

**40V COMPLEMENTARY ENHANCEMENT MODE MOSFET H-BRIDGE**

**Product Summary**

Device	$V_{(BR)DSS}$	$R_{DS(ON)} \text{ max}$	$I_D \text{ max}$ $T_A = +25^\circ\text{C}$
N-Channel	40V	45mΩ @ $V_{GS} = 10\text{V}$	4.5A
		58mΩ @ $V_{GS} = 4.5\text{V}$	4A
P-Channel	-40V	65mΩ @ $V_{GS} = -10\text{V}$	-3.7A
		100mΩ @ $V_{GS} = -4.5\text{V}$	-2.9A

**Description and Applications**


This new generation complementary MOSFET H-Bridge features 2 N and 2 P channel in an SOIC package. Qualified to AECQ101 the H bridge is ideally suited to driving :

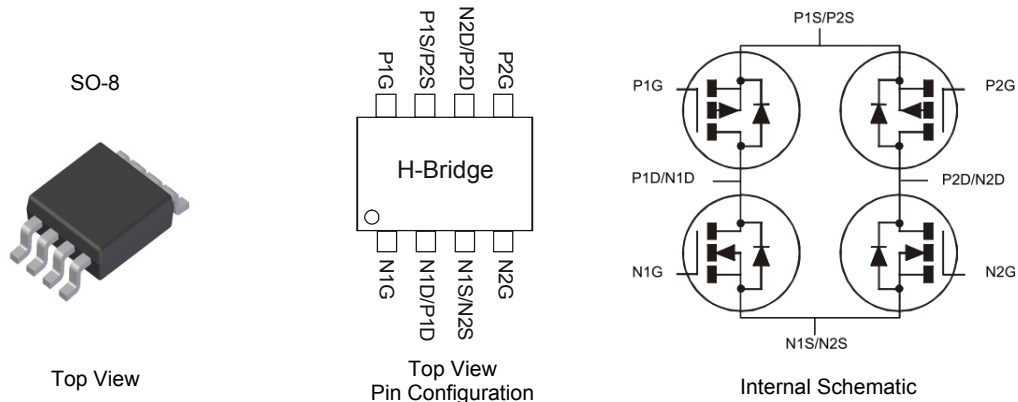
- Solenoids
- DC Motors
- Audio Outputs

**Features**

- 2 x N + 2 x P channels in a SOIC package
- Low On-Resistance
- Low Input Capacitance
- Fast Switching Speed
- **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**
- **PPAP Capable (Note 4)**

**Mechanical Data**

- Case: SO-8
- 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 
- Weight: 0.074 grams (approximate)

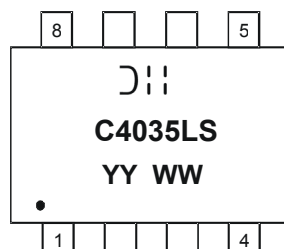


**Ordering Information (Note 5)**

Part Number	Compliance	Case	Packaging
DMHC4035LSDQ-13	Automotive	SO-8	2,500/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](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. Automotive products are AEC-Q101 qualified and are PPAP capable. Automotive, AEC-Q101 and standard products are electrically and thermally the same, except where specified. For more information, please refer to [http://www.diodes.com/quality/product\\_grade\\_definitions/](http://www.diodes.com/quality/product_grade_definitions/).
  5. For packaging details, go to our website at <http://www.diodes.com/products/packages.html>.

**Marking Information**



DII = Manufacturer's Marking  
C4035LS = Product Type Marking Code  
YYWW = Date Code Marking  
YY = Year (ex: 13 = 2013)  
WW = Week (01 - 53)

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

Characteristic		Symbol	Value	Units
Total Power Dissipation (Note 6)		P <sub>D</sub>	1.5	W
Thermal Resistance, Junction to Ambient (Note 6)	Steady State	R <sub>θJA</sub>	85	°C/W
	t < 10s		53	
Thermal Resistance, Junction to Case		R <sub>θJC</sub>	15	
Operating and Storage Temperature Range		T <sub>J</sub> , T <sub>STG</sub>	-55 to +150	°C

**Maximum Ratings N-CHANNEL** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Characteristic			Symbol	Value	Units
Drain-Source Voltage			V <sub>DSS</sub>	40	V
Gate-Source Voltage			V <sub>GSS</sub>	±20	V
Continuous Drain Current (Note 6) V <sub>GS</sub> = 10V	Steady State	T <sub>A</sub> = +25°C T <sub>A</sub> = +70°C	I <sub>D</sub>	4.5 3.5	A
	t < 10s	T <sub>A</sub> = +25°C T <sub>A</sub> = +70°C	I <sub>D</sub>	5.8 4.5	A
Continuous Drain Current (Note 6) V <sub>GS</sub> = 4.5V	Steady State	T <sub>A</sub> = +25°C T <sub>A</sub> = +70°C	I <sub>D</sub>	4 3.1	A
	t < 10s	T <sub>A</sub> = +25°C T <sub>A</sub> = +70°C	I <sub>D</sub>	5.1 4	A
Maximum Continuous Body Diode Forward Current (Note 6)			I <sub>S</sub>	1.5	A
Pulsed Drain Current (10μs pulse, duty cycle = 1%)			I <sub>DM</sub>	25	A

**Maximum Ratings P-CHANNEL** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Characteristic			Symbol	Value	Units
Drain-Source Voltage			V <sub>DSS</sub>	-40	V
Gate-Source Voltage			V <sub>GSS</sub>	±20	V
Continuous Drain Current (Note 6) V <sub>GS</sub> = -10V	Steady State	T <sub>A</sub> = +25°C T <sub>A</sub> = +70°C	I <sub>D</sub>	-3.7 -2.9	A
	t < 10s	T <sub>A</sub> = +25°C T <sub>A</sub> = +70°C	I <sub>D</sub>	-4.8 -3.8	A
Continuous Drain Current (Note 6) V <sub>GS</sub> = -4.5V	Steady State	T <sub>A</sub> = +25°C T <sub>A</sub> = +70°C	I <sub>D</sub>	-2.9 -2.3	A
	t < 10s	T <sub>A</sub> = +25°C T <sub>A</sub> = +70°C	I <sub>D</sub>	-3.9 -3.0	A
Maximum Continuous Body Diode Forward Current (Note 6)			I <sub>S</sub>	-1.5	A
Pulsed Drain Current (10μs pulse, duty cycle = 1%)			I <sub>DM</sub>	-15	A

Note: 6. Device mounted on FR-4 substrate PC board, 2oz copper, with 1inch square copper plate.

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

Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
<b>OFF CHARACTERISTICS (Note 7)</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	40	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	—	—	1	μA	V <sub>DS</sub> = 40V, V <sub>GS</sub> = 0V
Gate-Source Leakage	I <sub>GSS</sub>	—	—	±100	nA	V <sub>GS</sub> = ±20V, V <sub>DS</sub> = 0V
<b>ON CHARACTERISTICS (Note 7)</b>						
Gate Threshold Voltage	V <sub>GS(th)</sub>	1	—	3	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA
Static Drain-Source On-Resistance	R <sub>DS(on)</sub>	—	26	45	mΩ	V <sub>GS</sub> = 10V, I <sub>D</sub> = 3.9A
		—	35	58		V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 3.5A
Diode Forward Voltage	V <sub>SD</sub>	—	0.7	1	V	V <sub>GS</sub> = 0V, I <sub>S</sub> = 1.25A
<b>DYNAMIC CHARACTERISTICS (Note 8)</b>						
Input Capacitance	C <sub>iss</sub>	—	574	—	pF	V <sub>DS</sub> = 20V, V <sub>GS</sub> = 0V, f = 1MHz
Output Capacitance	C <sub>oss</sub>	—	87.8	—		
Reverse Transfer Capacitance	C <sub>rss</sub>	—	38.7	—		
Gate resistance	R <sub>g</sub>	—	1.6	—	Ω	V <sub>DS</sub> = 0V, V <sub>GS</sub> = 0V, f = 1MHz
Total Gate Charge (V <sub>GS</sub> = 4.5V)	Q <sub>g</sub>	—	5.9	—	nC	V <sub>DS</sub> = 20V, I <sub>D</sub> = 3.9A
Total Gate Charge (V <sub>GS</sub> = 10V)	Q <sub>g</sub>	—	12.5	—		
Gate-Source Charge	Q <sub>gs</sub>	—	1.7	—		
Gate-Drain Charge	Q <sub>gd</sub>	—	2.2	—		
Turn-On Delay Time	t <sub>D(on)</sub>	—	3.1	—	ns	V <sub>DD</sub> = 20V, V <sub>GS</sub> = 10V, R <sub>L</sub> = 20Ω, R <sub>G</sub> = 6Ω,
Turn-On Rise Time	t <sub>r</sub>	—	2.6	—		
Turn-Off Delay Time	t <sub>D(off)</sub>	—	15	—		
Turn-Off Fall Time	t <sub>f</sub>	—	5.5	—		
Reverse Recovery Time	t <sub>rr</sub>	—	6.5	—	ns	I <sub>F</sub> = 3.9A, di/dt = 500A/μs
Reverse Recovery Charge	Q <sub>rr</sub>	—	1.2	—	nC	

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

Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
<b>OFF CHARACTERISTICS (Note 7)</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	-40	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = -250μA
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	—	—	-1	μA	V <sub>DS</sub> = -40V, V <sub>GS</sub> = 0V
Gate-Source Leakage	I <sub>GSS</sub>	—	—	±100	nA	V <sub>GS</sub> = ±20V, V <sub>DS</sub> = 0V
<b>ON CHARACTERISTICS (Note 7)</b>						
Gate Threshold Voltage	V <sub>GS(th)</sub>	-1	—	-3	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250μA
Static Drain-Source On-Resistance	R <sub>DS(on)</sub>	—	49	65	mΩ	V <sub>GS</sub> = -10V, I <sub>D</sub> = -4.2A
		—	73	100		V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -3.3A
Diode Forward Voltage	V <sub>SD</sub>	—	-0.7	-1.2	V	V <sub>GS</sub> = 0V, I <sub>S</sub> = -1A
<b>DYNAMIC CHARACTERISTICS (Note 8)</b>						
Input Capacitance	C <sub>iss</sub>	—	587	—	pF	V <sub>DS</sub> = -20V, V <sub>GS</sub> = 0V, f = 1MHz
Output Capacitance	C <sub>oss</sub>	—	88.1	—	pF	
Reverse Transfer Capacitance	C <sub>rss</sub>	—	40.2	—	pF	
Gate resistance	R <sub>g</sub>	—	12.3	—	Ω	V <sub>DS</sub> = 0V, V <sub>GS</sub> = 0V, f = 1MHz
Total Gate Charge (V <sub>GS</sub> = -4.5V)	Q <sub>g</sub>	—	5.4	—	nC	V <sub>DS</sub> = -20V, I <sub>D</sub> = -4.2A
Total Gate Charge (V <sub>GS</sub> = -10V)	Q <sub>g</sub>	—	11.1	—		
Gate-Source Charge	Q <sub>gs</sub>	—	1.5	—		
Gate-Drain Charge	Q <sub>gd</sub>	—	2	—		
Turn-On Delay Time	t <sub>D(on)</sub>	—	3.6	—	ns	V <sub>DD</sub> = -15V, V <sub>GS</sub> = -10V, R <sub>G</sub> = 6Ω, I <sub>D</sub> = -1A
Turn-On Rise Time	t <sub>r</sub>	—	2.9	—	ns	
Turn-Off Delay Time	t <sub>D(off)</sub>	—	36.3	—	ns	
Turn-Off Fall Time	t <sub>f</sub>	—	15.3	—	ns	
Reverse Recovery Time	t <sub>rr</sub>	—	15.5	—	ns	I <sub>F</sub> = -4.2A, di/dt = 500A/μs
Reverse Recovery Charge	Q <sub>rr</sub>	—	16.9	—	nC	

Notes: 7. Short duration pulse test used to minimize self-heating effect.  
8. Guaranteed by design. Not subject to product testing.

# Typical Characteristics - N-CHANNEL

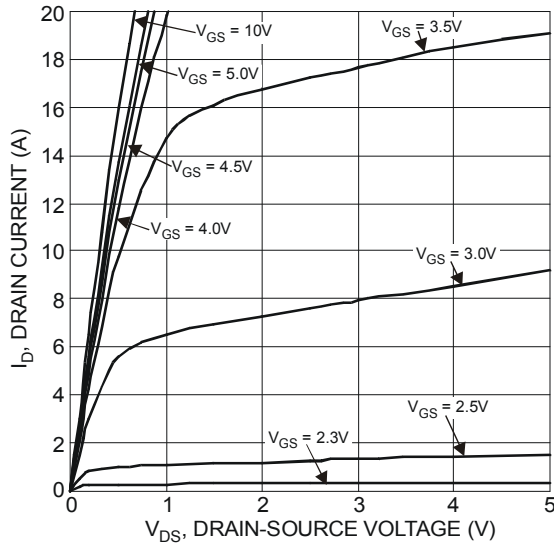


Figure 1 Typical Output Characteristics

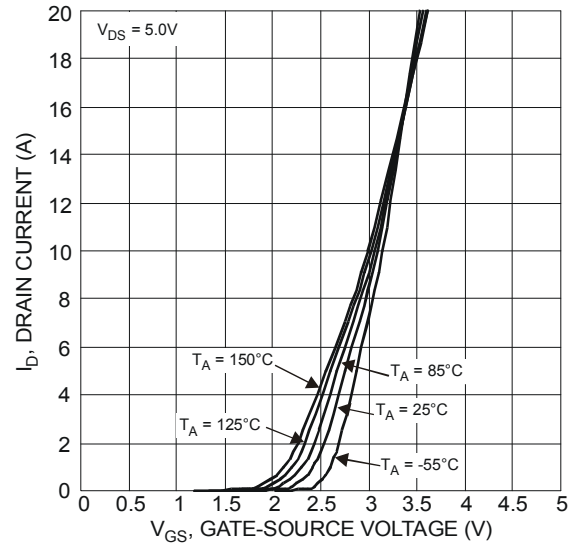


Figure 2 Typical Transfer Characteristics

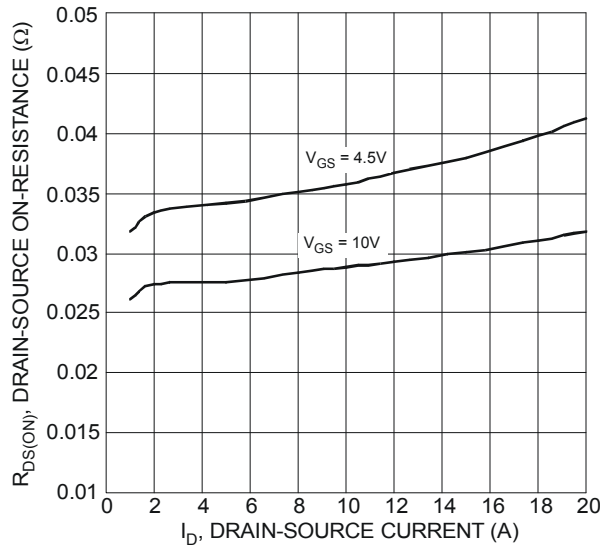


Figure 3 Typical On-Resistance vs. Drain Current and Gate Voltage

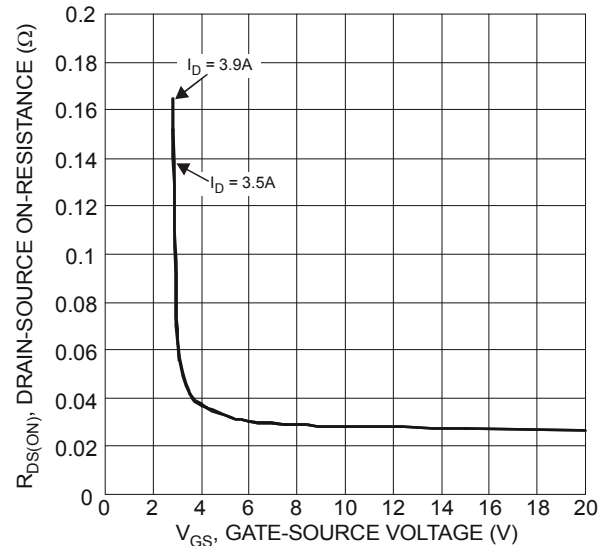


Figure 4 Typical Transfer Characteristics

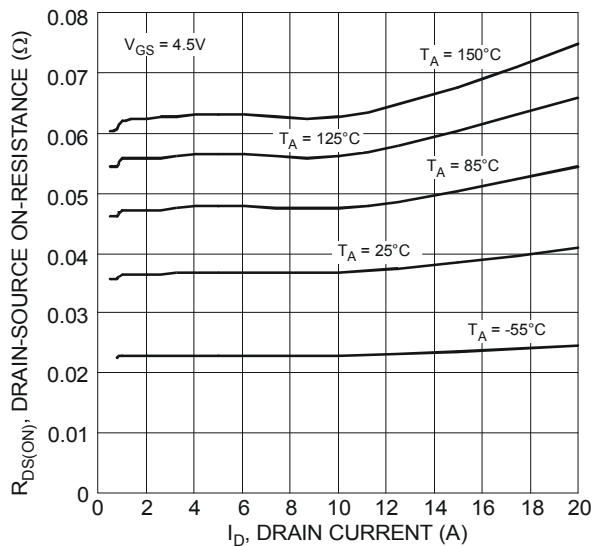


Figure 5 Typical On-Resistance vs. Drain Current and Temperature

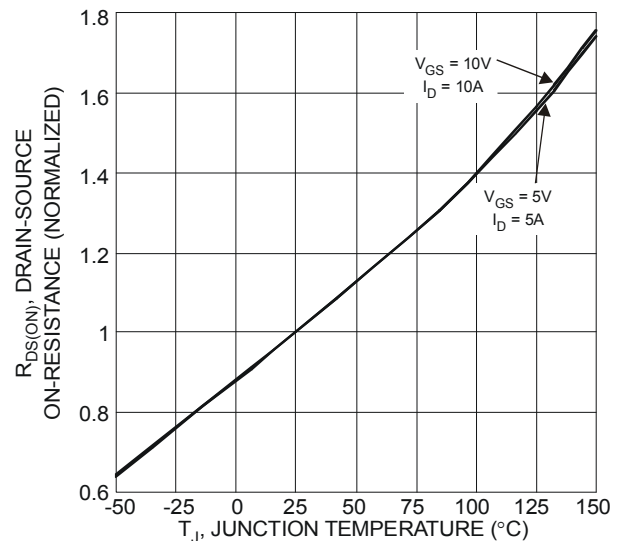


Figure 6 On-Resistance Variation with Temperature

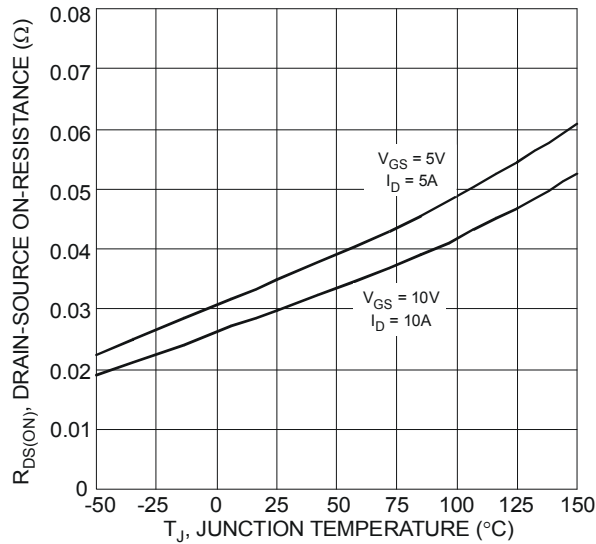


Figure 7 On-Resistance Variation with Temperature

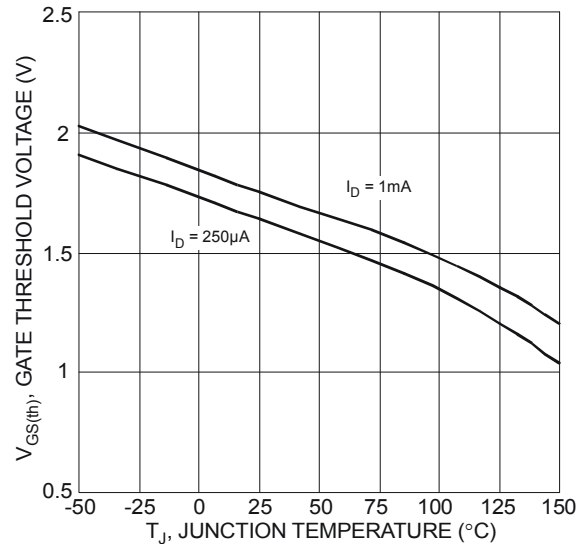


Figure 8 Gate Threshold Variation vs. Ambient Temperature

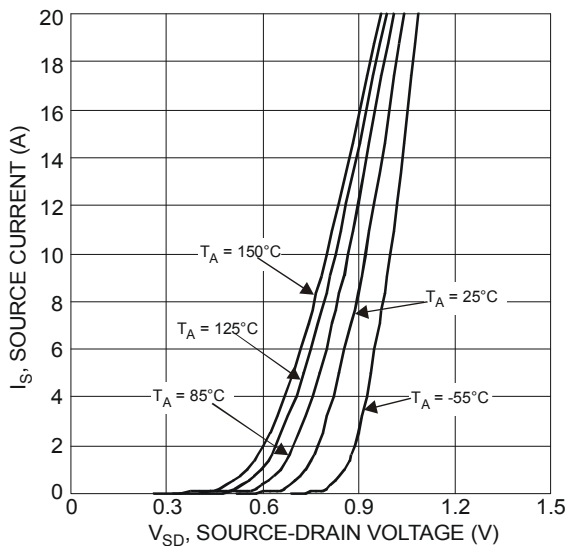


Figure 9 Diode Forward Voltage vs. Current

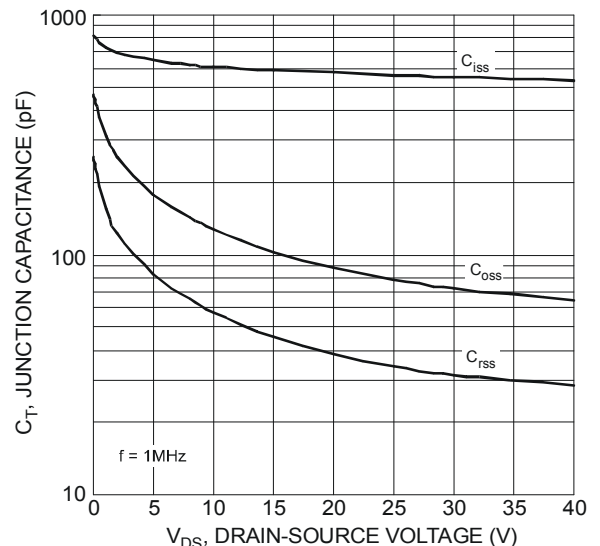


Figure 10 Typical Junction Capacitance

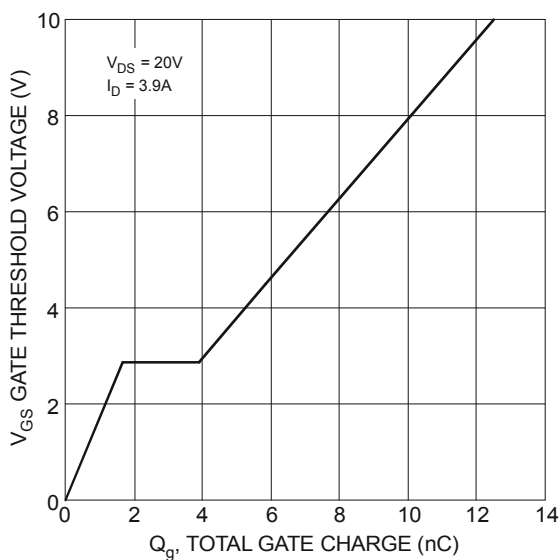


Figure 11 Gate Charge

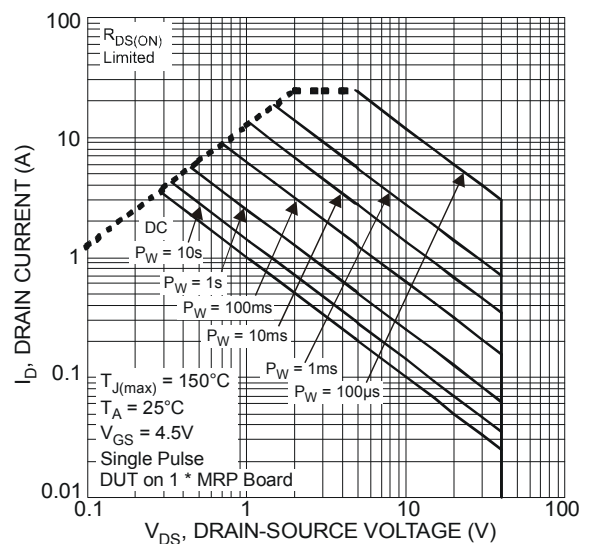


Figure 12 SOA, Safe Operation Area

Typical Characteristics - P-CHANNEL

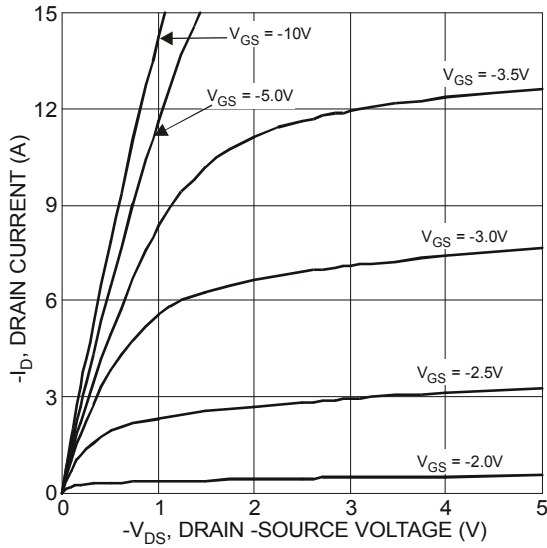


Figure 13 Typical Output Characteristics

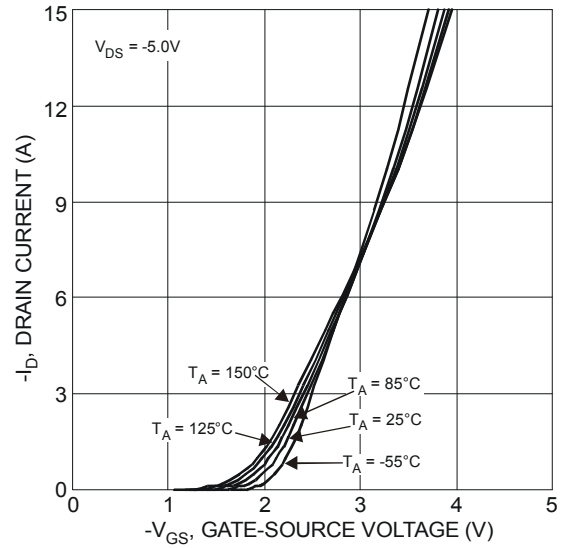


Figure 14 Typical Transfer Characteristics

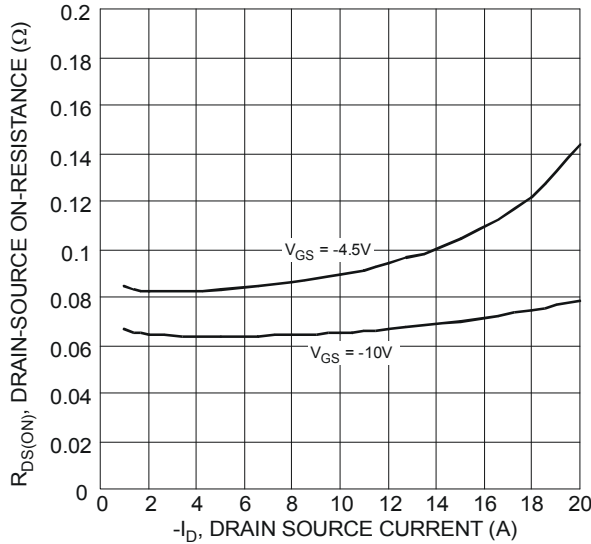


Figure 15 Typical On-Resistance vs. Drain Current and Gate Voltage

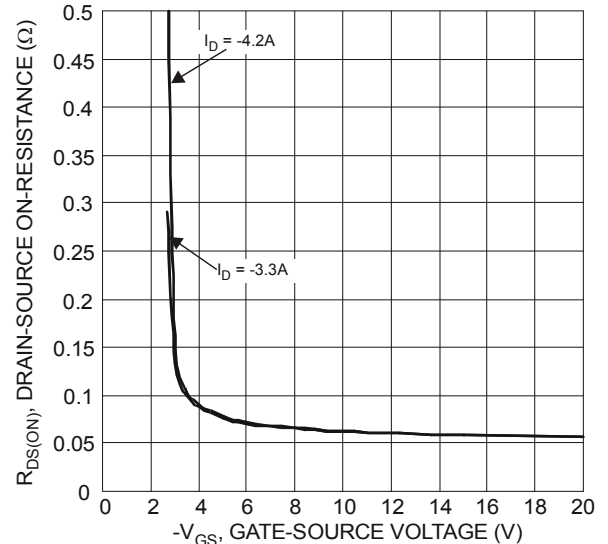


Figure 16 Typical Transfer Characteristics

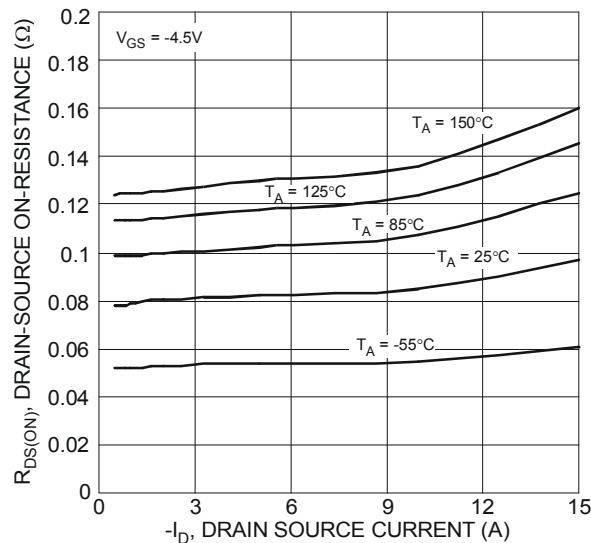


Figure 17 Typical On-Resistance vs. Drain Current and Temperature

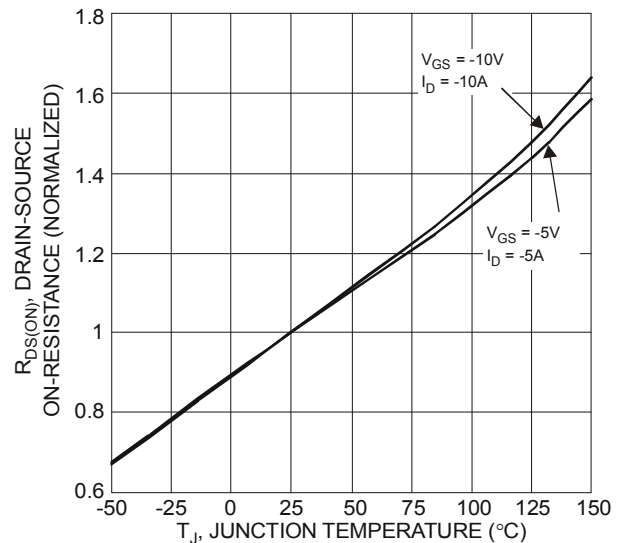


Figure 18 On-Resistance Variation with Temperature

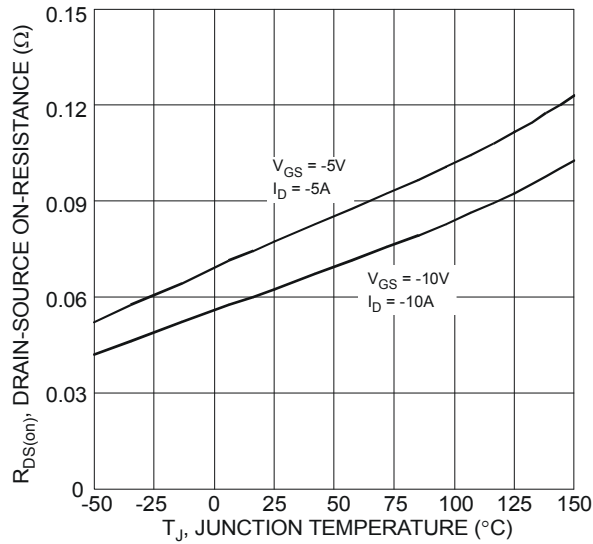


Figure 19 On-Resistance Variation with Temperature

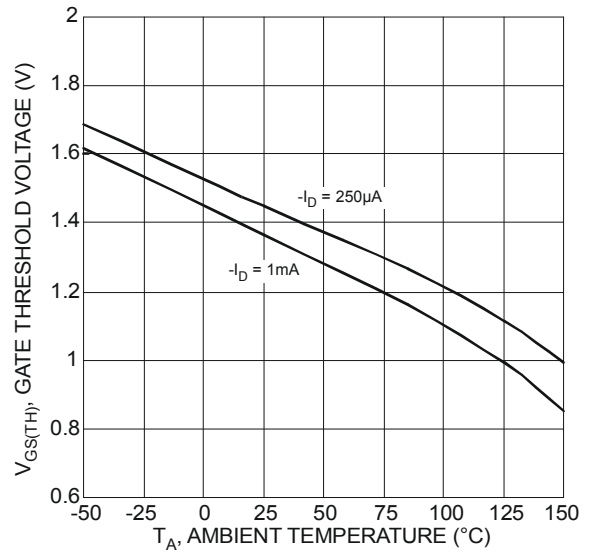


Figure 20 Gate Threshold Variation vs. Ambient Temperature

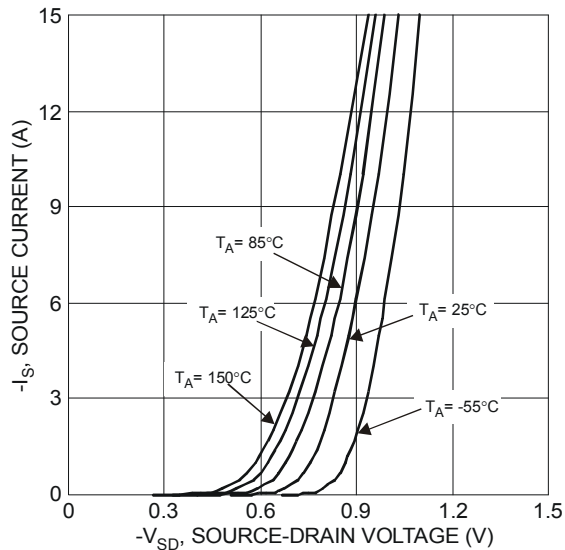


Figure 21 Diode Forward Voltage vs. Current

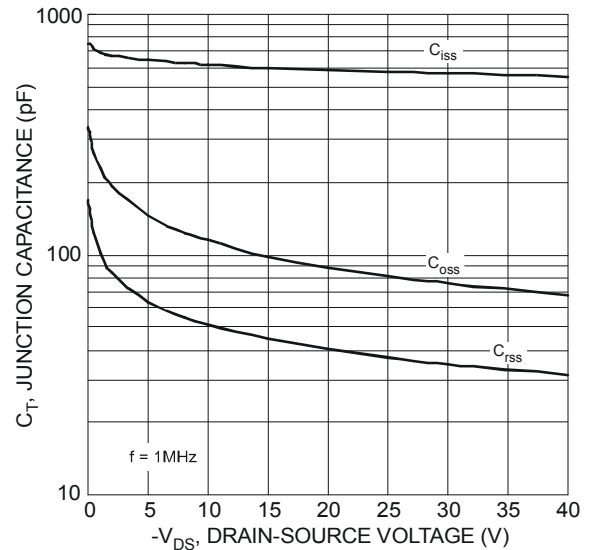


Figure 22 Typical Junction Capacitance

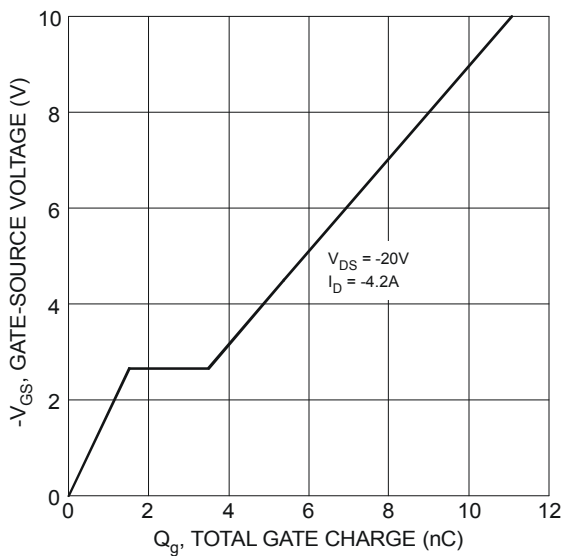


Figure 23 Gate-Charge Characteristics

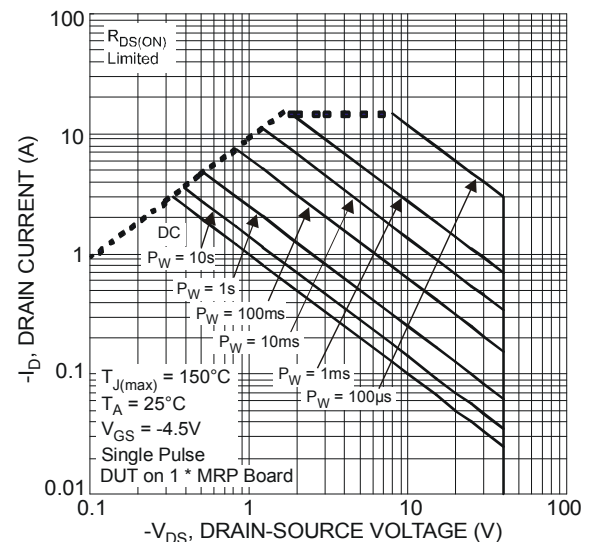
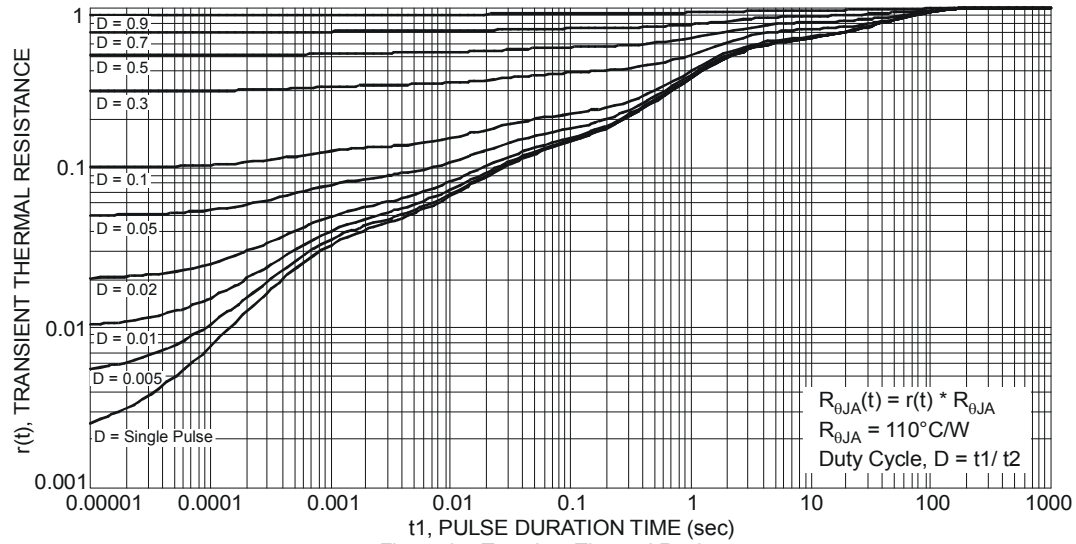
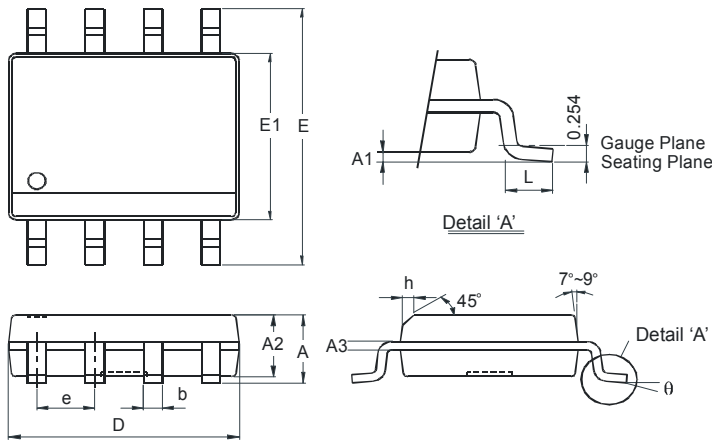


Figure 24 SOA, Safe Operation Area



## Package Outline Dimensions

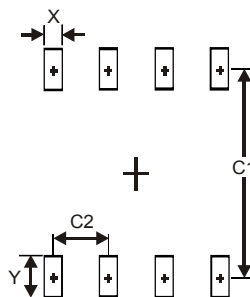
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.



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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