



AO4613

Complementary Enhancement Mode Field Effect Transistor

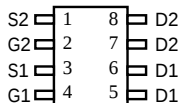
General Description

The AO4613 uses advanced trench technology MOSFETs to provide excellent $R_{DS(ON)}$ and low gate charge. The complementary MOSFETs may be used to form a level shifted high side switch, and for a host of other applications. It is ESD protected. Standard product AO4613 is Pb-free (meets ROHS & Sony 259 specifications). AO4613L is a Green Product ordering option. AO4613 and AO4613L are electrically identical

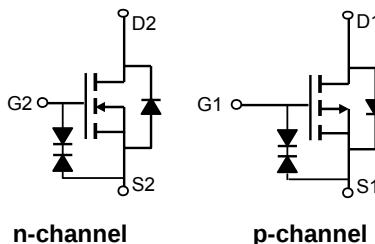
Features

n-channel	p-channel
$V_{DS} (V) = 30V$	-30V
$I_D = 7.2A (V_{GS}=10V)$	-6.1A ($V_{GS}=10V$)
$R_{DS(ON)}$	$R_{DS(ON)}$
< 24m Ω ($V_{GS}=10V$)	< 37m Ω ($V_{GS} = -10V$)
< 40m Ω ($V_{GS}=4.5V$)	< 60m Ω ($V_{GS} = -4.5V$)

ESD rating: 1500V (HBM)



SOIC-8



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}	30	-30	V
Gate-Source Voltage	V_{GS}	± 20	± 20	V
Continuous Drain Current ^A	I_D	7.2	-6.1	A
$T_A=70^\circ C$		6.1	-5.1	
Pulsed Drain Current ^B	I_{DM}	30	-30	A
Power Dissipation	P_D	2	2	W
$T_A=70^\circ C$		1.44	1.44	
Avalanche Current ^B	I_{AR}	15	20	A
Repetitive avalanche energy 0.1mH ^B	E_{AR}	11	20	mJ
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 ^A	$R_{\theta JA}$	n-ch	55	$^\circ C/W$
$t \leq 10s$			62.5	
Maximum Junction-to-Ambient ^A	$R_{\theta JA}$	n-ch	92	$^\circ C/W$
Steady-State			110	
Maximum Junction-to-Lead ^C	$R_{\theta JL}$	n-ch	37	$^\circ C/W$
Steady-State			50	
Maximum Junction-to-Ambient ^A	$R_{\theta JA}$	p-ch	48	$^\circ C/W$
$t \leq 10s$			62.5	
Maximum Junction-to-Ambient ^A	$R_{\theta JA}$	p-ch	84	$^\circ C/W$
Steady-State			110	
Maximum Junction-to-Lead ^C	$R_{\theta JL}$	p-ch	37	$^\circ C/W$
Steady-State			50	

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	$I_D=250\mu\text{A}$, $V_{GS}=0\text{V}$	30			V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS}=24\text{V}$, $V_{GS}=0\text{V}$ $T_J=55^{\circ}\text{C}$			1 5	μA
I_{GSS}	Gate-Body leakage current	$V_{DS}=0\text{V}$, $V_{GS}=\pm 20\text{V}$			10	μA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}$, $I_D=250\mu\text{A}$	1	2	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	$V_{GS}=10\text{V}$, $I_D=7.2\text{A}$ $T_J=125^{\circ}\text{C}$		20 29	24 35	$\text{m}\Omega$
		$V_{GS}=4.5\text{V}$, $I_D=4\text{A}$		30	40	$\text{m}\Omega$
g_{FS}	Forward Transconductance	$V_{DS}=5\text{V}$, $I_D=7.2\text{A}$	10	18		S
V_{SD}	Diode Forward Voltage	$I_S=1\text{A}$		0.77	1	V
I_S	Maximum Body-Diode Continuous Current				3	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	$V_{GS}=0\text{V}$, $V_{DS}=15\text{V}$, $f=1\text{MHz}$		522	630	pF
C_{oss}	Output Capacitance			110		pF
C_{rss}	Reverse Transfer Capacitance			75		pF
R_g	Gate resistance	$V_{GS}=0\text{V}$, $V_{DS}=0\text{V}$, $f=1\text{MHz}$		2.1	3	Ω
SWITCHING PARAMETERS						
$Q_g(10\text{V})$	Total Gate Charge	$V_{GS}=10\text{V}$, $V_{DS}=15\text{V}$, $I_D=7.2\text{A}$		11	15	nC
$Q_g(4.5\text{V})$	Total Gate Charge			5.3	7	nC
Q_{gs}	Gate Source Charge			1.9		nC
Q_{gd}	Gate Drain Charge			4		nC
$t_{D(on)}$	Turn-On DelayTime	$V_{GS}=10\text{V}$, $V_{DS}=15\text{V}$, $R_L=2.1\Omega$, $R_{GEN}=3\Omega$		4.7	7	ns
t_r	Turn-On Rise Time			4.9	10	ns
$t_{D(off)}$	Turn-Off DelayTime			16.2	22	ns
t_f	Turn-Off Fall Time			3.5	7	ns
t_{rr}	Body Diode Reverse Recovery Time	$I_F=7.2\text{A}$, $dI/dt=100\text{A}/\mu\text{s}$		15.7	20	ns
Q_{rr}	Body Diode Reverse Recovery Charge	$I_F=7.2\text{A}$, $dI/dt=100\text{A}/\mu\text{s}$		7.9	10	nC

A: The value of $R_{\theta JA}$ is measured with the device mounted on 1in² FR-4 board with 2oz. Copper, in a still air environment with $T_A=25^{\circ}\text{C}$. The value in any given application depends on the user's specific board design. The current rating is based on the $\leq 10\text{s}$ 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. $R_{\theta JL}$ and $R_{\theta JC}$ are equivalent terms referring to thermal resistance from junction to drain lead.

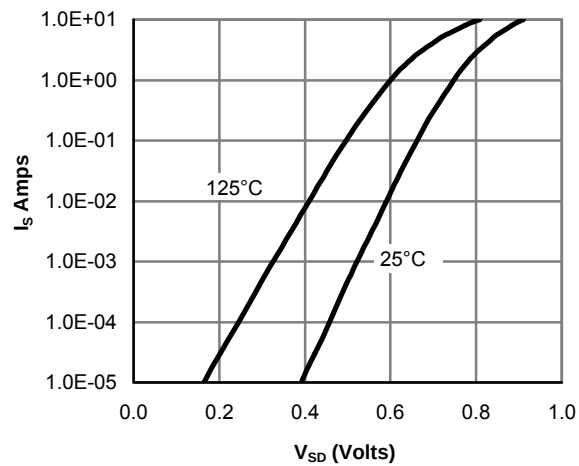
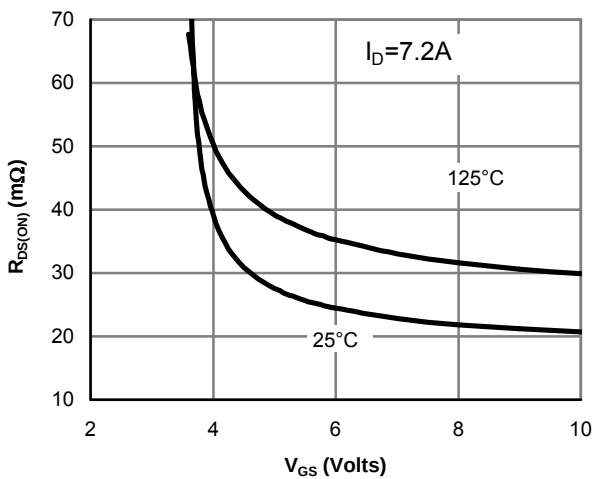
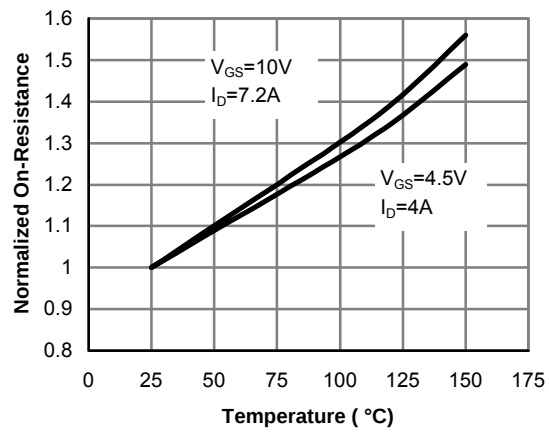
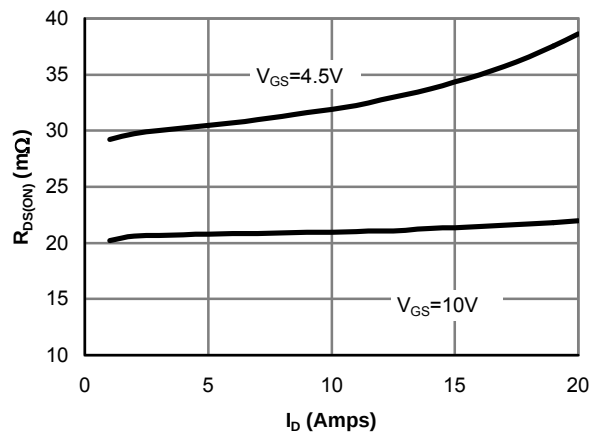
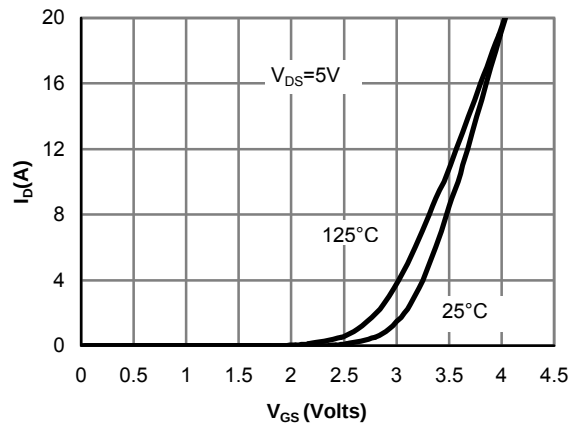
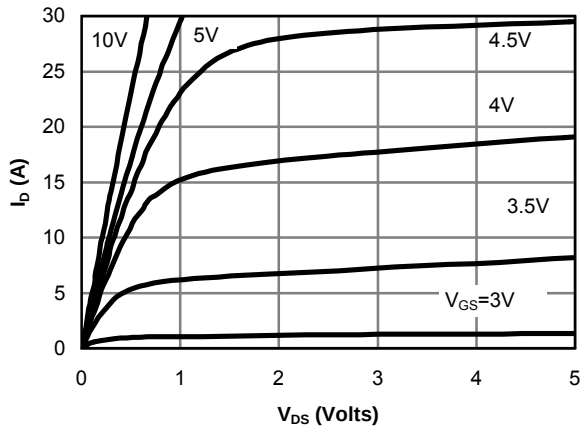
D: The static characteristics in Figures 1 to 6 are obtained using 80 μs pulses, duty cycle 0.5% max.

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

F. Rev 0: August 2005

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N-CH TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS



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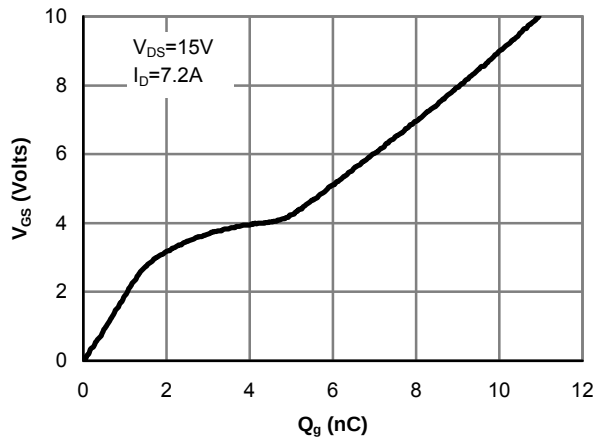


Figure 7: Gate-Charge characteristics

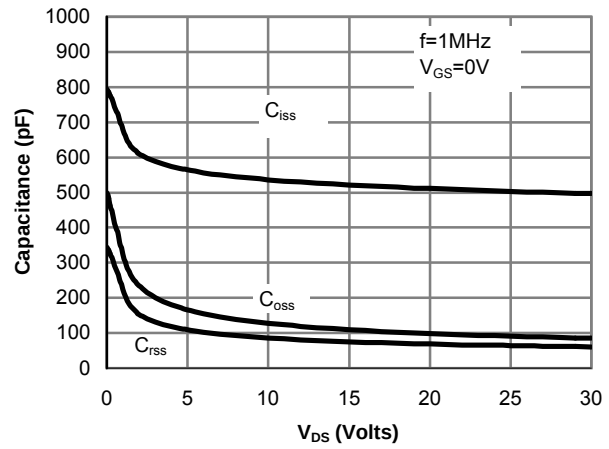


Figure 8: Capacitance Characteristics

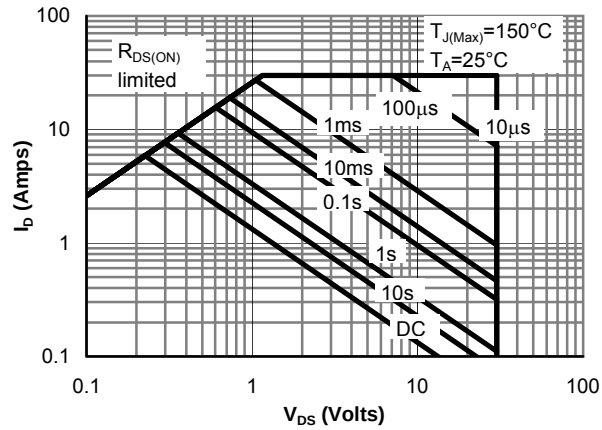


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

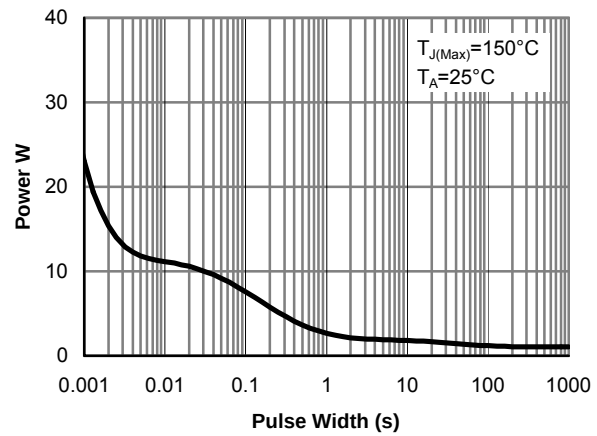


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

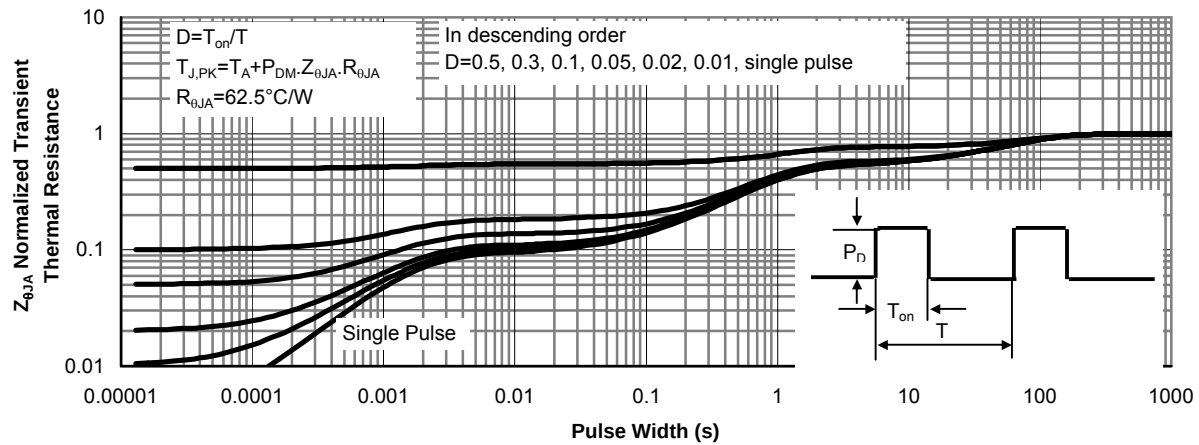


Figure 11: Normalized Maximum Transient Thermal Impedance

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	$I_D=-250\mu\text{A}$, $V_{GS}=0\text{V}$	-30			V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS}=-24\text{V}$, $V_{GS}=0\text{V}$ $T_J=55^\circ\text{C}$			-1 -5	μA
I_{GSS}	Gate-Body leakage current	$V_{DS}=0\text{V}$, $V_{GS}=\pm 20\text{V}$			10	μA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}$, $I_D=-250\mu\text{A}$	-1	-1.7	-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	$V_{GS}=-10\text{V}$, $I_D=-6.1\text{A}$ $T_J=125^\circ\text{C}$		28 39	37 48	$\text{m}\Omega$
		$V_{GS}=-4.5\text{V}$, $I_D=-4\text{A}$		45	60	$\text{m}\Omega$
g_{FS}	Forward Transconductance	$V_{DS}=-5\text{V}$, $I_D=-6.1\text{A}$		12.5		S
V_{SD}	Diode Forward Voltage	$I_S=-1\text{A}$, $V_{GS}=0\text{V}$		-0.77	-1	V
I_S	Maximum Body-Diode Continuous Current				3	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	$V_{GS}=0\text{V}$, $V_{DS}=-15\text{V}$, $f=1\text{MHz}$		1040	1250	pF
C_{oss}	Output Capacitance			179		pF
C_{rss}	Reverse Transfer Capacitance			134		pF
R_g	Gate resistance	$V_{GS}=0\text{V}$, $V_{DS}=0\text{V}$, $f=1\text{MHz}$		5	10	Ω
SWITCHING PARAMETERS						
$Q_g(10\text{V})$	Total Gate Charge (10V)	$V_{GS}=-10\text{V}$, $V_{DS}=-15\text{V}$, $I_D=-6.1\text{A}$		16.8	22	nC
$Q_g(4.5\text{V})$	Total Gate Charge (4.5V)			8.7	12	nC
Q_{gs}	Gate Source Charge			3.4		nC
Q_{gd}	Gate Drain Charge			5		nC
$t_{D(on)}$	Turn-On DelayTime	$V_{GS}=-10\text{V}$, $V_{DS}=-15\text{V}$, $R_L=2.5\Omega$, $R_{GEN}=3\Omega$		9	12	ns
t_r	Turn-On Rise Time			5.7	11	ns
$t_{D(off)}$	Turn-Off DelayTime			22.7	30	ns
t_f	Turn-Off Fall Time			10.2	20	ns
t_{rr}	Body Diode Reverse Recovery Time	$I_F=-6.1\text{A}$, $dI/dt=100\text{A}/\mu\text{s}$		21.7	27	ns
Q_{rr}	Body Diode Reverse Recovery Charge	$I_F=-6.1\text{A}$, $dI/dt=100\text{A}/\mu\text{s}$		13.6	18	nC

A: The value of $R_{\theta JA}$ is measured with the device mounted on 1in² FR-4 board with 2oz. Copper, in a still air environment with $T_A=25^\circ\text{C}$. The value in any given application depends on the user's specific board design. The current rating is based on the $\leq 10\text{s}$ 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. $R_{\theta JL}$ and $R_{\theta JC}$ are equivalent terms referring to thermal resistance from junction to drain lead.

D: The static characteristics in Figures 1 to 6, 12, 14 are obtained using 80 μs pulses, duty cycle 0.5% max.

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

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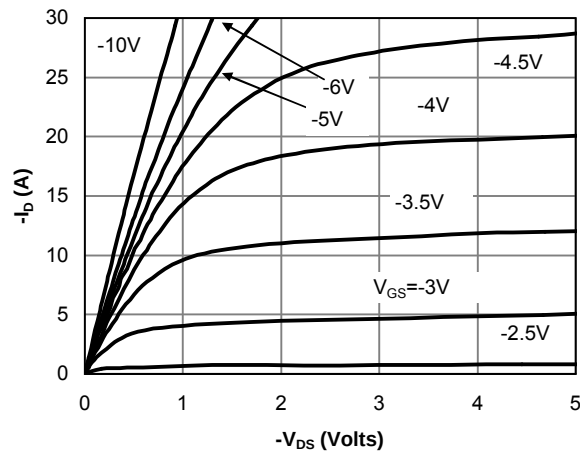


Fig 1: On-Region Characteristics

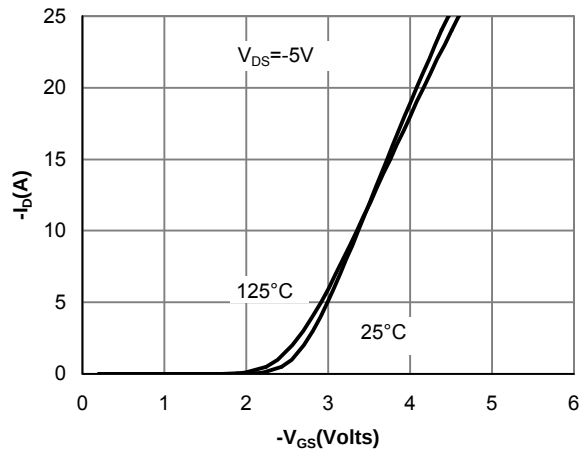


Figure 2: Transfer Characteristics

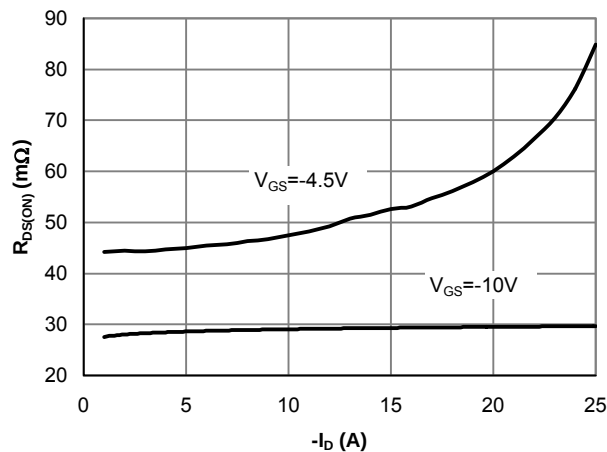


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

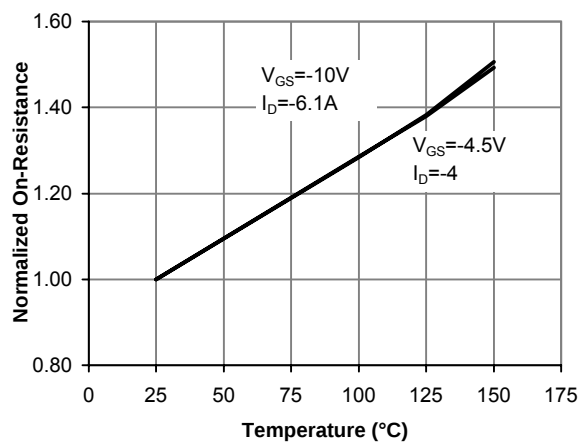


Figure 4: On-Resistance vs. Junction Temperature

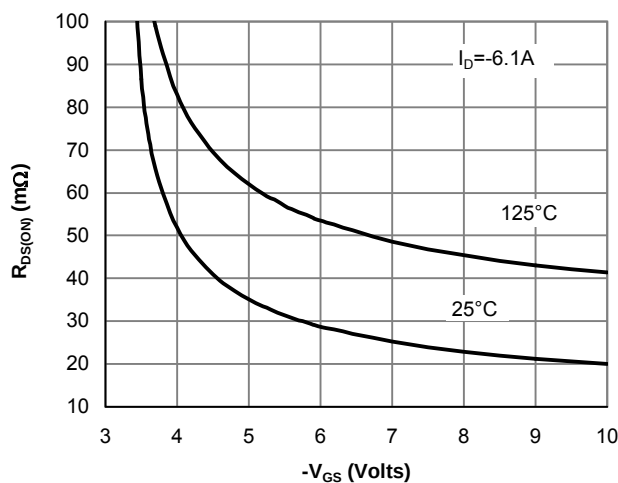


Figure 5: On-Resistance vs. Gate-Source Voltage

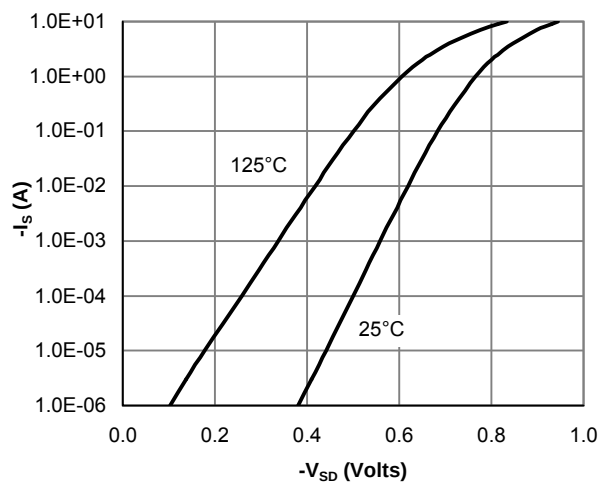


Figure 6: Body-Diode Characteristics

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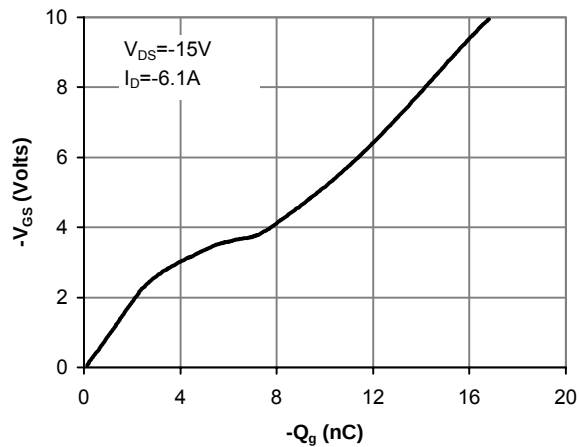


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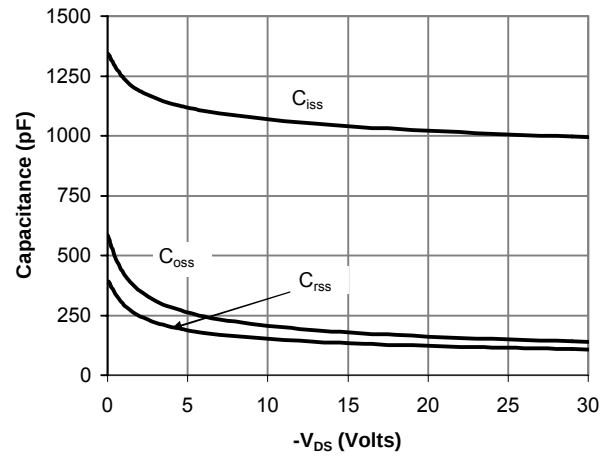


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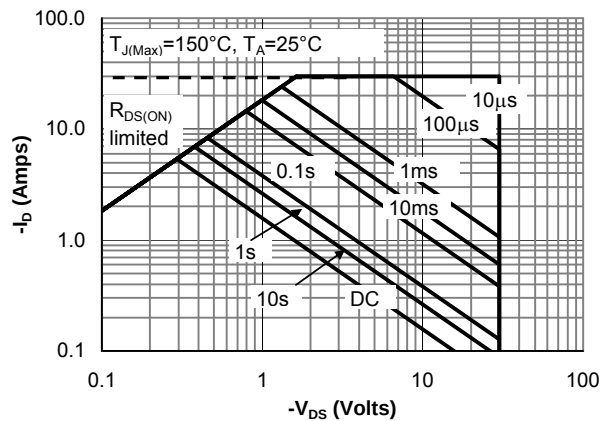


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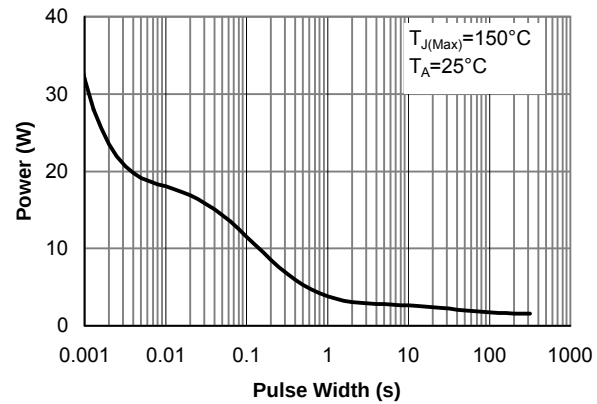


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

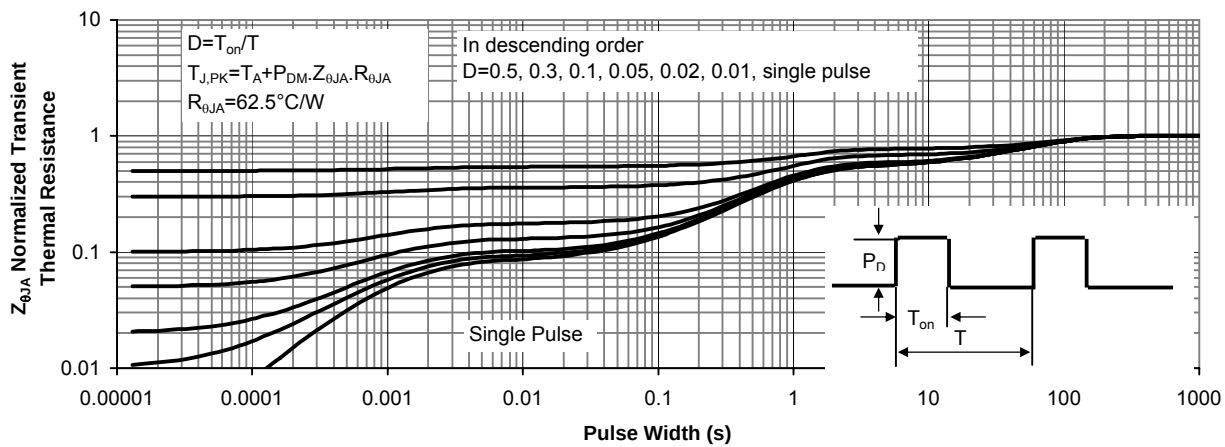


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