

**20V N-CHANNEL ENHANCEMENT MODE MOSFET**
**Product Summary**

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

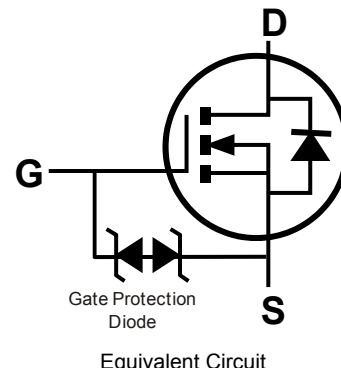
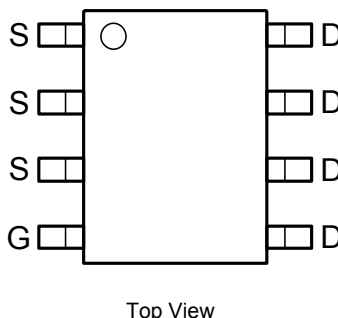
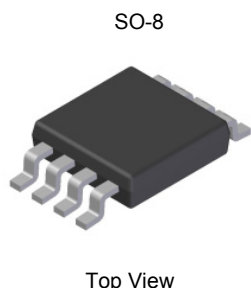
- Battery charging
- Power management functions
- DC-DC converters
- Portable power adaptors

**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**

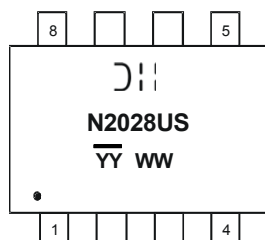
**Mechanical Data**

- 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)

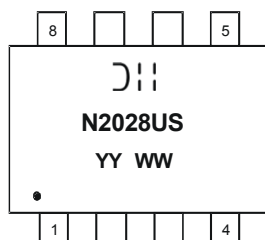

**Ordering Information** (Note 4)

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<sub>A</sub> = +25°C, unless otherwise specified.)

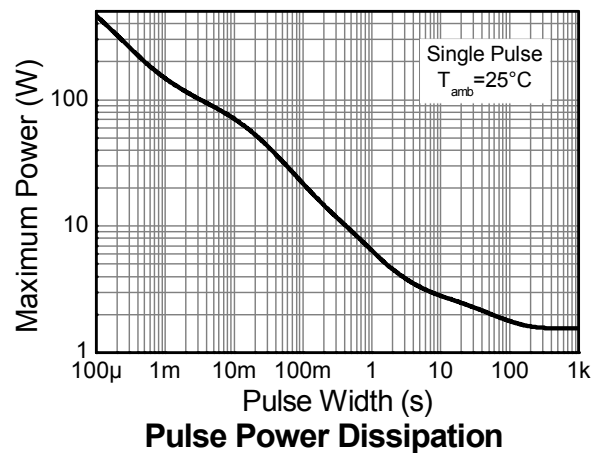
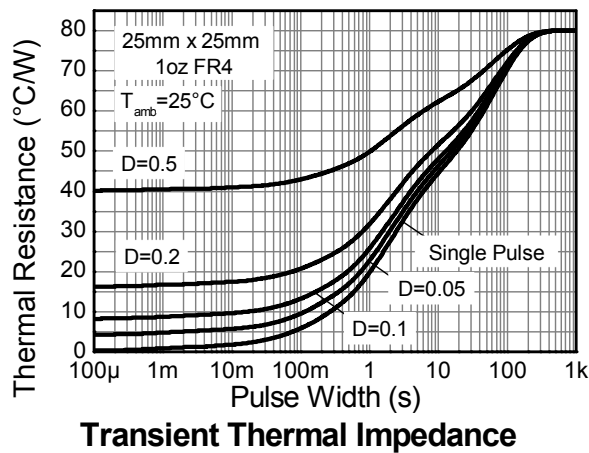
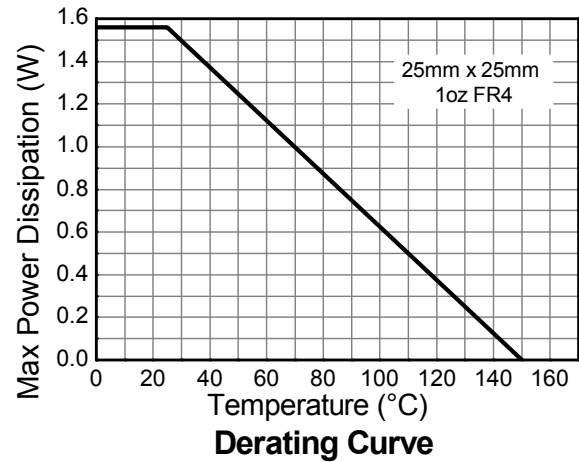
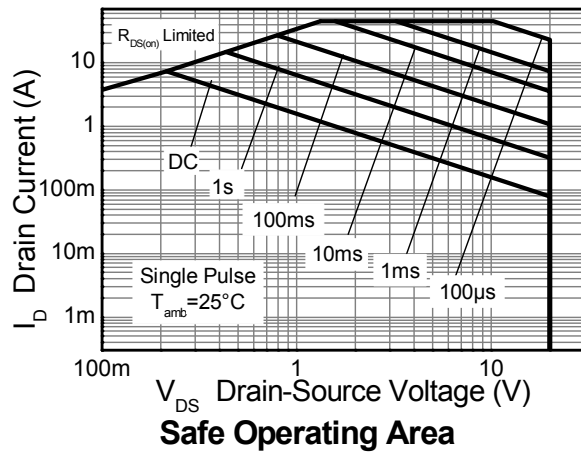
Characteristic			Symbol	Value	Unit
Drain-Source voltage			V <sub>DSS</sub>	20	V
Gate-Source voltage			V <sub>GS</sub>	±12	
Continuous Drain current	V <sub>GS</sub> = 4.5V	(Note 6)	I <sub>D</sub>	9.8	A
		T <sub>A</sub> = +70°C (Note 6)		7.9	
		(Note 5)		7.3	
Pulsed Drain current	V <sub>GS</sub> = 4.5V	(Note 7)	I <sub>DM</sub>	45.0	
Continuous Source current (Body diode)		(Note 6)	I <sub>S</sub>	6.0	
Pulsed Source current (Body diode)		(Note 7)	I <sub>SM</sub>	45.0	

**Thermal Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Characteristic		Symbol	Value	Unit
Power dissipation	(Note 5)	P <sub>D</sub>	1.56	W
			12.5	
Linear derating factor	(Note 6)		2.81	mW/°C
			22.5	
Thermal Resistance, Junction to Ambient	(Note 5)	R <sub>θJA</sub>	80.0	°C/W
	(Note 6)		44.5	
Thermal Resistance, Junction to Lead	(Note 8)	R <sub>θJL</sub>	37.0	
Operating and storage temperature range		T <sub>J</sub> , T <sub>STG</sub>	-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



# Electrical Characteristics (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
<b>OFF CHARACTERISTICS</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	20	-	-	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	-	-	1.0	μA	V <sub>DS</sub> = 20V, V <sub>GS</sub> = 0V
Gate-Source Leakage	I <sub>GSS</sub>	-	-	±10	μA	V <sub>GS</sub> = ±12V, V <sub>DS</sub> = 0V
<b>ON CHARACTERISTICS</b>						
Gate Threshold Voltage	V <sub>GS(th)</sub>	0.6	1.0	1.3	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA
Static Drain-Source On-Resistance (Note 9)	R <sub>DS(on)</sub>	-	11	20	mΩ	V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 9.4A
			15	28		V <sub>GS</sub> = 2.5V, I <sub>D</sub> = 8.3A
Forward Transfer Admittance (Note 9 & 10)	Y <sub>fs</sub>	-	16	-	S	V <sub>DS</sub> = 5V, I <sub>D</sub> = 9.4A
Diode Forward Voltage (Note 9)	V <sub>SD</sub>	-	0.7	1.3	V	V <sub>GS</sub> = 0V, I <sub>S</sub> = 1.3A
<b>DYNAMIC CHARACTERISTICS (Note 10)</b>						
Input Capacitance	C <sub>iss</sub>	-	1000	-	pF	V <sub>DS</sub> = 10V, V <sub>GS</sub> = 0V, f = 1.0MHz
Output Capacitance	C <sub>oss</sub>	-	166	-		
Reverse Transfer Capacitance	C <sub>rss</sub>	-	158	-		
Gate Resistance	R <sub>g</sub>	-	1.51	-	Ω	V <sub>DS</sub> = 0V, V <sub>GS</sub> = 0V, f = 1MHz
Total Gate Charge (Note 11)	Q <sub>g</sub>	-	7.0	-	nC	V <sub>DS</sub> = 10V I <sub>D</sub> = 9.4A
Total Gate Charge (Note 11)	Q <sub>g</sub>	-	11.6	-		
Gate-Source Charge (Note 11)	Q <sub>gs</sub>	-	2.7	-		
Gate-Drain Charge (Note 11)	Q <sub>gd</sub>	-	3.4	-		
Turn-On Delay Time (Note 11)	t <sub>D(on)</sub>	-	11.67	-	ns	V <sub>GS</sub> = 4.5V, V <sub>DS</sub> = 10V, R <sub>G</sub> = 6Ω, I <sub>D</sub> = 1A
Turn-On Rise Time (Note 11)	t <sub>r</sub>	-	12.49	-		
Turn-Off Delay Time (Note 11)	t <sub>D(off)</sub>	-	35.89	-		
Turn-Off Fall Time (Note 11)	t <sub>f</sub>	-	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.

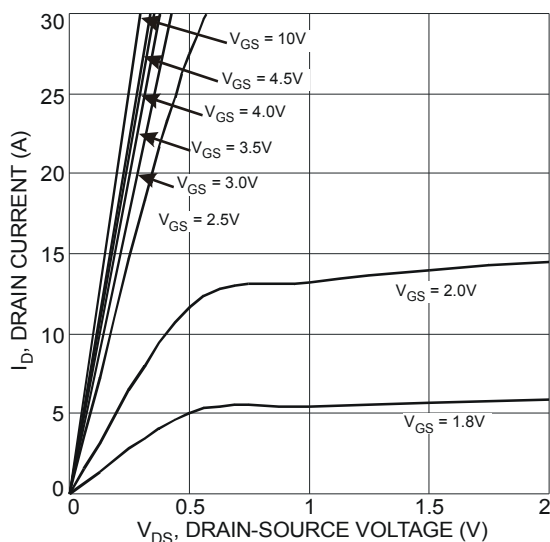


Fig. 1 Typical Output Characteristic

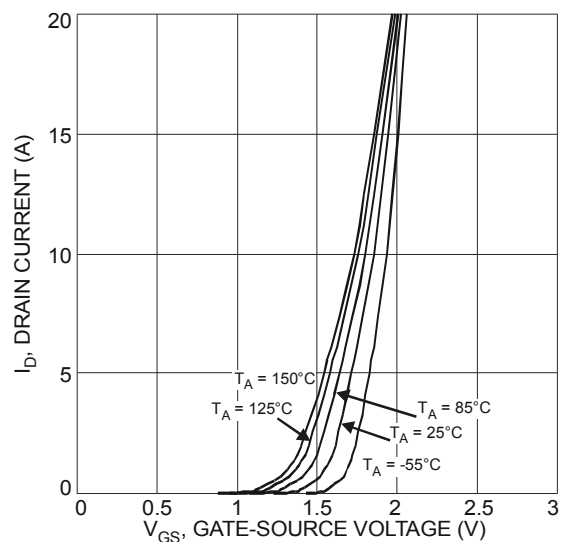


Fig. 2 Typical Transfer Characteristic

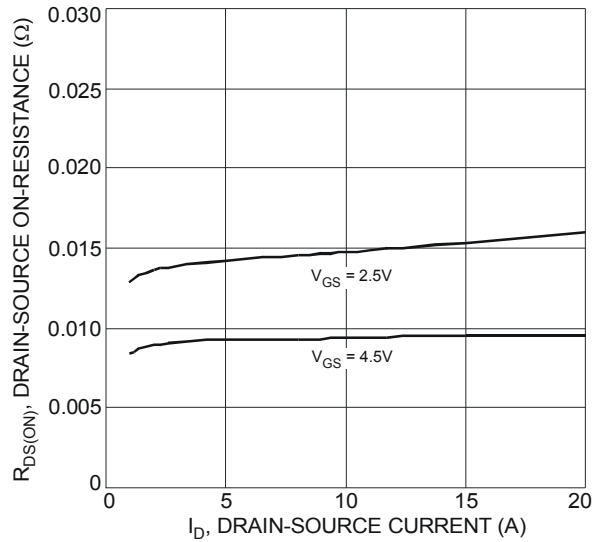


Fig. 3 Typical On-Resistance vs. Drain Current and Gate Voltage

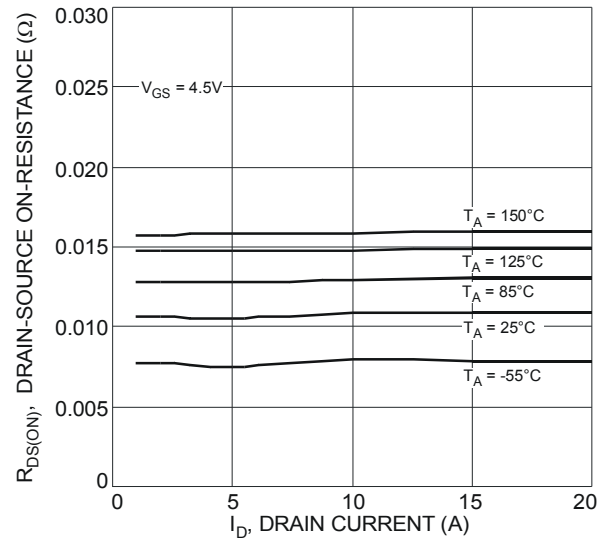


Fig. 4 Typical On-Resistance vs. Drain Current and Temperature

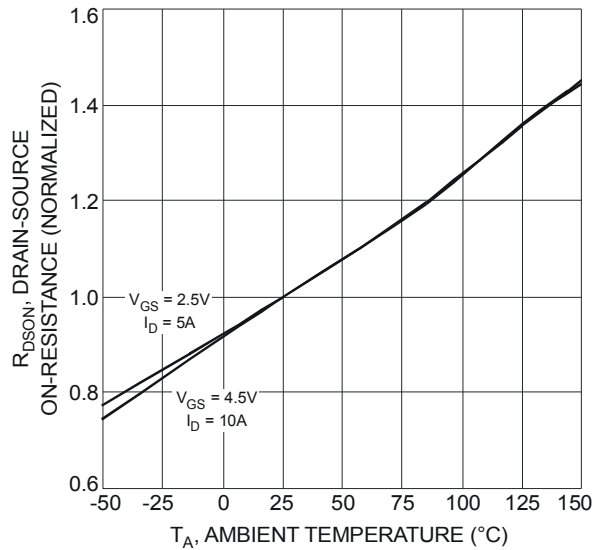


Fig. 5 On-Resistance Variation with Temperature

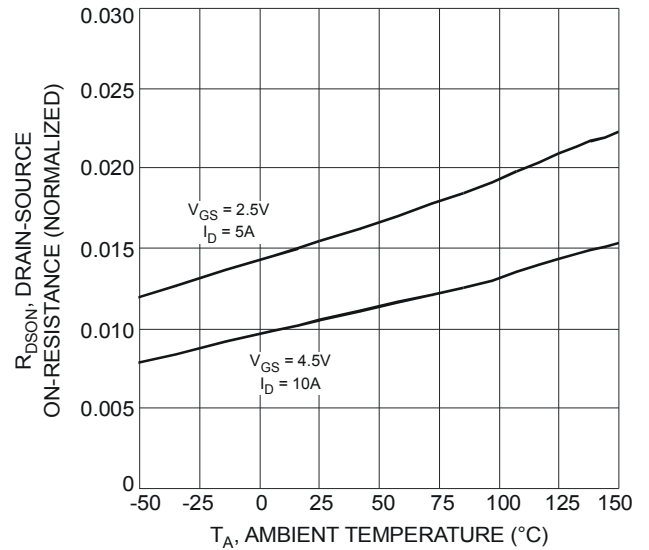


Fig. 6 On-Resistance Variation with Temperature

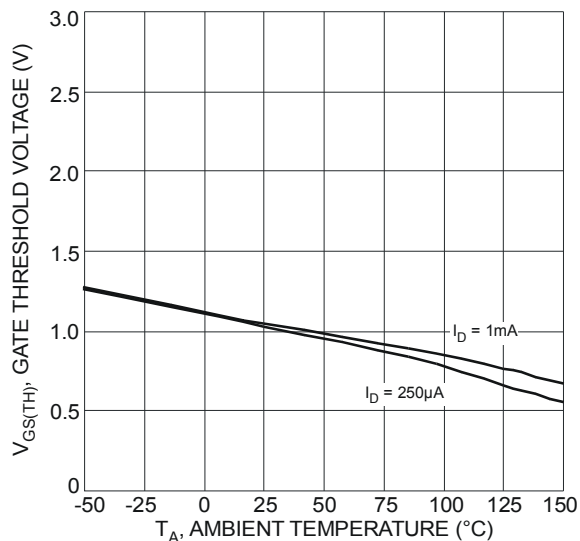


Fig. 7 Gate Threshold Variation vs. Ambient Temperature

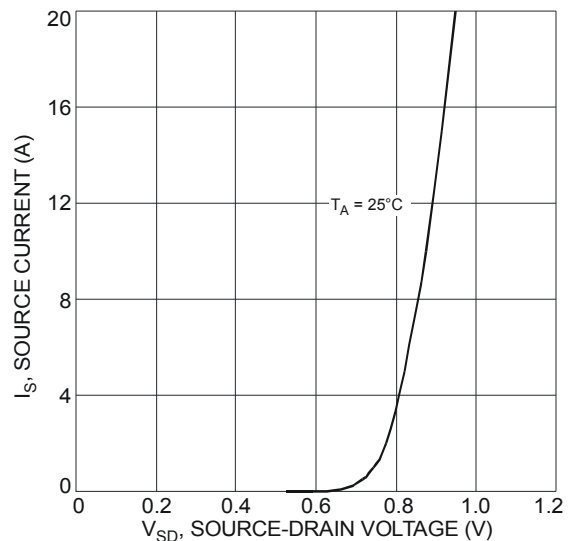
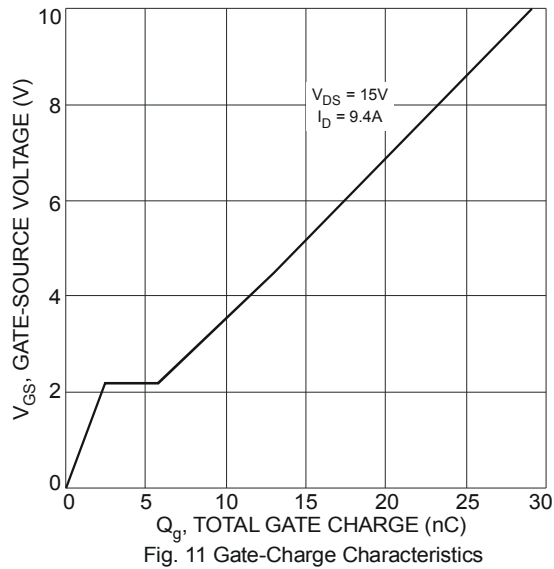
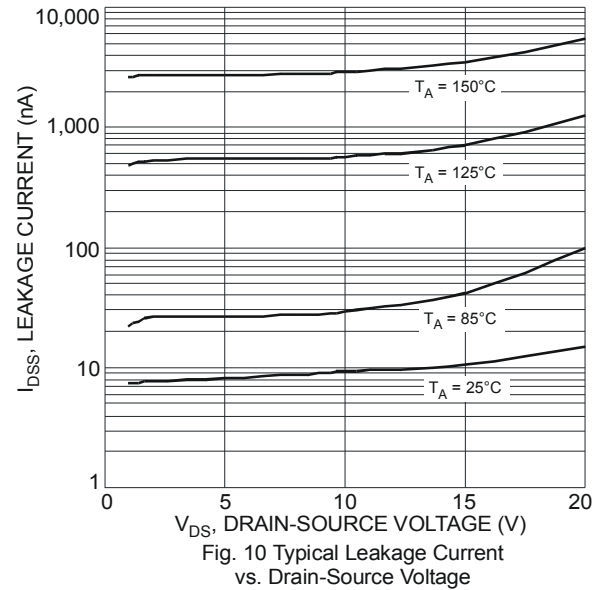
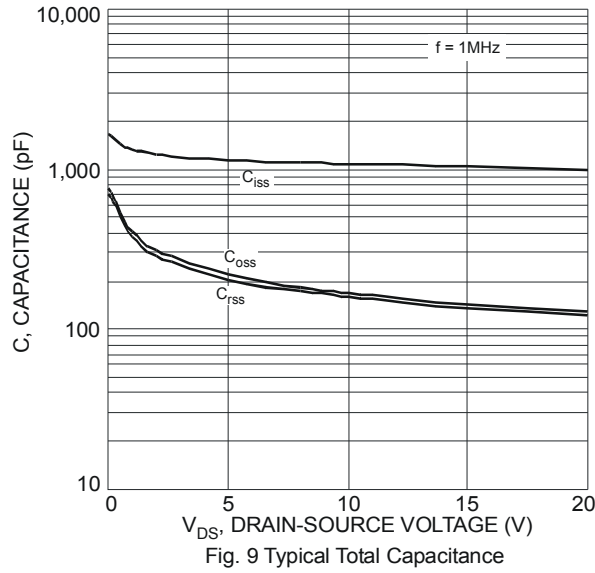
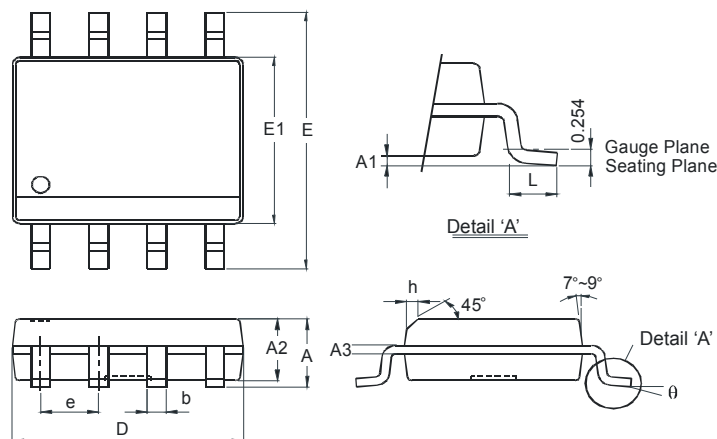


Fig. 8 Diode Forward Voltage vs. Current



## Package Outline Dimensions

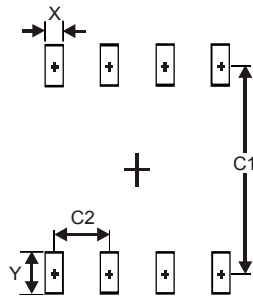
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.



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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