



Rev 3: May 2004

**AO3415**  
**P-Channel Enhancement Mode Field Effect Transistor**

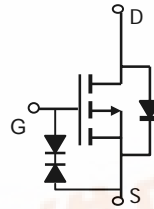
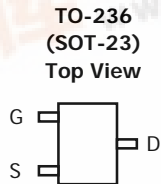


**General Description**

The AO3415 uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and operation with gate voltages as low as 1.8V. This device is suitable for use as a load switch or in PWM applications. It is ESD protected. AO3415 is Pb-free (meets ROHS & Sony 259 specifications). AO3415L is a Green Product ordering option. AO3415 and AO3415L are electrically identical.

**Features**

- $V_{DS}$  (V) = -20V
- $I_D$  = -4 A
- $R_{DS(ON)} < 43m\Omega$  ( $V_{GS} = -4.5V$ )
- $R_{DS(ON)} < 54m\Omega$  ( $V_{GS} = -2.5V$ )
- $R_{DS(ON)} < 73m\Omega$  ( $V_{GS} = -1.8V$ )
- ESD Rating: 3000V HBM



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

Parameter	Symbol	Maximum	Units
Drain-Source Voltage	$V_{DS}$	-20	V
Gate-Source Voltage	$V_{GS}$	$\pm 8$	V
Continuous Drain Current <sup>A</sup>	$I_D$	$T_A=25^\circ C$	-4.0
		$T_A=70^\circ C$	-3.5
Pulsed Drain Current <sup>B</sup>	$I_{DM}$	-30	A
Power Dissipation <sup>A</sup>	$P_D$	$T_A=25^\circ C$	1.4
		$T_A=70^\circ C$	0.9
Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 to 150	$^\circ C$

**Thermal Characteristics**

Parameter	Symbol	Typ	Max	Units
Maximum Junction-to-Ambient <sup>A</sup>	$R_{\theta JA}$	65	90	$^\circ C/W$
Maximum Junction-to-Ambient <sup>A</sup>		Steady-State	85	125
Maximum Junction-to-Lead <sup>C</sup>	$R_{\theta JL}$	43	60	$^\circ C/W$



**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	-20			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> =-16V, 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> =±4.5V V <sub>DS</sub> =0V, V <sub>GS</sub> =±8V			±1 ±10	μA
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> =V <sub>GS</sub> I <sub>D</sub> =-250μA	-0.3	-0.55	-1	
I <sub>D(ON)</sub>	On state drain current	V <sub>GS</sub> =-4.5V, V <sub>DS</sub> =-5V	-25			A
R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-4A T <sub>J</sub> =125°C		35 48	43 60	mΩ
		V <sub>GS</sub> =-2.5V, I <sub>D</sub> =-4A		45	54	
		V <sub>GS</sub> =-1.8V, I <sub>D</sub> =-2A		56	73	
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> =-5V, I <sub>D</sub> =-4A	8	16		S
V <sub>SD</sub>	Diode Forward Voltage	I <sub>S</sub> =-1A, V <sub>GS</sub> =0V		-0.78	-1	V
I <sub>S</sub>	Maximum Body-Diode Continuous Current				-2.2	A
<b>DYNAMIC PARAMETERS</b>						
C <sub>ISS</sub>	Input Capacitance	V <sub>GS</sub> =0V, V <sub>DS</sub> =-10V, f=1MHz		1450		pF
C <sub>OSS</sub>	Output Capacitance		205		pF	
C <sub>RSS</sub>	Reverse Transfer Capacitance		160		pF	
R <sub>g</sub>	Gate resistance	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz		6.5		Ω
<b>SWITCHING PARAMETERS</b>						
Q <sub>g</sub>	Total Gate Charge	V <sub>GS</sub> =-4.5V, V <sub>DS</sub> =-10V, I <sub>D</sub> =-4A		17.2		nC
Q <sub>gs</sub>	Gate Source Charge		1.3		nC	
Q <sub>gd</sub>	Gate Drain Charge		4.5		nC	
t <sub>D(on)</sub>	Turn-On Delay Time	V <sub>GS</sub> =-4.5V, V <sub>DS</sub> =-10V, R <sub>L</sub> =2.5Ω, R <sub>GEN</sub> =3Ω		9.5		ns
t <sub>r</sub>	Turn-On Rise Time		17		ns	
t <sub>D(off)</sub>	Turn-Off Delay Time		94		ns	
t <sub>f</sub>	Turn-Off Fall Time		35		ns	
t <sub>rr</sub>	Body Diode Reverse Recovery Time	I <sub>F</sub> =-4A, dI/dt=100A/μs		31		ns
Q <sub>rr</sub>	Body Diode Reverse Recovery Charge	I <sub>F</sub> =-4A, dI/dt=100A/μs		13.8		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 ≤ 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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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

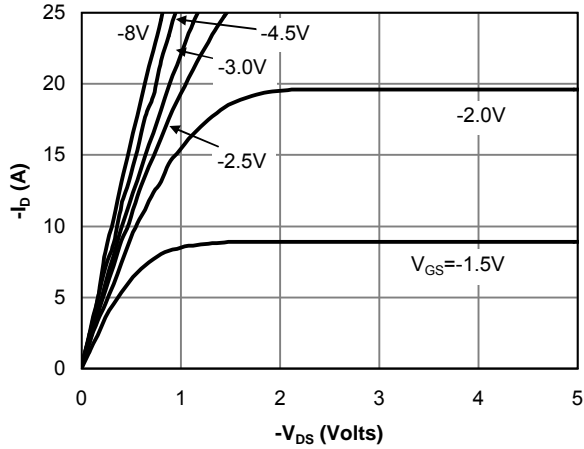


Fig 1: On-Region Characteristics

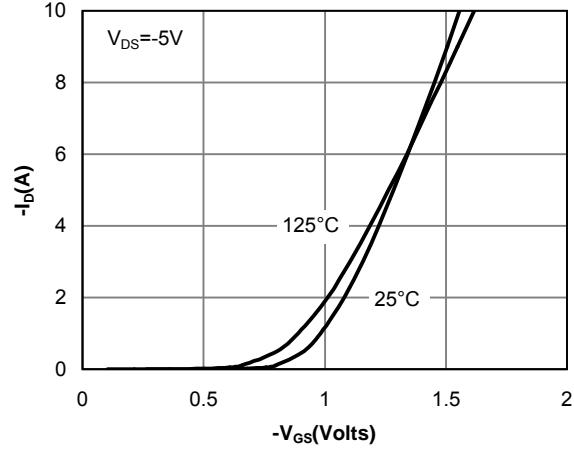


Figure 2: Transfer Characteristics

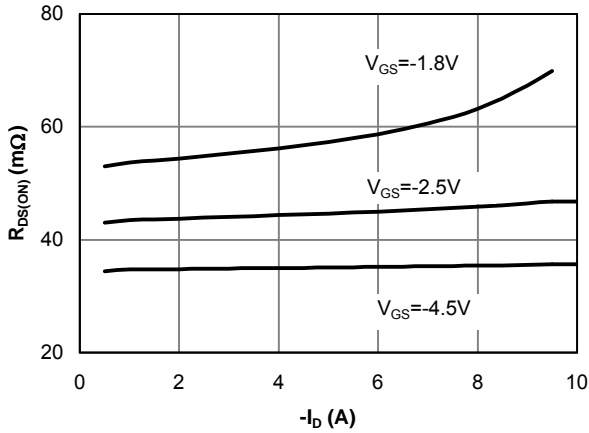


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

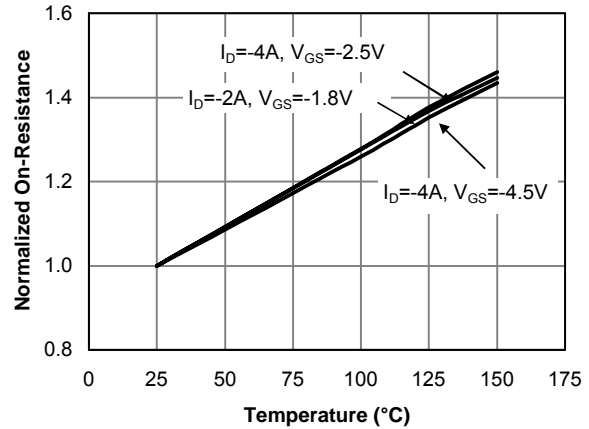


Figure 4: On-Resistance vs. Junction Temperature

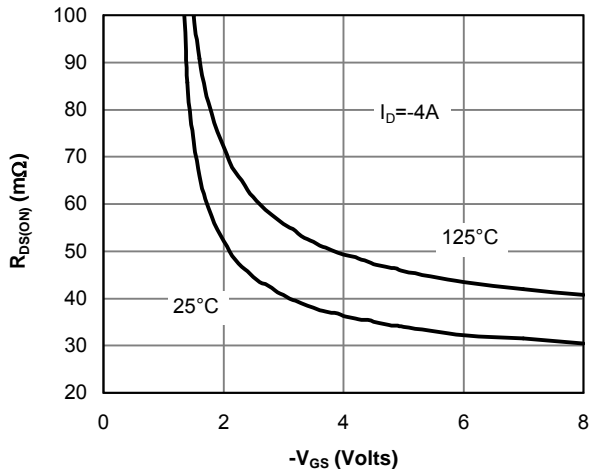


Figure 5: On-Resistance vs. Gate-Source Voltage

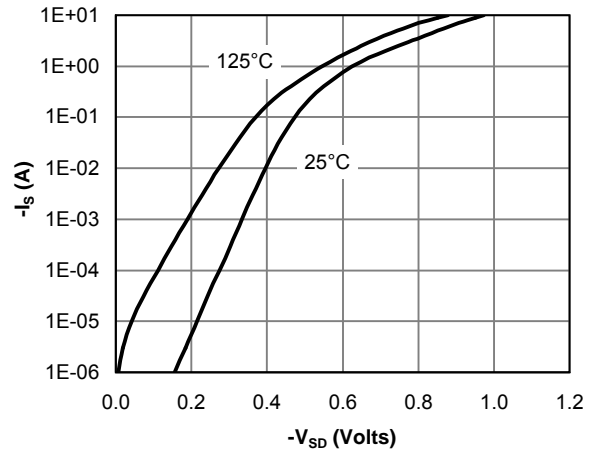


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

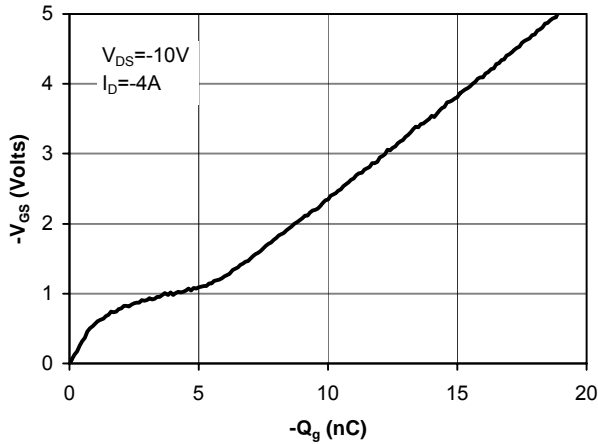


Figure 7: Gate-Charge Characteristics

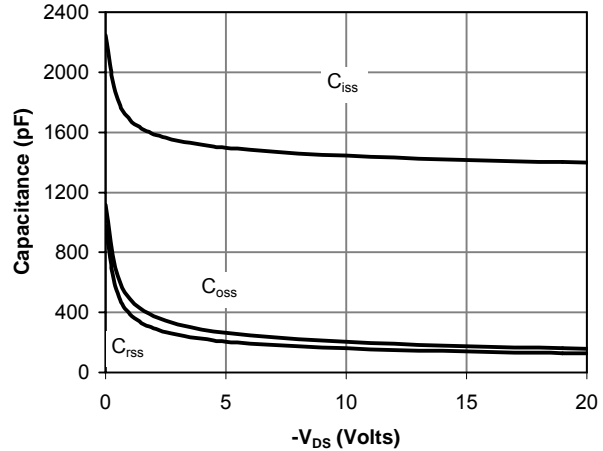


Figure 8: Capacitance Characteristics

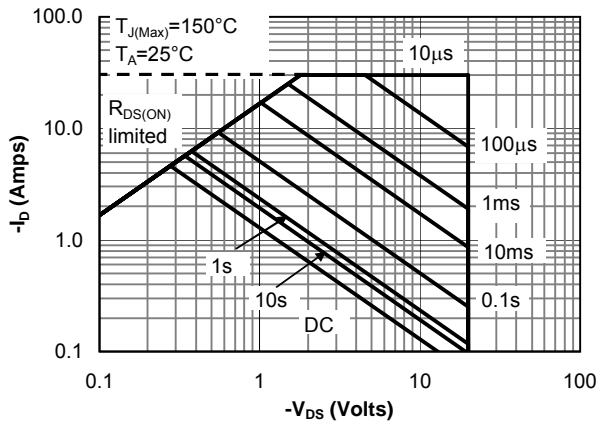


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

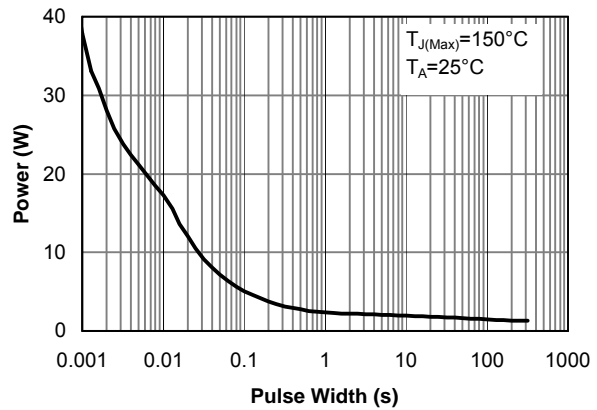


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

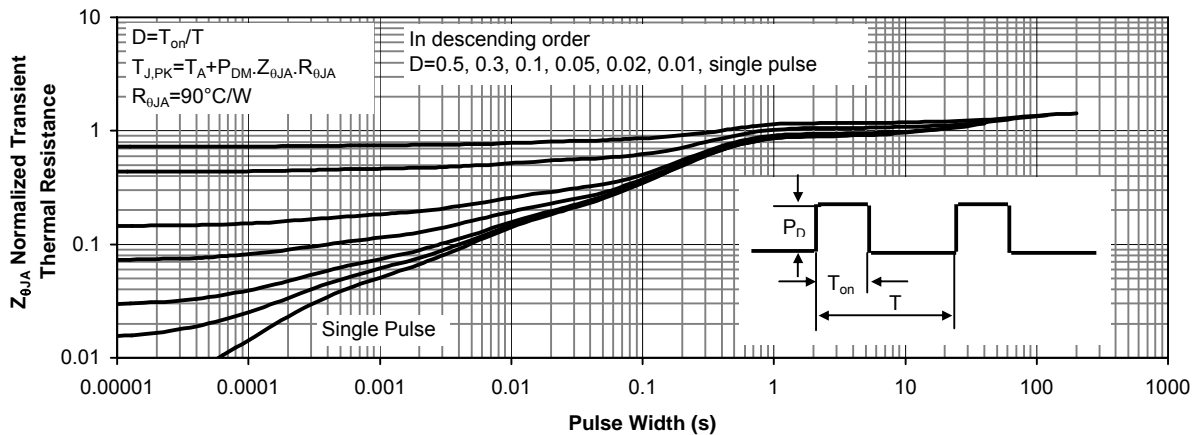


Figure 11: Normalized Maximum Transient Thermal Impedance