Lead-free Green

NEW PRODUCT

# COMPLEMENTARY PAIR ENHANCEMENT MODE MOSFET

## Product Summary

| Device | $V_{(BR)DSS}$ | $R_{DS(ON)}$ max | $I_D$ max $T_A$ = +25°C |
|---|---|---|---|
| Q1 | 30V | 1.5Ω @ $V_{GS}$ = 4.5V | 0.22A |
| | | 2.0Ω @ $V_{GS}$ = 2.5V | |
| | | 3.0Ω @ $V_{GS}$ = 1.8V | |
| | | 4.5Ω @ $V_{GS}$ = 1.5V | |
| Q2 | -30V | 5Ω @ $V_{GS}$ = -4.5V | -0.2A |
| | | 6Ω @ $V_{GS}$ = -2.5V | |
| | | 7Ω @ $V_{GS}$ = -1.8V | |
| | | 10Ω @ $V_{GS}$ = -1.5V | |

## Features and Benefits

- Low On-Resistance
- Very low Gate Threshold Voltage, 1.0V max
- Low Input Capacitance
- Fast Switching Speed
- Ultra-Small Surface Mount Package 1mm x 1mm
- 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**

## Description

This 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.

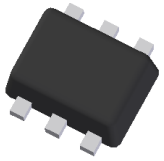
## Mechanical Data

- Case: SOT963
- Case Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminal Connections Indicator: See Diagram
- Terminals: Finish — Matte Tin Annealed over Copper Leadframe Solderable per MIL-STD-202, Method 208 e3
- Weight: 0.027 grams (approximate)

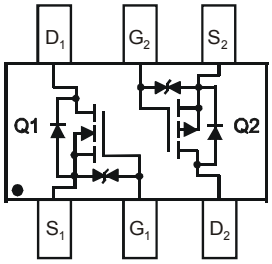
## Applications

- General Purpose Interfacing Switch
- Power Management Functions
- Analog Switch


SOT963



Top View



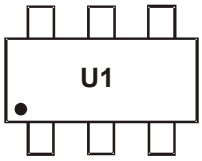

Top View
Schematic and
Transistor Diagram

## Ordering Information (Note 4)

| Part Number | Case | Packaging |
|---|---|---|
| DMC31D5UDJ-7 | SOT963 | 10K/Tape & Reel |
| DMC31D5UDJ-7B | SOT963 | 10K/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. For packaging details, go to our website at http://www.diodes.com/products/packages.html. The options -7 and -7B stand for different taping orientations.

## Marking Information




U1 = Product Type Marking Code

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## Maximum Ratings Q1 N-CHANNEL (@$T_A$ = +25°C, unless otherwise specified.)

| Characteristic | | | Symbol | Value | Units |
|---|---|---|---|---|---|
| Drain-Source Voltage | | | $V_{DSS}$ | 30 | V |
| Gate-Source Voltage | | | $V_{GSS}$ | ±12 | V |
| Continuous Drain Current (Note 5) $V_{GS}$ = 4.5V | Steady State | $T_A$ = +25°C<br>$T_A$ = +70°C | $I_D$ | 220<br>160 | mA |
| Maximum Continuous Body Diode Forward Current (Note 6) | | | $I_S$ | 200 | mA |
| Pulsed Drain Current (Note 6) | | | $I_{DM}$ | 600 | mA |

## Maximum Ratings Q2 P-CHANNEL (@$T_A$ = +25°C, unless otherwise specified.)

| Characteristic | | | Symbol | Value | Units |
|---|---|---|---|---|---|
| Drain-Source Voltage | | | $V_{DSS}$ | -30 | V |
| Gate-Source Voltage | | | $V_{GSS}$ | ±12 | V |
| Continuous Drain Current (Note 5) $V_{GS}$ = -4.5V | Steady State | $T_A$ = +25°C<br>$T_A$ = +70°C | $I_D$ | -200<br>-140 | mA |
| Maximum Continuous Body Diode Forward Current (Note 6) | | | $I_S$ | -200 | mA |
| Pulsed Drain Current (Note 6) | | | $I_{DM}$ | -600 | mA |

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

| Characteristic | | Symbol | Value | Units |
|---|---|---|---|---|
| Total Power Dissipation (Note 5) | | $P_D$ | 350 | mW |
| Thermal Resistance, Junction to Ambient (Note 5) | Steady State | $R_{\theta JA}$ | 361 | °C/W |
| Operating and Storage Temperature Range | | $T_J$, $T_{STG}$ | -55 to +150 | °C |

## Electrical Characteristics Q1 N-CHANNEL (@$T_A$ = +25°C, unless otherwise specified.)

| Characteristic | Symbol | Min | Typ | Max | Unit | Test Condition |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS (Note 7)** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | 30 | — | — | V | $V_{GS}$ = 0V, $I_D$ = 250μA |
| Zero Gate Voltage Drain Current @$T_C$ = +25°C | $I_{DSS}$ | — | — | 100 | nA | $V_{DS}$ = 24V, $V_{GS}$ = 0V |
| Gate-Source Leakage | $I_{GSS}$ | — | — | ±10 | μA | $V_{GS}$ = ±10V, $V_{DS}$ = 0V |
| **ON CHARACTERISTICS (Note 7)** | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | 0.4 | — | 1.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA |
| Static Drain-Source On-Resistance | $R_{DS(ON)}$ | — | 0.9 | 1.5 | Ω | $V_{GS}$ = 4.5V, $I_D$ = 100mA |
| | | — | 1.0 | 2.0 | | $V_{GS}$ = 2.5V, $I_D$ = 50mA |
| | | — | 1.2 | 3.0 | | $V_{GS}$ = 1.8V, $I_D$ = 20mA |
| | | — | 1.4 | 4.5 | | $V_{GS}$ = 1.5V, $I_D$ = 10mA |
| | | — | 2.3 | — | | $V_{GS}$ = 1.2V, $I_D$ = 1mA |
| Diode Forward Voltage | $V_{SD}$ | — | 0.6 | 1.0 | V | $V_{GS}$ = 0V, $I_S$ = 10mA |
| **DYNAMIC CHARACTERISTICS (Note 8)** | | | | | | |
| Input Capacitance | $C_{iss}$ | — | 22.6 | — | pF | $V_{DS}$ = 15V, $V_{GS}$ = 0V, f = 1.0MHz |
| Output Capacitance | $C_{oss}$ | — | 2.68 | — | pF | |
| Reverse Transfer Capacitance | $C_{rss}$ | — | 1.8 | — | pF | |
| Total Gate Charge | $Q_g$ | — | 0.38 | — | nC | $V_{GS}$ = 4.5V, $V_{DS}$ = 15V, $I_D$ = 200mA |
| Gate-Source Charge | $Q_{gs}$ | — | 0.05 | — | nC | |
| Gate-Drain Charge | $Q_{gd}$ | — | 0.07 | — | nC | |
| Turn-On Delay Time | $t_{D(on)}$ | — | 3.2 | — | ns | $V_{DD}$ = 15V, $V_{GS}$ = 4.5V, $R_G$ = 2Ω, $I_D$ = 200mA |
| Turn-On Rise Time | $t_r$ | — | 2.2 | — | ns | |
| Turn-Off Delay Time | $t_{D(off)}$ | — | 21 | — | ns | |
| Turn-Off Fall Time | $t_f$ | — | 7.5 | — | ns | |

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## Electrical Characteristics Q2 P-CHANNEL (@$T_A$ = +25°C, unless otherwise specified.)

| Characteristic | Symbol | Min | Typ | Max | Unit | Test Condition |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS (Note 7)** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | -30 | — | — | V | $V_{GS}$ = 0V, $I_D$ = -250µA |
| Zero Gate Voltage Drain Current @$T_C$ = +25°C | $I_{DSS}$ | — | — | 100 | nA | $V_{DS}$ = -24V, $V_{GS}$ = 0V |
| Gate-Source Leakage | $I_{GSS}$ | — | — | ±10 | µA | $V_{GS}$ = ±10V, $V_{DS}$ = 0V |
| **ON CHARACTERISTICS (Note 7)** | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | -0.4 | — | -1.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = -250µA |
| Static Drain-Source On-Resistance | $R_{DS(ON)}$ | — | 2.0 | 5 | Ω | $V_{GS}$ = -4.5V, $I_D$ = -100mA |
| | | — | 2.5 | 6 | | $V_{GS}$ = -2.5V, $I_D$ = -50mA |
| | | — | 3.0 | 7 | | $V_{GS}$ = -1.8V, $I_D$ = -20mA |
| | | — | 3.4 | 10 | | $V_{GS}$ = -1.5V, $I_D$ = -10mA |
| | | — | 5.1 | — | | $V_{GS}$ = -1.2V, $I_D$ = -1mA |
| Diode Forward Voltage | $V_{SD}$ | — | -0.6 | -1.0 | V | $V_{GS}$ = 0V, $I_S$ = -10mA |
| **DYNAMIC CHARACTERISTICS (Note 8)** | | | | | | |
| Input Capacitance | $C_{iss}$ | — | 21.8 | — | pF | $V_{DS}$ = -15V, $V_{GS}$ = 0V, f = 1.0MHz |
| Output Capacitance | $C_{oss}$ | — | 2.82 | — | pF | |
| Reverse Transfer Capacitance | $C_{rss}$ | — | 1.66 | — | pF | |
| Total Gate Charge | $Q_g$ | — | 0.35 | — | nC | $V_{GS}$ = -4.5V, $V_{DS}$ =- 15V, $I_D$ = -200mA |
| Gate-Source Charge | $Q_{gs}$ | — | 0.05 | — | nC | |
| Gate-Drain Charge | $Q_{gd}$ | — | 0.10 | — | nC | |
| Turn-On Delay Time | $t_{D(on)}$ | — | 3.5 | — | ns | $V_{DD}$ = -15V, $V_{GS}$ = -4.5V, $R_G$ = 2Ω, $I_D$ = -200mA |
| Turn-On Rise Time | $t_r$ | — | 5.2 | — | ns | |
| Turn-Off Delay Time | $t_{D(off)}$ | — | 18.8 | — | ns | |
| Turn-Off Fall Time | $t_f$ | — | 8.7 | — | ns | |

Notes:
5. Device mounted on FR-4 PCB, with minimum recommended pad layout.
6. Device mounted on minimum recommended pad layout test board, 10µs pulse duty cycle = 1%.
7. Short duration pulse test used to minimize self-heating effect.
8. Guaranteed by design. Not subject to product testing.

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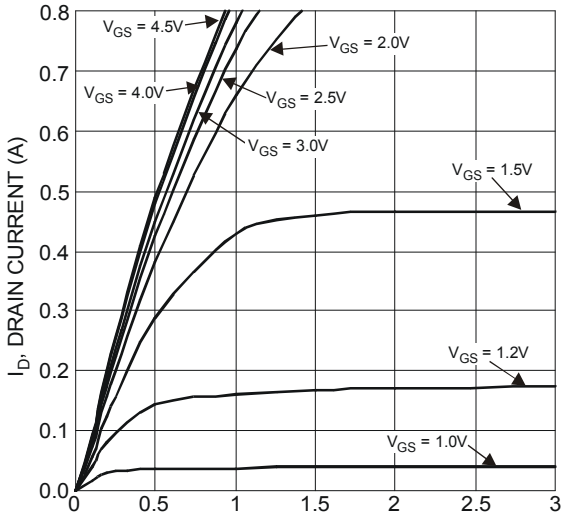


Figure 1 Typical Output Characteristics

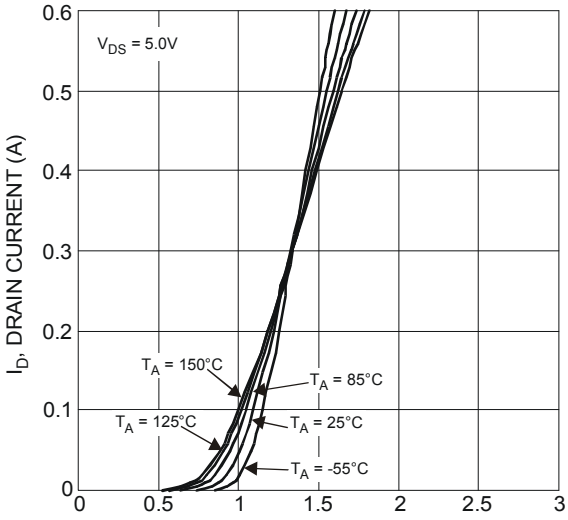


Figure 2 Typical Transfer Characteristics

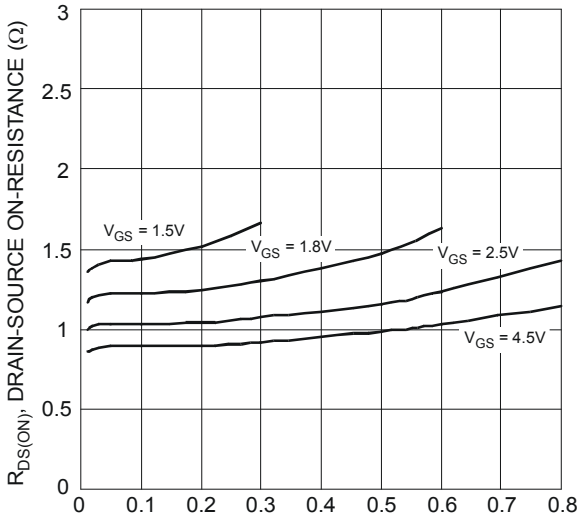


Figure 3 Typical On-Resistance vs. Drain Current and Gate Voltage

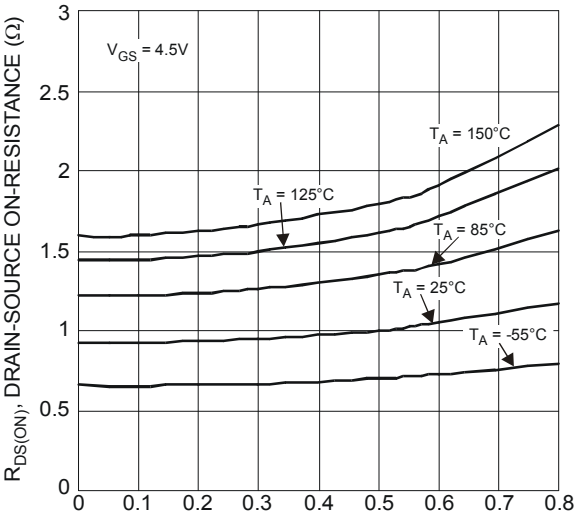


Figure 4 Typical On-Resistance vs. Drain Current and Temperature

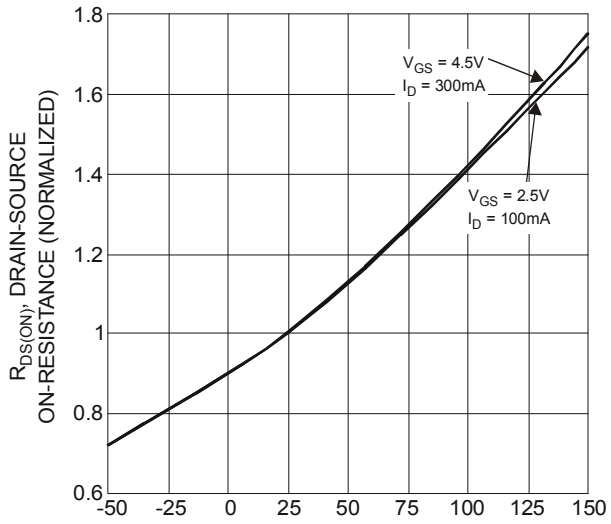


Figure 5 On-Resistance Variation with Temperature

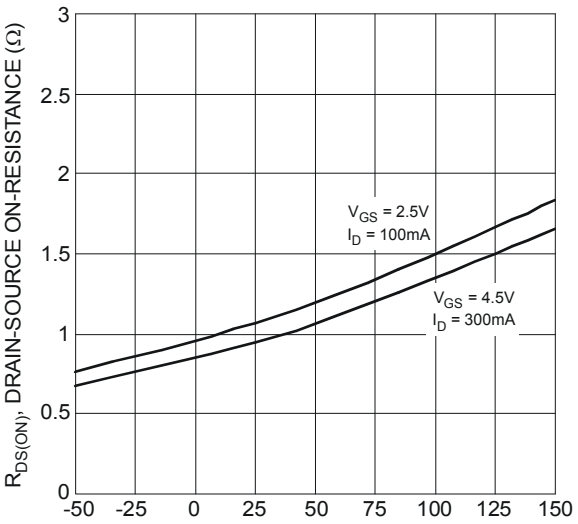


Figure 6 On-Resistance Variation with Temperature

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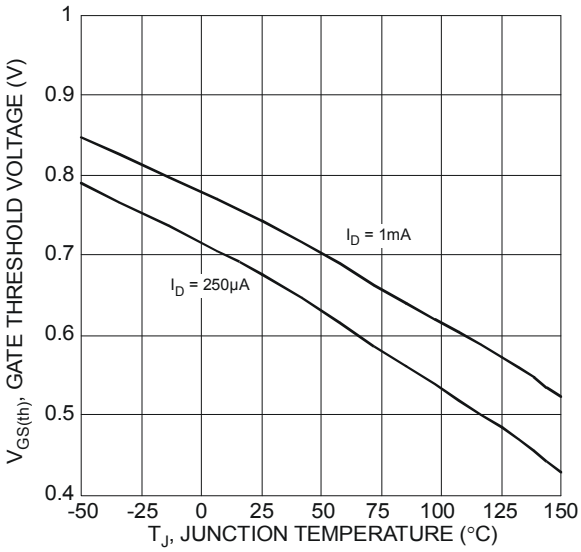


Figure 7 Gate Threshold Variation vs. Ambient Temperature

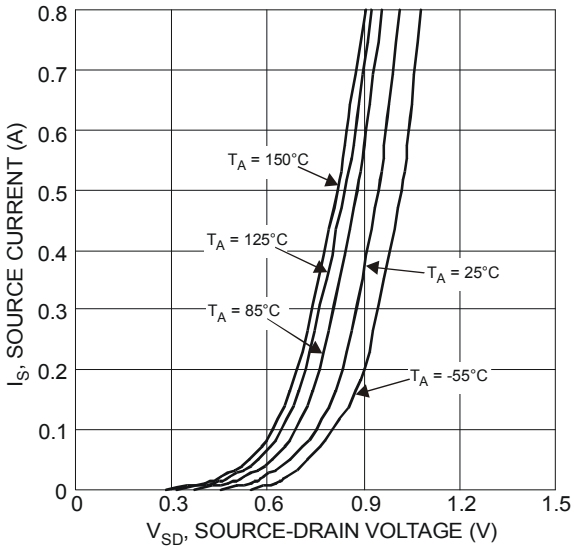


Figure 8 Diode Forward Voltage vs. Current

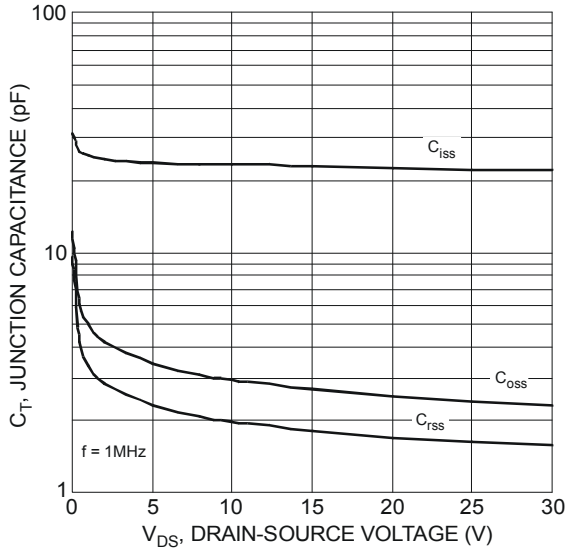


Figure 9 Typical Junction Capacitance

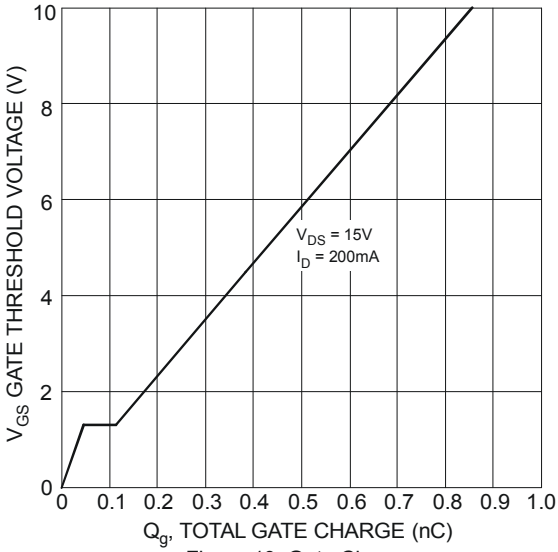


Figure 10 Gate Charge

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## P-CHANNEL

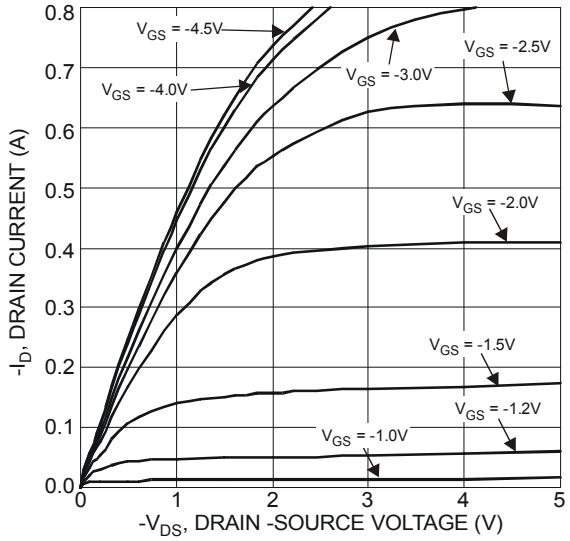


Figure 1 Typical Output Characteristics

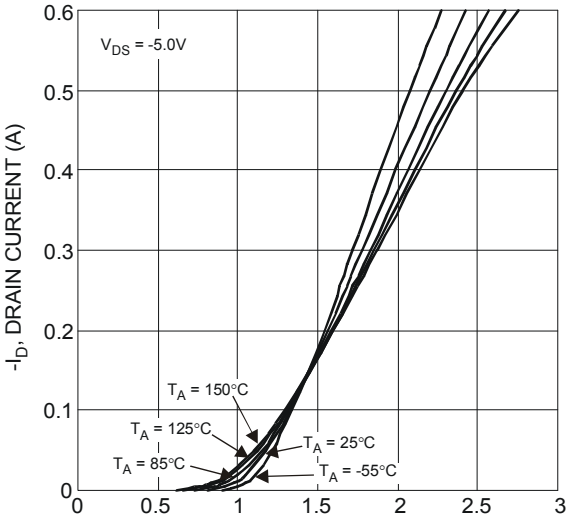


Figure 2 Typical Transfer Characteristics

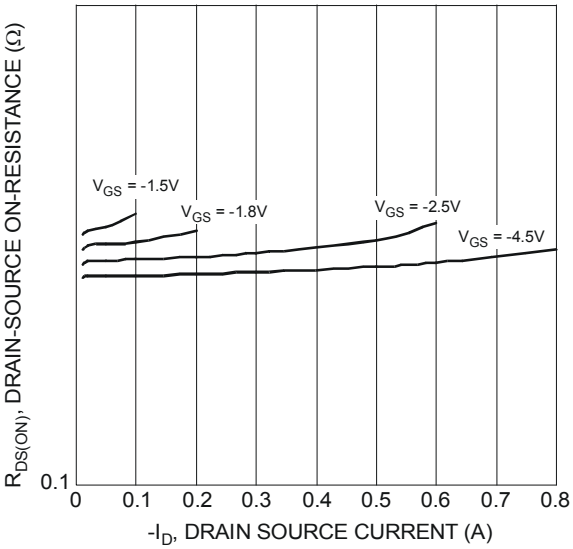


Figure 3 Typical On-Resistance vs. Drain Current and Gate Voltage

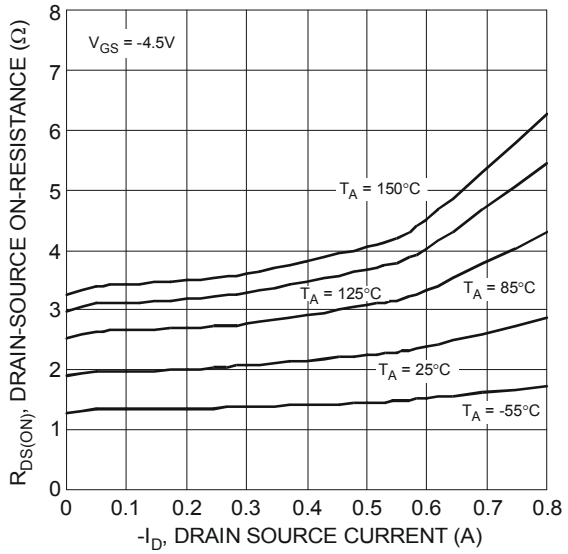


Figure 4 Typical On-Resistance vs. Drain Current and Temperature

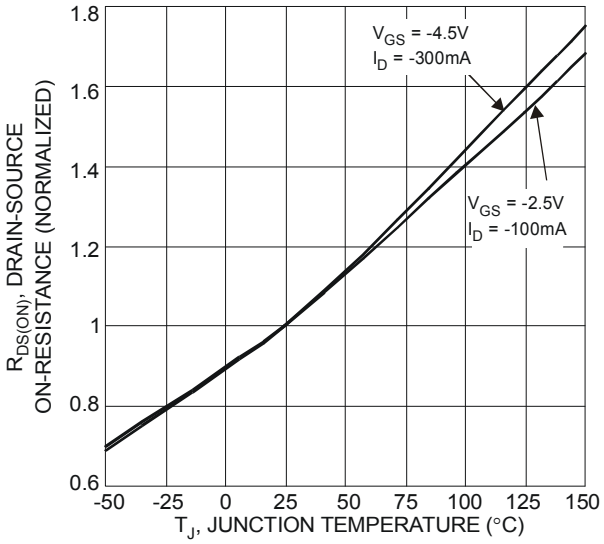


Figure 5 On-Resistance Variation with Temperature

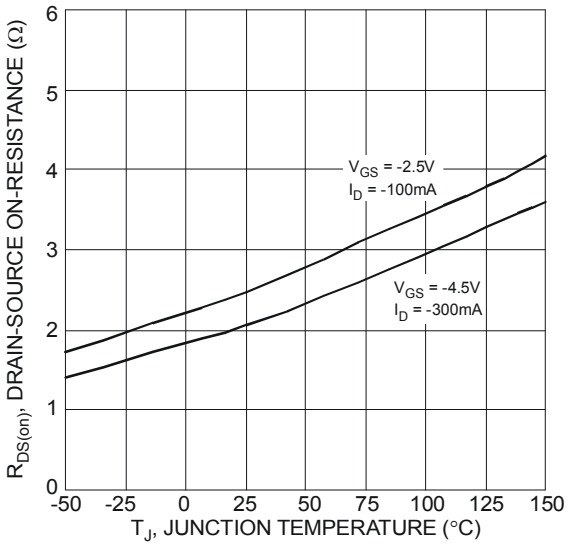


Figure 6 On-Resistance Variation with Temperature

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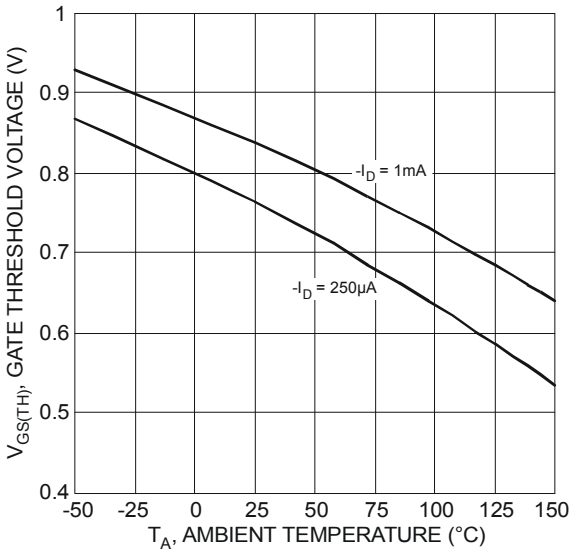


Figure 7 Gate Threshold Variation vs. Ambient Temperature

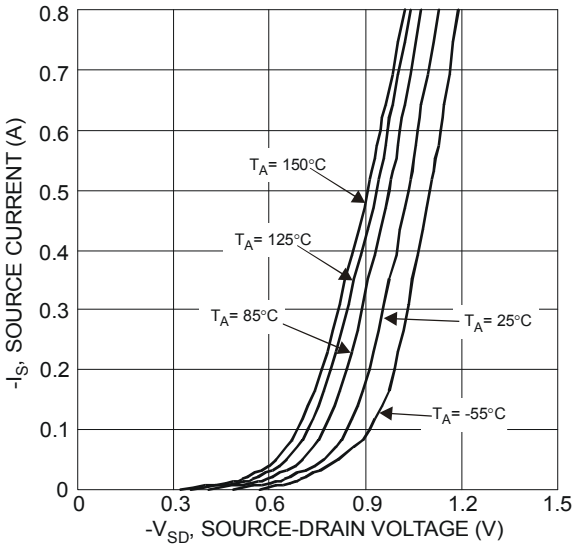


Figure 8 Diode Forward Voltage vs. Current

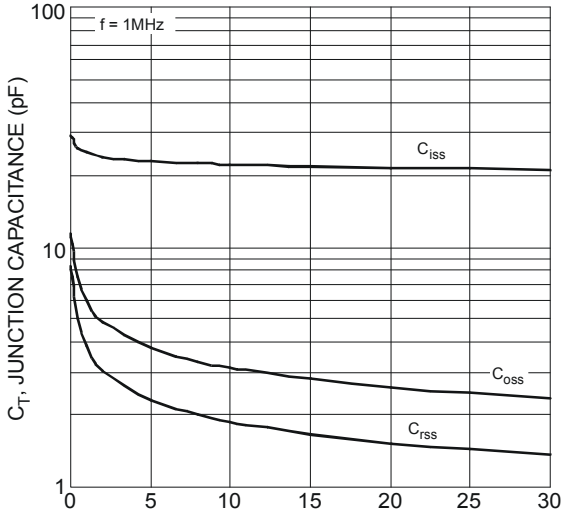


Figure 9 Typical Junction Capacitance

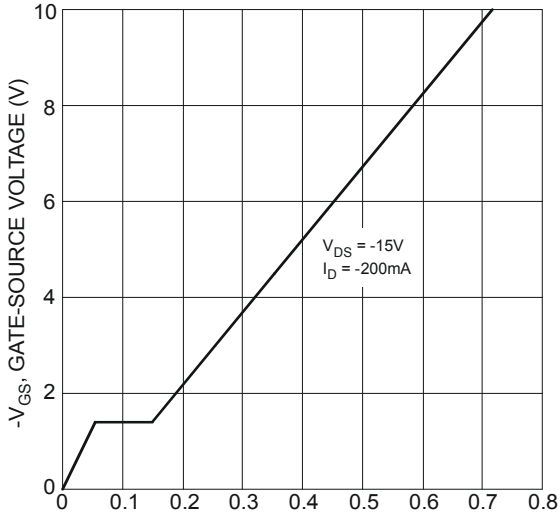


Figure 10 Gate-Charge Characteristics

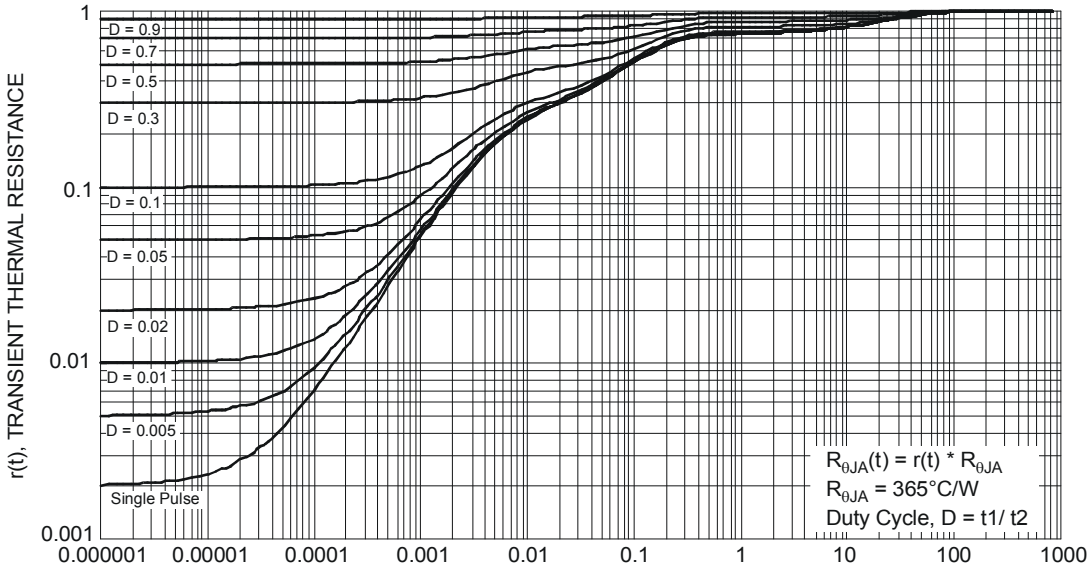


Figure 11 Transient Thermal Resistance

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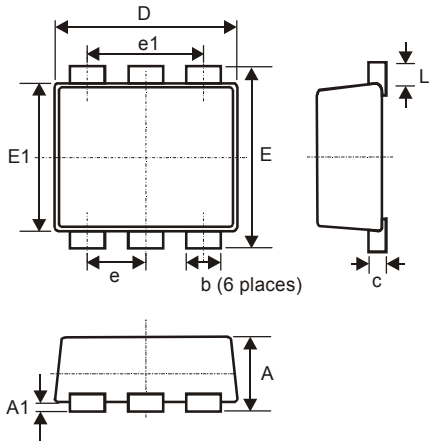
## Package Outline Dimensions

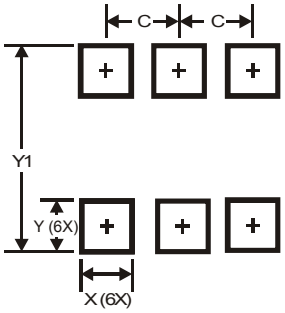
Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for the latest version.




| SOT963 | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | 0.40 | 0.50 | 0.45 |
| **A1** | 0 | 0.05 | - |
| **c** | 0.120 | 0.180 | 0.150 |
| **D** | 0.95 | 1.05 | 1.00 |
| **E** | 0.95 | 1.05 | 1.00 |
| **E1** | 0.75 | 0.85 | 0.80 |
| **L** | 0.05 | 0.15 | 0.10 |
| **b** | 0.10 | 0.20 | 0.15 |
| **e** | 0.35 Typ | | |
| **e1** | 0.70 Typ | | |
| **All Dimensions in mm** | | | |

## Suggested Pad Layout

Please see AP02001 at http://www.diodes.com/datasheets/ap02001.pdf for the latest version.




| Dimensions | Value (in mm) |
|---|---|
| **C** | 0.350 |
| **X** | 0.200 |
| **Y** | 0.200 |
| **Y1** | 1.100 |

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2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

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