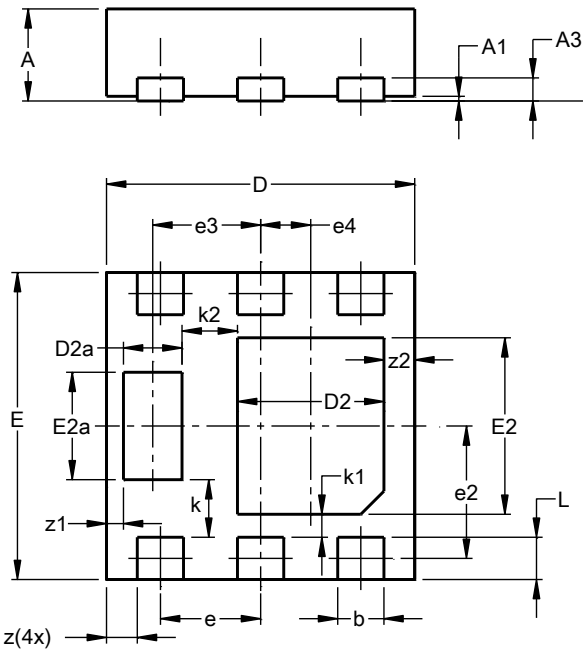



Figure 13. Transient Thermal Resistance

## Package Outline Dimensions

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

**U-DFN2020-6 (Type F)**

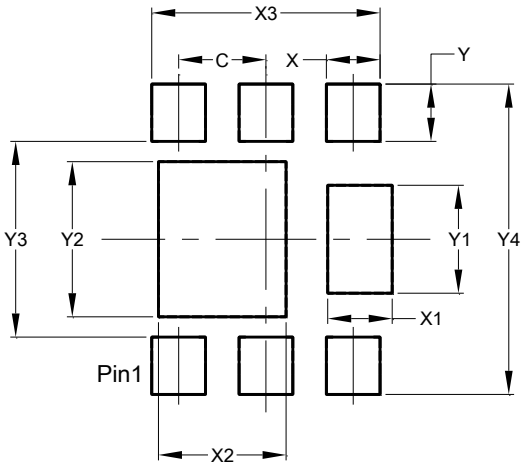



| U-DFN2020-6 (Type F) | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | 0.57 | 0.63 | 0.60 |
| **A1** | 0.00 | 0.05 | 0.03 |
| **A3** | - | - | 0.15 |
| **b** | 0.25 | 0.35 | 0.30 |
| **D** | 1.95 | 2.05 | 2.00 |
| **D2** | 0.85 | 1.05 | 0.95 |
| **D2a** | 0.33 | 0.43 | 0.38 |
| **E** | 1.95 | 2.05 | 2.00 |
| **E2** | 1.05 | 1.25 | 1.15 |
| **E2a** | 0.65 | 0.75 | 0.70 |
| **e** | 0.65 BSC | | |
| **e2** | 0.863 BSC | | |
| **e3** | 0.70 BSC | | |
| **e4** | 0.325 BSC | | |
| **k** | 0.37 BSC | | |
| **k1** | 0.15 BSC | | |
| **k2** | 0.36 BSC | | |
| **L** | 0.225 | 0.325 | 0.275 |
| **z** | 0.20 BSC | | |
| **z1** | 0.110 BSC | | |
| **z2** | 0.20 BSC | | |
| **All Dimensions in mm** | | | |

## Suggested Pad Layout

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

**U-DFN2020-6 (Type F)**




| Dimensions | Value (in mm) |
|---|---|
| **C** | 0.650 |
| **X** | 0.400 |
| **X1** | 0.480 |
| **X2** | 0.950 |
| **X3** | 1.700 |
| **Y** | 0.425 |
| **Y1** | 0.800 |
| **Y2** | 1.150 |
| **Y3** | 1.450 |
| **Y4** | 2.300 |

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