# 20V N-CHANNEL ENHANCEMENT MODE MOSFET

## Product Summary

| $V_{(BR)DSS}$ | $R_{DS(ON)\ max}$ | $I_{D\ max}$ $T_A$ = +25°C |
|---|---|---|
| 20V | 9.5mΩ @ $V_{GS}$ = 4.5V | 11.7A |
| | 11mΩ @ $V_{GS}$ = 2.5V | 10.8A |

## Description

This new generation 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.

## Applications

- General Purpose Interfacing Switch
- Power Management Functions

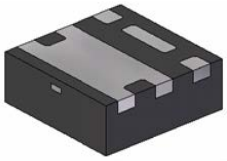
## Features

- 0.6mm Profile – Ideal for Low Profile Applications
- PCB Footprint of 4mm$^2$
- Low Gate Threshold Voltage
- Low On-Resistance
- ESD Protected Gate
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **Qualified to AEC-Q101 Standards for High Reliability**

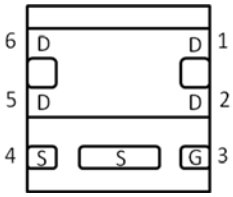
## Mechanical Data

- Case: U-DFN2020-6
- Case 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 Leadframe. Solderable per MIL-STD-202, Method 208 e4
- Weight: 0.0065 grams (Approximate)

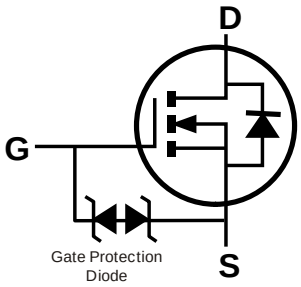

U-DFN2020-6



Bottom View




Bottom View
Pin Out



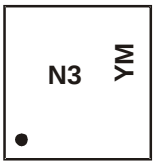

Equivalent Circuit

## Ordering Information (Note 4)

| Part Number | Marking | Reel size (inches) | Quantity per reel |
|---|---|---|---|
| DMN2011UFDE-7 | N3 | 7 | 3,000 |
| DMN2011UFDE-13 | N3 | 13 | 10,000 |

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See http://www.diodes.com/quality/lead_free.html 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 http://www.diodes.com/products/packages.html.

## Marking Information




N3 = Product Type Marking Code
YM = Date Code Marking
Y = Year (ex: A = 2013)
M = Month (ex: 9 = September)

Date Code Key

| Year | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|
| Code | Y | Z | A | B | C | D | E |

| 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 (@$T_A$ = +25°C, unless otherwise specified.)

| Characteristic | | | Symbol | Value | Units |
|---|---|---|---|---|---|
| Drain-Source Voltage | | | $V_{DSS}$ | 20 | V |
| Gate-Source Voltage | | | $V_{GSS}$ | ±12 | V |
| Continuous Drain Current (Note 6) $V_{GS}$ = 4.5V | Steady State | $T_A$ = +25°C<br>$T_A$ = +70°C | $I_D$ | 11.7<br>9.3 | A |
| | t<10s | $T_A$ = +25°C<br>$T_A$ = +70°C | $I_D$ | 14.2<br>11.4 | A |
| Continuous Drain Current (Note 6) $V_{GS}$ = 2.5V | Steady State | $T_A$ = +25°C<br>$T_A$ = +70°C | $I_D$ | 10.8<br>8.7 | A |
| | t<10s | $T_A$ = +25°C<br>$T_A$ = +70°C | $I_D$ | 13.2<br>10.6 | A |
| Pulsed Drain Current (10µs pulse, duty cycle = 1%) | | | $I_{DM}$ | 80 | A |
| Maximum Body Diode Continuous Current | | | $I_S$ | 2.5 | A |
| Avalanche Current (Note 7) L = 0.1mH | | | $I_{AS}$ | 18 | A |
| Avalanche Energy (Note 7) L = 0.1mH | | | $E_{AS}$ | 17 | mJ |

## Thermal Characteristics

| Characteristic | | Symbol | Value | Units |
|---|---|---|---|---|
| Total Power Dissipation (Note 5) | $T_A$ = +25°C | $P_D$ | 0.61 | W |
| | $T_A$ = +70°C | | 0.39 | |
| Thermal Resistance, Junction to Ambient (Note 5) | Steady state | $R_{\theta JA}$ | 209 | °C/W |
| | t<10s | | 142 | |
| Total Power Dissipation (Note 6) | $T_A$ = +25°C | $P_D$ | 1.97 | W |
| | $T_A$ = +70°C | | 1.27 | |
| Thermal Resistance, Junction to Ambient (Note 6) | Steady state | $R_{\theta JA}$ | 64 | °C/W |
| | t<10s | | 43 | |
| Thermal Resistance, Junction to Case (Note 6) | | $R_{\theta JC}$ | 9.8 | |
| 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 |
| Zero Gate Voltage Drain Current $T_J$ = +150°C (Note 9) | $I_{DSS}$ | — | — | 100 | μA | $V_{DS}$ = 16V, $V_{GS}$ = 0V |
| Gate-Source Leakage | $I_{GSS}$ | — | — | ±10 | μA | $V_{GS}$ = ±10V, $V_{DS}$ = 0V |
| **ON CHARACTERISTICS (Note 8)** | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | 0.4 | — | 1.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA |
| Static Drain-Source On-Resistance | $R_{DS(ON)}$ | — | 6.5 | 9.5 | mΩ | $V_{GS}$ = 4.5V, $I_D$ = 7A |
| | | | 7.5 | 11 | | $V_{GS}$ = 2.5V, $I_D$ = 7A |
| | | | 10 | 20 | | $V_{GS}$ = 1.8V, $I_D$ = 5A |
| | | | 15 | 35 | | $V_{GS}$ = 1.5V, $I_D$ = 3A |
| Diode Forward Voltage | $V_{SD}$ | — | 0.7 | 1.2 | V | $V_{GS}$ = 0V, $I_S$ = 8.5A |
| On State Drain Current (Note 9) | $I_{D(ON)}$ | 20 | — | — | A | $V_{DS}$ ≦5V, $V_{GS}$ = 4.5V |
| **DYNAMIC CHARACTERISTICS (Note 9)** | | | | | | |
| Input Capacitance | $C_{iss}$ | — | 2248 | 3372 | pF | $V_{DS}$ = 10V, $V_{GS}$ = 0V, f = 1.0MHz |
| Output Capacitance | $C_{oss}$ | — | 295 | 443 | pF | |
| Reverse Transfer Capacitance | $C_{rss}$ | — | 265 | 398 | pF | |
| Gate Resistance | $R_g$ | — | 1.5 | 3 | Ω | $V_{DS}$ = 0V, $V_{GS}$ = 0V, f = 1MHz |
| Total Gate Charge ($V_{GS}$ = 4.5V) | $Q_g$ | — | 24 | 36 | nC | $V_{DS}$ = 10V, $I_D$ = 8.5A |
| Total Gate Charge ($V_{GS}$ = 10V) | $Q_g$ | — | 56 | 84 | nC | |
| Gate-Source Charge | $Q_{gs}$ | — | 3.5 | 6 | nC | |
| Gate-Drain Charge | $Q_{gd}$ | — | 5.1 | 8 | nC | |
| Turn-On Delay Time | $t_{D(on)}$ | — | 3.6 | 6 | ns | $V_{DS}$ = 10V, $I_D$ = 8.5A $V_{GS}$ = 4.5V, $R_G$ = 1.8Ω |
| Turn-On Rise Time | $t_r$ | — | 2.6 | 4 | ns | |
| Turn-Off Delay Time | $t_{D(off)}$ | — | 21.6 | 33 | ns | |
| Turn-Off Fall Time | $t_f$ | — | 13.5 | 21 | ns | |
| Reverse Recovery Time | $T_{rr}$ | — | 12.8 | 20 | ns | $I_F$ = 8.5A, di/dt = 210A/μs |
| Reverse Recovery Charge | $Q_{rr}$ | — | 6.9 | 11 | nC | |

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 1inch square copper plate.
7. $I_{AS}$ and $E_{AS}$ rating are based on low frequency and duty cycles to keep $T_J$ = +25°C
8. Short duration pulse test used to minimize self-heating effect.
9. Guaranteed by design. Not subject to product testing.

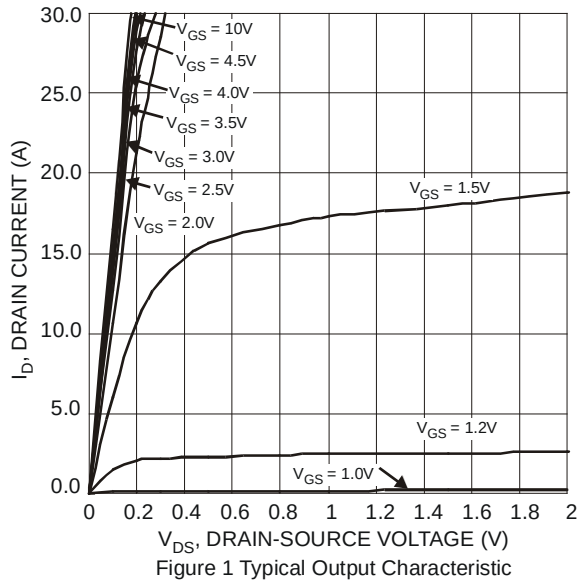


Figure 1 Typical Output Characteristic

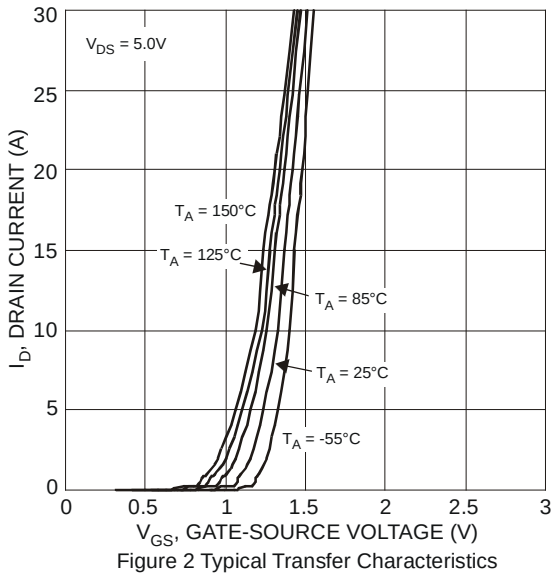


Figure 2 Typical Transfer Characteristics

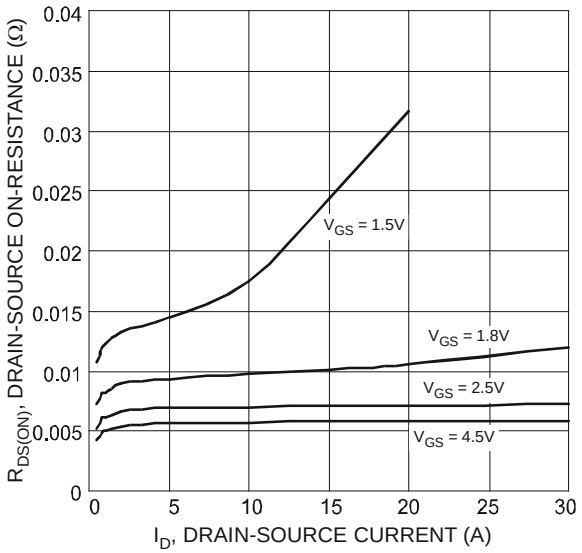



Figure 3 Typical On-Resistance vs. Drain Current and Gate Voltage

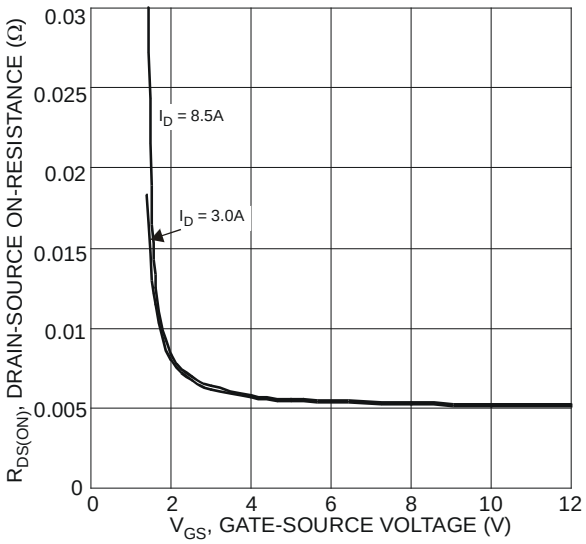



Figure 4 Typical Transfer Characteristics

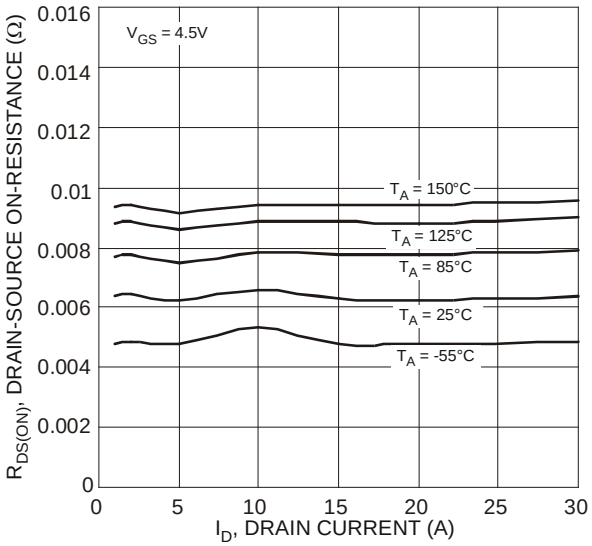



Figure 5 Typical On-Resistance vs. Drain Current and Temperature

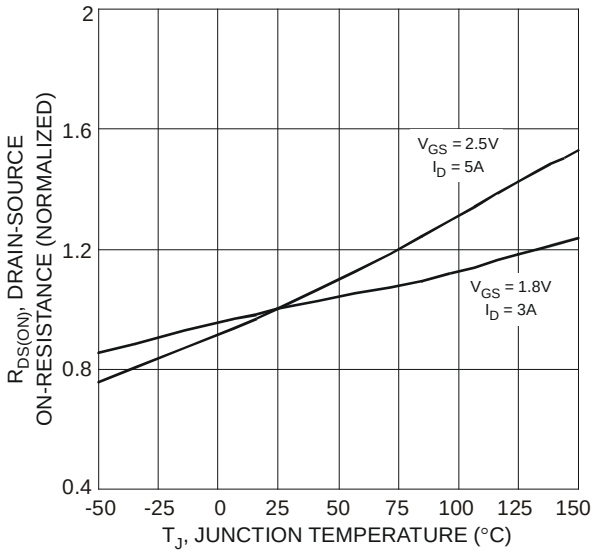



Figure 6 On-Resistance Variation with Temperature

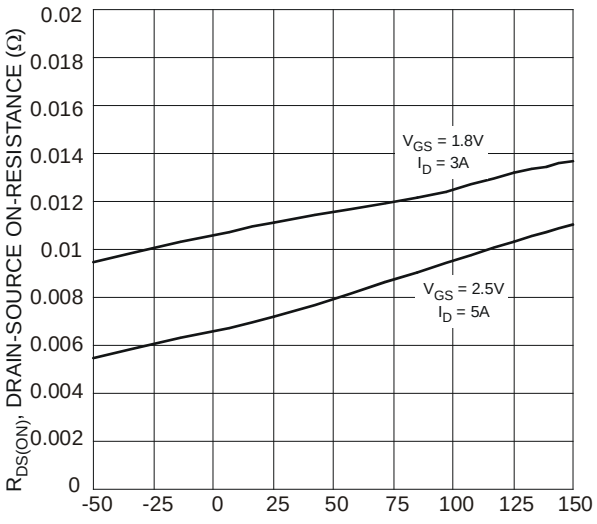



Figure 7 On-Resistance Variation with Temperature

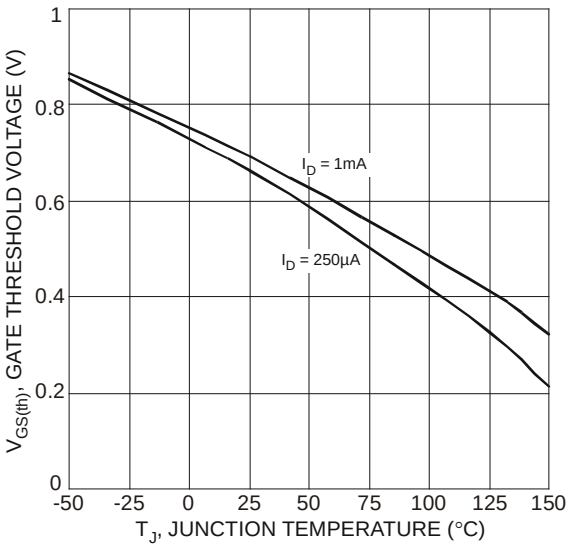



Figure 8 Gate Threshold Variation vs. Ambient Temperature

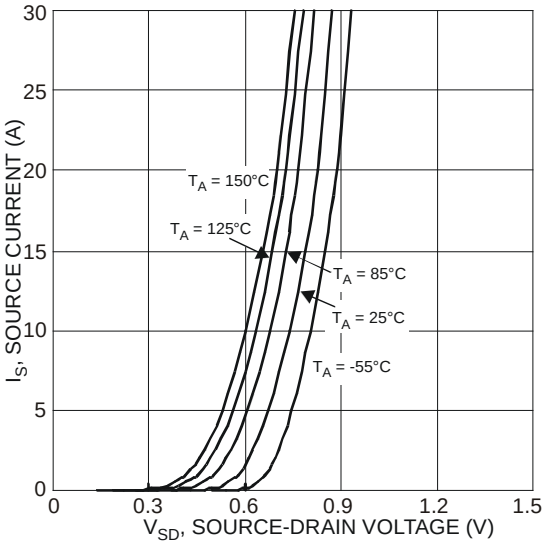



Figure 9 Diode Forward Voltage vs. Current

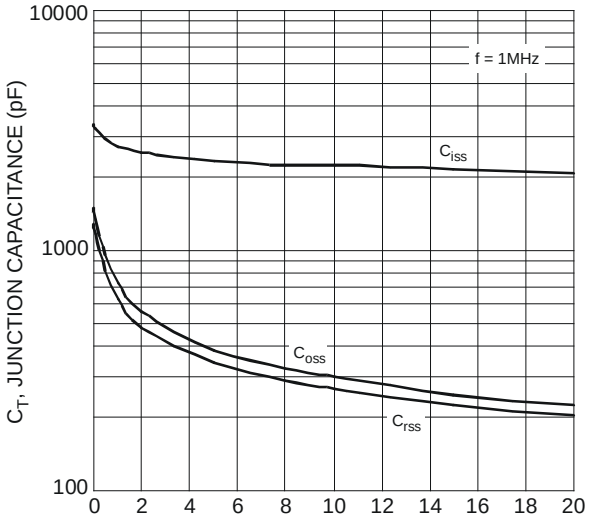



Figure 10 Typical Junction Capacitance

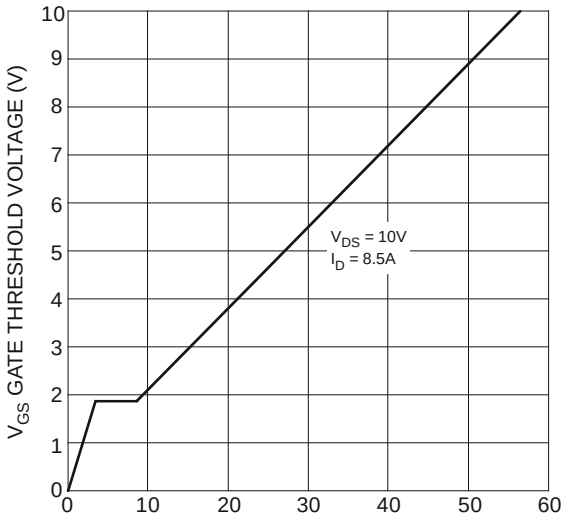



Figure 11 Gate Charge

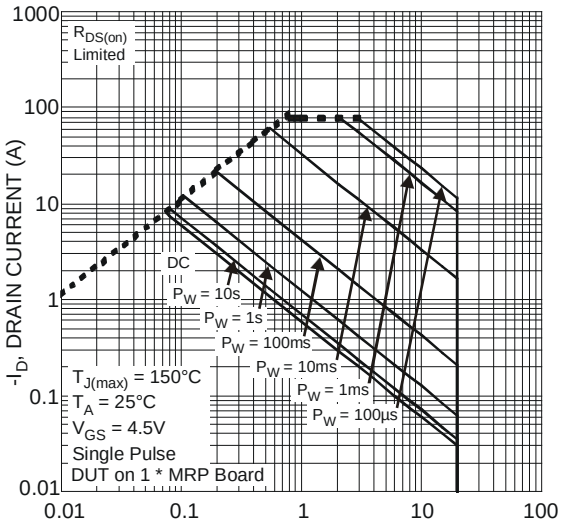



Figure 12 SOA, Safe Operation Area

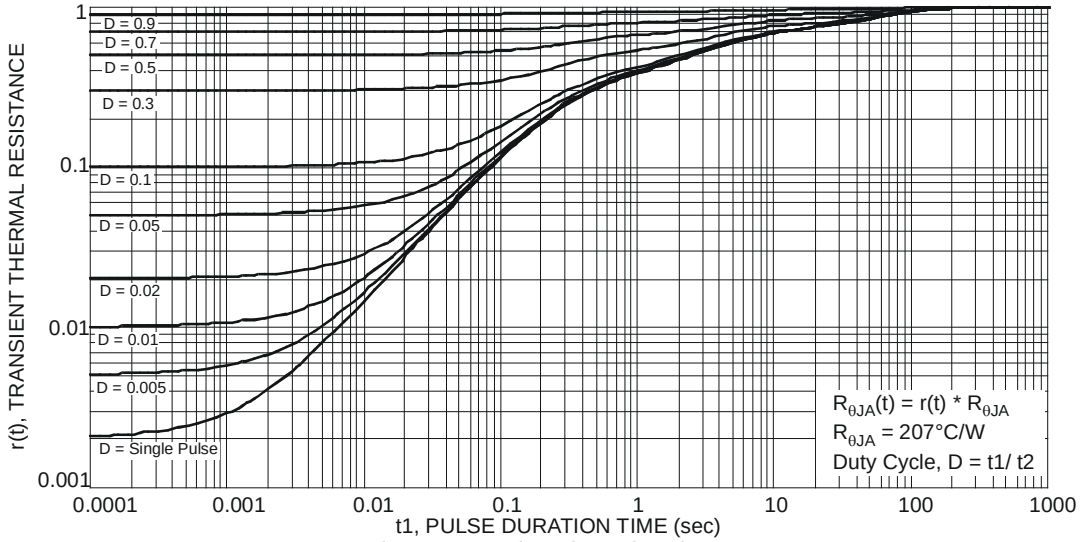
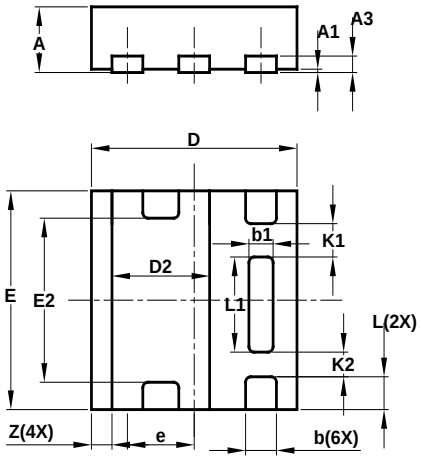



Figure 13 Transient Thermal Resistance

## Package Outline Dimensions

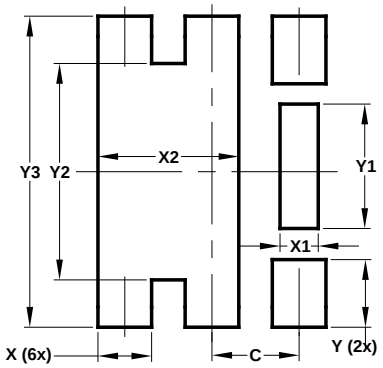
Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for latest version.




| U-DFN2020-6 Type E | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | 0.57 | 0.63 | 0.60 |
| **A1** | 0 | 0.05 | 0.03 |
| **A3** | — | — | 0.15 |
| **b** | 0.25 | 0.35 | 0.30 |
| **b1** | 0.185 | 0.285 | 0.235 |
| **D** | 1.95 | 2.05 | 2.00 |
| **D2** | 0.85 | 1.05 | 0.95 |
| **E** | 1.95 | 2.05 | 2.00 |
| **E2** | 1.40 | 1.60 | 1.50 |
| **e** | — | — | 0.65 |
| **L** | 0.25 | 0.35 | 0.30 |
| **L1** | 0.82 | 0.92 | 0.87 |
| **K1** | — | — | 0.305 |
| **K2** | — | — | 0.225 |
| **Z** | — | — | 0.20 |
| **All Dimensions in mm** | | | |

## Suggested Pad Layout

Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for latest version.




| Dimensions | Value (in mm) |
|---|---|
| **C** | 0.650 |
| **X** | 0.400 |
| **X1** | 0.285 |
| **X2** | 1.050 |
| **Y** | 0.500 |
| **Y1** | 0.920 |
| **Y2** | 1.600 |
| **Y3** | 2.300 |

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