40V COMPLEMENTARY DUAL ENHANCEMENT MODE MOSFET

Product Summary

Device	$V_{(BR)DSS}$	$R_{DS(on)}$ Max	I_D T_A = +25°C
Q1	40V	28mΩ @ V_{GS}= 10V	7.2A
		49mΩ @ V_{GS}= 4.5V	5.4A
Q2	-40V	50mΩ @ V_{GS}= -10V	-5.2A
		79mΩ @ V_{GS}= -4.5V	-4.7A

Description

This MOSFET has been designed to minimize the on-state resistance and yet maintain superior switching performance, making it ideal for high efficiency power management applications.

Applications

- Motor Control
- Backlighting
- DC-DC Converters
- Power Management Functions

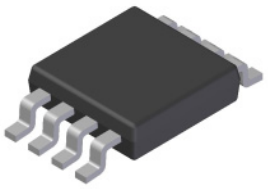
Features and Benefits

- Low On-Resistance
- 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**

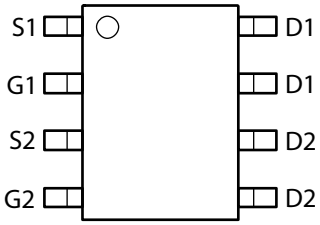
Mechanical Data

- Case: SO-8
- Case Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals Connections: See diagram below
- Terminals: Finish - Matte Tin annealed over Copper lead frame. Solderable per MIL-STD-202, Method 208 (e3)
- Weight: 0.074 grams (approximate)

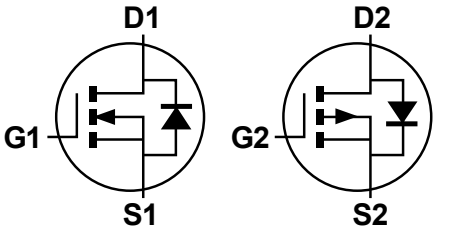
SO-8



Top View



Top View



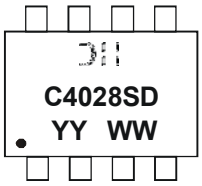
Equivalent Circuit

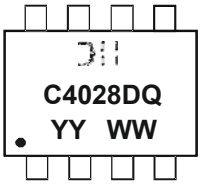
Ordering Information (Note 4)

Part Number	Compliance	Case	Packaging
DMC4028SSD-13	Standard	SO-8	2500 / Tape & Reel
DMC4028SSDQ-13	Automotive	SO-8	2500 / 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 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





= Manufacturer's Marking
C4028SD = Product Type Marking Code for DMC4028SSD-13
C4028DQ = Product Type Marking Code for DMC4028SSDQ-13
YYWW = Date Code Marking
YY = Year (ex: 09 = 2009)
WW = Week (01 - 53)

Maximum Ratings (@T_A = +25°C, unless otherwise specified.)

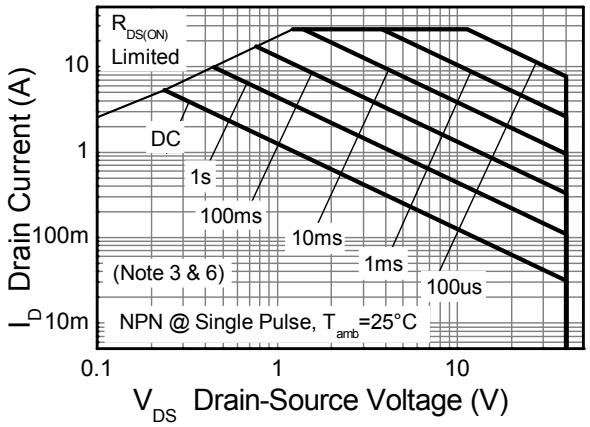
Characteristic			Symbol	N-Channel - Q1	P-Channel - Q2	Units
Drain-Source Voltage			V_{DSS}	40	-40	V
Gate-Source Voltage		(Note 5)	V_{GSS}	±20	±20	V
Continuous Drain Current	V_{GS} = 10V	(Notes 7 & 9)	I_D	7.2	5.2	A
		T_A = 70°C (Notes 7 & 9)		5.5	4.2	
		(Notes 6 & 9)		5.4	4	
		(Notes 6 & 10)		6.5	4.8	
Pulsed Drain Current	V_{GS} = 10V	(Notes 7 & 9)	I_{DM}	27.3	20.4	A
Continuous Source Current (Body diode)		(Notes 7 & 9)	I_S	3.35	3.15	A
Pulsed Source Current (Body diode)		(Notes 8 & 9)	I_{SM}	27.3	20.4	A

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

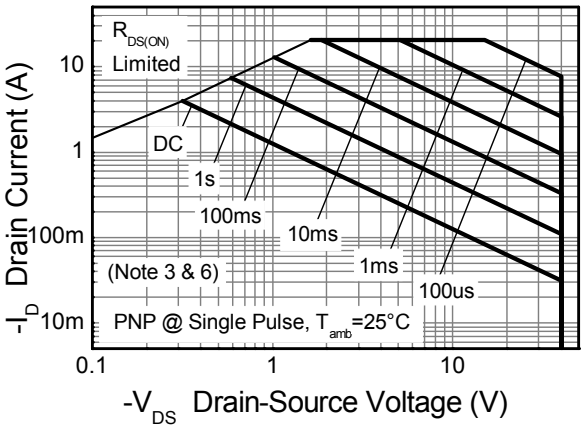
Characteristic		Symbol	N-Channel - Q1	P-Channel - Q2	Unit
Power Dissipation Linear Derating Factor	(Notes 6 & 9)	P_D	1.25 10		W mW/°C
	(Notes 6 & 10)		1.8 14.3		
	(Notes 7 & 9)		2.16 17.2		
Thermal Resistance, Junction to Ambient	(Notes 6 & 9)	$R_{\theta JA}$	100		°C/W
	(Notes 6 & 10)		70		
	(Notes 7 & 9)		58		
Thermal Resistance, Junction to Lead	(Notes 9 & 11)	$R_{\theta JL}$	53	53	
Operating and Storage Temperature Range		T_J, T_{STG}	-55 to +150		°C

Notes:
5. AEC-Q101 V_{GS} maximum is ±16V.
6. 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.
7. Same as note (5), except the device is measured at t ≤ 10 sec.
8. Same as note (5), except the device is pulsed with D= 0.02 and pulse width 300 µs. The pulse current is limited by the maximum junction temperature.
9. For a dual device with one active die.
10. For a device with two active die running at equal power.
11. Thermal resistance from junction to solder-point (at the end of the drain lead).

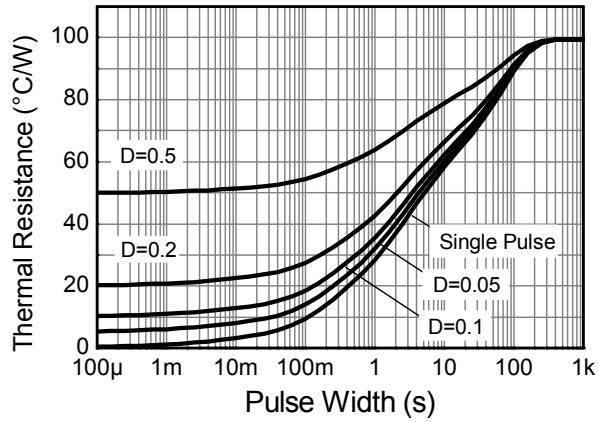
Thermal Characteristics



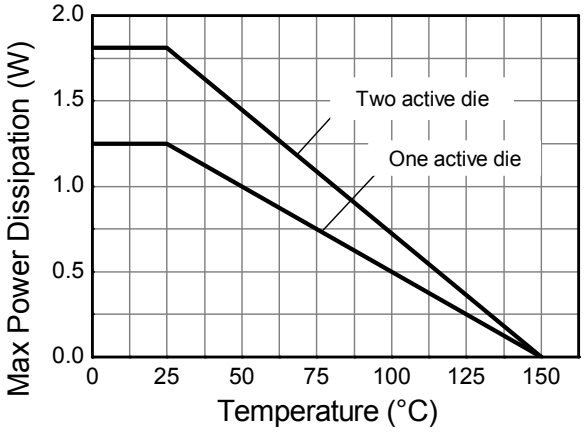
N-channel Safe Operating Area



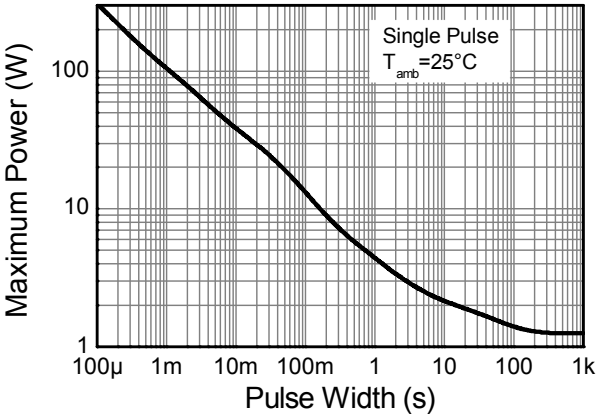
P-channel Safe Operating Area



Transient Thermal Impedance



Derating Curve



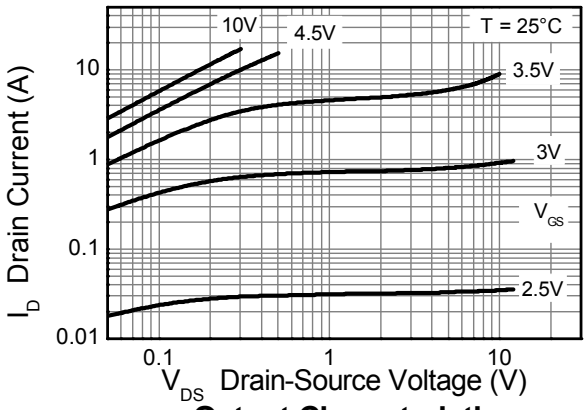
Pulse Power Dissipation

Electrical Characteristics – Q1 N-Channel (@T_A = +25°C, unless otherwise specified.)

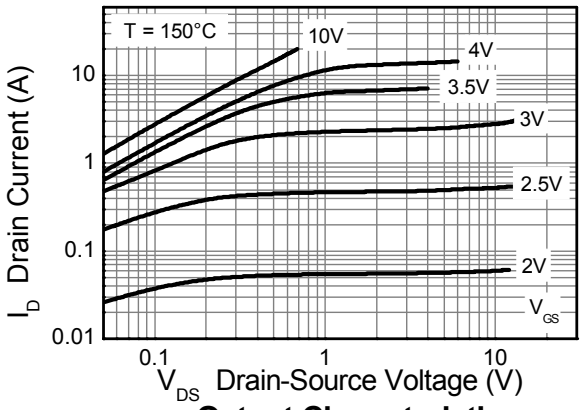
Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
OFF CHARACTERISTICS						
Drain-Source Breakdown Voltage	BV_{DSS}	40	—	—	V	I_D = 250μA, V_{GS} = 0V
Zero Gate Voltage Drain Current	I_{DSS}	—	—	0.5	μA	V_{DS} = 40V, V_{GS} = 0V
Gate-Source Leakage	I_{GSS}	—	—	±100	nA	V_{GS} = ±20V, V_{DS} = 0V
ON CHARACTERISTICS						
Gate Threshold Voltage	$V_{GS(th)}$	1.0	—	3.0	V	I_D = 250μA, V_{DS} = V_{GS}
Static Drain-Source On-Resistance (Note 12)	$R_{DS\ (ON)}$	—	0.018	0.028	Ω	V_{GS} = 10V, I_D = 6A
			0.033	0.049		V_{GS} = 4.5V, I_D = 5A
Forward Transconductance (Notes 12 & 13)	g_{fs}	—	22.8	—	S	V_{DS} = 15V, I_D = 6A
Diode Forward Voltage (Note 12)	V_{SD}	—	0.845	1.1	V	I_S = 6A, V_{GS} = 0V
Reverse recovery time (Note 13)	t_{rr}		135	—	ns	I_S = 6A, di/dt = 100A/μs
Reverse recovery charge (Note 13)	Q_{rr}	—	799	—	nC	
DYNAMIC CHARACTERISTICS (Note 13)						
Input Capacitance	C_{iss}	—	604	—	pF	V_{DS} = 20V, V_{GS} = 0V f = 1MHz
Output Capacitance	C_{oss}	—	106	—	pF	
Reverse Transfer Capacitance	C_{rss}	—	59.6	—	pF	
Total Gate Charge (Note 14)	Q_g	—	6.5	—	nC	V_{GS} = 4.5V; V_{DS} = 20V, I_D = 6A
Total Gate Charge (Note 14)	Q_g	—	12.9	—	nC	V_{GS} = 10V; V_{DS} = 20V, I_D = 6A
Gate-Source Charge (Note 14)	Q_{gs}	—	2.3	—	nC	V_{GS} = 10V; V_{DS} = 20V, I_D = 6A
Gate-Drain Charge (Note 14)	Q_{gd}	—	3.6	—	nC	V_{GS} = 10V; V_{DS} = 20V, I_D = 6A
Turn-On Delay Time (Note 14)	$t_{D(on)}$	—	4.2	—	ns	V_{DD} = 20V, V_{GS} = 10V I_D = 6A, $R_G \cong$ 6.0Ω
Turn-On Rise Time (Note 14)	t_r	—	12.4	—	ns	
Turn-Off Delay Time (Note 14)	$t_{D(off)}$	—	13.8	—	ns	
Turn-Off Fall Time (Note 14)	t_f	—	10.7	—	ns	

Notes: 12. Measured under pulsed conditions. Pulse width ≤ 300μs; duty cycle ≤ 2%
13. For design aid only, not subject to production testing.
14. Switching characteristics are independent of operating junction temperatures.

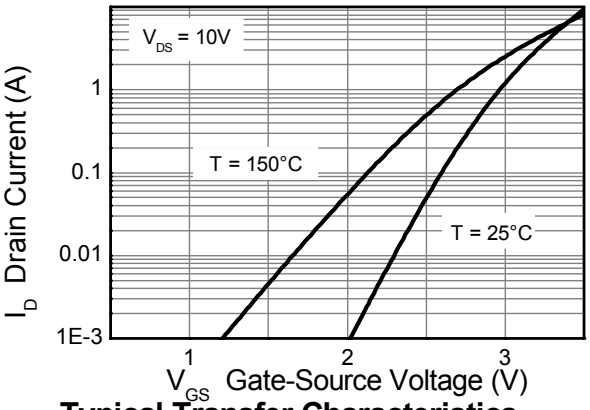
Typical Characteristics – Q1 N-Channel



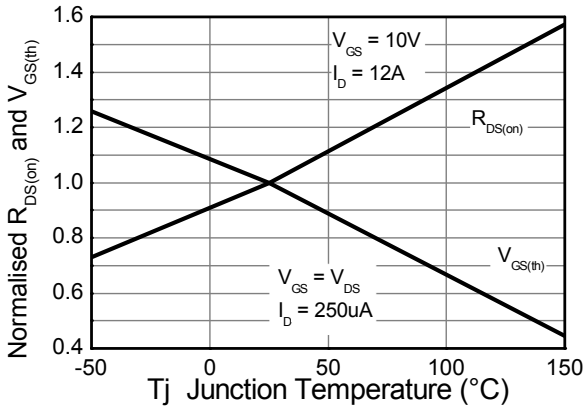
Output Characteristics



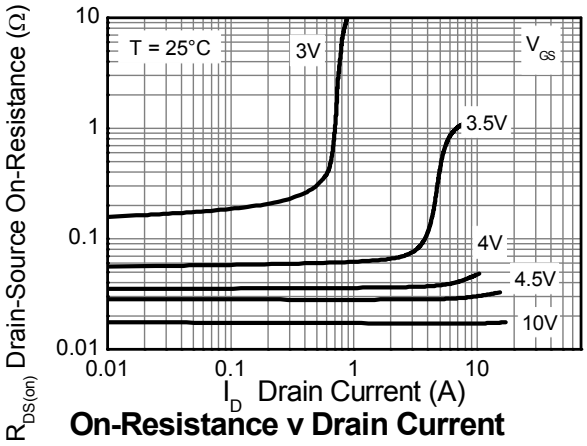
Output Characteristics



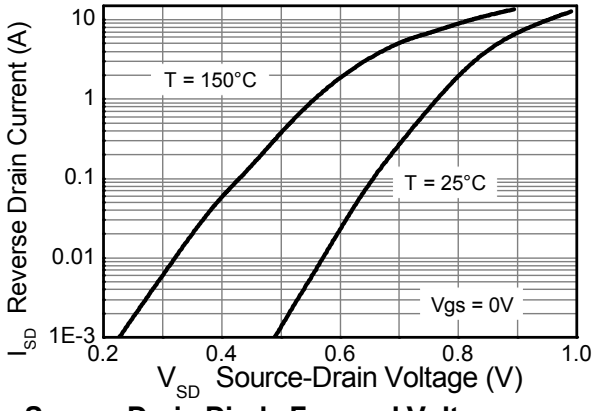
Typical Transfer Characteristics



Normalised Curves v Temperature

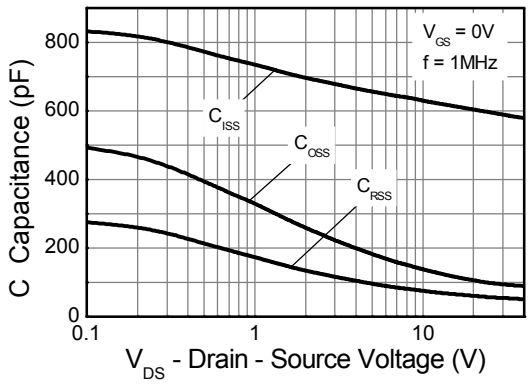


On-Resistance v Drain Current

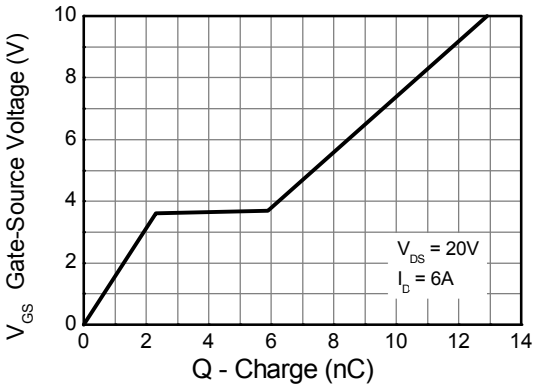


Source-Drain Diode Forward Voltage

Typical Characteristics – Q1 N-Channel - (cont.)

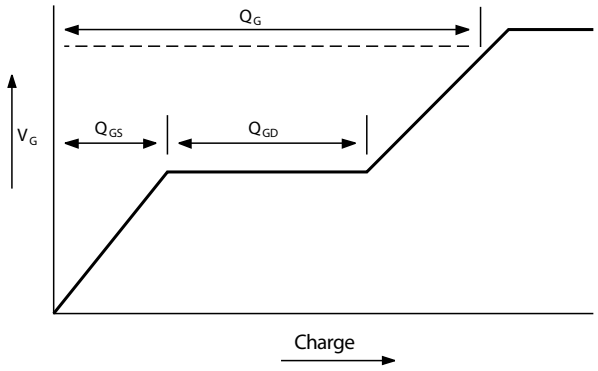


Capacitance v Drain-Source Voltage

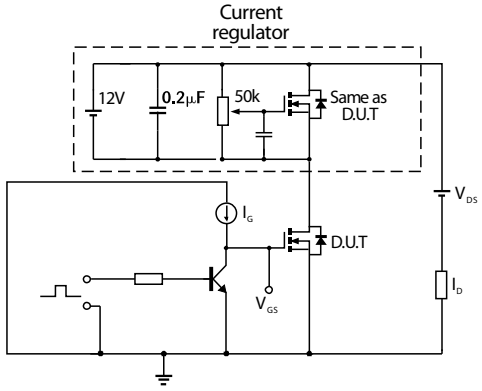


Gate-Source Voltage v Gate Charge

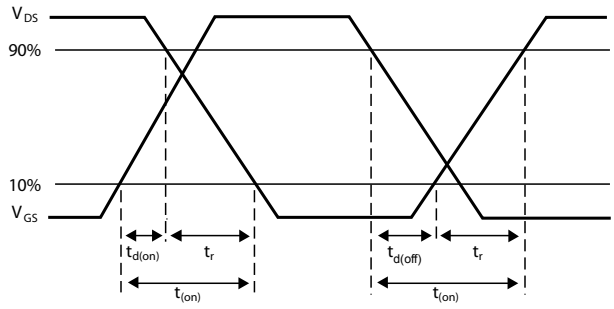
Test Circuits – Q1 N-Channel



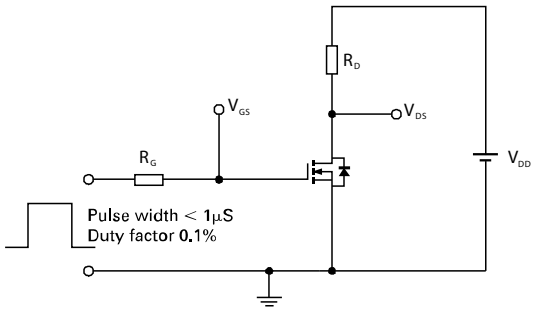
Basic gate charge waveform



Gate charge test circuit



Switching time waveforms



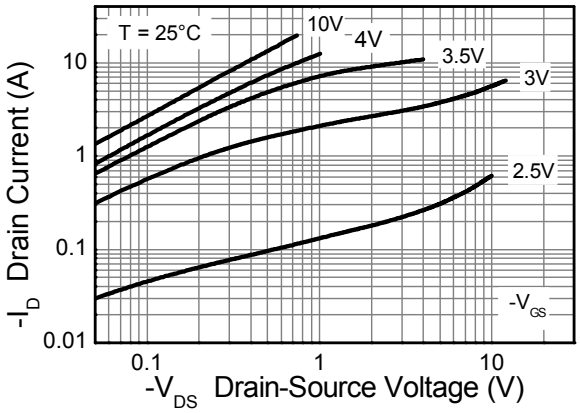
Switching time test circuit

Electrical Characteristics – Q2 P-Channel (@T_A = +25°C, unless otherwise specified.)

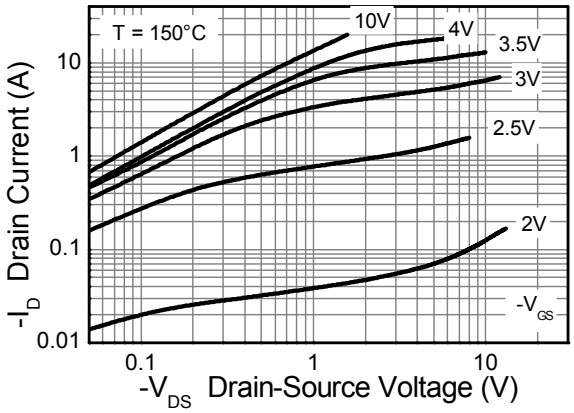
Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
OFF CHARACTERISTICS						
Drain-Source Breakdown Voltage	BV_{DSS}	-40	—	—	V	I_D = -250 µA, V_{GS} = 0V
Zero Gate Voltage Drain Current	I_{DSS}	—	—	-0.5	µA	V_{DS} = -40V, V_{GS} = 0V
Gate-Source Leakage	I_{GSS}	—	—	±100	nA	V_{GS} = ±20V, V_{DS} = 0V
ON CHARACTERISTICS						
Gate Threshold Voltage	$V_{GS(th)}$	-1.0	–	-3.0	V	I_D = -250 µA, V_{DS} = V_{GS}
Static Drain-Source On-Resistance (Note 12)	$R_{DS(ON)}$	—	0.039	0.050	Ω	V_{GS} = -10V, I_D = -6A
			0.060	0.079		V_{GS} = -4.5V, I_D = -5A
Forward Transconductance (Notes 12 & 13)	g_{fs}	—	16.6	—	S	V_{DS} = -15V, I_D = -6A
Diode Forward Voltage (Note 13)	V_{SD}	—	-0.865	-1.1	V	I_S = -6A, V_{GS} = 0V
Reverse Recovery Time (Note 13)	t_{rr}	—	138	—	ns	I_S = -6A, di/dt = 100A/µs
Reverse Recovery Charge (Note 13)	Q_{rr}	—	841	—	nC	
DYNAMIC CHARACTERISTICS (Note 13)						
Input Capacitance	C_{iss}	—	674	—	pF	V_{DS} = -20V, V_{GS} = 0V f = 1MHz
Output Capacitance	C_{oss}	—	115	—	pF	
Reverse Transfer Capacitance	C_{rss}	—	67.7	—	pF	
Total Gate Charge (Note 14)	Q_g	—	7.0	—	nC	V_{GS} = -4.5V; V_{DS} = -20V, I_D = -6A
Total Gate Charge (Note 14)	Q_g	—	14	—	nC	V_{GS} = -10V; V_{DS} = -20V, I_D = -6A
Gate-Source Charge (Note 14)	Q_{gs}	—	2.2	—	nC	V_{GS} = -10V; V_{DS} = -20V, I_D = -6A
Gate-Drain Charge (Note 14)	Q_{gd}	—	3.7	—	nC	V_{GS} = -10V; V_{DS} = -20V, I_D = -6A
Turn-On Delay Time (Note 14)	$t_{D(on)}$	—	2.3	—	ns	V_{DD} = -20V, V_{GS} = -10V I_D = -6A, $R_G \cong 6.0\Omega$
Turn-On Rise Time (Note 14)	t_r	—	14.1	—	ns	
Turn-Off Delay Time (Note 14)	$t_{D(off)}$	—	25.1	—	ns	
Turn-Off Fall Time (Note 14)	t_f	—	14.3	—	ns	

Notes: 12. Measured under pulsed conditions. Pulse width ≤ 300µs; duty cycle ≤ 2%
13. For design aid only, not subject to production testing.
14. Switching characteristics are independent of operating junction temperatures.

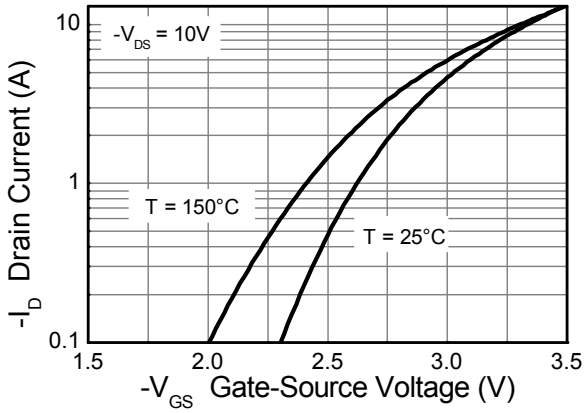
Typical Characteristics – Q2 P-Channel



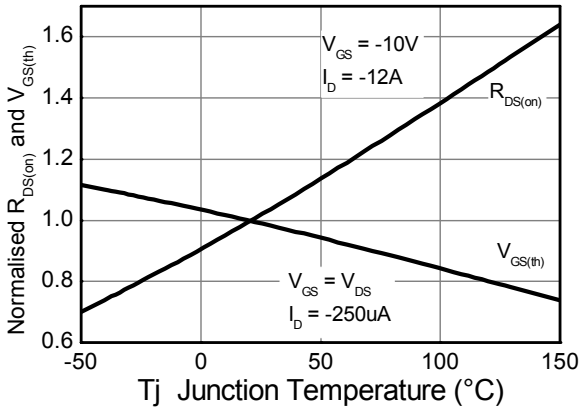
Output Characteristics



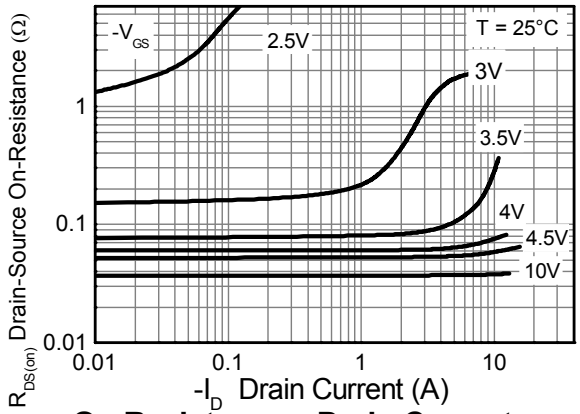
Output Characteristics



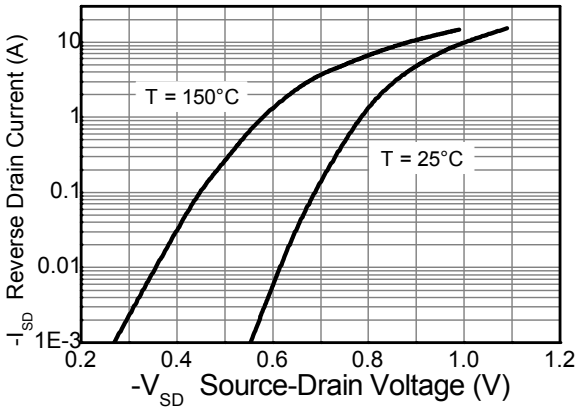
Typical Transfer Characteristics



Normalised Curves v Temperature

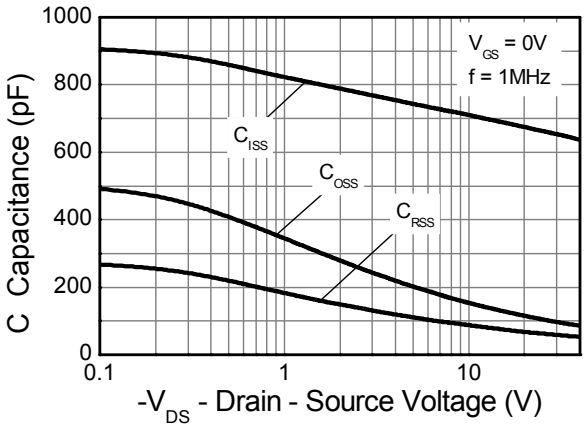


On-Resistance v Drain Current

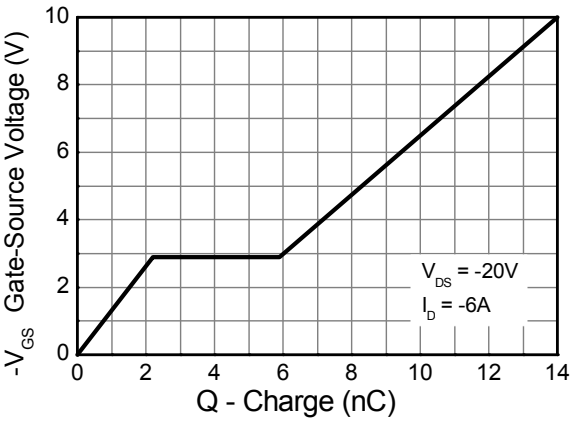


Source-Drain Diode Forward Voltage

Typical Characteristics – Q2 P-Channel – (cont.)

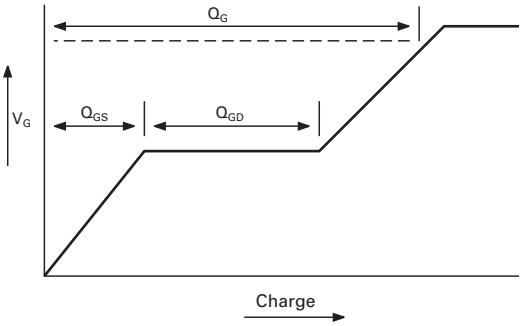


Capacitance v Drain-Source Voltage

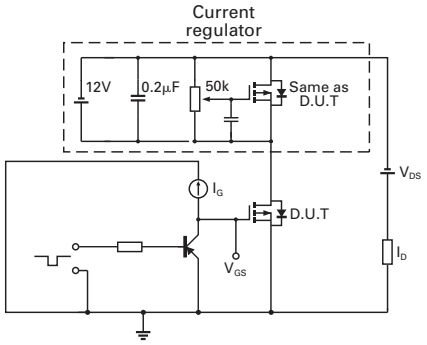


Gate-Source Voltage v Gate Charge

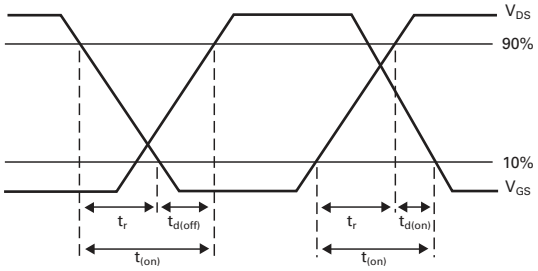
Test Circuits – Q2 P-Channel



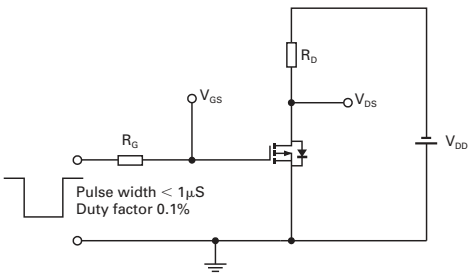
Basic gate charge waveform



Gate charge test circuit



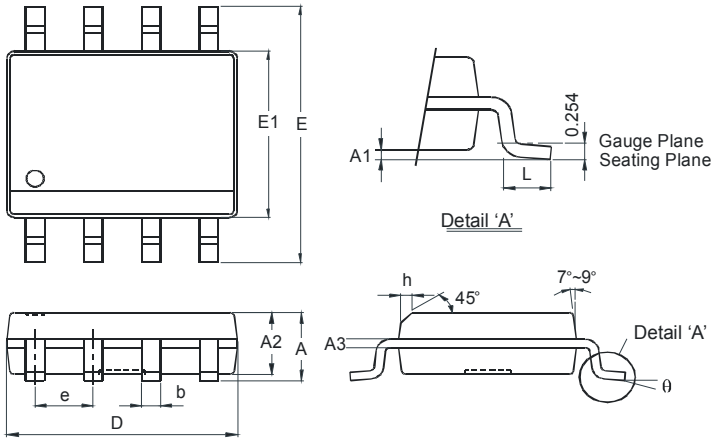
Switching time waveforms



Switching time test circuit

Package Outline Dimensions

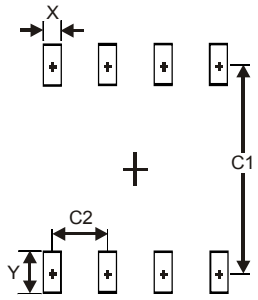
Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for latest version.



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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