



ALPHA & OMEGA
SEMICONDUCTOR

AO6405

P-Channel Enhancement Mode Field Effect Transistor



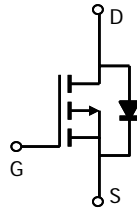
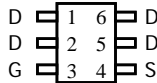
General Description

The AO6405 uses advanced trench technology to provide excellent $R_{DS(ON)}$ with low gate charge. This device is suitable for use as a load switch or in PWM applications. *Standard Product AO6405 is Pb-free (meets ROHS & Sony 259 specifications). AO6405L is a Green Product ordering option. AO6405 and AO6405L are electrically identical.*

Features

$V_{DS} (V) = -30V$
 $I_D = -5 A (V_{GS} = -10V)$
 $R_{DS(ON)} < 52m\Omega (V_{GS} = -10V)$
 $R_{DS(ON)} < 87m\Omega (V_{GS} = -4.5V)$

TSOP6
Top View



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 | $T_A=25^\circ C$ $T_A=70^\circ C$ | I_D | A |
| | | | |
| Pulsed Drain Current ^B | I_{DM} | -20 | |
| Power Dissipation ^A | $T_A=25^\circ C$ $T_A=70^\circ C$ | P_D | W |
| | | | |
| 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 | $R_{\theta JA}$ | 47.5 | 62.5 | $^\circ C/W$ |
| Maximum Junction-to-Ambient ^A | | Steady-State | 74 | |
| Maximum Junction-to-Lead ^C | $R_{\theta JL}$ | 37 | 50 | $^\circ C/W$ |

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 | -1.8 | -3 | V |
| $I_{D(ON)}$ | On state drain current | $V_{GS}=-4.5\text{V}$, $V_{DS}=-5\text{V}$ | -20 | | | A |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}=-10\text{V}$, $I_D=5.0\text{A}$ $T_J=125^\circ\text{C}$ | | 39 54 | 52 70 | m Ω |
| | | $V_{GS}=-4.5\text{V}$, $I_D=-4\text{A}$ | | 67 | 87 | m Ω |
| g_{FS} | Forward Transconductance | $V_{DS}=-5\text{V}$, $I_D=-5\text{A}$ | 6 | 8.6 | | S |
| V_{SD} | Diode Forward Voltage | $I_S=-1\text{A}$, $V_{GS}=0\text{V}$ | | -0.77 | -1 | V |
| I_S | Maximum Body-Diode Continuous Current | | | | -2.8 | A |
| DYNAMIC PARAMETERS | | | | | | |
| C_{iss} | Input Capacitance | $V_{GS}=0\text{V}$, $V_{DS}=-15\text{V}$, $f=1\text{MHz}$ | | 700 | 840 | pF |
| C_{oss} | Output Capacitance | | | 120 | | pF |
| C_{riss} | Reverse Transfer Capacitance | | | 75 | | pF |
| R_g | Gate resistance | $V_{GS}=0\text{V}$, $V_{DS}=0\text{V}$, $f=1\text{MHz}$ | | 10 | 15 | Ω |
| SWITCHING PARAMETERS | | | | | | |
| $Q_g(10\text{V})$ | Total Gate Charge (10V) | $V_{GS}=-10\text{V}$, $V_{DS}=-15\text{V}$, $I_D=-5\text{A}$ | | 14.7 | 18 | nC |
| $Q_g(4.5\text{V})$ | Total Gate Charge (4.5V) | | | 7.6 | 9.5 | nC |
| Q_{gs} | Gate Source Charge | | | 2 | | nC |
| Q_{gd} | Gate Drain Charge | | | 3.8 | | nC |
| $t_{D(on)}$ | Turn-On Delay Time | $V_{GS}=-10\text{V}$, $V_{DS}=-15\text{V}$, $R_L=3\Omega$, $R_{GEN}=3\Omega$ | | 8.3 | | ns |
| t_r | Turn-On Rise Time | | | 5 | | ns |
| $t_{D(off)}$ | Turn-Off Delay Time | | | 29 | | ns |
| t_f | Turn-Off Fall Time | | | 14 | | ns |
| t_{rr} | Body Diode Reverse Recovery Time | $I_F=-5\text{A}$, $dI/dt=100\text{A}/\mu\text{s}$ | | 23.5 | 30 | ns |
| Q_{rr} | Body Diode Reverse Recovery Charge | $I_F=-5\text{A}$, $dI/dt=100\text{A}/\mu\text{s}$ | | 13.4 | | 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 $t \leq 10\text{s}$ 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

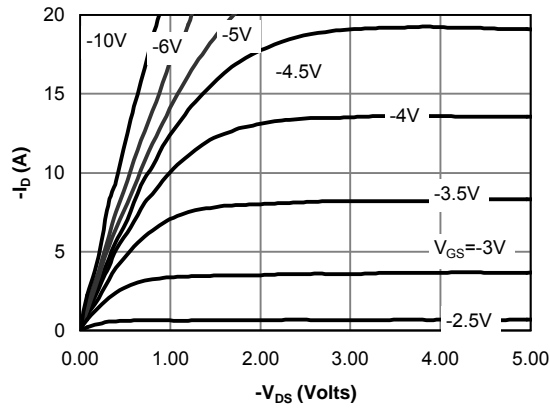


Figure 1: On-Region Characteristics

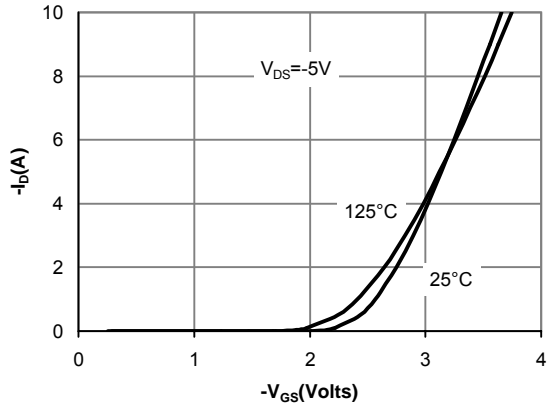


Figure 2: Transfer Characteristics

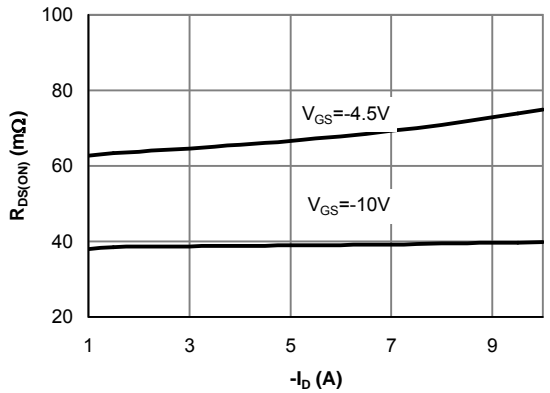


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

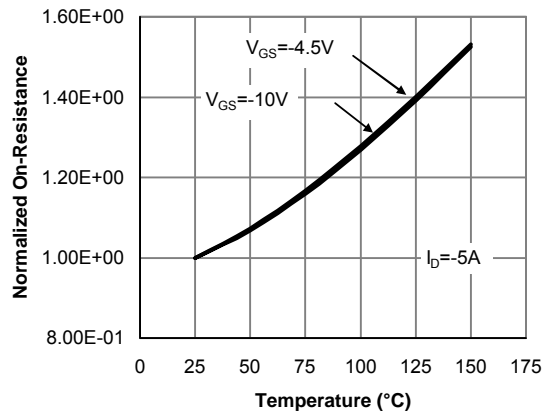


Figure 4: On-Resistance vs. Junction Temperature

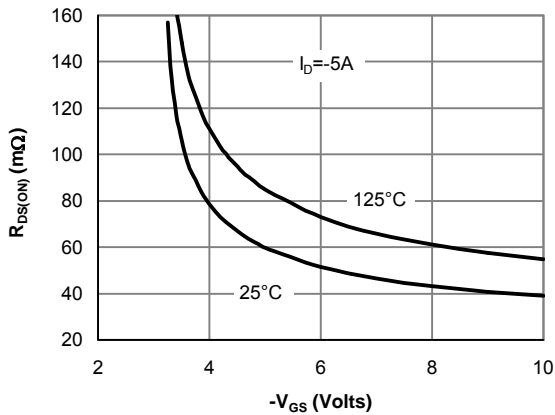


Figure 5: On-Resistance vs. Gate-Source Voltage

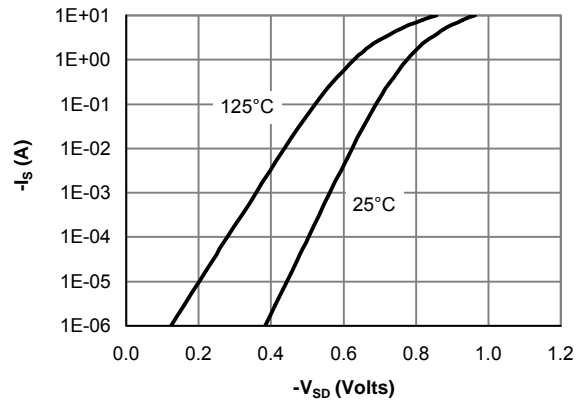


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

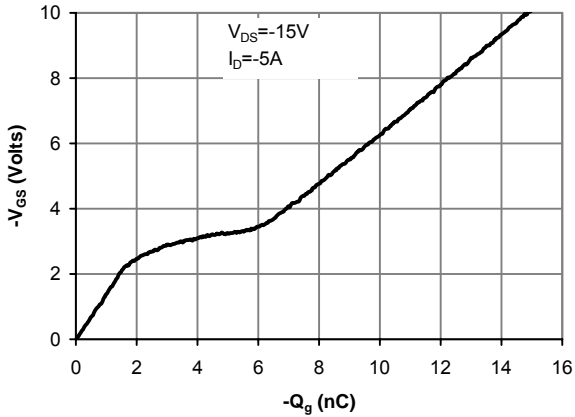


Figure 7: Gate-Charge Characteristics

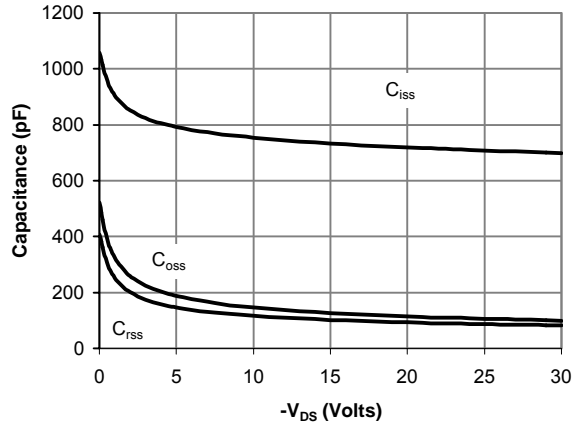


Figure 8: Capacitance Characteristics

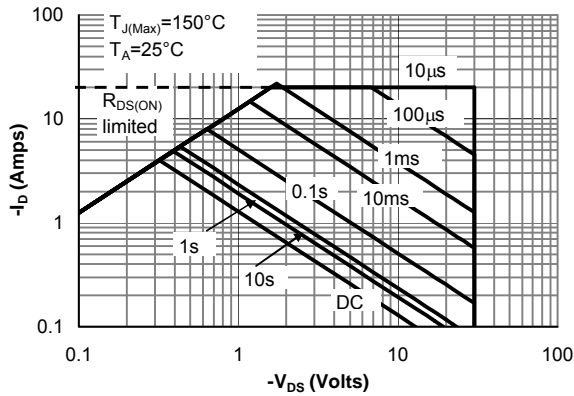


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

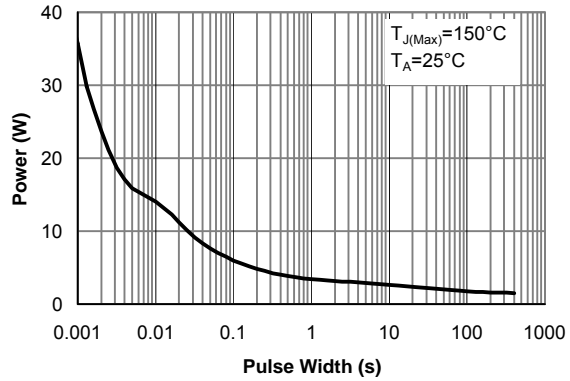


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

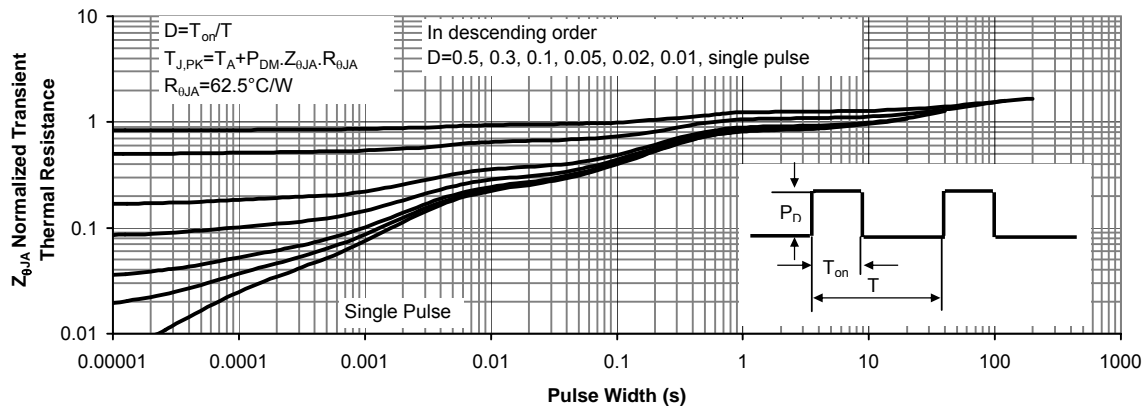


Figure 11: Normalized Maximum Transient Thermal Impedance