



## AOP611

### Complementary Enhancement Mode Field Effect Transistor

#### General Description

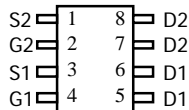
The AOP611 uses advanced trench technology MOSFETs to provide excellent  $R_{DS(ON)}$  and low gate charge. The complementary MOSFETs may be used in H-bridge, Inverters and other applications. *Standard Product AOP611 is Pb-free (meets ROHS & Sony 259 specifications). AOP611L is a Green Product ordering option. AOP611 and AOP611L are electrically identical.*

#### Features

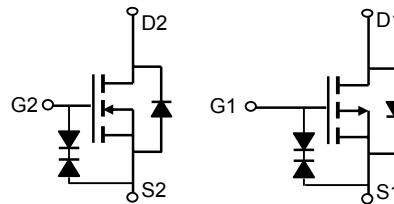
n-channel	p-channel
$V_{DS} (V) = 40V$	-40V
$I_D = 6.5A (V_{GS}=10V)$	-5.5A ( $V_{GS} = -10V$ )
$R_{DS(ON)}$	$R_{DS(ON)}$
< 35m $\Omega$ ( $V_{GS}=10V$ )	< 52m $\Omega$ ( $V_{GS} = -10V$ )
< 47m $\Omega$ ( $V_{GS}=4.5V$ )	< 80m $\Omega$ ( $V_{GS} = -4.5V$ )

ESD rating: 3000V (HBM)

**UIS TESTED!**  
**R<sub>g</sub>, C<sub>iss</sub>, C<sub>oss</sub>, C<sub>rss</sub> Tested**



PDIP-8



n-channel

p-channel

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

Parameter	Symbol	Max n-channel	Max p-channel	Units
Drain-Source Voltage	$V_{DS}$	40	-40	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	$\pm 20$	V
Continuous Drain Current <sup>A</sup>	$I_D$	$T_A=25^\circ\text{C}$	6.5	-5.5
		$T_A=70^\circ\text{C}$	5.3	-4.4
Pulsed Drain Current <sup>B</sup>	$I_{DM}$	30	-25	A
Power Dissipation	$P_D$	$T_A=25^\circ\text{C}$	2.5	2.5
		$T_A=70^\circ\text{C}$	1.6	1.6
Avalanche Current <sup>B</sup>	$I_{AR}$	13	17	A
Repetitive avalanche energy 0.3mH <sup>B</sup>	$E_{AR}$	25	43	mJ
Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 to 150	-55 to 150	$^\circ\text{C}$

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

Parameter	Symbol	Device	Typ	Max	Units
Maximum Junction-to-Ambient <sup>A</sup>	$R_{\theta JA}$	n-ch	37	50	$^\circ\text{C/W}$
Maximum Junction-to-Ambient <sup>A</sup>		n-ch	74	90	$^\circ\text{C/W}$
Maximum Junction-to-Lead <sup>C</sup>	$R_{\theta JL}$	n-ch	28	40	$^\circ\text{C/W}$
Maximum Junction-to-Ambient <sup>A</sup>	$R_{\theta JA}$	p-ch	35	50	$^\circ\text{C/W}$
Maximum Junction-to-Ambient <sup>A</sup>		p-ch	73	90	$^\circ\text{C/W}$
Maximum Junction-to-Lead <sup>C</sup>	$R_{\theta JL}$	p-ch	32	40	$^\circ\text{C/W}$

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	$I_D=250\mu\text{A}$ , $V_{GS}=0\text{V}$	40			V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=32\text{V}$ , $V_{GS}=0\text{V}$ $T_J=55^\circ\text{C}$			1	$\mu\text{A}$
					5	
$I_{GSS}$	Gate-Body leakage current	$V_{DS}=0\text{V}$ , $V_{GS}=\pm 20\text{V}$			1	mA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}$ , $I_D=250\mu\text{A}$	1	2.2	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	$V_{GS}=10\text{V}$ , $I_D=6.5\text{A}$ $T_J=125^\circ\text{C}$		28.5	35	m $\Omega$
				40	48	
		$V_{GS}=4.5\text{V}$ , $I_D=5\text{A}$		38.5	47	m $\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS}=5\text{V}$ , $I_D=6.5\text{A}$		18		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				3.5	A
<b>DYNAMIC PARAMETERS</b>						
$C_{iss}$	Input Capacitance	$V_{GS}=0\text{V}$ , $V_{DS}=30\text{V}$ , $f=1\text{MHz}$		506		pF
$C_{oss}$	Output Capacitance			106		pF
$C_{rss}$	Reverse Transfer Capacitance			38		pF
$R_g$	Gate resistance	$V_{GS}=0\text{V}$ , $V_{DS}=0\text{V}$ , $f=1\text{MHz}$		2.6	3.9	$\Omega$
<b>SWITCHING PARAMETERS</b>						
$Q_g(10\text{V})$	Total Gate Charge	$V_{GS}=10\text{V}$ , $V_{DS}=20\text{V}$ , $I_D=6.7\text{A}$		8.4		nC
$Q_g(4.5\text{V})$	Total Gate Charge			4.1		nC
$Q_{gs}$	Gate Source Charge			1.6		nC
$Q_{gd}$	Gate Drain Charge			2.6		nC
$t_{D(on)}$	Turn-On DelayTime	$V_{GS}=10\text{V}$ , $V_{DS}=20\text{V}$ , $R_L=3\Omega$ , $R_{GEN}=3\Omega$		4.8		ns
$t_r$	Turn-On Rise Time			2		ns
$t_{D(off)}$	Turn-Off DelayTime			17		ns
$t_f$	Turn-Off Fall Time			2.1		ns
$t_{rr}$	Body Diode Reverse Recovery Time	$I_F=6.5\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$		17.5		ns
$Q_{rr}$	Body Diode Reverse Recovery Charge	$I_F=6.5\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$		11.1		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  $t \leq 10\text{s}$  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  $<300\mu\text{s}$  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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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS: N-CHANNEL

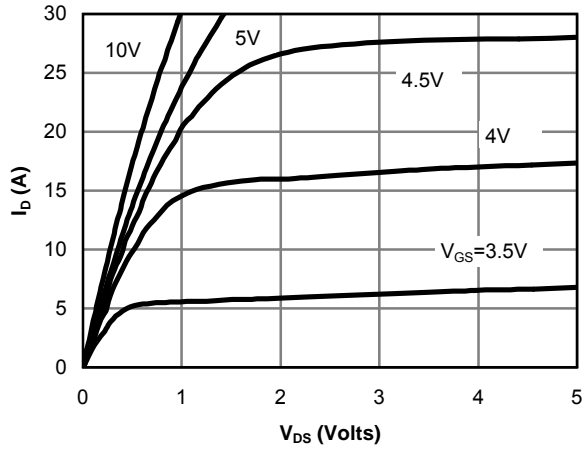


Figure 1: On-Region Characteristics

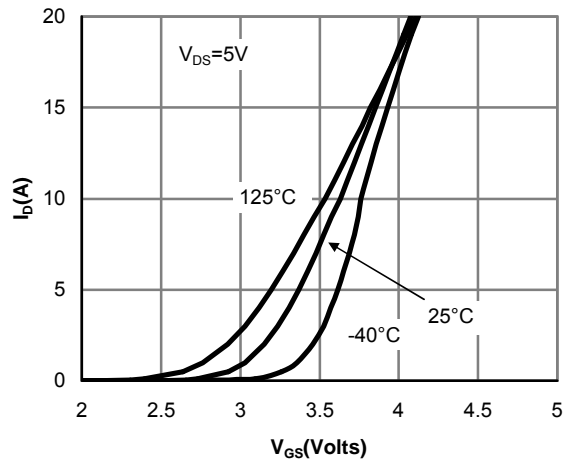


Figure 2: Transfer Characteristics

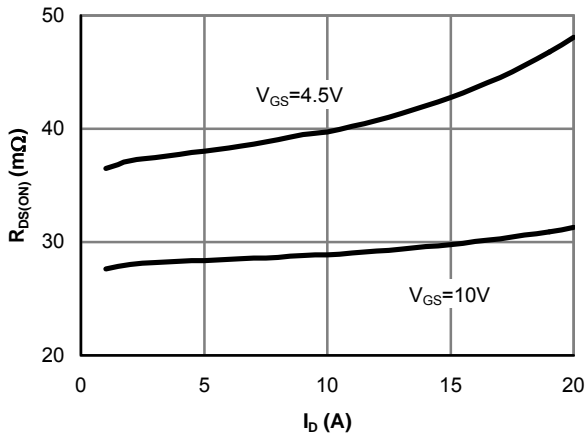


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

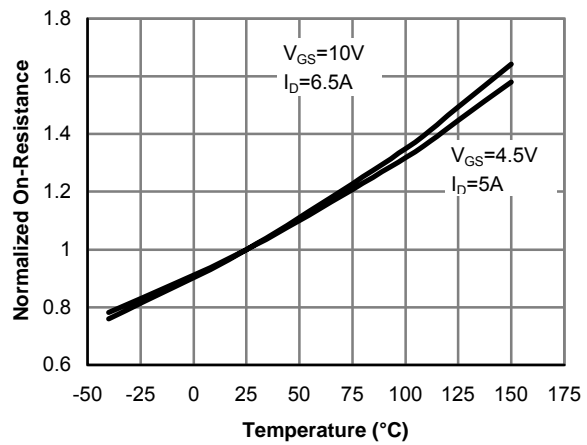


Figure 4: On-Resistance vs. Junction Temperature

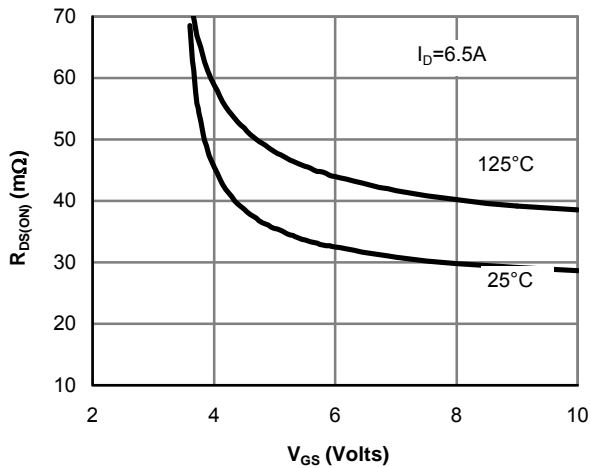


Figure 5: On-Resistance vs. Gate-Source Voltage

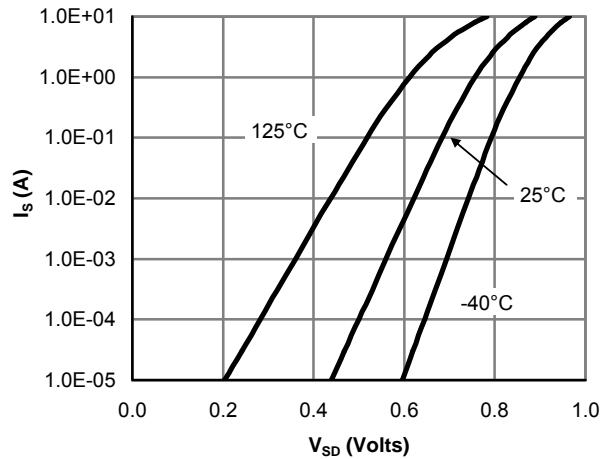


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS: N-CHANNEL

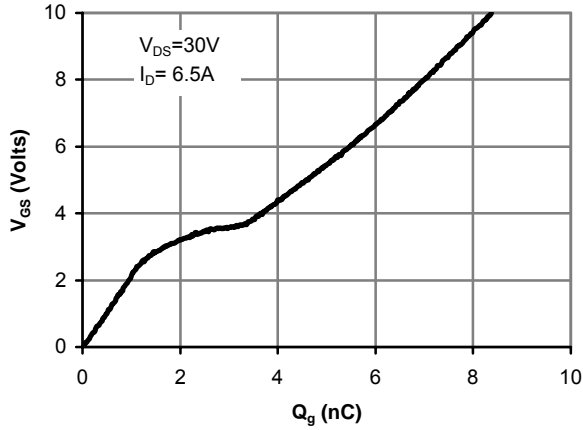


Figure 7: Gate-Charge Characteristics

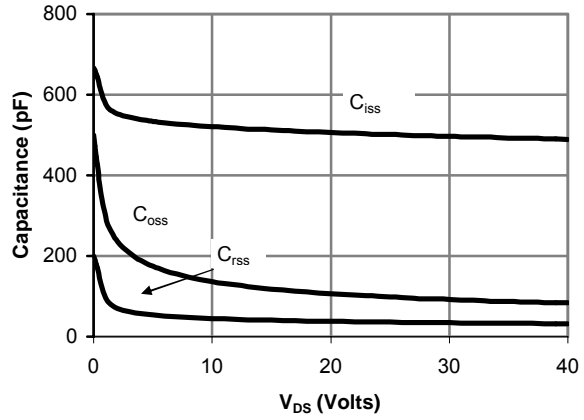


Figure 8: Capacitance Characteristics

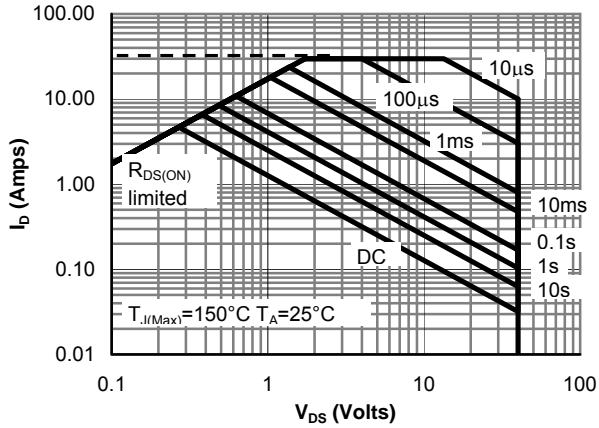


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

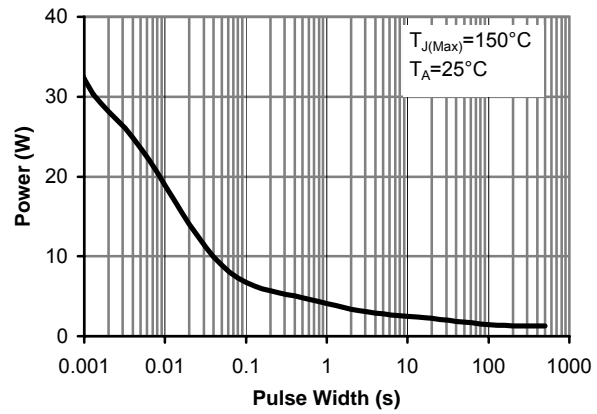


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

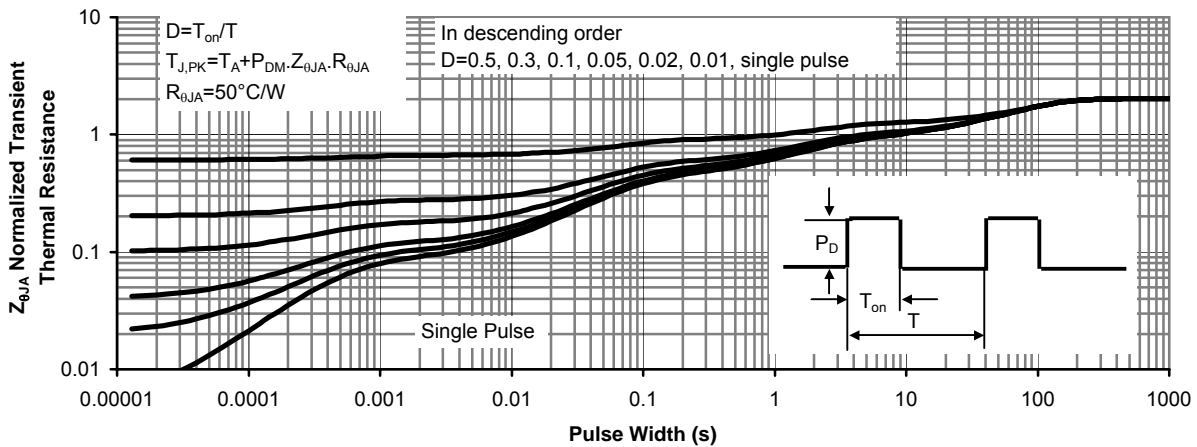


Figure 11: Normalized Maximum Transient Thermal Impedance

P-Channel Electrical Characteristics ( $T_J=25^\circ\text{C}$  unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>STATIC PARAMETERS</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$I_D=-250\mu\text{A}$ , $V_{GS}=0\text{V}$	-40			V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=-32\text{V}$ , $V_{GS}=0\text{V}$ $T_J=55^\circ\text{C}$			-1 -5	$\mu\text{A}$
$I_{GSS}$	Gate-Body leakage current	$V_{DS}=0\text{V}$ , $V_{GS}=\pm 20\text{V}$			$\pm 150$	$\mu\text{A}$
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}$ , $I_D=-250\mu\text{A}$	-1	-2	-3	V
$I_{D(ON)}$	On state drain current	$V_{GS}=-10\text{V}$ , $V_{DS}=-5\text{V}$	-25			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS}=-10\text{V}$ , $I_D=-5.5\text{A}$ $T_J=125^\circ\text{C}$		43 60	52 72	$\text{m}\Omega$
		$V_{GS}=-4.5\text{V}$ , $I_D=-4.4\text{A}$		65	80	$\text{m}\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS}=-5\text{V}$ , $I_D=-5.5\text{A}$		11		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				-3.5	A
<b>DYNAMIC PARAMETERS</b>						
$C_{iss}$	Input Capacitance	$V_{GS}=0\text{V}$ , $V_{DS}=-20\text{V}$ , $f=1\text{MHz}$		1006		pF
$C_{oss}$	Output Capacitance			152		pF
$C_{rss}$	Reverse Transfer Capacitance			77		pF
$R_g$	Gate resistance	$V_{GS}=0\text{V}$ , $V_{DS}=0\text{V}$ , $f=1\text{MHz}$		11	16.5	$\Omega$
<b>SWITCHING PARAMETERS</b>						
$Q_g(10\text{V})$	Total Gate Charge (10V)	$V_{GS}=-10\text{V}$ , $V_{DS}=-20\text{V}$ , $I_D=-5.5\text{A}$		17.4		nC
$Q_g(4.5\text{V})$	Total Gate Charge (4.5V)			8.8		nC
$Q_{gs}$	Gate Source Charge			3.3		nC
$Q_{gd}$	Gate Drain Charge			4.5		nC
$t_{D(on)}$	Turn-On Delay Time	$V_{GS}=-10\text{V}$ , $V_{DS}=-20\text{V}$ , $R_L=3.6\Omega$ , $R_{GEN}=3\Omega$		9.7		ns
$t_r$	Turn-On Rise Time			6.3		ns
$t_{D(off)}$	Turn-Off Delay Time			35.5		ns
$t_f$	Turn-Off Fall Time			26		ns
$t_{rr}$	Body Diode Reverse Recovery Time	$I_F=-5.5\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$		22		ns
$Q_{rr}$	Body Diode Reverse Recovery Charge	$I_F=-5.5\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$		15.9		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  $t \leq 10\text{s}$  thermal resistance rating.

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

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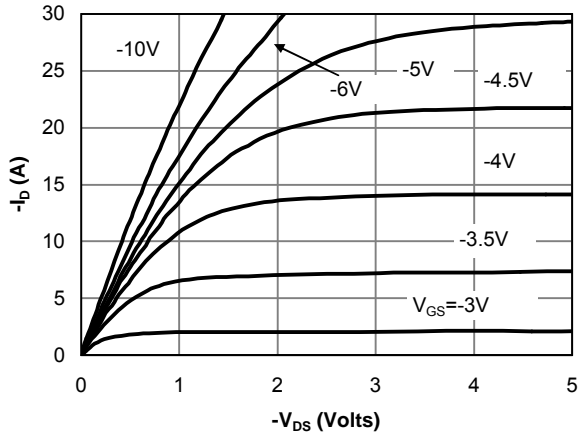


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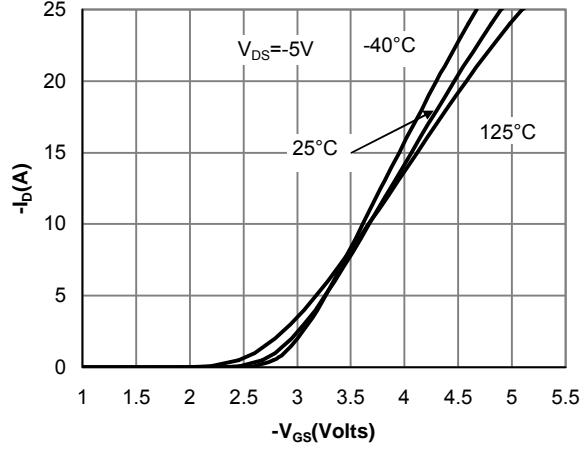


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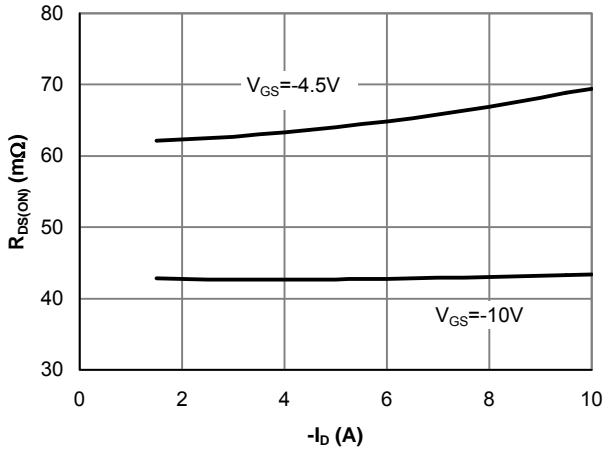


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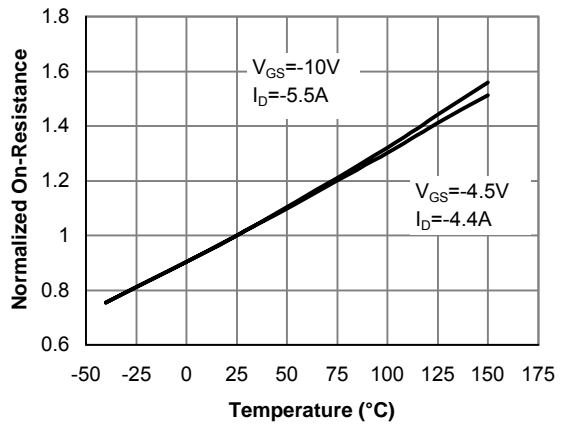


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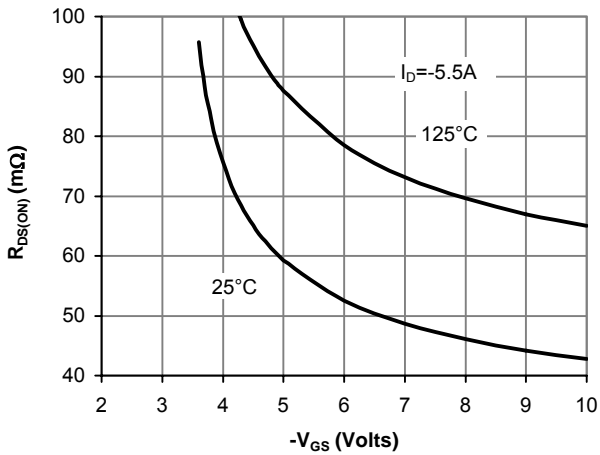


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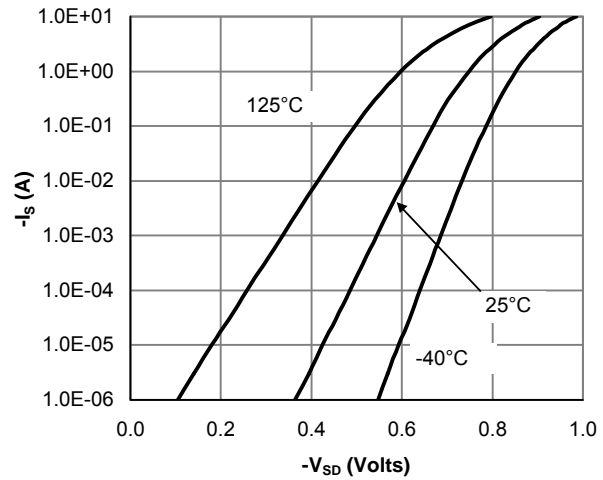


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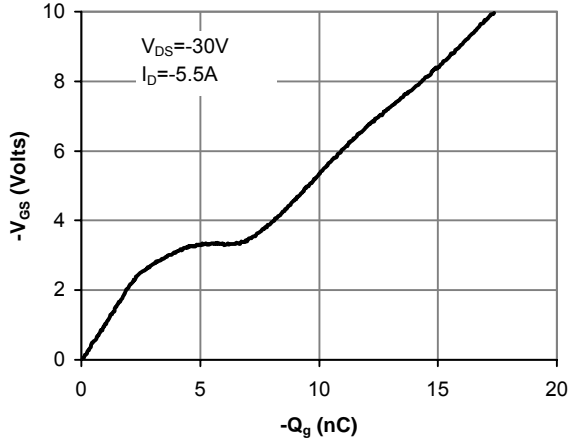


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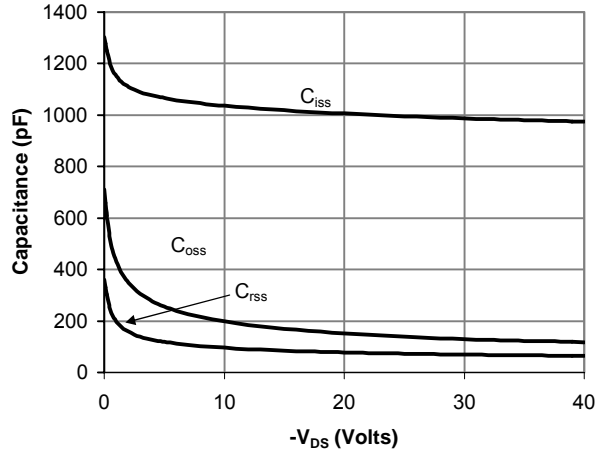


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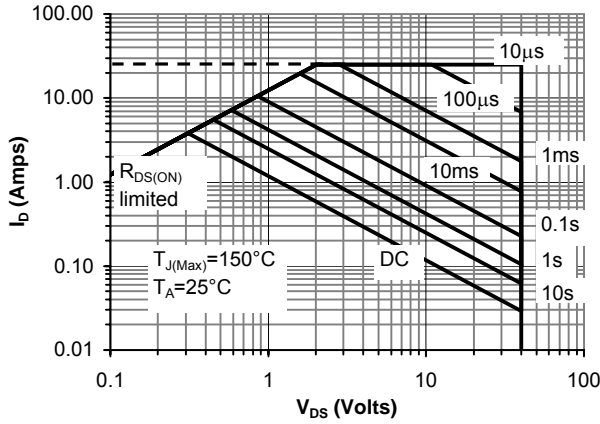


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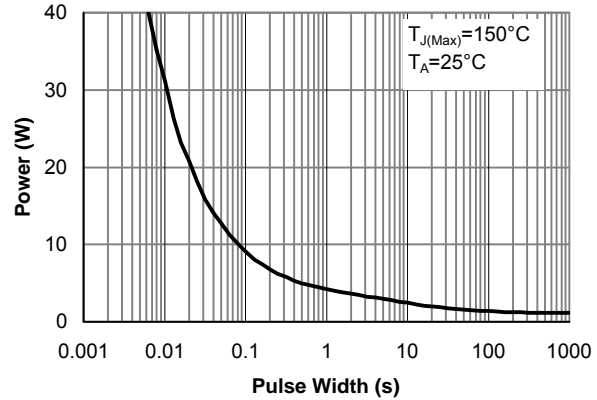


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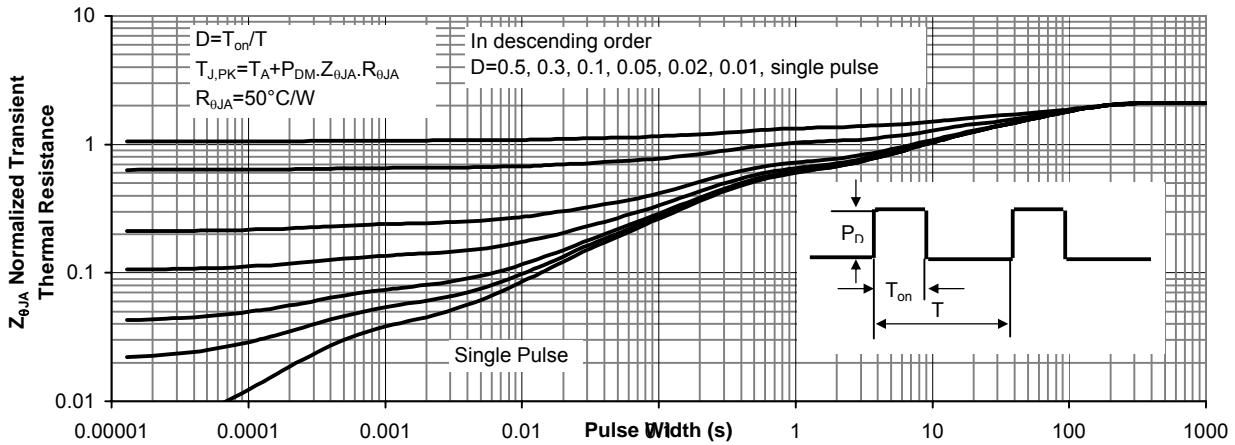


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