

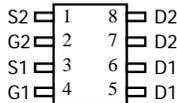
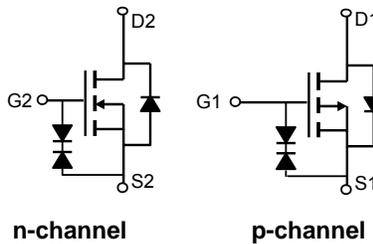

**AO4613**
**Complementary Enhancement Mode Field Effect Transistor**
**General Description**

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 $\Omega$ ( $V_{GS}=10V$ )	< 37m $\Omega$ ( $V_{GS} = -10V$ )
< 40m $\Omega$ ( $V_{GS}=4.5V$ )	< 60m $\Omega$ ( $V_{GS} = -4.5V$ )

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	$V_{GS}$	$\pm 20$	$\pm 20$	V	
Continuous Drain Current <sup>A</sup>	$I_D$	$T_A=25^\circ C$	7.2	-6.1	A
		$T_A=70^\circ C$	6.1	-5.1	
Pulsed Drain Current <sup>B</sup>	$I_{DM}$	30	-30		
Power Dissipation	$P_D$	$T_A=25^\circ C$	2	2	W
		$T_A=70^\circ C$	1.44	1.44	
Avalanche Current <sup>B</sup>	$I_{AR}$	15	20	A	
Repetitive avalanche energy 0.1mH <sup>B</sup>	$E_{AR}$	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 <sup>A</sup>	$R_{\theta JA}$	n-ch	55	62.5	$^\circ C/W$
		p-ch	92	110	
Maximum Junction-to-Ambient <sup>A</sup>	$R_{\theta JA}$	n-ch	37	50	$^\circ C/W$
Maximum Junction-to-Lead <sup>C</sup>		p-ch	48	62.5	
Maximum Junction-to-Ambient <sup>A</sup>	$R_{\theta JA}$	n-ch	84	110	$^\circ C/W$
Maximum Junction-to-Ambient <sup>A</sup>		p-ch	37	50	
Maximum Junction-to-Lead <sup>C</sup>	$R_{\theta JL}$	p-ch	37	50	$^\circ C/W$

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	$I_D=250\mu\text{A}$ , $V_{GS}=0\text{V}$	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	$\mu\text{A}$
$I_{GSS}$	Gate-Body leakage current	$V_{DS}=0\text{V}$ , $V_{GS}=\pm 20\text{V}$			10	$\mu\text{A}$
$V_{GS(th)}$	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
<b>DYNAMIC PARAMETERS</b>						
$C_{iss}$	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
$C_{riss}$	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	$\Omega$
<b>SWITCHING PARAMETERS</b>						
$Q_g(10\text{V})$	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 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 given application depends on the user's specific board design. The current rating is based on the  $t_s \leq 10\text{s}$  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.

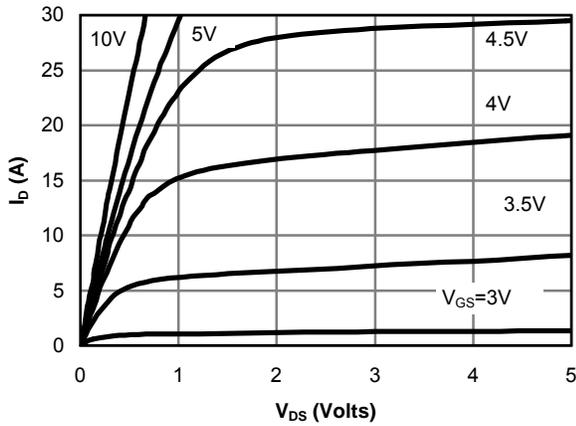
D: The static characteristics in Figures 1 to 6 are obtained using 80 $\mu\text{s}$  pulses, duty cycle 0.5% max.

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.

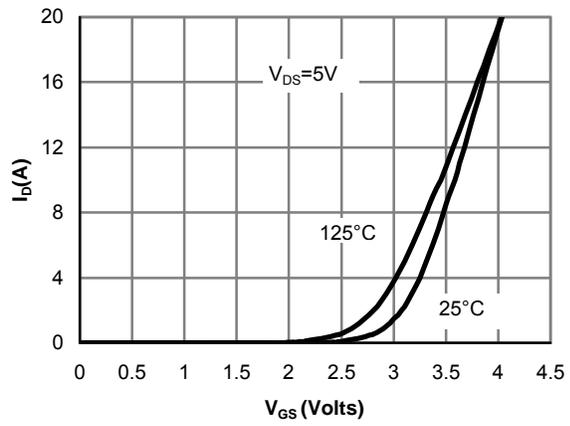
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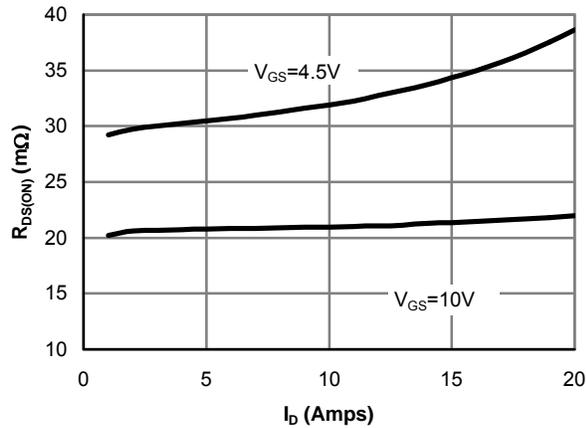
**N-CH TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**



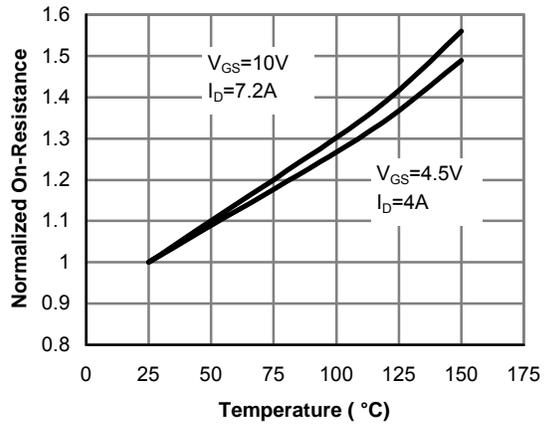
**Fig 1: On-Region Characteristics**



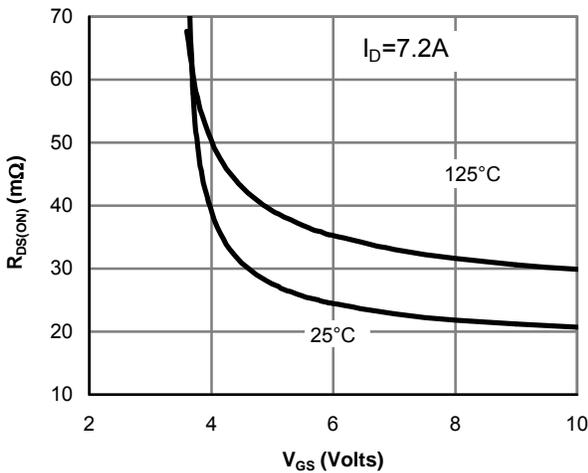
**Figure 2: Transfer Characteristics**



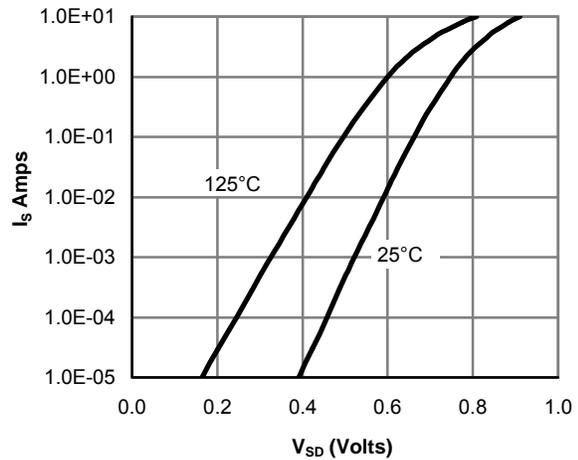
**Figure 3: On-Resistance vs. Drain Current and Gate Voltage**



**Figure 4: On-Resistance vs. Junction Temperature**



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



**Figure 6: Body diode characteristics**

**N-CH TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**

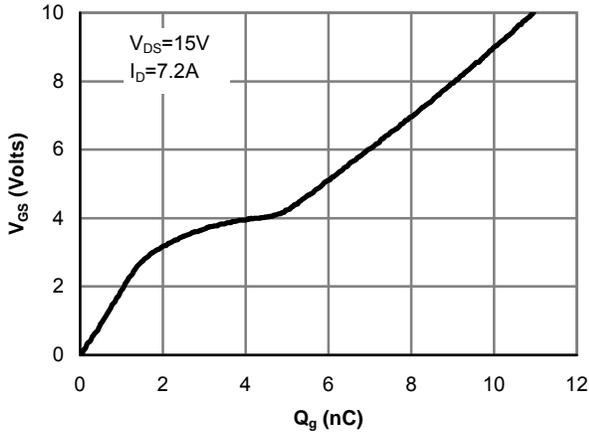


Figure 7: Gate-Charge characteristics

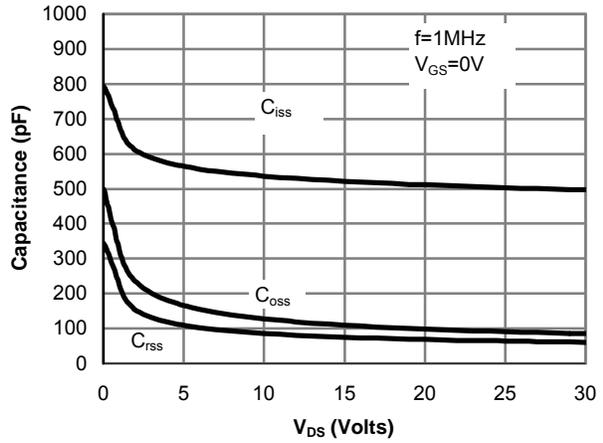


Figure 8: Capacitance Characteristics

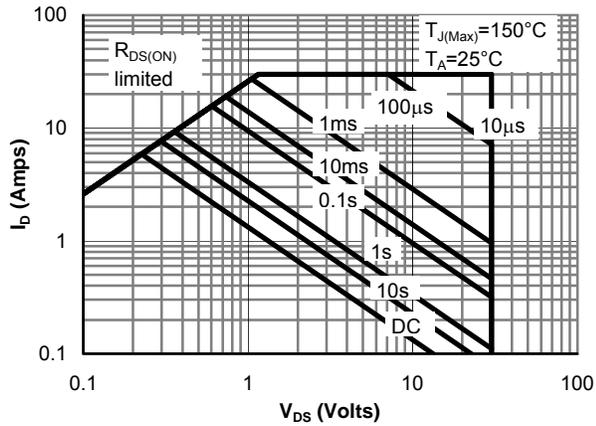


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

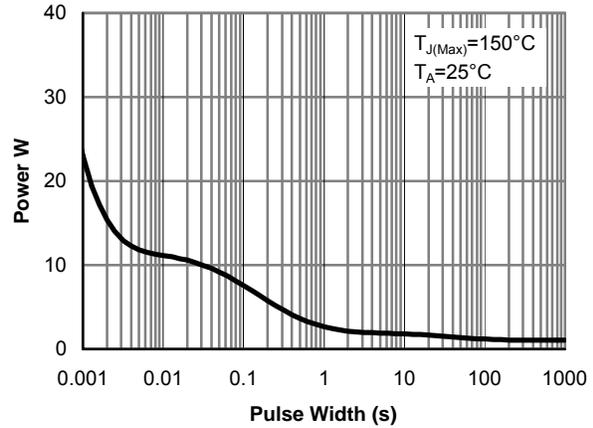


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

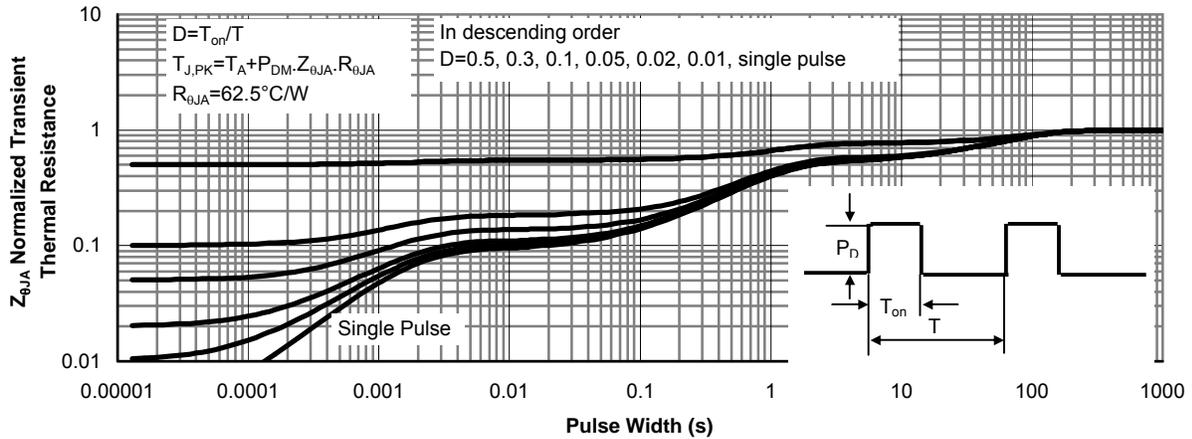


Figure 11: Normalized Maximum Transient Thermal Impedance

**P-Channel Electrical Characteristics (T<sub>J</sub>=25°C unless otherwise noted)**

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>STATIC PARAMETERS</b>						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	I <sub>D</sub> =-250μA, V <sub>GS</sub> =0V	-30			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> =-24V, V <sub>GS</sub> =0V T <sub>J</sub> =55°C			-1 -5	μA
I <sub>GSS</sub>	Gate-Body leakage current	V <sub>DS</sub> =0V, V <sub>GS</sub> =±20V			10	μA
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> =V <sub>GS</sub> I <sub>D</sub> =-250μA	-1	-1.7	-3	V
I <sub>D(ON)</sub>	On state drain current	V <sub>GS</sub> =-10V, V <sub>DS</sub> =-5V	30			A
R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> =-10V, I <sub>D</sub> =-6.1A T <sub>J</sub> =125°C		28 39	37 48	mΩ
		V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-4A		45	60	
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> =-5V, I <sub>D</sub> =-6.1A		12.5		S
V <sub>SD</sub>	Diode Forward Voltage	I <sub>S</sub> =-1A, V <sub>GS</sub> =0V		-0.77	-1	V
I <sub>S</sub>	Maximum Body-Diode Continuous Current				3	A
<b>DYNAMIC PARAMETERS</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> =0V, V <sub>DS</sub> =-15V, f=1MHz		1040	1250	pF
C <sub>oss</sub>	Output Capacitance			179		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			134		pF
R <sub>g</sub>	Gate resistance	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz		5	10	Ω
<b>SWITCHING PARAMETERS</b>						
Q <sub>g(10V)</sub>	Total Gate Charge (10V)	V <sub>GS</sub> =-10V, V <sub>DS</sub> =-15V, I <sub>D</sub> =-6.1A		16.8	22	nC
Q <sub>g(4.5V)</sub>	Total Gate Charge (4.5V)			8.7	12	nC
Q <sub>gs</sub>	Gate Source Charge			3.4		nC
Q <sub>gd</sub>	Gate Drain Charge			5		nC
t <sub>D(on)</sub>	Turn-On DelayTime	V <sub>GS</sub> =-10V, V <sub>DS</sub> =-15V, R <sub>L</sub> =2.5Ω, R <sub>GEN</sub> =3Ω		9	12	ns
t <sub>r</sub>	Turn-On Rise Time			5.7	11	ns
t <sub>D(off)</sub>	Turn-Off DelayTime			22.7	30	ns
t <sub>f</sub>	Turn-Off Fall Time			10.2	20	ns
t <sub>rr</sub>	Body Diode Reverse Recovery Time	I <sub>F</sub> =-6.1A, di/dt=100A/μs		21.7	27	ns
Q <sub>rr</sub>	Body Diode Reverse Recovery Charge	I <sub>F</sub> =-6.1A, di/dt=100A/μs		13.6	18	nC

A: The value of R<sub>θJA</sub> is measured with the device mounted on 1in<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with T<sub>A</sub>=25°C. The value in any given application depends on the user's specific board design. The current rating is based on the t<sub>s</sub> 10s thermal resistance rating.

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

C: The R<sub>θJA</sub> is the sum of the thermal impedance from junction to lead R<sub>θJL</sub> and lead to ambient. R<sub>θJL</sub> and R<sub>θJC</sub> 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 80μs 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<sub>A</sub>=25°C. The SOA curve provides a single pulse rating.

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P-CH TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

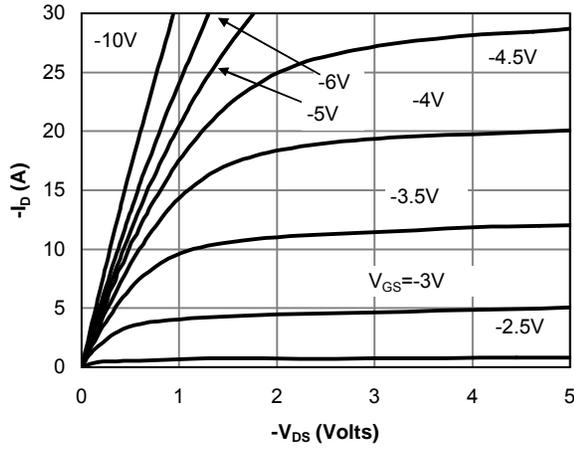


Fig 1: On-Region Characteristics

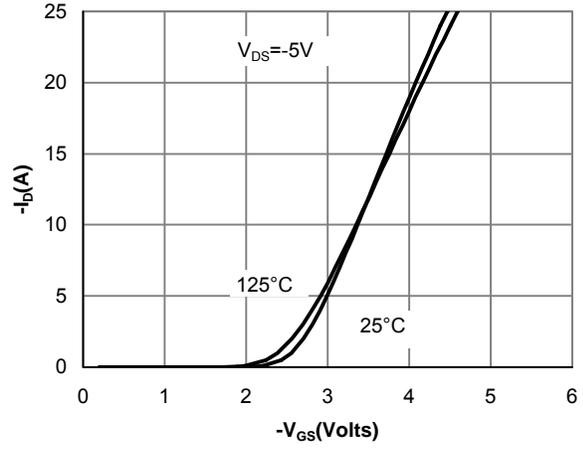


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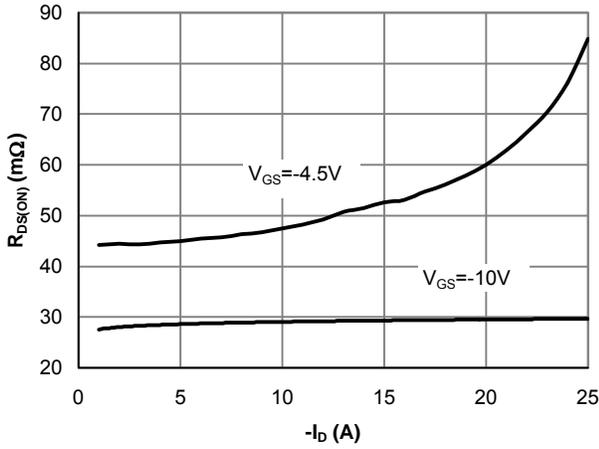


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

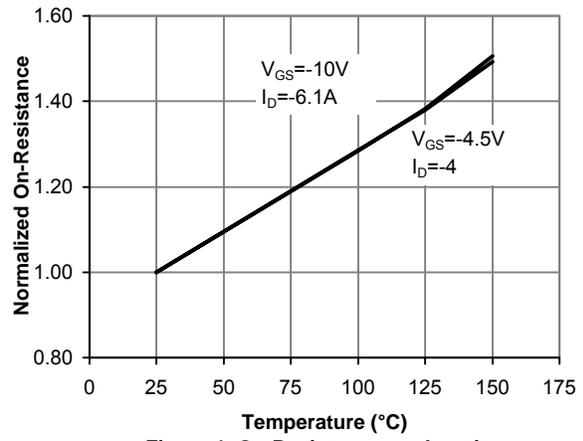


Figure 4: On-Resistance vs. Junction Temperature

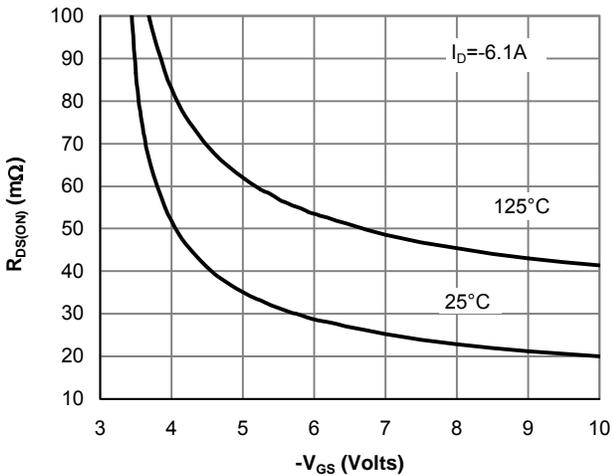


Figure 5: On-Resistance vs. Gate-Source Voltage

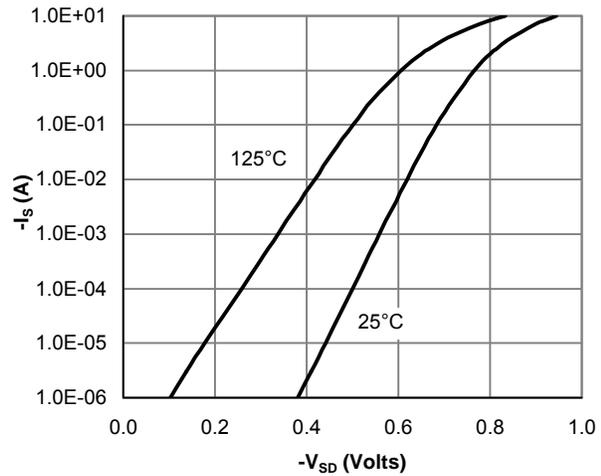


Figure 6: Body-Diode Characteristics

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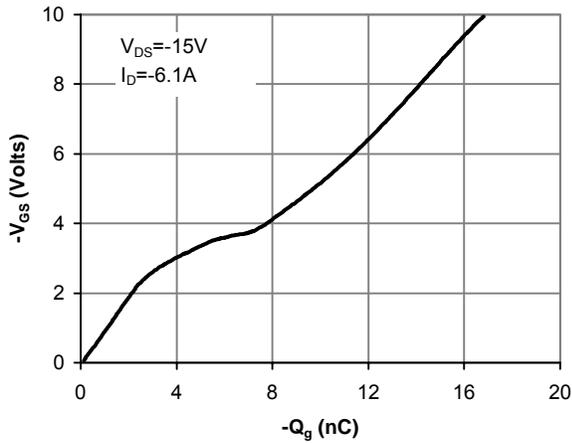


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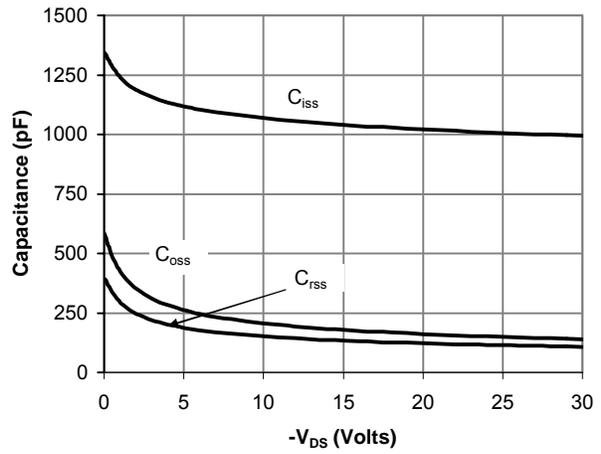


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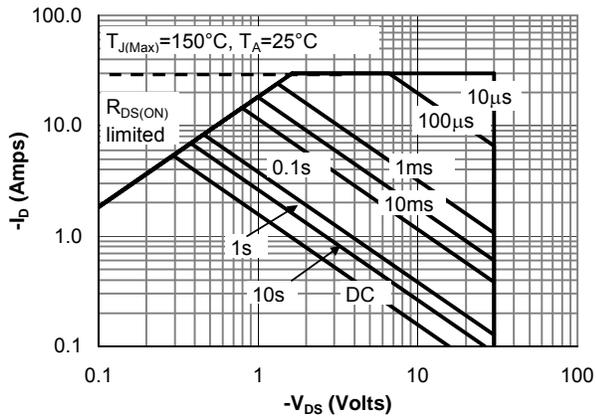


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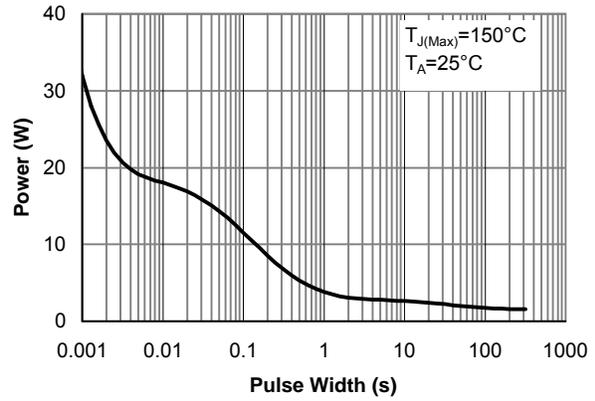


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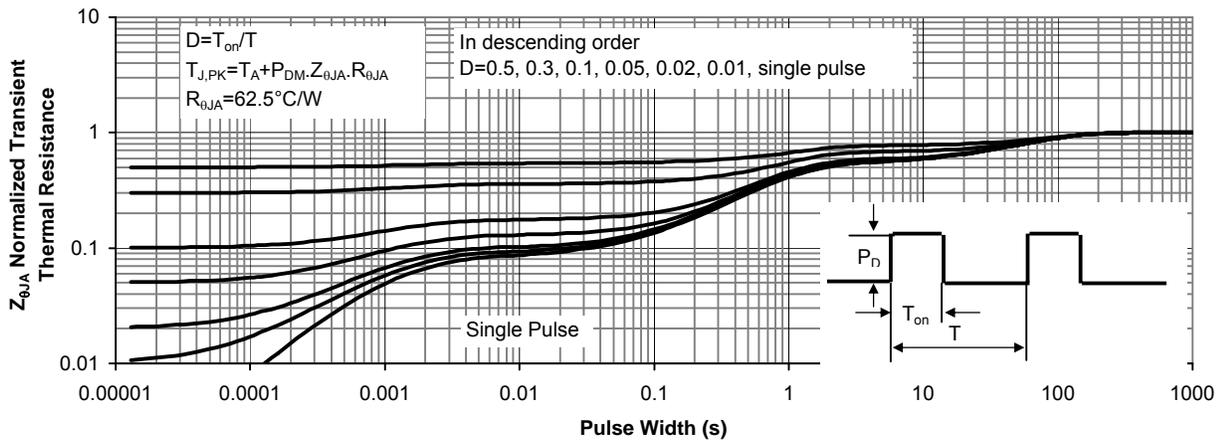


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