

Product Summary

| $V_{(BR)DSS}$ | $R_{DS(on) \max}$ | $I_D \max$ $T_A = +25^\circ\text{C}$ (Note 6) |
|---------------|---------------------------------------|---|
| 20V | 20m Ω @ $V_{GS} = 4.5\text{V}$ | 9.8A |
| | 28m Ω @ $V_{GS} = 2.5\text{V}$ | 8.3A |

Description and Applications

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.

- Battery charging
- Power management functions
- DC-DC converters
- Portable power adaptors

Features and Benefits

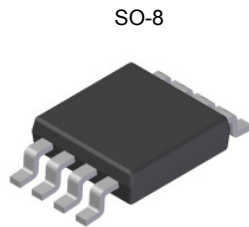
- Low On-Resistance
- Low Input Capacitance
- Fast Switching Speed
- Low Output Leakage
- **ESD Protected Up to 2kV**
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **Qualified to AEC-Q101 Standards for High Reliability**

Mechanical Data

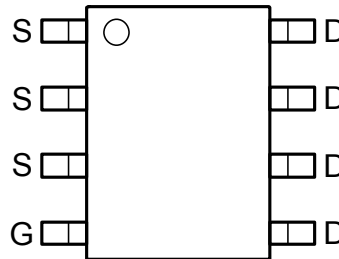
- Case: SO-8
- Case Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0 (Note 1)
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminal Connections: See Diagram Below
- Terminals: Finish – Matte Tin annealed over Copper leadframe. Solderable per MIL-STD-202,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



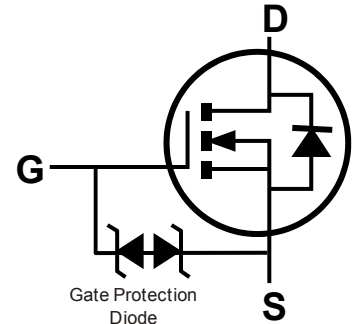
ESD PROTECTED TO 2kV



Top View



Top View



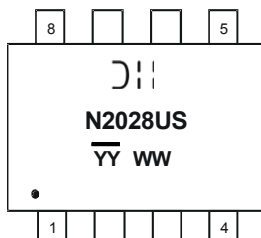
Equivalent Circuit

Ordering Information (Note 4)

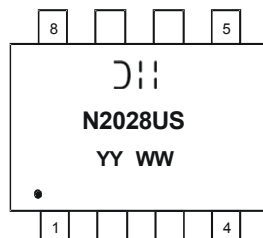
| Product | Marking | Reel size (inches) | Tape width (mm) | Quantity per reel |
|---------------|---------|--------------------|-----------------|-------------------|
| DMN2028USS-13 | N2028US | 13 | 12 | 2,500 |

- 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>.

Marking Information



Chengdu A/T Site



Shanghai A/T Site

⌋⌋ = Manufacturer's Marking
 N2028US = Product Type Marking Code
 YYWW = Date Code Marking
 YY or YY = Year (ex: 13 = 2013)
 WW = Week (01 - 53)
 YY = Date Code Marking for SAT (Shanghai Assembly/ Test site)
 YY = Date Code Marking for CAT (Chengdu Assembly/ Test site)

Maximum Ratings (@ $T_A = +25^\circ\text{C}$, unless otherwise specified.)

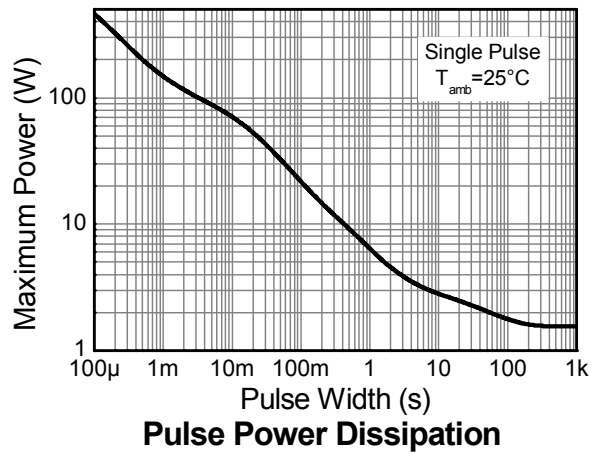
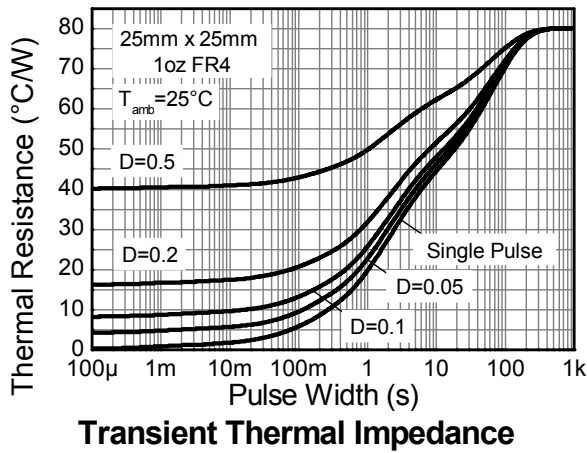
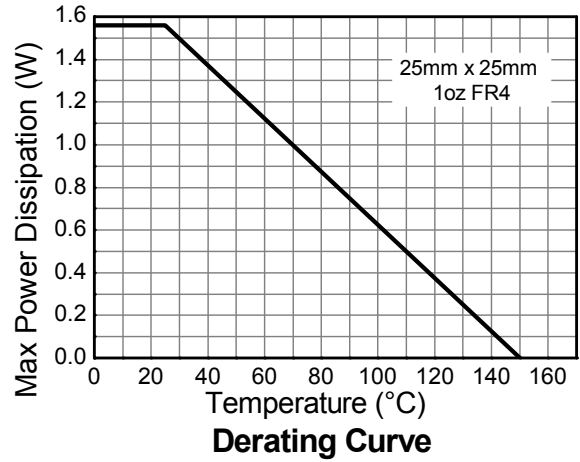
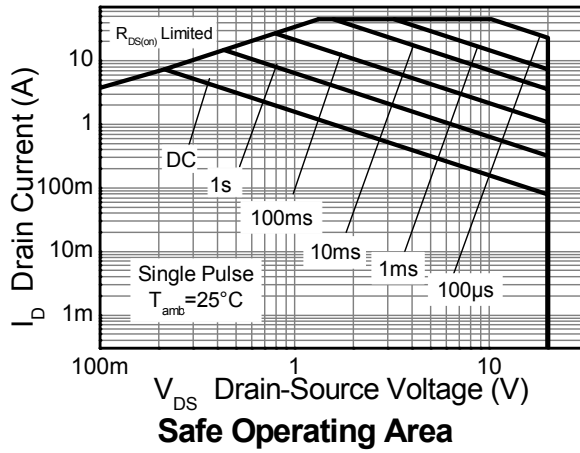
| Characteristic | | | Symbol | Value | Unit |
|--|------------------------|------------------------------------|-----------|----------|------|
| Drain-Source voltage | | | V_{DSS} | 20 | V |
| Gate-Source voltage | | | V_{GS} | ± 12 | |
| Continuous Drain current | $V_{GS} = 4.5\text{V}$ | (Note 6) | I_D | 9.8 | A |
| | | $T_A = +70^\circ\text{C}$ (Note 6) | | 7.9 | |
| | | (Note 5) | | 7.3 | |
| Pulsed Drain current | $V_{GS} = 4.5\text{V}$ | (Note 7) | I_{DM} | 45.0 | |
| Continuous Source current (Body diode) | | | (Note 6) | I_S | |
| Pulsed Source current (Body diode) | | | (Note 7) | I_{SM} | 45.0 |

Thermal Characteristics (@ $T_A = +25^\circ\text{C}$, unless otherwise specified.)

| Characteristic | | | Symbol | Value | Unit | |
|---|--|----------|-----------------|-------------|--------------------|----------------------|
| Power dissipation | | (Note 5) | P_D | 1.56 | W | |
| | | | | 12.5 | | |
| Linear derating factor | | (Note 6) | | 2.81 | | mW/ $^\circ\text{C}$ |
| | | | | 22.5 | | |
| Thermal Resistance, Junction to Ambient | | (Note 5) | $R_{\theta JA}$ | 80.0 | $^\circ\text{C/W}$ | |
| | | (Note 6) | | 44.5 | | |
| Thermal Resistance, Junction to Lead | | (Note 8) | $R_{\theta JL}$ | 37.0 | | |
| Operating and storage temperature range | | | T_J, T_{STG} | -55 to +150 | | $^\circ\text{C}$ |

- Notes:
5. For a device surface mounted on 25mm x 25mm x 1.6mm FR4 PCB with high coverage of single sided 1oz copper, in still air conditions; the device is measured when operating in a steady-state condition.
 6. Same as note (5), except the device is measured at $t \leq 10$ sec.
 7. Same as note (5), except the device is pulsed with $D = 0.02$ and pulse width 300 μs .
 8. Thermal resistance from junction to solder-point (at the end of the drain lead).

Thermal Characteristics



Electrical Characteristics (@ $T_A = +25^\circ\text{C}$, unless otherwise specified.)

| Characteristic | Symbol | Min | Typ | Max | Unit | Test Condition |
|--|--------------|-----|-------|----------|------------|---|
| OFF CHARACTERISTICS | | | | | | |
| Drain-Source Breakdown Voltage | BV_{DSS} | 20 | - | - | V | $V_{GS} = 0V, I_D = 250\mu A$ |
| Zero Gate Voltage Drain Current | I_{DSS} | - | - | 1.0 | μA | $V_{DS} = 20V, V_{GS} = 0V$ |
| Gate-Source Leakage | I_{GSS} | - | - | ± 10 | μA | $V_{GS} = \pm 12V, V_{DS} = 0V$ |
| ON CHARACTERISTICS | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | 0.6 | 1.0 | 1.3 | V | $V_{DS} = V_{GS}, I_D = 250\mu A$ |
| Static Drain-Source On-Resistance (Note 9) | $R_{DS(on)}$ | - | 11 | 20 | m Ω | $V_{GS} = 4.5V, I_D = 9.4A$ |
| | | | 15 | 28 | | $V_{GS} = 2.5V, I_D = 8.3A$ |
| Forward Transfer Admittance (Note 9 & 10) | $ Y_{fs} $ | - | 16 | - | S | $V_{DS} = 5V, I_D = 9.4A$ |
| Diode Forward Voltage (Note 9) | V_{SD} | - | 0.7 | 1.3 | V | $V_{GS} = 0V, I_S = 1.3A$ |
| DYNAMIC CHARACTERISTICS (Note 10) | | | | | | |
| Input Capacitance | C_{iss} | - | 1000 | - | pF | $V_{DS} = 10V, V_{GS} = 0V,$ $f = 1.0MHz$ |
| Output Capacitance | C_{oss} | - | 166 | - | | |
| Reverse Transfer Capacitance | C_{rss} | - | 158 | - | | |
| Gate Resistance | R_g | - | 1.51 | - | Ω | $V_{DS} = 0V, V_{GS} = 0V, f = 1MHz$ |
| Total Gate Charge (Note 11) | Q_g | - | 7.0 | - | nC | $V_{DS} = 10V$ $I_D = 9.4A$ |
| Total Gate Charge (Note 11) | Q_g | - | 11.6 | - | | |
| Gate-Source Charge (Note 11) | Q_{gs} | - | 2.7 | - | | |
| Gate-Drain Charge (Note 11) | Q_{gd} | - | 3.4 | - | | |
| Turn-On Delay Time (Note 11) | $t_{D(on)}$ | - | 11.67 | - | ns | $V_{GS} = 4.5V, V_{DS} = 10V,$ $R_G = 6\Omega, I_D = 1A$ |
| Turn-On Rise Time (Note 11) | t_r | - | 12.49 | - | | |
| Turn-Off Delay Time (Note 11) | $t_{D(off)}$ | - | 35.89 | - | | |
| Turn-Off Fall Time (Note 11) | t_f | - | 12.33 | - | | |

- Notes:
9. Measured under pulsed conditions. Pulse width $\leq 300\mu s$; duty cycle $\leq 2\%$
 10. For design aid only, not subject to production testing.
 11. Switching characteristics are independent of operating junction temperatures.

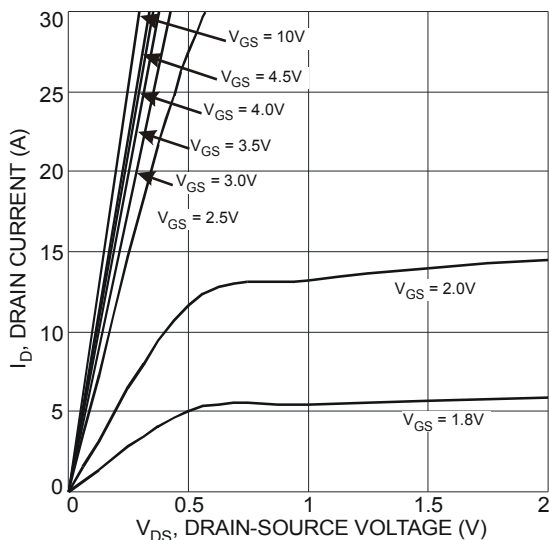


Fig. 1 Typical Output Characteristic

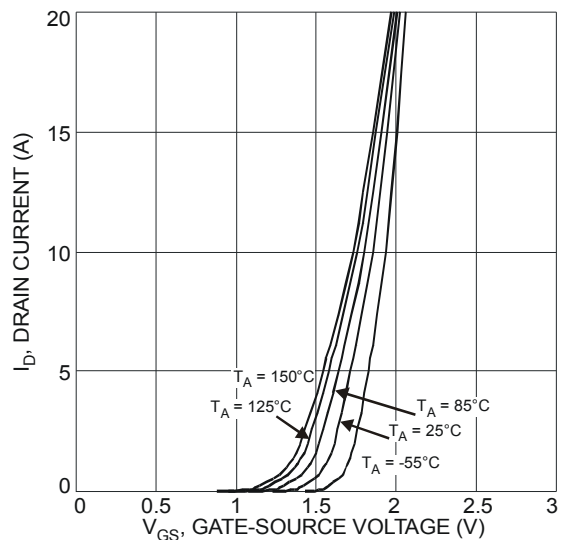


Fig. 2 Typical Transfer Characteristic

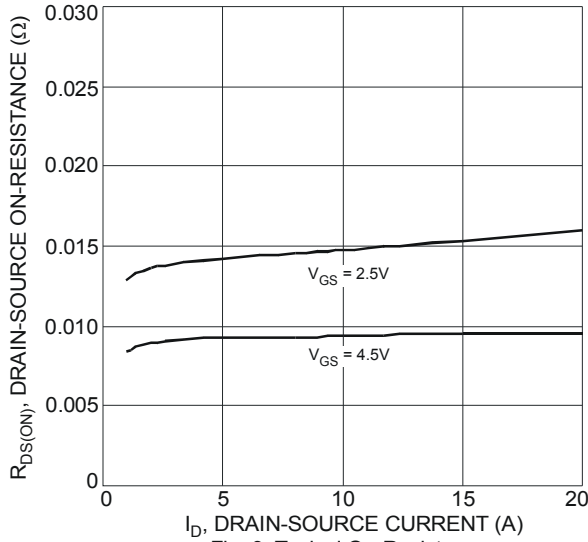


Fig. 3 Typical On-Resistance vs. Drain Current and Gate Voltage

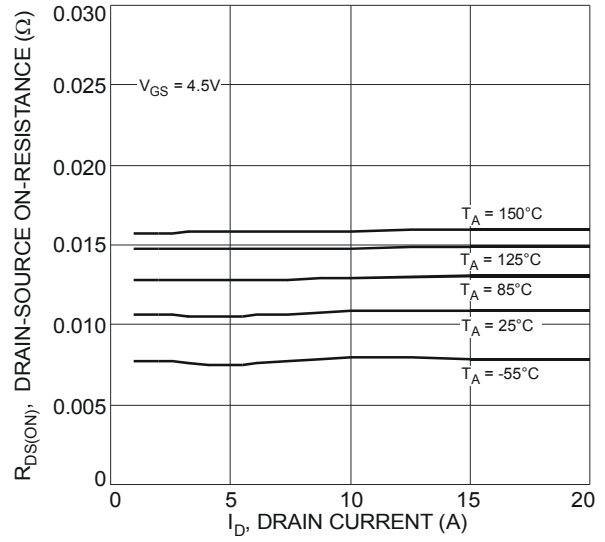


Fig. 4 Typical On-Resistance vs. Drain Current and Temperature

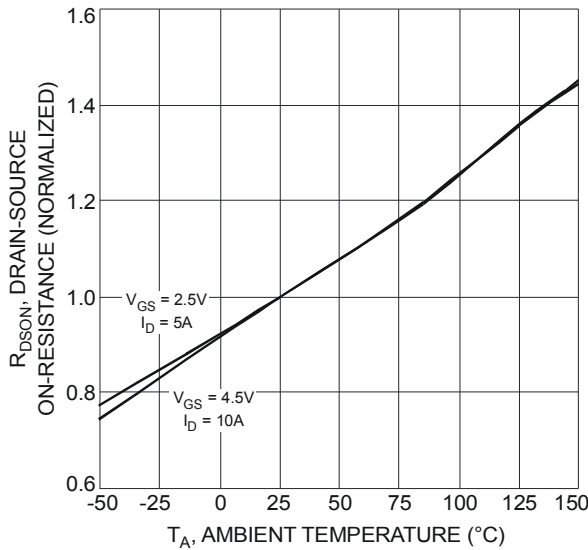


Fig. 5 On-Resistance Variation with Temperature

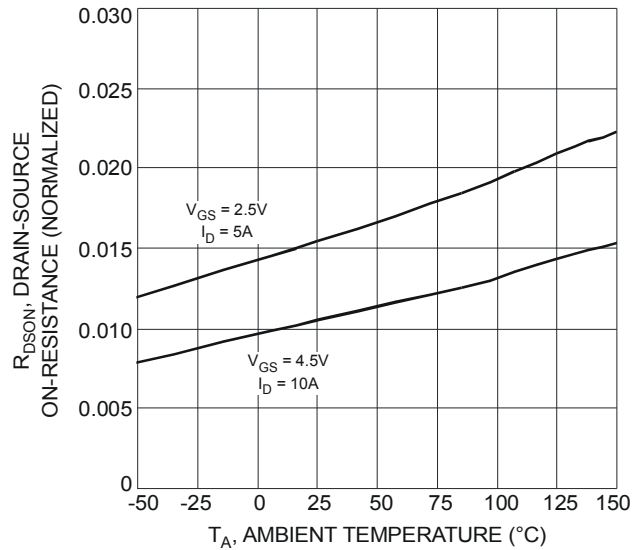


Fig. 6 On-Resistance Variation with Temperature

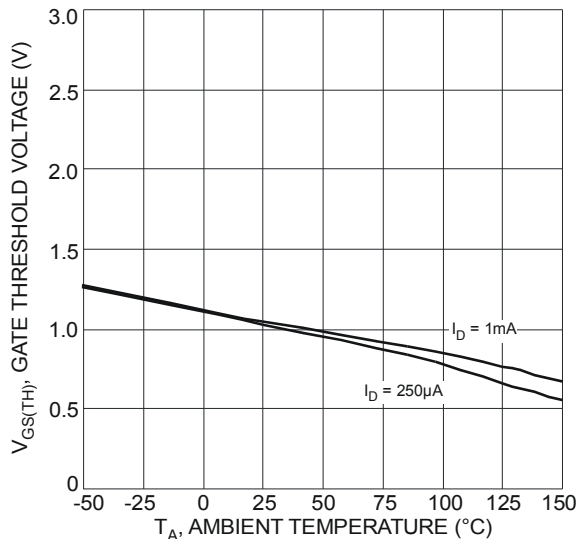


Fig. 7 Gate Threshold Variation vs. Ambient Temperature

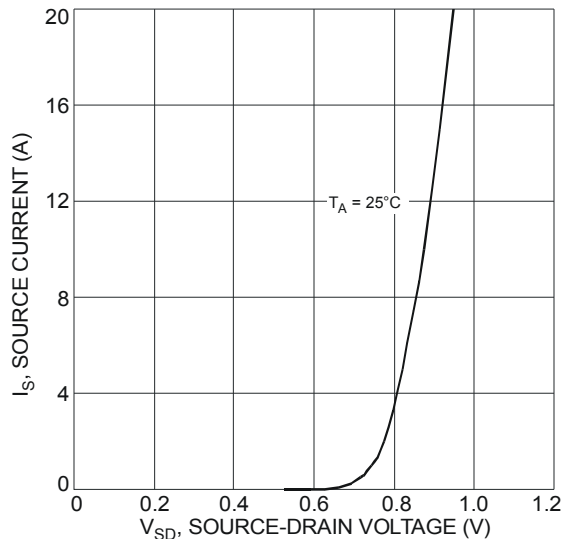


Fig. 8 Diode Forward Voltage vs. Current

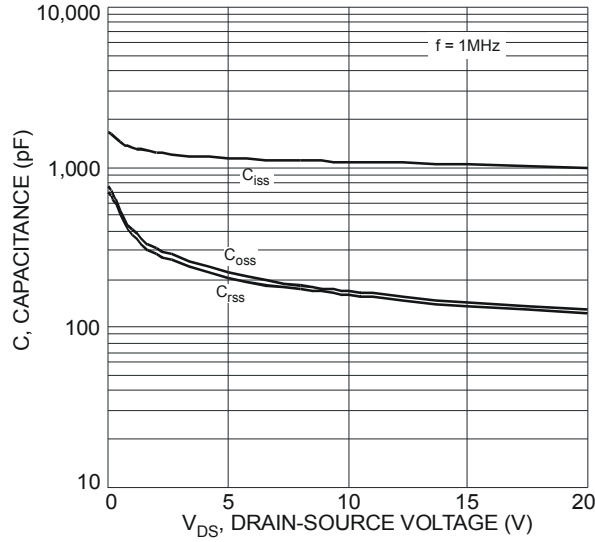


Fig. 9 Typical Total Capacitance

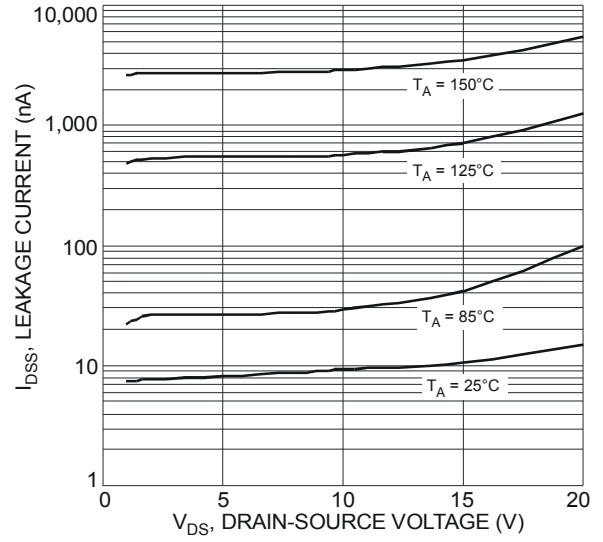


Fig. 10 Typical Leakage Current vs. Drain-Source Voltage

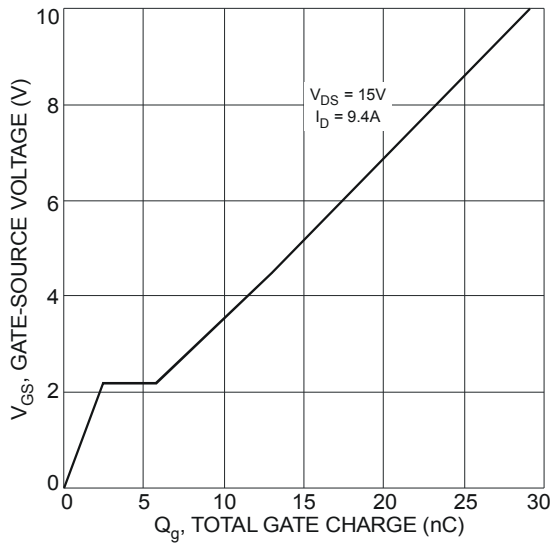
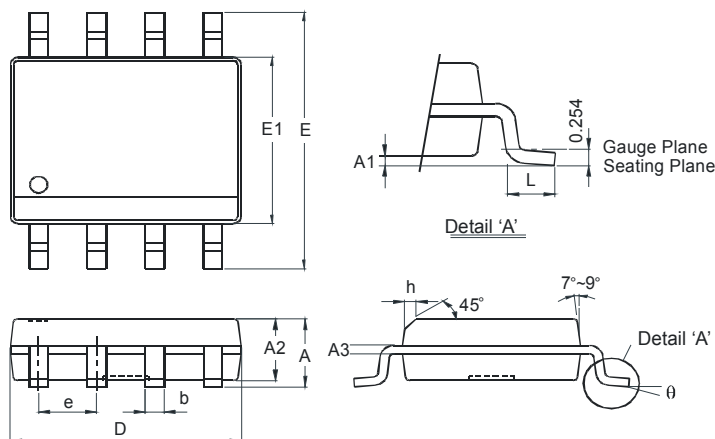


Fig. 11 Gate-Charge Characteristics

Package Outline Dimensions

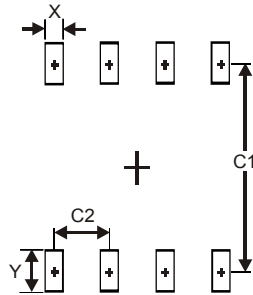
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.



| 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 AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.



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

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