

**AO4604**
**Complementary Enhancement Mode Field Effect Transistor**
**General Description**

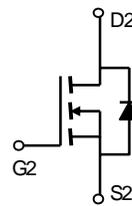
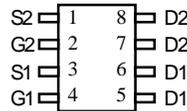
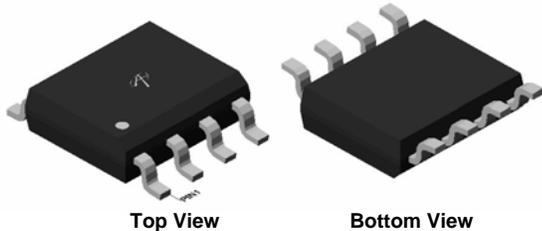
The AO4604 uses advanced trench technology MOSFETs to provide excellent  $R_{DS(ON)}$  and low gate charge. The complementary MOSFETs may be used in power inverters, and other applications. AO4604 and AO4604L are electrically identical.

- RoHS Compliant
- AO4604L is Halogen Free

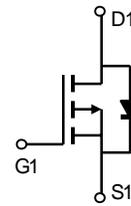
**Features**

n-channel	p-channel
$V_{DS}$ (V) = 30V	-30V
$I_D$ = 6.9A ( $V_{GS}$ =10V)	-5A ( $V_{GS}$ = -10V)
$R_{DS(ON)}$	$R_{DS(ON)}$
< 28m $\Omega$ ( $V_{GS}$ =10V)	< 52m $\Omega$ ( $V_{GS}$ = -10V)
< 42m $\Omega$ ( $V_{GS}$ =4.5V)	< 87m $\Omega$ ( $V_{GS}$ = -4.5V)

**100% Rg Tested!**

**SOIC-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	$V_{DS}$	30	-30	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	$\pm 20$	V
Continuous Drain Current <sup>A</sup>	$T_A=25^\circ\text{C}$	6.9	-5	A
	$T_A=70^\circ\text{C}$	5.8	-4.2	
Pulsed Drain Current <sup>B</sup>	$I_{DM}$	30	-20	
Power Dissipation	$T_A=25^\circ\text{C}$	2	2	W
	$T_A=70^\circ\text{C}$	1.44	1.44	
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>	$t \leq 10\text{s}$	$R_{\theta JA}$	n-ch	48	62.5	$^\circ\text{C/W}$
			n-ch	74	110	$^\circ\text{C/W}$
Maximum Junction-to-Lead <sup>C</sup>	Steady-State	$R_{\theta JL}$	n-ch	35	40	$^\circ\text{C/W}$
Maximum Junction-to-Ambient <sup>A</sup>	$t \leq 10\text{s}$	$R_{\theta JA}$	p-ch	48	62.5	$^\circ\text{C/W}$
			p-ch	74	110	$^\circ\text{C/W}$
Maximum Junction-to-Lead <sup>C</sup>	Steady-State	$R_{\theta JL}$	p-ch	35	40	$^\circ\text{C/W}$

**N-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		0.004	1 5	μA
I <sub>GSS</sub>	Gate-Body leakage current	V <sub>DS</sub> =0V, V <sub>GS</sub> =±20V			100	nA
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> =V <sub>GS</sub> I <sub>D</sub> =250μA	1	1.9	3	V
I <sub>D(ON)</sub>	On state drain current	V <sub>GS</sub> =4.5V, 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> =6.9A T <sub>J</sub> =125°C		22.5 31.3	28 38	mΩ
		V <sub>GS</sub> =4.5V, I <sub>D</sub> =5.0A		34.5	42	mΩ
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> =5V, I <sub>D</sub> =6.9A	10	15.4		S
V <sub>SD</sub>	Diode Forward Voltage	I <sub>S</sub> =1A		0.76	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		680	820	pF
C <sub>oss</sub>	Output Capacitance			102		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			77		pF
R <sub>g</sub>	Gate resistance	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz		1.2	2	Ω
<b>SWITCHING PARAMETERS</b>						
Q <sub>g(10V)</sub>	Total Gate Charge	V <sub>GS</sub> =10V, V <sub>DS</sub> =15V, I <sub>D</sub> =6.9A		13.84	17	nC
Q <sub>g(4.5V)</sub>	Total Gate Charge			6.74	8.1	nC
Q <sub>gs</sub>	Gate Source Charge			1.82		nC
Q <sub>gd</sub>	Gate Drain Charge			3.2		nC
t <sub>D(on)</sub>	Turn-On Delay Time	V <sub>GS</sub> =10V, V <sub>DS</sub> =15V, R <sub>L</sub> =2.2Ω, R <sub>GEN</sub> =3Ω		4.6		ns
t <sub>r</sub>	Turn-On Rise Time			4.1		ns
t <sub>D(off)</sub>	Turn-Off Delay Time			20.6		ns
t <sub>f</sub>	Turn-Off Fall Time			5.2		ns
t <sub>rr</sub>	Body Diode Reverse Recovery Time	I <sub>F</sub> =6.9A, dI/dt=100A/μs		16.5	20	ns
Q <sub>rr</sub>	Body Diode Reverse Recovery Charge	I <sub>F</sub> =6.9A, dI/dt=100A/μs		7.8		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 a 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.

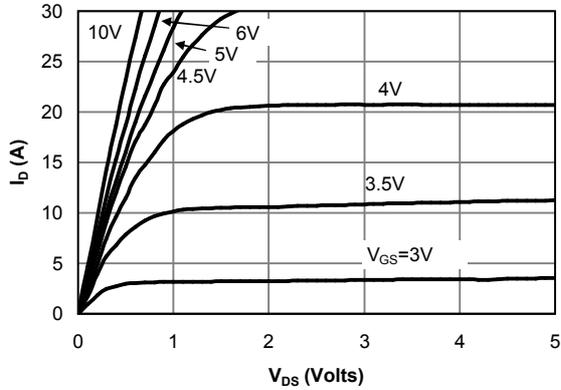
D. The static characteristics in Figures 1 to 6 are obtained using 80μs pulses, duty cycle 0.5% max.

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.

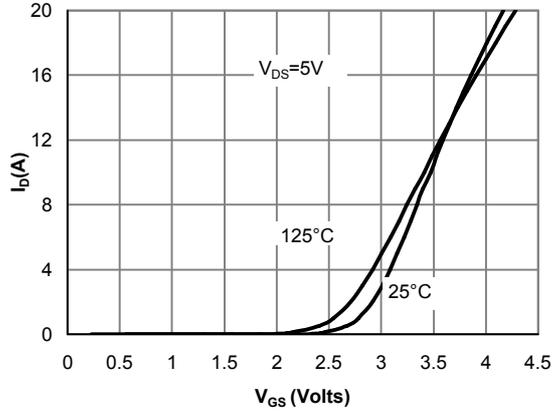
Rev 4: Jan 2009

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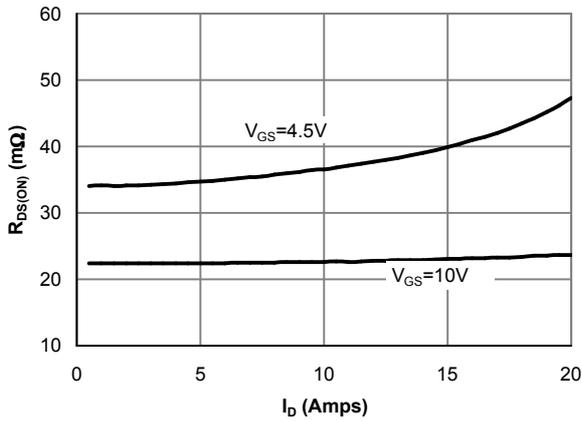
**N-CHANNEL: TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**



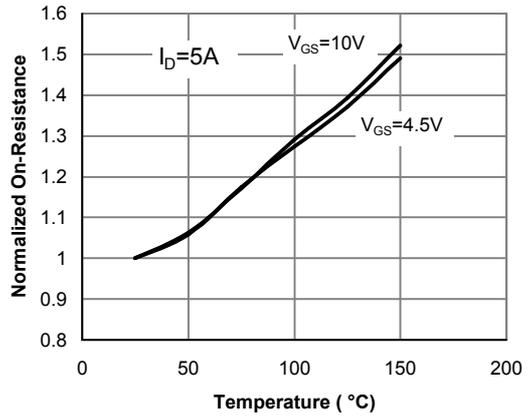
**Fig 1: On-Region Characteristics**



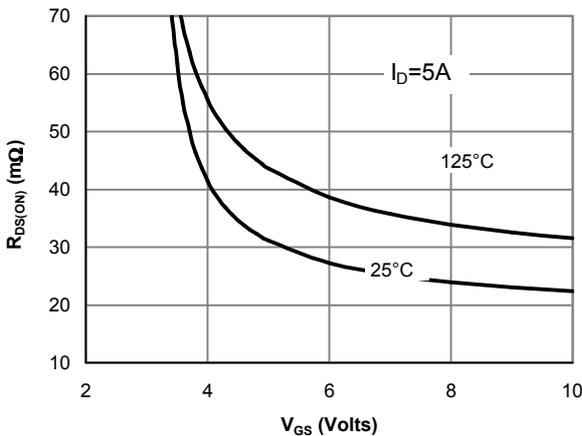
**Figure 2: Transfer Characteristics**



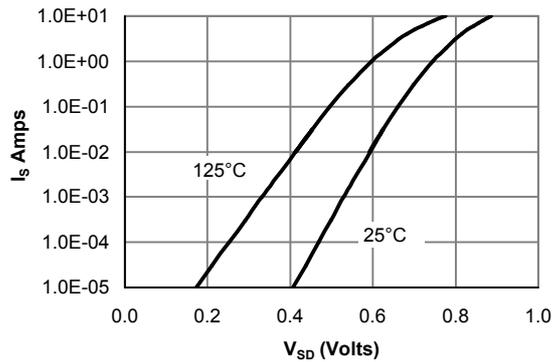
**Figure 3: On-Resistance vs. Drain Current and Gate Voltage**



**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**

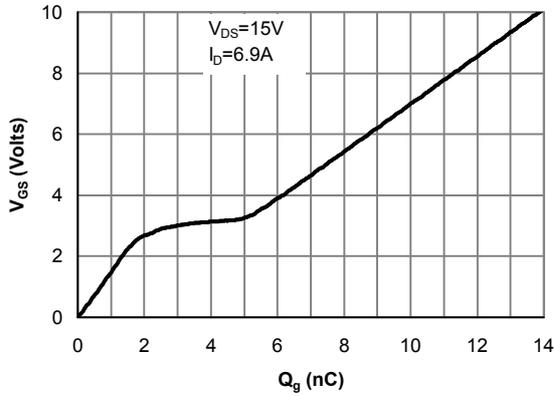


Figure 7: Gate-Charge characteristics

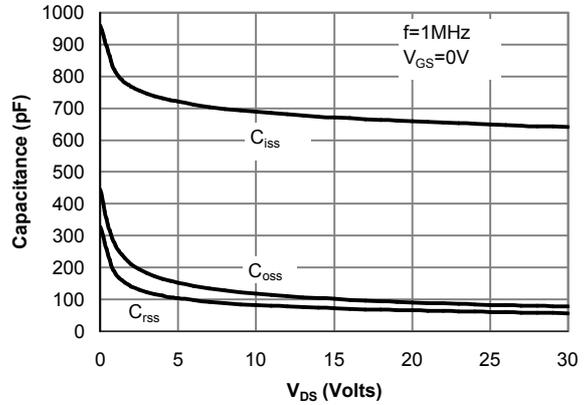


Figure 8: Capacitance Characteristics

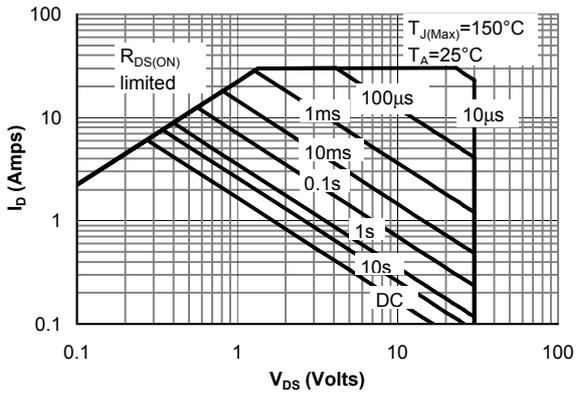


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

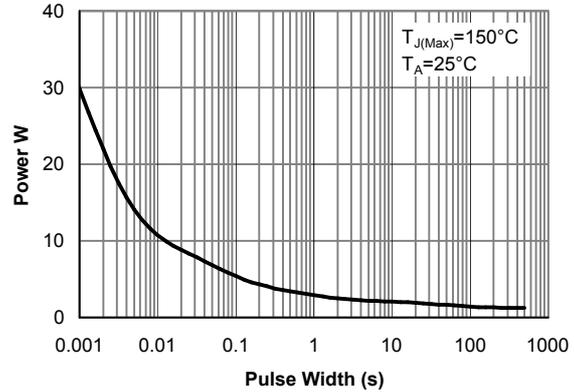


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

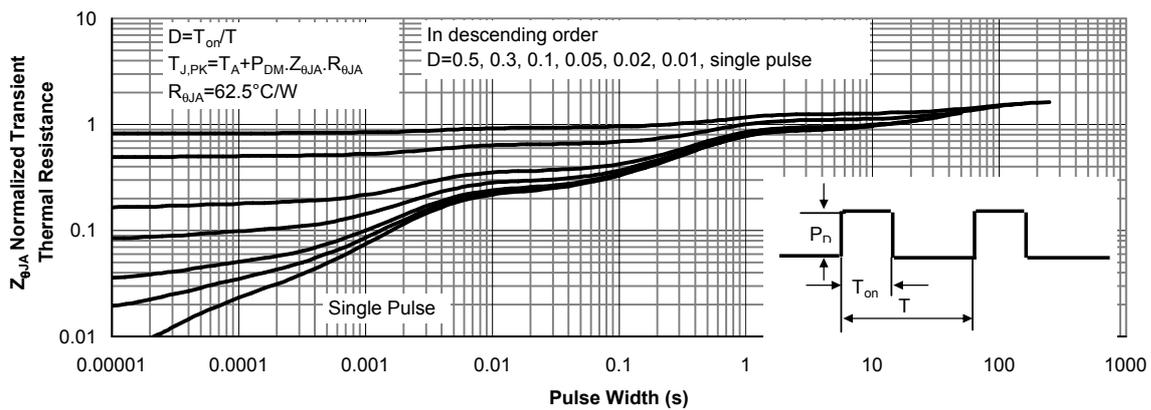
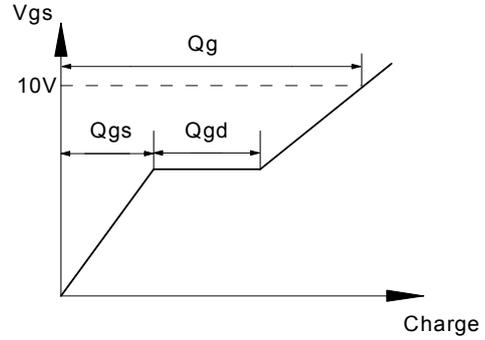
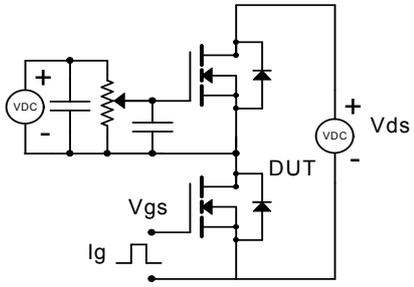
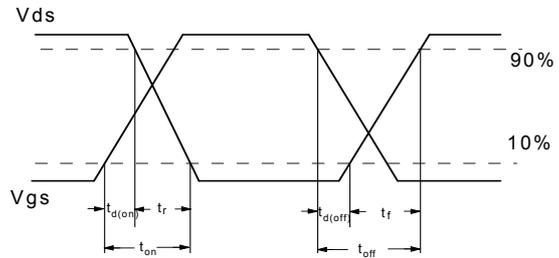
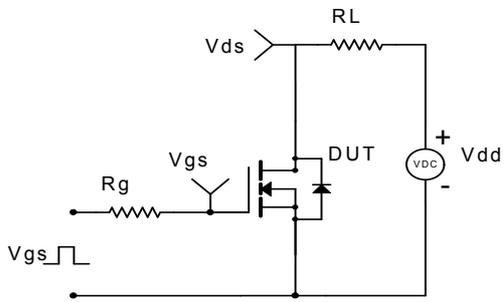


Figure 11: Normalized Maximum Transient Thermal Impedance

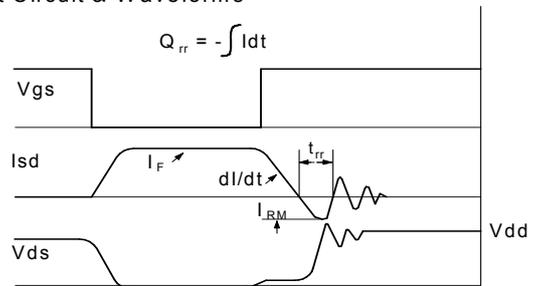
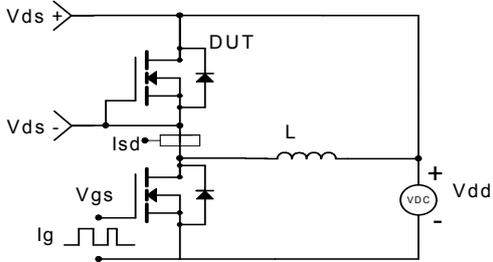
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms



**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			±100	nA
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> =-4.5V, 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> =-5A		39	52	mΩ
		T <sub>J</sub> =125°C		54	70	
		V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-4A		67	87	mΩ
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> =-5V, I <sub>D</sub> =-5A	6	8.6		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				-2.8	A
<b>DYNAMIC PARAMETERS</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> =0V, V <sub>DS</sub> =-15V, f=1MHz		700	900	pF
C <sub>oss</sub>	Output Capacitance			120		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			75		pF
R <sub>g</sub>	Gate resistance	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz		10	15	Ω
<b>SWITCHING PARAMETERS</b>						
Q <sub>g</sub> (10V)	Total Gate Charge (10V)	V <sub>GS</sub> =-10V, V <sub>DS</sub> =-15V, I <sub>D</sub> =-5A		14.7	19	nC
Q <sub>g</sub> (4.5V)	Total Gate Charge (4.5V)			7.6	10	nC
Q <sub>gs</sub>	Gate Source Charge			2		nC
Q <sub>gd</sub>	Gate Drain Charge			3.8		nC
t <sub>D(on)</sub>	Turn-On DelayTime			8.3		ns
t <sub>r</sub>	Turn-On Rise Time	V <sub>GS</sub> =-10V, V <sub>DS</sub> =-15V, R <sub>L</sub> =3Ω,		5		ns
t <sub>D(off)</sub>	Turn-Off DelayTime	R <sub>GEN</sub> =3Ω		29		ns
t <sub>f</sub>	Turn-Off Fall Time			14		ns
t <sub>rr</sub>	Body Diode Reverse Recovery Time	I <sub>F</sub> =-5A, dI/dt=100A/μs		23.5	30	ns
Q <sub>rr</sub>	Body Diode Reverse Recovery Charge	I <sub>F</sub> =-5A, dI/dt=100A/μs		13.4		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 a 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 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-CHANNEL: TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**

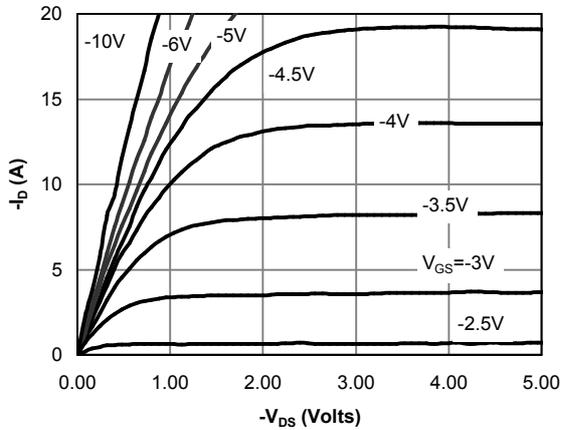


Figure 1: On-Region Characteristics

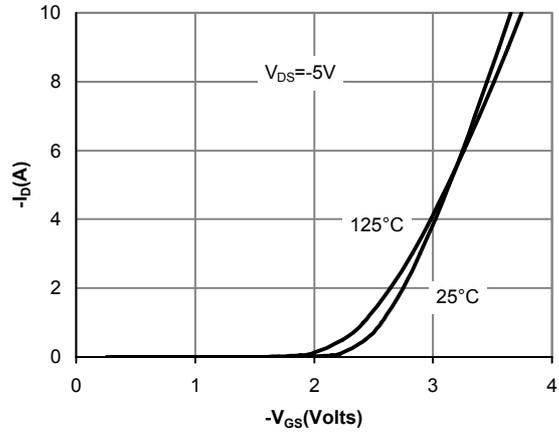


Figure 2: Transfer Characteristics

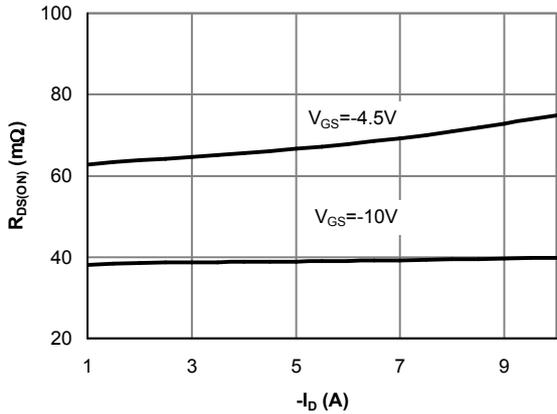


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

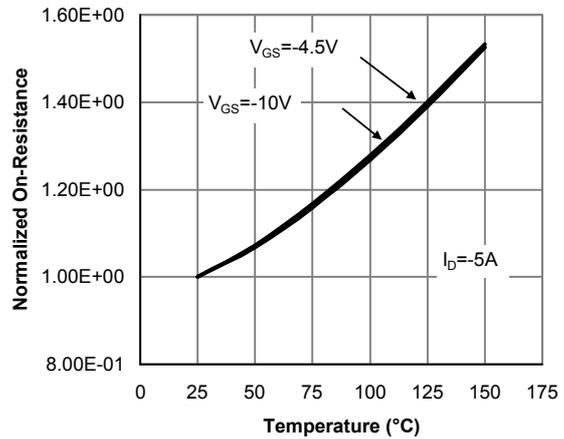


Figure 4: On-Resistance vs. Junction Temperature

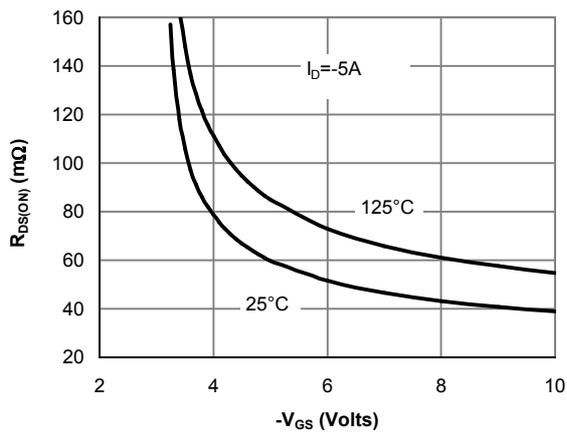


Figure 5: On-Resistance vs. Gate-Source Voltage

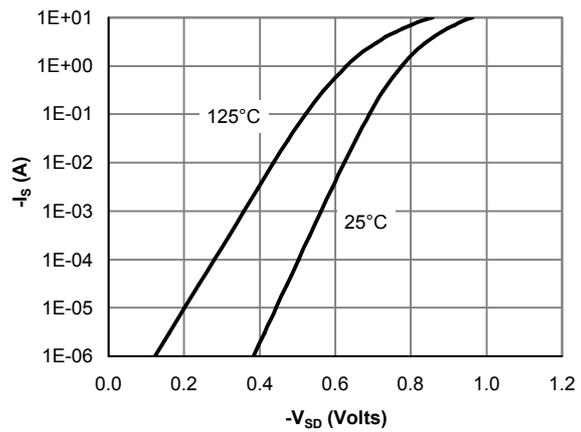


Figure 6: Body-Diode Characteristics

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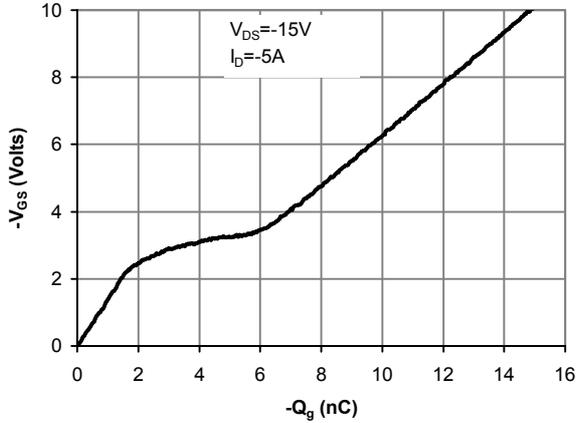


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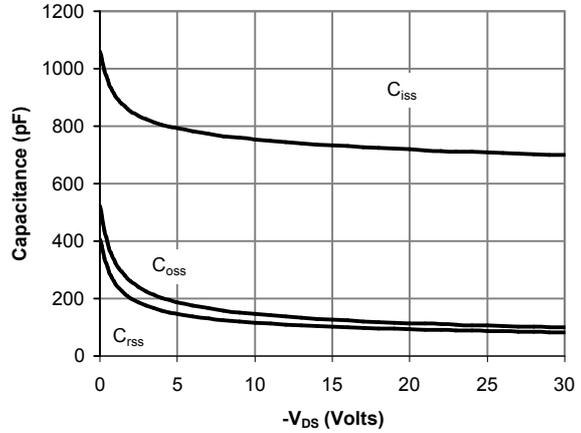


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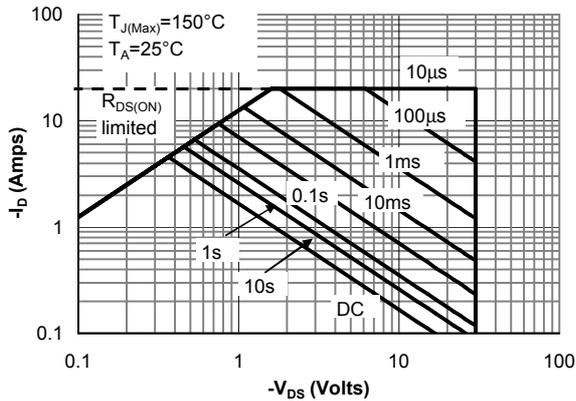


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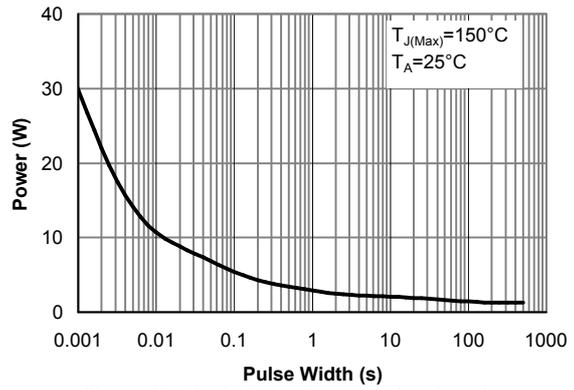


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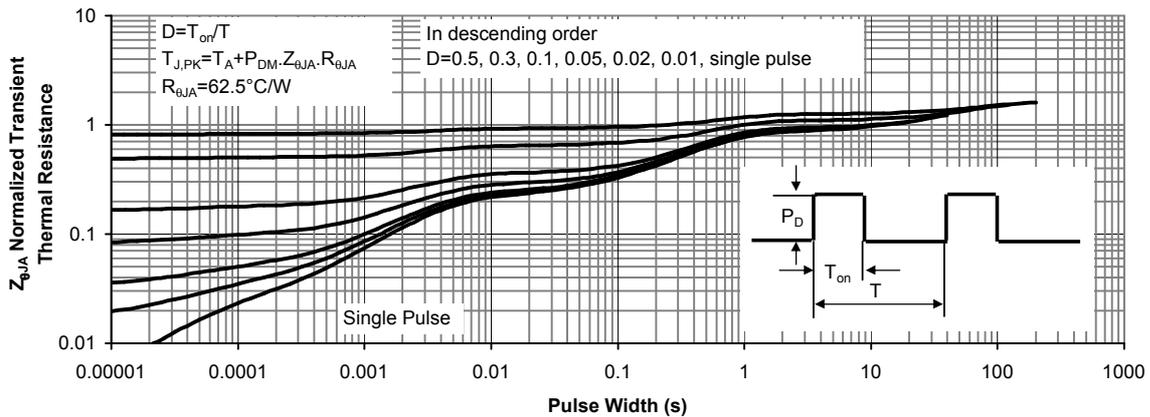
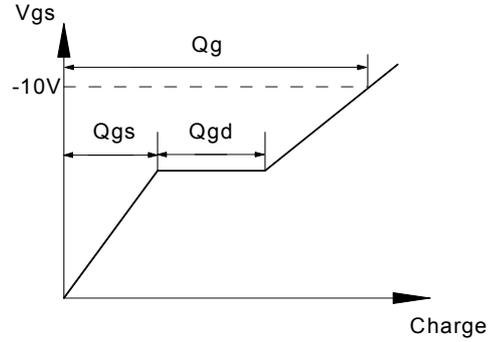
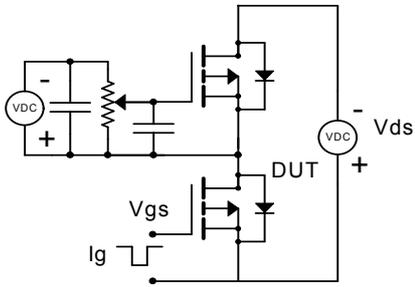
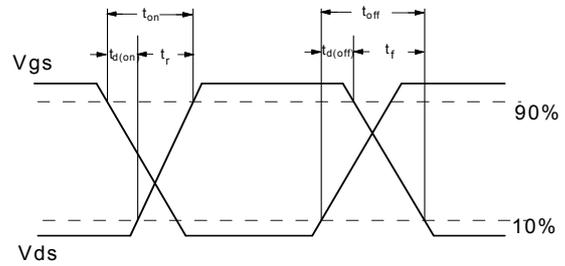
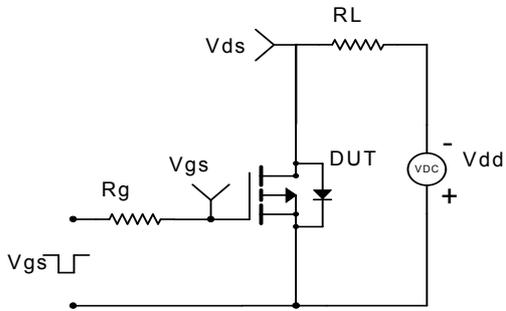


Figure 11: Normalized Maximum Transient Thermal Impedance

Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms

