



# AO6409

## 20V P-Channel MOSFET

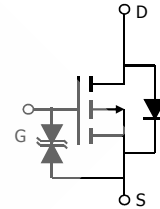
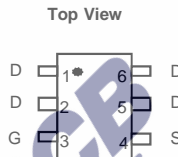
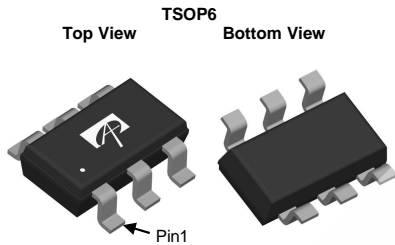
### General Description

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 $V_{GS}=-4.5V$ )	< 41m $\Omega$
$R_{DS(ON)}$ (at $V_{GS}=-2.5V$ )	< 53m $\Omega$
$R_{DS(ON)}$ (at $V_{GS}=-1.8V$ )	< 65m $\Omega$

ESD Protected



### Absolute Maximum Ratings $T_A=25^\circ\text{C}$ 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	$I_D$	$T_A=25^\circ\text{C}$	-5.5
		$T_A=70^\circ\text{C}$	-4.2
Pulsed Drain Current <sup>C</sup>	$I_{DM}$	-30	A
Power Dissipation <sup>B</sup>	$P_D$	$T_A=25^\circ\text{C}$	2.1
		$T_A=70^\circ\text{C}$	1.3
Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 to 150	$^\circ\text{C}$

### Thermal Characteristics

Parameter		Symbol	Typ	Max	Units
Maximum Junction-to-Ambient <sup>A</sup>	$t \leq 10s$	$R_{\theta JA}$	48	60	$^\circ\text{C/W}$
	Steady-State		75	90	$^\circ\text{C/W}$
Maximum Junction-to-Lead	Steady-State	$R_{\theta JL}$	37	45	$^\circ\text{C/W}$

**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> =-20V, 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> = ±8V			±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	-0.57	-0.9	V
I <sub>D(ON)</sub>	On state drain current	V <sub>GS</sub> =-4.5V, V <sub>DS</sub> =-5V	-30			A
R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-5.5A T <sub>J</sub> =125°C		34 49	41 59	mΩ
		V <sub>GS</sub> =-2.5V, I <sub>D</sub> =-4A		42	53	mΩ
		V <sub>GS</sub> =-1.8V, I <sub>D</sub> =-2A		52	65	mΩ
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> =-5V, I <sub>D</sub> =-5.5A		20		S
V <sub>SD</sub>	Diode Forward Voltage	I <sub>S</sub> =-1A, V <sub>GS</sub> =0V		-0.64	-1	V
I <sub>S</sub>	Maximum Body-Diode Continuous Current				-2	A
<b>DYNAMIC PARAMETERS</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> =0V, V <sub>DS</sub> =-10V, f=1MHz	600	751	905	pF
C <sub>oss</sub>	Output Capacitance		80	115	150	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		48	80	115	pF
R <sub>g</sub>	Gate resistance	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz	6	13	20	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> =-5.5A	7.4	9.3	11	nC
Q <sub>gs</sub>	Gate Source Charge		0.8	1	1.2	nC
Q <sub>gd</sub>	Gate Drain Charge		1.3	2.2	3.1	nC
t <sub>D(on)</sub>	Turn-On DelayTime	V <sub>GS</sub> =-4.5V, V <sub>DS</sub> =-10V, R <sub>L</sub> =1.8Ω, R <sub>GEN</sub> =3Ω		13		ns
t <sub>r</sub>	Turn-On Rise Time			9		ns
t <sub>D(off)</sub>	Turn-Off DelayTime			19		ns
t <sub>f</sub>	Turn-Off Fall Time			29		ns
t <sub>rr</sub>	Body Diode Reverse Recovery Time	I <sub>F</sub> =-5.5A, di/dt=500A/μs	20	26	32	ns
Q <sub>rr</sub>	Body Diode Reverse Recovery Charge	I <sub>F</sub> =-5.5A, di/dt=500A/μs	40	51	62	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 given application depends on the user's specific board design.

B. The power dissipation P<sub>D</sub> is based on T<sub>J(MAX)</sub>=150° C, using ≤ 10s junction-to-ambient thermal resistance.

C. Repetitive rating, pulse width limited by junction temperature T<sub>J(MAX)</sub>=150° C. Ratings are based on low frequency and duty cycles to keep initial T<sub>J</sub>=25° C.

D. The R<sub>θJA</sub> is the sum of the thermal impedance from junction to lead R<sub>θJL</sub> 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 1in<sup>2</sup> FR-4 board with 2oz. Copper, assuming a maximum junction temperature of T<sub>J(MAX)</sub>=150° C. The SOA curve provides a single pulse rating.

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**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**

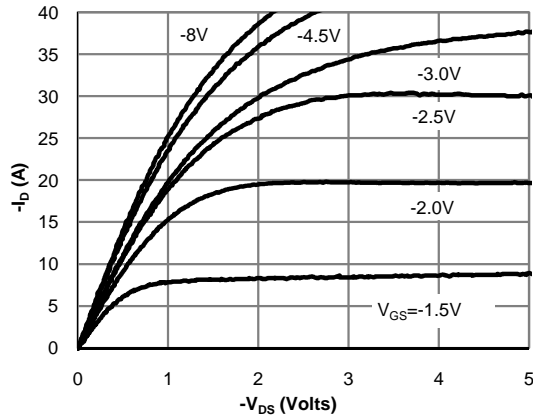


Fig 1: On-Region Characteristics (Note E)

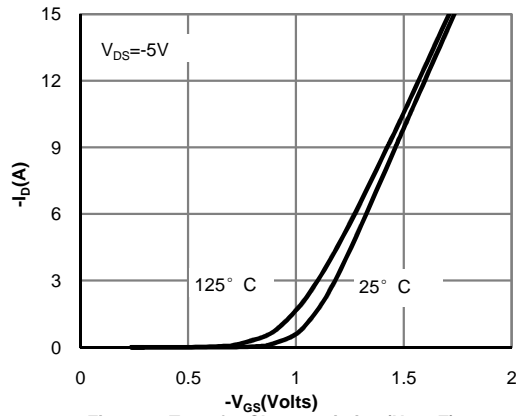


Figure 2: Transfer Characteristics (Note E)

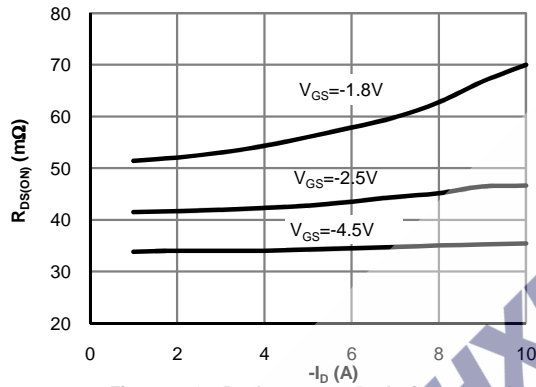


Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)

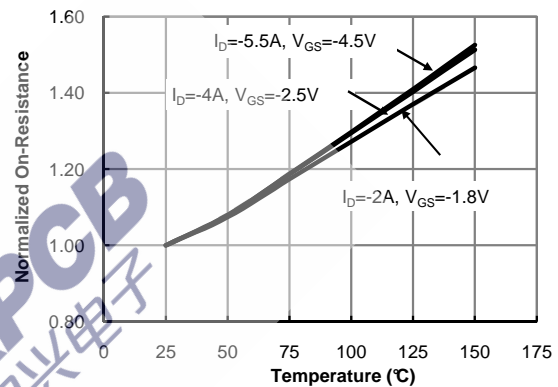


Figure 4: On-Resistance vs. Junction Temperature (Note E)

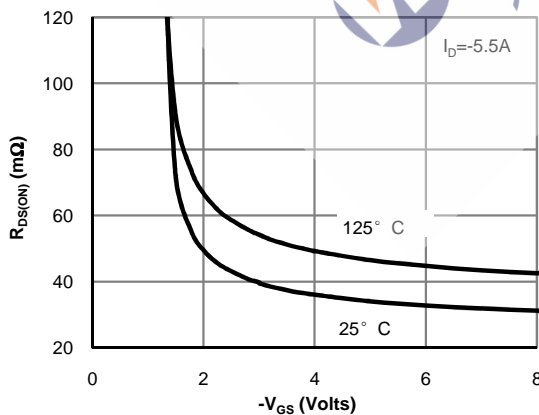


Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)

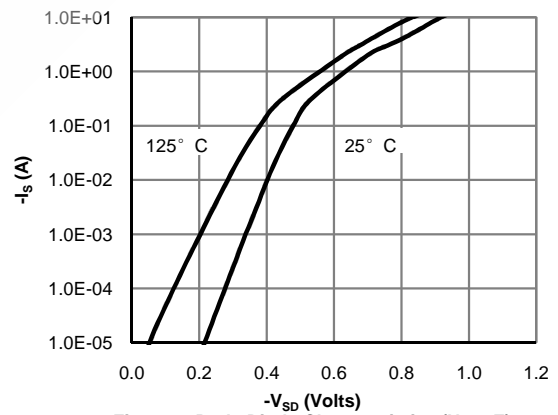


Figure 6: Body-Diode Characteristics (Note E)

**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**

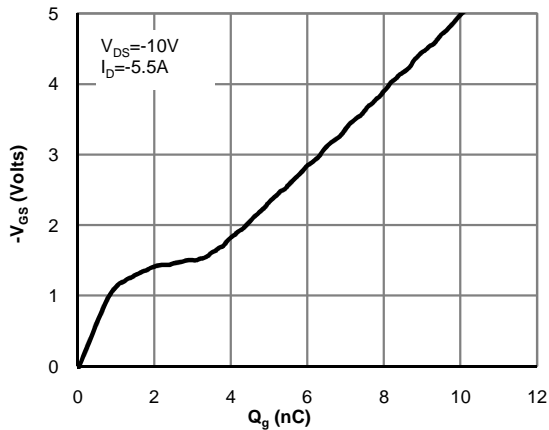


Figure 7: Gate-Charge Characteristics

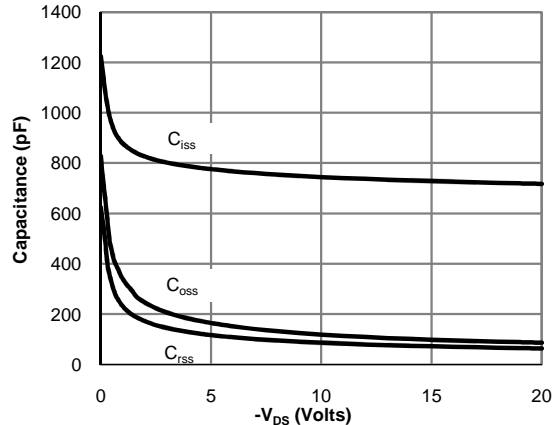


Figure 8: Capacitance Characteristics

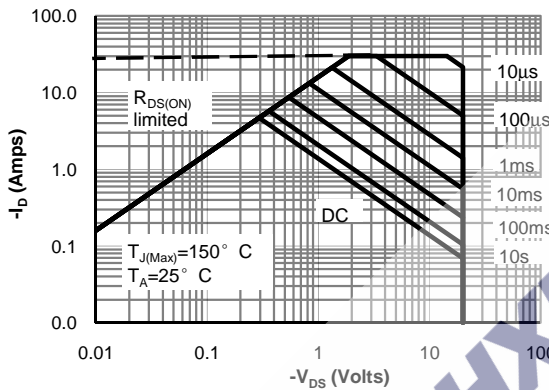


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

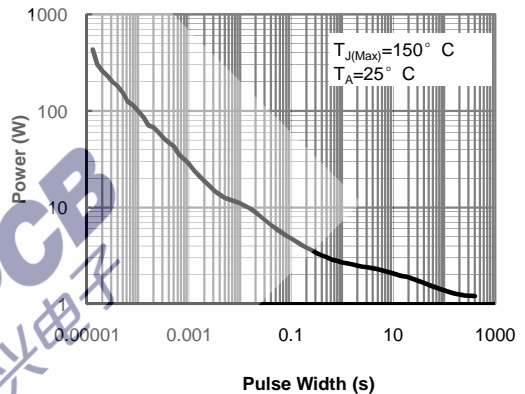


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note F)

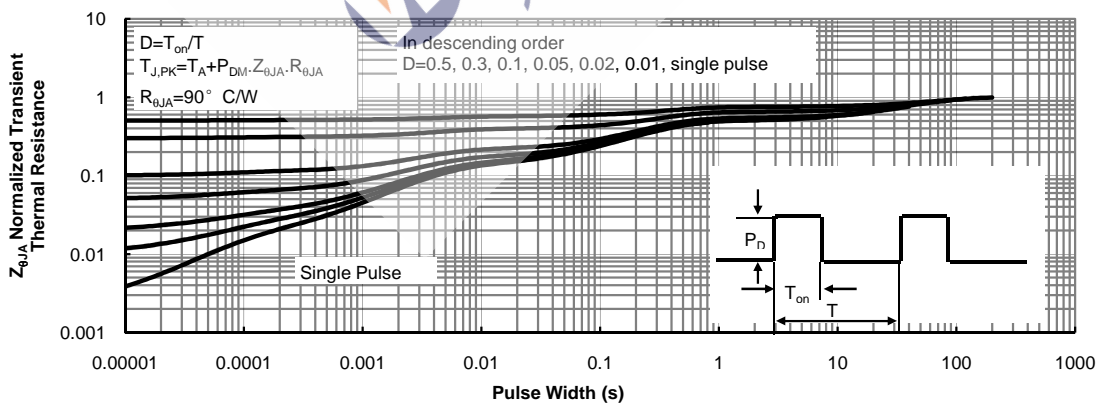
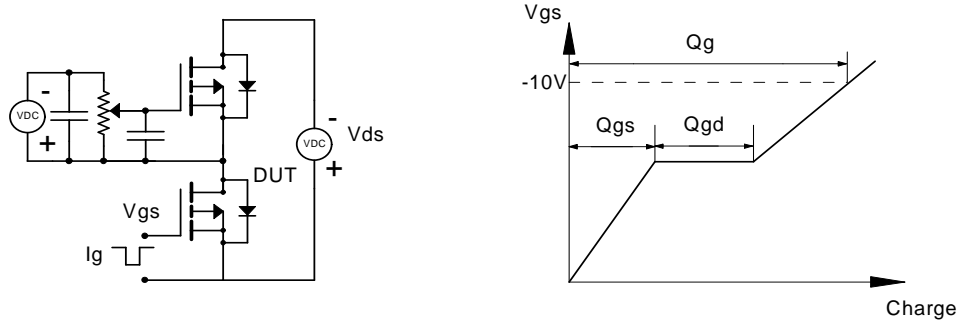
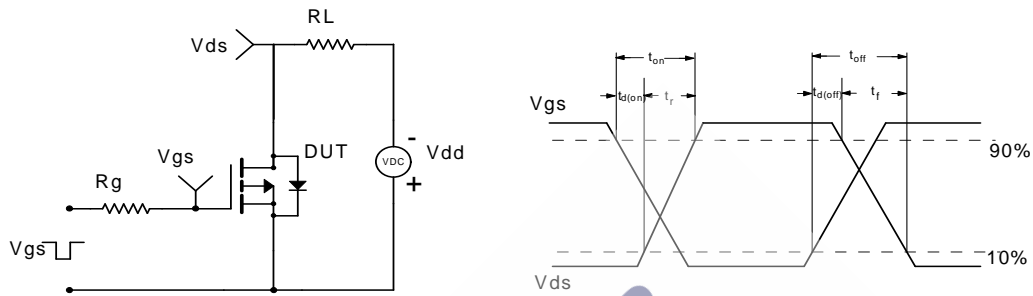


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms

