## Product Summary

| Device | $BV_{DSS}$ | $R_{DS(ON)}$ Max | $I_D$ $T_A$ = +25°C |
|---|---|---|---|
| Q1 N-Channel | 60V | 40mΩ @ $V_{GS}$ = 10V | 6.5A |
| | | 55mΩ @ $V_{GS}$ = 4.5V | 5.6A |
| Q2 P-Channel | -60V | 110mΩ @ $V_{GS}$ = -10V | -3.9A |
| | | 130mΩ @ $V_{GS}$ = -4.5V | -3.6A |

## Features and Benefits

- Low Input Capacitance
- Low On-Resistance
- Fast Switching Speed
- **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**
- **PPAP Capable (Note 4)**

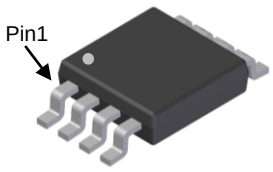
## Description and Applications

This MOSFET is 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:

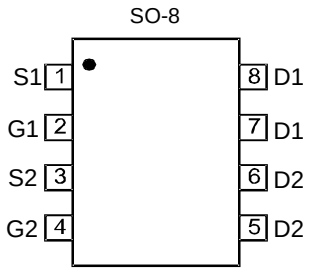
- DC-DC Converters
- Power Management Functions
- Backlighting

## Mechanical Data

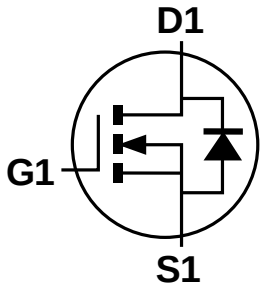
- Case: SO-8
- Case Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminal Connections: See Diagram
- Terminals: Finish – Tin Finish Annealed over Copper Leadframe. Solderable per MIL-STD-202, Method 208 e3
- Weight: 0.074 grams (Approximate)



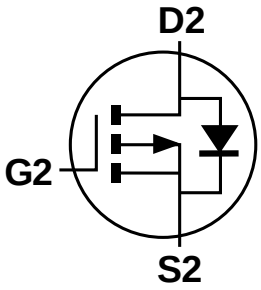

Top View




Top View
Pin Configuration




Q1 N-Channel MOSFET



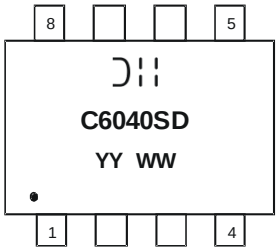

Q2 P-Channel MOSFET

## Ordering Information (Note 5)

| Part Number | Case | Packaging |
|---|---|---|
| DMC6040SSDQ-13 | SO-8 | 2,500/Tape & Reel |

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. 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
C6040SD = Product Type Marking Code
YYWW = Date Code Marking
YY or YY = Year (ex: 16 = 2016)
WW = Week (01 - 53)

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

| Characteristic | | | Symbol | Q1 | Q2 | Units |
|---|---|---|---|---|---|---|
| Drain-Source Voltage | | | $V_{DSS}$ | 60 | -60 | V |
| Gate-Source Voltage | | | $V_{GSS}$ | ±20 | ±20 | V |
| Continuous Drain Current (Note 7) $V_{GS}$ = -10V | Steady State | $T_A$ = +25°C<br>$T_A$ = +70°C | $I_D$ | 5.1<br>4.1 | -3.1<br>-2.5 | A |
| | t<10s | $T_A$ = +25°C<br>$T_A$ = +70°C | $I_D$ | 6.5<br>5.2 | -3.9<br>-3.1 | A |
| Maximum Body Diode Forward Current (Note 7) | | | $I_S$ | 2.1 | -2.1 | A |
| Pulsed Drain Current (10µs Pulse, Duty Cycle = 1%) | | | $I_{DM}$ | 28 | -19 | A |
| Avalanche Current (Note 8) L = 0.1mH | | | $I_{AS}$ | 17.2 | -17.6 | A |
| Avalanche Energy (Note 8) L = 0.1mH | | | $E_{AS}$ | 14.7 | 15.4 | mJ |

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

| Characteristic | | Symbol | Value | Units |
|---|---|---|---|---|
| Total Power Dissipation (Note 6) | $T_A$ = +25°C | $P_D$ | 1.24 | W |
| | $T_A$ = +70°C | | 0.8 | |
| Thermal Resistance, Junction to Ambient (Note 6) | Steady State | $R_{\theta JA}$ | 101 | °C/W |
| | t < 10s | | 61 | |
| Total Power Dissipation (Note 7) | $T_A$ = +25°C | $P_D$ | 1.56 | W |
| | $T_A$ = +70°C | | 1.0 | |
| Thermal Resistance, Junction to Ambient (Note 7) | Steady State | $R_{\theta JA}$ | 80 | °C/W |
| | t<10s | | 49 | |
| Thermal Resistance, Junction to Case (Note 7) | | $R_{\theta JC}$ | 14.7 | |
| Operating and Storage Temperature Range | | $T_J$, $T_{STG}$ | -55 to +150 | °C |

## Electrical Characteristics – N-Channel Q1 (@$T_A$ = +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 | $I_{DSS}$ | — | — | 1 | µA | $V_{DS}$ = 48V, $V_{GS}$ = 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 | — | 3 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 250µA |
| Static Drain-Source On-Resistance | $R_{DS(ON)}$ | — | 33 | 40 | mΩ | $V_{GS}$ = 10V, $I_D$ = 8A |
| | | — | 37 | 55 | | $V_{GS}$ = 4.5V, $I_D$ = 5A |
| Diode Forward Voltage | $V_{SD}$ | — | 0.7 | 1.2 | V | $V_{GS}$ = 0V, $I_S$ = 1A |
| **DYNAMIC CHARACTERISTICS** (Note 10) | | | | | | |
| Input Capacitance | $C_{ISS}$ | — | 1,130 | — | pF | $V_{DS}$ = 15V, $V_{GS}$ = 0V f = 1.0MHz |
| Output Capacitance | $C_{OSS}$ | — | 69 | — | | |
| Reverse Transfer Capacitance | $C_{RSS}$ | — | 42 | — | | |
| Gate Resistance | $R_G$ | — | 1.7 | — | Ω | $V_{DS}$ = 0V, $V_{GS}$ = 0V, f = 1.0MHz |
| Total Gate Charge ($V_{GS}$ = 10V) | $Q_G$ | — | 20.8 | — | nC | $V_{DS}$ = 30V, $I_D$ = 4.3A |
| Total Gate Charge ($V_{GS}$ = 4.5V) | $Q_G$ | — | 9.4 | — | | |
| Gate-Source Charge | $Q_{GS}$ | — | 3.3 | — | | |
| Gate-Drain Charge | $Q_{GD}$ | — | 3.0 | — | | |
| Turn-On Delay Time | $t_{D(ON)}$ | — | 3.6 | — | ns | $V_{GS}$ = 10V, $V_{DD}$ = 30V, $R_G$ = 6Ω, $I_D$ = 4.3A |
| Turn-On Rise Time | $t_R$ | — | 1.8 | — | | |
| Turn-Off Delay Time | $t_{D(OFF)}$ | — | 20.1 | — | | |
| Turn-Off Fall Time | $t_F$ | — | 4.3 | — | | |
| Body Diode Reverse Recovery Time | $t_{RR}$ | — | 14.2 | — | ns | $I_S$ = 4.3A, dI/dt = 100A/µs |
| Body Diode Reverse Recovery Charge | $Q_{RR}$ | — | 7.5 | — | nC | $I_S$ = 4.3A, dI/dt = 100A/µs |

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 1inch square copper plate.
8. UIS in production with L = 0.1mH, starting $T_A$ = +25°C.
9. Short duration pulse test used to minimize self-heating effect.
10. Guaranteed by design. Not subject to product testing.

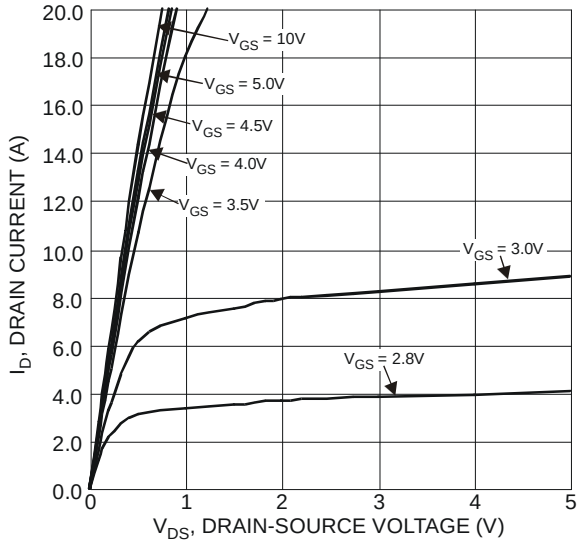



Figure 1 Typical Output Characteristics

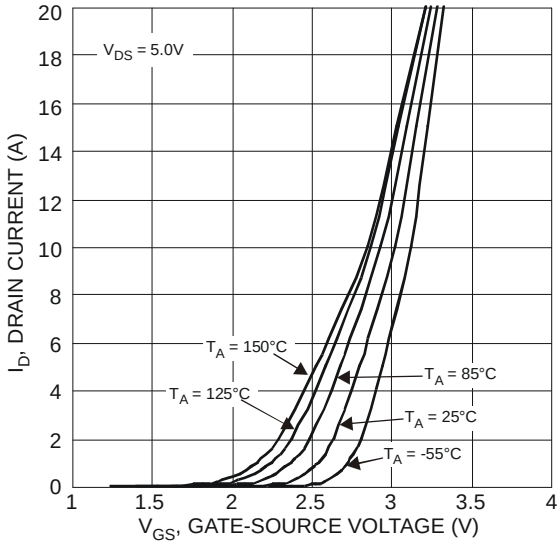



Figure 2 Typical Transfer Characteristics

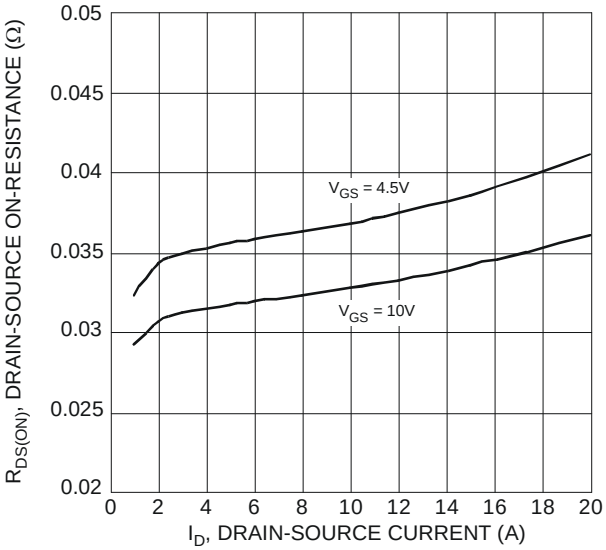



Figure 3 Typical On-Resistance vs. Drain Current and Gate Voltage

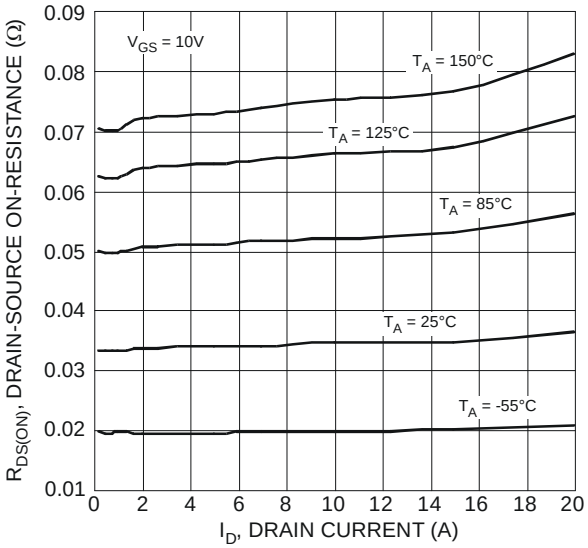



Figure 4 Typical On-Resistance vs. Drain Current and Temperature

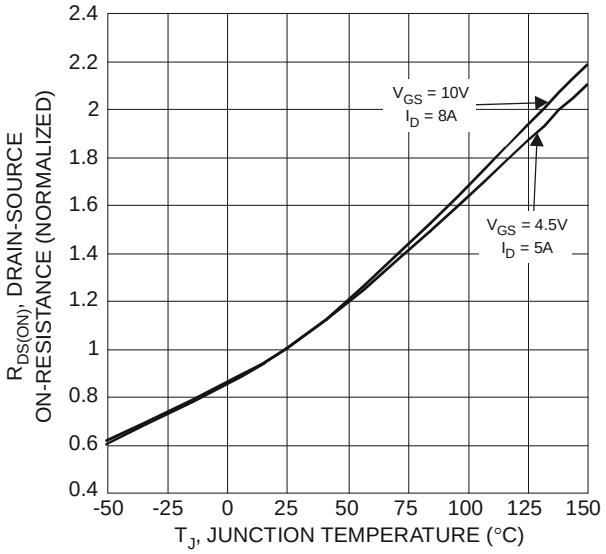



Figure 5 On-Resistance Variation with Temperature

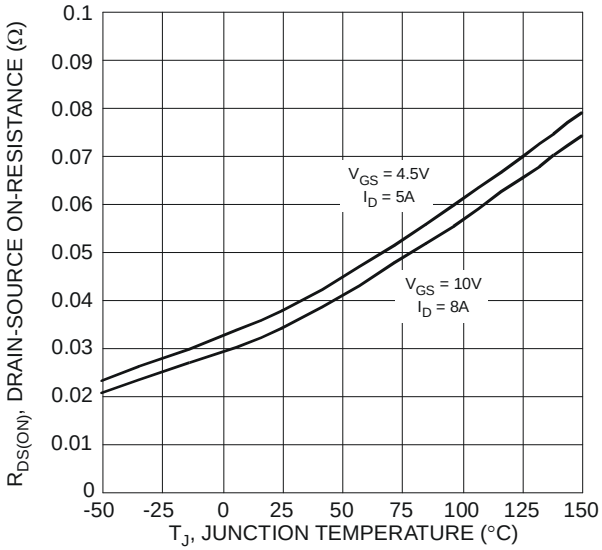



Figure 6 On-Resistance Variation with Temperature

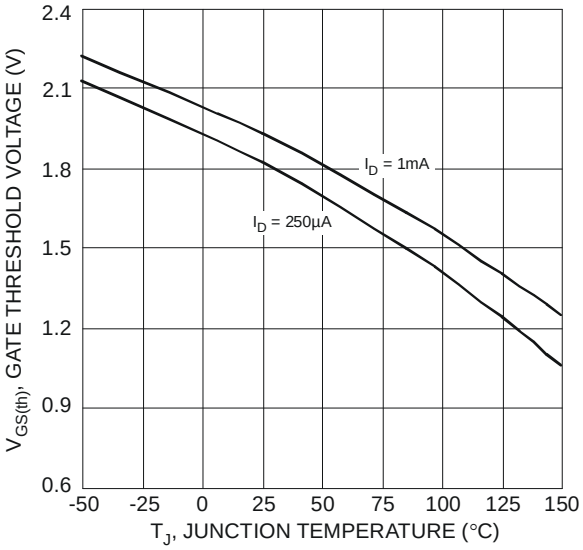



Figure 7 Gate Threshold Variation vs. Ambient Temperature

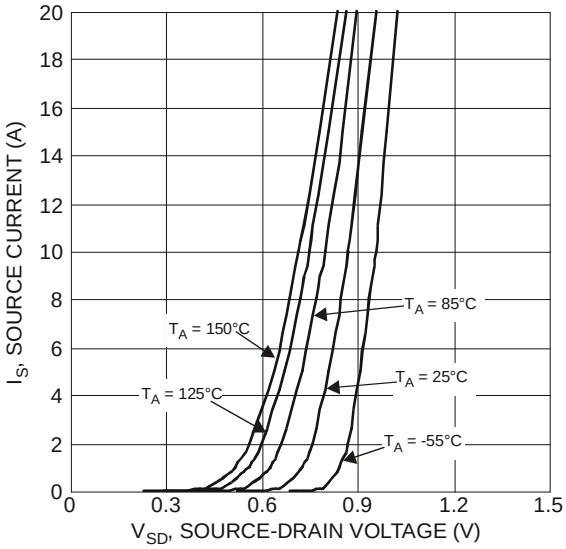



Figure 8 Diode Forward Voltage vs. Current

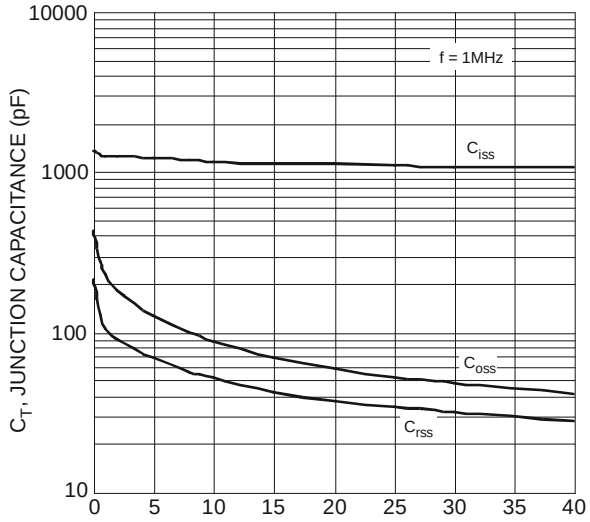



Figure 9 Typical Junction Capacitance

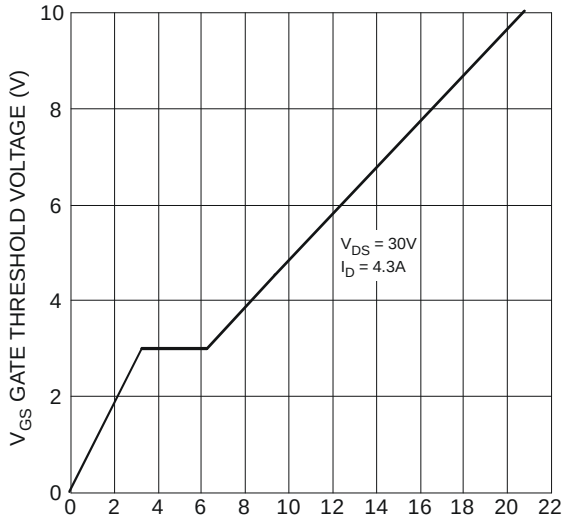



Figure 10 Gate Charge

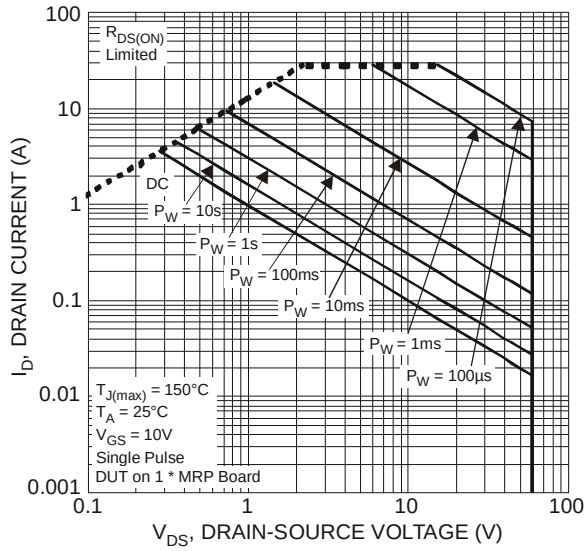



Figure 11 SOA, Safe Operation Area

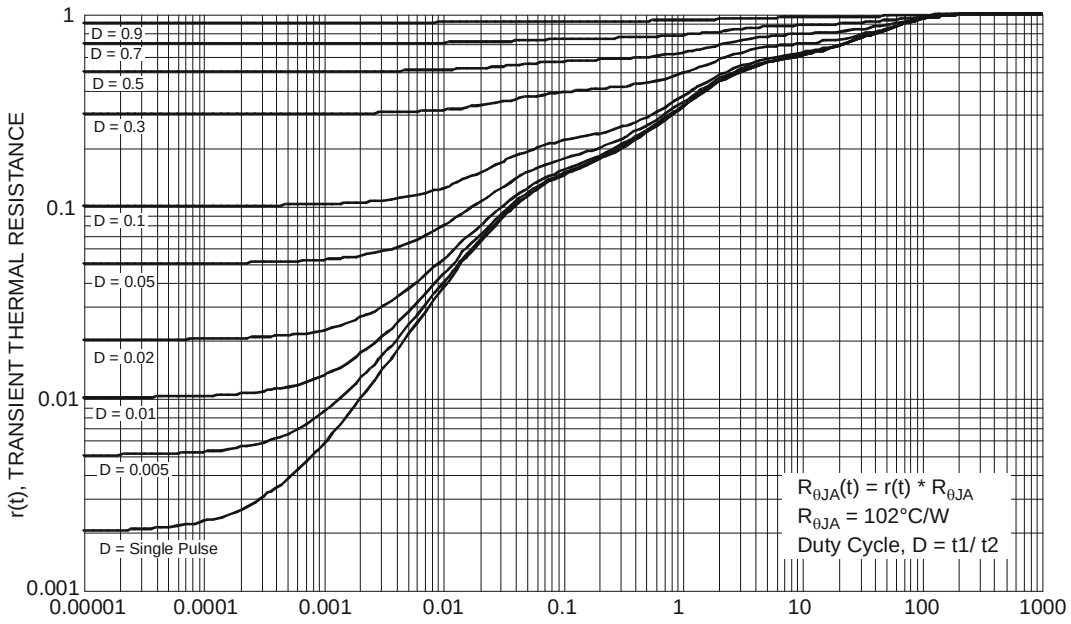


Figure 12 Transient Thermal Resistance

## Electrical Characteristics – P-Channel Q2 (@$T_A$ = +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 | $I_{DSS}$ | — | — | -1 | µA | $V_{DS}$ = -48V, $V_{GS}$ = 0V |
| Gate-Source Leakage | $I_{GSS}$ | — | — | 100 | nA | $V_{GS}$ = ±16V, $V_{DS}$ = 0V |
| **ON CHARACTERISTICS** (Note 9) | | | | | | |
| Gate Threshold Voltage | $V_{GS(TH)}$ | -1 | — | -3 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = -250µA |
| Static Drain-Source On-Resistance | $R_{DS(ON)}$ | — | 91 | 110 | mΩ | $V_{GS}$ = -10V, $I_D$ = -4.5A |
| | | — | 110 | 130 | | $V_{GS}$ = -4.5V, $I_D$ =-3.5A |
| Diode Forward Voltage | $V_{SD}$ | — | -0.7 | -1.2 | V | $V_{GS}$ = 0V, $I_S$ = -1A |
| **DYNAMIC CHARACTERISTICS** (Note 10) | | | | | | |
| Input Capacitance | $C_{ISS}$ | — | 1,030 | — | pF | $V_{DS}$ = -30V, $V_{GS}$ = 0V, f = 1.0MHz |
| Output Capacitance | $C_{OSS}$ | — | 49.1 | — | | |
| Reverse Transfer Capacitance | $C_{RSS}$ | — | 38.7 | — | | |
| Gate Resistance | $R_G$ | — | 13.6 | — | Ω | $V_{DS}$ = 0V, $V_{GS}$ = 0V, f = 1.0MHz |
| Total Gate Charge ($V_{GS}$ = -4.5V) | $Q_G$ | — | 9.5 | — | nC | $V_{DS}$ = -30V, $I_D$ = -5A |
| Total Gate Charge ($V_{GS}$ = -10V) | $Q_G$ | — | 19.4 | — | | |
| Gate-Source Charge | $Q_{GS}$ | — | 2.3 | — | | |
| Gate-Drain Charge | $Q_{GD}$ | — | 3.6 | — | | |
| Turn-On Delay Time | $t_{D(ON)}$ | — | 3.7 | — | ns | $V_{GS}$ = -10V, $V_{DS}$ = -30V, $R_{GEN}$ = 6Ω, $I_D$ = -5A |
| Turn-On Rise Time | $t_R$ | — | 6.3 | — | | |
| Turn-Off Delay Time | $t_{D(OFF)}$ | — | 58.7 | — | | |
| Turn-Off Fall Time | $t_F$ | — | 26.1 | — | | |
| Body Diode Reverse Recovery Time | $t_{RR}$ | — | 14.85 | — | ns | $I_S$ = -5A, dI/dt = 100A/µs |
| Body Diode Reverse Recovery Charge | $Q_{RR}$ | — | 8.8 | — | nC | $I_S$ = -5A, dI/dt = 100A/µs |

Notes: 9. Short duration pulse test used to minimize self-heating effect.
10. Guaranteed by design. Not subject to product testing.

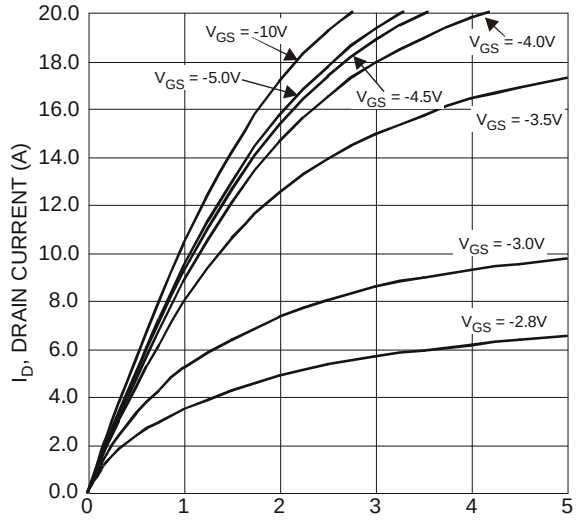



Figure 13 Typical Output Characteristics

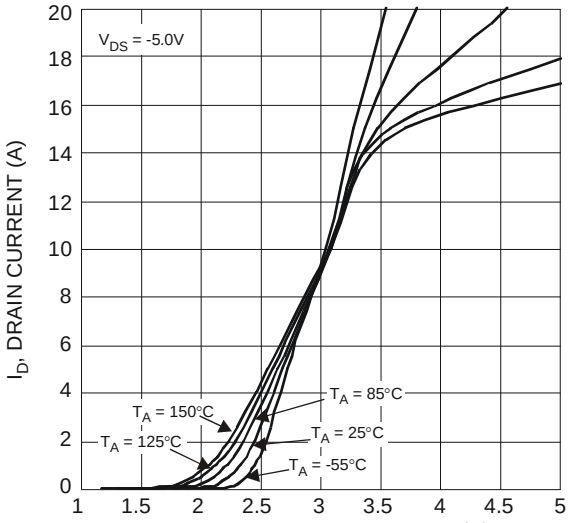



Figure 14 Typical Transfer Characteristics

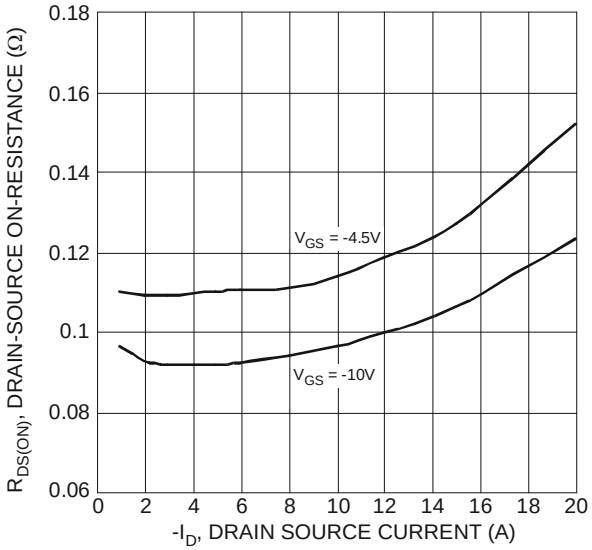



Figure 15 Typical On-Resistance vs. Drain Current and Gate Voltage

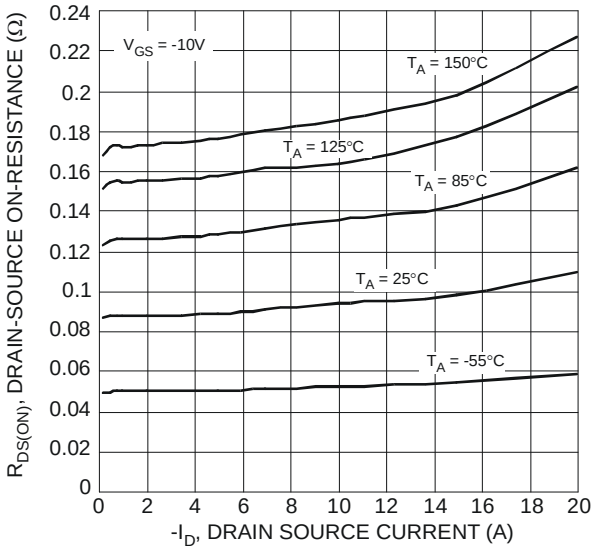



Figure 16 Typical On-Resistance vs. Drain Current and Temperature

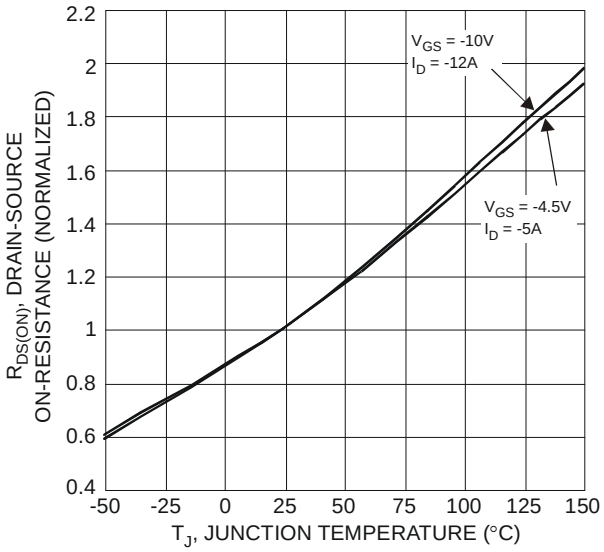



Fig. 17 On-Resistance Variation with Temperature

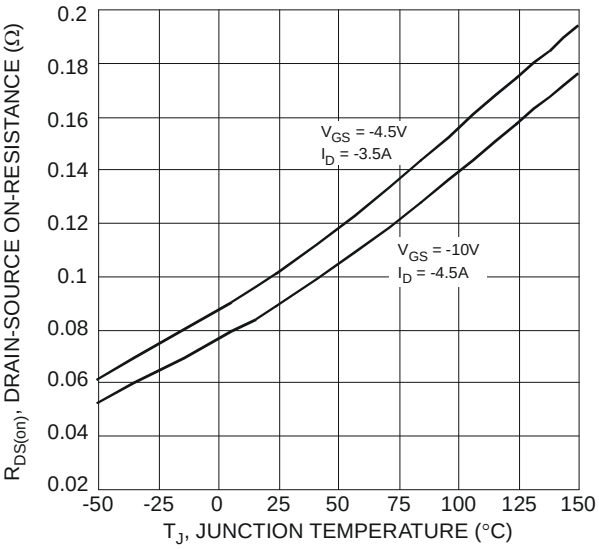



Figure 18 On-Resistance Variation with Temperature

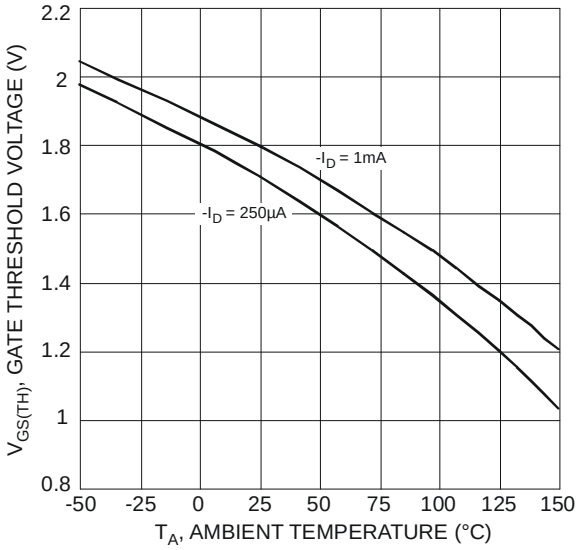



Figure 19 Gate Threshold Variation vs. Ambient Temperature

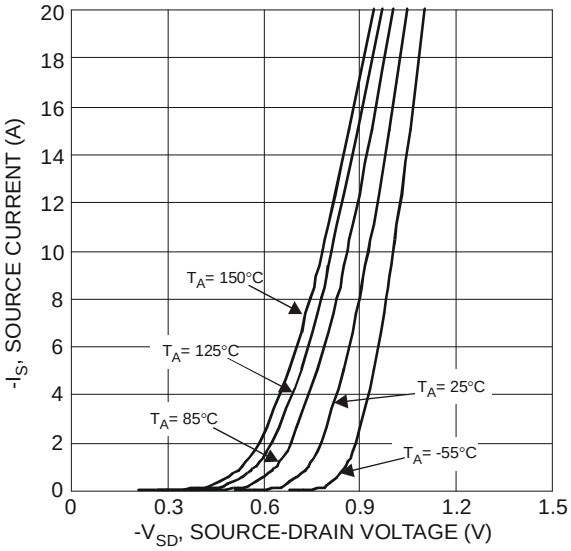



Figure 20 Diode Forward Voltage vs. Current

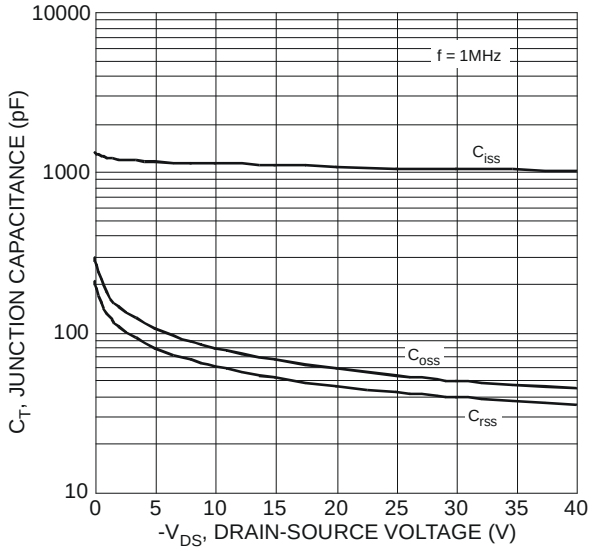



Figure 21 Typical Junction Capacitance

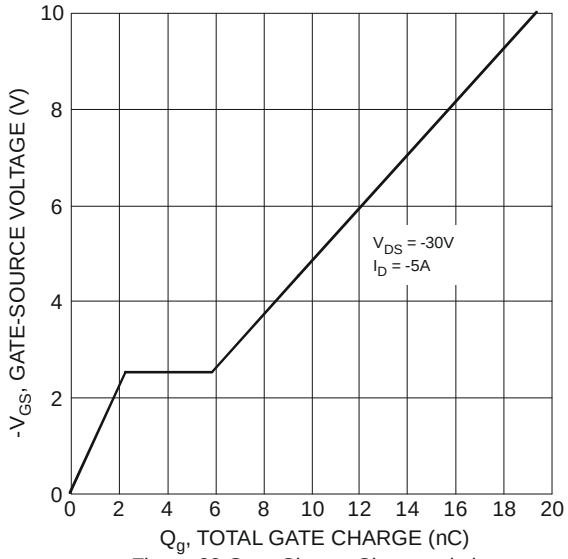



Figure 22 Gate-Charge Characteristics

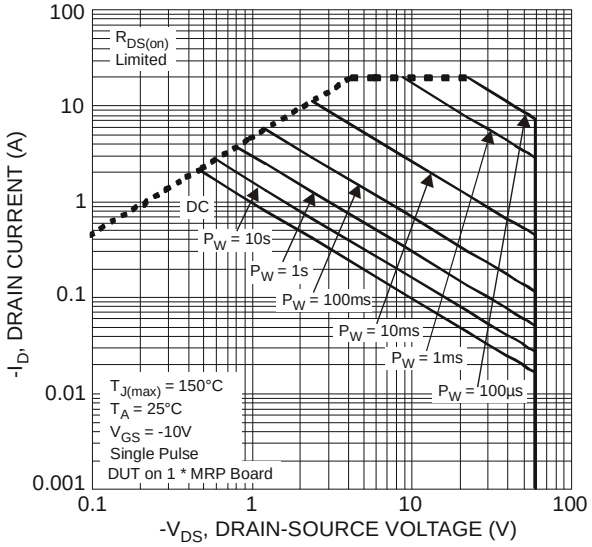
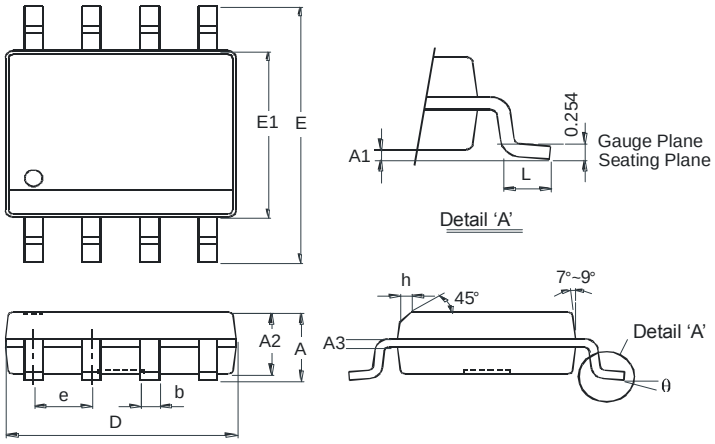



Figure 23 SOA, Safe Operation Area

## Package Outline Dimensions

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

**SO-8**

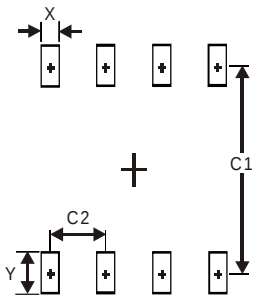



| SO-8 | | |
|---|---|---|
| **Dim** | **Min** | **Max** |
| **A** | – | 1.75 |
| **A1** | 0.10 | 0.20 |
| **A2** | 1.30 | 1.50 |
| **A3** | 0.15 | 0.25 |
| **b** | 0.3 | 0.5 |
| **D** | 4.85 | 4.95 |
| **E** | 5.90 | 6.10 |
| **E1** | 3.85 | 3.95 |
| **e** | 1.27 Typ | |
| **h** | – | 0.35 |
| **L** | 0.62 | 0.82 |
| **θ** | 0° | 8° |
| **All Dimensions in mm** | | |

## Suggested Pad Layout

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

**SO-8**




| Dimensions | Value (in mm) |
|---|---|
| **X** | 0.60 |
| **Y** | 1.55 |
| **C1** | 5.4 |
| **C2** | 1.27 |

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