



**AO4940**

**Asymmetric Dual N-Channel Enhancement Mode Field Effect Transistor**

**SRFET™**

**General Description**

The AO4940 uses advanced trench technology to provide excellent  $R_{DS(ON)}$  and low gate charge. The two MOSFETs make a compact and efficient switch and synchronous rectifier combination for use in DC-DC converters. A monolithically integrated Schottky diode in parallel with the synchronous MOSFET to boost efficiency further. *Standard Product AO4940 is Pb-free (meets ROHS & Sony 259 specifications).*

**Features**

**FET1**

$V_{DS}$  (V) = 30V  
 $I_D$  = 9.1A  
 $R_{DS(ON)}$  < 15m $\Omega$   
 $R_{DS(ON)}$  < 23m $\Omega$

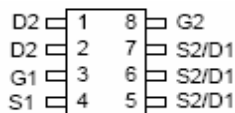
**FET2**

$V_{DS}$ (V) = 30V  
 $I_D$ =7.5A ( $V_{GS}$  = 10V)  
< 23m $\Omega$  ( $V_{GS}$  = 10V)  
< 36m $\Omega$  ( $V_{GS}$  = 4.5V)

**UIS TESTED!**

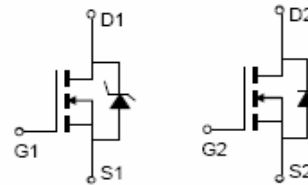
**Rg,Ciss,Coss,Crss Tested**

**SOIC-8**



**SRFET™**

**Soft Recovery MOSFET:**  
**Integrated Schottky Diode**



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

Parameter	Symbol	Max FET1		Max FET2		Units
		10 sec	Steady-State	10 sec	Steady-State	
Drain-Source Voltage	$V_{DS}$	30		30		V
Gate-Source Voltage	$V_{GS}$	$\pm 20$		$\pm 20$		V
Continuous Drain Current <sup>AF</sup>	$T_A=25^\circ\text{C}$	9.1	7.6	7.5	6.2	A
	$T_A=70^\circ\text{C}$	7.3	6.1	6.0	5.0	
Pulsed Drain Current <sup>B</sup>	$I_{DM}$	100		50		A
Avalanche Current <sup>B</sup>	$I_{AR}$	17		13		A
Repetitive avalanche energy $L=0.3\text{mH}$ <sup>B</sup>	$E_{AR}$	43		25		mJ
Power Dissipation <sup>A</sup>	$T_A=25^\circ\text{C}$	2	1.4	2	1.4	W
	$T_A=70^\circ\text{C}$	1.3	0.9	1.3	0.9	
Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 to 150		-55 to 150		$^\circ\text{C}$

**Thermal Characteristics FET1(Integrated Schottky Diode)**

Parameter	Symbol	Typ	Max	Units
Maximum Junction-to-Ambient <sup>A</sup> $t \leq 10\text{s}$	$R_{\theta JA}$	48	62.5	$^\circ\text{C/W}$
Maximum Junction-to-Ambient <sup>A</sup> Steady-State		74	90	$^\circ\text{C/W}$
Maximum Junction-to-Lead <sup>C</sup> Steady-State	$R_{\theta JL}$	32	40	$^\circ\text{C/W}$

**Thermal Characteristics FET2**

Parameter	Symbol	Typ	Max	Units
Maximum Junction-to-Ambient <sup>A</sup> $t \leq 10\text{s}$	$R_{\theta JA}$	48	62.5	$^\circ\text{C/W}$
Maximum Junction-to-Ambient <sup>A</sup> Steady-State		74	90	$^\circ\text{C/W}$
Maximum Junction-to-Lead <sup>C</sup> Steady-State	$R_{\theta JL}$	32	40	$^\circ\text{C/W}$

FET1(Intergrated Schottky Diode) Electrical Characteristics (T<sub>J</sub>=25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>STATIC PARAMETERS</b>						
B <sub>V</sub> DSS	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> =30V, V <sub>GS</sub> =0V T <sub>J</sub> =125°C			0.1 10	mA
I <sub>GSS</sub>	Gate-Body leakage current	V <sub>DS</sub> =0V, V <sub>GS</sub> = ±20V			0.1	μA
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> =V <sub>GS</sub> I <sub>D</sub> =250μA	1.3	1.65	2.5	V
I <sub>D(ON)</sub>	On state drain current	V <sub>GS</sub> =10V, V <sub>DS</sub> =5V	100			A
R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> =10V, I <sub>D</sub> =9.1A T <sub>J</sub> =125°C		12.5 18	15 22	mΩ
		V <sub>GS</sub> =4.5V, I <sub>D</sub> =7.3A		18.5	23	mΩ
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> =5V, I <sub>D</sub> =9.1A		26		S
V <sub>SD</sub>	Diode Forward Voltage	I <sub>S</sub> =1A, V <sub>GS</sub> =0V		0.43	0.5	V
I <sub>S</sub>	Maximum Body-Diode + Schottky 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		903	1100	pF
C <sub>oss</sub>	Output Capacitance			225		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			91		pF
R <sub>g</sub>	Gate resistance	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz		1.7	3.0	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> =9.1A		15.3	20	
Q <sub>g(4.5V)</sub>	Total Gate Charge			7.8	10	nC
Q <sub>gs</sub>	Gate Source Charge			2.0		nC
Q <sub>gd</sub>	Gate Drain Charge			3.9		nC
t <sub>D(on)</sub>	Turn-On DelayTime	V <sub>GS</sub> =10V, V <sub>DS</sub> =15V, R <sub>L</sub> =1.65Ω, R <sub>GEN</sub> =3Ω		5.0		ns
t <sub>r</sub>	Turn-On Rise Time			9.2		ns
t <sub>D(off)</sub>	Turn-Off DelayTime			17.8		ns
t <sub>f</sub>	Turn-Off Fall Time			4.4		ns
t <sub>rr</sub>	Body Diode Reverse Recovery Time	I <sub>F</sub> =9.1A, di/dt=300A/μs		17	20	ns
Q <sub>rr</sub>	Body Diode Reverse Recovery Charge	I <sub>F</sub> =9.1A, di/dt=300A/μs		30.0		nC

A: The value of R<sub>θJA</sub> is measured with the device mounted on 1in 2 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.

B: Repetitive rating, pulse width limited by junction temperature T<sub>J(MAX)</sub>=150°C.

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 <300 μs 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<sub>A</sub>=25°C. The SOA curve provides a single pulse rating.

F: The current rating is based on the t<sub>s</sub> ≤ 10s thermal resistance rating.

Rev 0: Mar. 2007

THIS PRODUCT HAS BEEN DESIGNED AND QUALIFIED FOR THE CONSUMER MARKET. APPLICATIONS OR USES AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS ARE NOT AUTHORIZED. AOS DOES NOT ASSUME ANY LIABILITY ARISING OUT OF SUCH APPLICATIONS OR USES OF ITS PRODUCTS. AOS RESERVES THE RIGHT TO IMPROVE PRODUCT DESIGN, FUNCTIONS AND RELIABILITY WITHOUT NOTICE.

FET1: TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

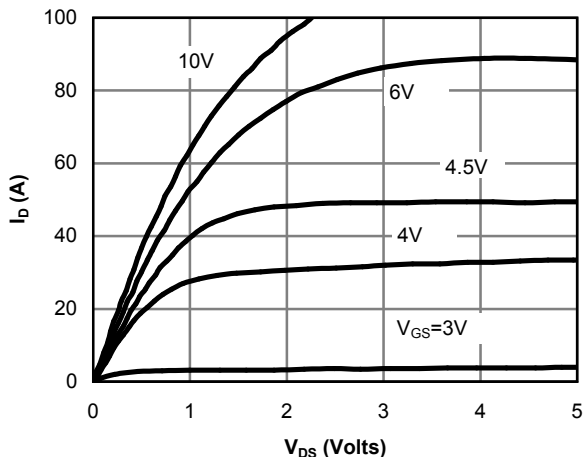


Figure 1: On-Region Characteristics

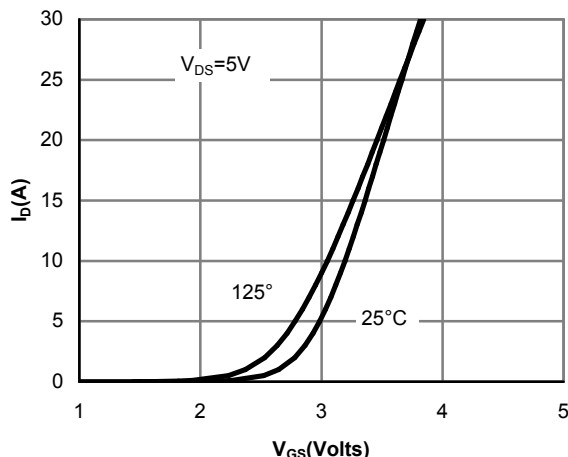


Figure 2: Transfer Characteristics

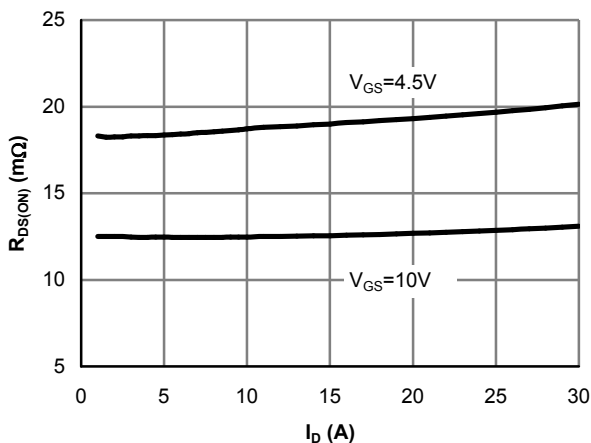


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

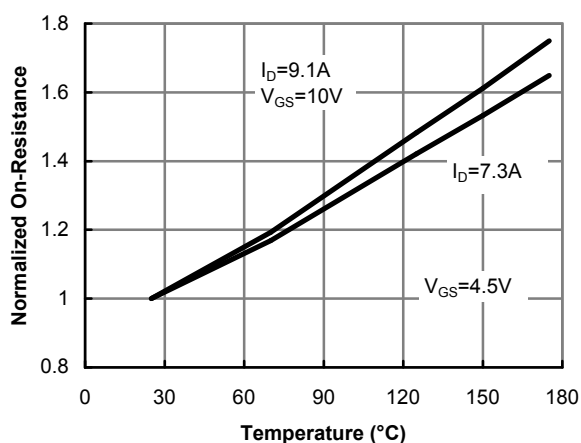


Figure 4: On-Resistance vs. Junction Temperature

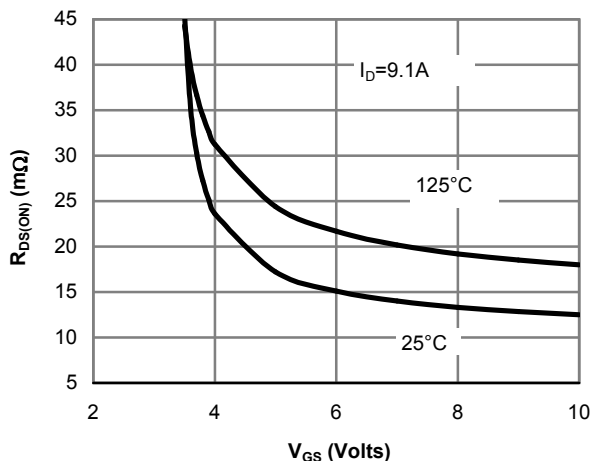


Figure 5: On-Resistance vs. Gate-Source Voltage

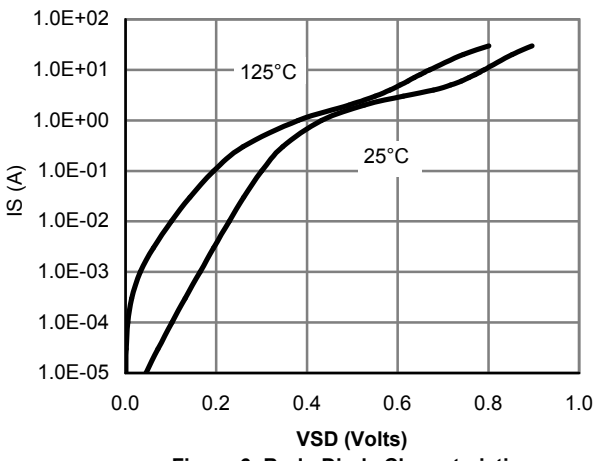


Figure 6: Body-Diode Characteristics

FET1: TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

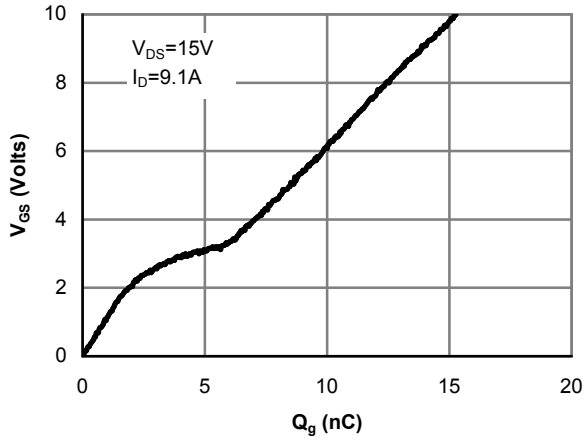


Figure 7: Gate-Charge Characteristics

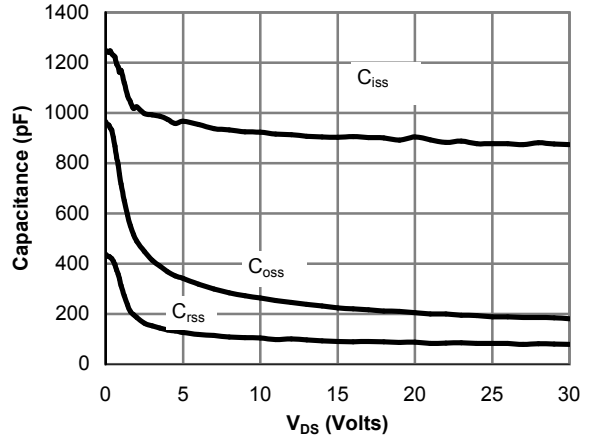


Figure 8: Capacitance Characteristics

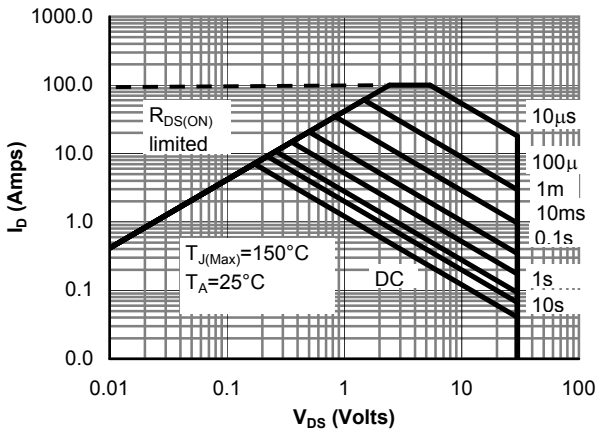


Figure 9: Maximum Biased Safe Operating Area (Note E)

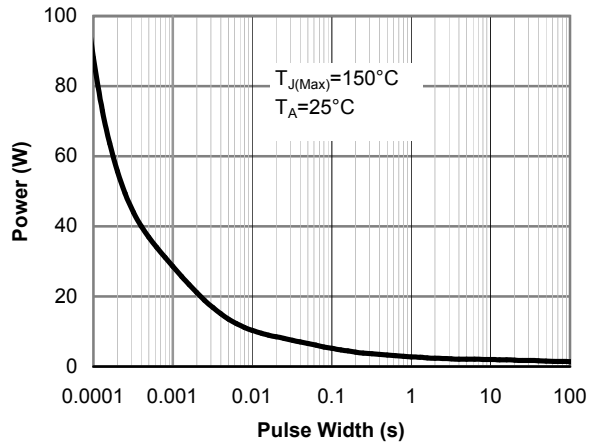


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

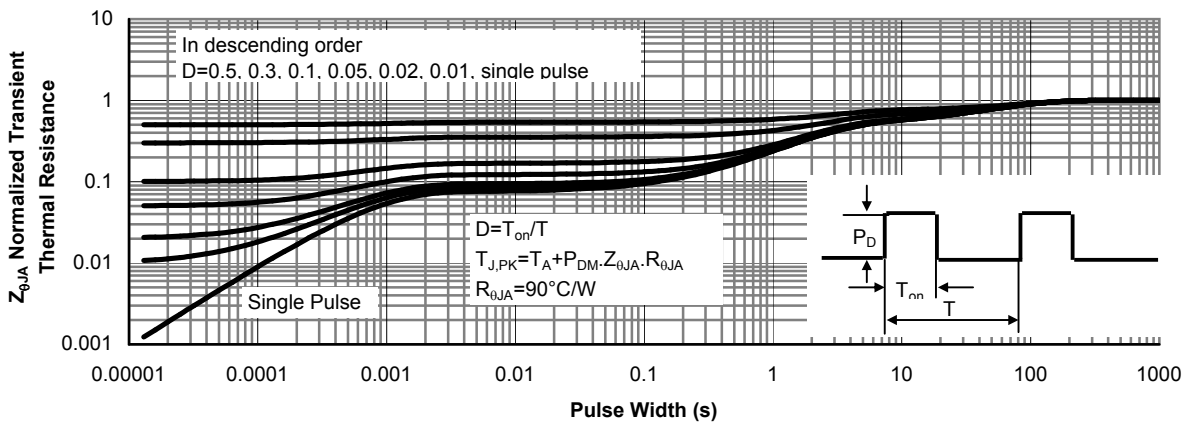


Figure 11: Normalized Maximum Transient Thermal Impedance (Note E)

FET2 Electrical Characteristics (T<sub>J</sub>=25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>STATIC PARAMETERS</b>						
B <sub>V</sub> DSS	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> =30V, 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	1.3	1.6	2.5	V
I <sub>D(ON)</sub>	On state drain current	V <sub>GS</sub> =10V, V <sub>DS</sub> =5V	50			A
R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> =10V, I <sub>D</sub> =7.5A T <sub>J</sub> =125°C		19 27	23 34	mΩ
		V <sub>GS</sub> =4.5V, I <sub>D</sub> =6A		29	36	mΩ
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> =5V, I <sub>D</sub> =7.5A		22		S
V <sub>SD</sub>	Diode Forward Voltage	I <sub>S</sub> =1A, V <sub>GS</sub> =0V		0.75	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		621	820	pF
C <sub>oss</sub>	Output Capacitance			118		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			85		pF
R <sub>g</sub>	Gate resistance	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz		0.8	1.5	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> =7.5A		11.3	17	nC
Q <sub>g(4.5V)</sub>	Total Gate Charge			5.7	8.5	nC
Q <sub>gs</sub>	Gate Source Charge			2.1		nC
Q <sub>gd</sub>	Gate Drain Charge			3		nC
t <sub>D(on)</sub>	Turn-On DelayTime	V <sub>GS</sub> =10V, V <sub>DS</sub> =15V, R <sub>L</sub> =2Ω, R <sub>GEN</sub> =3Ω		4.5		ns
t <sub>r</sub>	Turn-On Rise Time			3.1		ns
t <sub>D(off)</sub>	Turn-Off DelayTime			15.1		ns
t <sub>f</sub>	Turn-Off Fall Time			2.7		ns
t <sub>rr</sub>	Body Diode Reverse Recovery Time	I <sub>F</sub> =7.5A, dI/dt=100A/μs		15.5	21	ns
Q <sub>rr</sub>	Body Diode Reverse Recovery Charge	I <sub>F</sub> =7.5A, dI/dt=100A/μs		7.1		nC

A: The value of R<sub>θJA</sub> is measured 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 value in any given application depends on the user's specific board design.

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 <300 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.

F: The current rating is based on the t<sub>s</sub> ≤ 10s thermal resistance rating.

Rev 0: Mar. 2007

THIS PRODUCT HAS BEEN DESIGNED AND QUALIFIED FOR THE CONSUMER MARKET. APPLICATIONS OR USES AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS ARE NOT AUTHORIZED. AOS DOES NOT ASSUME ANY LIABILITY ARISING OUT OF SUCH APPLICATIONS OR USES OF ITS PRODUCTS. AOS RESERVES THE RIGHT TO IMPROVE PRODUCT DESIGN, FUNCTIONS AND RELIABILITY WITHOUT NOTICE.

FET2: TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

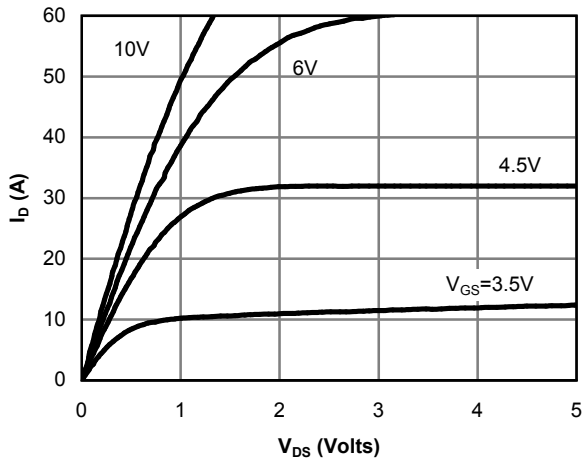


Fig 1: On-Region Characteristics

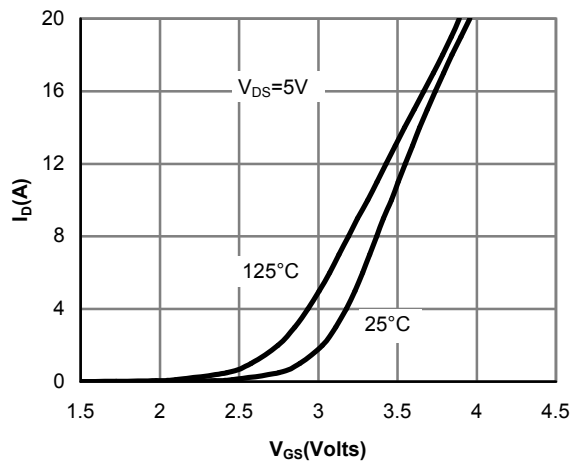


Figure 2: Transfer Characteristics

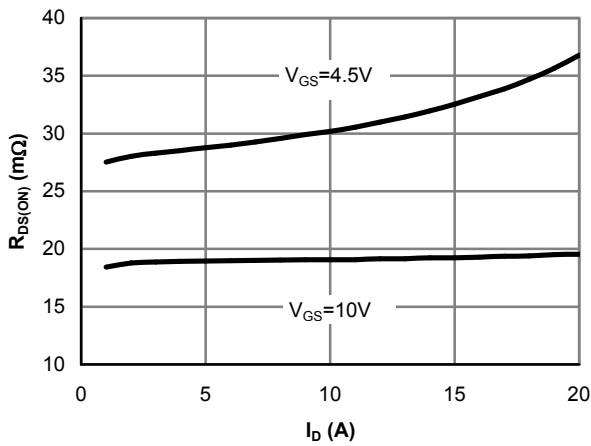


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

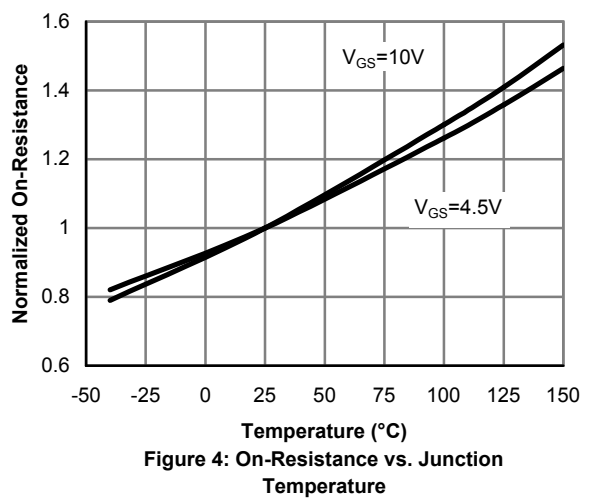


Figure 4: On-Resistance vs. Junction Temperature

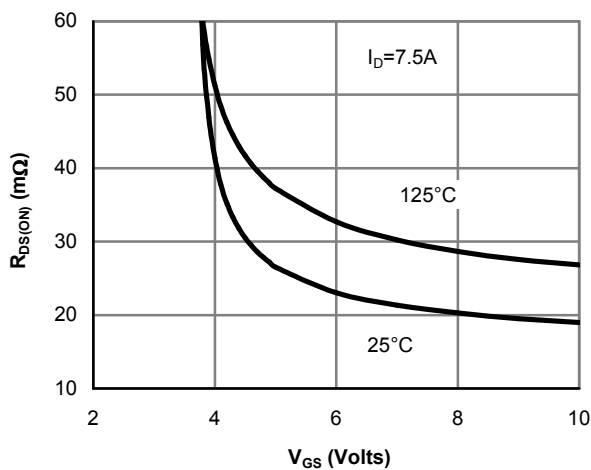


Figure 5: On-Resistance vs. Gate-Source Voltage

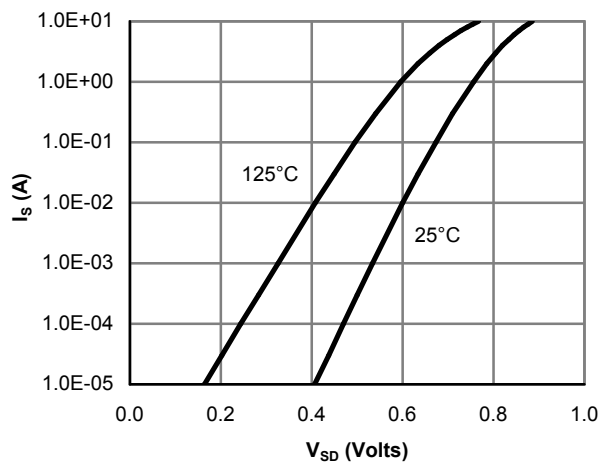


Figure 6: Body-Diode Characteristics