



ALPHA & OMEGA
SEMICONDUCTOR

AO3409

P-Channel Enhancement Mode Field Effect Transistor

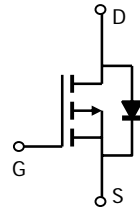
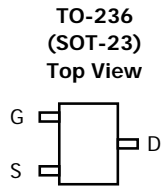


General Description

The AO3409 uses advanced trench technology to provide excellent $R_{DS(ON)}$ and low gate charge. This device is suitable for use as a load switch or in PWM applications. *Standard Product AO3409 is Pb-free (meets ROHS & Sony 259 specifications). AO3409L is a Green Product ordering option. AO3409 and AO3409L are electrically identical.*

Features

$V_{DS} (V) = -30V$
 $I_D = -2.6 A (V_{GS} = -10V)$
 $R_{DS(ON)} < 130m\Omega (V_{GS} = -10V)$
 $R_{DS(ON)} < 200m\Omega (V_{GS} = -4.5V)$



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

Parameter	Symbol	Maximum	Units
Drain-Source Voltage	V_{DS}	-30	V
Gate-Source Voltage	V_{GS}	± 20	V
Continuous Drain Current ^A	$T_A=25^\circ C$	-2.6	A
	$T_A=70^\circ C$	-2.2	
Pulsed Drain Current ^B	I_{DM}	-20	
Power Dissipation ^A	$T_A=25^\circ C$	1.4	W
	$T_A=70^\circ C$	1	
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 ^A	$R_{\theta JA}$	70	90	$^\circ C/W$
Maximum Junction-to-Ambient ^A		Steady-State	100	125
Maximum Junction-to-Lead ^C	$R_{\theta JL}$	63	80	$^\circ C/W$

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
STATIC PARAMETERS						
BV_{DSS}	Drain-Source Breakdown Voltage	$I_D=-250\mu\text{A}$, $V_{GS}=0\text{V}$	-30			V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS}=-24\text{V}$, $V_{GS}=0\text{V}$ $T_J=55^\circ\text{C}$			-1 -5	μA
I_{GSS}	Gate-Body leakage current	$V_{DS}=0\text{V}$, $V_{GS}=\pm 20\text{V}$			± 100	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}$, $I_D=-250\mu\text{A}$	-1	-1.9	-3	V
$I_{D(ON)}$	On state drain current	$V_{GS}=-4.5\text{V}$, $V_{DS}=-5\text{V}$	-5			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS}=-10\text{V}$, $I_D=-2.6\text{A}$ $T_J=125^\circ\text{C}$		97	130	$\text{m}\Omega$
		$V_{GS}=-4.5\text{V}$, $I_D=-2\text{A}$		135	150	$\text{m}\Omega$
g_{FS}	Forward Transconductance	$V_{DS}=-5\text{V}$, $I_D=-2.5\text{A}$	3	3.8		S
V_{SD}	Diode Forward Voltage	$I_S=-1\text{A}$, $V_{GS}=0\text{V}$		-0.82	-1	V
I_S	Maximum Body-Diode Continuous Current				-2	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	$V_{GS}=0\text{V}$, $V_{DS}=-15\text{V}$, $f=1\text{MHz}$		302	370	pF
C_{oss}	Output Capacitance			50.3		pF
C_{rss}	Reverse Transfer Capacitance			37.8		pF
R_g	Gate resistance	$V_{GS}=0\text{V}$, $V_{DS}=0\text{V}$, $f=1\text{MHz}$		12	18	Ω
SWITCHING PARAMETERS						
$Q_g(10)$	Total Gate Charge(10V)	$V_{GS}=-10\text{V}$, $V_{DS}=-15\text{V}$, $I_D=-2.6\text{A}$		6.8	9	nC
$Q_g(4.5)$	Total Gate Charge(4.5V)			2.4		nC
Q_{gs}	Gate Source Charge			1.6		nC
Q_{gd}	Gate Drain Charge			0.95		nC
$t_{D(on)}$	Turn-On DelayTime	$V_{GS}=-10\text{V}$, $V_{DS}=-15\text{V}$, $R_L=5.8\Omega$, $R_{GEN}=3\Omega$		7.5		ns
t_r	Turn-On Rise Time			3.2		ns
$t_{D(off)}$	Turn-Off DelayTime			17		ns
t_f	Turn-Off Fall Time			6.8		ns
t_{rr}	Body Diode Reverse Recovery Time	$I_F=-2.6\text{A}$, $dI/dt=100\text{A}/\mu\text{s}$		16.8	22	ns
Q_{rr}	Body Diode Reverse Recovery Charge	$I_F=-2.6\text{A}$, $dI/dt=100\text{A}/\mu\text{s}$		10		nC

A: The value of $R_{\theta JA}$ is measured with the device mounted on 1in² 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 $\leq 10\text{s}$ 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 6,12,14 are obtained using 80 μs pulses, duty cycle 0.5% max.

E: These tests are performed with the device mounted on 1 in² 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

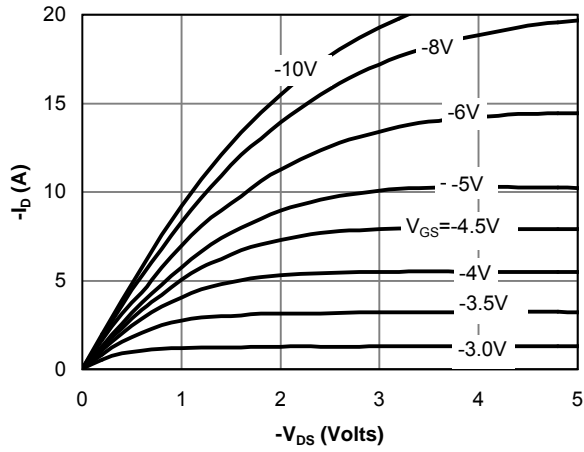


Fig 1: On-Region Characteristics

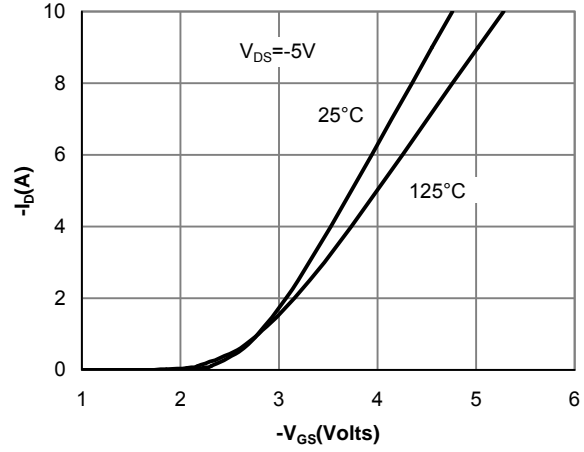


Figure 2: Transfer Characteristics

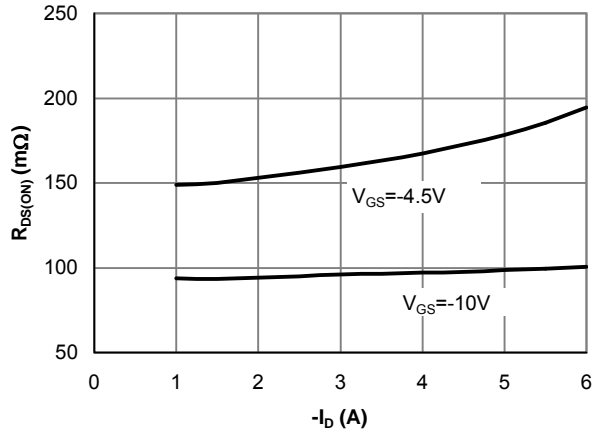


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

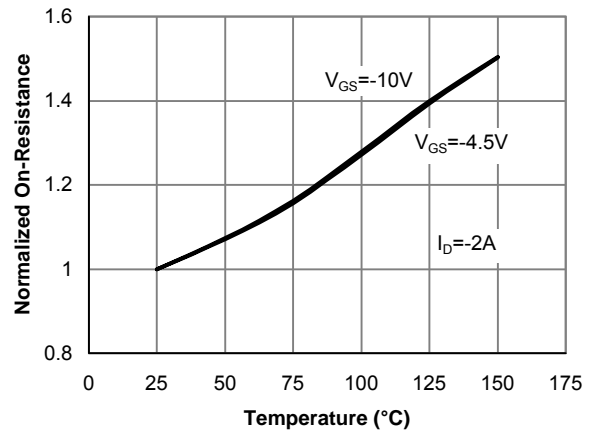


Figure 4: On-Resistance vs. Junction Temperature

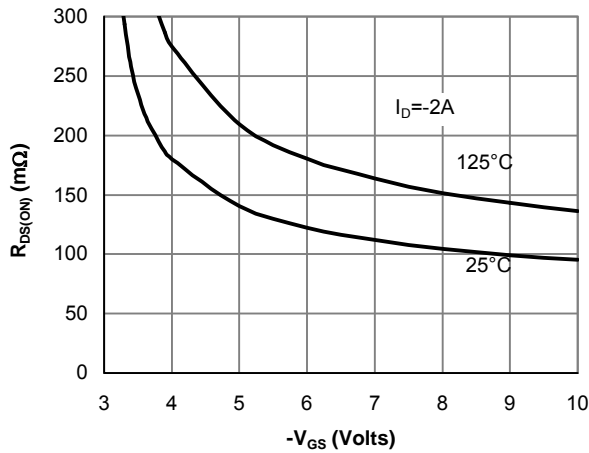


Figure 5: On-Resistance vs. Gate-Source Voltage

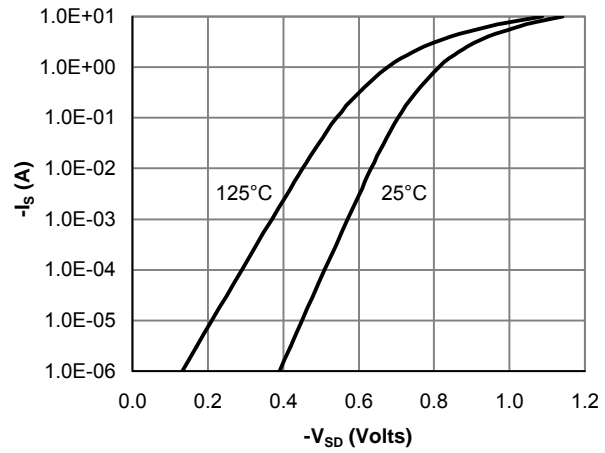


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

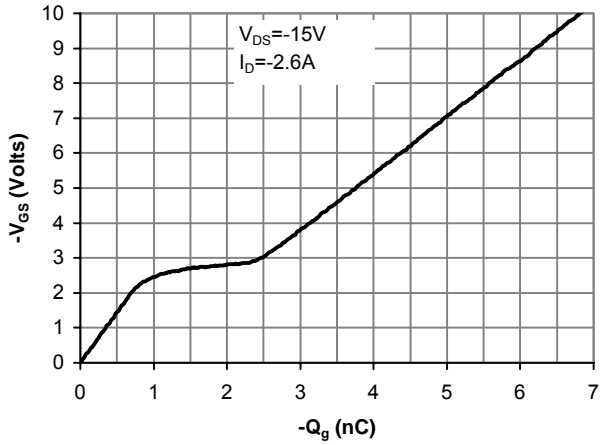


Figure 7: Gate-Charge Characteristics

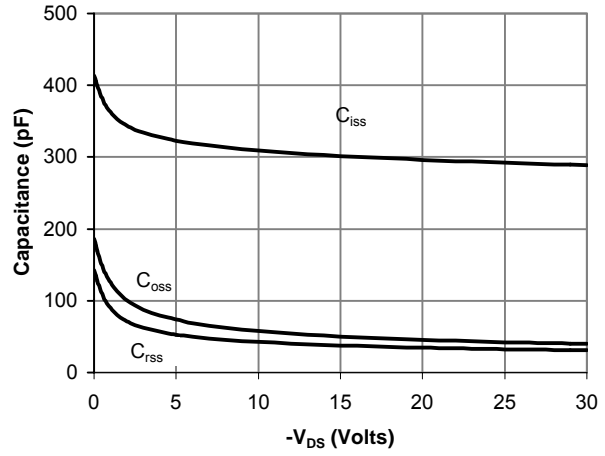


Figure 8: Capacitance Characteristics

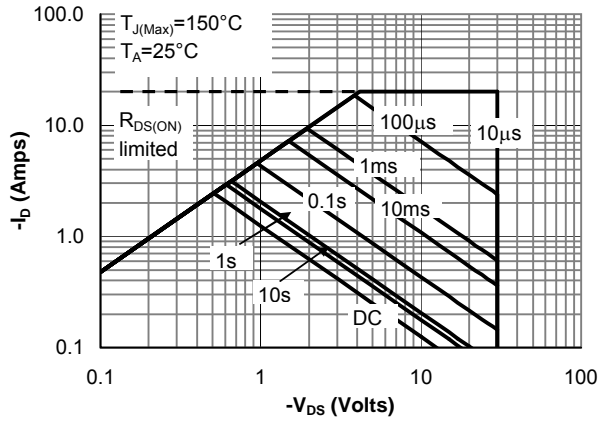


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

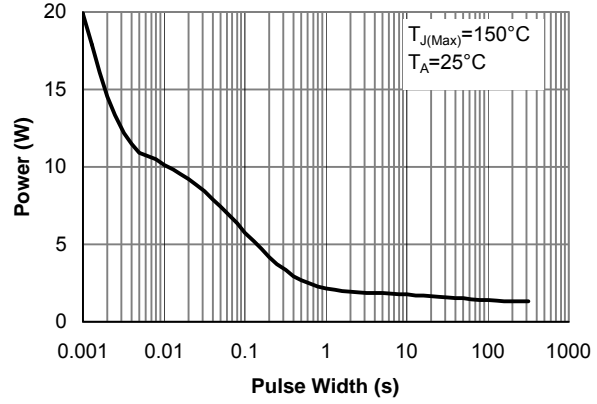


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

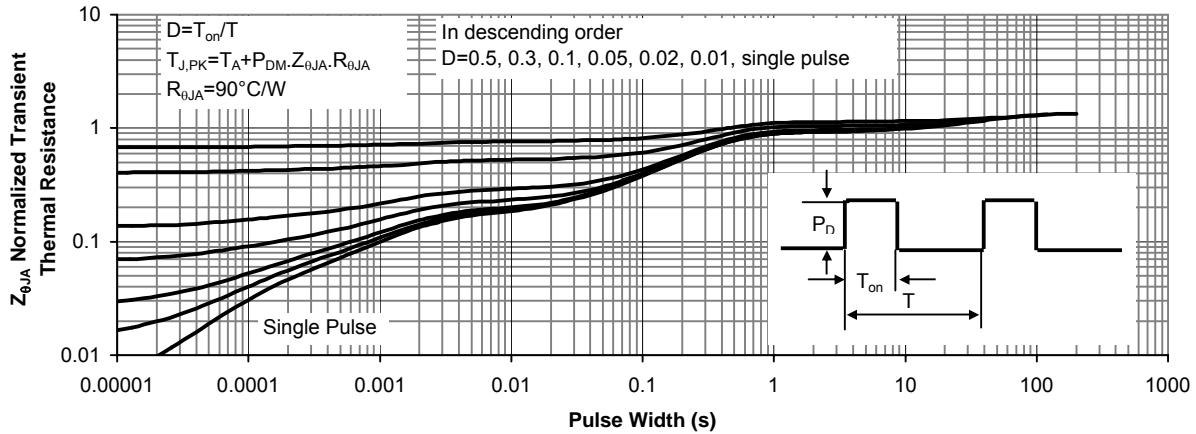


Figure 11: Normalized Maximum Transient Thermal Impedance