ALPHA & OMEGA SEMICONDUCTOR

# AO4407

## 30V P-Channel MOSFET

### General Description

The AO4407 combines advanced trench MOSFET technology with a low resistance package to provide extremely low $R_{DS(ON)}$. This device is ideal for load switch and battery protection applications.

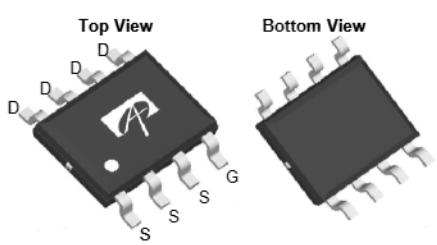
### Product Summary

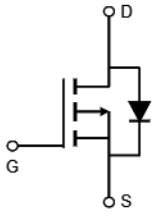
| | |
|---|---|
| $V_{DS}$ | -30V |
| $I_D$ (at $V_{GS}$=-20V) | -12A |
| $R_{DS(ON)}$ (at $V_{GS}$=-20V) | < 13mΩ |
| $R_{DS(ON)}$ (at $V_{GS}$ =-10V) | < 14mΩ |
| $R_{DS(ON)}$ (at $V_{GS}$ =-5V) | < 30mΩ |

100% UIS Tested
100% $R_g$ 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 | $T_A$=25°C | $I_D$ | -12 | A |
| | $T_A$=70°C | | -10 | |
| Pulsed Drain Current [C] | | $I_{DM}$ | -60 | |
| Avalanche Current [C] | | $I_{AS}$, $I_{AR}$ | 26 | A |
| Avalanche energy L=0.3mH [C] | | $E_{AS}$, $E_{AR}$ | 101 | mJ |
| Power Dissipation [B] | $T_A$=25°C | $P_D$ | 3.1 | W |
| | $T_A$=70°C | | 2 | |
| 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 | $R_{\theta JA}$ | 31 | 40 | °C/W |
| Maximum Junction-to-Ambient [A D] | Steady-State | | 59 | 75 | °C/W |
| Maximum Junction-to-Lead | Steady-State | $R_{\theta JL}$ | 16 | 24 | °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, $V_{GS}$= ±25V | | | ±100 | nA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$ $I_D$=-250µA | -1.7 | -2.25 | -2.8 | 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 | 13 | mΩ |
| | | $V_{GS}$=-10V, $I_D$=-12A | | 10 | 14 | mΩ |
| | | $T_J$=125°C | | 12 | 19 | |
| | | $V_{GS}$=-5V, $I_D$=-7A | | 19 | 30 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$=-5V, $I_D$=-10.5A | | 27 | | S |
| $V_{SD}$ | Diode Forward Voltage | $I_S$=-1A,$V_{GS}$=0V | | -0.72 | -1 | V |
| $I_S$ | Maximum Body-Diode Continuous Current | | | | -4 | 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 | 1.2 | 2.4 | 3.6 | Ω |
| SWITCHING PARAMETERS | | | | | | |
| $Q_g$ | Total Gate Charge | $V_{GS}$=-10V, $V_{DS}$=-15V, $I_D$=-12A | 24 | 30 | 36 | 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 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 impedence 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 impedence 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.

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## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

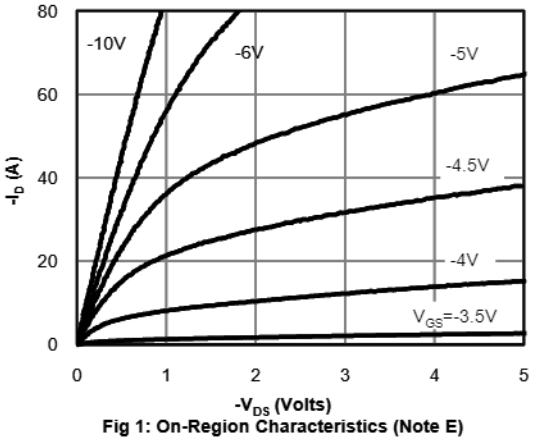



Fig 1: On-Region Characteristics (Note E)

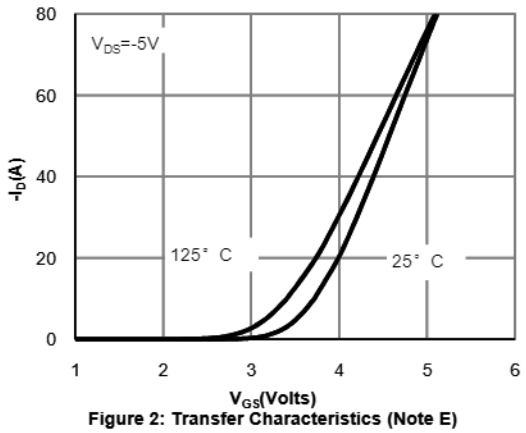



Figure 2: Transfer Characteristics (Note E)

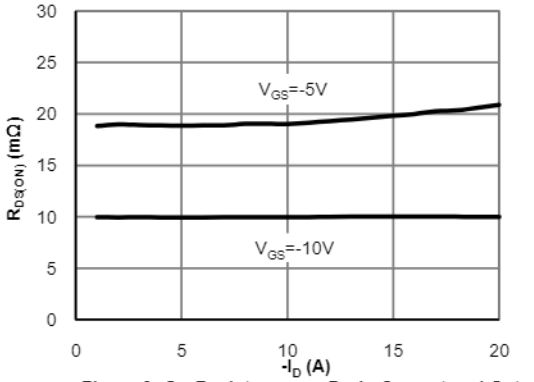



Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)

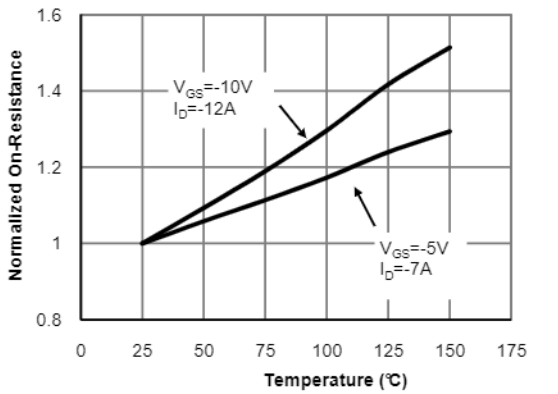



Figure 4: On-Resistance vs. Junction Temperature (Note E)

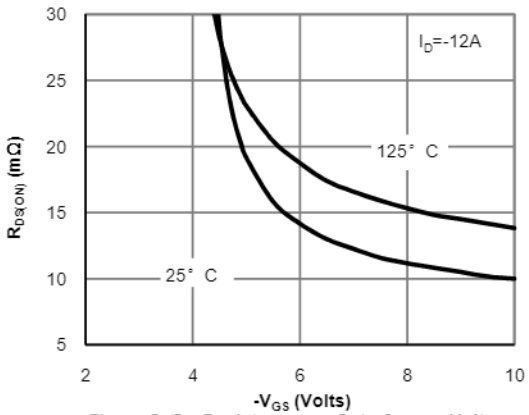



Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)

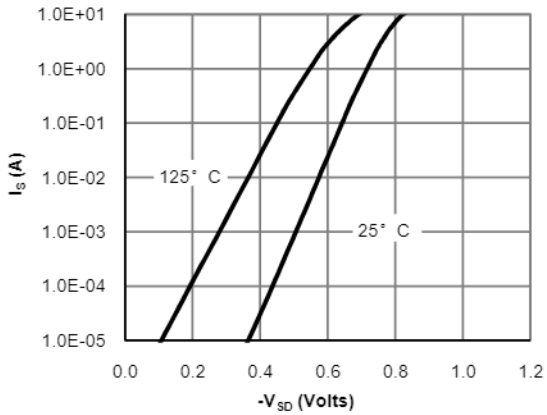



Figure 6: Body-Diode Characteristics (Note E)

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

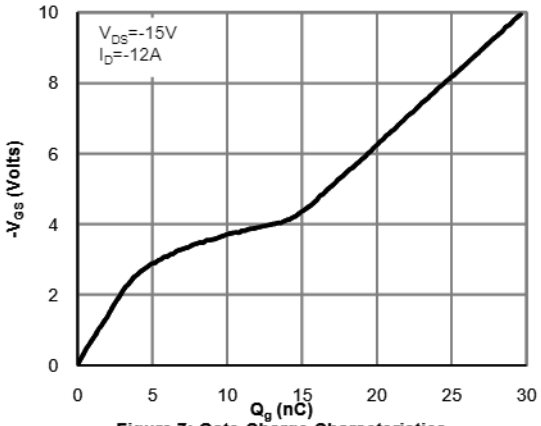



Figure 7: Gate-Charge Characteristics

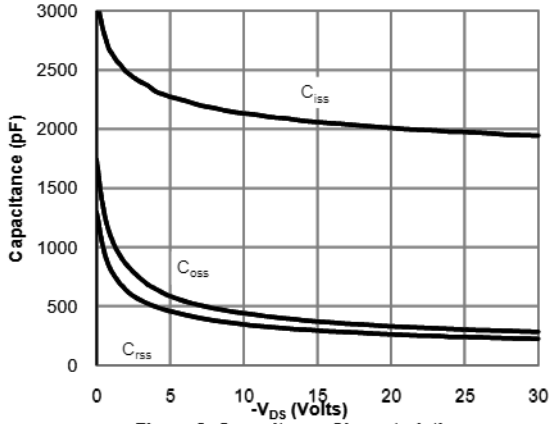



Figure 8: Capacitance Characteristics

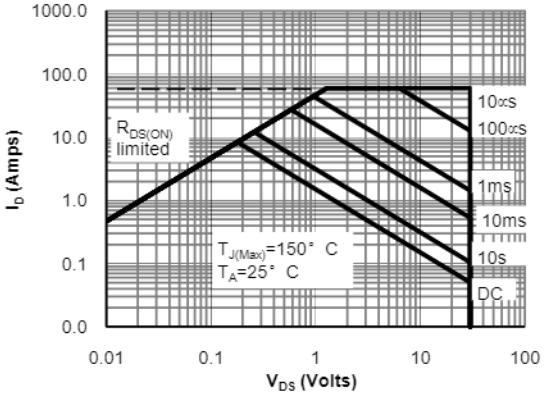



Figure 10: Maximum Forward Biased Safe Operating Area (Note F)

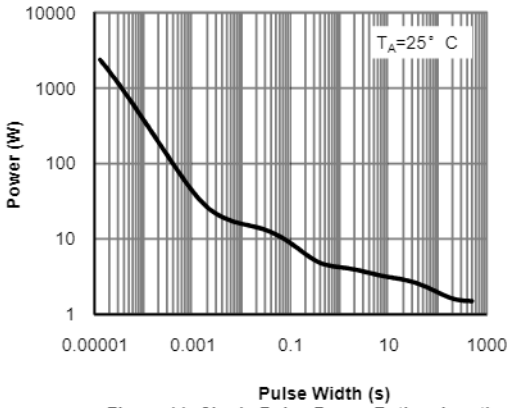



Figure 11: Single Pulse Power Rating Junction-to-Ambient (Note F)

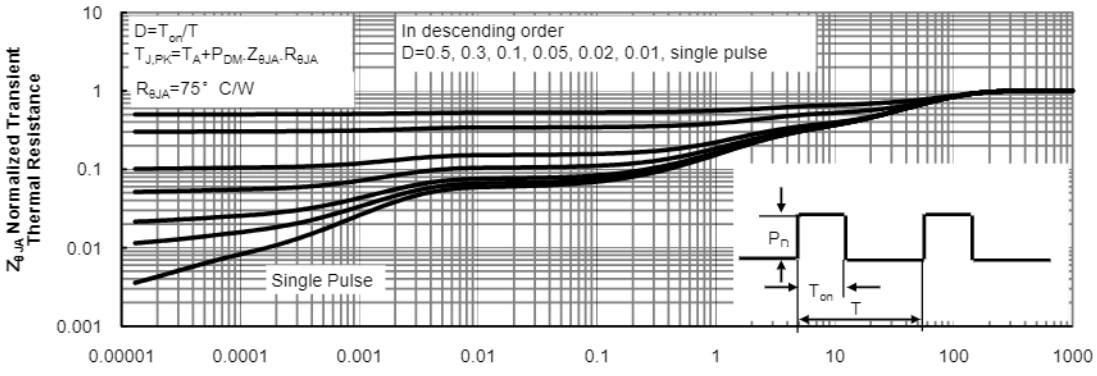
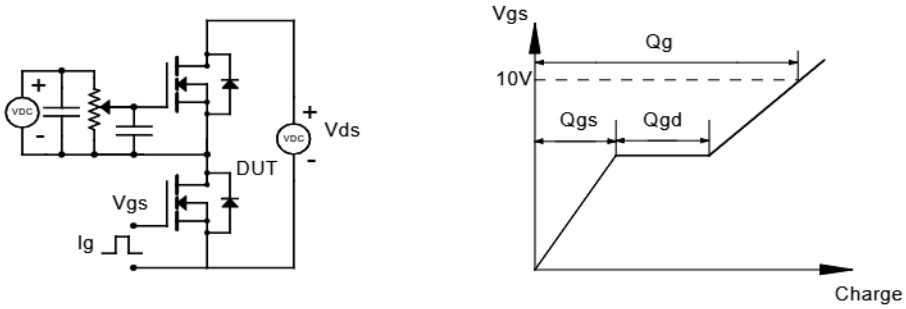
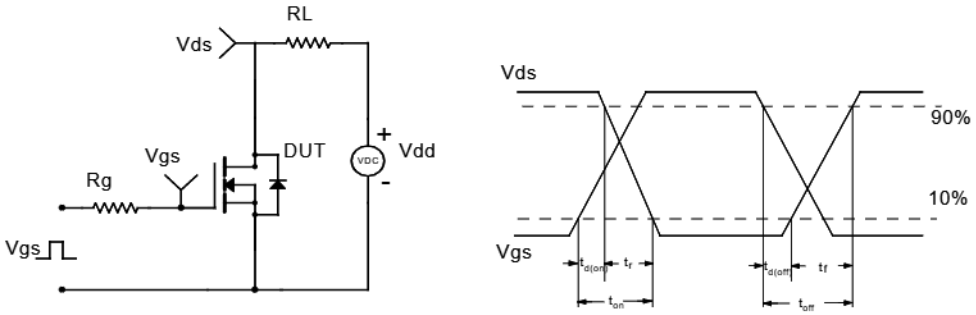



Figure 12: Normalized Maximum Transient Thermal Impedance (Note F)

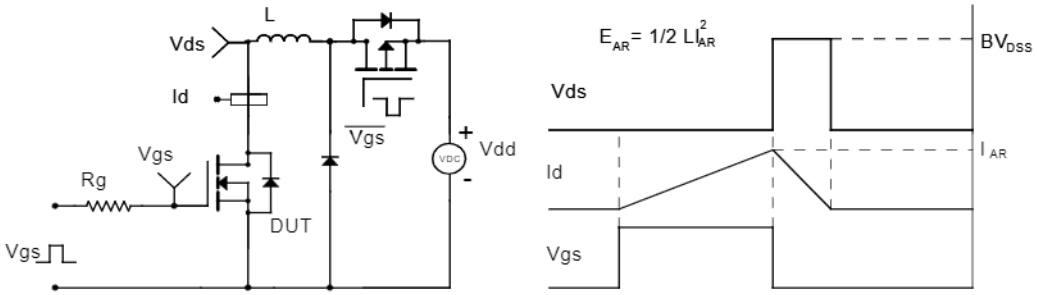
## Gate Charge Test Circuit & Waveform




## Resistive Switching Test Circuit & Waveforms




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




## Diode Recovery Test Circuit & Waveforms

