



## AOP610

### Complementary Enhancement Mode Field Effect Transistor

#### General Description

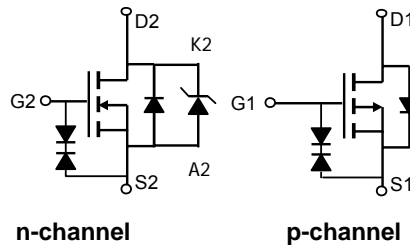
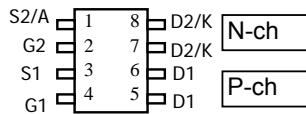
The AOP610 uses advanced trench technology MOSFETs to provide excellent  $R_{DS(ON)}$  and low gate charge. The complementary MOSFETs may be used to form a level shifted high side switch, and for a host of other applications. A Schottky diode in parallel with the n-channel FET reduces body diode related losses. It is ESD protected. *Standard product AOP610 is Pb-free (meets ROHS & Sony 259 specifications). AOP610L is a Green Product ordering option. AOP610 and AOP610L are electrically identical.*

#### Features

n-channel	p-channel
$V_{DS} (V) = 30V$	-30V
$I_D = 7.7A (V_{GS}=10V)$	-6.2A ( $V_{GS}=10V$ )
$R_{DS(ON)}$	$R_{DS(ON)}$
< 24m $\Omega$ ( $V_{GS}=10V$ )	< 37m $\Omega$ ( $V_{GS} = -10V$ )
< 42m $\Omega$ ( $V_{GS}=4.5V$ )	< 60m $\Omega$ ( $V_{GS} = -4.5V$ )

ESD rating: 1500V (HBM)

#### PDIP-8



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

Parameter	Symbol	Max n-channel	Max p-channel	Units	
Drain-Source Voltage	$V_{DS}$	30	-30	V	
Gate-Source Voltage	$V_{GS}$	$\pm 20$	$\pm 20$	V	
Continuous Drain Current <sup>A</sup>	$I_D$	$T_A=25^\circ\text{C}$	7.7	-6.2	A
		$T_A=70^\circ\text{C}$	6.1	-4.9	
Pulsed Drain Current <sup>B</sup>	$I_{DM}$	30	-30		
Power Dissipation	$P_D$	$T_A=25^\circ\text{C}$	2.3	2.3	W
		$T_A=70^\circ\text{C}$	1.45	1.45	
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	$^\circ\text{C}$	

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

Parameter	Symbol	Typ	Max		Units
			n-ch	p-ch	
Maximum Junction-to-Ambient <sup>A</sup>	$R_{\theta JA}$	n-ch	45	55	$^\circ\text{C/W}$
Maximum Junction-to-Ambient <sup>A</sup>			Steady-State	78	
Maximum Junction-to-Lead <sup>C</sup>	$R_{\theta JL}$	n-ch	30	40	$^\circ\text{C/W}$
Maximum Junction-to-Ambient <sup>A</sup>			$t \leq 10s$	38.5	
Maximum Junction-to-Ambient <sup>A</sup>	$R_{\theta JA}$	p-ch	78	95	$^\circ\text{C/W}$
Maximum Junction-to-Ambient <sup>A</sup>			Steady-State	28	
Maximum Junction-to-Lead <sup>C</sup>	$R_{\theta JL}$	p-ch	28	40	$^\circ\text{C/W}$

**N-Channel+Schottky 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		2	50 125	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	2	3	V
I <sub>D(ON)</sub>	On state drain current	V <sub>GS</sub> =10V, V <sub>DS</sub> =5V	20			A
R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> =10V, I <sub>D</sub> =7.7A T <sub>J</sub> =125°C		20 29	24 35	mΩ
		V <sub>GS</sub> =4.5V, I <sub>D</sub> =4A		34	42	mΩ
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> =5V, I <sub>D</sub> =7.7A	10	18		S
V <sub>SD</sub>	Diode Forward Voltage	I <sub>S</sub> =1A		0.5	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		543	630	pF
C <sub>oss</sub>	Output Capacitance			142		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			76		pF
R <sub>g</sub>	Gate resistance	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz		2.1	3	Ω
<b>SWITCHING PARAMETERS</b>						
Q <sub>g</sub> (10V)	Total Gate Charge	V <sub>GS</sub> =10V, V <sub>DS</sub> =15V, I <sub>D</sub> =7.7A		11	15	nC
Q <sub>g</sub> (4.5V)	Total Gate Charge			5.3	7	nC
Q <sub>gs</sub>	Gate Source Charge			1.9		nC
Q <sub>gd</sub>	Gate Drain Charge			4		nC
t <sub>D(on)</sub>	Turn-On DelayTime	V <sub>GS</sub> =10V, V <sub>DS</sub> =15V, R <sub>L</sub> =1.9Ω, R <sub>GEN</sub> =3Ω		4.7	7	ns
t <sub>r</sub>	Turn-On Rise Time			4.9	10	ns
t <sub>D(off)</sub>	Turn-Off DelayTime			16.2	22	ns
t <sub>f</sub>	Turn-Off Fall Time			3.5	7	ns
t <sub>rr</sub>	Body Diode Reverse Recovery Time	I <sub>F</sub> =7.7A, di/dt=100A/μs		15.7	20	ns
Q <sub>rr</sub>	Body Diode Reverse Recovery Charge	I <sub>F</sub> =7.7A, di/dt=100A/μs		7.9	10	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.

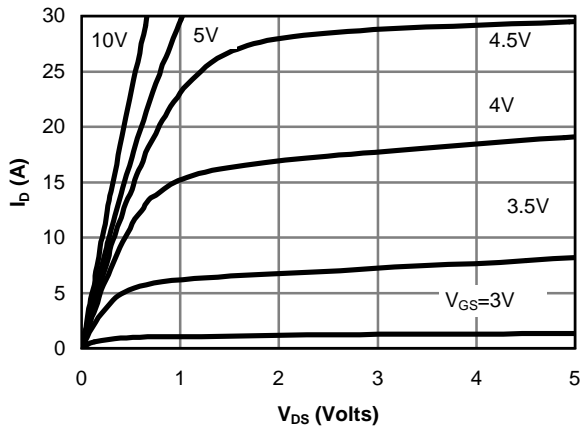
D: The static characteristics in Figures 1 to 6 are obtained using 80μs pulses, duty cycle 0.5% max.

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.

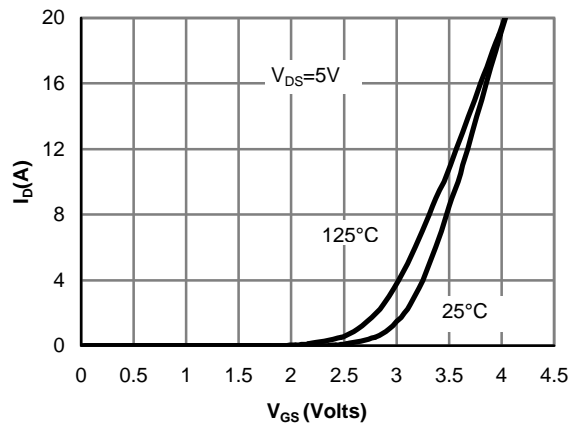
F: Rev 0: October 2005

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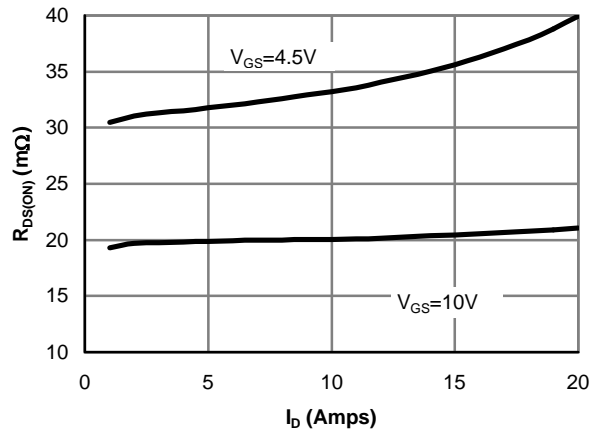
**N-CH+SCHOTTKY TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**



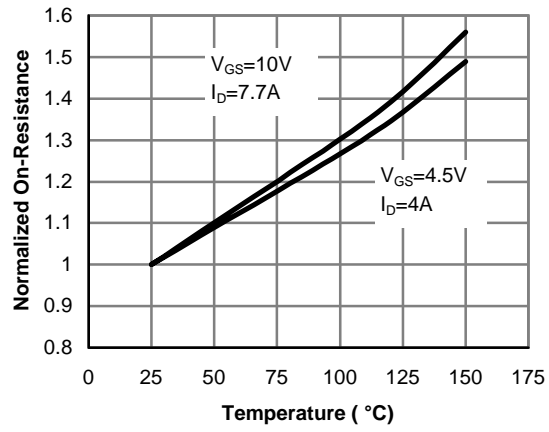
**Fig 1: On-Region Characteristics**



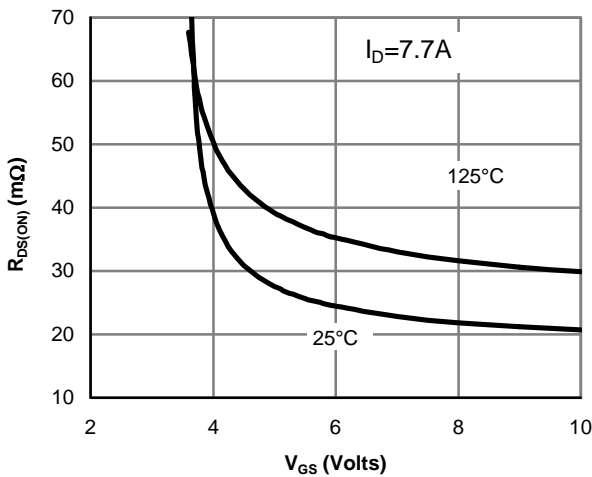
**Figure 2: Transfer Characteristics**



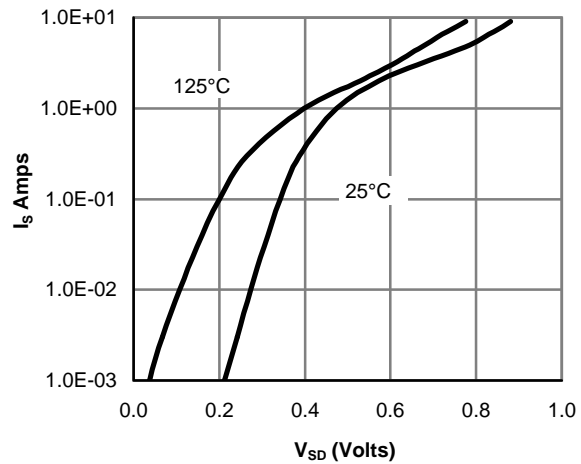
**Figure 3: On-Resistance vs. Drain Current and Gate Voltage**



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



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



**Figure 6: Body diode characteristics**

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

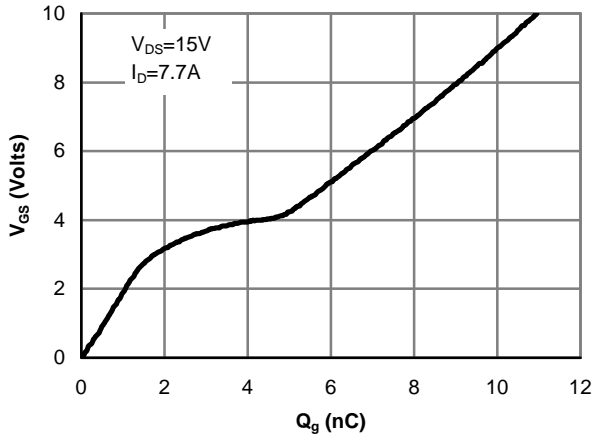


Figure 7: Gate-Charge characteristics

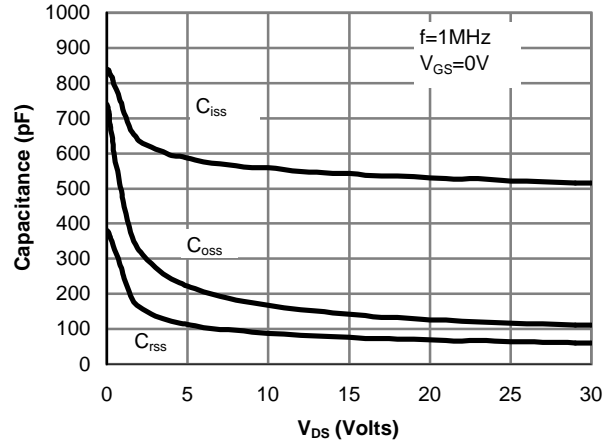


Figure 8: Capacitance Characteristics

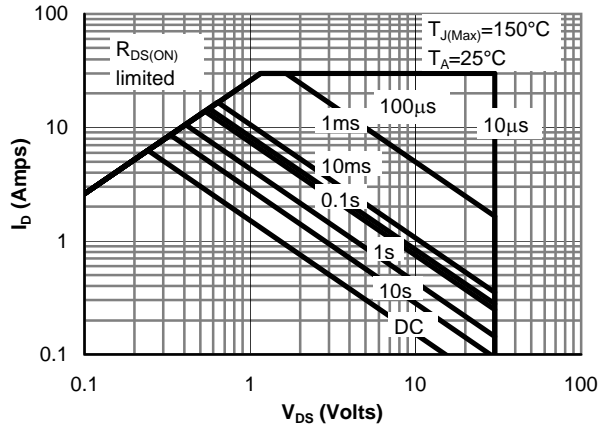


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

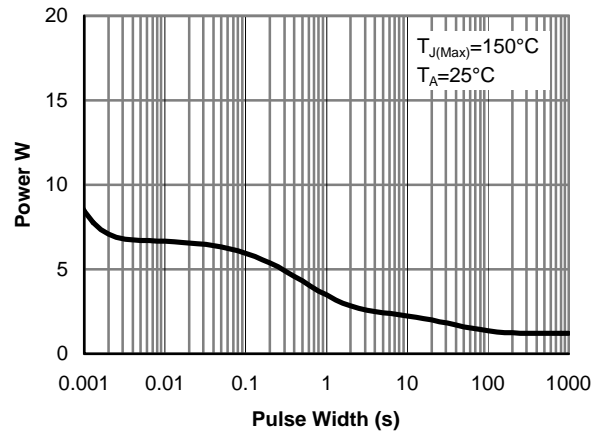


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

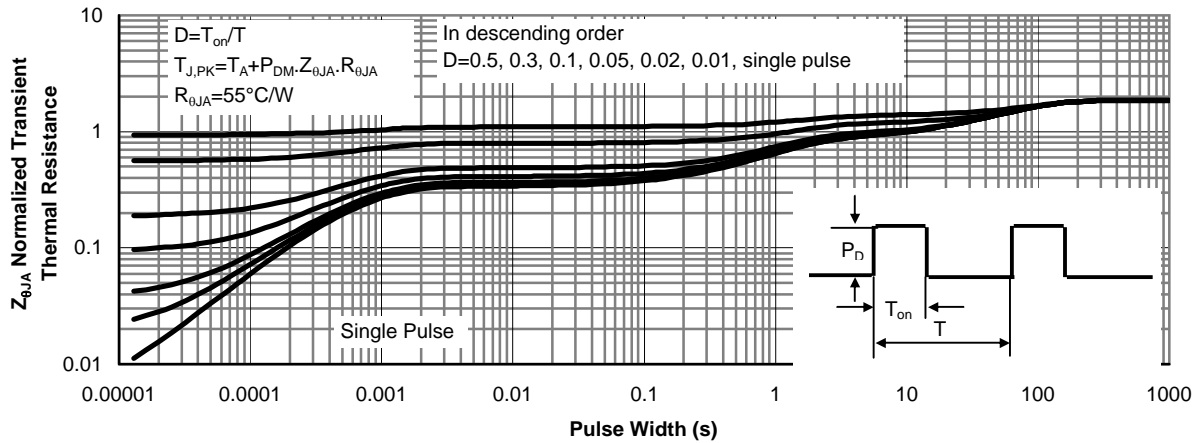


Figure 11: Normalized Maximum Transient Thermal Impedance

**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	-1.8	-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> =-6.2A T <sub>J</sub> =125°C		30.5 43	37 52	mΩ
		V <sub>GS</sub> =-4.5V, I <sub>D</sub> =4A		47	60	
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> =-5V, I <sub>D</sub> =-6.2A		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> =-6.2A		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> =-6.2A, di/dt=100A/μs		21.7	27	ns
Q <sub>rr</sub>	Body Diode Reverse Recovery Charge	I <sub>F</sub> =-6.2A, 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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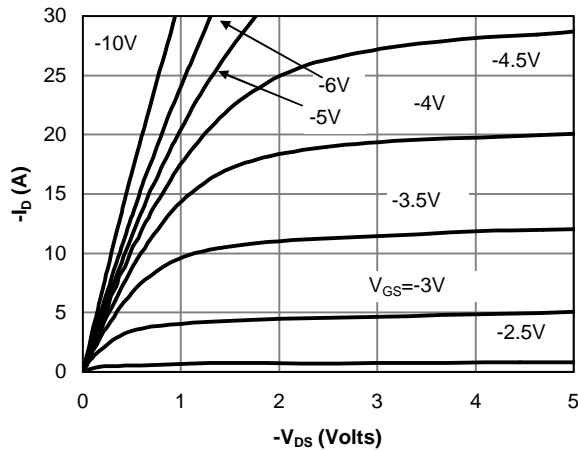


Fig 1: On-Region Characteristics

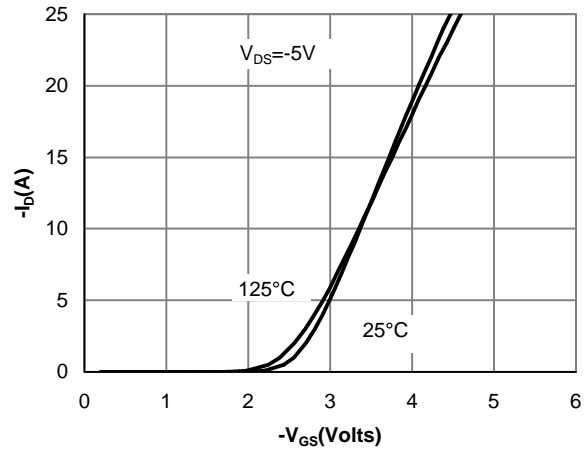


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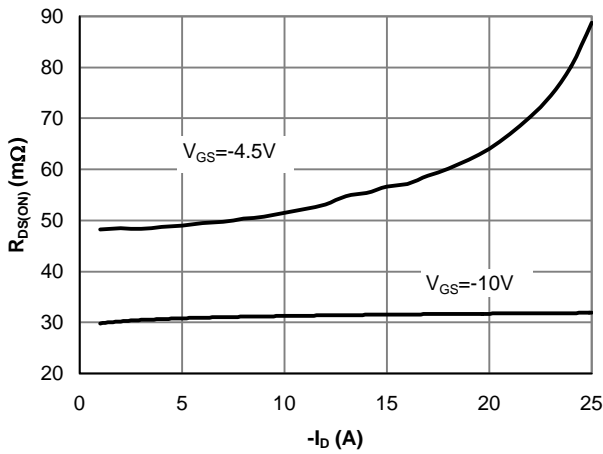


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

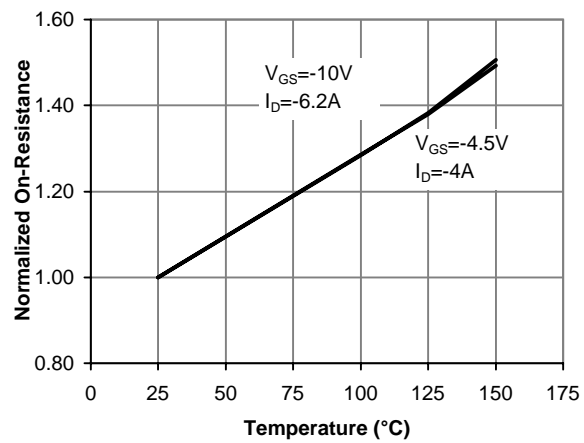


Figure 4: On-Resistance vs. Junction Temperature

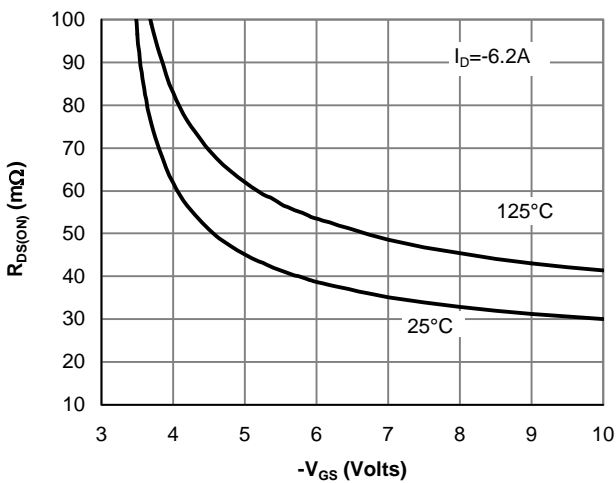


Figure 5: On-Resistance vs. Gate-Source Voltage

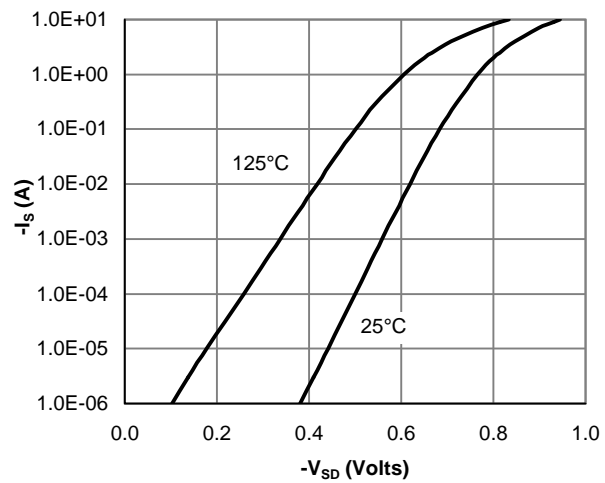


Figure 6: Body-Diode Characteristics

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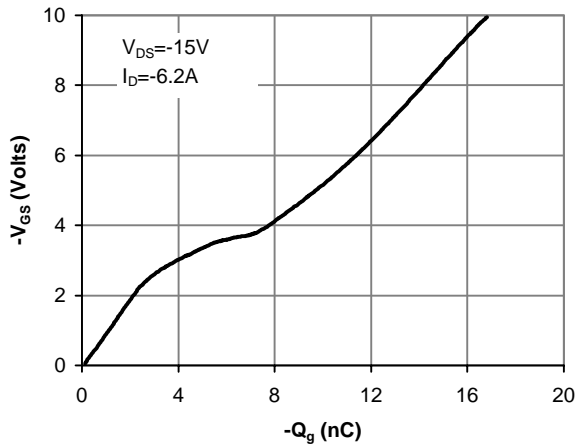


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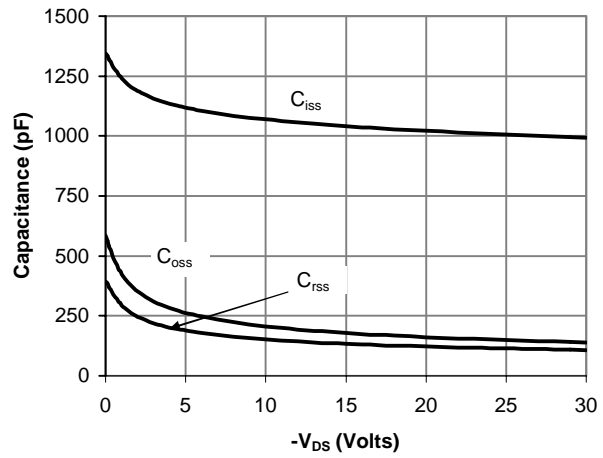


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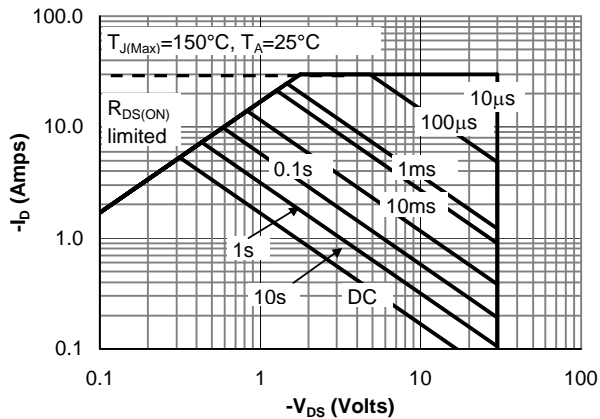


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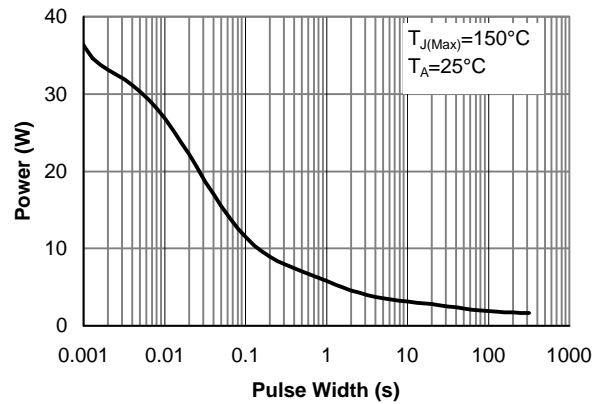


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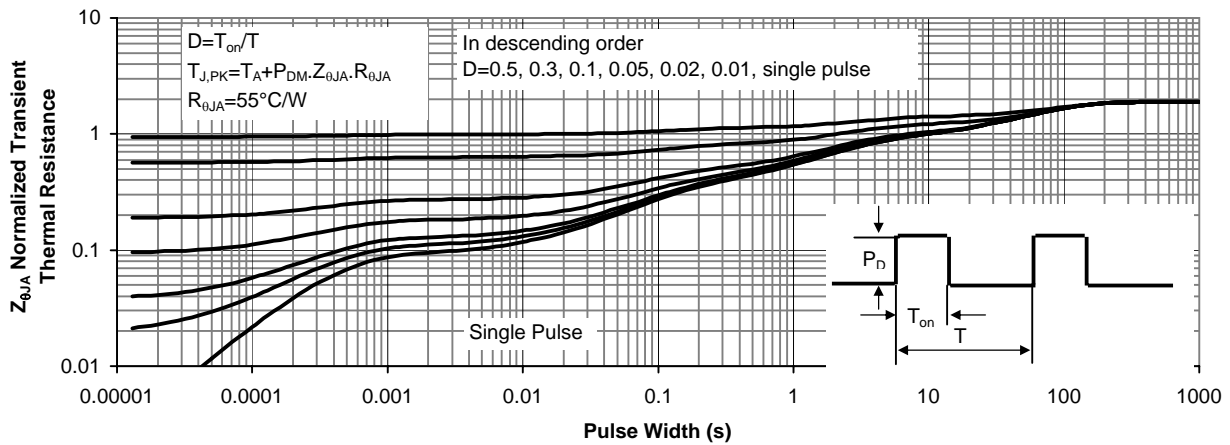


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