## ALPHA & OMEGA SEMICONDUCTOR
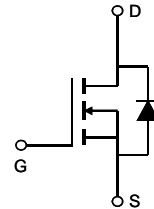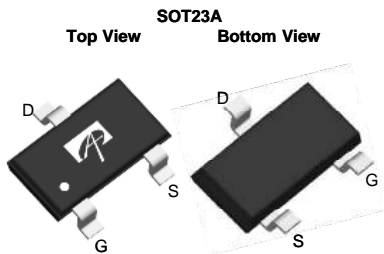
# AO3160
### 600V,0.04A N-Channel MOSFET

## General Description

The AO3160 is fabricated using an advanced high voltage MOSFET process that is designed to deliver high levels of performance and robustness in popular AC-DC applications.
By providing low $R_{DS(on)}$, $C_{iss}$ and $C_{rss}$ along with guaranteed avalanche capability this device can be adopted quickly into new and existing offline power supply designs.

## Product Summary

| | |
|---|---|
| $V_{DS}$ | 700V@150℃ |
| $I_D$ (at $V_{GS}$=10V) | 0.04A |
| $R_{DS(ON)}$ (at $V_{GS}$=10V) | < 500Ω |
| $R_{DS(ON)}$ (at $V_{GS}$=4.5V) | < 600Ω |

Green Product

**SOT23A**
Top View    Bottom View



## Absolute Maximum Ratings  $T_A$=25℃ unless otherwise noted

| Parameter | | Symbol | Maximum | Units |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 600 | V |
| Gate-Source Voltage | | $V_{GS}$ | ±20 | V |
| Continuous Drain Current[A,F] | $T_A$=25℃ | $I_D$ | 0.04 | A |
| | $T_A$=70℃ | | 0.03 | |
| Pulsed Drain Current [B] | | $I_{DM}$ | 0.12 | |
| Peak diode recovery dv/dt | | dv/dt | 5 | V/ns |
| Power Dissipation [A] | $T_A$=25℃ | $P_D$ | 1.39 | W |
| | $T_A$=70℃ | | 0.89 | |
| Junction and Storage Temperature Range | | $T_J$, $T_{STG}$ | -50 to 150 | ℃ |

## Thermal Characteristics

| Parameter | | Symbol | Typ | Max | Units |
|---|---|---|---|---|---|
| Maximum Junction-to-Ambient [A] | t ≤ 10s | $R_{\theta JA}$ | 70 | 90 | ℃/W |
| Maximum Junction-to-Ambient [A] | Steady-State | | 100 | 125 | ℃/W |
| Maximum Junction-to-Lead [C] | Steady-State | $R_{\theta JL}$ | 63 | 80 | ℃/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, T$_J$=25℃ | 600 | - | - | V |
| | | I$_D$=250µA, V$_{GS}$=0V, T$_J$=150℃ | - | 700 | - | |
| BV$_{DSS}$/∆TJ | Zero Gate Voltage Drain Current | ID=250µA, VGS=0V | - | 0.64 | - | V/°C |
| I$_{DSS}$ | Zero Gate Voltage Drain Current | V$_{DS}$=600V, V$_{GS}$=0V | - | - | 1 | µA |
| | | V$_{DS}$=480V, T$_J$=125℃ | - | - | 10 | |
| I$_{GSS}$ | Gate-Body leakage current | V$_{DS}$=0V, V$_{GS}$=±20V | - | - | ±100 | nA |
| V$_{GS(th)}$ | Gate Threshold Voltage | V$_{DS}$=5V, I$_D$=8µA | 1.4 | 2 | 3.2 | V |
| R$_{DS(ON)}$ | Static Drain-Source On-Resistance | V$_{GS}$=10V, I$_D$=0.016A | - | 232 | 500 | Ω |
| | Static Drain-Source On-Resistance | V$_{GS}$=4.5V, I$_D$=0.016A | - | 315 | 600 | Ω |
| g$_{FS}$ | Forward Transconductance | V$_{DS}$=40V, I$_D$=0.016A | - | 0.024 | - | S |
| V$_{SD}$ | Diode Forward Voltage | I$_S$=0.016A,V$_{GS}$=0V | - | 0.74 | 1 | V |
| I$_S$ | Maximum Body-Diode Continuous Current | | - | - | 0.04 | A |
| I$_{SM}$ | Maximum Body-Diode Pulsed Current | | - | - | 0.12 | A |
| **DYNAMIC PARAMETERS** | | | | | | |
| C$_{iss}$ | Input Capacitance | V$_{GS}$=0V, V$_{DS}$=25V, f=1MHz | - | 10 | 15 | pF |
| C$_{oss}$ | Output Capacitance | | - | 1.8 | 3 | pF |
| C$_{rss}$ | Reverse Transfer Capacitance | | - | 0.7 | 1 | pF |
| R$_g$ | Gate resistance | V$_{GS}$=0V, V$_{DS}$=0V, f=1MHz | 5 | 10 | 15 | Ω |
| **SWITCHING PARAMETERS** | | | | | | |
| Q$_g$ | Total Gate Charge | V$_{GS}$=10V, V$_{DS}$=400V, I$_D$=0.01A | - | 1 | 1.5 | nC |
| Q$_{gs}$ | Gate Source Charge | | - | 0.1 | 0.15 | nC |
| Q$_{gd}$ | Gate Drain Charge | | - | 0.52 | 0.8 | nC |
| t$_{D(on)}$ | Turn-On DelayTime | V$_{GS}$=10V, V$_{DS}$=300V, I$_D$=0.01A, R$_G$=6Ω | - | 4 | 12 | ns |
| t$_r$ | Turn-On Rise Time | | - | 5.2 | 8 | ns |
| t$_{D(off)}$ | Turn-Off DelayTime | | - | 12.5 | 19 | ns |
| t$_f$ | Turn-Off Fall Time | | - | 55 | 82.5 | ns |
| t$_{rr}$ | Body Diode Reverse Recovery Time | I$_F$=0.016A,dI/dt=100A/µs,V$_{DS}$=300V | - | 105 | 160 | ns |
| Q$_{rr}$ | Body Diode Reverse Recovery Charge | I$_F$=0.016A,dI/dt=100A/µs,V$_{DS}$=300V | - | 9.5 | 14.3 | nC |

A: The value of R$_{θJA}$ is measured with the device mounted on 1in$^2$ 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.
B: Repetitive rating, pulse width limited by junction temperature.
C. The R$_{θJA}$ is the sum of the thermal impedence from junction to lead R$_{θJL}$ and lead to ambient.
D. The static characteristics in Figures 1 to 6 are obtained using <300 µs 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.

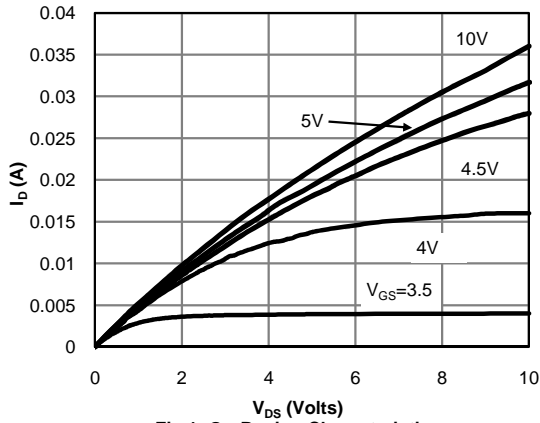## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS
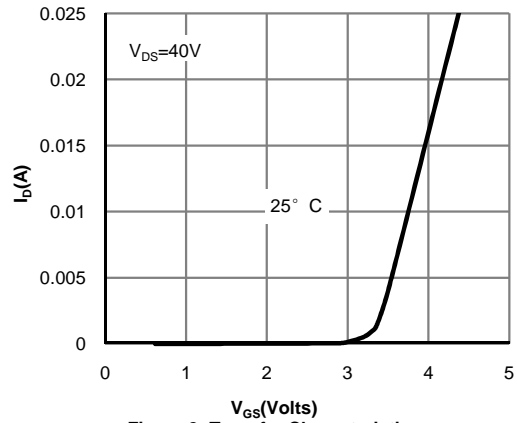


Fig 1: On-Region Characteristics
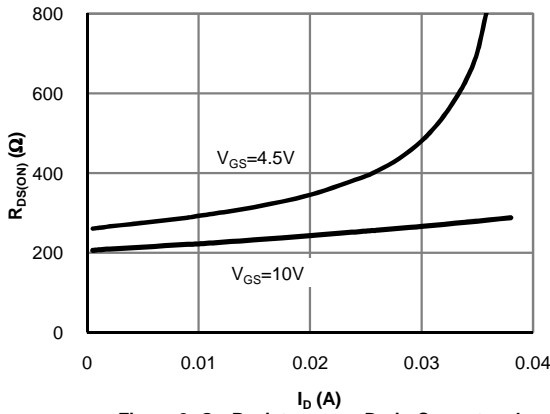


Figure 2: Transfer Characteristics



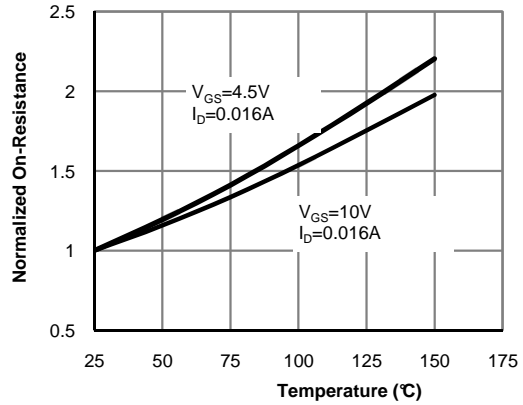Figure 3: On-Resistance vs. Drain Current and Gate Voltage
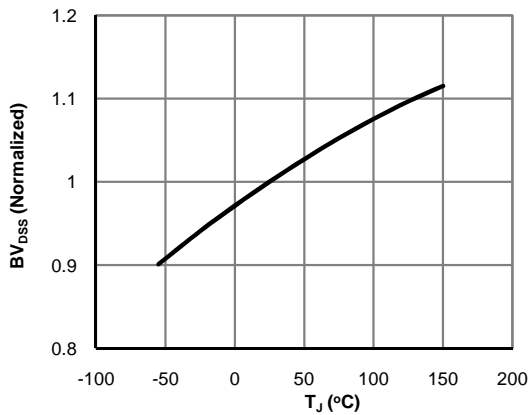


Figure 4: On-Resistance vs. Junction Temperature
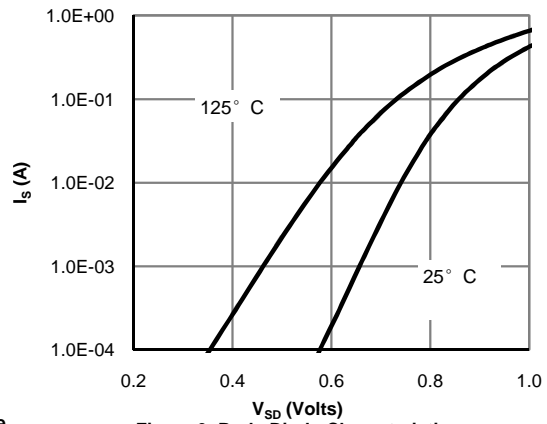


Figure 5: Break Down vs. Junction Temperature



Figure 6: Body-Diode Characteristics
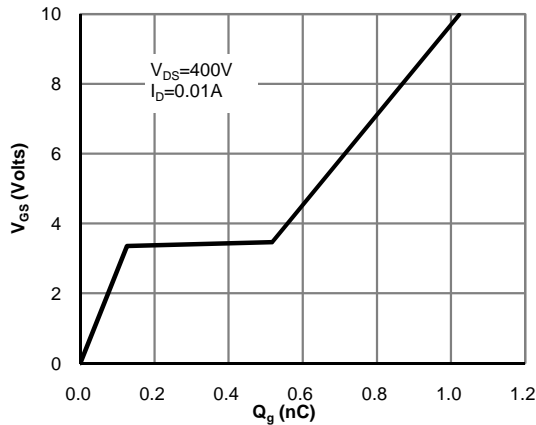
**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**
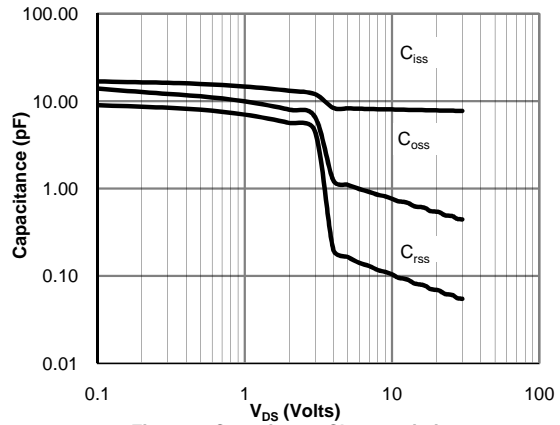


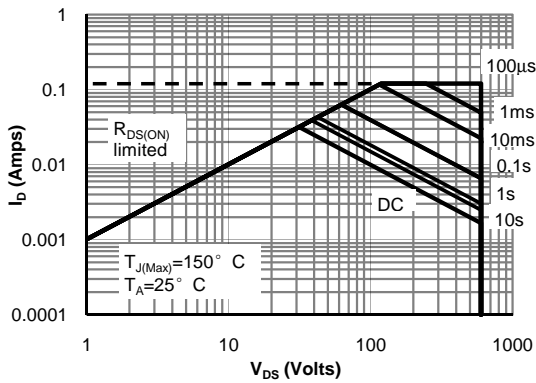Figure 7: Gate-Charge Characteristics



Figure 8: Capacitance Characteristics



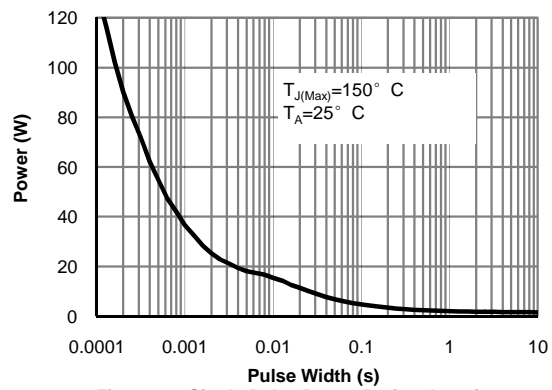Figure 9: Maximum Forward Biased Safe Operating Area (Note E)



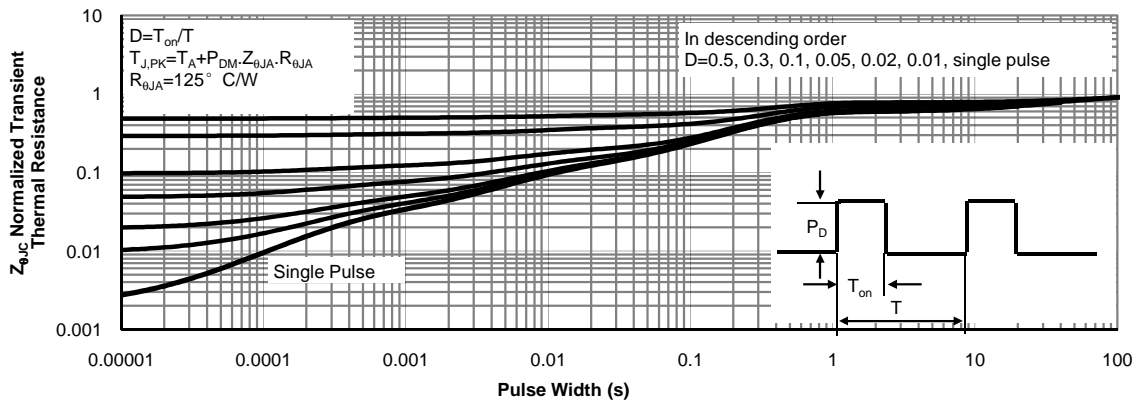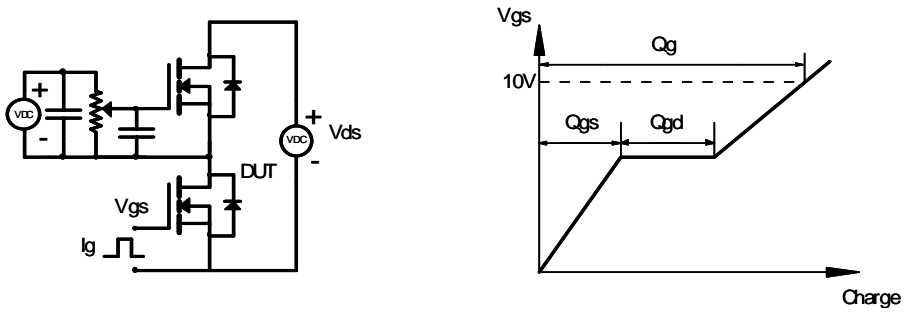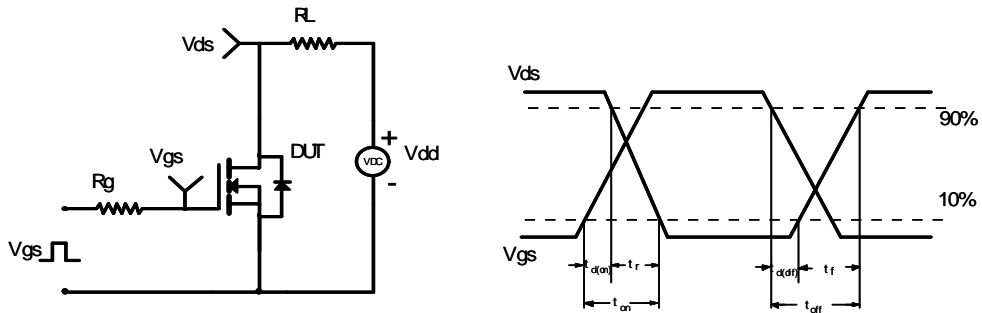Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)
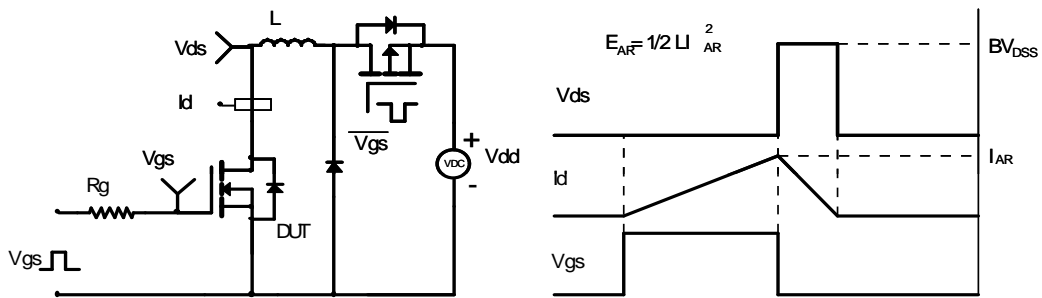


Figure 11: Normalized Maximum Transient Thermal Impedance (Note E)

### Gate Charge Test Circuit & Waveform



### Resistive Switching Test Circuit & Waveforms



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

$$E_{AR} = 1/2 \, LI_{AR}^2$$



### Diode Recovery Test Circuit & Waveforms

$$Q_{rr} = -\int I dt$$