Lead-free Green

20V N-CHANNEL ENHANCEMENT MODE MOSFET

Product Summary

$V_{(BR)DSS}$	$R_{DS(on)}$ max	I_D max T_A = +25°C (Note 6)
20V	20mΩ @ V_{GS}= 4.5V	9.8A
	28mΩ @ V_{GS}= 2.5V	8.3A

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**

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.

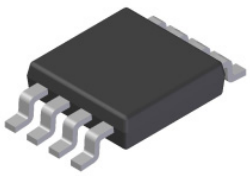
- Battery charging
- Power management functions
- DC-DC converters
- Portable power adaptors

Mechanical Data

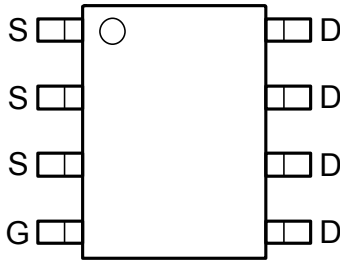
- Case: SO-8
- Case Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0 (Note 1)
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminal Connections: See Diagram Below
- Terminals: Finish – Matte Tin annealed over Copper leadframe. Solderable per MIL-STD-202,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

ESD PROTECTED TO 2kV

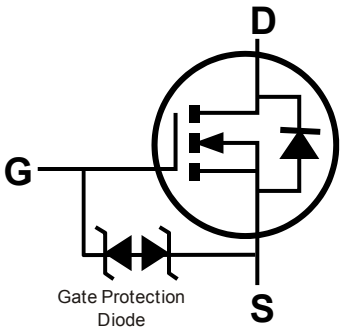
SO-8



Top View



Top View



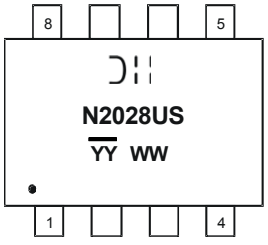
Equivalent Circuit

Ordering Information (Note 4)

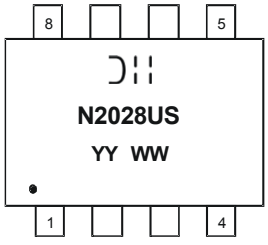
Product	Marking	Reel size (inches)	Tape width (mm)	Quantity per reel
DMN2028USS-13	N2028US	13	12	2,500

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°C, unless otherwise specified.)

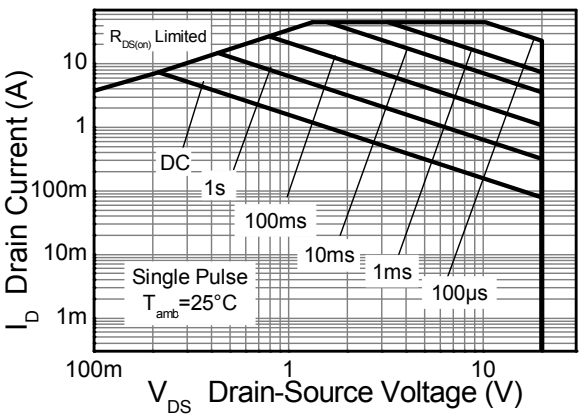
Characteristic			Symbol	Value	Unit
Drain-Source voltage			V_{DSS}	20	V
Gate-Source voltage			V_{GS}	±12	
Continuous Drain current	V_{GS} = 4.5V	(Note 6)	I_D	9.8	A
		T_A = +70°C (Note 6)		7.9	
		(Note 5)		7.3	
Pulsed Drain current	V_{GS} = 4.5V	(Note 7)	I_{DM}	45.0	
Continuous Source current (Body diode)		(Note 6)	I_S	6.0	
Pulsed Source current (Body diode)		(Note 7)	I_{SM}	45.0	

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

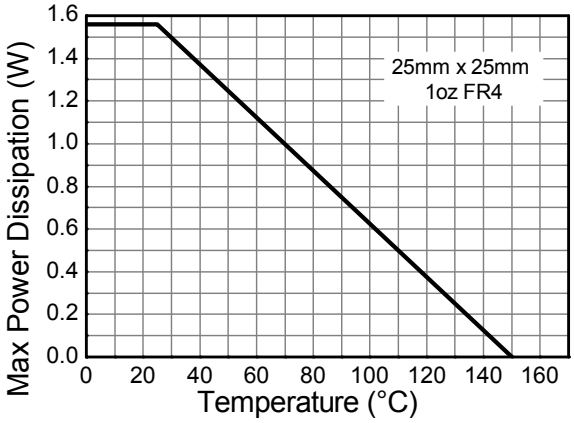
Characteristic		Symbol	Value	Unit
Power dissipation Linear derating factor	(Note 5)	P_D	1.56 12.5	W mW/°C
	(Note 6)		2.81 22.5	
Thermal Resistance, Junction to Ambient	(Note 5)	$R_{\theta JA}$	80.0	°C/W
	(Note 6)		44.5	
Thermal Resistance, Junction to Lead	(Note 8)	$R_{\theta JL}$	37.0	
Operating and storage temperature range		T_J, T_{STG}	-55 to +150	°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 ≤ 10 sec.
7. Same as note (5), except the device is pulsed with D = 0.02 and pulse width 300µs.
8. Thermal resistance from junction to solder-point (at the end of the drain lead).

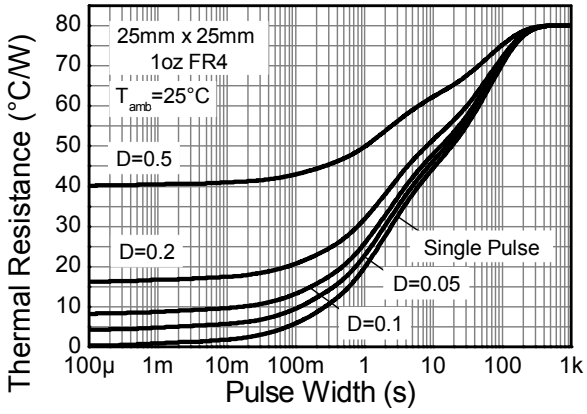
Thermal Characteristics



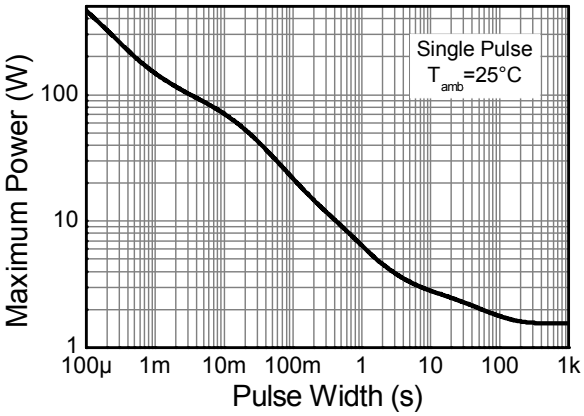
Safe Operating Area



Derating Curve



Transient Thermal Impedance



Pulse Power Dissipation

Electrical Characteristics (@T_A = +25°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 = 250µA
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} = ±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 = 250µA
Static Drain-Source On-Resistance (Note 9)	$R_{DS\ (ON)}$	-	11	20	mΩ	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_{GS} = 2.5V; V_{DS} = 10V, I_D = 9.4A
Total Gate Charge (Note 11)	Q_g	-	11.6	-		V_{GS} = 4.5V; V_{DS} = 10V, I_D = 9.4A
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 = 6Ω , 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 ≤ 300µs; duty cycle ≤ 2%
10. For design aid only, not subject to production testing.
11. Switching characteristics are independent of operating junction temperatures.

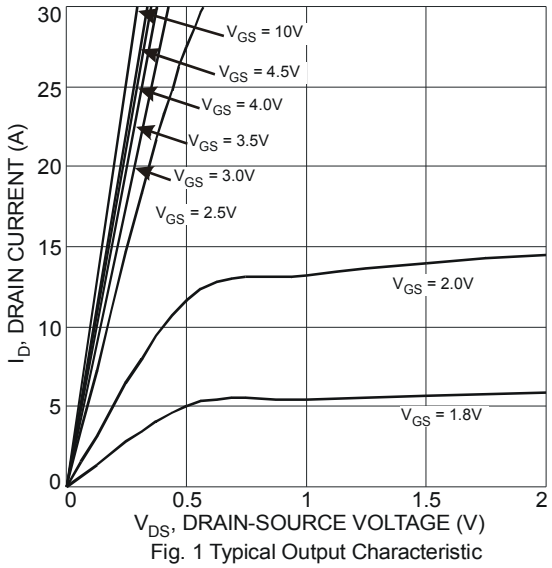


Fig. 1 Typical Output Characteristic

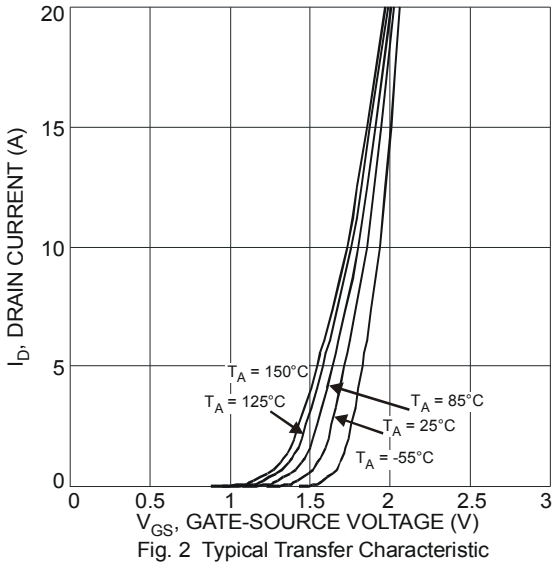


Fig. 2 Typical Transfer Characteristic

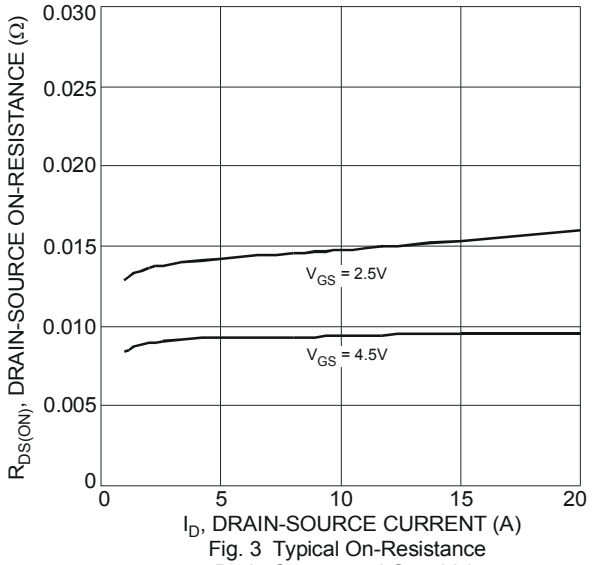


Fig. 3 Typical On-Resistance vs. Drain Current and Gate Voltage

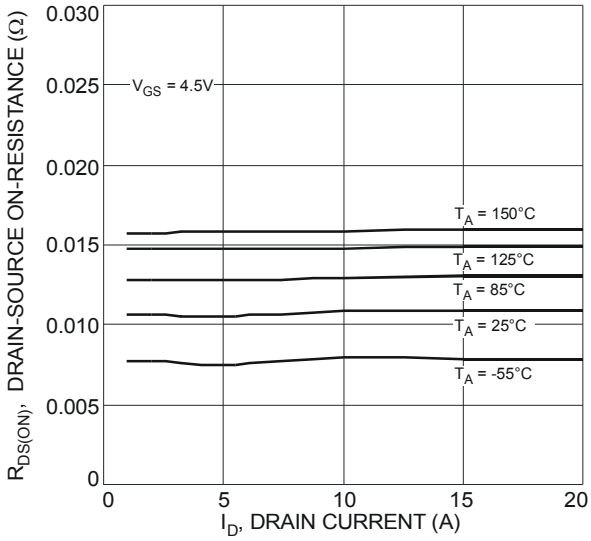


Fig. 4 Typical On-Resistance vs. Drain Current and Temperature

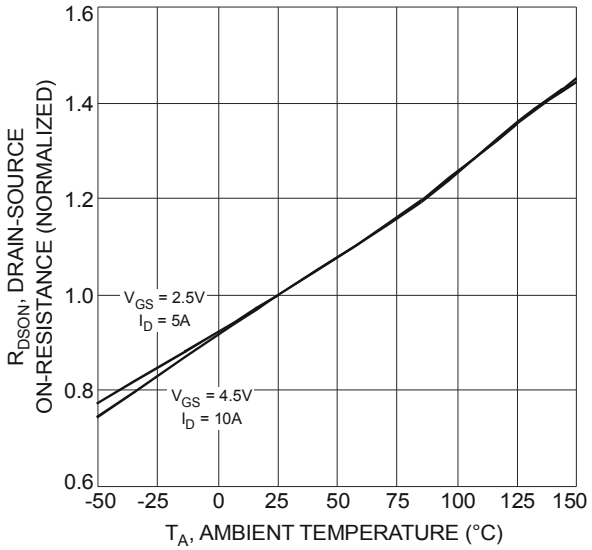


Fig. 5 On-Resistance Variation with Temperature

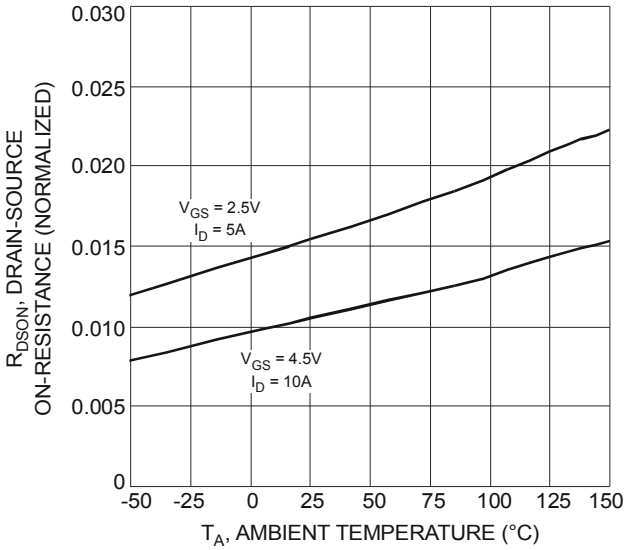


Fig. 6 On-Resistance Variation with Temperature

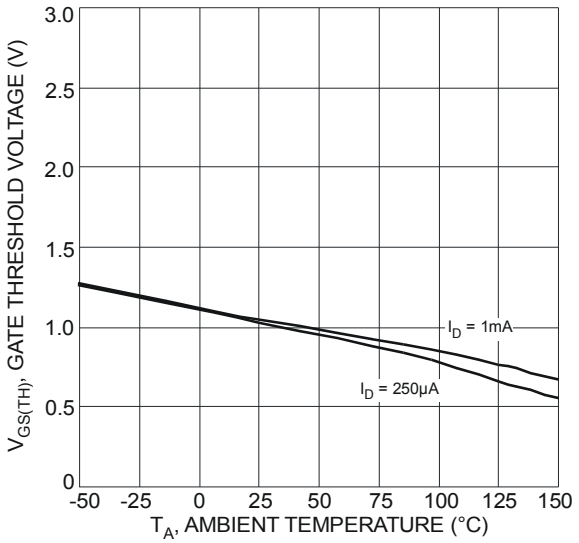


Fig. 7 Gate Threshold Variation vs. Ambient Temperature

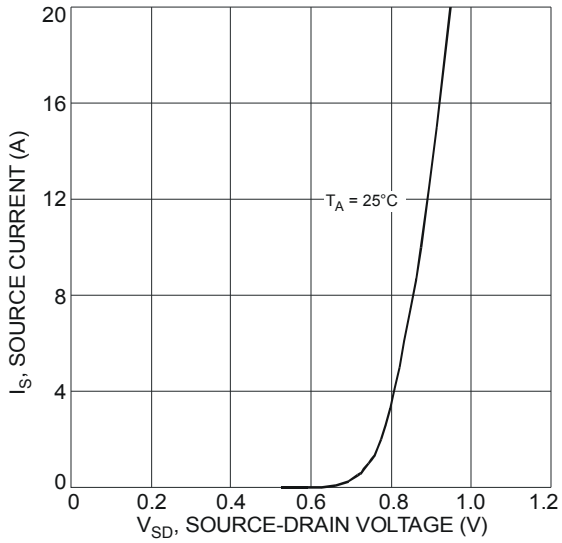


Fig. 8 Diode Forward Voltage vs. Current

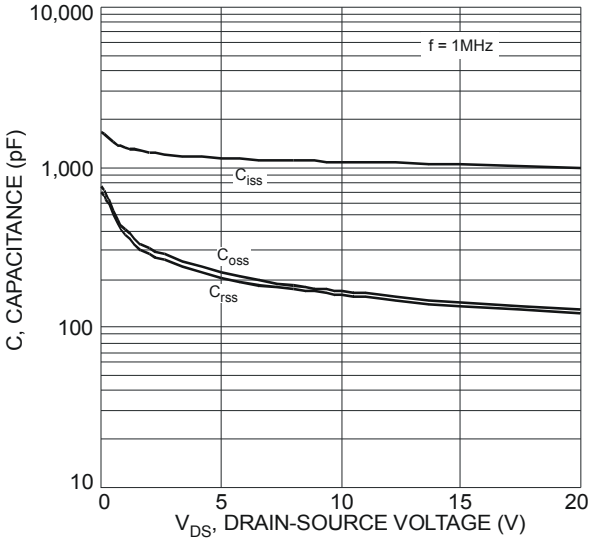


Fig. 9 Typical Total Capacitance

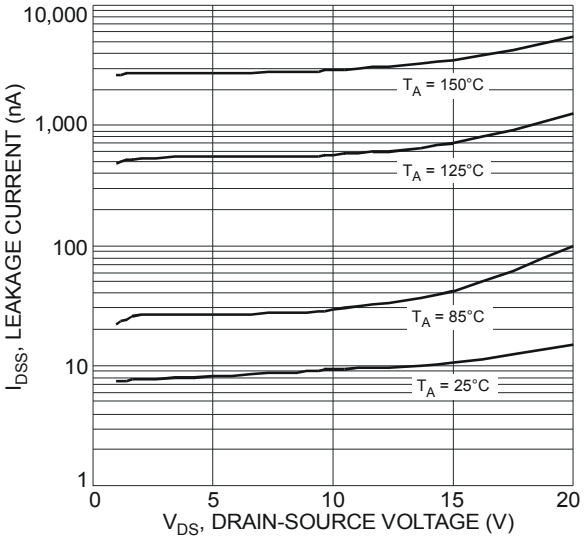


Fig. 10 Typical Leakage Current vs. Drain-Source Voltage

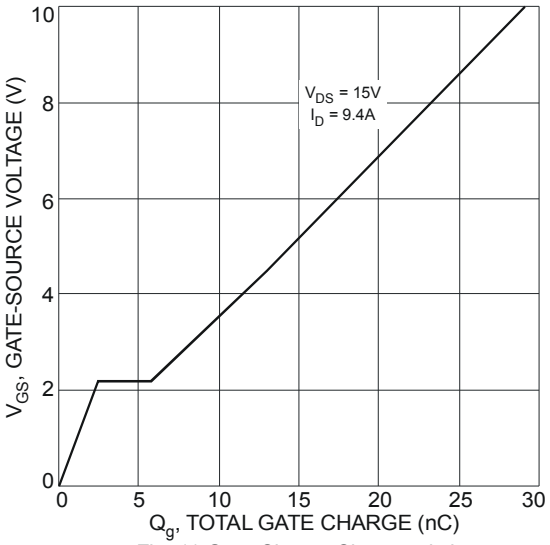
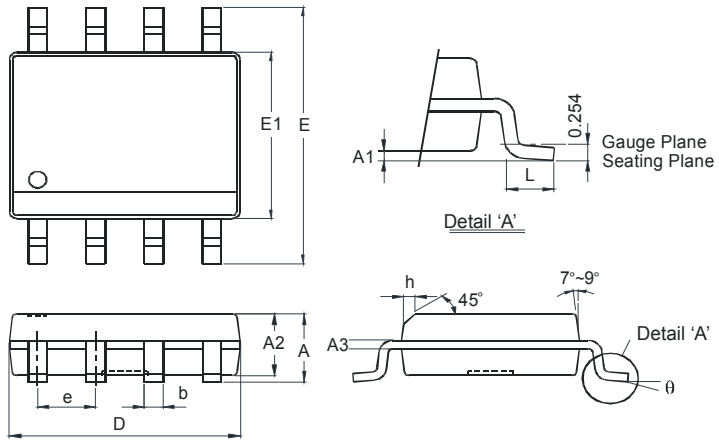


Fig. 11 Gate-Charge Characteristics

Package Outline Dimensions

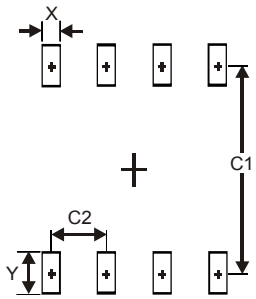
Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for latest version.



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