# 25V P-CHANNEL ENHANCEMENT MODE MOSFET

## Product Summary

| $V_{(BR)DSS}$ | $R_{DS(on)\ max}$ | $I_D$ $T_A = 25°C$ |
|---|---|---|
| -25V | 26mΩ @ $V_{GS}$ = -4.5V | -7.3 |
| | 40mΩ @ $V_{GS}$ = -1.8V | -6.0 |

## Features and Benefits

- Low $R_{DS(ON)}$ – ensures on state losses are minimized
- 0.4mm profile – ideal for low profile applications
- PCB footprint of $4mm^2$
- Low Input Capacitance
- **ESD Protected Gate**
- **Lead, Halogen, and Antimony Free, RoHS Compliant (Note 1)**
- **"Green" Device (Note 2)**
- **Qualified to AEC-Q101 Standards for High Reliability**

## Description and Applications

This new generation MOSFET has been 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.

- Load Switching
- Battery Management Application
- Power Management Functions

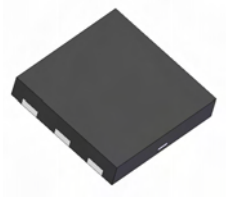
## Mechanical Data

- Case: X2-DFN2020-6
- Case Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminal Connections: See Diagram
- Terminals: Finish – NiPdAu over Copper leadframe. Solderable per MIL-STD-202, Method 208
- Weight: 0.006 grams (approximate)

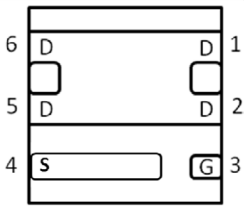
X2-DFN2020-6

ESD PROTECTED

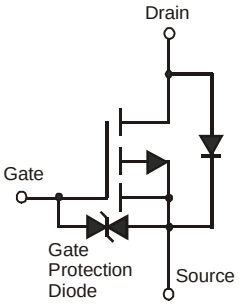
Bottom View



Top View




Bottom View
Internal Schematic




Equivalent Circuit

## Ordering Information (Note 3)

| Part Number | Case | Packaging |
|---|---|---|
| DMP2039UFDE4-7 | X2-DFN2020-6 | 3,000/Tape & Reel |

Notes:
1. EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant. No purposely added lead. Halogen and Antimony free.
2. Diodes Inc.'s "Green" policy can be found on our website at http://www.diodes.com.
3. For packaging details, go to our website at http://www.diodes.com.

## Marking Information


PD = Product Type Marking Code
YM = Date Code Marking
Y = Year (ex: Y = 2011)
M = Month (ex: 9 = September)
Dot Denotes Pin 1

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 | | | $V_{DSS}$ | -25 | V |
| Gate-Source Voltage | | | $V_{GSS}$ | ±8 | V |
| Continuous Drain Current (Note 5) $V_{GS}$ = -4.5V | Steady State | $T_A$ = 25°C<br>$T_A$ = 70°C | $I_D$ | -7.3<br>-5.8 | A |
| | t<5s | $T_A$ = 25°C<br>$T_A$ = 70°C | $I_D$ | -9.2<br>-7.3 | A |
| Continuous Drain Current (Note 5) $V_{GS}$ = -1.8V | Steady State | $T_A$ = 25°C<br>$T_A$ = 70°C | $I_D$ | -6.0<br>-4.7 | A |
| | t<5s | $T_A$ = 25°C<br>$T_A$ = 70°C | $I_D$ | -7.6<br>-6.0 | A |
| Pulsed Drain Current (10µs pulse, duty cycle = 1%) | | | $I_{DM}$ | -60 | A |
| Continuous Source-Drain Diode Current | | | $I_S$ | -2.0 | A |

## Thermal Characteristics @$T_A$ = 25°C unless otherwise specified

| Characteristic | | Symbol | Value | Units |
|---|---|---|---|---|
| Total Power Dissipation (Note 4) | $T_A$ = 25°C | $P_D$ | 0.69 | W |
| | $T_A$ = 70°C | | 0.44 | |
| Thermal Resistance, Junction to Ambient (Note 4) | Steady state | $R_{\theta JA}$ | 182 | °C/W |
| | t<5s | | 113 | |
| Total Power Dissipation (Note 5) | $T_A$ = 25°C | $P_D$ | 2.4 | W |
| | $T_A$ = 70°C | | 1.5 | |
| Thermal Resistance, Junction to Ambient (Note 5) | Steady state | $R_{\theta JA}$ | 52 | °C/W |
| | t<5s | | 33 | |
| Thermal Resistance, Junction to Case (Note 5) | Steady state | $R_{\theta JC}$ | 9.1 | °C/W |
| 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 6)** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | -25 | — | — | V | $V_{GS}$ = 0V, $I_D$ = -250µA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | — | — | -1 | µA | $V_{DS}$ = -25V, $V_{GS}$ = 0V |
| Gate-Source Leakage | $I_{GSS}$ | — | — | ±10 | µA | $V_{GS}$ = ±8.0V, $V_{DS}$ = 0V |
| **ON CHARACTERISTICS (Note 6)** | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | -0.4 | — | -1.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = -250µA |
| Static Drain-Source On-Resistance | $R_{DS\ (ON)}$ | — | 19 | 26 | mΩ | $V_{GS}$ = -4.5V, $I_D$ = -6.4A |
| | | — | 24 | 33 | | $V_{GS}$ = -2.5V, $I_D$ = -4.8A |
| | | — | 29 | 40 | | $V_{GS}$ = -1.8V, $I_D$ = -2.5A |
| | | — | 35 | 70 | | $V_{GS}$ = -1.5V, $I_D$ = -1.5A |
| Forward Transfer Admittance | $\|Y_{fs}\|$ | — | 14 | — | mS | $V_{DS}$ = -5V, $I_D$ = -4A |
| Diode Forward Voltage (Note 5) | $V_{SD}$ | — | -0.7 | -1.0 | V | $V_{GS}$ = 0V, $I_S$ = -1A |
| **DYNAMIC CHARACTERISTICS (Note 7)** | | | | | | |
| Input Capacitance | $C_{iss}$ | — | 2530 | — | pF | $V_{DS}$ = -15V, $V_{GS}$ = 0V<br>f = 1.0MHz |
| Output Capacitance | $C_{oss}$ | — | 203 | — | pF | |
| Reverse Transfer Capacitance | $C_{rss}$ | — | 177 | — | pF | |
| Gate Resistance | $R_g$ | — | 9.1 | — | Ω | $V_{DS}$ = 0V, $V_{GS}$ = 0V, f = 1.0MHz |
| Total Gate Charge | $Q_g$ | — | 28.2 | — | nC | $V_{DS}$ = -15V, $I_D$ = -4.0A |
| Gate-Source Charge | $Q_{gs}$ | — | 48.7 | — | | |
| Gate-Drain Charge | $Q_{gd}$ | — | 3.2 | — | | |
| Turn-On Delay Time | $t_{D(on)}$ | — | 5.0 | — | nS | $V_{DD}$ = -15V, $V_{GS}$ = -4.5V, $R_G$ = 1Ω,<br>$I_D$ = -4.0A |
| Turn-On Rise Time | $t_r$ | — | 15.1 | — | | |
| Turn-Off Delay Time | $t_{D(off)}$ | — | 23.5 | — | | |
| Turn-Off Fall Time | $t_f$ | — | 137.6 | — | | |

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

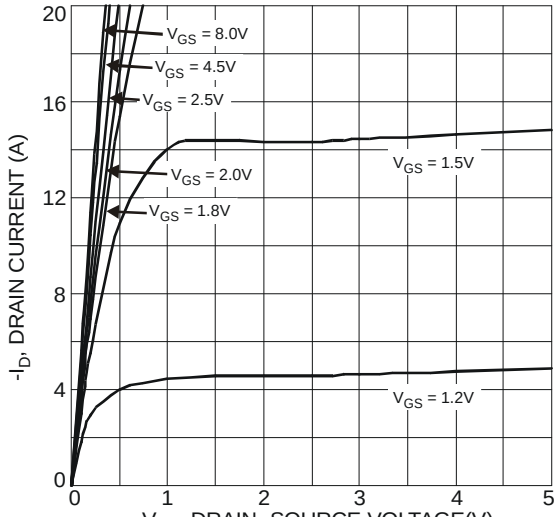



Fig. 1 Typical Output Characteristics

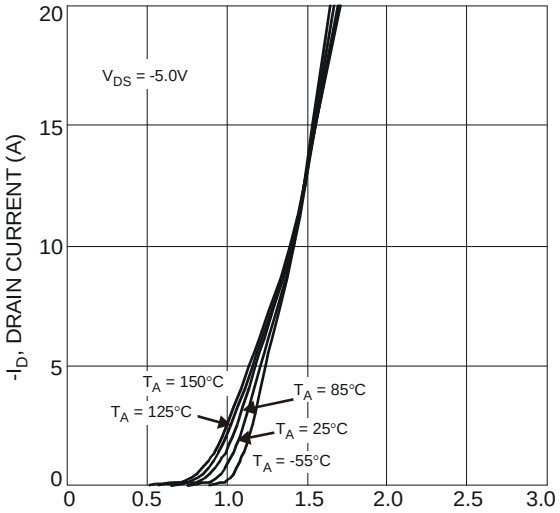



Fig. 2 Typical Transfer Characteristics

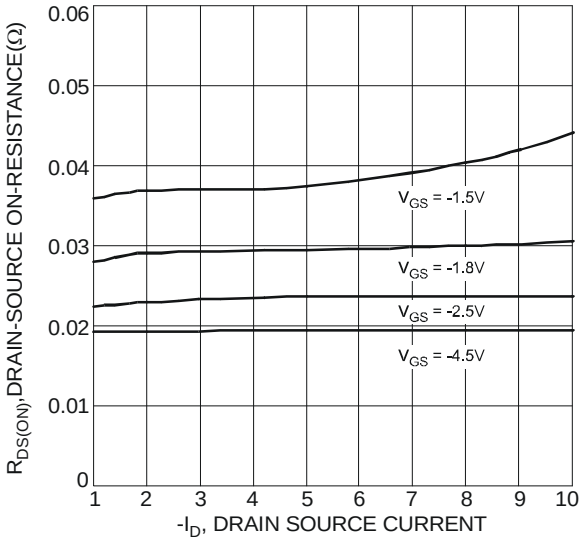



Fig. 3 Typical On-Resistance vs. Drain Current and Gate Voltage

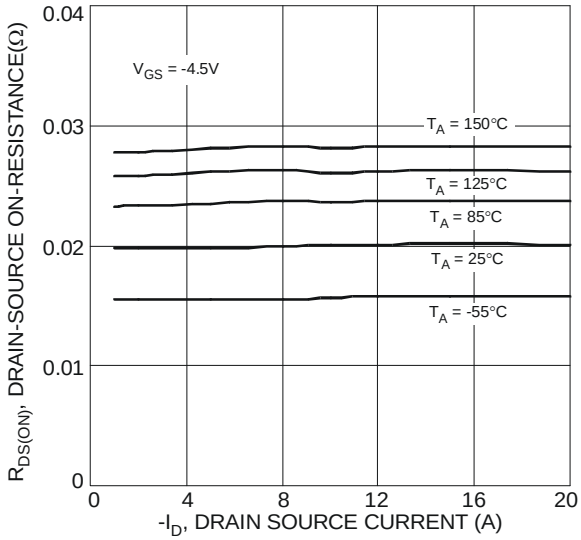



Fig. 4 Typical On-Resistance vs. Drain Current and Temperature

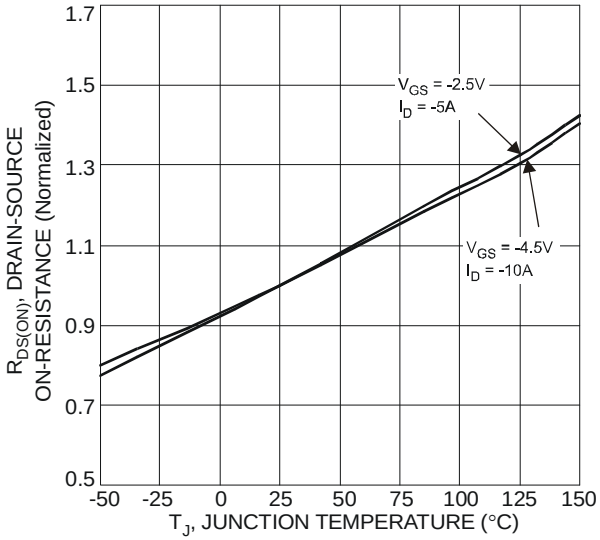



Fig. 5 On-Resistance Variation with Temperature

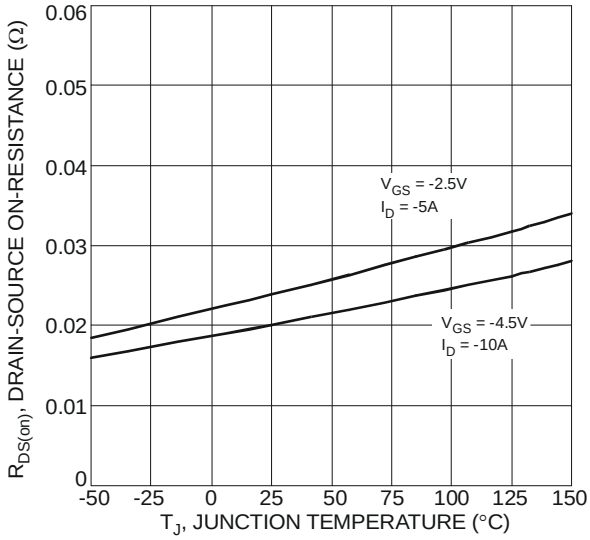



Fig. 6 On-Resistance Variation with Temperature

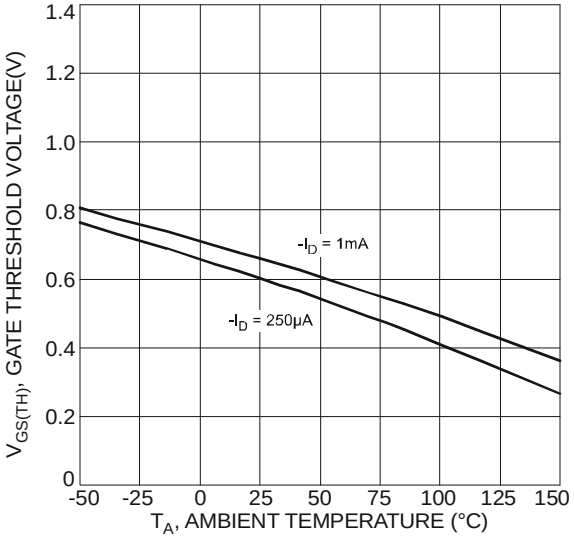



Fig. 7 Gate Threshold Variation vs. Ambient Temperature

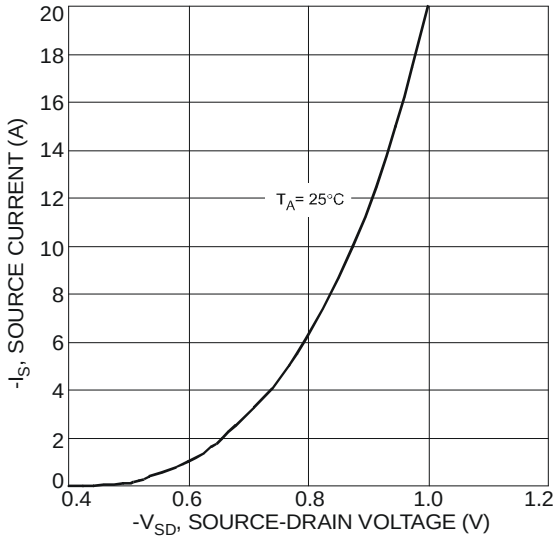



Fig. 8 Diode Forward Voltage vs. Current

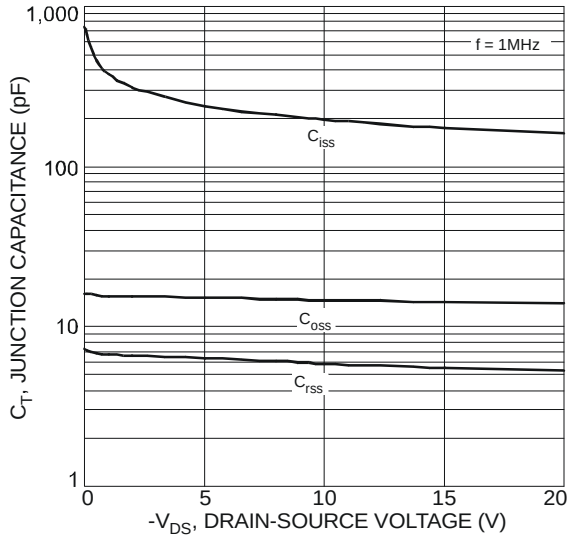



Fig. 9 Typical Junction Capacitance

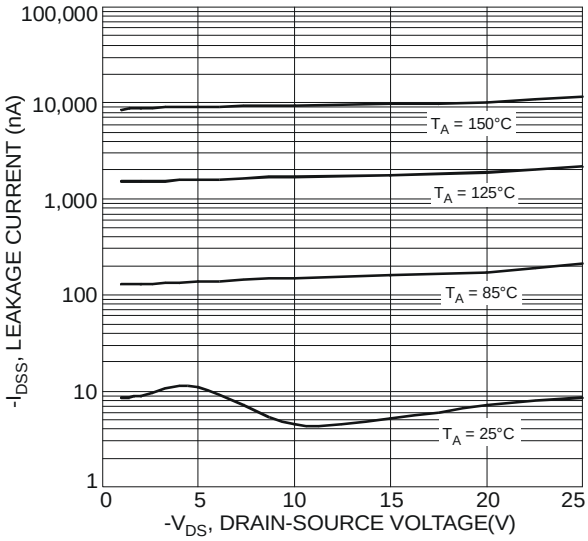



Fig. 10 Typical Drain-Source Leakage Current vs. Voltage

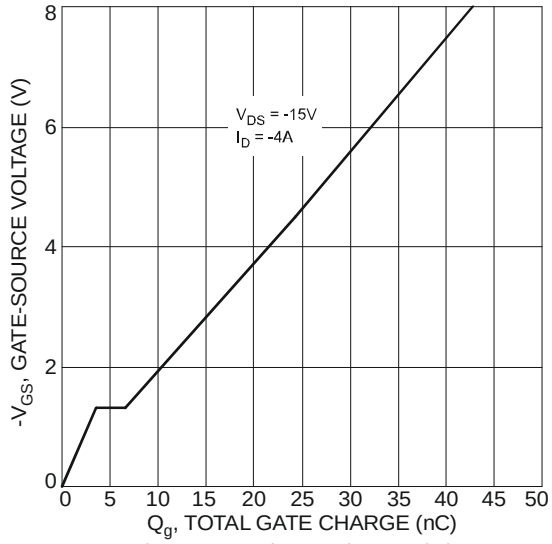



Fig. 11 Gate-Charge Characteristics

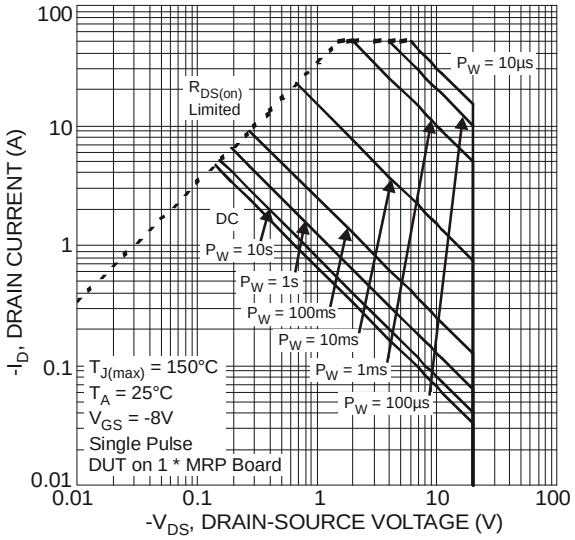



Fig. 12 SOA, Safe Operation Area

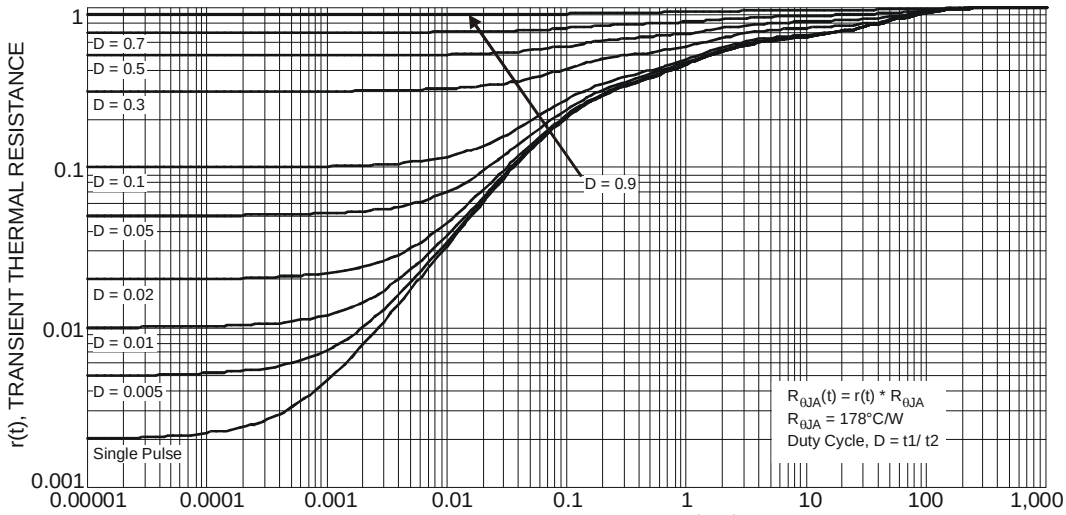
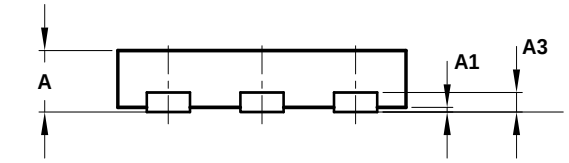
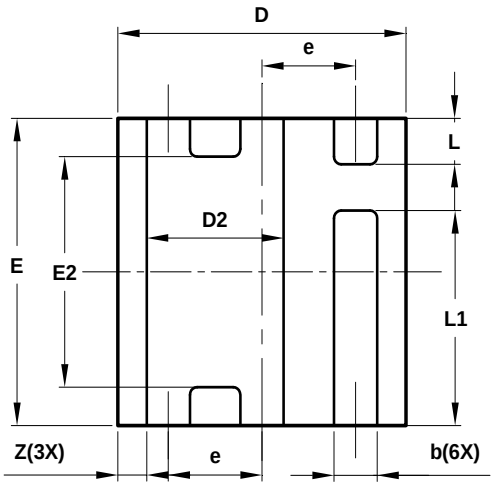



Fig. 13 Transient Thermal Resistance

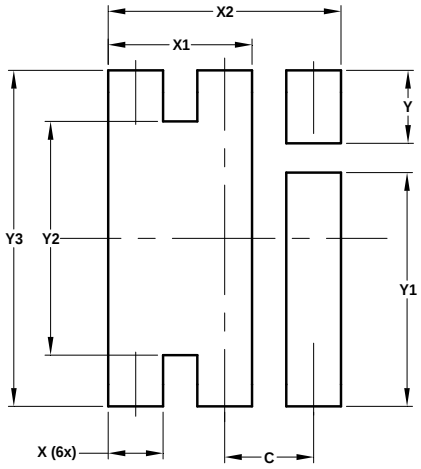
## Package Outline Dimensions




| X2-DFN2020-6 | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | – | 0.40 | – |
| **A1** | 0 | 0.05 | 0.03 |
| **A3** | – | – | 0.13 |
| **b** | 0.25 | 0.35 | 0.30 |
| **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** | 1.35 | 1.45 | 1.40 |
| **Z** | – | – | 0.20 |
| **All Dimensions in mm** | | | |

## Suggested Pad Layout




| Dimensions | Value (in mm) |
|---|---|
| C | 0.650 |
| X | 0.400 |
| X1 | 1.050 |
| X2 | 1.700 |
| Y | 0.500 |
| Y1 | 1.600 |
| Y2 | 1.600 |
| Y3 | 2.300 |