

AOD609

Complementary Enhancement Mode Field Effect Transistor

General Description

The AOD609 uses advanced trench technology MOSFETs to provide excellent $R_{DS(ON)}$ and low gate charge. The complementary MOSFETs may be used in H-bridge, Inverters and other applications.

- RoHS Compliant
- Halogen Free*

Features

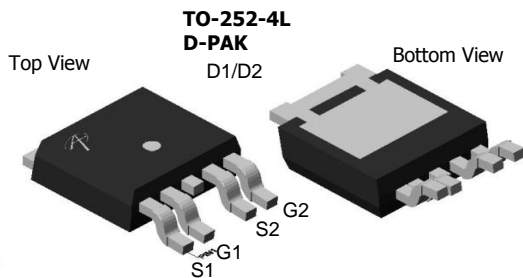
n-channel

V_{DS} (V) = 40V, I_D = 12A ($V_{GS}=10V$)
 $R_{DS(ON)} < 30m\Omega$ ($V_{GS}=10V$)
 $R_{DS(ON)} < 40m\Omega$ ($V_{GS}=4.5V$)

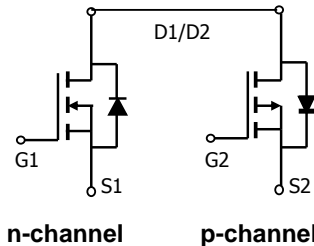
p-channel

V_{DS} (V) = -40V, I_D = -12A ($V_{GS}=-10V$)
 $R_{DS(ON)} < 45m\Omega$ ($V_{GS}= -10V$)
 $R_{DS(ON)} < 66m\Omega$ ($V_{GS}= -4.5V$)

100% UIS Tested!
100% Rg Tested!



Top View
 Drain Connected to Tab



Absolute Maximum Ratings $T_A=25^\circ\text{C}$ unless otherwise noted

Parameter	Symbol	Max n-channel	Max p-channel	Units
Drain-Source Voltage	V_{DS}	40	-40	V
Gate-Source Voltage	V_{GS}	± 20	± 20	V
Continuous Drain Current ^{B,H}	I_D	$T_C=25^\circ\text{C}$	-12	A
		$T_C=100^\circ\text{C}$	12	
Pulsed Drain Current ^B	I_{DM}	30	-30	
Avalanche Current ^C	I_{AR}	14	-20	
Repetitive avalanche energy $L=0.1\text{mH}$ ^C	E_{AR}	9.8	20	mJ
Power Dissipation	P_D	$T_C=25^\circ\text{C}$	30	W
		$T_C=100^\circ\text{C}$	15	
Power Dissipation	P_{DSM}	$T_A=25^\circ\text{C}$	2	W
		$T_A=70^\circ\text{C}$	1.3	
Junction and Storage Temperature Range	T_J, T_{STG}	-55 to 175	-55 to 175	$^\circ\text{C}$

Thermal Characteristics: n-channel and p-channel

Parameter	Symbol	Device	Typ	Max	Units
Maximum Junction-to-Ambient ^{A,D}	$R_{\theta JA}$	n-ch	$t \leq 10\text{s}$	17.4	25
Maximum Junction-to-Ambient ^{A,D}			Steady-State	50	60
Maximum Junction-to-Lead ^C	$R_{\theta JC}$	n-ch	4	5.5	$^\circ\text{C/W}$
Maximum Junction-to-Ambient ^{A,D}	$R_{\theta JA}$	p-ch	$t \leq 10\text{s}$	16.7	25
Maximum Junction-to-Ambient ^{A,D}			Steady-State	50	60
Maximum Junction-to-Lead ^C	$R_{\theta JC}$	p-ch	3.5	5	$^\circ\text{C/W}$

N Channel Electrical Characteristics ($T_J=25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
STATIC PARAMETERS						
BV_{DSS}	Drain-Source Breakdown Voltage	$I_D=250\mu\text{A}$, $V_{GS}=0\text{V}$	40			V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS}=40\text{V}$, $V_{GS}=0\text{V}$ $T_J=55^\circ\text{C}$			1 5	μA
I_{GSS}	Gate-Body leakage current	$V_{DS}=0\text{V}$, $V_{GS}=\pm 20\text{V}$			± 100	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}$, $I_D=250\mu\text{A}$	1.7	2.5	3	V
$I_{D(ON)}$	On state drain current	$V_{GS}=10\text{V}$, $V_{DS}=5\text{V}$	30			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS}=10\text{V}$, $I_D=12\text{A}$ $T_J=125^\circ\text{C}$		24 37	30 46	m Ω
		$V_{GS}=4.5\text{V}$, $I_D=8\text{A}$		31	40	
g_{FS}	Forward Transconductance	$V_{DS}=5\text{V}$, $I_D=12\text{A}$		25		S
V_{SD}	Diode Forward Voltage	$I_S=1\text{A}$, $V_{GS}=0\text{V}$		0.76	1	V
I_S	Maximum Body-Diode Continuous Current ^H				12	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	$V_{GS}=0\text{V}$, $V_{DS}=20\text{V}$, $f=1\text{MHz}$		516	650	pF
C_{oss}	Output Capacitance			82		pF
C_{riss}	Reverse Transfer Capacitance			43		pF
R_g	Gate resistance	$V_{GS}=0\text{V}$, $V_{DS}=0\text{V}$, $f=1\text{MHz}$		4.6	6.9	Ω
SWITCHING PARAMETERS						
$Q_g(10\text{V})$	Total Gate Charge	$V_{GS}=10\text{V}$, $V_{DS}=20\text{V}$, $I_D=12\text{A}$		8.3	10.8	nC
Q_{gs}	Gate Source Charge			2.3		nC
Q_{gd}	Gate Drain Charge			1.6		nC
$t_{D(on)}$	Turn-On Delay Time	$V_{GS}=10\text{V}$, $V_{DS}=20\text{V}$, $R_L=1.4\Omega$, $R_{GEN}=3\Omega$		6.4		ns
t_r	Turn-On Rise Time			3.6		ns
$t_{D(off)}$	Turn-Off Delay Time			16.2		ns
t_f	Turn-Off Fall Time			6.6		ns
t_{rr}	Body Diode Reverse Recovery Time	$I_F=12\text{A}$, $dI/dt=100\text{A}/\mu\text{s}$		18	24	ns
Q_{rr}	Body Diode Reverse Recovery Charge	$I_F=12\text{A}$, $dI/dt=100\text{A}/\mu\text{s}$		10		nC

A: The value of $R_{\theta JA}$ is measured with the device in a still air environment with $T_A=25^\circ\text{C}$. The power dissipation P_{DSM} and current rating I_{DSM} are based on $T_{J(MAX)}=150^\circ\text{C}$, using the steady state junction-to-ambient thermal resistance.

B: The power dissipation P_D is based on $T_{J(MAX)}=175^\circ\text{C}$, using junction-to-case thermal resistance, and is more useful in setting the upper dissipation limit for cases where additional heatsinking is used.

C: Repetitive rating, pulse width limited by junction temperature $T_{J(MAX)}=175^\circ\text{C}$.

D: The $R_{\theta JA}$ is the sum of the thermal impedance from junction to case $R_{\theta JC}$ and case to ambient.

E: The static characteristics in Figures 1 to 6 are obtained using $<300\mu\text{s}$ pulses, duty cycle 0.5% max.

F: These curves are based on the junction-to-case thermal impedance which is measured with the device mounted to a large heatsink, assuming a maximum junction temperature of $T_{J(MAX)}=175^\circ\text{C}$. The SOA curve provides a single pulse rating.

G: These tests are performed with the device mounted on 1 in² FR-4 board with 2oz. Copper, in a still air environment with $T_A=25^\circ\text{C}$.

H: The maximum current rating is limited by bond-wires.

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P-Channel Electrical Characteristics ($T_J=25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
STATIC PARAMETERS						
BV_{DSS}	Drain-Source Breakdown Voltage	$I_D = -250\mu\text{A}$, $V_{GS} = 0\text{V}$	-40			V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = -40\text{V}$, $V_{GS} = 0\text{V}$ $T_J = 55^\circ\text{C}$			-1 -5	μA
I_{GSS}	Gate-Body leakage current	$V_{DS} = 0\text{V}$, $V_{GS} = \pm 20\text{V}$			± 100	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$, $I_D = -250\mu\text{A}$	-1.7	-2	-3	V
$I_{D(ON)}$	On state drain current	$V_{GS} = -10\text{V}$, $V_{DS} = -5\text{V}$	-30			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS} = -10\text{V}$, $I_D = -12\text{A}$ $T_J = 125^\circ\text{C}$		36	45	m Ω
		$V_{GS} = -4.5\text{V}$, $I_D = -8\text{A}$		52	65	
				51	66	
g_{FS}	Forward Transconductance	$V_{DS} = -5\text{V}$, $I_D = -12\text{A}$		22		S
V_{SD}	Diode Forward Voltage	$I_S = -1\text{A}$, $V_{GS} = 0\text{V}$		-0.76	-1	V
I_S	Maximum Body-Diode Continuous Current ^H				-12	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance			900	1125	pF
C_{oss}	Output Capacitance	$V_{GS} = 0\text{V}$, $V_{DS} = -20\text{V}$, $f = 1\text{MHz}$		97		pF
C_{rss}	Reverse Transfer Capacitance			68		pF
R_g	Gate resistance	$V_{GS} = 0\text{V}$, $V_{DS} = 0\text{V}$, $f = 1\text{MHz}$		14		Ω
SWITCHING PARAMETERS						
$Q_g(-10\text{V})$	Total Gate Charge			16.2	21	nC
$Q_g(-4.5\text{V})$	Total Gate Charge	$V_{GS} = -10\text{V}$, $V_{DS} = -20\text{V}$, $I_D = -12\text{A}$		7.2	9.4	nC
Q_{gs}	Gate Source Charge			3.8		nC
Q_{gd}	Gate Drain Charge			3.5		nC
$t_{D(on)}$	Turn-On DelayTime			6.2		ns
t_r	Turn-On Rise Time	$V_{GS} = -10\text{V}$, $V_{DS} = -20\text{V}$, $R_L = 1.4\Omega$, $R_{GEN} = 3\Omega$		8.4		ns
$t_{D(off)}$	Turn-Off DelayTime			44.8		ns
t_f	Turn-Off Fall Time			41.2		ns
t_{rr}	Body Diode Reverse Recovery Time	$I_F = -12\text{A}$, $dI/dt = 100\text{A}/\mu\text{s}$		21	27	ns
Q_{rr}	Body Diode Reverse Recovery Charge	$I_F = -12\text{A}$, $dI/dt = 100\text{A}/\mu\text{s}$		14		nC

A: The value of $R_{\theta JA}$ is measured with the device in a still air environment with $T_A = 25^\circ\text{C}$. The power dissipation P_{DSM} and current rating I_{DSM} are based on $T_{J(MAX)} = 150^\circ\text{C}$, using $t \leq 10\text{s}$ junction-to-ambient thermal resistance.

B: The power dissipation P_D is based on $T_{J(MAX)} = 175^\circ\text{C}$, using junction-to-case thermal resistance, and is more useful in setting the upper dissipation limit for cases where additional heatsinking is used.

C: Repetitive rating, pulse width limited by junction temperature $T_{J(MAX)} = 175^\circ\text{C}$.

D: The $R_{\theta JA}$ is the sum of the thermal impedance from junction to case $R_{\theta JC}$ and case to ambient.

E: The static characteristics in Figures 1 to 6 are obtained using $<300\mu\text{s}$ pulses, duty cycle 0.5% max.

F: These curves are based on the junction-to-case thermal impedance which is measured with the device mounted to a large heatsink, assuming a maximum junction temperature of $T_{J(MAX)} = 175^\circ\text{C}$. The SOA curve provides a single pulse rating.

G: These tests are performed with the device mounted on 1 in² FR-4 board with 2oz. Copper, in a still air environment with $T_A = 25^\circ\text{C}$.

H: The maximum current rating is limited by bond-wires.

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS: N-CANNEL

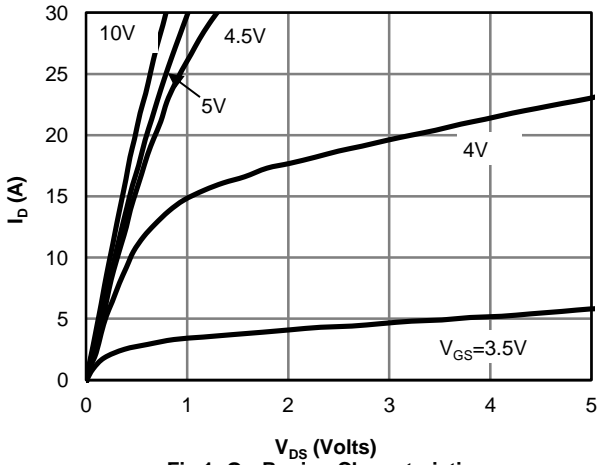


Fig 1: On-Region Characteristics

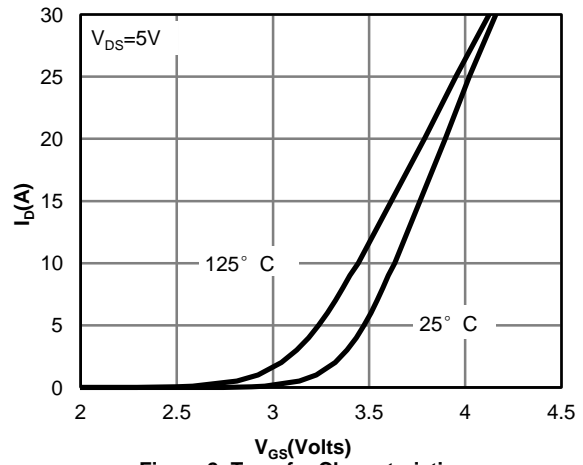


Figure 2: Transfer Characteristics

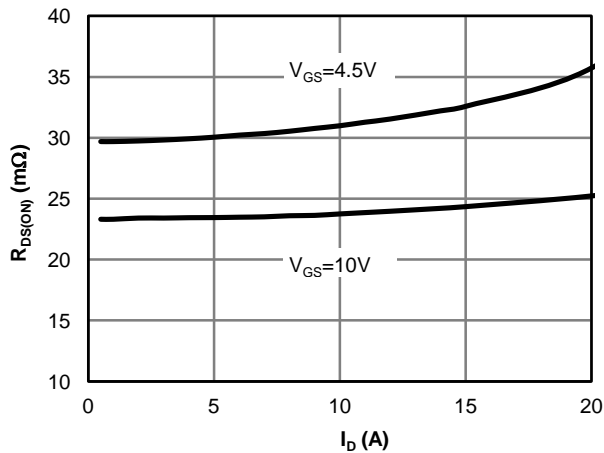


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

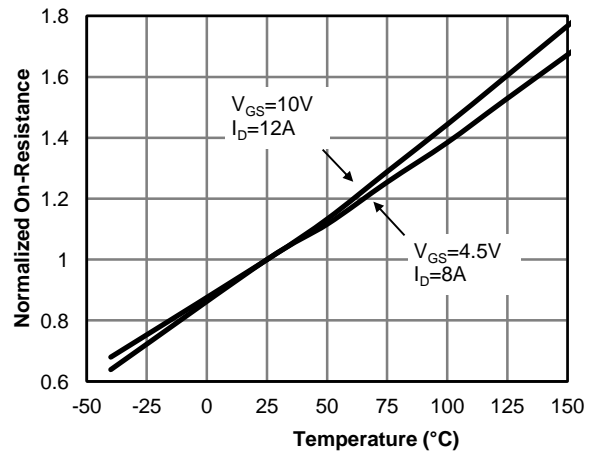


Figure 4: On-Resistance vs. Junction Temperature

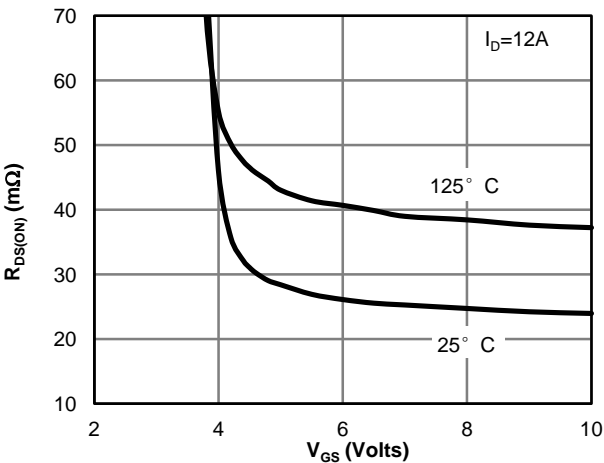


Figure 5: On-Resistance vs. Gate-Source Voltage

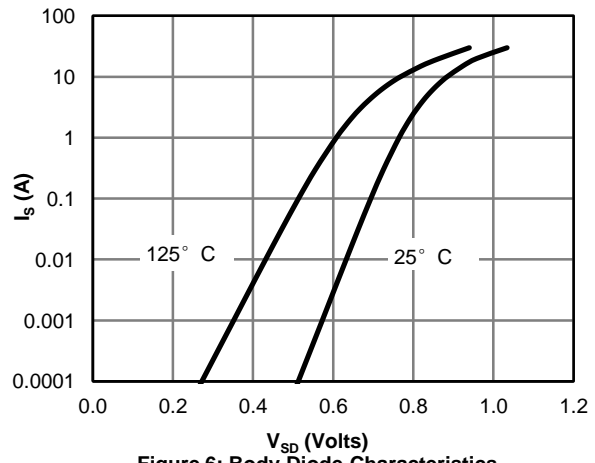


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS: N-CHANNEL

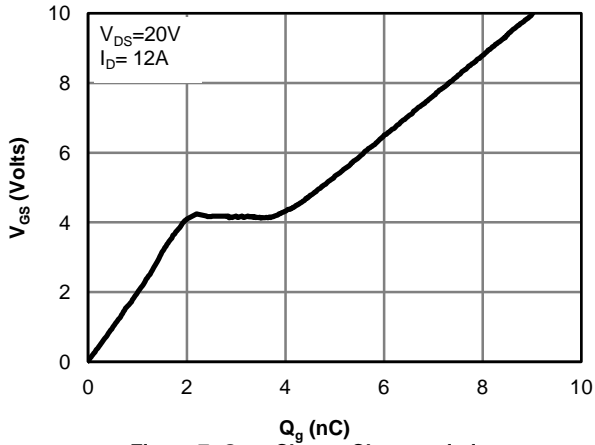


Figure 7: Gate-Charge Characteristics

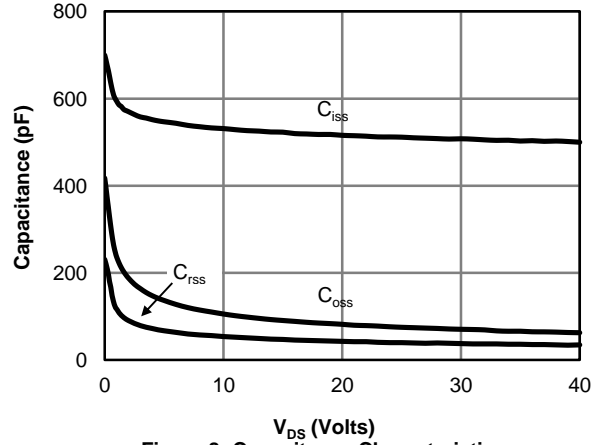


Figure 8: Capacitance Characteristics

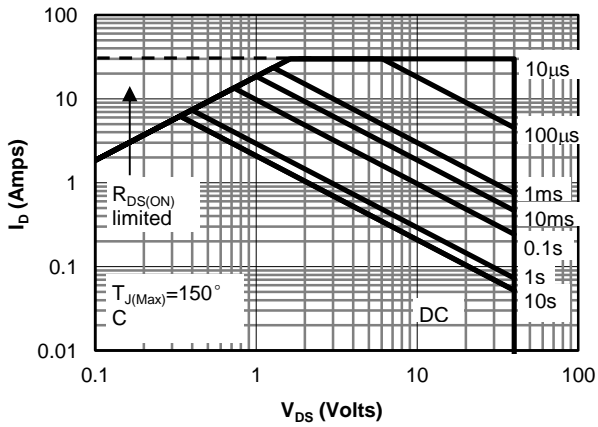


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

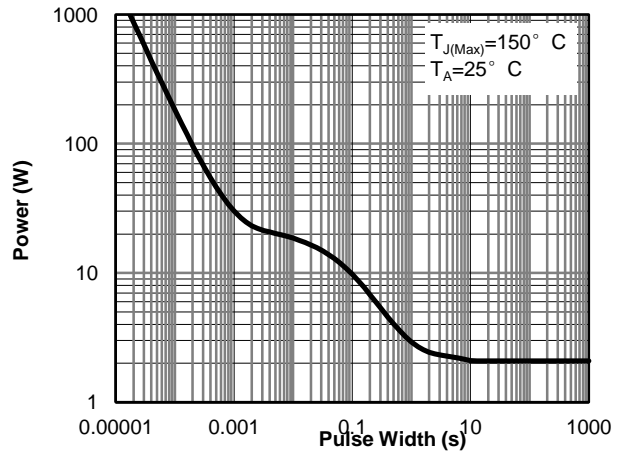


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

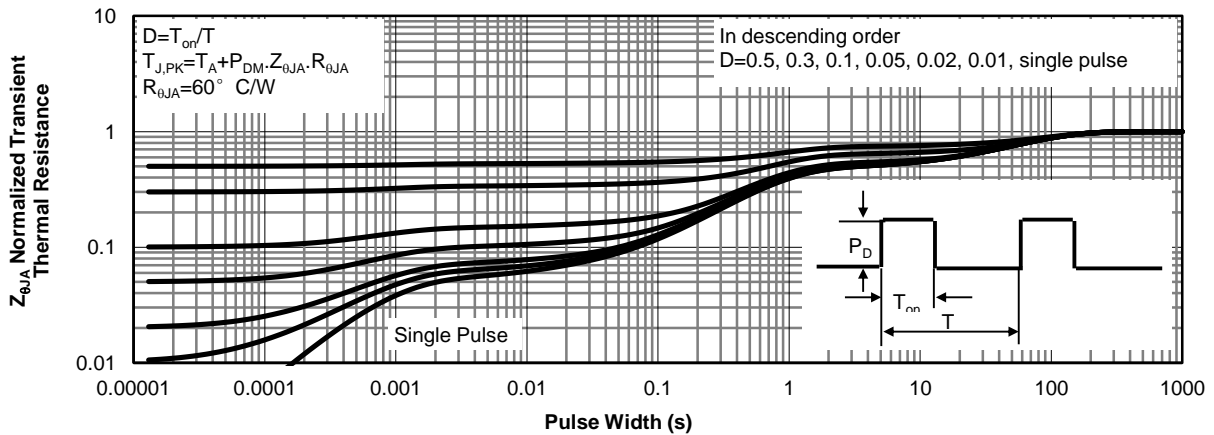
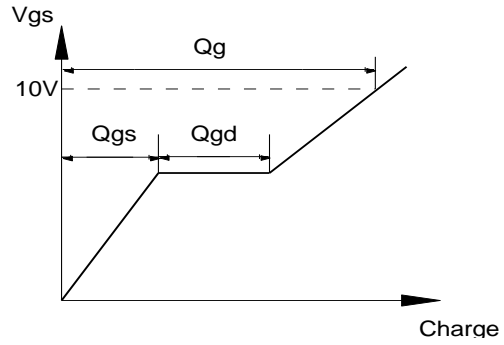
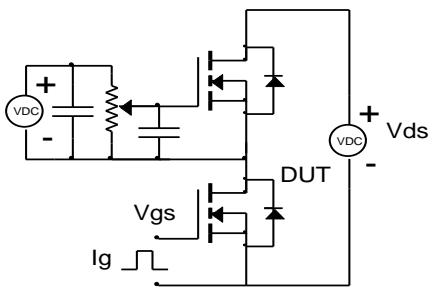
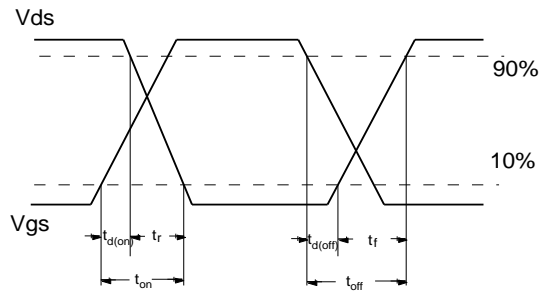
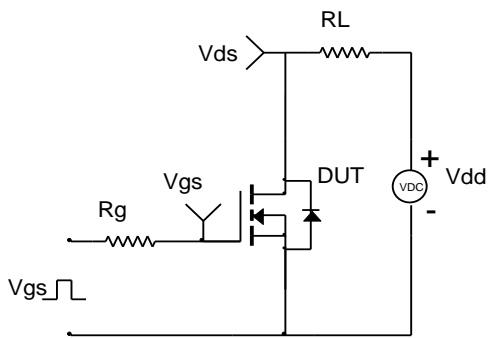


Figure 11: Normalized Maximum Transient Thermal Impedance

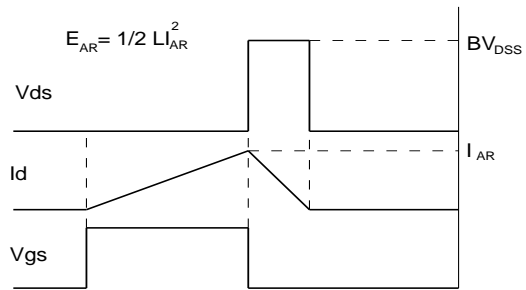
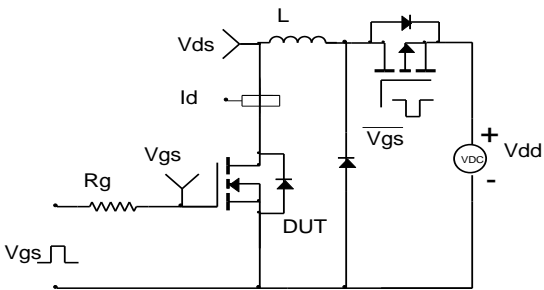
Gate Charge Test Circuit & Waveform



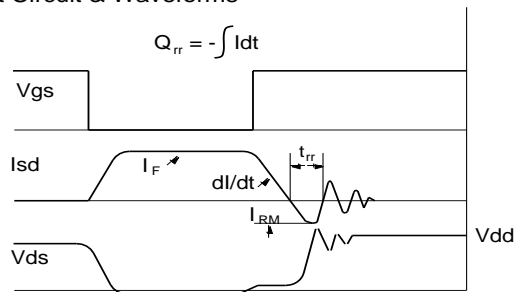
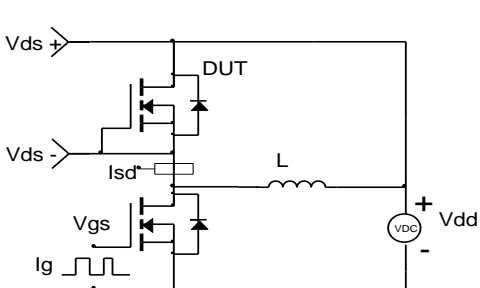
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms



TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS: P-CHANNEL

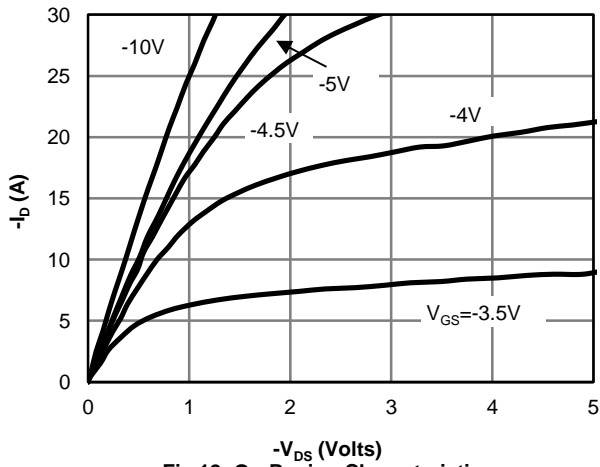


Fig 12: On-Region Characteristics

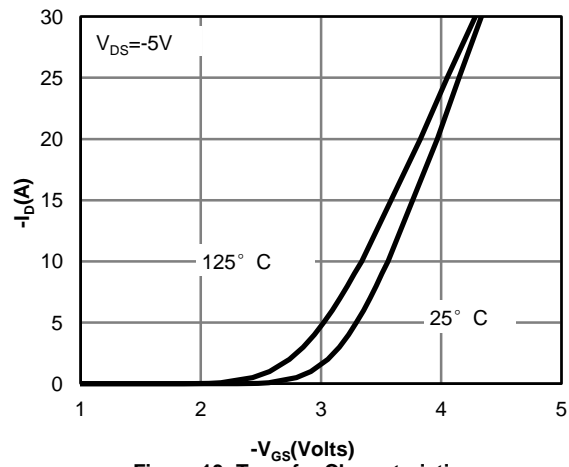


Figure 13: Transfer Characteristics

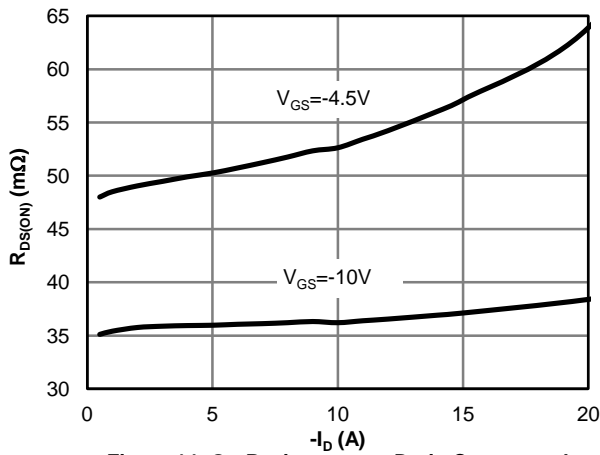


Figure 14: On-Resistance vs. Drain Current and Gate Voltage

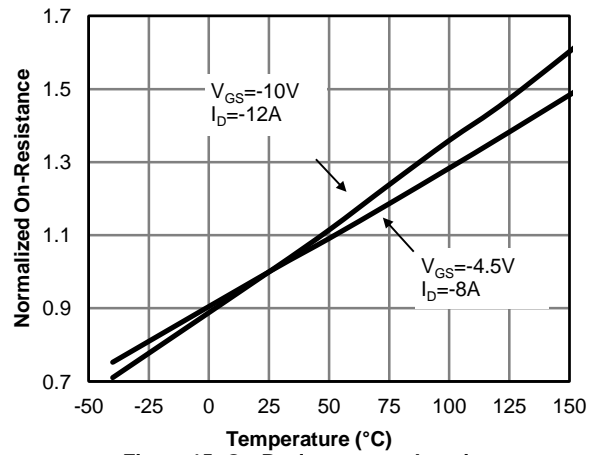


Figure 15: On-Resistance vs. Junction Temperature

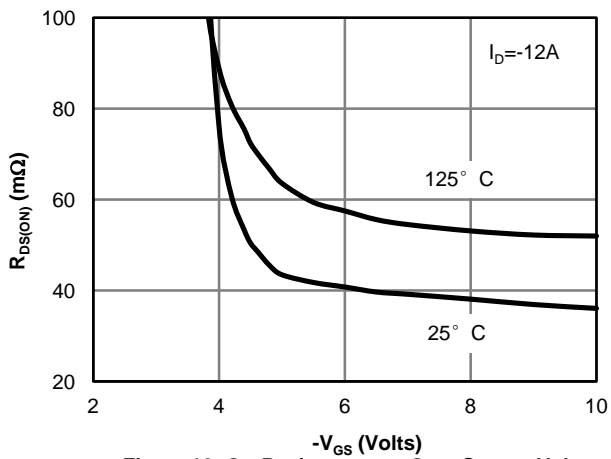


Figure 16: On-Resistance vs. Gate-Source Voltage

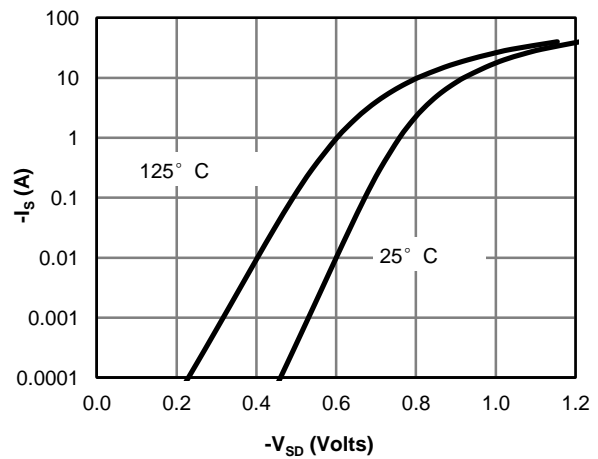


Figure 17: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS: P-CHANNEL

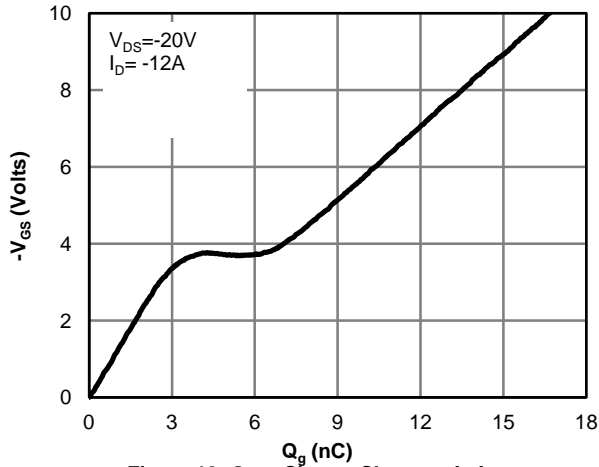


Figure 18: Gate-Charge Characteristics

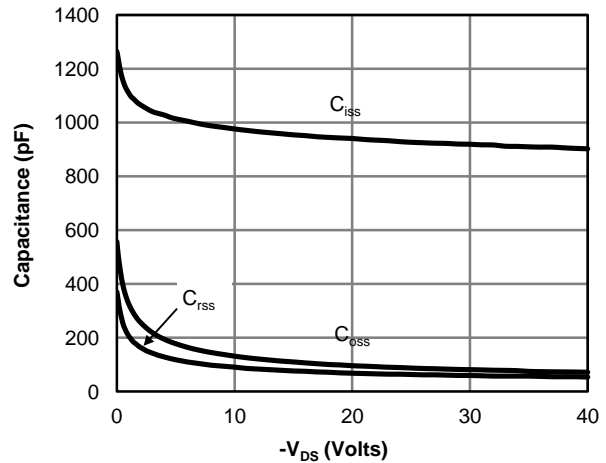


Figure 19: Capacitance Characteristics

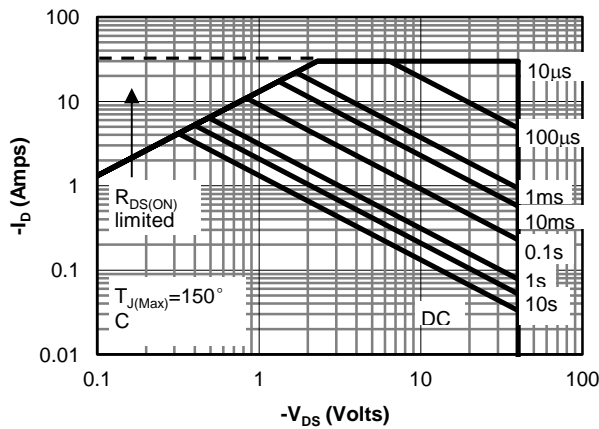


Figure 20: Maximum Forward Biased Safe Operating Area (Note E)

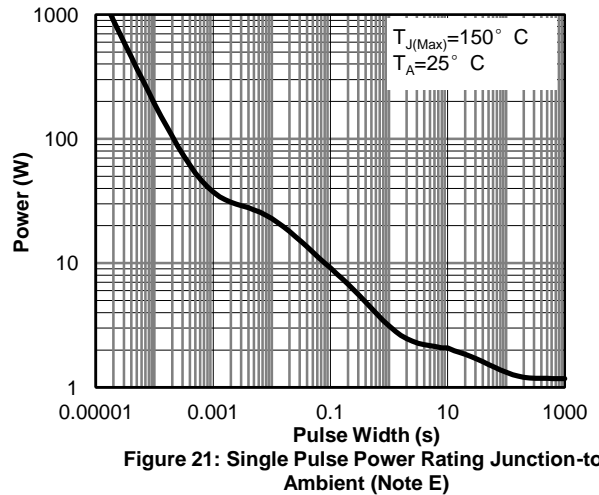


Figure 21: Single Pulse Power Rating Junction-to-Ambient (Note E)

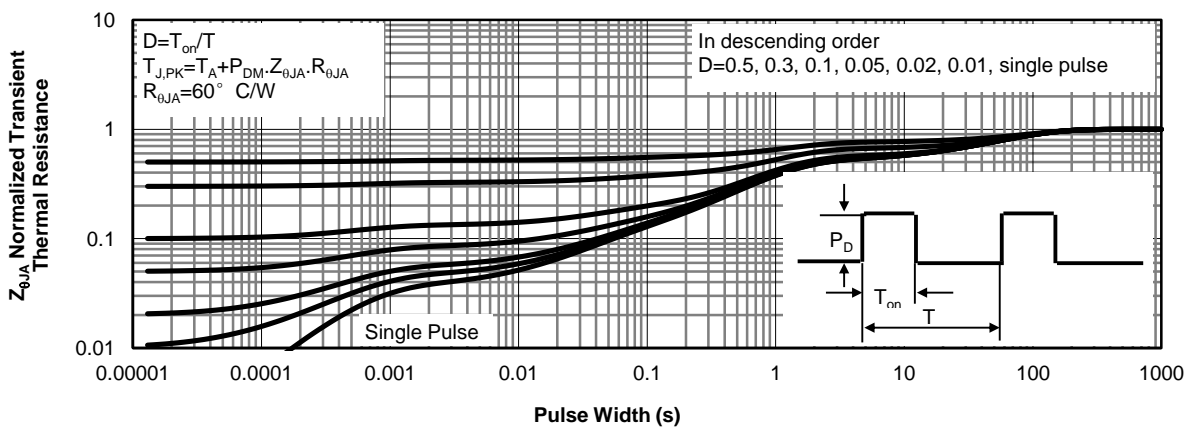
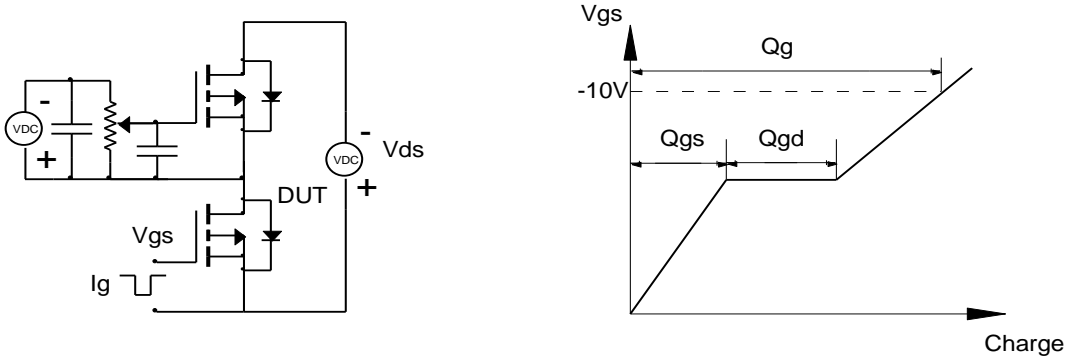
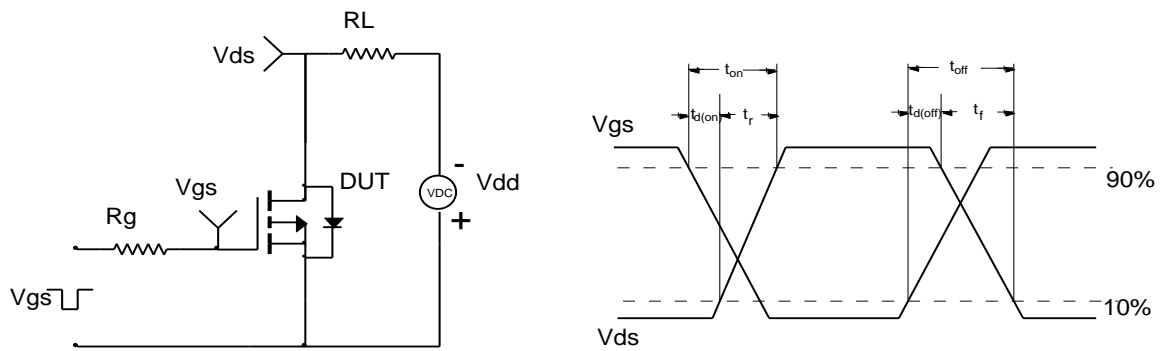


Figure 22: Normalized Maximum Transient Thermal Impedance

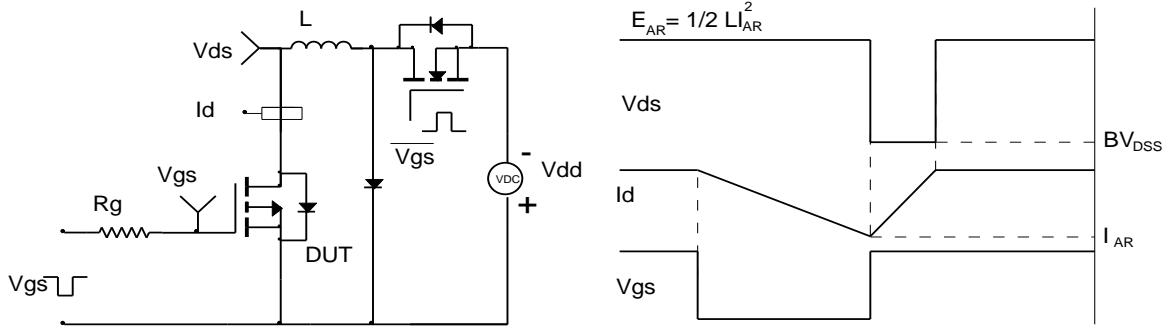
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms

