ALPHA & OMEGA SEMICONDUCTOR

# AO4407A

## 30V P-Channel MOSFET

## General Description

The AO4407A uses advanced trench technology to provide excellent $R_{DS(ON)}$, and ultra-low low gate charge with a 25V gate rating. This device is suitable for use as a load switch or in PWM applications.

* RoHS and Halogen-Free Complaint

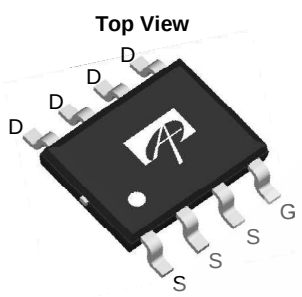
## Product Summary

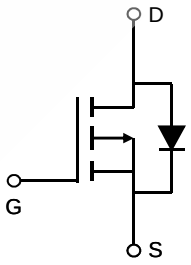
$V_{DS}$ = -30V
$I_D$ = -12A ($V_{GS}$ = -20V)
$R_{DS(ON)}$ < 11mΩ ($V_{GS}$ = -20V)
$R_{DS(ON)}$ < 13mΩ ($V_{GS}$ = -10V)
$R_{DS(ON)}$ < 17mΩ ($V_{GS}$ = -6V)

100% UIS Tested
100% Rg Tested

Green Product

SOIC-8




**Absolute Maximum Ratings $T_A$=25°C unless otherwise noted**

| Parameter | | Symbol | Maximum | Units |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | -30 | V |
| Gate-Source Voltage | | $V_{GS}$ | ±25 | V |
| Continuous Drain Current [A] | $T_A$=25°C | $I_D$ | -12 | A |
| | $T_A$=70°C | | -10 | |
| Pulsed Drain Current [B] | | $I_{DM}$ | -60 | |
| Avalanche Current [G] | | $I_{AR}$ | -26 | |
| Repetitive avalanche energy L=0.3mH [G] | | $E_{AR}$ | 101 | mJ |
| Power Dissipation [A] | $T_A$=25°C | $P_D$ | 3.1 | W |
| | $T_A$=70°C | | 2.0 | |
| 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 | $R_{\theta JA}$ | 32 | 40 | °C/W |
| Maximum Junction-to-Ambient [A] | Steady State | | 60 | 75 | °C/W |
| Maximum Junction-to-Lead [C] | Steady State | $R_{\theta JL}$ | 17 | 24 | °C/W |

**Electrical Characteristics ($T_J$=25℃ 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℃ | | | -5 | |
| $I_{GSS}$ | Gate-Body leakage current | $V_{DS}$ = 0V, $V_{GS}$ = ±25V | | | ±100 | nA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$ $I_D$ = -250µA | -1.7 | -2.3 | -3 | V |
| $I_{D(ON)}$ | On state drain current | $V_{GS}$ = -10V, $V_{DS}$ = -5V | -60 | | | A |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}$ = -20V, $I_D$ = -12A | | 8.5 | 11 | mΩ |
| | | $T_J$=125℃ | | 11.5 | 15 | |
| | | $V_{GS}$ = -10V, $I_D$ = -12A | | 10 | 13 | |
| | | $V_{GS}$ = -6V, $I_D$ = -10A | | 12.7 | 17 | |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = -5V, $I_D$ = -10A | | 21 | | S |
| $V_{SD}$ | Diode Forward Voltage | $I_S$ = -1A,$V_{GS}$ = 0V | | -0.7 | -1 | V |
| $I_S$ | Maximum Body-Diode Continuous Current | | | | -3 | A |
| **DYNAMIC PARAMETERS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=-15V, f=1MHz | | 2060 | 2600 | pF |
| $C_{oss}$ | Output Capacitance | | | 370 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 295 | | pF |
| $R_g$ | Gate resistance | $V_{GS}$=0V, $V_{DS}$=0V, f=1MHz | | 2.4 | 3.6 | Ω |
| **SWITCHING PARAMETERS** | | | | | | |
| $Q_g$ | Total Gate Charge | $V_{GS}$=-10V, $V_{DS}$=-15V, $I_D$=-12A | | 30 | 39 | nC |
| $Q_{gs}$ | Gate Source Charge | | | 4.6 | | nC |
| $Q_{gd}$ | Gate Drain Charge | | | 10 | | nC |
| $t_{D(on)}$ | Turn-On DelayTime | $V_{GS}$=-10V, $V_{DS}$=-15V, $R_L$=1.25Ω, $R_{GEN}$=3Ω | | 11 | | ns |
| $t_r$ | Turn-On Rise Time | | | 9.4 | | ns |
| $t_{D(off)}$ | Turn-Off DelayTime | | | 24 | | ns |
| $t_f$ | Turn-Off Fall Time | | | 12 | | ns |
| $t_{rr}$ | Body Diode Reverse Recovery Time | $I_F$=-12A, dI/dt=100A/µs | | 30 | 40 | ns |
| $Q_{rr}$ | Body Diode Reverse Recovery Charge | $I_F$=-12A, dI/dt=100A/µs | | 22 | | nC |

A: The value of $R_{\theta JA}$ is measured with the device mounted on 1 in $^2$ 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. The current rating is based on the t ≤ 10s thermal resistance rating.
B: Repetitive rating, pulse width limited by junction temperature.
C. The $R_{\theta JA}$ is the sum of the thermal impedence from junction to lead $R_{\theta JL}$ and lead to ambient.
D. The static characteristics in Figures 1 to 6 are obtained using < 300µs pulses, duty cycle 0.5% max.
E. These tests are performed with the device mounted on 1 in $^2$ FR-4 board with 2oz. Copper, in a still air environment with $T_A$=25° C. The SOA curve provides a single pulse rating.
F. The current rating is based on the t ≤ 10s thermal resistance rating.
G. $E_{AR}$ and $I_{AR}$ ratings are based on low frequency and duty cycles to keep $T_j$=25C.

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

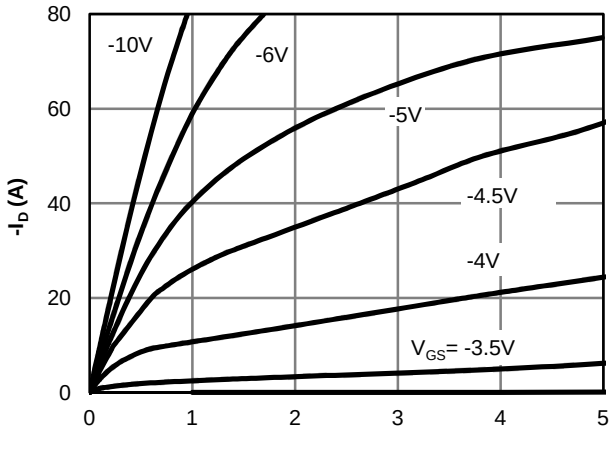



Figure 1: On-Region Characteristics

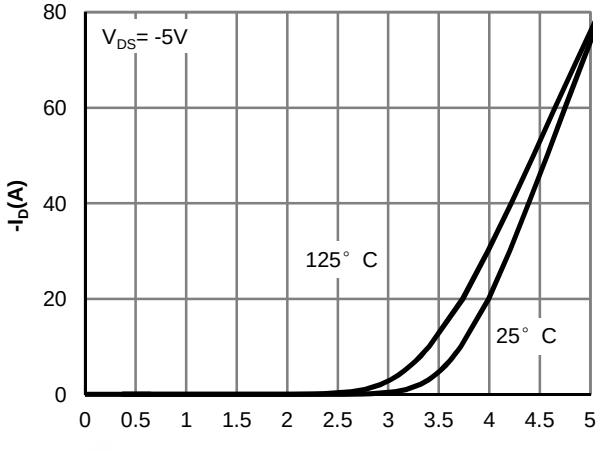



Figure 2: Transfer Characteristics

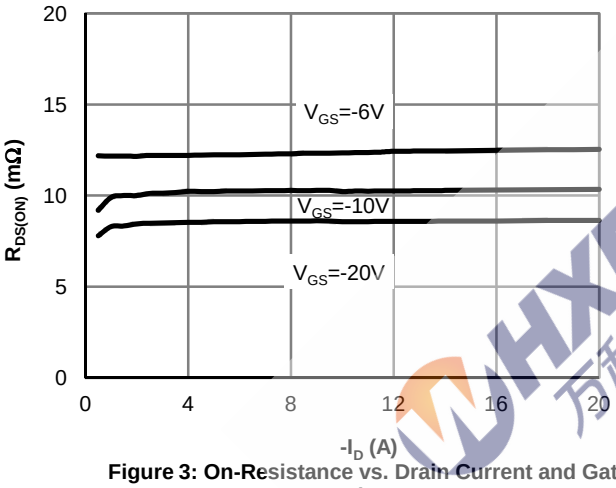



Figure 3: On-Resistance vs. Drain Current and Gate Voltage

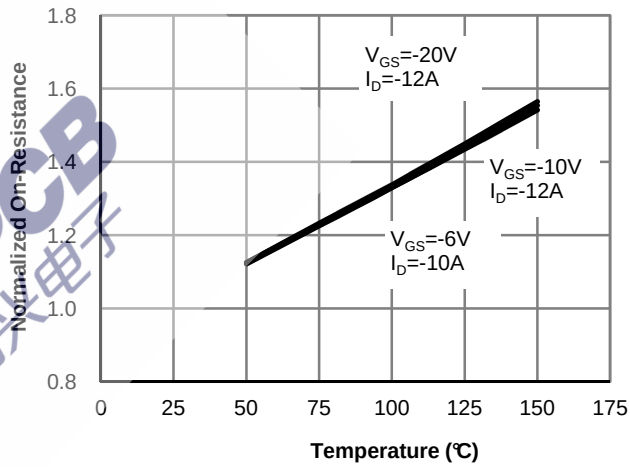



Figure 4: On-Resistance vs. Junction Temperature

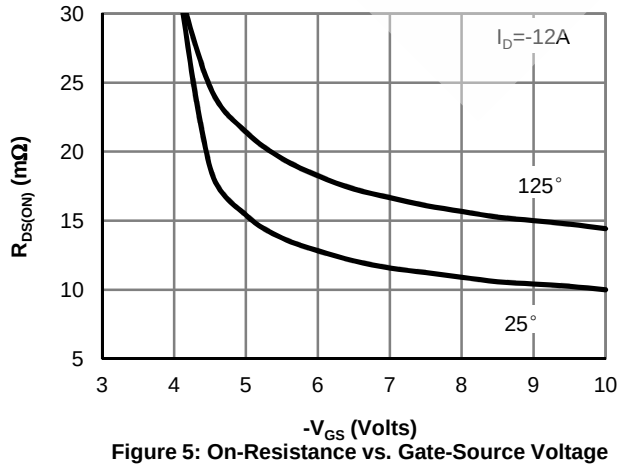



Figure 5: On-Resistance vs. Gate-Source Voltage

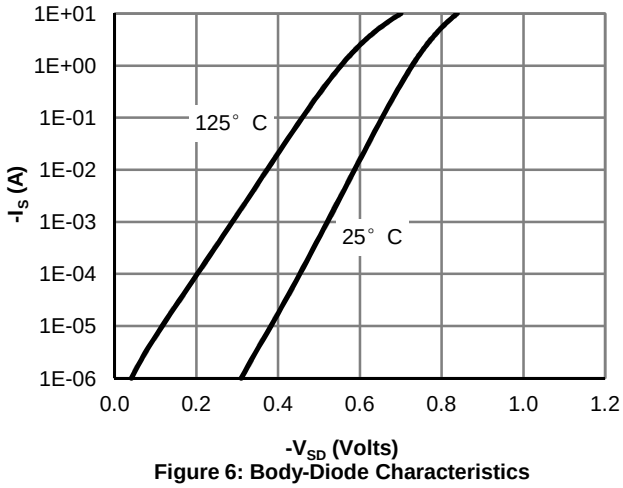



Figure 6: Body-Diode Characteristics

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

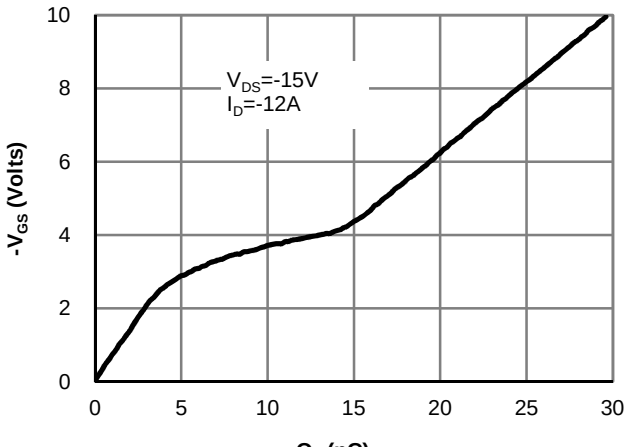



Figure 7: Gate-Charge Characteristics

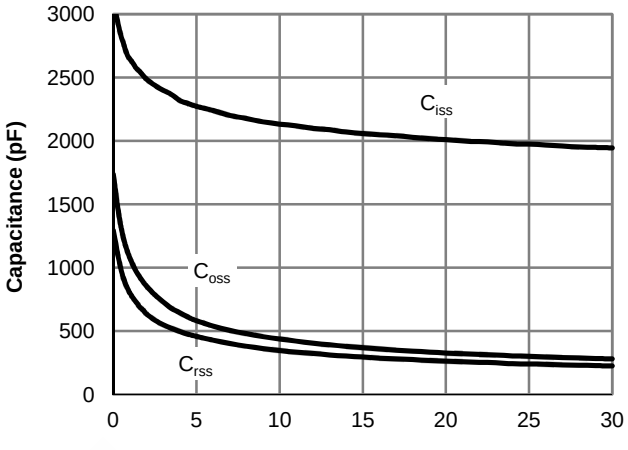



Figure 8: Capacitance Characteristics

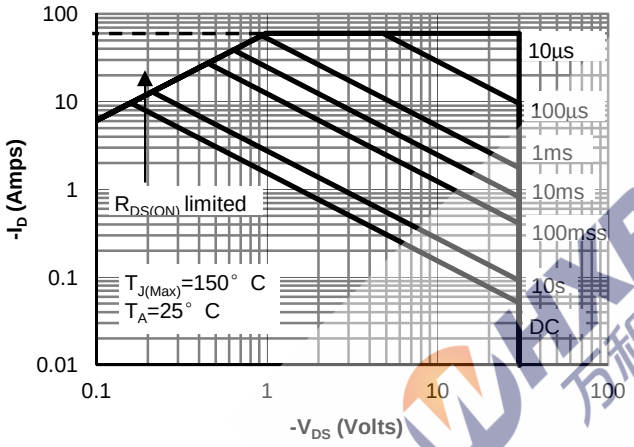



Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

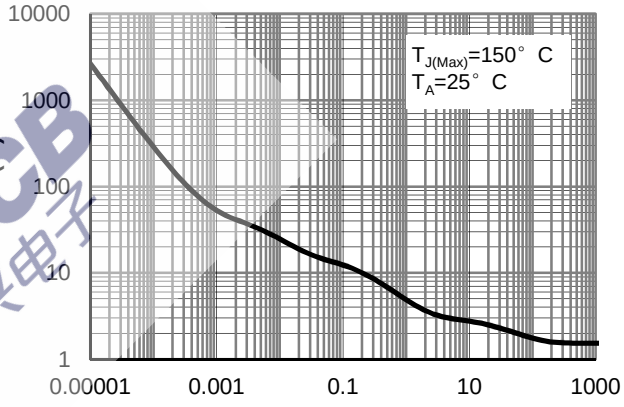



Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

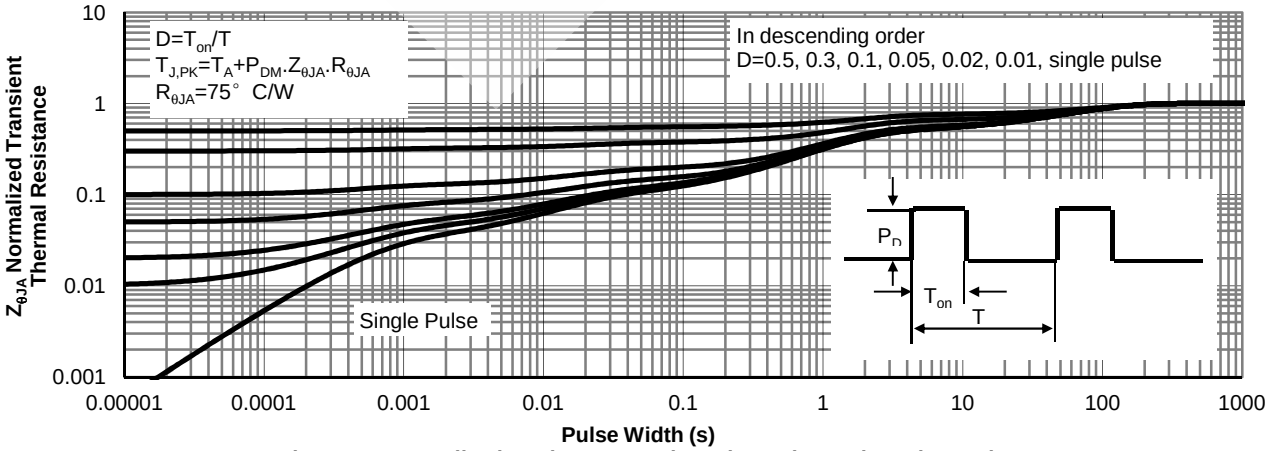
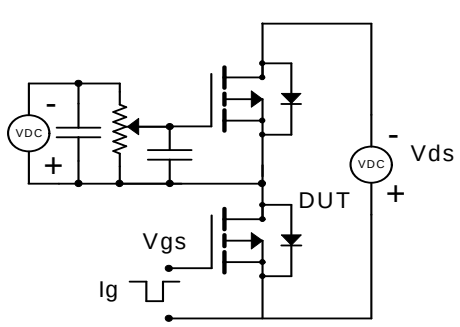
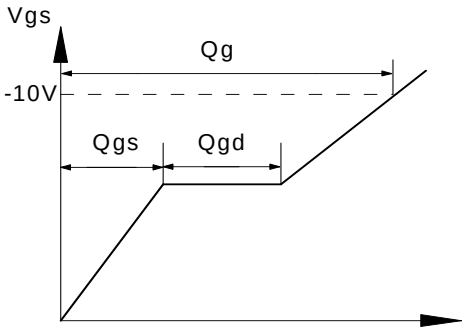


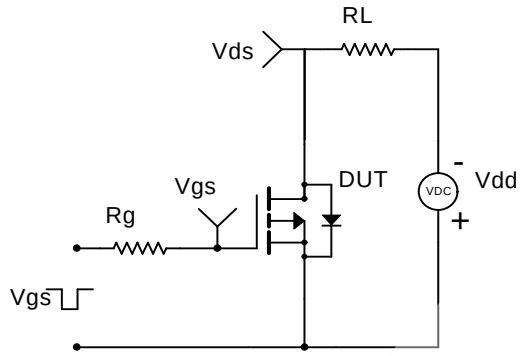

Figure 11: Normalized Maximum Transient Thermal Impedance(Note E)

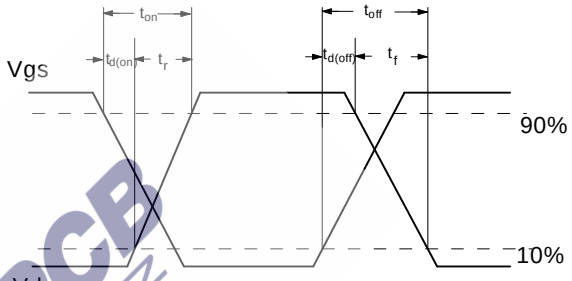
## Gate Charge Test Circuit & Waveform



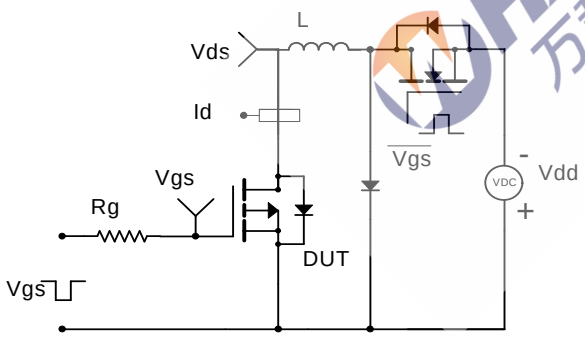



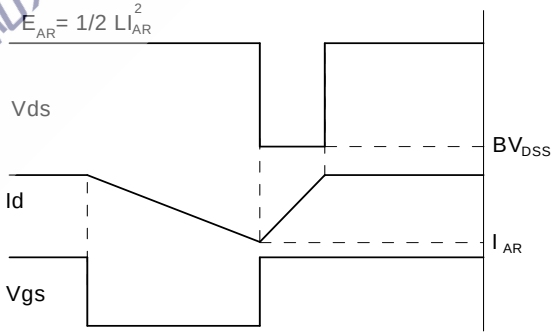

## Resistive Switching Test Circuit & Waveforms




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




## Diode Recovery Test Circuit & Waveforms