ALPHA & OMEGA SEMICONDUCTOR

# AO7405

## 30V P-Channel MOSFET

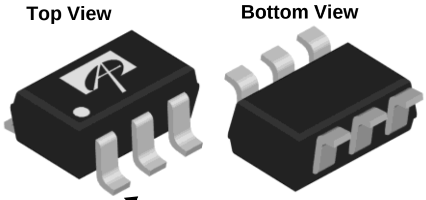
## General Description

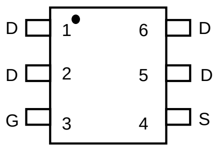
The AO7405 uses advanced trench technology to provide excellent $R_{DS(ON)}$, low gate charge, and operation with gate voltages as low as 2.5V, in the small SOT363 footprint. It can be used for a wide variety of applications, including load switching, low current inverters and low current DC-DC converters.

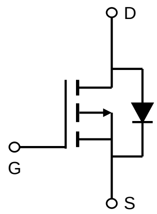
## Product Summary

| | |
|---|---|
| $V_{DS}$ | -30V |
| $I_D$ (at $V_{GS}$=-10V) | -1.4A |
| $R_{DS(ON)}$ (at $V_{GS}$=-10V) | < 115mΩ |
| $R_{DS(ON)}$ (at $V_{GS}$ =-4.5V) | < 140mΩ |
| $R_{DS(ON)}$ (at $V_{GS}$ =-2.5V) | < 200mΩ |

SC70-6L
(SOT363)




| Absolute Maximum Ratings $T_A$=25°C unless otherwise noted | | | | |
|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Maximum** | **Units** |
| Drain-Source Voltage | | $V_{DS}$ | -30 | V |
| Gate-Source Voltage | | $V_{GS}$ | ±12 | V |
| Continuous Drain Current | $T_A$=25°C | $I_D$ | -1.4 | A |
| | $T_A$=70°C | | -1.0 | |
| Pulsed Drain Current [C] | | $I_{DM}$ | -10 | |
| Power Dissipation [B] | $T_A$=25°C | $P_D$ | 0.35 | W |
| | $T_A$=70°C | | 0.22 | |
| 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 | $R_{\theta JA}$ | 300 | 360 | °C/W |
| Maximum Junction-to-Ambient [A D] | Steady-State | | 340 | 425 | °C/W |
| Maximum Junction-to-Lead | Steady-State | $R_{\theta JL}$ | 280 | 320 | °C/W |

**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 | -30 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=-30V, $V_{GS}$=0V | | | -1 | µA |
| | | $T_J$=55°C | | | -5 | |
| $I_{GSS}$ | Gate-Body leakage current | $V_{DS}$=0V, $V_{GS}$= ±12V | | | ±100 | nA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$ $I_D$=-250µA | -0.6 | -1 | -1.4 | V |
| $I_{D(ON)}$ | On state drain current | $V_{GS}$=-10V, $V_{DS}$=-5V | -10 | | | A |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}$=-10V, $I_D$=-1.4A | | 92.5 | 115 | mΩ |
| | | $T_J$=125°C | | 130 | 160 | |
| | | $V_{GS}$=-4.5V, $I_D$=-1.2A | | 110 | 140 | mΩ |
| | | $V_{GS}$=-2.5V, $I_D$=-1A | | 150 | 200 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$=-5V, $I_D$=-1.4A | | 6 | | S |
| $V_{SD}$ | Diode Forward Voltage | $I_S$=-1A,$V_{GS}$=0V | | -0.78 | -1 | V |
| $I_S$ | Maximum Body-Diode Continuous Current | | | | -0.5 | A |
| **DYNAMIC PARAMETERS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=-15V, f=1MHz | | 260 | 315 | pF |
| $C_{oss}$ | Output Capacitance | | | 37 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 20 | | pF |
| $R_g$ | Gate resistance | $V_{GS}$=0V, $V_{DS}$=0V, f=1MHz | 4 | 8 | 12 | Ω |
| **SWITCHING PARAMETERS** | | | | | | |
| $Q_g$(10V) | Total Gate Charge | $V_{GS}$=-10V, $V_{DS}$=-15V, $I_D$=-1.4A | | 5.9 | 7.2 | nC |
| $Q_g$(4.5V) | Total Gate Charge | | | 2.8 | 3.5 | nC |
| $Q_{gs}$ | Gate Source Charge | | | 0.7 | | nC |
| $Q_{gd}$ | Gate Drain Charge | | | 1 | | nC |
| $t_{D(on)}$ | Turn-On DelayTime | $V_{GS}$=-10V, $V_{DS}$=-15V, $R_L$=10Ω, $R_{GEN}$=3Ω | | 6 | | ns |
| $t_r$ | Turn-On Rise Time | | | 3.5 | | ns |
| $t_{D(off)}$ | Turn-Off DelayTime | | | 20 | | ns |
| $t_f$ | Turn-Off Fall Time | | | 5 | | ns |
| $t_{rr}$ | Body Diode Reverse Recovery Time | $I_F$=-1.4A, dI/dt=100A/µs | | 11.5 | 15 | ns |
| $Q_{rr}$ | Body Diode Reverse Recovery Charge | $I_F$=-1.4A, dI/dt=100A/µs | | 4.5 | | 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° 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 initial$T_J$=25° C.
D. The $R_{\theta JA}$ is the sum of the thermal impedance from junction to lead $R_{\theta JL}$ 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

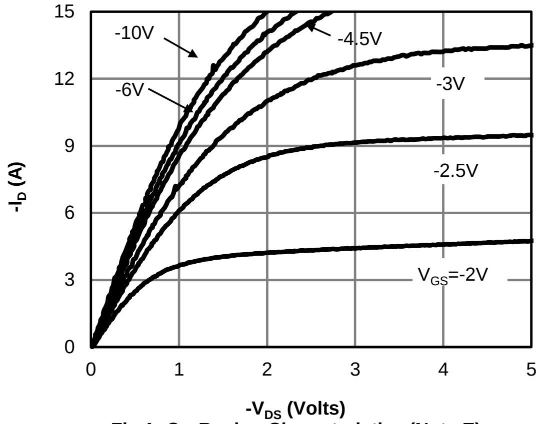



Fig 1: On-Region Characteristics (Note E)

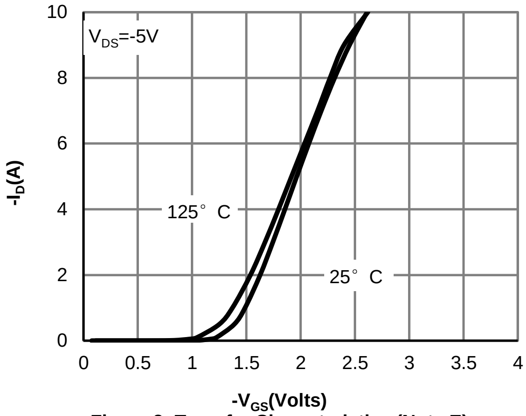



Figure 2: Transfer Characteristics (Note E)

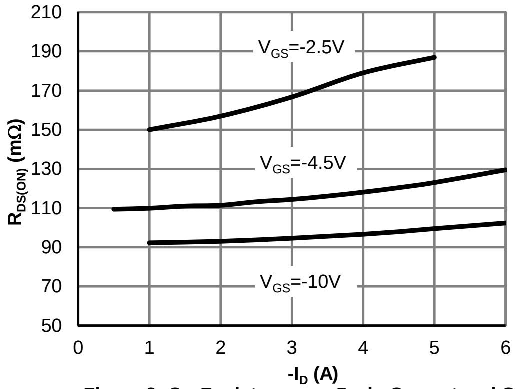



Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)

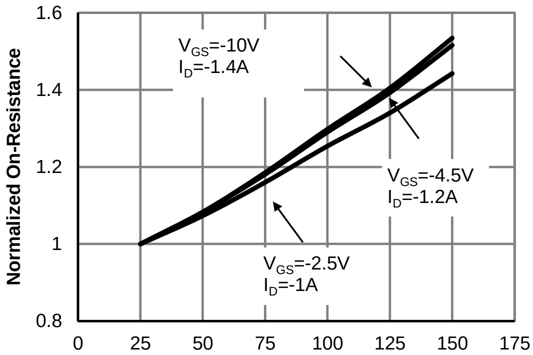



Figure 4: On-Resistance vs. Junction Temperature (Note E)

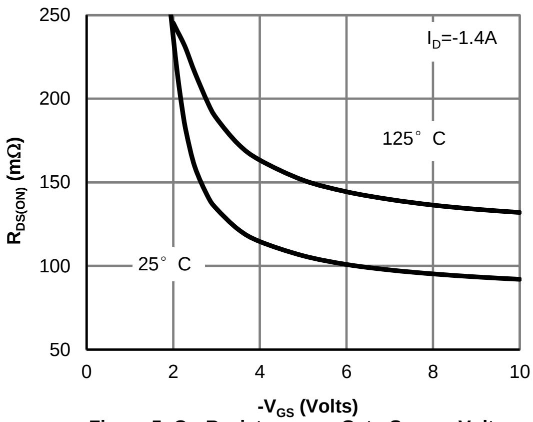



Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)

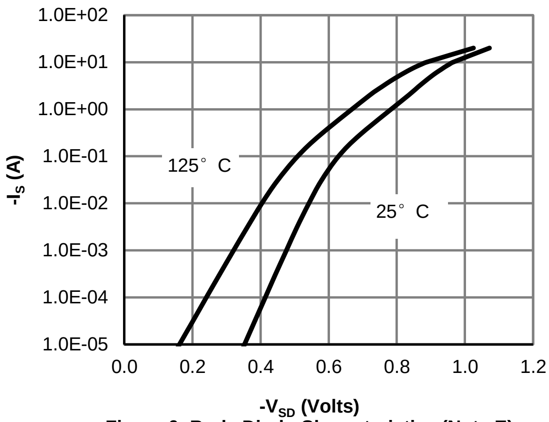



Figure 6: Body-Diode Characteristics (Note E)

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

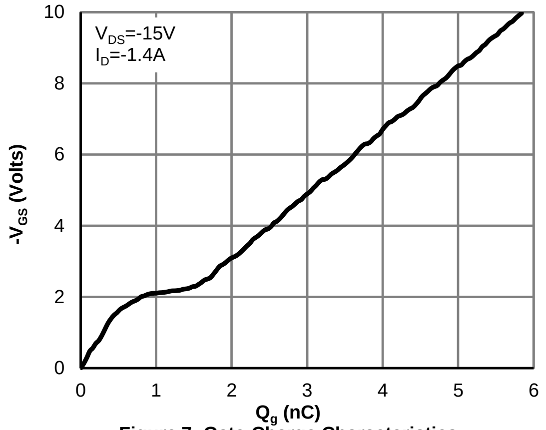


Figure 7: Gate-Charge Characteristics

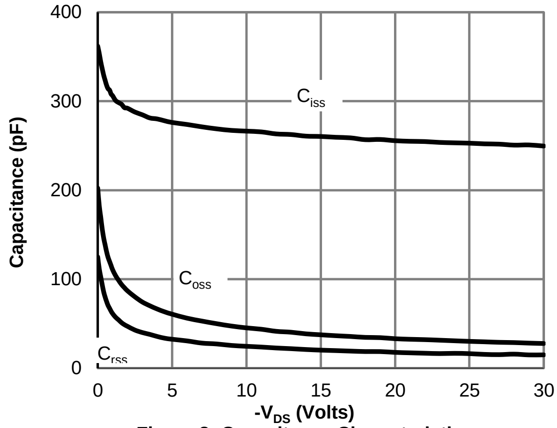


Figure 8: Capacitance Characteristics

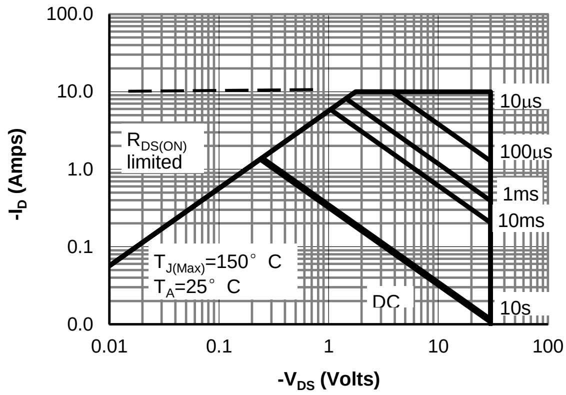


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

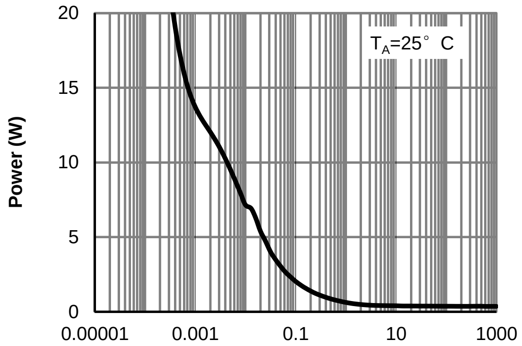


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note F)

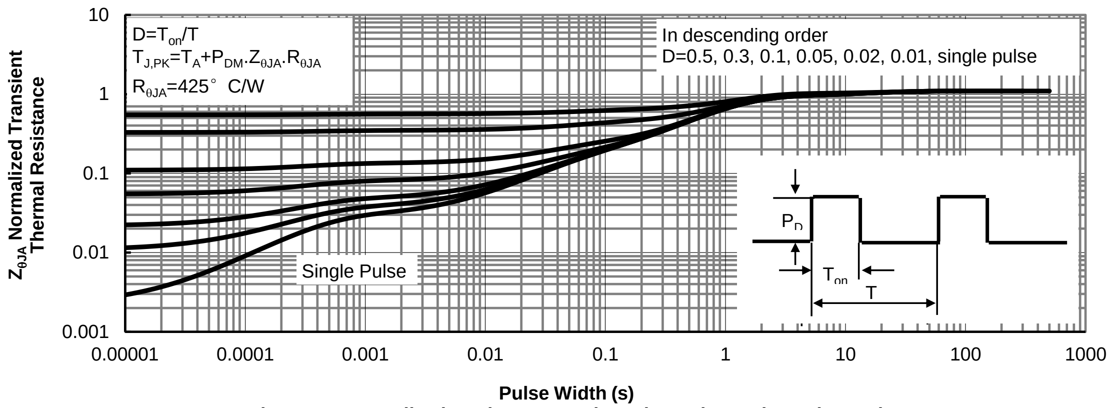
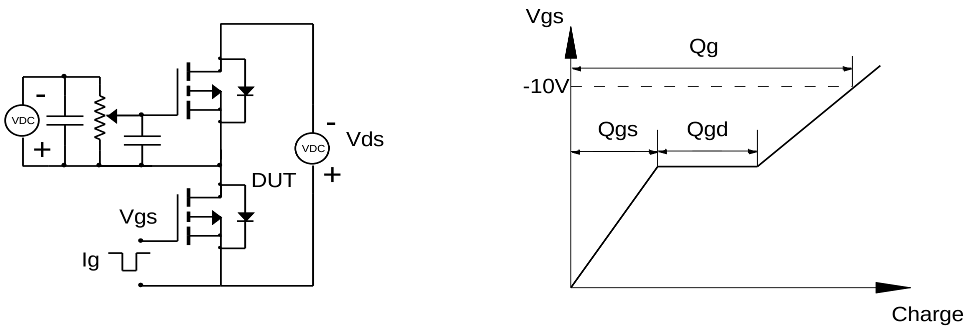
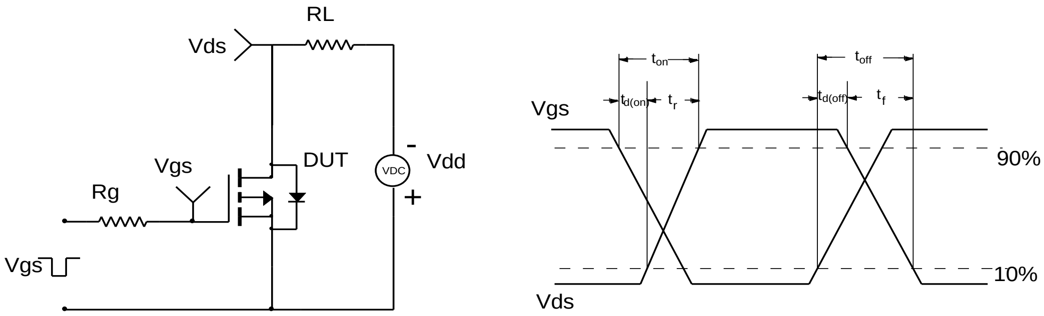


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

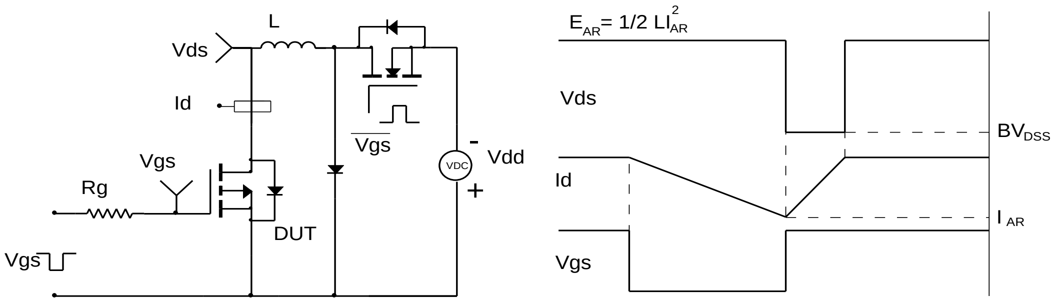
## Gate Charge Test Circuit & Waveform




## Resistive Switching Test Circuit & Waveforms




## Unclamped Inductive Switching (UIS) Test Circuit & Waveforms




## Diode Recovery Test Circuit & Waveforms