# 60V 175°C P-CHANNEL ENHANCEMENT MODE MOSFET

## Product Summary

| $BV_{DSS}$ | $R_{DS(ON)}$ Max | $I_D$ Max $T_C$ = +25°C |
|---|---|---|
| -60V | 33mΩ @ $V_{GS}$ = -10V | -35A |
| | 40mΩ @ $V_{GS}$ = -4.5V | -32A |

## Features

- Rated to +175°C – Ideal for High Ambient Temperature Environments
- 100% Unclamped Inductive Switching – Ensures More Reliable and Robust End Application
- Low On-Resistance
- Low Input Capacitance
- **Lead-Free Finish; RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **Qualified to AEC-Q101 Standards for High Reliability**
- **PPAP Capable (Note 4)**

## Description and Applications

This MOSFET has been designed to meet the stringent requirements of automotive applications. It is qualified to AEC-Q101, supported by a PPAP and is ideal for use in:

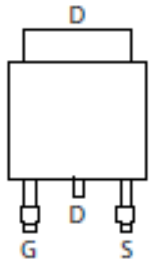
- Engine Management Systems
- Body Control Electronics
- DC-DC Converters

## Mechanical Data

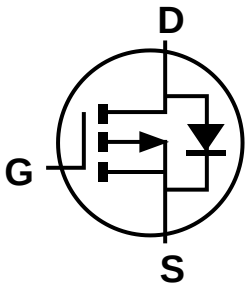
- Case: TO252 (DPAK)
- Case Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish – Matte Tin Annealed over Copper Leadframe. Solderable per MIL-STD-202, Method 208 e3
- Terminal Connections: See Diagram
- Weight: 0.33 grams (Approximate)

**TO252 (DPAK)**

Top View




Pin Out Top View



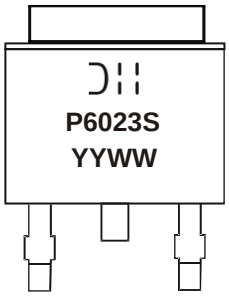

Equivalent Circuit

## Ordering Information (Note 5)

| Part Number | Case | Packaging |
|---|---|---|
| DMPH6023SK3Q-13 | TO252 (DPAK) | 2,500/Tape & Reel |

Notes:
1. EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant. All applicable RoHS exemptions applied.
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. Automotive products are AEC-Q101 qualified and are PPAP capable. Refer to http://www.diodes.com/product_compliance_definitions.html.
5. For packaging details, go to our website at http://www.diodes.com/products/packages.html.

## Marking Information




=Manufacturer's Marking
P6023S = Product Type Marking Code
YYWW = Date Code Marking
YY = Last Two Digits of Year (ex: 16 = 2016)
WW = Week Code (01 to 53)

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

| Characteristic | | | Symbol | Value | Unit |
|---|---|---|---|---|---|
| Drain-Source Voltage | | | $V_{DSS}$ | -60 | V |
| Gate-Source Voltage | | | $V_{GSS}$ | ±20 | V |
| Continuous Drain Current (Note 7) $V_{GS}$ = -10V | Steady State | $T_C$ = +25°C<br>$T_C$ = +100°C | $I_D$ | -35<br>-27 | A |
| | Steady State | $T_A$ = +25°C<br>$T_A$ = +70°C | $I_D$ | -7.3<br>-6.1 | A |
| Pulsed Drain Current (380µs Pulse, Duty Cycle = 1%) | | | $I_{DM}$ | -60 | A |
| Maximum Continuous Body Diode Forward Current (Note 7) | | | $I_S$ | -2.2 | A |
| Avalanche Current (Note 8) L = 0.1mH | | | $I_{AS}$ | -35 | A |
| Avalanche Energy (Note 8) L = 0.1mH | | | $E_{AS}$ | 60 | mJ |

## Thermal Characteristics

| Characteristic | | Symbol | Value | Unit |
|---|---|---|---|---|
| Total Power Dissipation (Note 6) | | $P_D$ | 2.0 | W |
| Thermal Resistance, Junction to Ambient (Note 6) | Steady State | $R_{\theta JA}$ | 80 | °C/W |
| Total Power Dissipation (Note 7) | | $P_D$ | 3.2 | W |
| Thermal Resistance, Junction to Ambient (Note 7) | Steady State | $R_{\theta JA}$ | 41 | °C/W |
| Thermal Resistance, Junction to Case | | $R_{\theta JC}$ | 1.6 | |
| Operating and Storage Temperature Range | | $T_J$, $T_{STG}$ | -55 to +175 | °C |

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

| Characteristic | Symbol | Min | Typ | Max | Unit | Test Condition |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS (Note 9)** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | -60 | — | — | V | $V_{GS}$ = 0V, $I_D$ = -250µA |
| Zero Gate Voltage Drain Current , $T_J$ = +25°C | $I_{DSS}$ | — | — | -1 | µA | $V_{DS}$ = -60V, $V_{GS}$ = 0V |
| Gate-Source Leakage | $I_{GSS}$ | — | — | ±100 | nA | $V_{GS}$ = ±20V, $V_{DS}$ = 0V |
| **ON CHARACTERISTICS (Note 9)** | | | | | | |
| Gate Threshold Voltage | $V_{GS(TH)}$ | -1.0 | — | -3.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = -250µA |
| Static Drain-Source On-Resistance | $R_{DS(ON)}$ | — | — | 33 | mΩ | $V_{GS}$ = -10V, $I_D$ = -10A |
| | | — | — | 40 | | $V_{GS}$ = -4.5V, $I_D$ = -8A |
| Diode Forward Voltage | $V_{SD}$ | — | -0.7 | -1.2 | V | $V_{GS}$ = 0V, $I_S$ = -1A |
| **DYNAMIC CHARACTERISTICS (Note 10)** | | | | | | |
| Input Capacitance | $C_{iss}$ | — | 2,569 | — | pF | $V_{DS}$ = -30V, $V_{GS}$ = 0V, f = 1.0MHz |
| Output Capacitance | $C_{oss}$ | — | 179 | — | pF | |
| Reverse Transfer Capacitance | $C_{rss}$ | — | 143 | — | pF | |
| Gate Resistance | $R_g$ | — | 5 | — | Ω | $V_{DS}$ = 0V, $V_{GS}$ = 0V, f = 1MHz |
| Total Gate Charge ($V_{GS}$ = -4.5V) | $Q_g$ | — | 26.5 | — | nC | $V_{DS}$ = -30V, $I_D$ = -5A |
| Total Gate Charge ($V_{GS}$ = -10V) | $Q_g$ | — | 53.1 | — | nC | |
| Gate-Source Charge | $Q_{gs}$ | — | 7.1 | — | nC | |
| Gate-Drain Charge | $Q_{gd}$ | — | 12.6 | — | nC | |
| Turn-On Delay Time | $t_{D(ON)}$ | — | 6 | — | ns | $V_{GS}$ = -10V, $V_{DS}$ = -30V, $R_G$ = 3Ω, $I_D$ = -5A |
| Turn-On Rise Time | $t_R$ | — | 7.1 | — | ns | |
| Turn-Off Delay Time | $t_{D(OFF)}$ | — | 110 | — | ns | |
| Turn-Off Fall Time | $t_F$ | — | 62 | — | ns | |
| Body Diode Reverse Recovery Time | $t_{RR}$ | — | 20 | — | ns | $I_F$ = -5A, di/dt = 100A/µs |
| Body Diode Reverse Recovery Charge | $Q_{RR}$ | — | 14 | — | nC | |

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

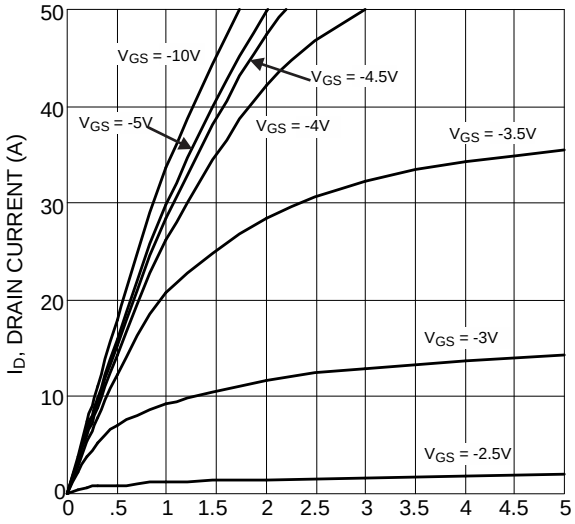


Figure 1 Typical Output Characteristic

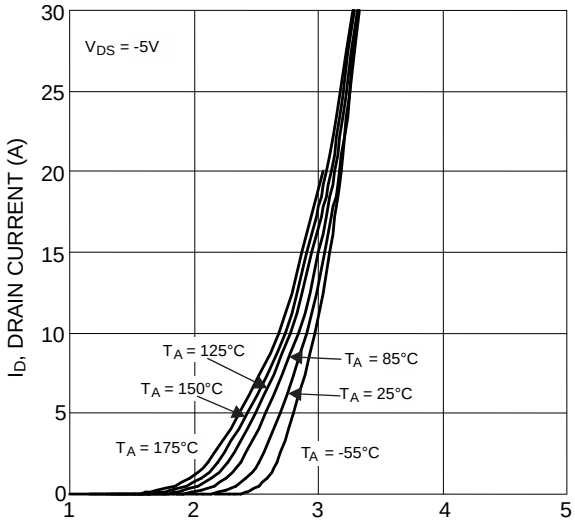


Figure 2 Typical Transfer Characteristics

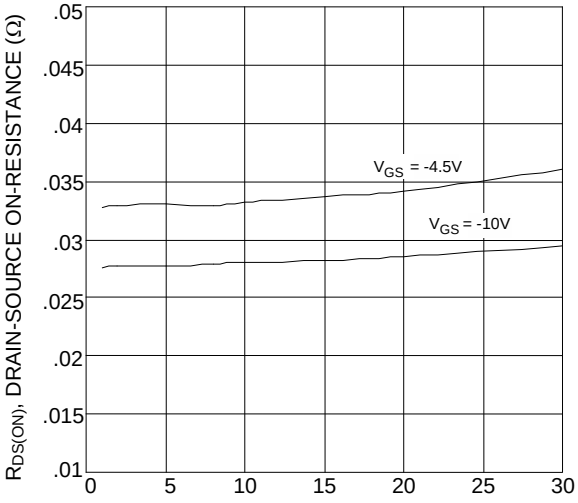


Figure 3 Typical On-Resistance vs. Drain Current and Gate Voltage

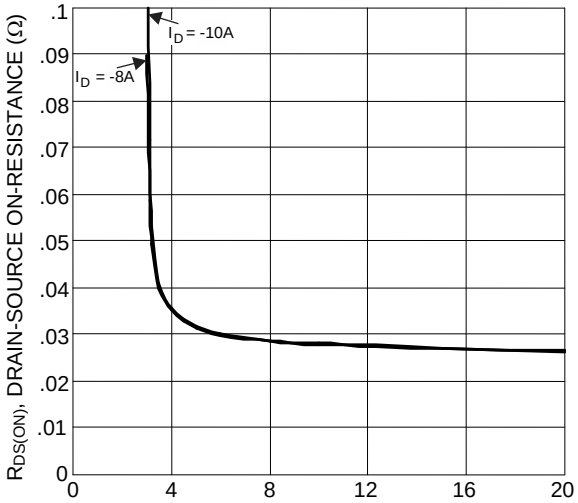


Figure 4 Typical Drain-Source On-Resistance vs. Gate-Source Voltage

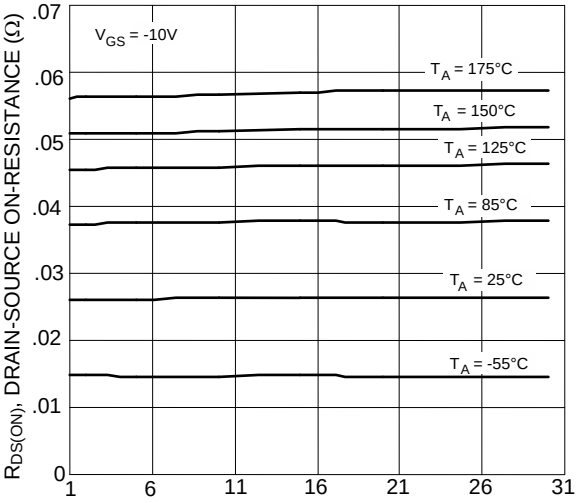


Figure 5 Typical On-Resistance vs. Drain Current and Temperature

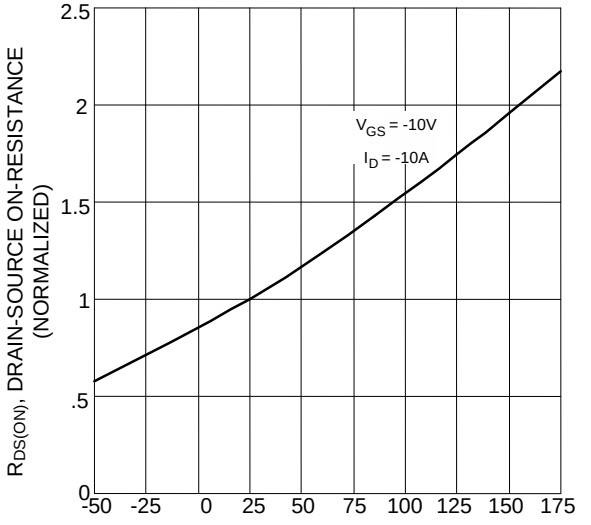


Figure 6 On-Resistance Variation with Temperature

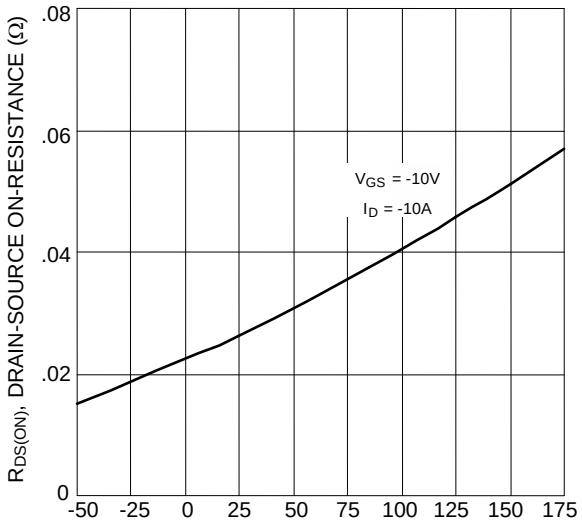



Figure 7 On-Resistance Variation with Temperature

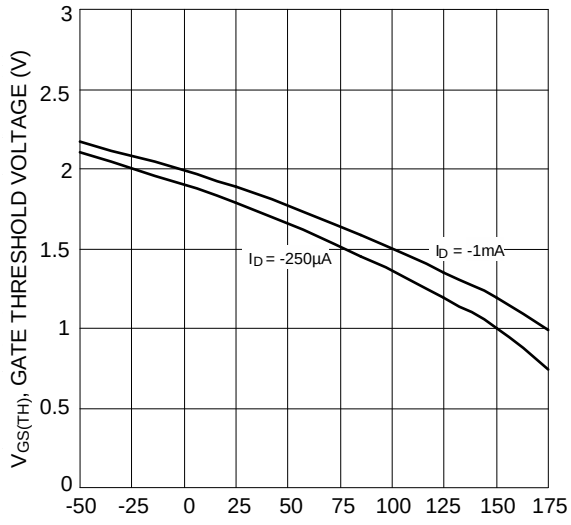



Figure 8 Gate Threshold Variation vs. Junction Temperature

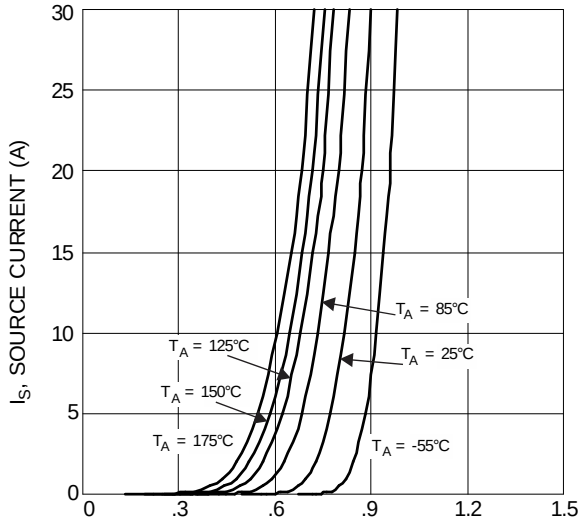



Figure 9 Diode Forward Voltage vs. Current

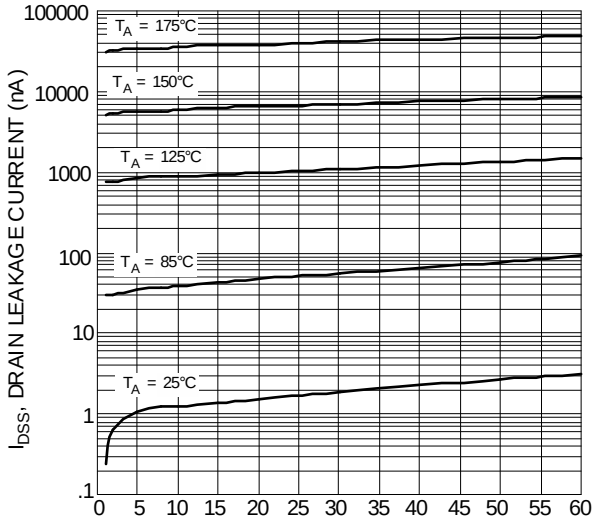



Figure 10 Typical Drain-Source Leakage Current vs. Voltage

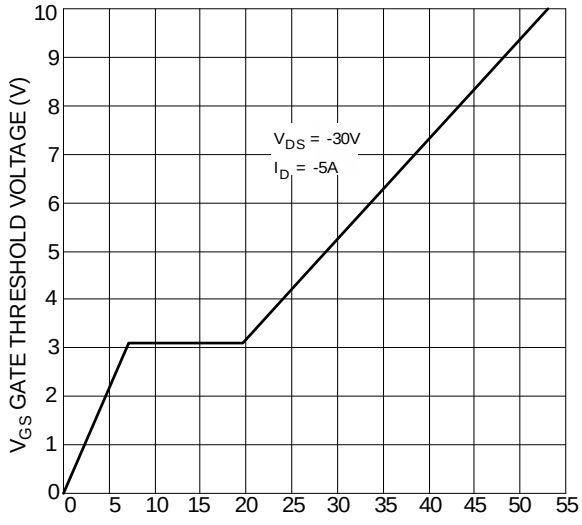



Figure 11 Gate Charge

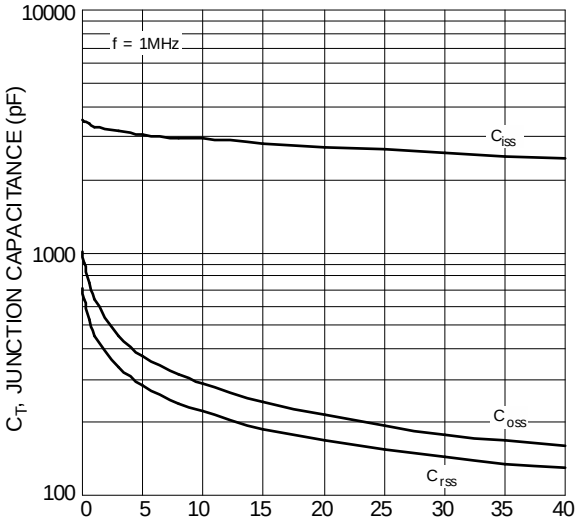



Figure 12 Typical Junction Capacitance

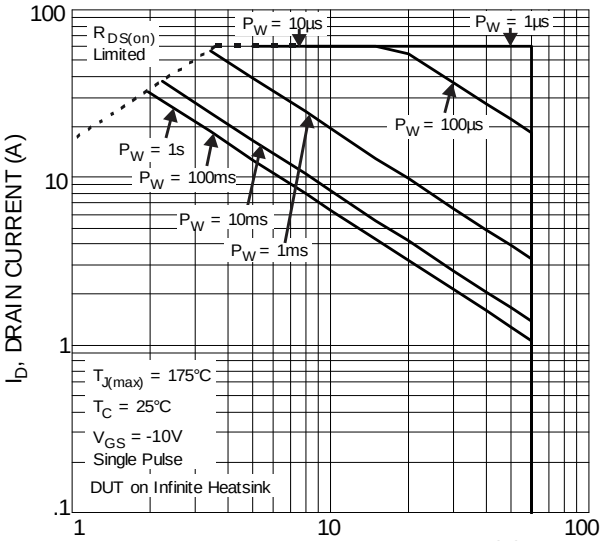



Figure 13 SOA, Safe Operation Area

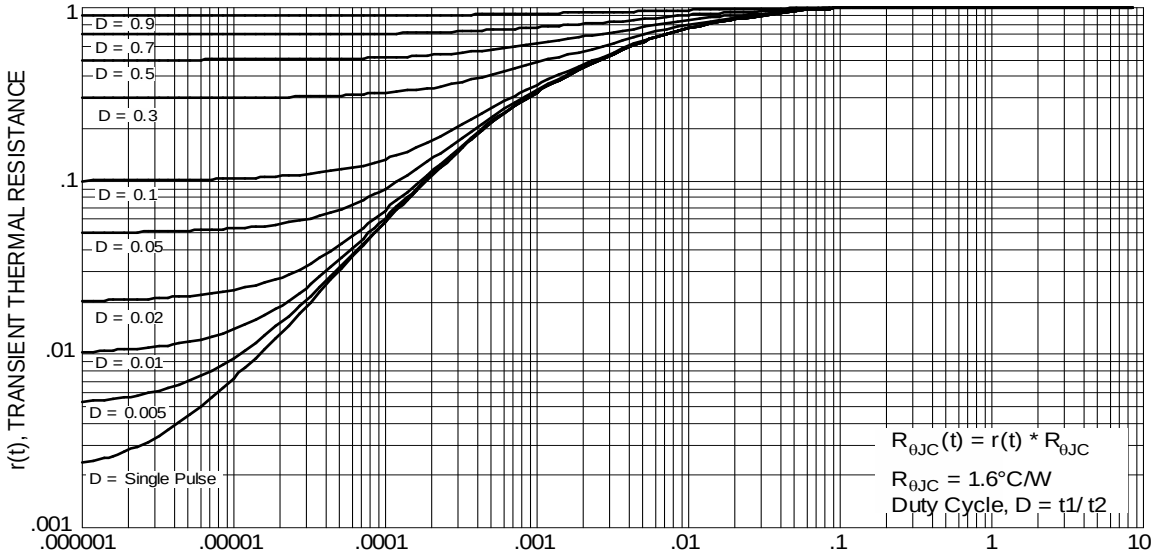
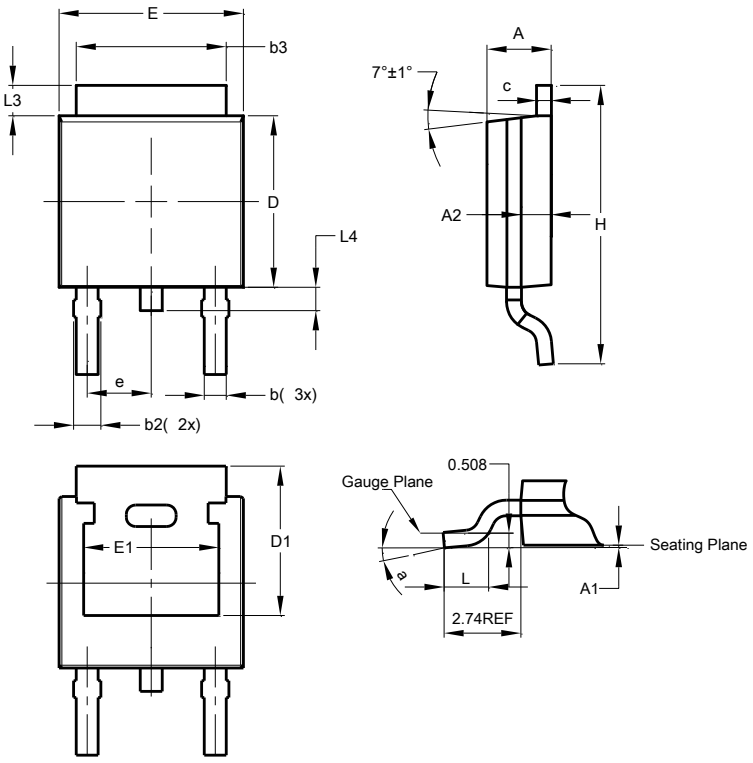



Figure 14 Transient Thermal Resistance

## Package Outline Dimensions

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

**TO252 (DPAK)**

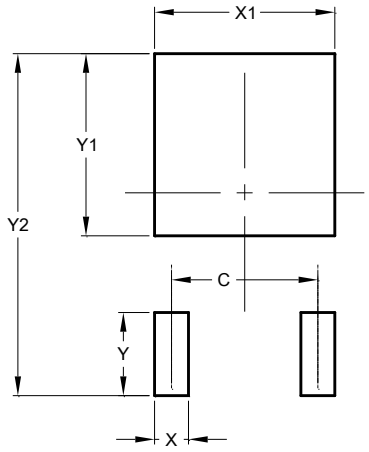



| TO252 (DPAK) | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | 2.19 | 2.39 | 2.29 |
| **A1** | 0.00 | 0.13 | 0.08 |
| **A2** | 0.97 | 1.17 | 1.07 |
| **b** | 0.64 | 0.88 | 0.783 |
| **b2** | 0.76 | 1.14 | 0.95 |
| **b3** | 5.21 | 5.46 | 5.33 |
| **c** | 0.45 | 0.58 | 0.531 |
| **D** | 6.00 | 6.20 | 6.10 |
| **D1** | 5.21 | - | - |
| **e** | - | - | 2.286 |
| **E** | 6.45 | 6.70 | 6.58 |
| **E1** | 4.32 | - | - |
| **H** | 9.40 | 10.41 | 9.91 |
| **L** | 1.40 | 1.78 | 1.59 |
| **L3** | 0.88 | 1.27 | 1.08 |
| **L4** | 0.64 | 1.02 | 0.83 |
| **a** | 0° | 10° | - |
| **All Dimensions in mm** | | | |

## Suggested Pad Layout

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

**TO252 (DPAK)**




| Dimensions | Value (in mm) |
|---|---|
| **C** | 4.572 |
| **X** | 1.060 |
| **X1** | 5.632 |
| **Y** | 2.600 |
| **Y1** | 5.700 |
| **Y2** | 10.700 |

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