

## Product Summary

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

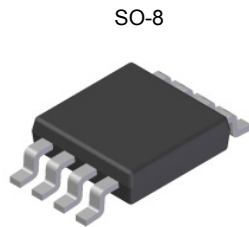
- Low On-Resistance
- Low Input Capacitance
- Fast Switching Speed
- Low Output Leakage
- **ESD Protected Up to 2kV**
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **Qualified to AEC-Q101 Standards for High Reliability**

## Mechanical Data

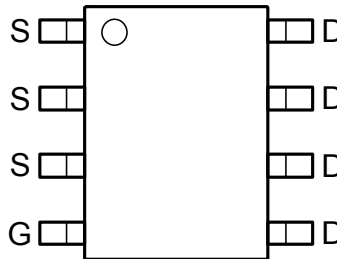
- Case: SO-8
- Case Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0 (Note 1)
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminal Connections: See Diagram Below
- Terminals: Finish – Matte Tin annealed over Copper leadframe. Solderable per MIL-STD-202,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



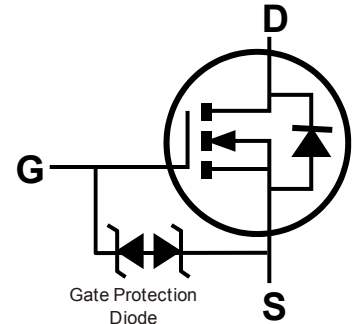
ESD PROTECTED TO 2kV



Top View



Top View



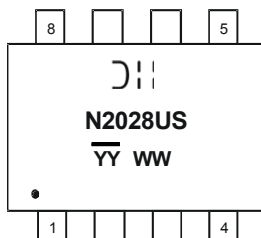
Equivalent Circuit

## Ordering Information (Note 4)

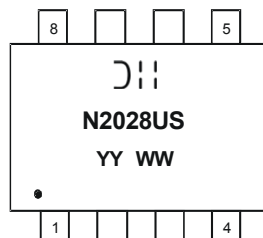
Product	Marking	Reel size (inches)	Tape width (mm)	Quantity per reel
DMN2028USS-13	N2028US	13	12	2,500

- 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](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.)

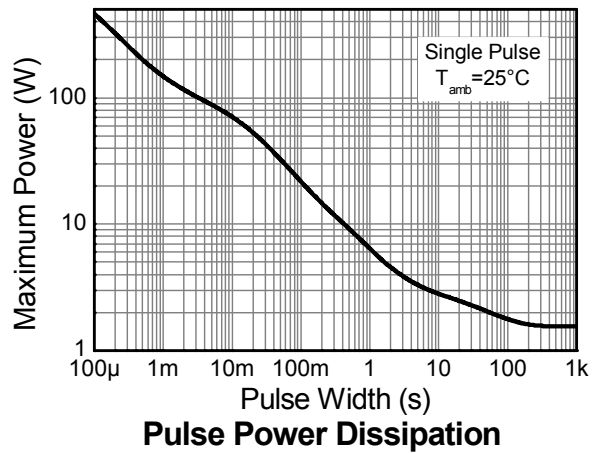
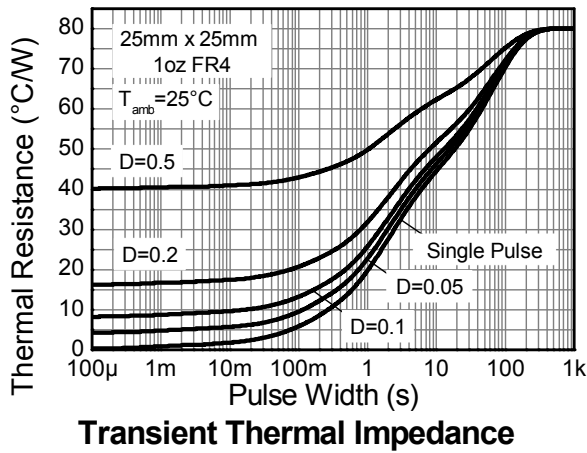
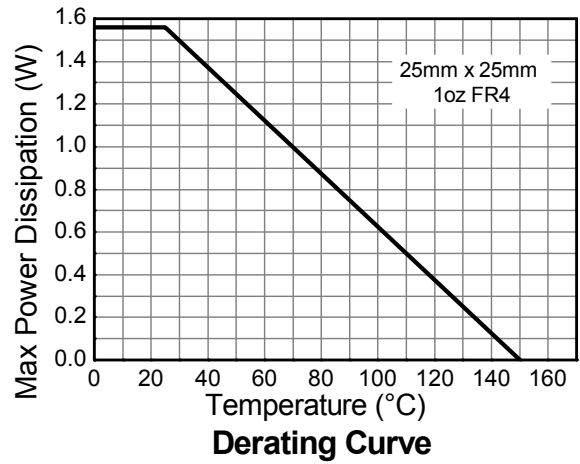
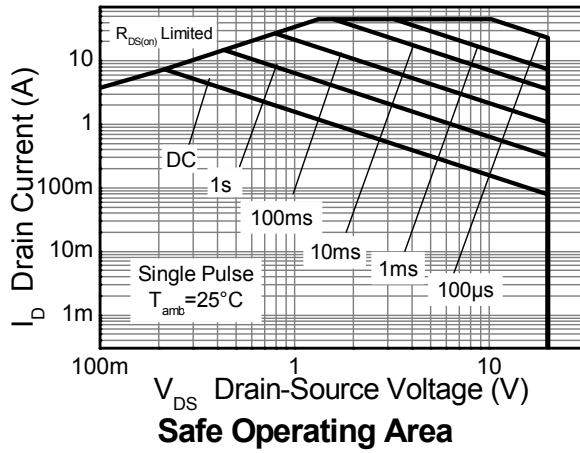
Characteristic			Symbol	Value	Unit
Drain-Source voltage			$V_{DSS}$	20	V
Gate-Source voltage			$V_{GS}$	$\pm 12$	
Continuous Drain current	$V_{GS} = 4.5\text{V}$	(Note 6)	$I_D$	9.8	A
		$T_A = +70^\circ\text{C}$ (Note 6)		7.9	
		(Note 5)		7.3	
Pulsed Drain current	$V_{GS} = 4.5\text{V}$	(Note 7)	$I_{DM}$	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 $\mu\text{s}$ .
  8. Thermal resistance from junction to solder-point (at the end of the drain lead).

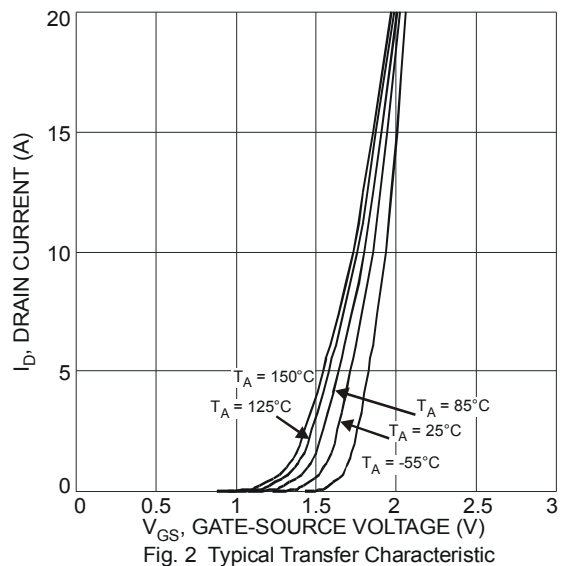
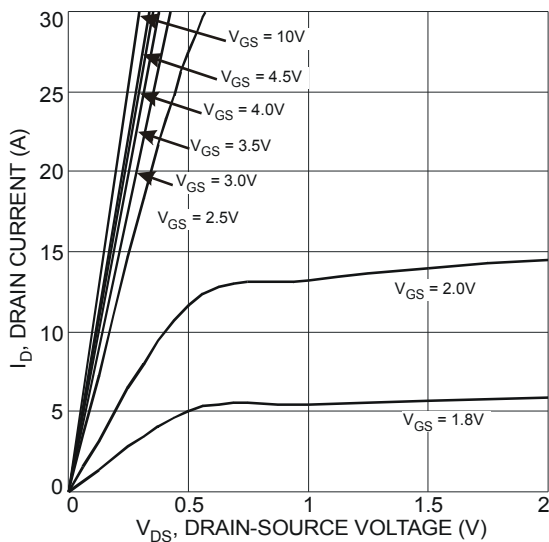
**Thermal Characteristics**



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

Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
<b>OFF CHARACTERISTICS</b>						
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	$\mu A$	$V_{DS} = 20V, V_{GS} = 0V$
Gate-Source Leakage	$I_{GSS}$	-	-	$\pm 10$	$\mu A$	$V_{GS} = \pm 12V, V_{DS} = 0V$
<b>ON CHARACTERISTICS</b>						
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 $\Omega$	$V_{GS} = 4.5V, I_D = 9.4A$
			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	$V_{GS} = 0V, I_S = 1.3A$
<b>DYNAMIC CHARACTERISTICS (Note 10)</b>						
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	-	$\Omega$	$V_{DS} = 0V, V_{GS} = 0V, f = 1MHz$
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.



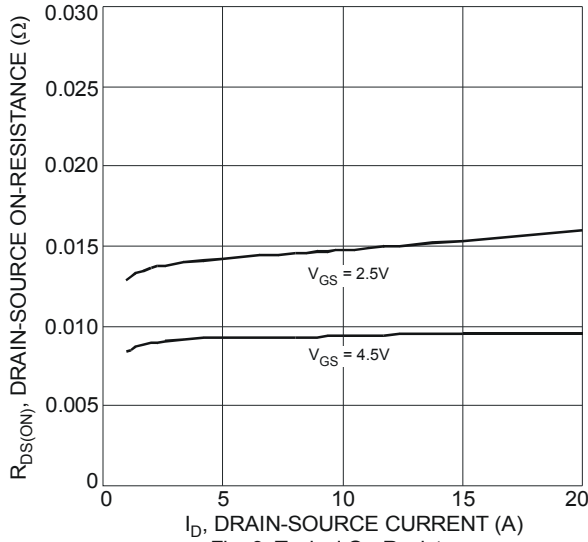


Fig. 3 Typical On-Resistance vs. Drain Current and Gate Voltage

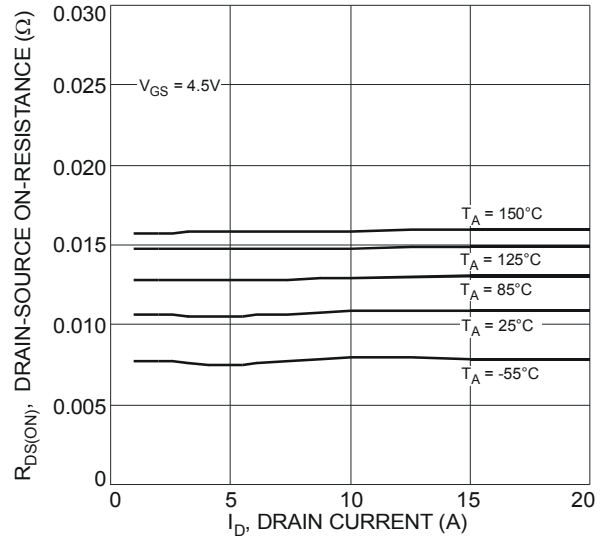


Fig. 4 Typical On-Resistance vs. Drain Current and Temperature

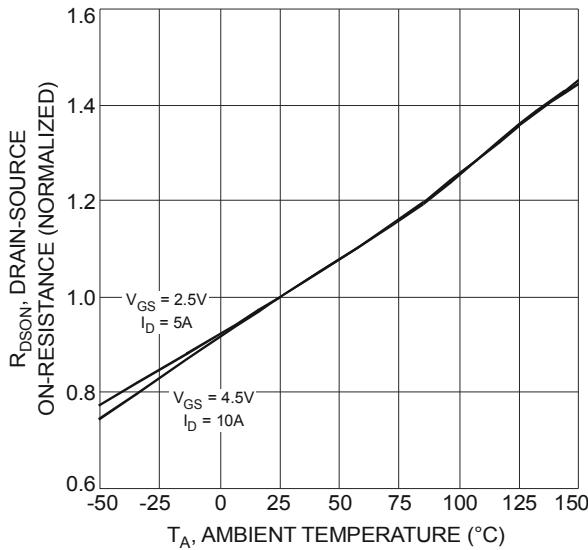


Fig. 5 On-Resistance Variation with Temperature

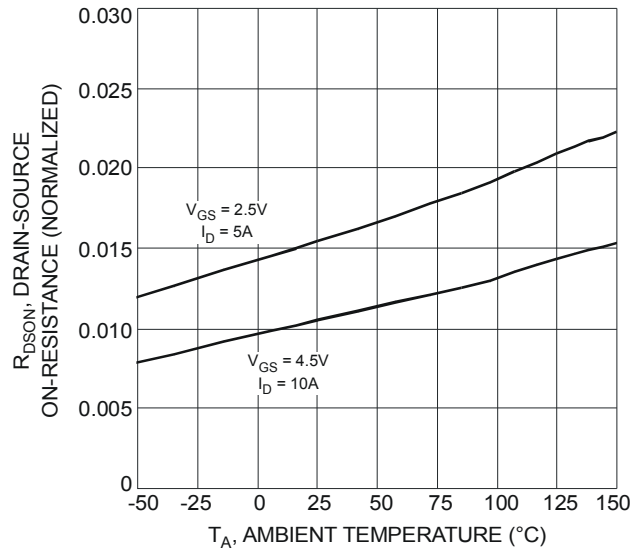


Fig. 6 On-Resistance Variation with Temperature

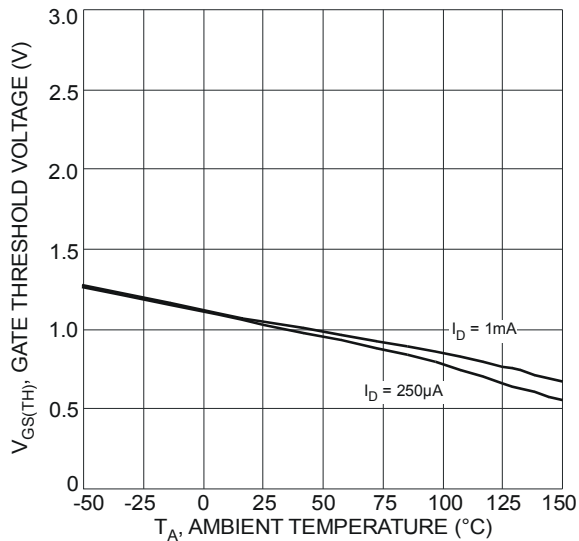


Fig. 7 Gate Threshold Variation vs. Ambient Temperature

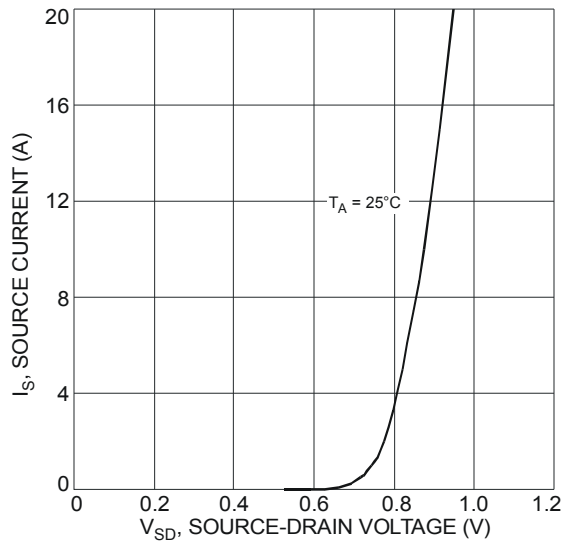


Fig. 8 Diode Forward Voltage vs. Current

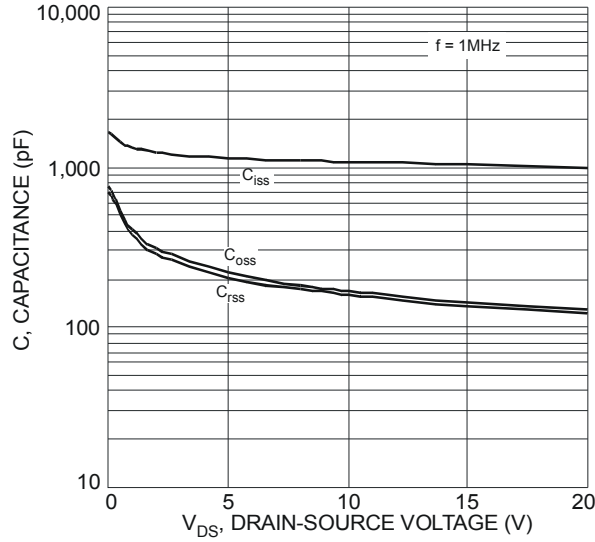


Fig. 9 Typical Total Capacitance

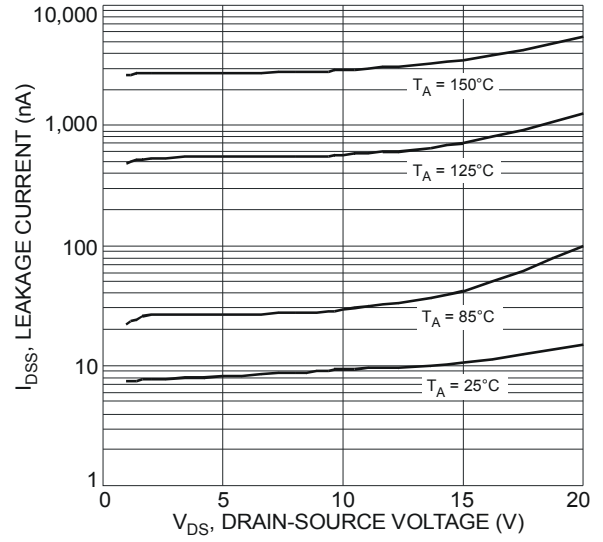


Fig. 10 Typical Leakage Current vs. Drain-Source Voltage

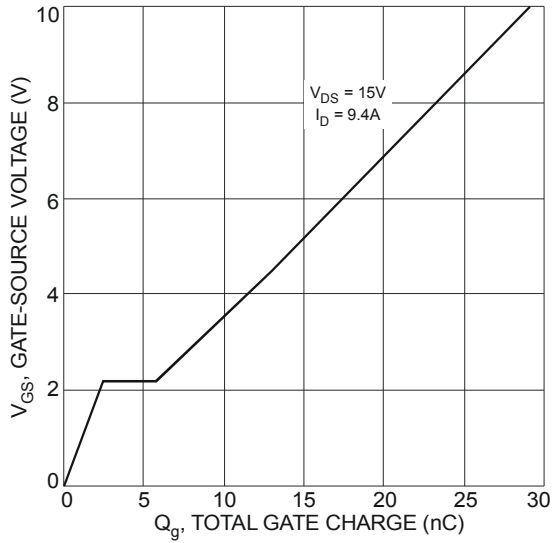
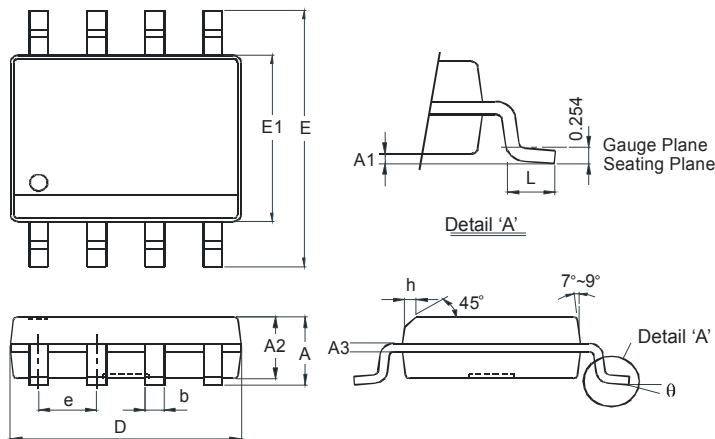


Fig. 11 Gate-Charge Characteristics

**Package Outline Dimensions**

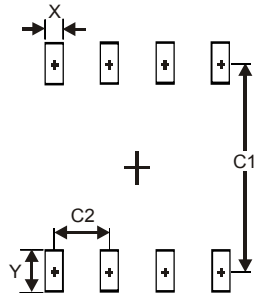
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.



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)
<b>X</b>	0.60
<b>Y</b>	1.55
<b>C1</b>	5.4
<b>C2</b>	1.27

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