AO6409
20V P-Channel MOSFET

ALPHA & OMEGA SEMICONDUCTOR

General Description

The AO6409 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 applications.

Product Summary

V_{DS}	-20V
I_D (at V_{GS}=-4.5V)	-5.5A
$R_{DS(ON)}$ (at V_{GS}= -4.5V)	< 41mΩ
$R_{DS(ON)}$ (at V_{GS}= -2.5V)	< 53mΩ
$R_{DS(ON)}$ (at V_{GS}= -1.8V)	< 65mΩ

ESD Protected

Green Product

TSOP6

Top View   Bottom View

Top View

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D  1•   6  D
D  2    5  D
G  3    4  S
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Pin1
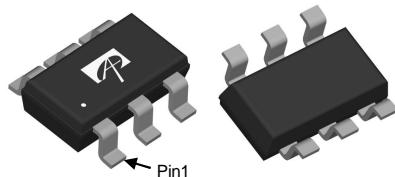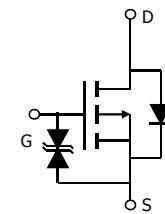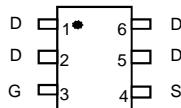
Absolute Maximum Ratings T_A=25°C unless otherwise noted

Parameter		Symbol	Maximum	Units
Drain-Source Voltage		V_{DS}	-20	V
Gate-Source Voltage		V_{GS}	±8	V
Continuous Drain Current	T_A=25°C	I_D	-5.5	A
	T_A=70°C		-4.2	
Pulsed Drain Current [C]		I_{DM}	-30	
Power Dissipation [B]	T_A=25°C	P_D	2.1	W
	T_A=70°C		1.3	
Junction and Storage Temperature Range		T_J, T_{STG}	-55 to 150	°C

Thermal Characteristics

Parameter		Symbol	Typ	Max	Units
Maximum Junction-to-Ambient [A]	t ≤ 10s	$R_{\theta JA}$	48	60	°C/W
Maximum Junction-to-Ambient [A D]	Steady-State		75	90	°C/W
Maximum Junction-to-Lead	Steady-State	$R_{\theta JL}$	37	45	°C/W

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Electrical Characteristics (T$_J$=25°C unless otherwise noted)

Symbol	Parameter	Conditions		Min	Typ	Max	Units
STATIC PARAMETERS							
BV$_{DSS}$	Drain-Source Breakdown Voltage	I$_D$=-250µA, V$_{GS}$=0V		-20			V
I$_{DSS}$	Zero Gate Voltage Drain Current	V$_{DS}$=-20V, V$_{GS}$=0V				-1	µA
			T$_J$=55°C			-5	
I$_{GSS}$	Gate-Body leakage current	V$_{DS}$=0V, V$_{GS}$= ±8V				±10	µA
V$_{GS(th)}$	Gate Threshold Voltage	V$_{DS}$=V$_{GS}$, I$_D$=-250µA		-0.3	-0.57	-0.9	V
I$_{D(ON)}$	On state drain current	V$_{GS}$=-4.5V, V$_{DS}$=-5V		-30			A
R$_{DS(ON)}$	Static Drain-Source On-Resistance	V$_{GS}$=-4.5V, I$_D$=-5.5A			34	41	mΩ
			T$_J$=125°C		49	59	
		V$_{GS}$=-2.5V, I$_D$=-4A			42	53	mΩ
		V$_{GS}$=-1.8V, I$_D$=-2A			52	65	mΩ
g$_{FS}$	Forward Transconductance	V$_{DS}$=-5V, I$_D$=-5.5A			20		S
V$_{SD}$	Diode Forward Voltage	I$_S$=-1A, V$_{GS}$=0V			-0.64	-1	V
I$_S$	Maximum Body-Diode Continuous Current					-2	A
DYNAMIC PARAMETERS							
C$_{iss}$	Input Capacitance	V$_{GS}$=0V, V$_{DS}$=-10V, f=1MHz		600	751	905	pF
C$_{oss}$	Output Capacitance			80	115	150	pF
C$_{rss}$	Reverse Transfer Capacitance			48	80	115	pF
R$_g$	Gate resistance	V$_{GS}$=0V, V$_{DS}$=0V, f=1MHz		6	13	20	Ω
SWITCHING PARAMETERS							
Q$_g$	Total Gate Charge	V$_{GS}$=-4.5V, V$_{DS}$=-10V, I$_D$=-5.5A		7.4	9.3	11	nC
Q$_{gs}$	Gate Source Charge			0.8	1	1.2	nC
Q$_{gd}$	Gate Drain Charge			1.3	2.2	3.1	nC
t$_{D(on)}$	Turn-On DelayTime	V$_{GS}$=-4.5V, V$_{DS}$=-10V, R$_L$=1.8Ω, R$_{GEN}$=3Ω			13		ns
t$_r$	Turn-On Rise Time				9		ns
t$_{D(off)}$	Turn-Off DelayTime				19		ns
t$_f$	Turn-Off Fall Time				29		ns
t$_{rr}$	Body Diode Reverse Recovery Time	I$_F$=-5.5A, dI/dt=500A/µs		20	26	32	ns
Q$_{rr}$	Body Diode Reverse Recovery Charge	I$_F$=-5.5A, dI/dt=500A/µs		40	51	62	nC

A. The value of R$_{θJA}$ is measured with the device mounted on 1in² FR-4 board with 2oz. Copper, in a still air environment with T$_A$ =25° C. The value in any given application depends on the user's specific board design.
B. The power dissipation P$_D$ is based on T$_{J(MAX)}$=150° C, using ≤ 10s junction-to-ambient thermal resistance.
C. Repetitive rating, pulse width limited by junction temperature T$_{J(MAX)}$=150° C. Ratings are based on low frequency and duty cycles to keep initialT$_J$=25° C.
D. The R$_{θJA}$ is the sum of the thermal impedance from junction to lead R$_{θJL}$ and lead to ambient.
E. The static characteristics in Figures 1 to 6 are obtained using <300µs pulses, duty cycle 0.5% max.
F. These curves are based on the junction-to-ambient thermal impedance which is measured with the device mounted on 1in² FR-4 board with 2oz. Copper, assuming a maximum junction temperature of T$_{J(MAX)}$=150° C. The SOA curve provides a single pulse rating.

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS
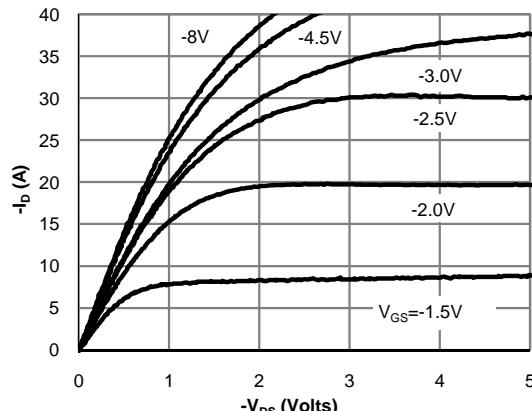
Fig 1: On-Region Characteristics (Note E)
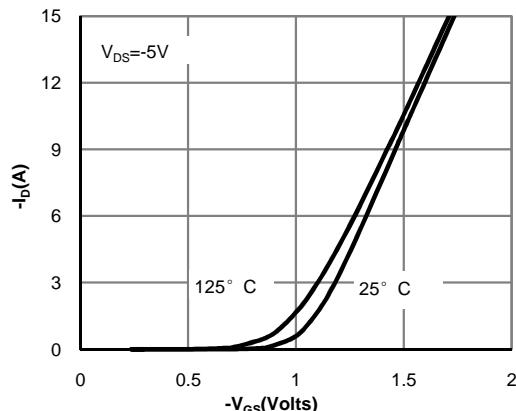
Figure 2: Transfer Characteristics (Note E)
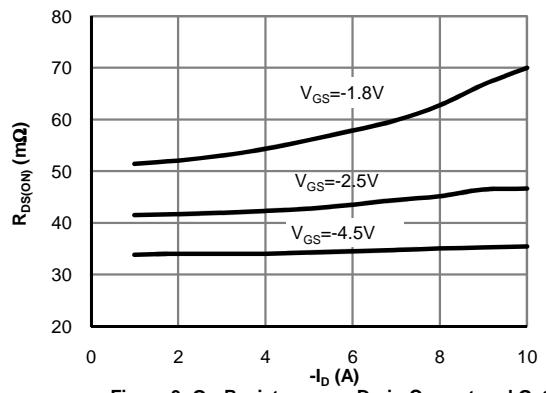
Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)
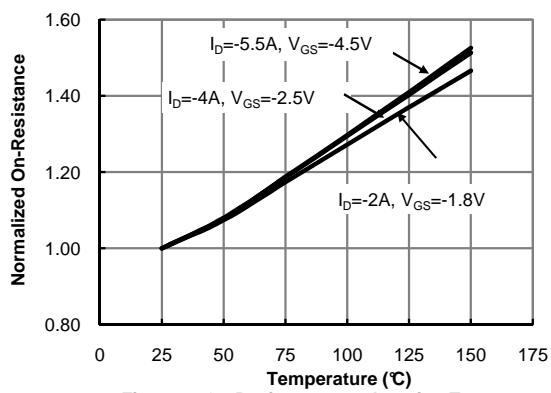
Figure 4: On-Resistance vs. Junction Temperature (Note E)
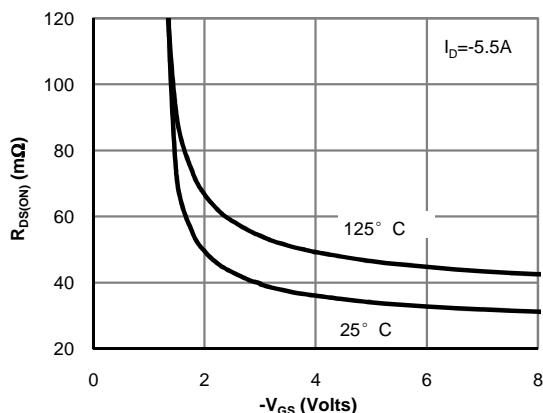
Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)
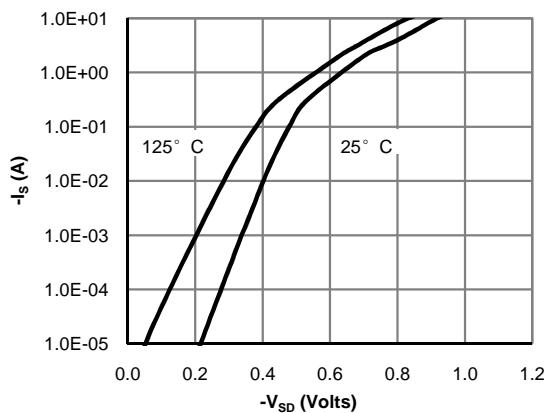
Figure 6: Body-Diode Characteristics (Note E)

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

Figure 7: Gate-Charge Characteristics

Figure 8: Capacitance Characteristics

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

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

Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)
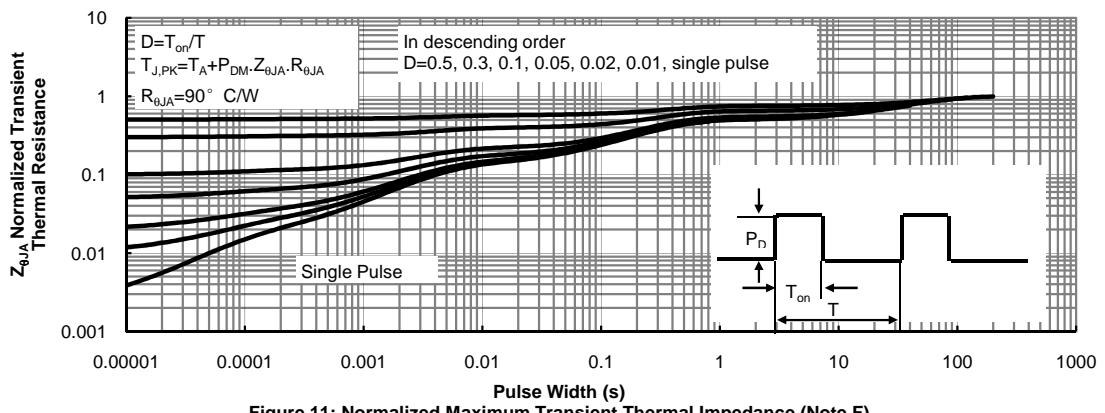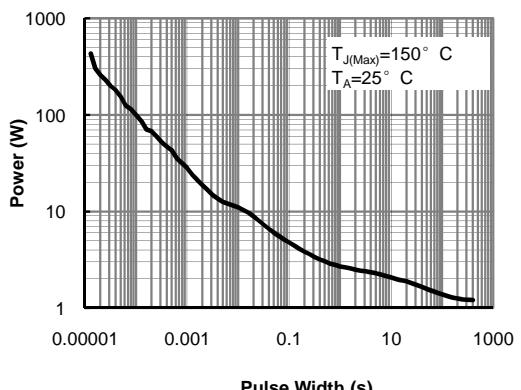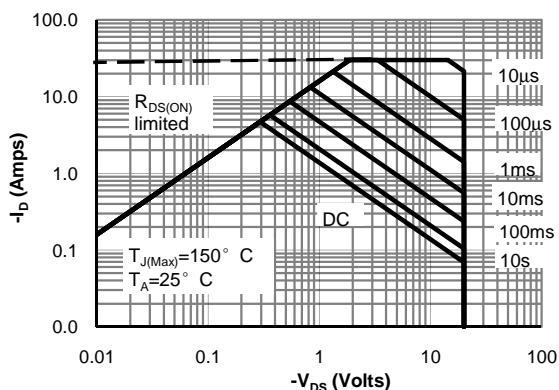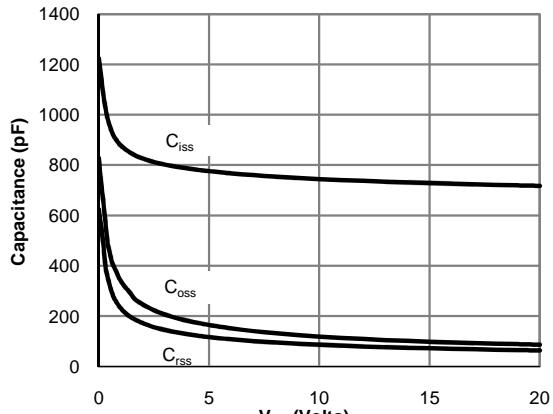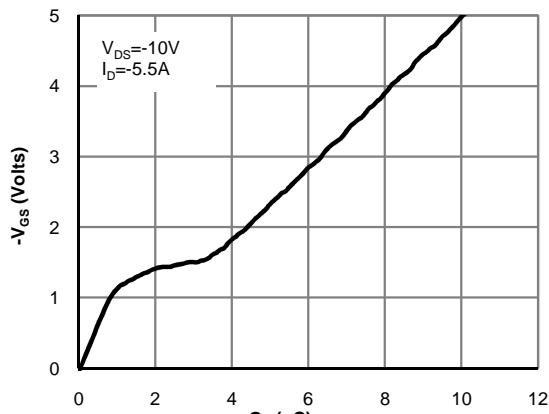
Gate Charge Test Circuit & Waveform
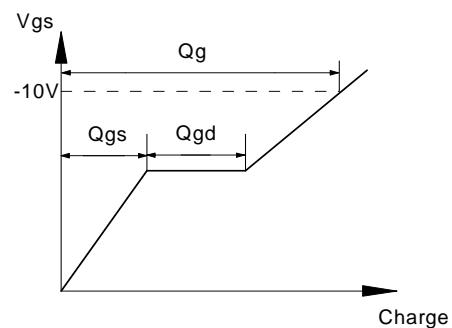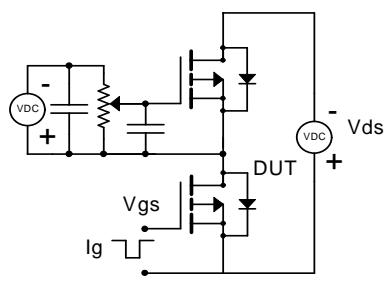
Resistive Switching Test Circuit & Waveforms
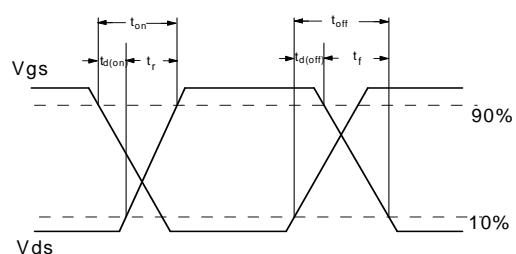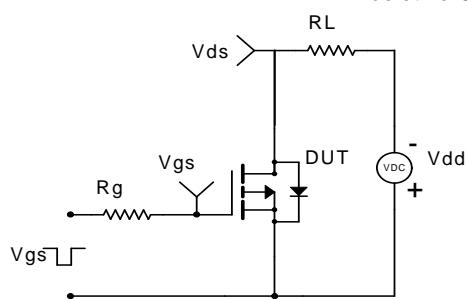
Diode Recovery Test Circuit & Waveforms

$$Q_{rr} = -\int Idt$$
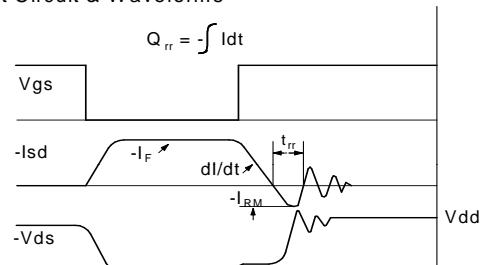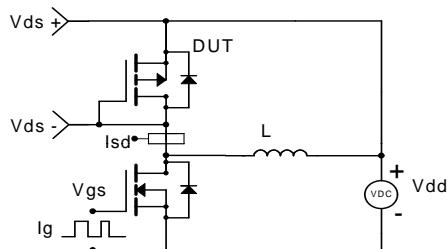
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