ALPHA & OMEGA SEMICONDUCTOR

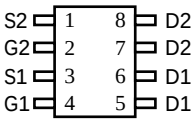
AO4609
Complementary Enhancement Mode Field Effect Transistor

General Description

The AO4609 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. *Standard Product AO4609 is Pb-free (meets ROHS & Sony 259 specifications). AO4609L is a Green Product ordering option. AO4609 and AO4609L are electrically identical.*

Features

n-channel	p-channel
V_{DS} (V) = 30V	-30V
I_D = 8.5A (V_{GS}=10V)	-3A (V_{GS} = -10V)
$R_{DS(ON)}$	$R_{DS(ON)}$
< 18mΩ (V_{GS}=10V)	< 130mΩ (V_{GS} = -10V)
< 28mΩ (V_{GS}=4.5V)	< 180mΩ (V_{GS} = -4.5V)
	< 260mΩ (V_{GS} = -2.5V)



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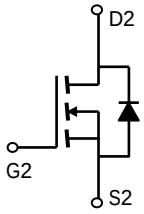
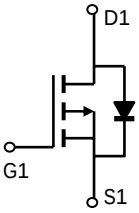


n-channel



p-channel

Absolute Maximum Ratings T_A=25°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	±12	V
Continuous Drain Current [A]	T_A=25°C	I_D	8.5	-3	A
	T_A=70°C		6.6	-2.4	
Pulsed Drain Current [B]		I_{DM}	40	-6	
Power Dissipation	T_A=25°C	P_D	2	2	W
	T_A=70°C		1.28	1.28	
Junction and Storage Temperature Range		T_J, T_{STG}	-55 to 150	-55 to 150	°C

Thermal Characteristics: n-channel and p-channel

Parameter		Symbol	Device	Typ	Max	Units
Maximum Junction-to-Ambient [A]	t ≤ 10s	$R_{\theta JA}$	n-ch	48	62.5	°C/W
Maximum Junction-to-Ambient [A]	Steady-State		n-ch	74	110	°C/W
Maximum Junction-to-Lead [C]	Steady-State	$R_{\theta JL}$	n-ch	35	40	°C/W
Maximum Junction-to-Ambient [A]	t ≤ 10s	$R_{\theta JA}$	p-ch	56	62.5	°C/W
Maximum Junction-to-Ambient [A]	Steady-State		p-ch	81	110	°C/W
Maximum Junction-to-Lead [C]	Steady-State	$R_{\theta JL}$	p-ch	40	48	°C/W

N-Channel Electrical Characteristics (T_J=25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
STATIC PARAMETERS						
BV_{DSS}	Drain-Source Breakdown Voltage	I_D=250µA, V_{GS}=0V	30			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=24V, V_{GS}=0V			1	µA
		T_J=55°C			5	
I_{GSS}	Gate-Body leakage current	V_{DS}=0V, V_{GS}= ±20V			100	nA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=V_{GS} I_D=250µA	1	1.8	3	V
$I_{D(ON)}$	On state drain current	V_{GS}=10V, V_{DS}=5V	40			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS}=10V, I_D=8.5A		15.5	18	mΩ
		T_J=125°C		22.3	27	
		V_{GS}=4.5V, I_D=6A		23	28	mΩ
g_{FS}	Forward Transconductance	V_{DS}=5V, I_D=8.5A		23		S
V_{SD}	Diode Forward Voltage	I_S=1A,V_{GS}=0V		0.75	1	V
I_S	Maximum Body-Diode Continuous Current				3	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=15V, f=1MHz		1040	1250	pF
C_{oss}	Output Capacitance			180		pF
C_{rss}	Reverse Transfer Capacitance			110		pF
R_g	Gate resistance	V_{GS}=0V, V_{DS}=0V, f=1MHz		0.7	0.85	Ω
SWITCHING PARAMETERS						
Q_g(10V)	Total Gate Charge	V_{GS}=10V, V_{DS}=15V, I_D=8.5A		19.2	23	nC
Q_g(4.5V)	Total Gate Charge			9.36	11.2	nC
Q_{gs}	Gate Source Charge			2.6		nC
Q_{gd}	Gate Drain Charge			4.2		nC
$t_{D(on)}$	Turn-On DelayTime	V_{GS}=10V, V_{DS}=15V, R_L=1.8Ω, R_{GEN}=3Ω		5.2	7.5	ns
t_r	Turn-On Rise Time			4.4	6.5	ns
$t_{D(off)}$	Turn-Off DelayTime			17.3	25	ns
t_f	Turn-Off Fall Time			3.3	5	ns
t_{rr}	Body Diode Reverse Recovery Time	I_F=8.5A, dI/dt=100A/µs		16.7	21	ns
Q_{rr}	Body Diode Reverse Recovery Charge	I_F=8.5A, dI/dt=100A/µs		6.7	10	nC

A: The value of $R_{\theta JA}$ is measured with the device mounted on 1in^2 FR-4 board with 2oz. Copper, in a still air environment with T_A=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 $R_{\theta JA}$ is the sum of the thermal impedence from junction to lead $R_{\theta JL}$ and lead to ambient.

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^2 FR-4 board with 2oz. Copper, in a still air environment with T_A=25°C. The SOA curve provides a single pulse rating.

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N-CHANNEL: TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

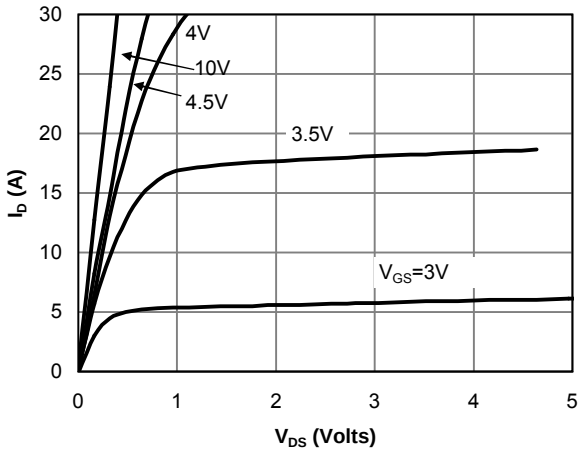

Fig 1: On-Region Characteristics

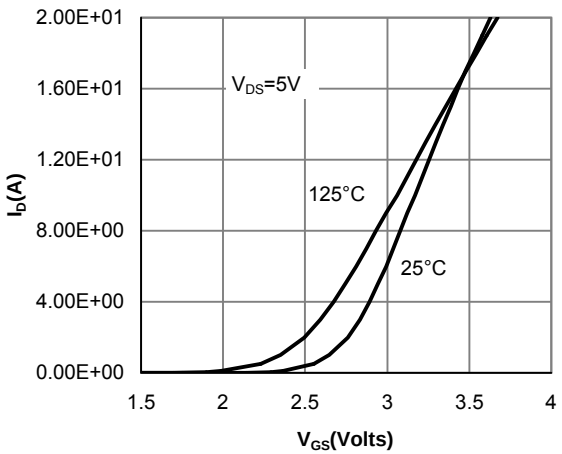

Figure 2: Transfer Characteristics

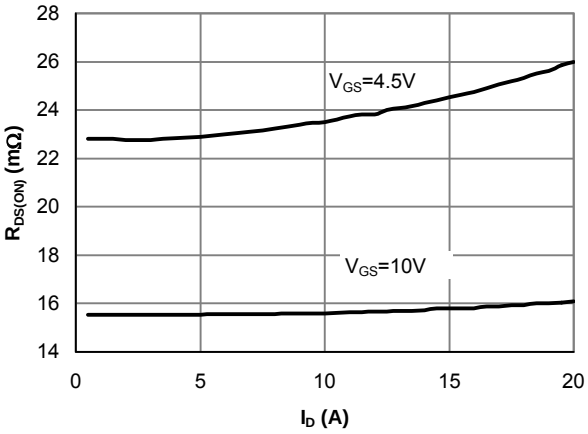

Figure 3: On-Resistance vs. Drain Current and Gate Voltage

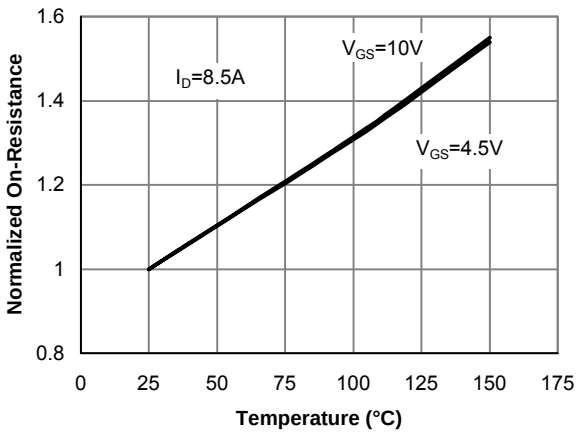

Figure 4: On-Resistance vs. Junction Temperature

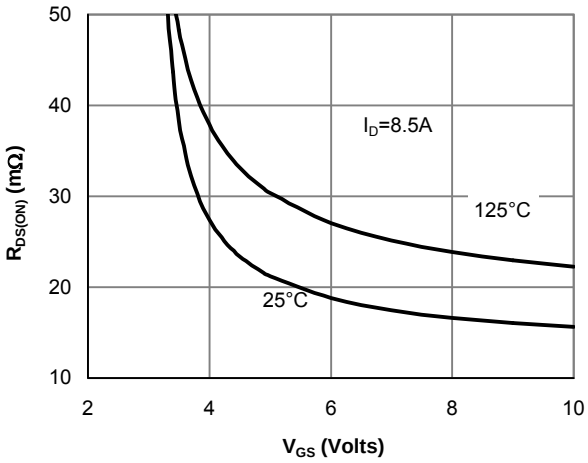

Figure 5: On-Resistance vs. Gate-Source Voltage

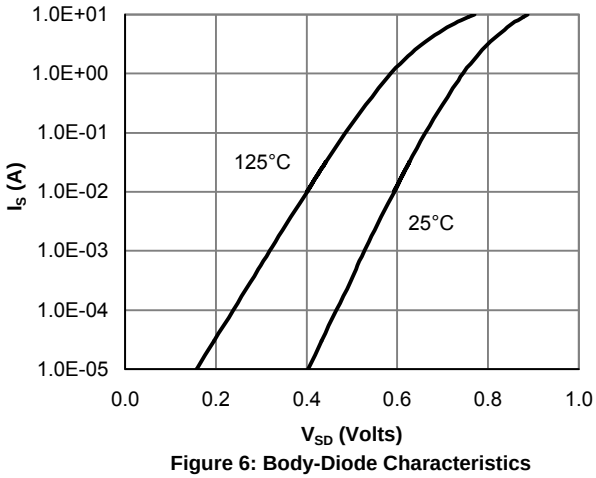

Figure 6: Body-Diode Characteristics

N-CHANNEL: TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

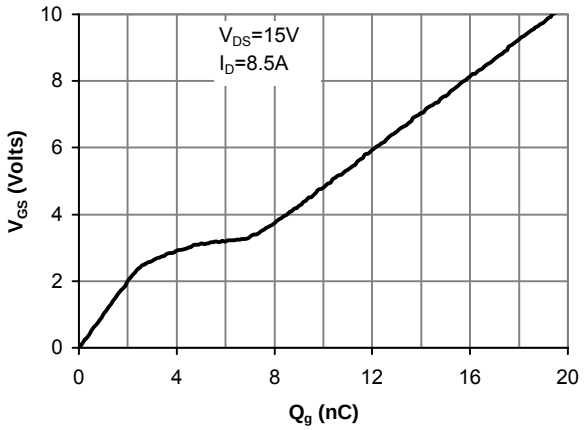

Figure 7: Gate-Charge Characteristics

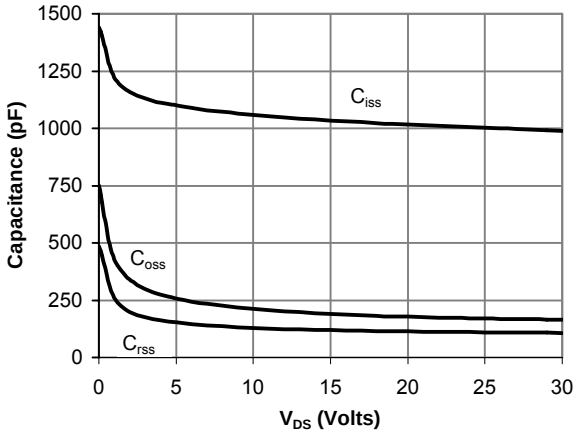

Figure 8: Capacitance Characteristics

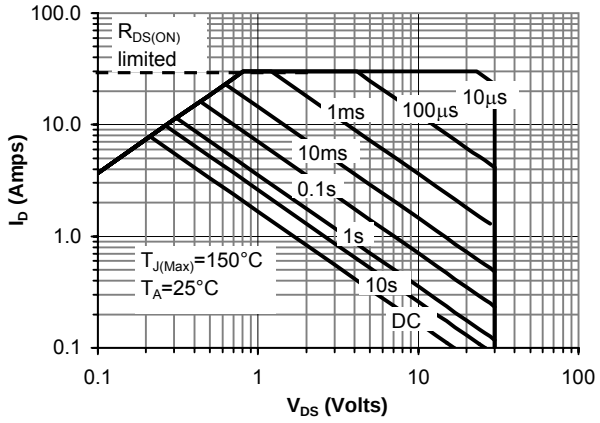

Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

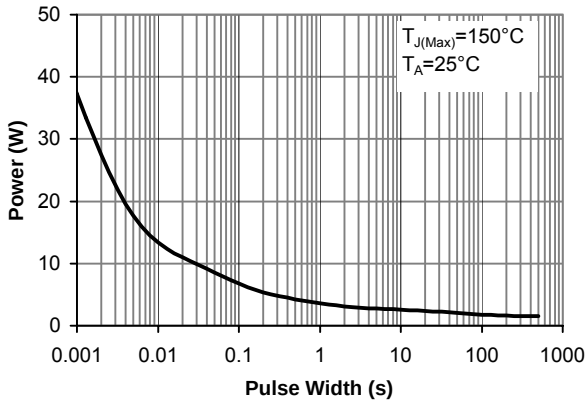

Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

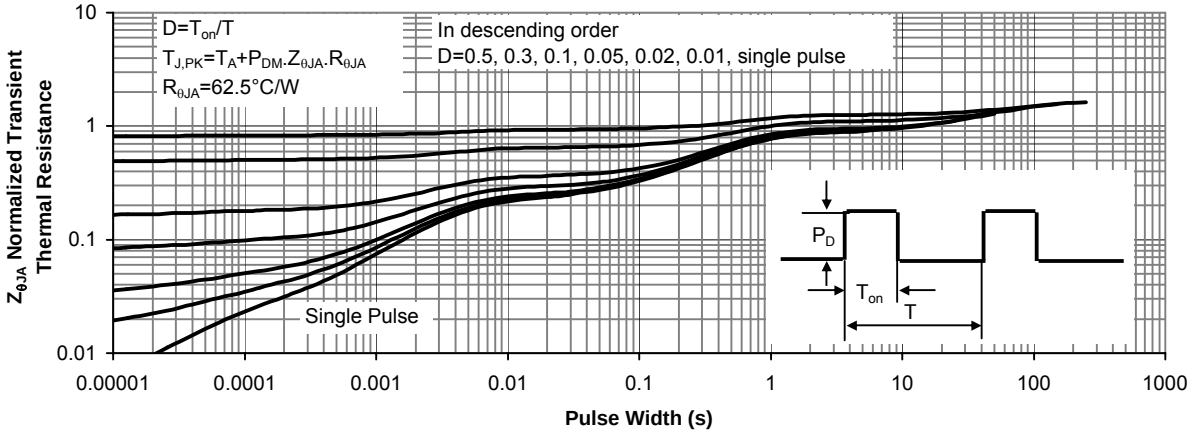

Figure 11: Normalized Maximum Transient Thermal Impedance

P-Channel Electrical Characteristics (T_J=25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
STATIC PARAMETERS						
BV_{DSS}	Drain-Source Breakdown Voltage	I_D=-250µA, V_{GS}=0V	-30			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=-24V, V_{GS}=0V			-1	µA
		T_J=55°C			-5	
I_{GSS}	Gate-Body leakage current	V_{DS}=0V, V_{GS}=±12V			±100	nA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=V_{GS} I_D=-250µA	-0.6	-1	-1.4	V
$I_{D(ON)}$	On state drain current	V_{GS}=-4.5V, V_{DS}=-5V	-10			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS}=-10V, I_D=-3A		102	130	mΩ
		T_J=125°C		154	200	
		V_{GS}=-4.5V, I_D=-2A		128	180	mΩ
		V_{GS}=-2.5V, I_D=-1A		187	260	mΩ
g_{FS}	Forward Transconductance	V_{DS}=-5V, I_D=-3A	3	4.5		S
V_{SD}	Diode Forward Voltage	I_S=-1A,V_{GS}=0V		-0.85	-1	V
I_S	Maximum Body-Diode Continuous Current				-2	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=-15V, f=1MHz		409		pF
C_{oss}	Output Capacitance			55		pF
C_{rss}	Reverse Transfer Capacitance			42		pF
R_g	Gate resistance	V_{GS}=0V, V_{DS}=0V, f=1MHz		12		Ω
SWITCHING PARAMETERS						
Q_g	Total Gate Charge	V_{GS}=-4.5V, V_{DS}=-15V, I_D=-3A		4.4		nC
Q_{gs}	Gate Source Charge			0.8		nC
Q_{gd}	Gate Drain Charge			1.32		nC
$t_{D(on)}$	Turn-On DelayTime	V_{GS}=-10V, V_{DS}=-15V, R_L=5Ω, R_{GEN}=3Ω		5.3		ns
t_r	Turn-On Rise Time			4.4		ns
$t_{D(off)}$	Turn-Off DelayTime			31.5		ns
t_f	Turn-Off Fall Time			8		ns
t_{rr}	Body Diode Reverse Recovery Time	I_F=-3A, dI/dt=100A/µs		15.8		ns
Q_{rr}	Body Diode Reverse Recovery Charge	I_F=-3A, dI/dt=100A/µs		8		nC

A: The value of $R_{\theta JA}$ is measured with the device mounted on 1in^2 FR-4 board with 2oz. Copper, in a still air environment with T_A =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 $R_{\theta JA}$ is the sum of the thermal impedence 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 80µs pulses, duty cycle 0.5% max.

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

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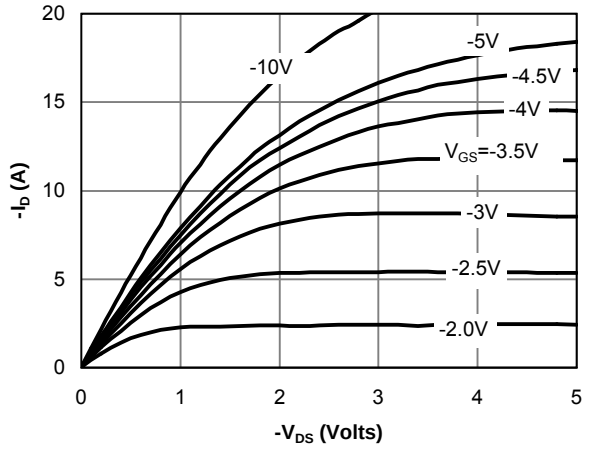
P-CHANNEL TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS



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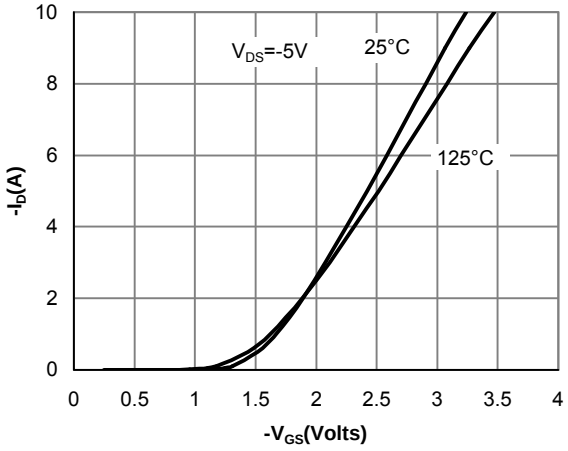

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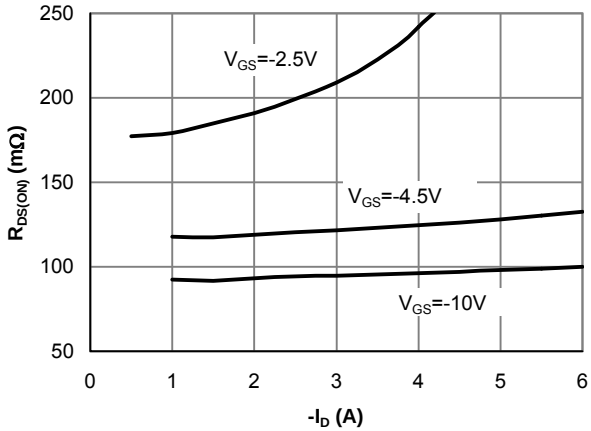

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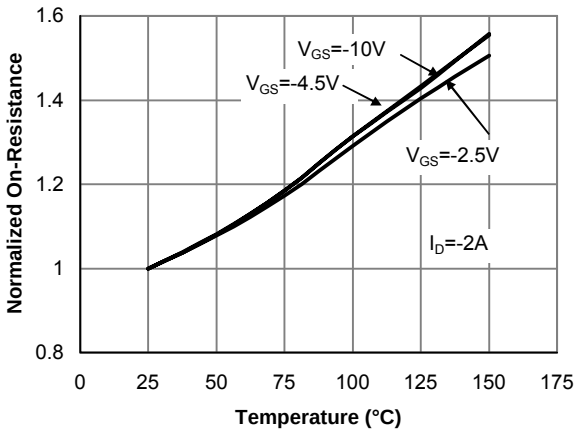

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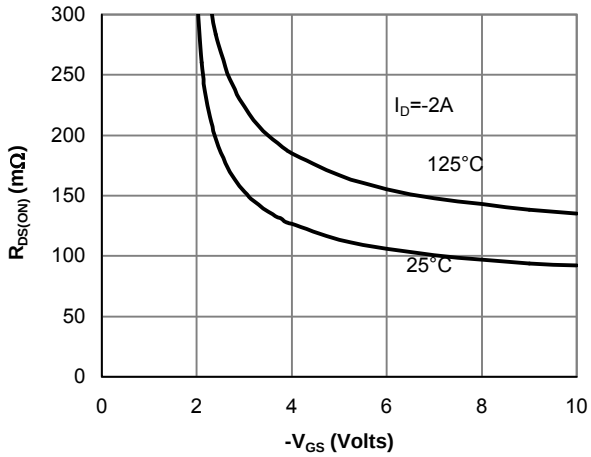

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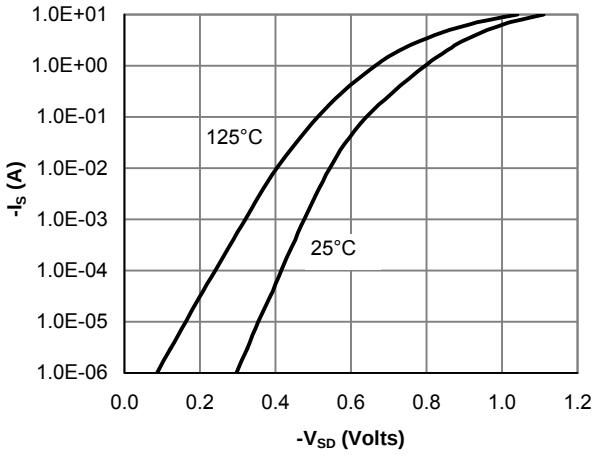

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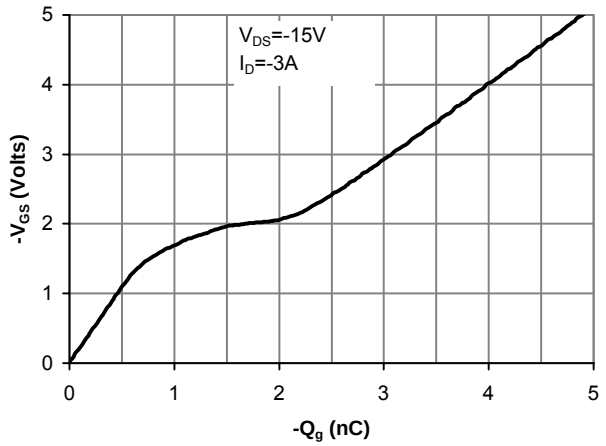

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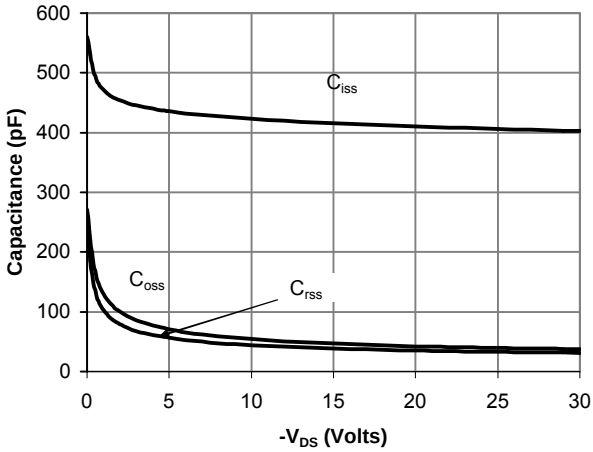

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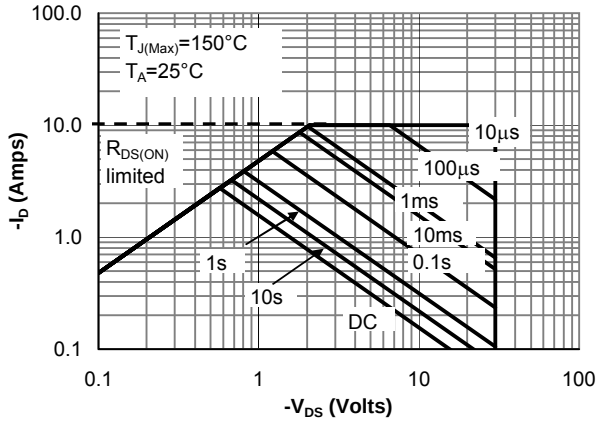

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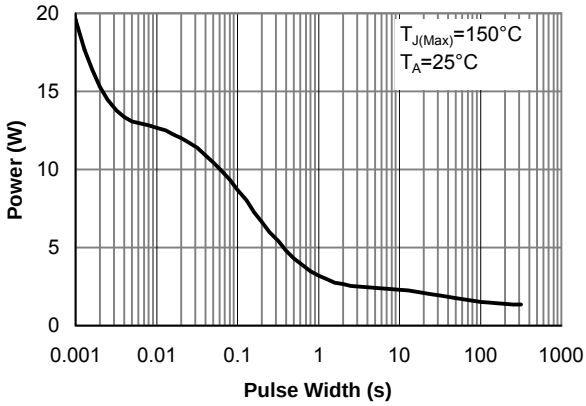

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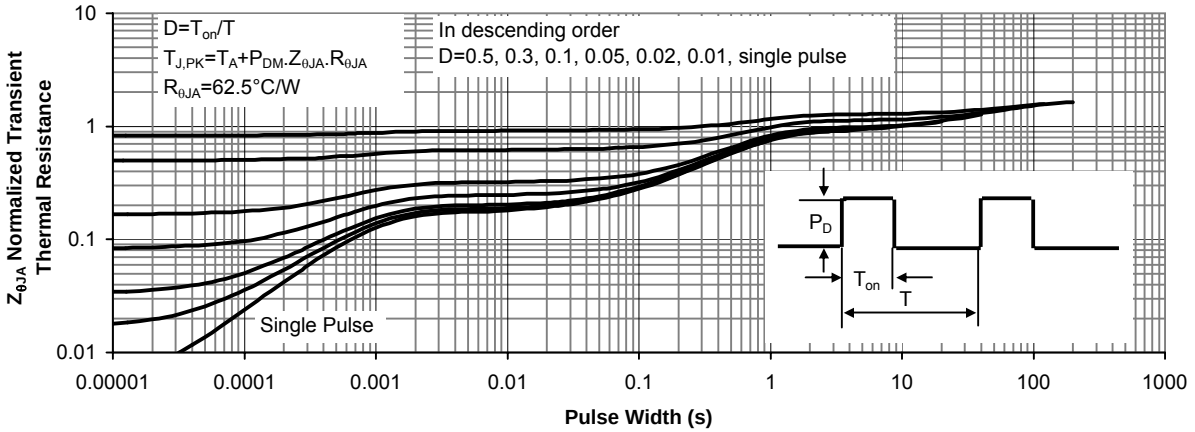

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