



**AO6604**

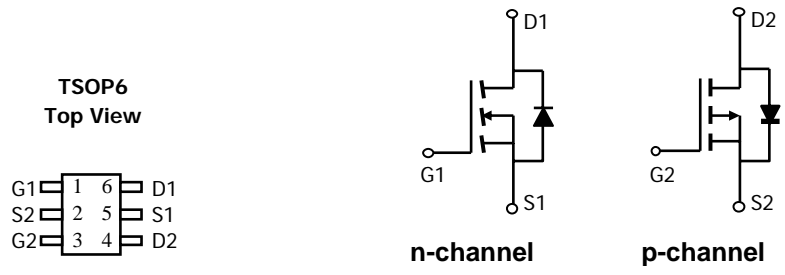
**Complementary Enhancement Mode Field Effect Transistor**

**General Description**

The AO6604 uses advanced trench technology to provide excellent  $R_{DS(ON)}$  and low gate charge. The complementary MOSFETs form a high-speed power inverter, suitable for a multitude of applications. *Standard Product AO6604 is Pb-free (meets ROHS & Sony 259 specifications). AO6604L is a Green Product ordering option. AO6604 and AO6604L are electrically identical.*

**Features**

	n-channel	p-channel
$V_{DS}$ (V)	20V	-20V
$I_D = 3.4A$ ( $V_{GS} = 4.5V$ )		-2.5A
$R_{DS(ON)}$		
< 60m $\Omega$		< 110m $\Omega$ ( $V_{GS} = 4.5V$ )
< 75m $\Omega$		< 140m $\Omega$ ( $V_{GS} = 2.5V$ )
< 100m $\Omega$		< 200m $\Omega$ ( $V_{GS} = 1.8V$ )



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

Parameter	Symbol	Max n-channel	Max p-channel	Units
Drain-Source Voltage	$V_{DS}$	20	-20	V
Gate-Source Voltage	$V_{GS}$	$\pm 8$	$\pm 8$	V
Continuous Drain Current <sup>A</sup>	$I_D$	$T_A=25^\circ C$	3.4	-2.5
		$T_A=70^\circ C$	2.7	-2.0
Pulsed Drain Current <sup>B</sup>	$I_{DM}$	15	-15	A
Power Dissipation	$P_D$	$T_A=25^\circ C$	1.15	1.15
		$T_A=70^\circ C$	0.73	0.73
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>	$R_{\theta JA}$	78	110	$^\circ C/W$
Maximum Junction-to-Ambient <sup>A</sup>		Steady-State	106	150
Maximum Junction-to-Lead <sup>C</sup>	$R_{\theta JL}$	64	80	$^\circ C/W$

N-channel MOSFET 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	$I_D=250\mu\text{A}$ , $V_{GS}=0\text{V}$	20			V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=16\text{V}$ , $V_{GS}=0\text{V}$ $T_J=55^\circ\text{C}$			1	$\mu\text{A}$
					5	
$I_{GSS}$	Gate-Body leakage current	$V_{DS}=0\text{V}$ , $V_{GS}=\pm 8\text{V}$			100	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}$ , $I_D=250\mu\text{A}$	0.4	0.6	1	V
$I_{D(ON)}$	On state drain current	$V_{GS}=4.5\text{V}$ , $V_{DS}=5\text{V}$	15			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS}=4.5\text{V}$ , $I_D=3.4\text{A}$ $T_J=125^\circ\text{C}$		46	60	m $\Omega$
				63	80	
		$V_{GS}=2.5\text{V}$ , $I_D=3\text{A}$		57	75	m $\Omega$
		$V_{GS}=1.8\text{V}$ , $I_D=2\text{A}$		72	100	m $\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS}=5\text{V}$ , $I_D=3.4\text{A}$		10		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				2	A
<b>DYNAMIC PARAMETERS</b>						
$C_{iss}$	Input Capacitance	$V_{GS}=0\text{V}$ , $V_{DS}=10\text{V}$ , $f=1\text{MHz}$		436	570	pF
$C_{oss}$	Output Capacitance			66		pF
$C_{rss}$	Reverse Transfer Capacitance			44		pF
$R_g$	Gate resistance	$V_{GS}=0\text{V}$ , $V_{DS}=0\text{V}$ , $f=1\text{MHz}$		3	4	$\Omega$
<b>SWITCHING PARAMETERS</b>						
$Q_g$	Total Gate Charge	$V_{GS}=4.5\text{V}$ , $V_{DS}=10\text{V}$ , $I_D=3.4\text{A}$		6.2	8.1	nC
$Q_{gs}$	Gate Source Charge			1.6		nC
$Q_{gd}$	Gate Drain Charge			0.5		nC
$t_{D(on)}$	Turn-On Delay Time	$V_{GS}=5\text{V}$ , $V_{DS}=10\text{V}$ , $R_L=3\Omega$ , $R_{GEN}=3\Omega$		5.5		ns
$t_r$	Turn-On Rise Time			6.3		ns
$t_{D(off)}$	Turn-Off Delay Time			40		ns
$t_f$	Turn-Off Fall Time			12.7		ns
$t_{rr}$	Body Diode Reverse Recovery Time	$I_F=3.4\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$		12.3	16	ns
$Q_{rr}$	Body Diode Reverse Recovery Charge	$I_F=3.4\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$		3.5		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  $\leq 10\text{s}$  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.

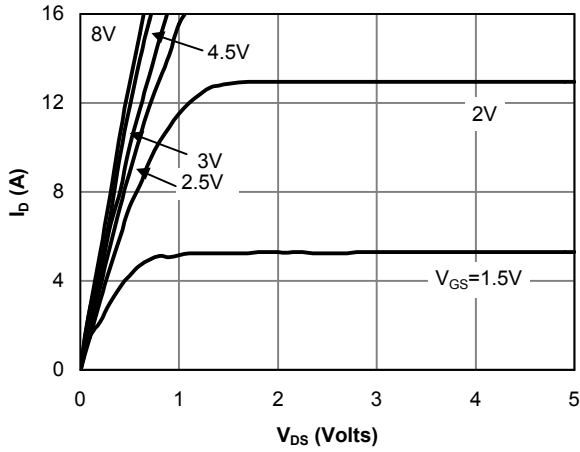
D: The static characteristics in Figures 1 to 6 are obtained using 80 $\mu\text{s}$  pulses, duty cycle 0.5% max.

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.

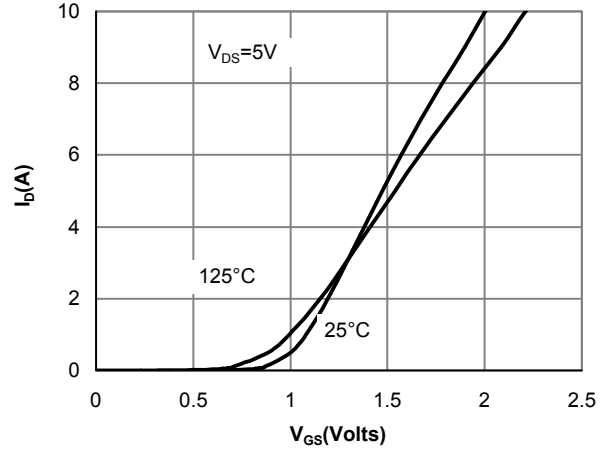
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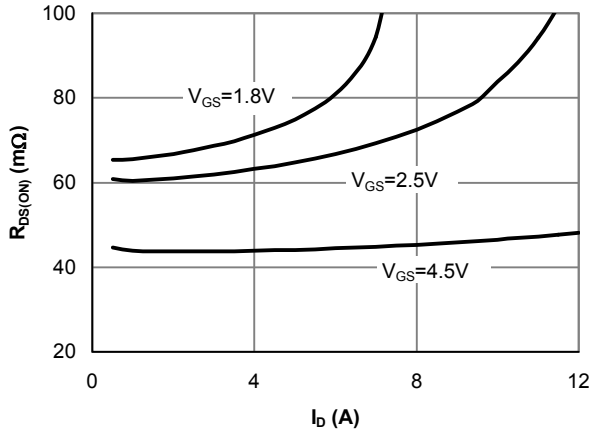
**N-CHANNEL TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**



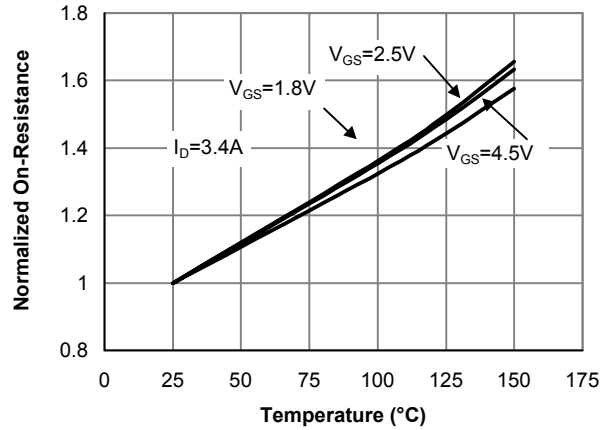
**Fig 1: On-Region Characteristics**



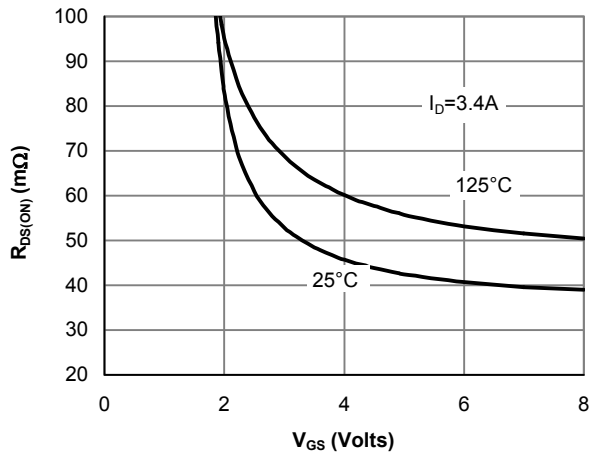
**Figure 2: Transfer Characteristics**



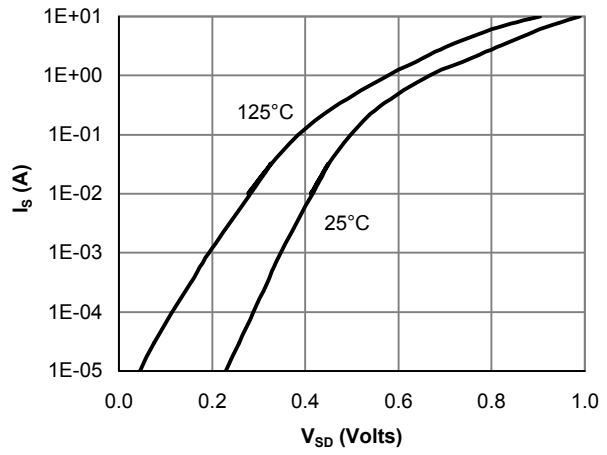
**Figure 3: On-Resistance vs. Drain Current and Gate Voltage**



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



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



**Figure 6: Body-Diode Characteristics**

N-CHANNEL TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

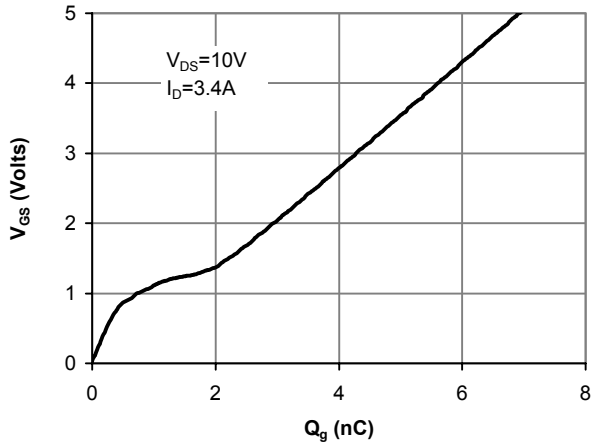


Figure 7: Gate-Charge Characteristics

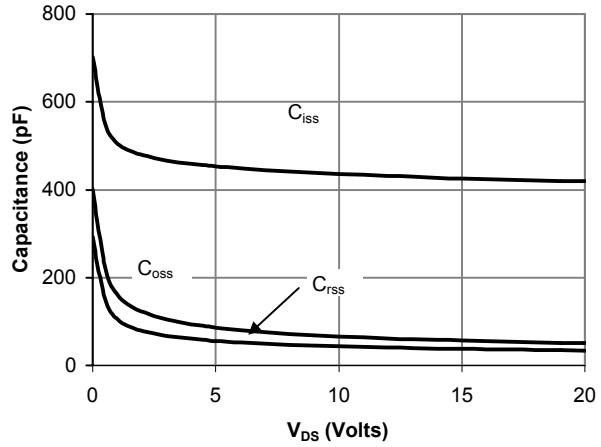


Figure 8: Capacitance Characteristics

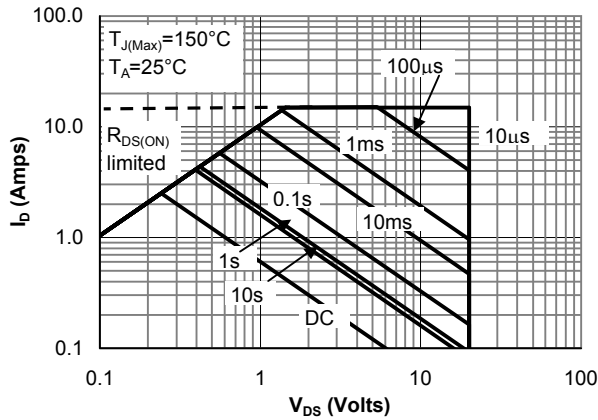


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

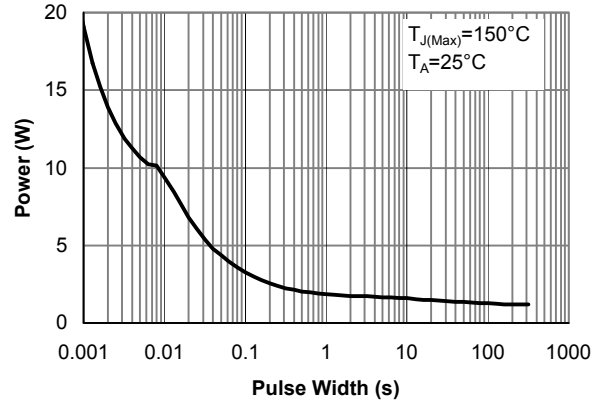


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

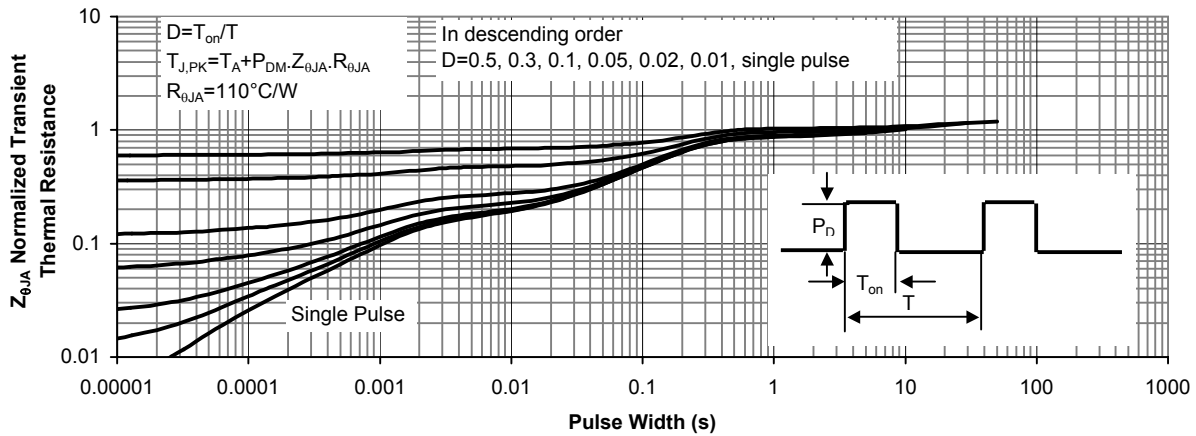


Figure 11: Normalized Maximum Transient Thermal Impedance

P-channel MOSFET 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	-20			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> =-16V, 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> =±8V			±100	nA
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> =V <sub>GS</sub> I <sub>D</sub> =-250μA	-0.3	-0.55	-1	V
I <sub>D(ON)</sub>	On state drain current	V <sub>GS</sub> =-4.5V, V <sub>DS</sub> =-5V	-15			A
R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-2.5A T <sub>J</sub> =125°C		86 116	110 145	mΩ
		V <sub>GS</sub> =-2.5V, I <sub>D</sub> =-2A		113	140	mΩ
		V <sub>GS</sub> =-1.8V, I <sub>D</sub> =-1A		151	200	mΩ
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> =-5V, I <sub>D</sub> =-3A	4	6		S
V <sub>SD</sub>	Diode Forward Voltage	I <sub>S</sub> =-1A, V <sub>GS</sub> =0V		-0.78	-1	V
I <sub>S</sub>	Maximum Body-Diode Continuous Current				-2	A
<b>DYNAMIC PARAMETERS</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> =0V, V <sub>DS</sub> =-10V, f=1MHz		540	700	pF
C <sub>oss</sub>	Output Capacitance			72		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			49		pF
R <sub>g</sub>	Gate resistance	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz		12	15.6	Ω
<b>SWITCHING PARAMETERS</b>						
Q <sub>g</sub>	Total Gate Charge	V <sub>GS</sub> =-4.5V, V <sub>DS</sub> =-10V, I <sub>D</sub> =-2.5A		6.1	8	nC
Q <sub>gs</sub>	Gate Source Charge			0.6		nC
Q <sub>gd</sub>	Gate Drain Charge			1.6		nC
t <sub>D(on)</sub>	Turn-On DelayTime	V <sub>GS</sub> =-4.5V, V <sub>DS</sub> =-10V, R <sub>L</sub> =3.9Ω, R <sub>GEN</sub> =3Ω		10		ns
t <sub>r</sub>	Turn-On Rise Time			12		ns
t <sub>D(off)</sub>	Turn-Off DelayTime			44		ns
t <sub>f</sub>	Turn-Off Fall Time			22		ns
t <sub>rr</sub>	Body Diode Reverse Recovery Time	I <sub>F</sub> =-2.5A, dI/dt=100A/μs		21	28	ns
Q <sub>rr</sub>	Body Diode Reverse Recovery Charge	I <sub>F</sub> =-2.5A, dI/dt=100A/μs		7.5		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 ≤ 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.

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 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-CHANNEL TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

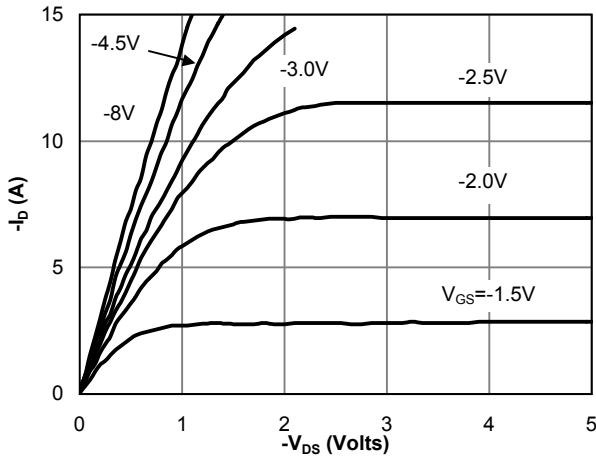


Fig 1: On-Region Characteristics

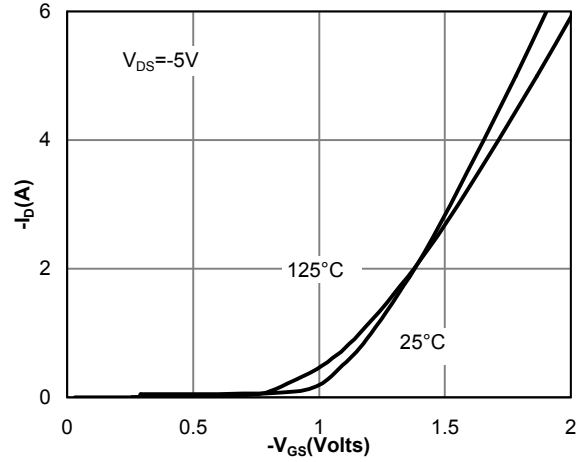


Figure 2: Transfer Characteristics

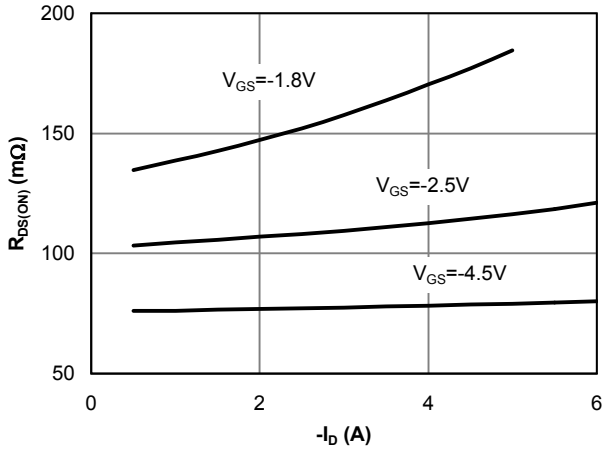


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

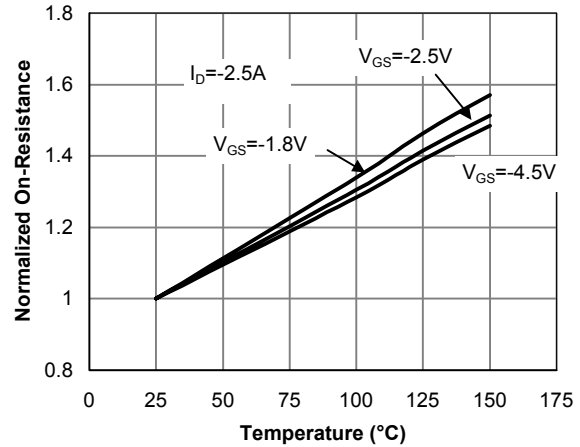


Figure 4: On-Resistance vs. Junction Temperature

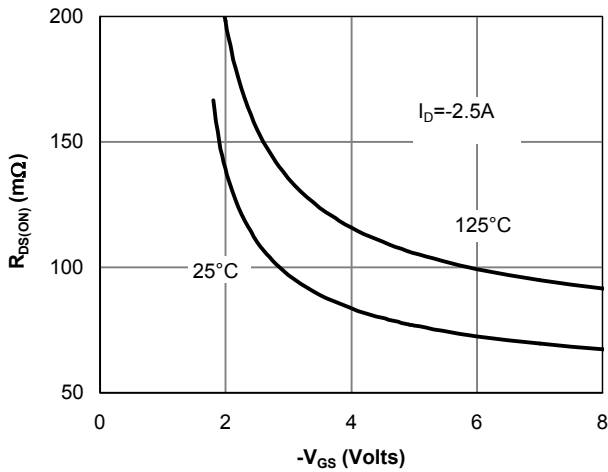


Figure 5: On-Resistance vs. Gate-Source Voltage

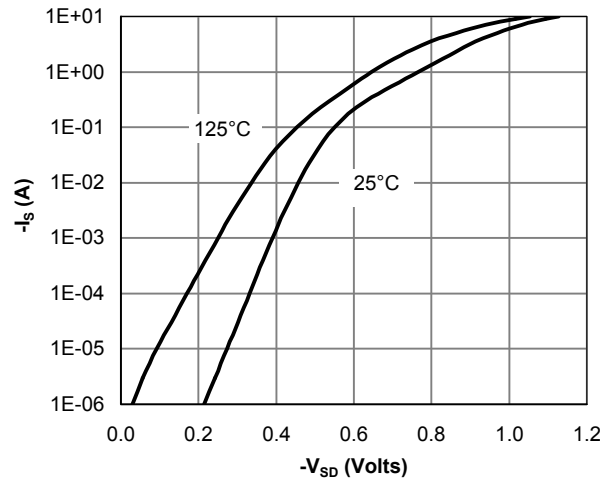


Figure 6: Body-Diode Characteristics

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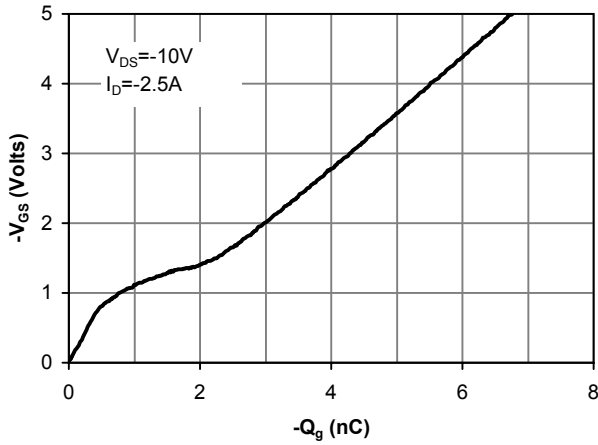


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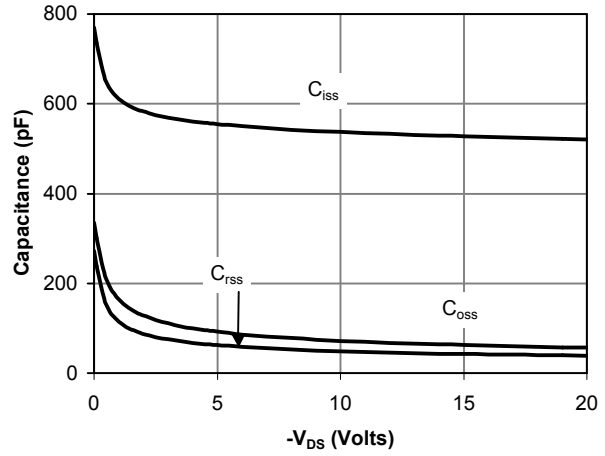


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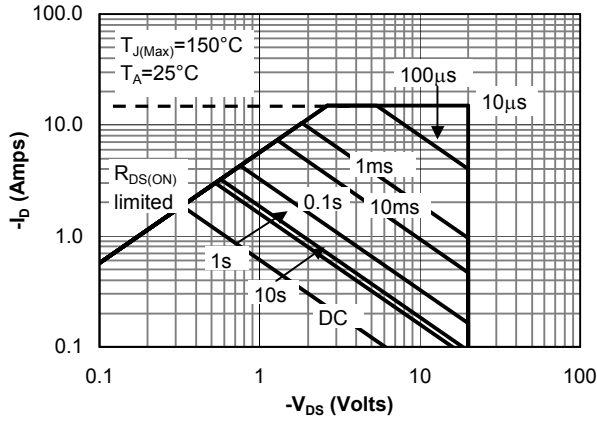


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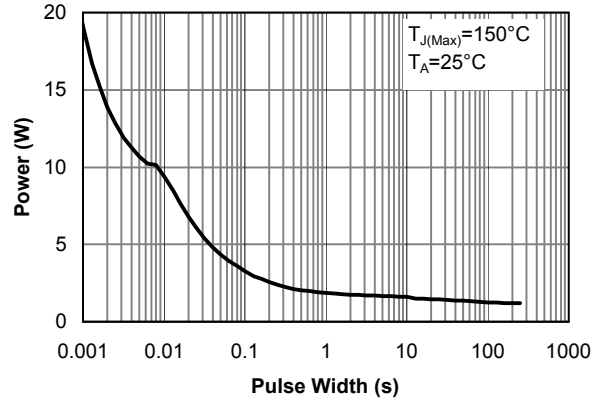


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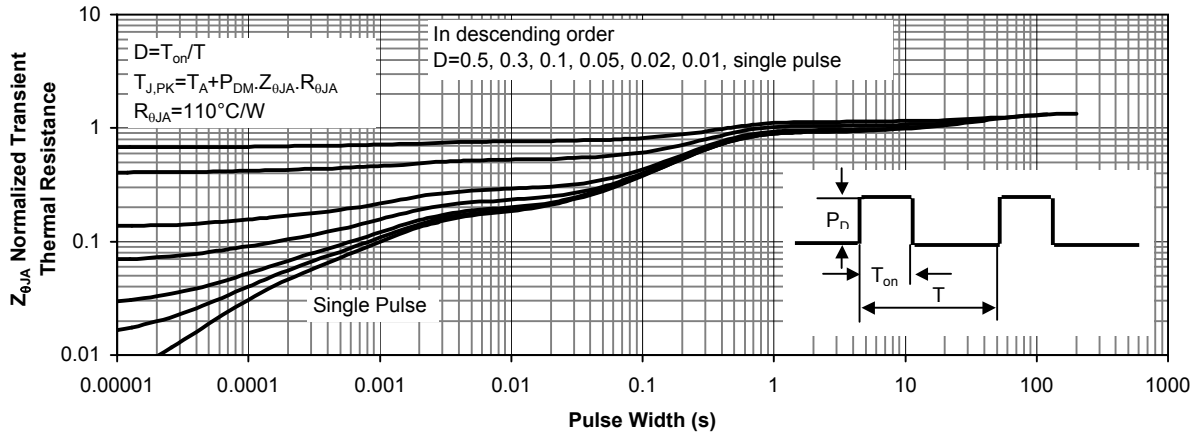


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