



## AO4612 60V Complementary Enhancement Mode Field Effect Transistor

### General Description

The AO4612 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.

### Features

n-channel	p-channel
$V_{DS} (V) = 60V$	-60V
$I_D = 4.5A (V_{GS}=10V)$	-3.2A ( $V_{GS} = -10V$ )
$R_{DS(ON)}$	$R_{DS(ON)}$
$< 56m\Omega (V_{GS}=10V)$	$< 105m\Omega (V_{GS} = -10V)$
$< 77m\Omega (V_{GS}=4.5V)$	$< 135m\Omega (V_{GS} = -4.5V)$

100% Rg tested



### Absolute Maximum Ratings $T_A=25^\circ C$ unless otherwise noted

Parameter	Symbol	Max n-channel	Max p-channel	Units
Drain-Source Voltage	$V_{DS}$	60	-60	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	$\pm 20$	V
Continuous Drain Current <sup>A</sup>	$I_D$	$T_A=25^\circ C$	4.5	-3.2
		$T_A=70^\circ C$	3.6	-2.6
Pulsed Drain Current <sup>B</sup>	$I_{DM}$	20	-20	A
Power Dissipation	$P_D$	$T_A=25^\circ C$	2	2
		$T_A=70^\circ C$	1.28	1.28
Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 to 150	-55 to 150	$^\circ C$

### Thermal Characteristics: n-channel and p-channel

Parameter	Symbol	Typ	Max	Units
Maximum Junction-to-Ambient <sup>A</sup> $t \leq 10s$	$R_{\theta JA}$	48	62.5	$^\circ C/W$
Maximum Junction-to-Ambient <sup>A</sup> Steady-State		74	90	$^\circ C/W$
Maximum Junction-to-Lead <sup>C</sup> Steady-State	$R_{\theta JL}$	35	40	$^\circ C/W$

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>STATIC PARAMETERS</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$I_D=250\mu\text{A}, V_{GS}=0\text{V}$	60			V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=48\text{V}, V_{GS}=0\text{V}$ $T_J=55^\circ\text{C}$			1	$\mu\text{A}$
					5	
$I_{GSS}$	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	2.1	3	V
$I_{D(ON)}$	On state drain current	$V_{GS}=10\text{V}, V_{DS}=5\text{V}$	20			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS}=10\text{V}, I_D=4.5\text{A}$ $T_J=125^\circ\text{C}$		46	56	m $\Omega$
				79		
		$V_{GS}=4.5\text{V}, I_D=3\text{A}$		64	77	m $\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS}=5\text{V}, I_D=4.5\text{A}$		11		S
$V_{SD}$	Diode Forward Voltage	$I_S=1\text{A}, V_{GS}=0\text{V}$		0.74	1	V
$I_S$	Maximum Body-Diode Continuous Current				3	A
<b>DYNAMIC PARAMETERS</b>						
$C_{iss}$	Input Capacitance	$V_{GS}=0\text{V}, V_{DS}=30\text{V}, f=1\text{MHz}$		450	540	pF
$C_{oss}$	Output Capacitance			60		pF
$C_{riss}$	Reverse Transfer Capacitance			25		pF
$R_g$	Gate resistance	$V_{GS}=0\text{V}, V_{DS}=0\text{V}, f=1\text{MHz}$		1.65	2	$\Omega$
<b>SWITCHING PARAMETERS</b>						
$Q_g(10\text{V})$	Total Gate Charge	$V_{GS}=10\text{V}, V_{DS}=30\text{V}, I_D=4.5\text{A}$		8.5	10.5	nC
$Q_g(4.5\text{V})$	Total Gate Charge			4.3	5.5	nC
$Q_{gs}$	Gate Source Charge			1.6		nC
$Q_{gd}$	Gate Drain Charge			2.2		nC
$t_{D(on)}$	Turn-On Delay Time	$V_{GS}=10\text{V}, V_{DS}=30\text{V}, R_L=6.7\Omega,$ $R_{GEN}=3\Omega$		4.7	7	ns
$t_r$	Turn-On Rise Time			2.3	4.5	ns
$t_{D(off)}$	Turn-Off Delay Time			15.7	24	ns
$t_f$	Turn-Off Fall Time			1.9	4	ns
$t_{rr}$	Body Diode Reverse Recovery Time	$I_F=4.5\text{A}, dI/dt=100\text{A}/\mu\text{s}$		27.5	35	ns
$Q_{rr}$	Body Diode Reverse Recovery Charge	$I_F=4.5\text{A}, dI/dt=100\text{A}/\mu\text{s}$		32		nC

A: The value of  $R_{\theta JA}$  is measured with the device mounted on 1 in<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with  $T_A=25^\circ\text{C}$ . The value in any a given application depends on the user's specific board design. The current rating is based on the  $t \leq 10\text{s}$  thermal resistance rating.

B: Repetitive rating, pulse width limited by junction temperature.

C: The  $R_{\theta JA}$  is the sum of the thermal impedance from junction to lead  $R_{\theta JL}$  and lead to ambient.

D: The static characteristics in Figures 1 to 6 are obtained using 80  $\mu\text{s}$  pulses, duty cycle 0.5% max.

E: These tests are performed with the device mounted on 1 in<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with  $T_A=25^\circ\text{C}$ . The SOA curve provides a single pulse rating. Rev3: Oct 2010

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS: N-CANNEL

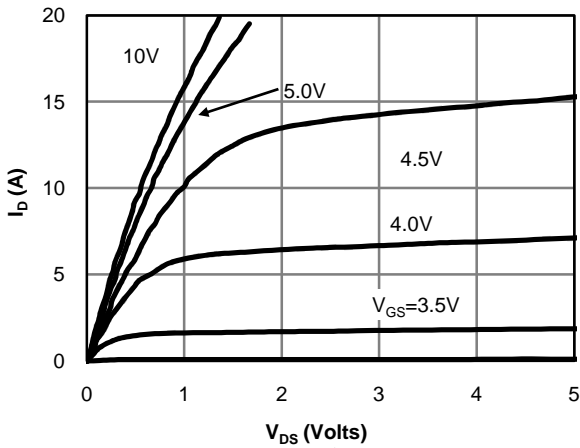


Fig 1: On-Region Characteristics

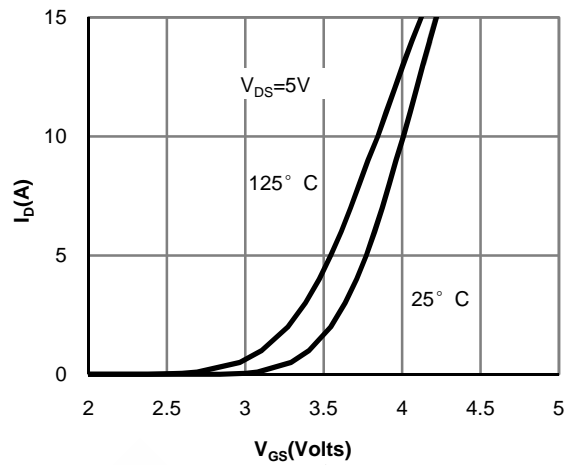


Figure 2: Transfer Characteristics

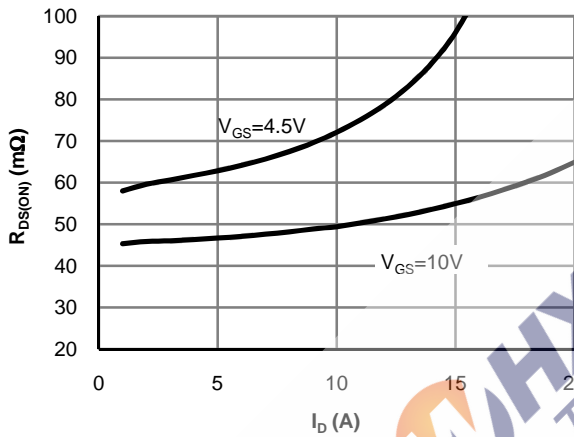


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

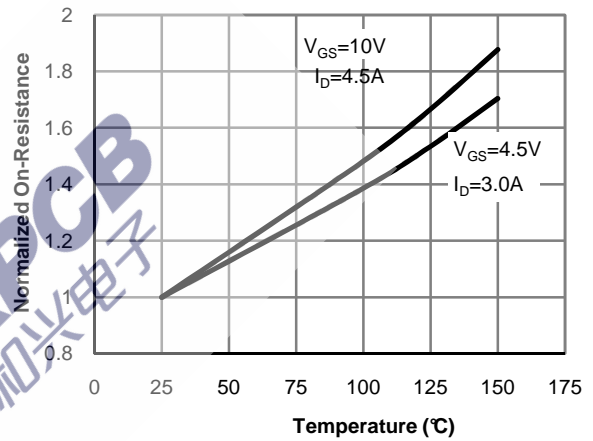


Figure 4: On-Resistance vs. Junction Temperature

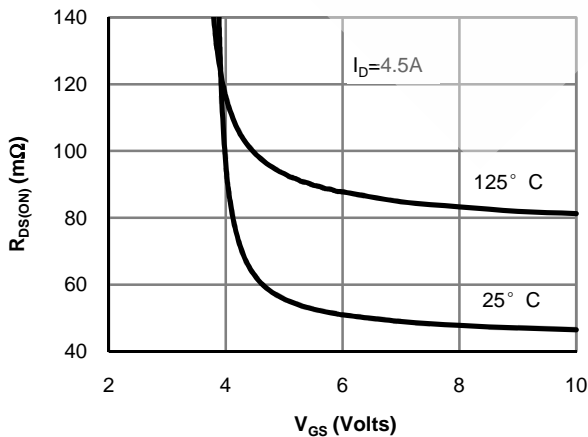


Figure 5: On-Resistance vs. Gate-Source Voltage

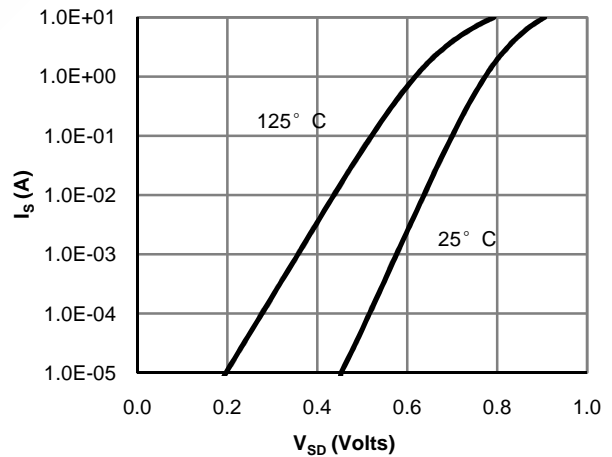


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS: N-CHANNEL

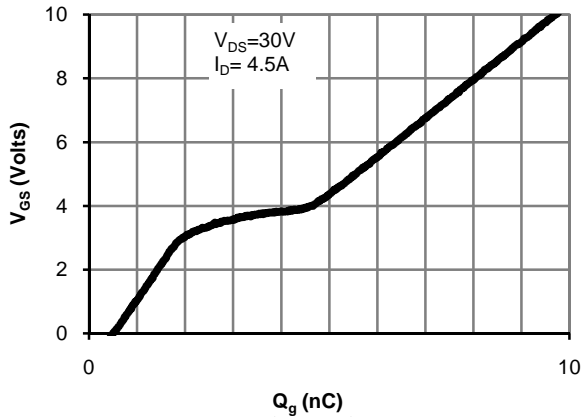


Figure 7: Gate-Charge Characteristics

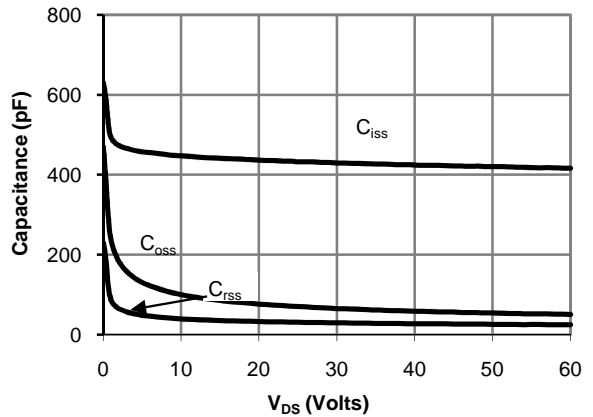


Figure 8: Capacitance Characteristics

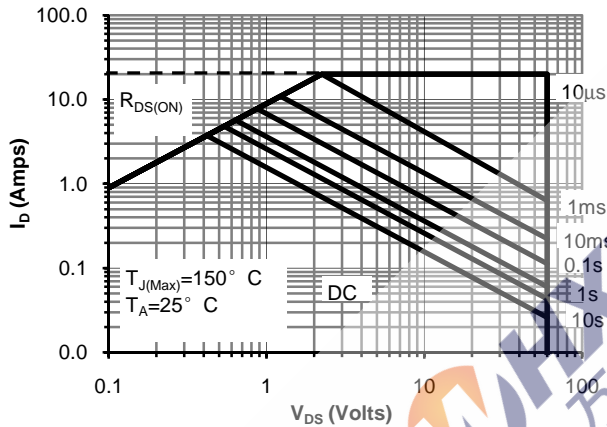


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

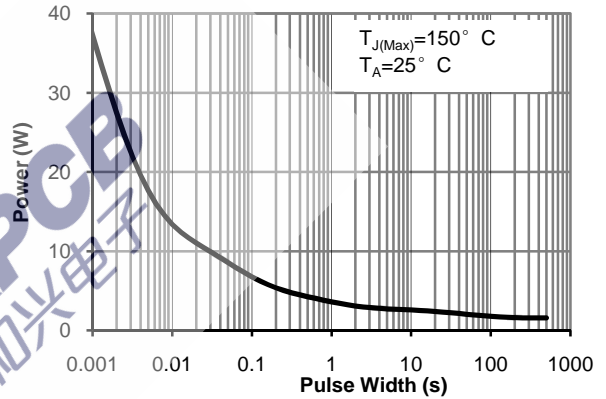


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

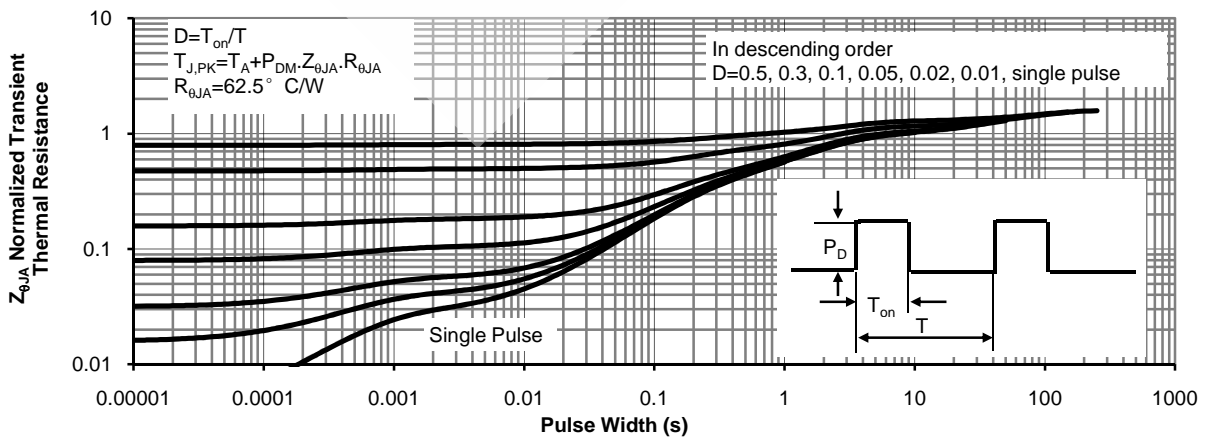
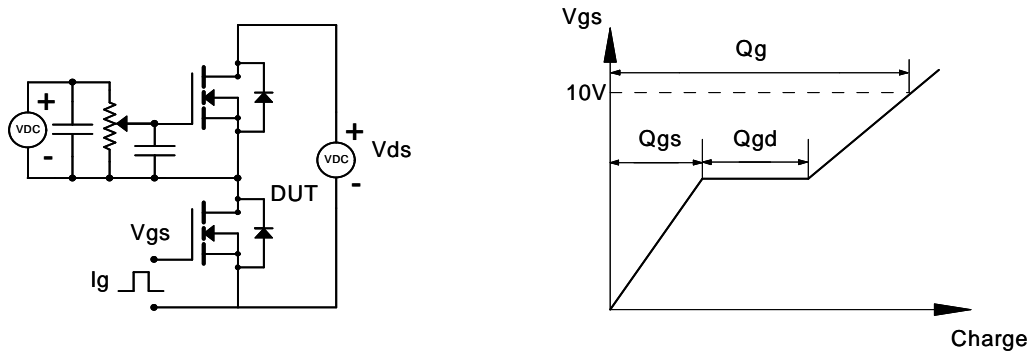
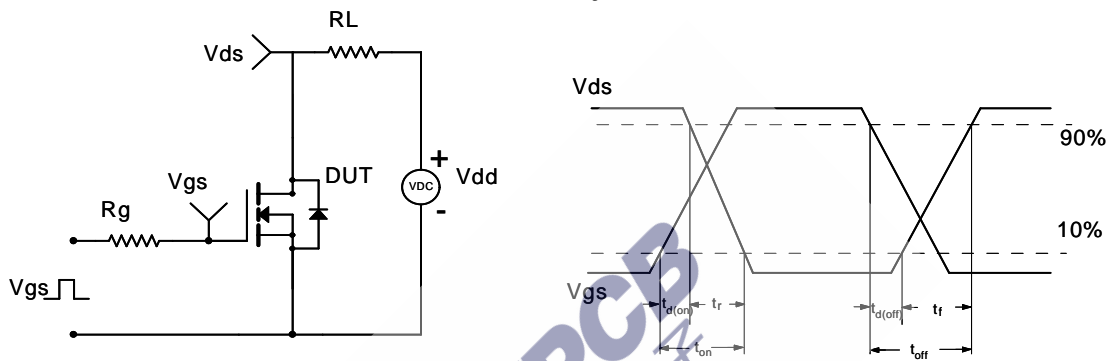


Figure 11: Normalized Maximum Transient Thermal Impedance

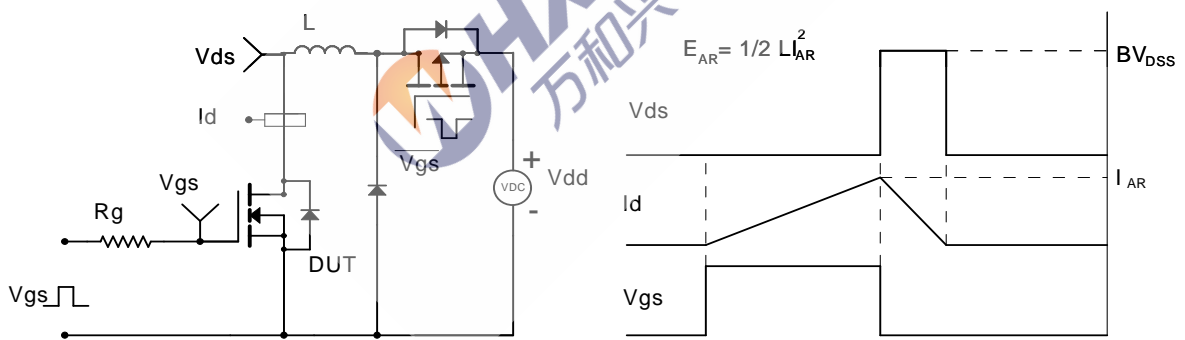
Gate Charge Test Circuit & Waveform



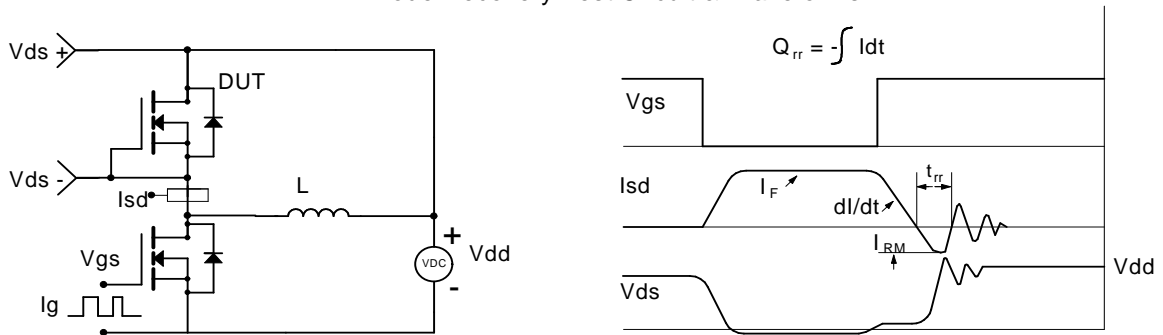
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms



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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>STATIC PARAMETERS</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$I_D=-250\mu\text{A}, V_{GS}=0\text{V}$	-60			V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=-48\text{V}, V_{GS}=0\text{V}$			-1	$\mu\text{A}$
		$T_J=55^\circ\text{C}$			-5	
$I_{GSS}$	Gate-Body leakage current	$V_{DS}=0\text{V}, V_{GS}=\pm 20\text{V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D=-250\mu\text{A}$	-1	-2.1	-3	V
$I_{D(ON)}$	On state drain current	$V_{GS}=-10\text{V}, V_{DS}=-5\text{V}$	-20			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS}=-10\text{V}, I_D=-3.2\text{A}$		84	105	m $\Omega$
		$T_J=125^\circ\text{C}$		145		
		$V_{GS}=-4.5\text{V}, I_D=-2.8\text{A}$		106	135	m $\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS}=-5\text{V}, I_D=-3.2\text{A}$		9		S
$V_{SD}$	Diode Forward Voltage	$I_S=-1\text{A}, V_{GS}=0\text{V}$		-0.73	-1	V
$I_S$	Maximum Body-Diode Continuous Current				-3	A
<b>DYNAMIC PARAMETERS</b>						
$C_{iss}$	Input Capacitance	$V_{GS}=0\text{V}, V_{DS}=-30\text{V}, f=1\text{MHz}$		930	1120	pF
$C_{oss}$	Output Capacitance			85		pF
$C_{rss}$	Reverse Transfer Capacitance			35		pF
$R_g$	Gate resistance	$V_{GS}=0\text{V}, V_{DS}=0\text{V}, f=1\text{MHz}$		7.2	9	$\Omega$
<b>SWITCHING PARAMETERS</b>						
$Q_g(10\text{V})$	Total Gate Charge (10V)	$V_{GS}=-10\text{V}, V_{DS}=-30\text{V}, I_D=-3.2\text{A}$		16	20	nC
$Q_g(4.5\text{V})$	Total Gate Charge (4.5V)			8	10	nC
$Q_{gs}$	Gate Source Charge			2.5		nC
$Q_{gd}$	Gate Drain Charge			3.2		nC
$t_{D(on)}$	Turn-On Delay Time	$V_{GS}=-10\text{V}, V_{DS}=-30\text{V}, R_L=9.4\Omega,$ $R_{GEN}=3\Omega$		8	12	ns
$t_r$	Turn-On Rise Time			3.8	7.5	ns
$t_{D(off)}$	Turn-Off Delay Time			31.5	48	ns
$t_f$	Turn-Off Fall Time			7.5	15	ns
$t_{rr}$	Body Diode Reverse Recovery Time		$I_F=-3.2\text{A}, di/dt=100\text{A}/\mu\text{s}$		27	35
$Q_{rr}$	Body Diode Reverse Recovery Charge	$I_F=-3.2\text{A}, di/dt=100\text{A}/\mu\text{s}$		32		nC

A: The value of  $R_{\theta JA}$  is measured with the device mounted on 1in<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with  $T_A=25^\circ\text{C}$ . The value in any a given application depends on the user's specific board design. The current rating is based on the  $t \leq 10\text{s}$  thermal resistance rating.

B: Repetitive rating, pulse width limited by junction temperature.

C: The  $R_{\theta JA}$  is the sum of the thermal impedance from junction to lead  $R_{\theta JL}$  and lead to ambient.

D: The static characteristics in Figures 1 to 6,12,14 are obtained using 80  $\mu\text{s}$  pulses, duty cycle 0.5% max.

E: These tests are performed with the device mounted on 1 in<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with  $T_A=25^\circ\text{C}$ . The SOA curve provides a single pulse rating.

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS: P-CHANNEL

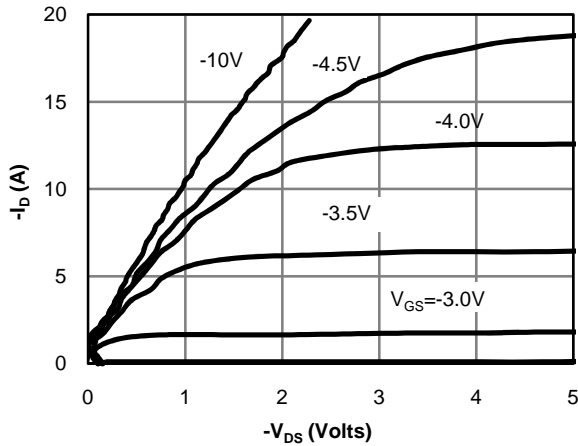


Fig 1: On-Region Characteristics

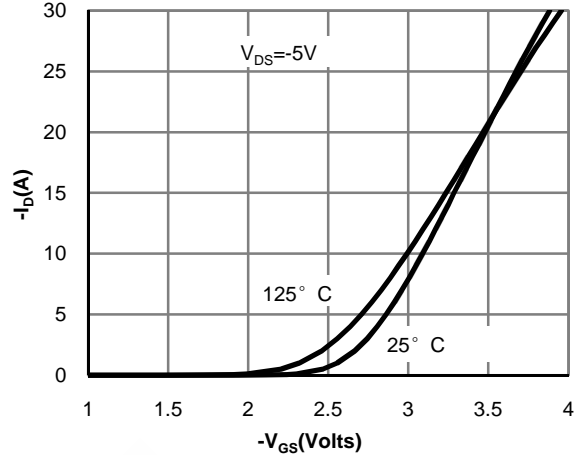


Figure 2: Transfer Characteristics

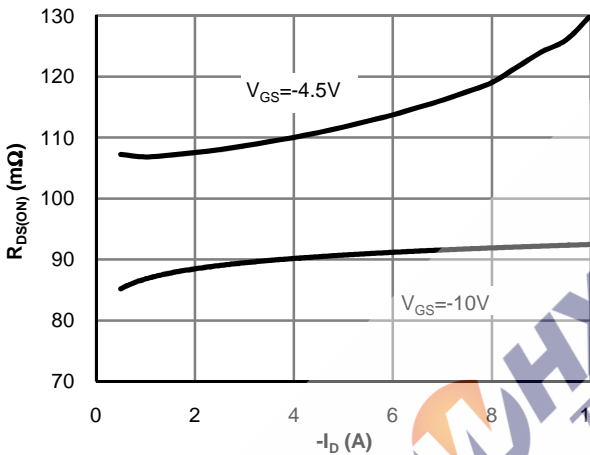


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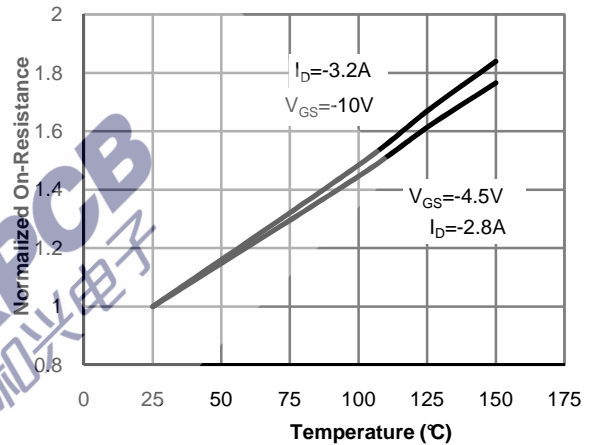


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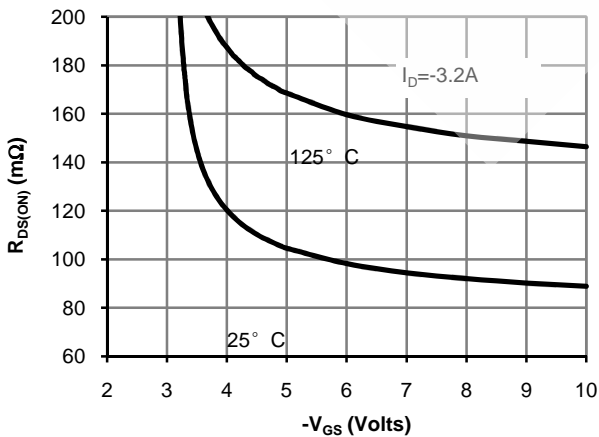


Figure 5: On-Resistance vs. Gate-Source Voltage

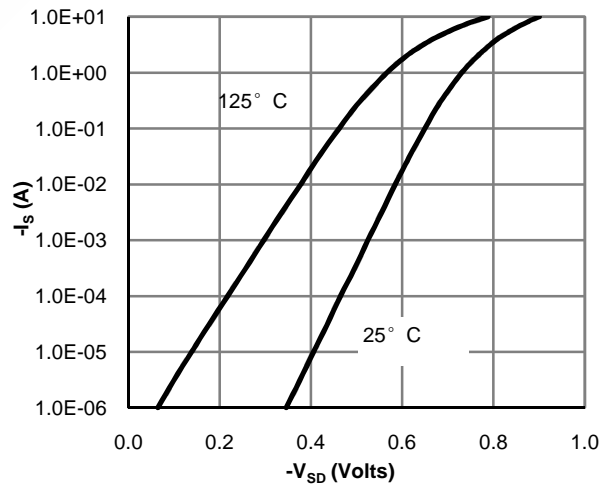


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS: P-CHANNEL

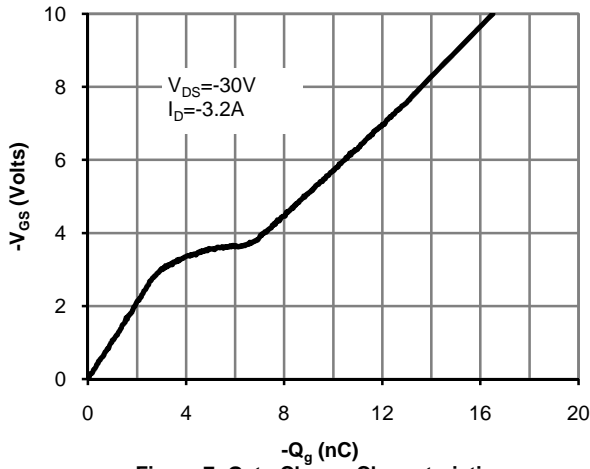


Figure 7: Gate-Charge Characteristics

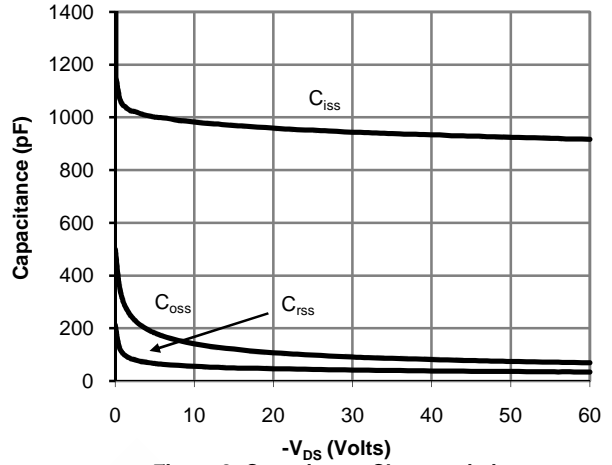


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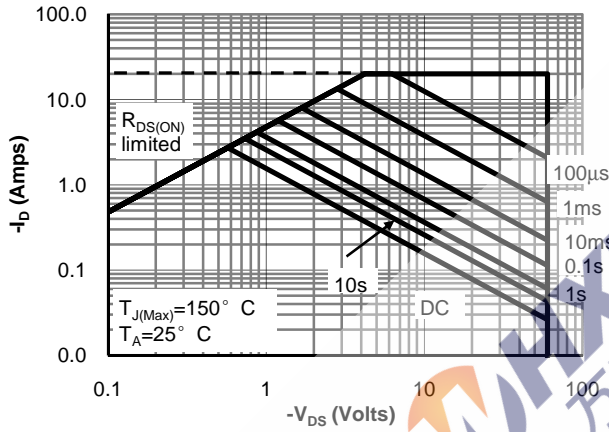


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

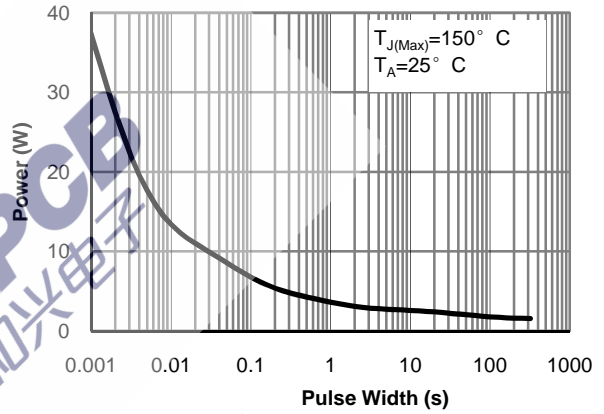


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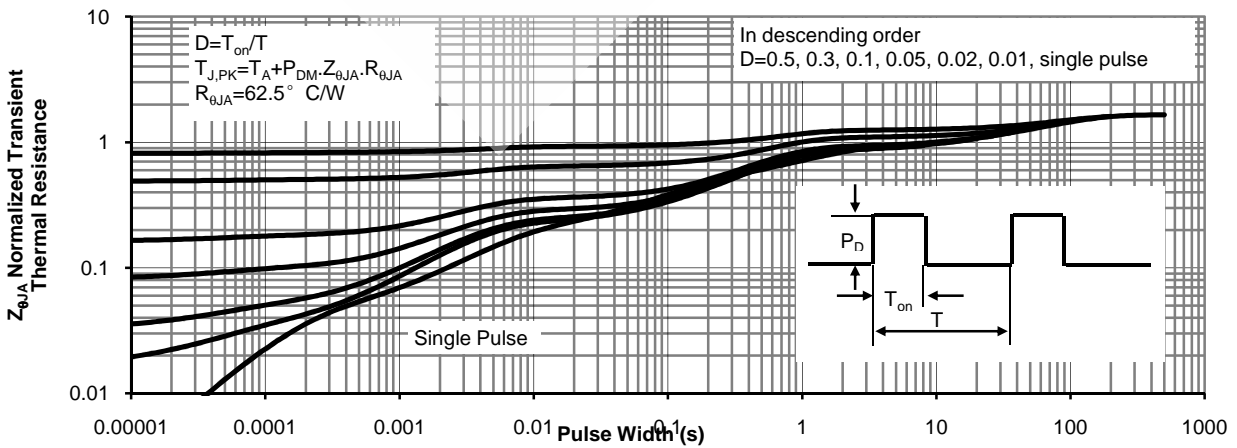
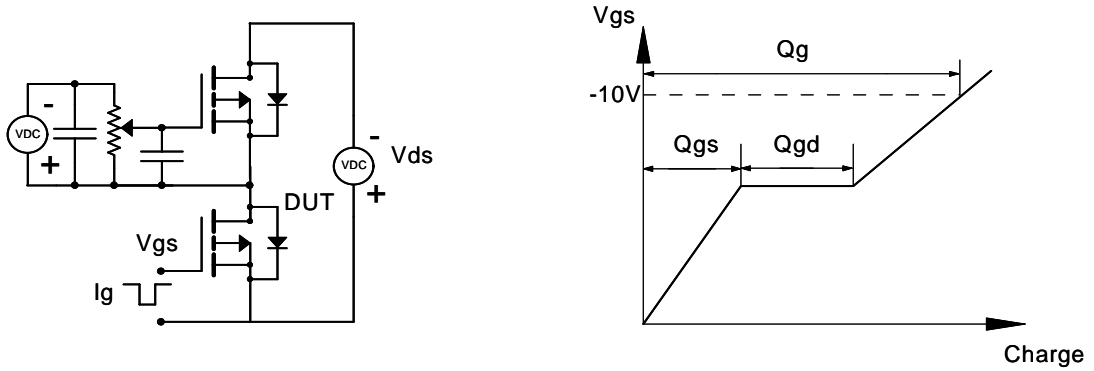


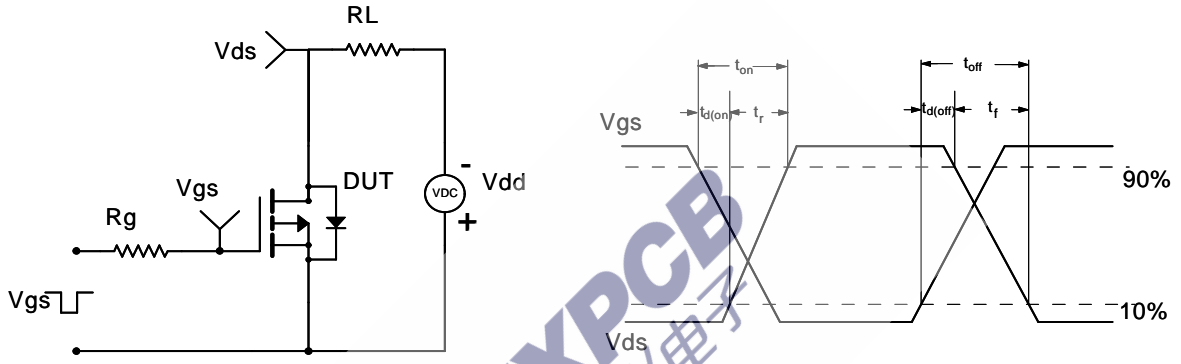
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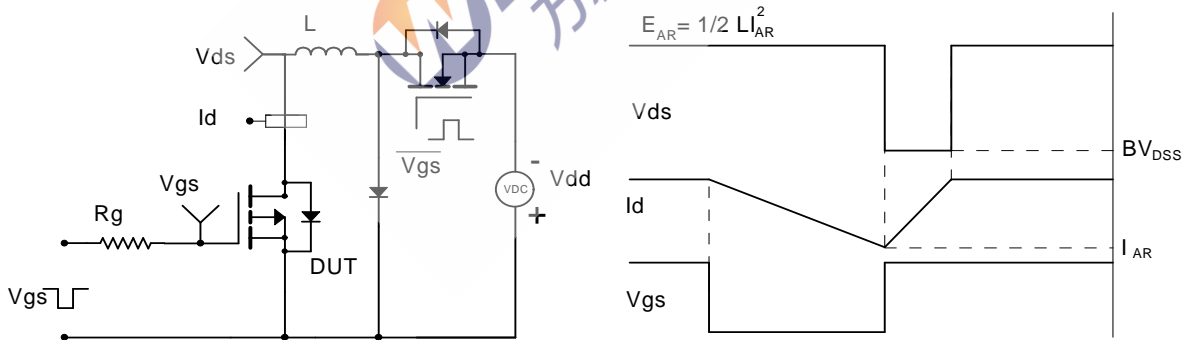
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms

