



# ALPHA & OMEGA SEMICONDUCTOR



AO4616

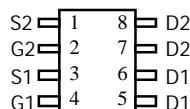
## Complementary Enhancement Mode Field Effect Transistor

## General Description

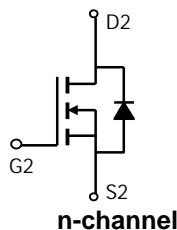
The AO4616 uses advanced trench technology MOSFETs to provide excellent  $R_{DS(ON)}$  and low gate charge. The complementary MOSFETs may be used in inverter and other applications. *Standard Product AO4616 is Pb-free (meets ROHS & Sony 259 specifications). AO4616L is a Green Product ordering option. AO4616 and AO4616L are electrically identical.*

## Features

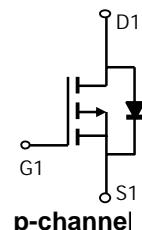
n-channel	p-channel
$V_{DS}$ (V) = 30V	-30V
$I_D = 8.1A$ ( $V_{GS} = 10V$ )	-7.1A ( $V_{GS} = -10V$ )
$R_{DS(ON)}$	$R_{DS(ON)}$
< 20m $\Omega$ ( $V_{GS} = 10V$ )	< 25m $\Omega$ ( $V_{GS} = -10V$ )
< 28m $\Omega$ ( $V_{GS} = 4.5V$ )	< 40m $\Omega$ ( $V_{GS} = -4.5V$ )



## 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>	$T_A=25^\circ\text{C}$	$I_D$	8.1	-7.1
	$T_A=70^\circ\text{C}$		6.5	-5.6
Pulsed Drain Current <sup>B</sup>		$I_{DM}$	30	-30
Power Dissipation	$T_A=25^\circ\text{C}$	$P_D$	2	2
	$T_A=70^\circ\text{C}$		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 <sup>A</sup>	$t \leq 10s$	$R_{\theta JA}$	n-ch	48	62.5	°C/W
Maximum Junction-to-Ambient <sup>A</sup>	Steady-State		n-ch	74	110	°C/W
Maximum Junction-to-Lead <sup>C</sup>	Steady-State	$R_{\theta JL}$	n-ch	35	60	°C/W
Maximum Junction-to-Ambient <sup>A</sup>	$t \leq 10s$	$R_{\theta JA}$	p-ch	48	62.5	°C/W
Maximum Junction-to-Ambient <sup>A</sup>	Steady-State		p-ch	74	110	°C/W
Maximum Junction-to-Lead <sup>C</sup>	Steady-State	$R_{\theta JL}$	p-ch	35	40	°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>						
$\text{BV}_{\text{DSS}}$	Drain-Source Breakdown Voltage	$I_D=250\mu\text{A}, V_{\text{GS}}=0\text{V}$	30			V
$I_{\text{DSS}}$	Zero Gate Voltage Drain Current	$V_{\text{DS}}=24\text{V}, V_{\text{GS}}=0\text{V}$ $T_J=55^\circ\text{C}$		1	5	$\mu\text{A}$
$I_{\text{GSS}}$	Gate-Body leakage current	$V_{\text{DS}}=0\text{V}, V_{\text{GS}}=\pm20\text{V}$		100		nA
$V_{\text{GS}(\text{th})}$	Gate Threshold Voltage	$V_{\text{DS}}=V_{\text{GS}}, I_D=250\mu\text{A}$	1	1.8	3	V
$I_{\text{D}(\text{ON})}$	On state drain current	$V_{\text{GS}}=10\text{V}, V_{\text{DS}}=5\text{V}$	30			A
$R_{\text{DS}(\text{ON})}$	Static Drain-Source On-Resistance	$V_{\text{GS}}=10\text{V}, I_D=8.1\text{A}$ $T_J=125^\circ\text{C}$		16.4	20	$\text{m}\Omega$
		$V_{\text{GS}}=4.5\text{V}, I_D=6\text{A}$		20	25	
$g_{\text{FS}}$	Forward Transconductance	$V_{\text{DS}}=5\text{V}, I_D=8.1\text{A}$		23		S
$V_{\text{SD}}$	Body-Diode Forward Voltage	$I_S=1\text{A}$		0.75	1	V
$I_S$	Maximum Body-Diode Continuous Current				3	A
<b>DYNAMIC PARAMETERS</b>						
$C_{\text{iss}}$	Input Capacitance	$V_{\text{GS}}=0\text{V}, V_{\text{DS}}=15\text{V}, f=1\text{MHz}$		1040	1250	pF
$C_{\text{oss}}$	Output Capacitance			180		pF
$C_{\text{rss}}$	Reverse Transfer Capacitance			110		pF
$R_g$	Gate resistance	$V_{\text{GS}}=0\text{V}, V_{\text{DS}}=0\text{V}, f=1\text{MHz}$		0.7		$\Omega$
<b>SWITCHING PARAMETERS</b>						
$Q_g(10\text{V})$	Total Gate Charge	$V_{\text{GS}}=10\text{V}, V_{\text{DS}}=15\text{V}, I_D=8.1\text{A}$		19.2		nC
$Q_g(4.5\text{V})$	Total Gate Charge			9.36		nC
$Q_{\text{gs}}$	Gate Source Charge			2.6		nC
$Q_{\text{gd}}$	Gate Drain Charge			4.2		nC
$t_{\text{D}(\text{on})}$	Turn-On Delay Time	$V_{\text{GS}}=10\text{V}, V_{\text{DS}}=15\text{V}, R_L=1.8\Omega, R_{\text{GEN}}=3\Omega$		5.2		ns
$t_r$	Turn-On Rise Time			4.4		ns
$t_{\text{D}(\text{off})}$	Turn-Off Delay Time			17.3		ns
$t_f$	Turn-Off Fall Time			3.3		ns
$t_{\text{rr}}$	Body-Diode Reverse Recovery Time	$I_F=8.1\text{A}, dI/dt=100\text{A}/\mu\text{s}$		16.7	21	ns
$Q_{\text{rr}}$	Body-Diode Reverse Recovery Charge	$I_F=8.1\text{A}, dI/dt=100\text{A}/\mu\text{s}$		6.7	10	nC

A: The value of  $R_{\text{DJA}}$  is measured with the device mounted on 1 in <sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with  $T_A=25^\circ\text{C}$ . 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  $R_{\text{DJA}}$  is the sum of the thermal impedance from junction to lead  $R_{\text{JL}}$  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-CH TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

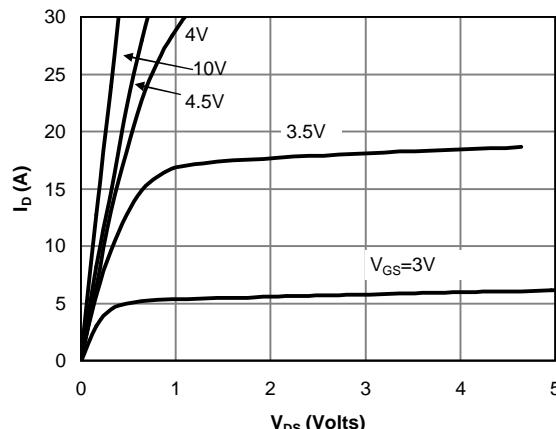


Figure 1: On-Region Characteristics

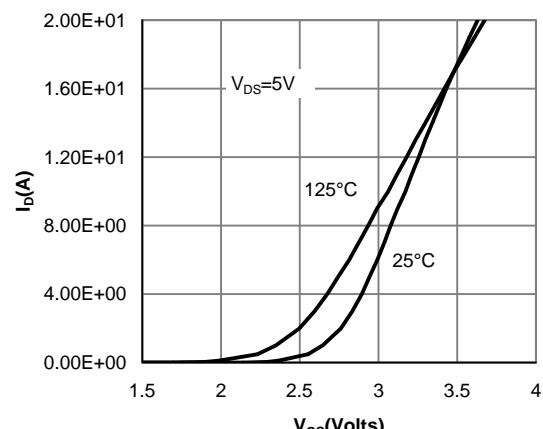


Figure 2: Transfer Characteristics

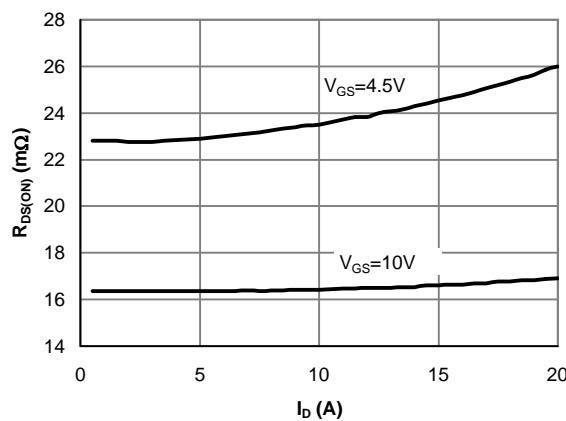


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

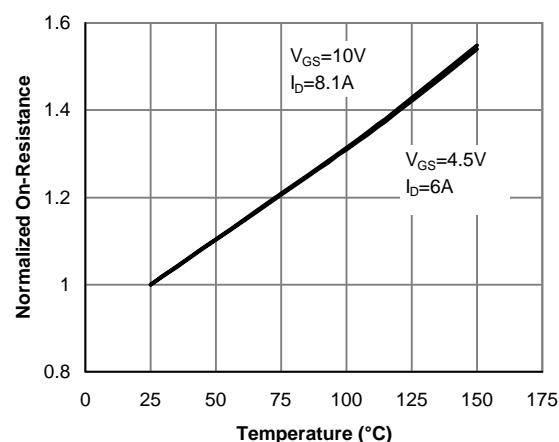


Figure 4: On-Resistance vs. Junction Temperature

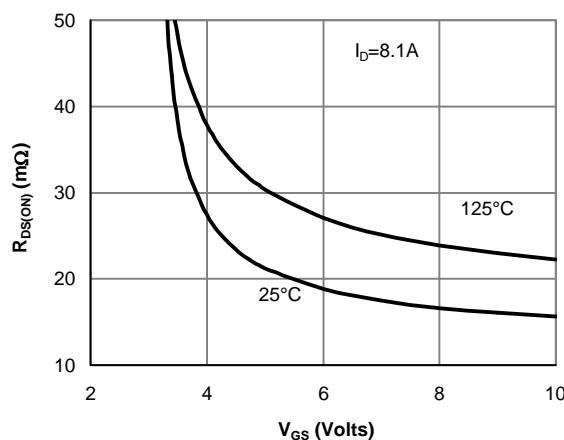


Figure 5: On-Resistance vs. Gate-Source Voltage

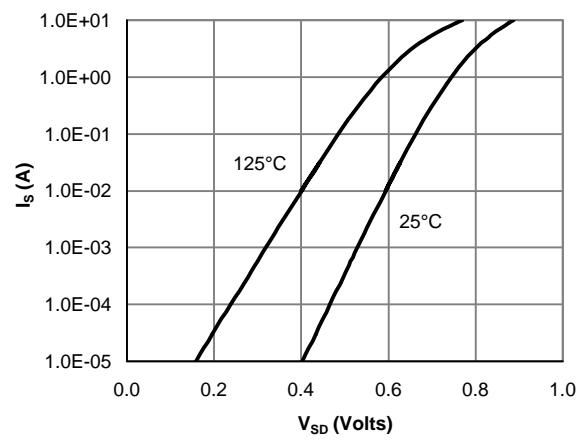
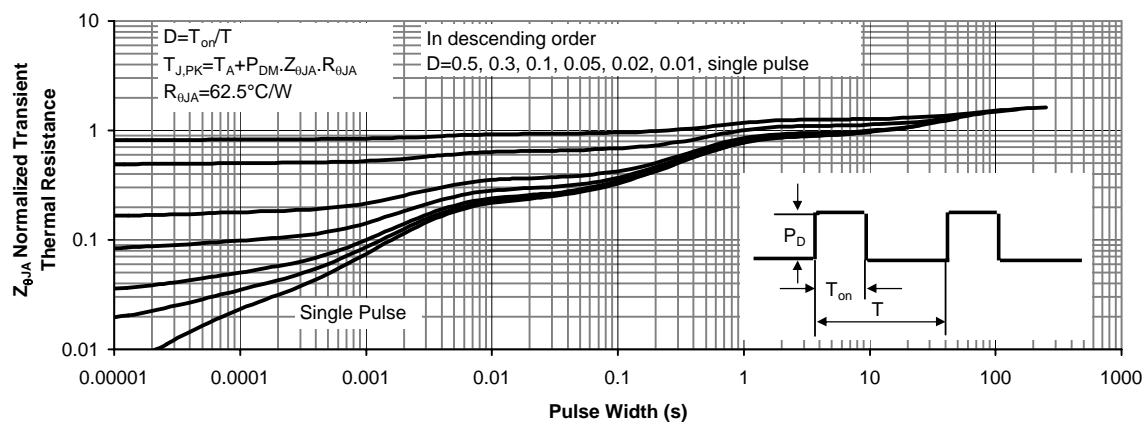
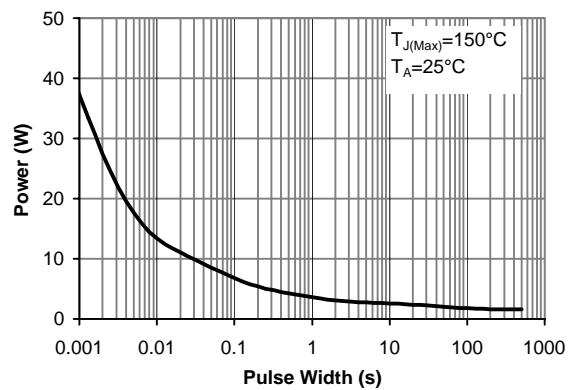
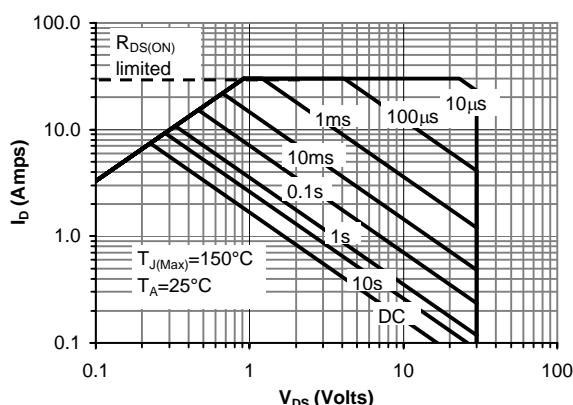
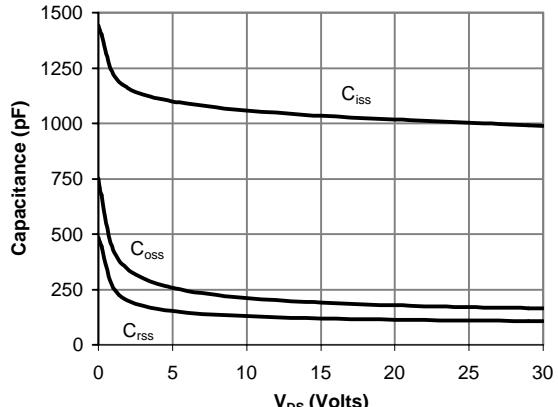
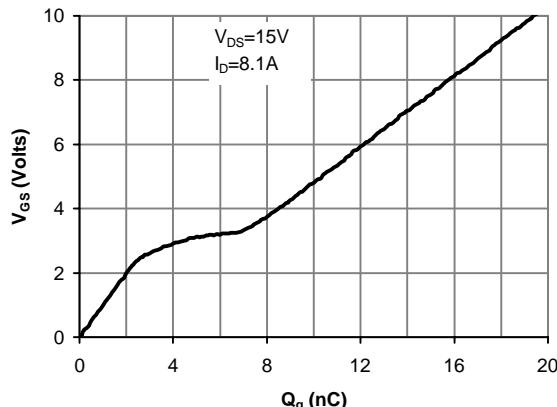


Figure 6: Body-Diode Characteristics

## N-CH TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS



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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>STATIC PARAMETERS</b>						
$\text{BV}_{\text{DSS}}$	Drain-Source Breakdown Voltage	$I_D=-250\mu\text{A}$ , $V_{\text{GS}}=0\text{V}$	-30			V
$I_{\text{DSS}}$	Zero Gate Voltage Drain Current	$V_{\text{DS}}=-24\text{V}$ , $V_{\text{GS}}=0\text{V}$ $T_J=55^\circ\text{C}$			-1	$\mu\text{A}$
$I_{\text{GSS}}$	Gate-Body leakage current	$V_{\text{DS}}=0\text{V}$ , $V_{\text{GS}}=\pm20\text{V}$			-5	nA
$V_{\text{GS(th)}}$	Gate Threshold Voltage	$V_{\text{DS}}=V_{\text{GS}}$ $I_D=-250\mu\text{A}$	-1.4	-2	-2.7	V
$I_{\text{D(ON)}}$	On state drain current	$V_{\text{GS}}=-10\text{V}$ , $V_{\text{DS}}=-5\text{V}$	30			A
$R_{\text{DS(ON)}}$	Static Drain-Source On-Resistance	$V_{\text{GS}}=-10\text{V}$ , $I_D=-7.1\text{A}$ $T_J=125^\circ\text{C}$		20	25	$\text{m}\Omega$
		$V_{\text{GS}}=-4.5\text{V}$ , $I_D=-5.6\text{A}$		27	33	$\text{m}\Omega$
$g_{\text{FS}}$	Forward Transconductance	$V_{\text{DS}}=-5\text{V}$ , $I_D=-7.1\text{A}$		19.6		S
$V_{\text{SD}}$	Diode Forward Voltage	$I_S=-1\text{A}$ , $V_{\text{GS}}=0\text{V}$		-0.7	-1	V
$I_S$	Maximum Body-Diode Continuous Current				-4.2	A
<b>DYNAMIC PARAMETERS</b>						
$C_{\text{iss}}$	Input Capacitance	$V_{\text{GS}}=0\text{V}$ , $V_{\text{DS}}=-15\text{V}$ , $f=1\text{MHz}$		1573		pF
$C_{\text{oss}}$	Output Capacitance			319		pF
$C_{\text{rss}}$	Reverse Transfer Capacitance			211		pF
$R_g$	Gate resistance	$V_{\text{GS}}=0\text{V}$ , $V_{\text{DS}}=0\text{V}$ , $f=1\text{MHz}$		6.7		$\Omega$
<b>SWITCHING PARAMETERS</b>						
$Q_g(10\text{V})$	Total Gate Charge (10V)	$V_{\text{GS}}=-10\text{V}$ , $V_{\text{DS}}=-15\text{V}$ , $I_D=-7.1\text{A}$		30.9		nC
$Q_g(4.5\text{V})$	Total Gate Charge (4.5V)			16.1		nC
$Q_{\text{gs}}$	Gate Source Charge			8		nC
$Q_{\text{gd}}$	Gate Drain Charge			4.4		nC
$t_{\text{D(on)}}$	Turn-On DelayTime	$V_{\text{GS}}=-10\text{V}$ , $V_{\text{DS}}=-15\text{V}$ , $R_L=2.2\Omega$ , $R_{\text{GEN}}=3\Omega$		9.5		ns
$t_r$	Turn-On Rise Time			8		ns
$t_{\text{D(off)}}$	Turn-Off DelayTime			44.2		ns
$t_f$	Turn-Off Fall Time			22.2		ns
$t_{\text{rr}}$	Body Diode Reverse Recovery Time	$I_F=-7.1\text{A}$ , $di/dt=100\text{A}/\mu\text{s}$		25.5		ns
$Q_{\text{rr}}$	Body Diode Reverse Recovery Charge	$I_F=-7.1\text{A}$ , $di/dt=100\text{A}/\mu\text{s}$		14.7		nC

A: The value of  $R_{\text{0JA}}$  is measured with the device mounted on 1 in <sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with  $T_A=25^\circ\text{C}$ . 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  $R_{\text{0JA}}$  is the sum of the thermal impedance from junction to lead  $R_{\text{0JL}}$  and lead to ambient.

D. The static characteristics in Figures 1 to 6,12,14 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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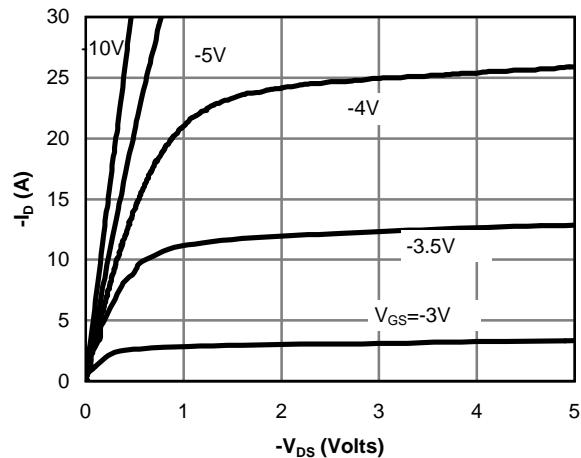


Fig 16: On-Region Characteristics

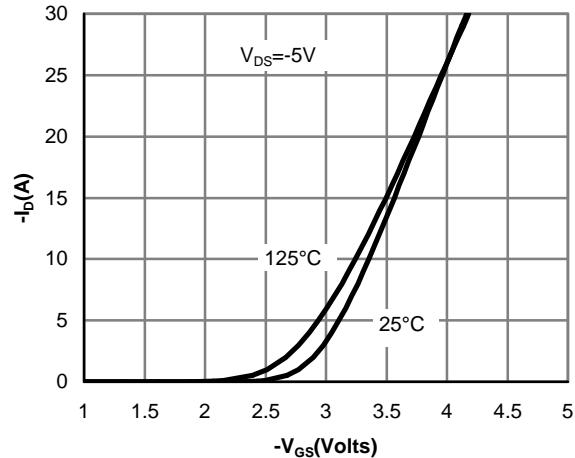


Figure 17: Transfer Characteristics

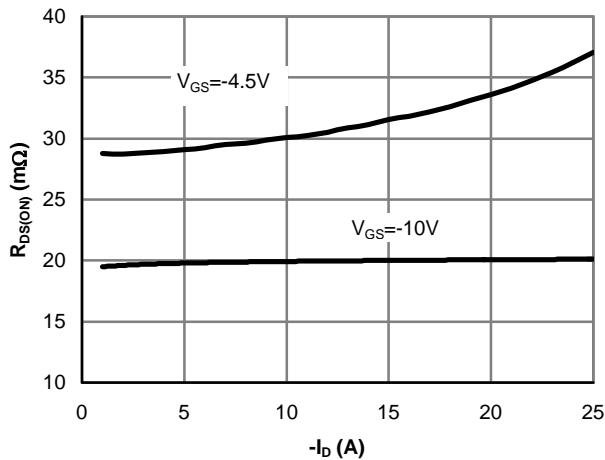


Figure 18: On-Resistance vs. Drain Current and Gate Voltage

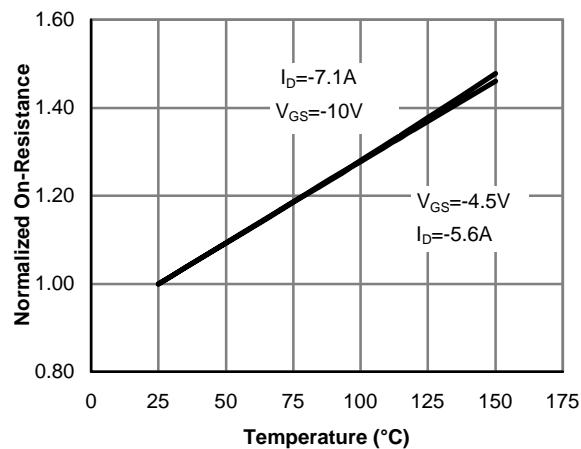


Figure 19: On-Resistance vs. Junction Temperature

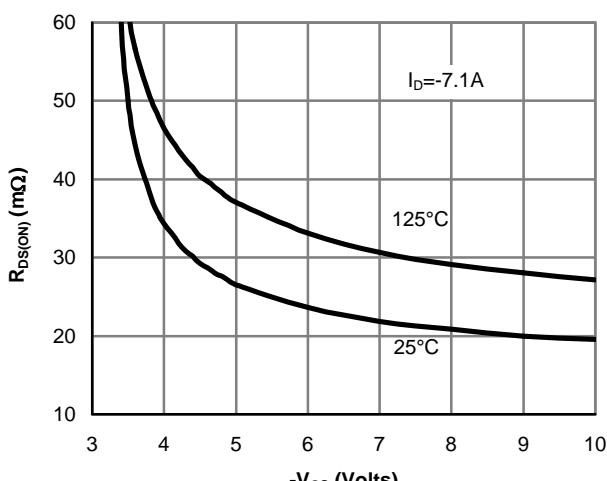


Figure 20: On-Resistance vs. Gate-Source Voltage

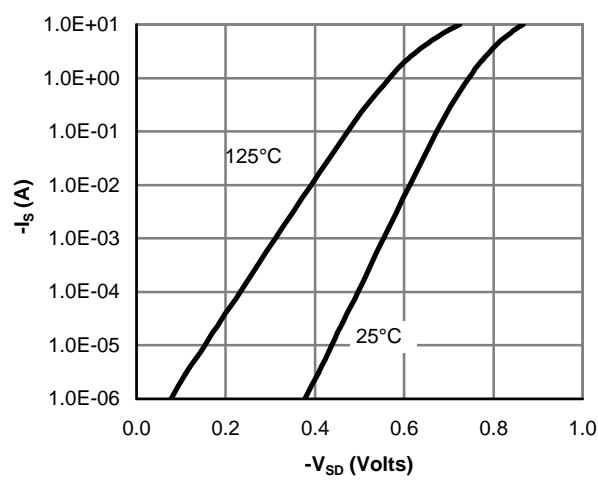


Figure 21: Body-Diode Characteristics

## P-CH TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

