# 12V P-CHANNEL ENHANCEMENT MODE MOSFET

## Product Summary

| $V_{(BR)DSS}$ | $R_{DS(ON)}$ max | $I_D$ max $T_A$ = 25°C |
|---|---|---|
| -12V | 16mΩ @ $V_{GS}$ = -4.5V | -9.1A |
| | 21.5mΩ @ $V_{GS}$ = -2.5V | -7.9A |
| | 26mΩ @ $V_{GS}$ = -1.8V | -7.0A |
| | 32mΩ @ $V_{GS}$ = -1.5V | -6.3A |

## Description

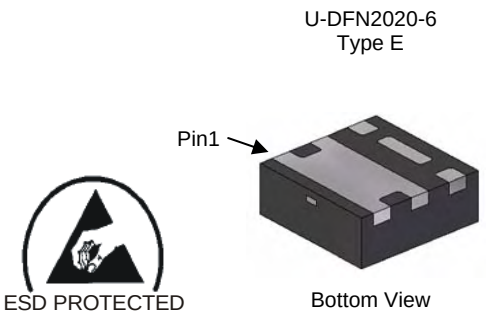
This MOSFET has been designed specifically for use in battery management applications.

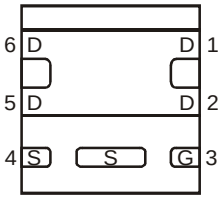
## Features

- 0.6mm profile – ideal for low profile applications
- PCB footprint of 4mm$^2$
- Low Gate Threshold Voltage
- Fast Switching Speed
- ESD Protected to 3KV
- **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**

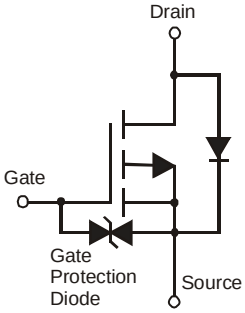
## Mechanical Data

- Case: U-DFN2020-6 Type E
- 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
- Weight: 0.0065 grams (approximate)



Pin Out
Bottom View



Internal Schematic

## Ordering Information (Note 4)

| Part Number | Marking | Reel size (inches) | Quantity per reel |
|---|---|---|---|
| DMP1022UFDE-7 | P4 | 7 | 3,000 |

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 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.

## Marking Information


P4 = Product Type Marking Code
YM = Date Code Marking
Y = Year (ex: Y = 2011)
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 | | | $V_{DSS}$ | -12 | V |
| Gate-Source Voltage | | | $V_{GSS}$ | ±8 | V |
| Continuous Drain Current (Note 6) $V_{GS}$ = -4.5V | Steady State | $T_A$ = +25°C<br>$T_A$ = +70°C | $I_D$ | -9.1<br>-7.2 | A |
| | t<5s | $T_A$ = +25°C<br>$T_A$ = +70°C | $I_D$ | -11.2<br>-9.0 | A |
| Pulsed Drain Current (10µs pulse, duty cycle = 1%) | | | $I_{DM}$ | -90 | A |
| Continuous Source-Drain Diode Current | | $T_A$ = +25°C<br>$T_C$ = +25°C | $I_S$ | -2.5<br>-7.1 | A |
| Pulsed Source-Drain Diode Current (10µs pulse, duty cycle = 1%) | | | $I_{SM}$ | -50 | A |

## Thermal Characteristics

| Characteristic | | Symbol | Value | Units |
|---|---|---|---|---|
| Total Power Dissipation (Note 5) | $T_A$ = +25°C | $P_D$ | 0.66 | W |
| | $T_A$ = +70°C | | 0.42 | |
| Thermal Resistance, Junction to Ambient (Note 5) | Steady state | $R_{\theta JA}$ | 189 | °C/W |
| | t<5s | | 123 | |
| Total Power Dissipation (Note 6) | $T_A$ = +25°C | $P_D$ | 2.03 | W |
| | $T_A$ = +70°C | | 1.3 | |
| Thermal Resistance, Junction to Ambient (Note 6) | Steady state | $R_{\theta JA}$ | 61 | °C/W |
| | t<5s | | 40 | |
| Thermal Resistance, Junction to Case (Note 6) | Steady state | $R_{\theta JC}$ | 9.3 | |
| Operating and Storage Temperature Range | | $T_J$, $T_{STG}$ | -55 to +150 | °C |

Notes: 5. Device mounted on FR-4 PC board, with minimum recommended pad layout, single sided.
6. Device mounted on FR-4 substrate PC board, 2oz copper, with thermal vias to bottom layer 1inch square copper plate

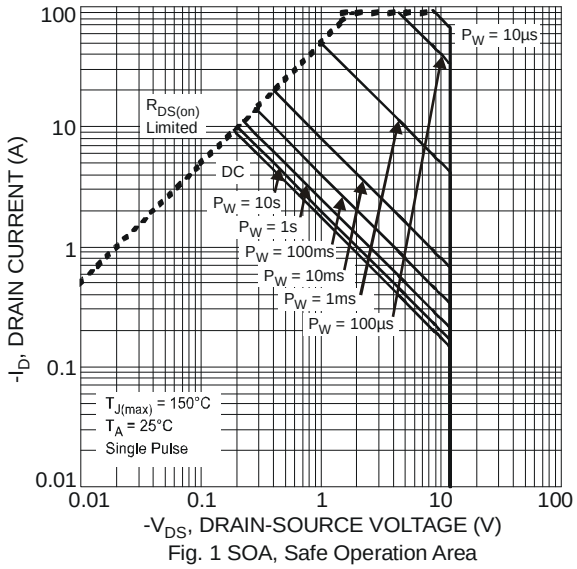


Fig. 1 SOA, Safe Operation Area

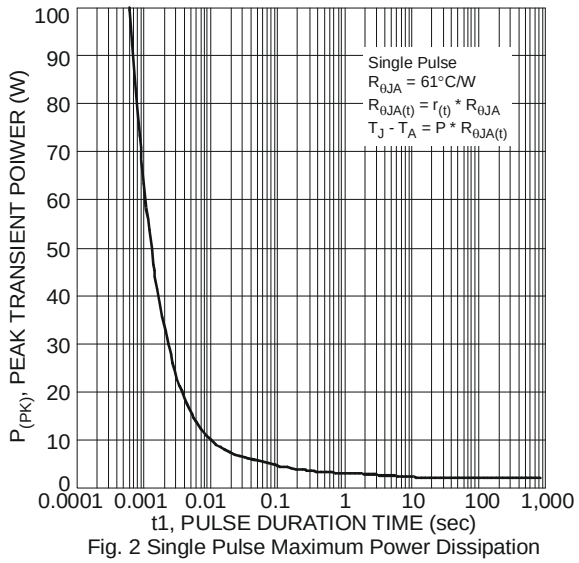


Fig. 2 Single Pulse Maximum Power Dissipation

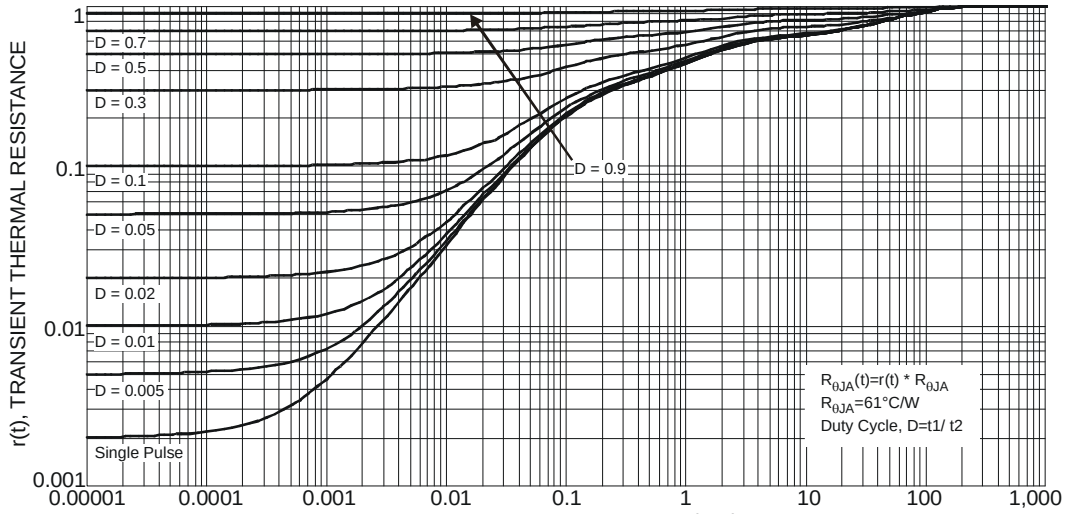


Fig. 3 Transient Thermal Resistance

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

| Characteristic | Symbol | Min | Typ | Max | Unit | Test Condition |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS (Note 7)** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | -12 | — | — | V | $V_{GS}$ = 0V, $I_D$ = -250µA |
| Zero Gate Voltage Drain Current $T_J$ = +25°C | $I_{DSS}$ | — | — | -1 | µA | $V_{DS}$ = -12V, $V_{GS}$ = 0V |
| Gate-Source Leakage | $I_{GSS}$ | — | — | ±2 | µA | $V_{GS}$ = ±5V, $V_{DS}$ = 0V |
| **ON CHARACTERISTICS (Note 7)** | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | -0.35 | — | -0.8 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = -250µA |
| $V_{GS(th)}$Temperature Coefficient | $\Delta V_{GS(th)}/\Delta T_J$ | - | 2.5 | — | mV/°C | $I_D$ = -250µA |
| On-State Drain Current | $I_{D(ON)}$ | -10 | — | — | A | $V_{GS}$ = -4.5V, $V_{DS}$ < -5A |
| Static Drain-Source On-Resistance | $R_{DS\ (ON)}$ | — | 12 | 16 | mΩ | $V_{GS}$ = -4.5V, $I_D$ = -8.2A |
| | | | 15 | 21.5 | | $V_{GS}$ = -2.5V, $I_D$ = -7.2A |
| | | | 20 | 26 | | $V_{GS}$ = -1.8V, $I_D$ = -6.6A |
| | | | 23 | 32 | | $V_{GS}$ = -1.5V, $I_D$ = -1A |
| | | | 46 | 95 | | $V_{GS}$ = -1.2V, $I_D$ = -1A |
| Forward Transfer Admittance | $\|Y_{fs}\|$ | — | 12 | - | S | $V_{DS}$ = -4V, $I_D$ = -8.2A |
| Diode Forward Voltage | $V_{SD}$ | — | -0.8 | -1.2 | V | $V_{GS}$ = 0V, $I_S$ = -8A |
| **DYNAMIC CHARACTERISTICS (Note 8)** | | | | | | |
| Input Capacitance | $C_{iss}$ | — | 2953 | — | pF | $V_{DS}$ = -4V, $V_{GS}$ = 0V, f = 1.0MHz |
| Output Capacitance | $C_{oss}$ | — | 756 | — | | |
| Reverse Transfer Capacitance | $C_{rss}$ | — | 678 | — | | |
| Gate Resistance | $R_g$ | — | 8.6 | 18 | Ω | $V_{DS}$ = 0V, $V_{GS}$ = 0V, f = 1MHz |
| Total Gate Charge | $Q_g$ | — | 28.4 | 42.6 | nC | $V_{GS}$ = -5V, $V_{DS}$ = -4, $I_D$ = -10A |
| Total Gate Charge | $Q_g$ | — | 25.3 | 38 | | $V_{GS}$ = -4.5V, $V_{DS}$ = -4V, $I_D$ = -10A |
| Gate-Source Charge | $Q_{gs}$ | — | 2.3 | — | | |
| Gate-Drain Charge | $Q_{gd}$ | — | 7.2 | — | | |
| Turn-On Delay Time | $t_{D(on)}$ | — | 20 | 30 | ns | $V_{DS}$ = -4V, $V_{GS}$ = -4.5V, $R_G$ = 1Ω, $R_L$ = 0.4Ω, $I_D$ = -9.8A |
| Turn-On Rise Time | $t_r$ | — | 28 | 42 | | |
| Turn-Off Delay Time | $t_{D(off)}$ | — | 117 | 176 | | |
| Turn-Off Fall Time | $t_f$ | — | 93 | 139 | | |
| **BODY DIODE CHARACTERISTICS** | | | | | | |
| Diode Forward Voltage | $V_{SD}$ | — | -0.8 | -1.2 | V | $V_{GS}$ = 0V, $I_S$ = -9.8A |
| Continuous Source-Drain Diode Current (Note 6) | $I_S$ | — | — | -2.5 | A | $T_A$ = +25°C |
| | | — | — | -7.1 | | $T_C$ = +25°C |
| Pulse Diode Forward Current (Note 8) | $I_{SM}$ | — | — | -50 | | — |
| Bodyy Diode Reverse Recovery Time (Note 8) | $t_{rr}$ | — | 28 | 56 | ns | $I_S$ = -9.8A, dI/dt = 100A/µs |
| Reverse Recovery Fall Time | $t_a$ | — | 10 | — | | |
| Reverse Recovery Rise Time | $t_b$ | — | 18 | — | | |
| Body Diode Reverse Recovery Charge (Note 8) | $Q_{rr}$ | — | 13 | 26 | nC | |

Notes: 7. Short duration pulse test used to minimize self-heating effect
8. Guaranteed by design. Not subject to production testing

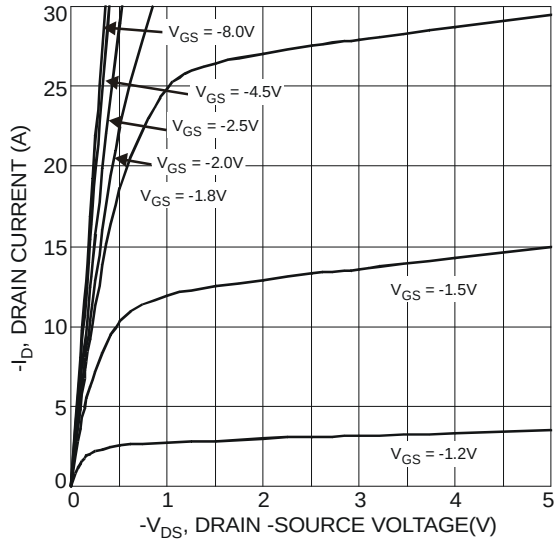


Fig. 4 Typical Output Characteristics

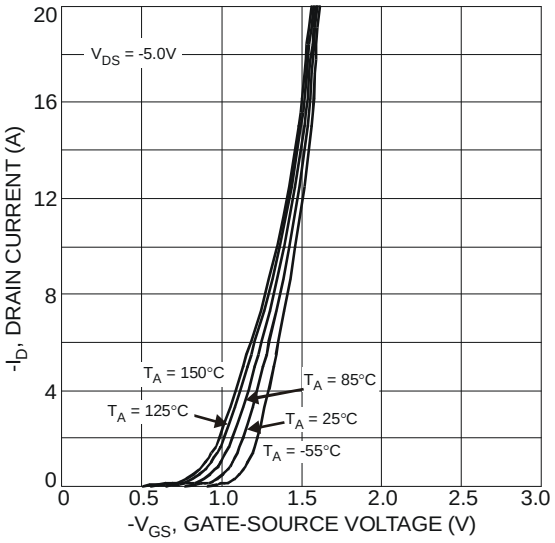


Fig. 5 Typical Transfer Characteristics

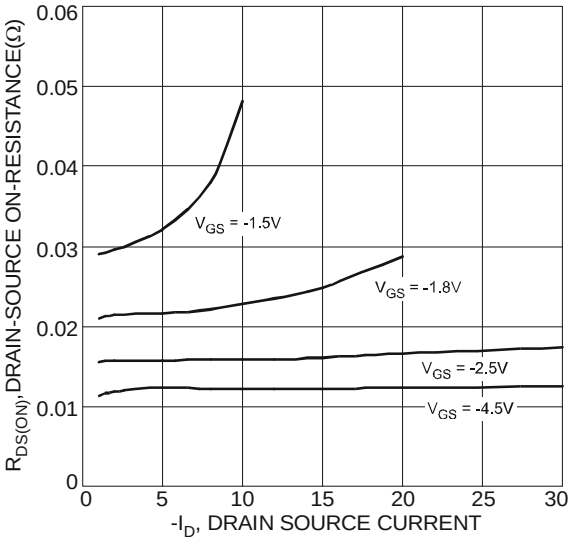


Fig. 6 Typical On-Resistance vs. Drain Current and Gate Voltage

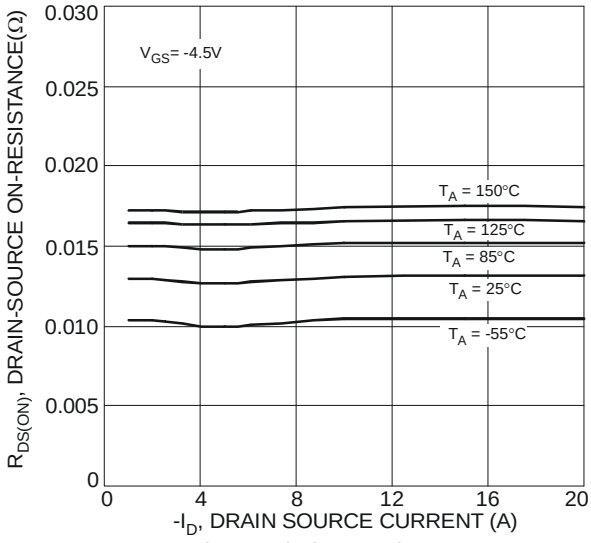


Fig. 7 Typical On-Resistance vs. Drain Current and Temperature

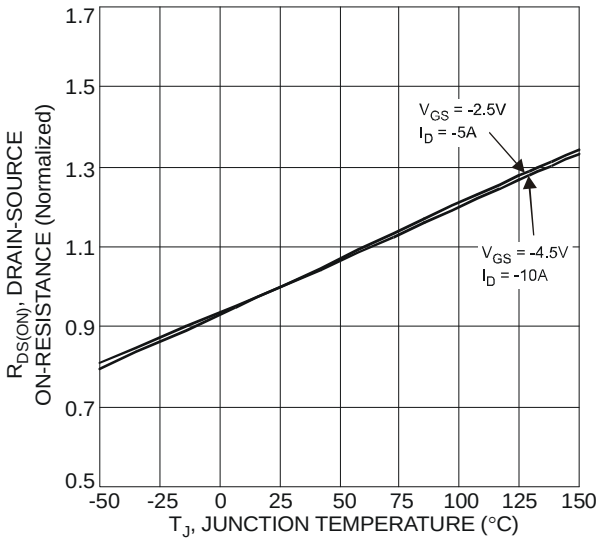


Fig. 8 On-Resistance Variation with Temperature

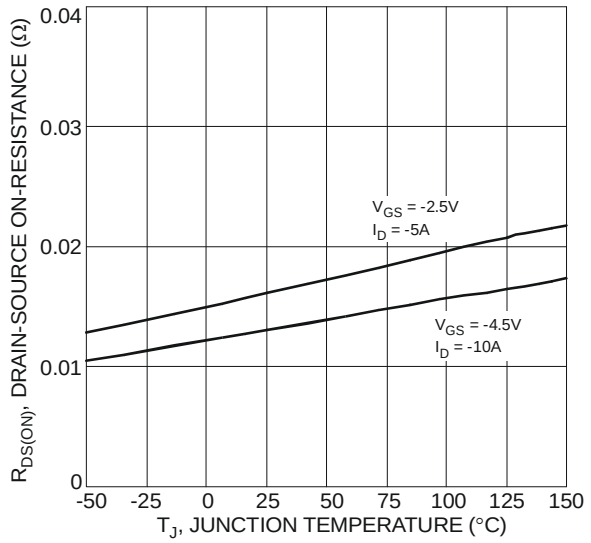


Fig. 9 On-Resistance Variation with Temperature

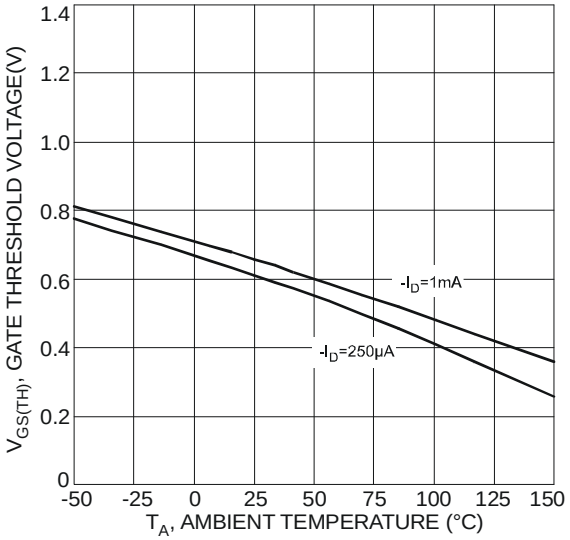



Fig. 10 Gate Threshold Variation vs. Ambient Temperature

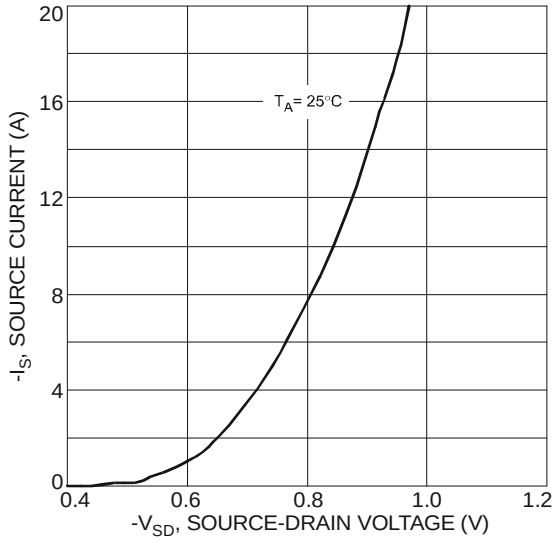



Fig. 11 Diode Forward Voltage vs. Current

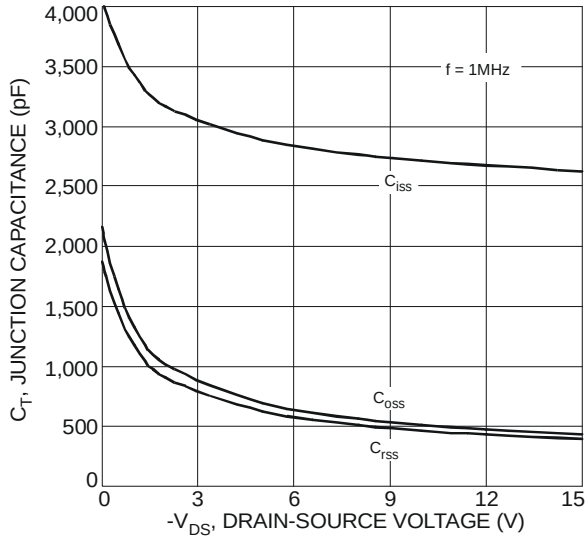



Fig. 12 Typical Junction Capacitance

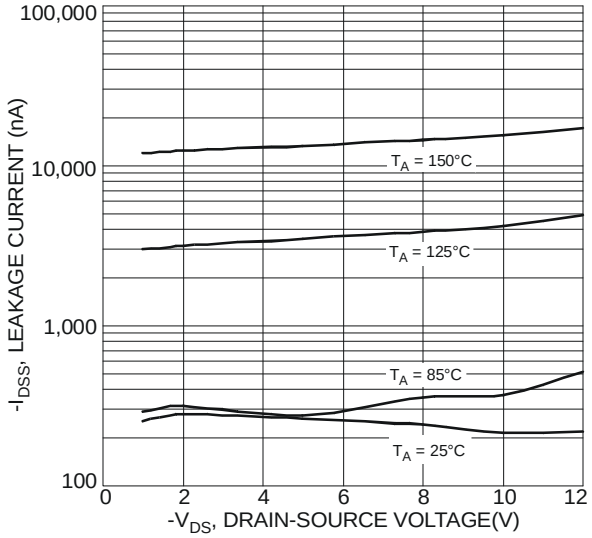



Fig. 13 Typical Drain-Source Leakage Current vs. Voltage

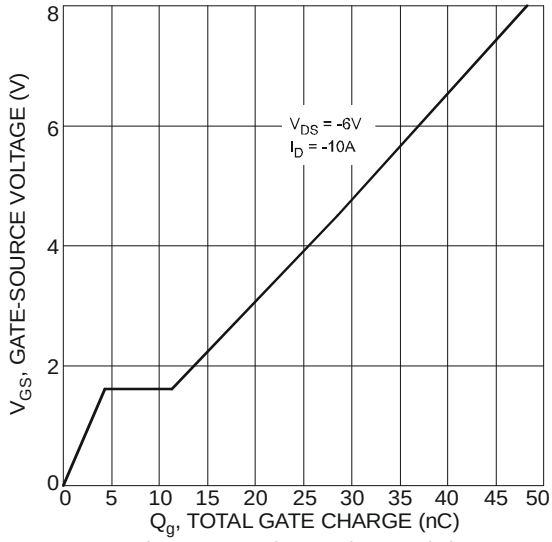
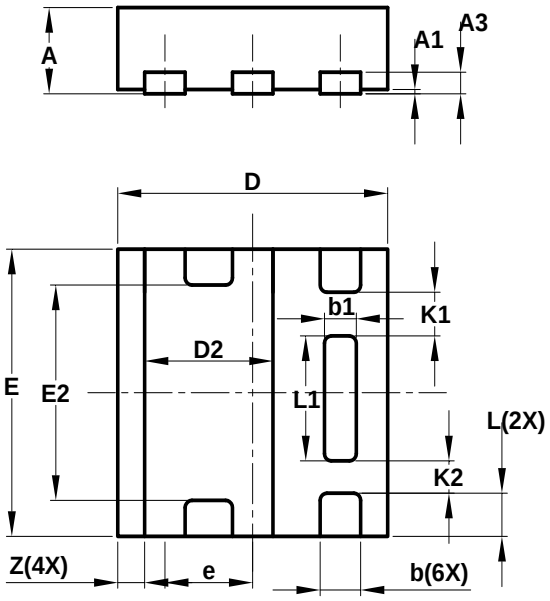


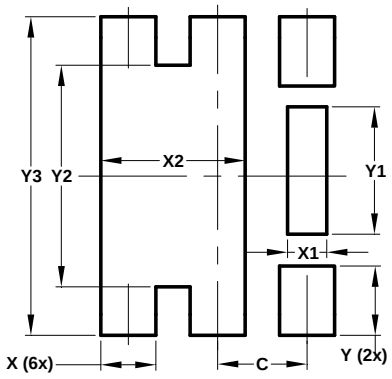

Fig. 14 Gate-Charge Characteristics

## Package Outline Dimensions




| 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




| 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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