ALPHA & OMEGA SEMICONDUCTOR

# AO4402G

## 20V N-Channel MOSFET

### General Description

- Trench Power MOSFET technology
- Low $R_{DS(ON)}$
- RoHS and Halogen-Free Compliant

### Applications

- DC/DC Converters in Computing, Servers, and POL
- Battery protection switch

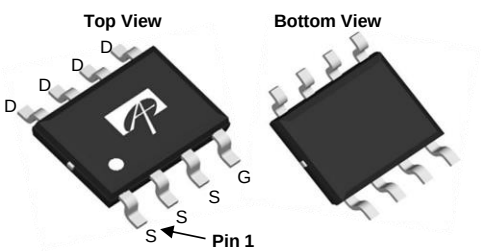
### Product Summary

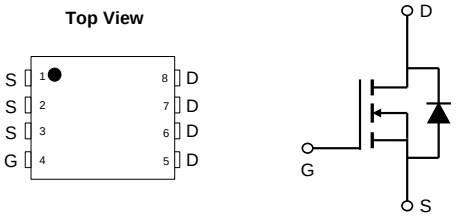
| | |
|---|---|
| $V_{DS}$ | 20V |
| $I_D$ (at $V_{GS}$=4.5V) | 20A |
| $R_{DS(ON)}$ (at $V_{GS}$=4.5V) | < 5.9mΩ |
| $R_{DS(ON)}$ (at $V_{GS}$=2.5V) | < 7.3mΩ |

100% UIS Tested
100% Rg Tested

Green Product

**SOIC-8**







| Orderable Part Number | Package Type | Form | Minimum Order Quantity |
|---|---|---|---|
| AO4402G | SO-8 | Tape & Reel | 3000 |

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

| Parameter | | Symbol | Maximum | Units |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 20 | V |
| Gate-Source Voltage | | $V_{GS}$ | ±12 | V |
| Continuous Drain Current | $T_A$=25°C | $I_D$ | 20 | A |
| | $T_A$=70°C | | 15 | |
| Pulsed Drain Current [C] | | $I_{DM}$ | 80 | |
| Avalanche Current [C] | | $I_{AS}$ | 40 | A |
| Avalanche energy | L=0.1mH [C] | $E_{AS}$ | 80 | mJ |
| Power Dissipation [B] | $T_A$=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 | $R_{\theta JA}$ | 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 | 20 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=20V, $V_{GS}$=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 | 0.45 | 0.85 | 1.25 | V |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}$=4.5V, $I_D$=20A | | 4.9 | 5.9 | mΩ |
| | | $T_J$=125°C | | 6.3 | 7.6 | |
| | | $V_{GS}$=2.5V, $I_D$=18A | | 5.8 | 7.3 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$=5V, $I_D$=20A | | 100 | | S |
| $V_{SD}$ | Diode Forward Voltage | $I_S$=1A, $V_{GS}$=0V | | 0.6 | 1 | V |
| $I_S$ | Maximum Body-Diode Continuous Current | | | | 5 | A |
| **DYNAMIC PARAMETERS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=10V, f=1MHz | | 3300 | | pF |
| $C_{oss}$ | Output Capacitance | | | 485 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 370 | | pF |
| $R_g$ | Gate resistance | f=1MHz | 1.2 | 2.4 | 3.6 | Ω |
| **SWITCHING PARAMETERS** | | | | | | |
| $Q_g$(4.5V) | Total Gate Charge | $V_{GS}$=4.5V, $V_{DS}$=10V, $I_D$=20A | | 31 | 45 | nC |
| $Q_{gs}$ | Gate Source Charge | | | 5.2 | | nC |
| $Q_{gd}$ | Gate Drain Charge | | | 8 | | nC |
| $t_{D(on)}$ | Turn-On DelayTime | $V_{GS}$=10V, $V_{DS}$=10V, $R_L$=0.5Ω, $R_{GEN}$=3Ω | | 7.5 | | ns |
| $t_r$ | Turn-On Rise Time | | | 15 | | ns |
| $t_{D(off)}$ | Turn-Off DelayTime | | | 72 | | ns |
| $t_f$ | Turn-Off Fall Time | | | 21 | | ns |
| $t_{rr}$ | Body Diode Reverse Recovery Time | $I_F$=20A, di/dt=500A/µs | | 17 | | ns |
| $Q_{rr}$ | Body Diode Reverse Recovery Charge | $I_F$=20A, di/dt=500A/µs | | 30 | | 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.

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## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

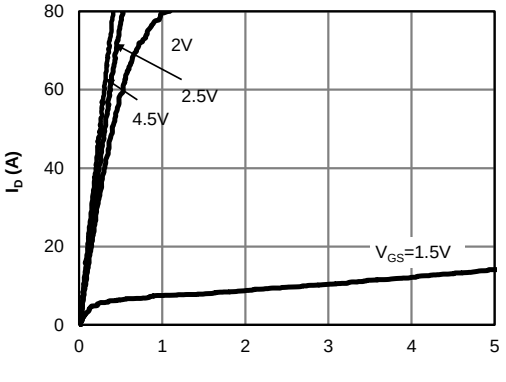



**Figure 1: On-Region Characteristics (Note E)**

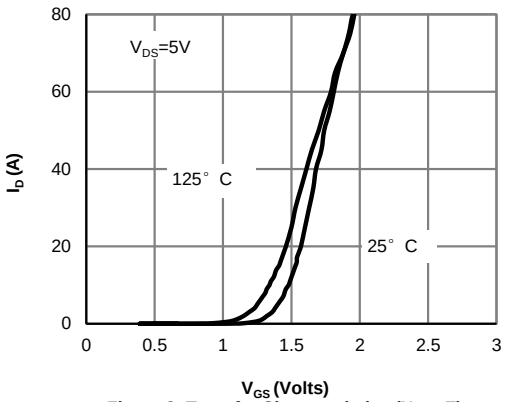



**Figure 2: Transfer Characteristics (Note E)**

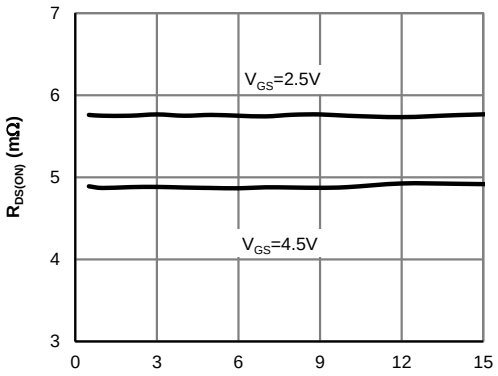



**Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)**

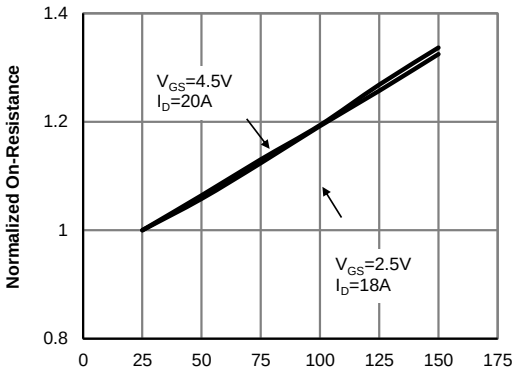



**Figure 4: On-Resistance vs. Junction Temperature (Note E)**

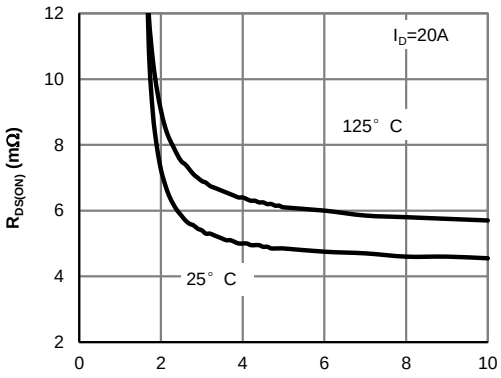



**Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)**

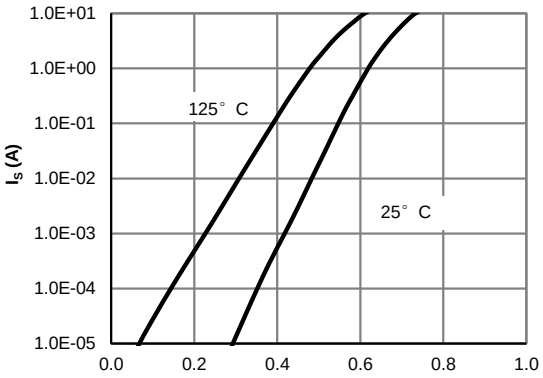



**Figure 6: Body-Diode Characteristics (Note E)**

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

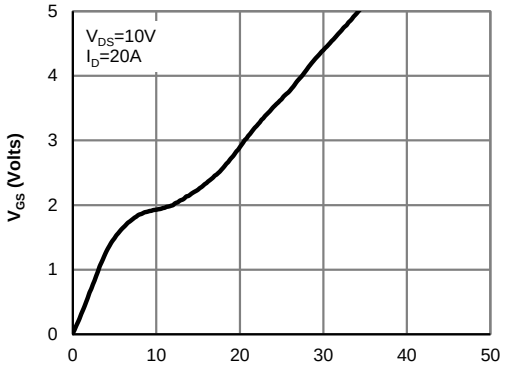



**Figure 7: Gate-Charge Characteristics**

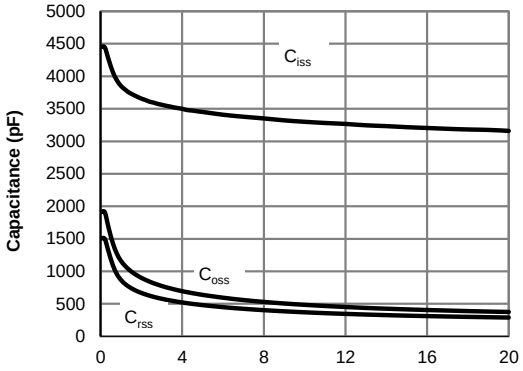
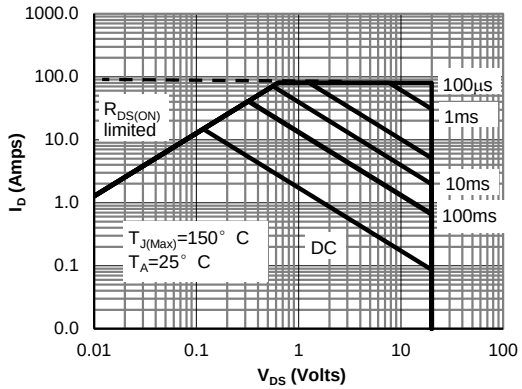



**Figure 8: Capacitance Characteristics**




**$V_{GS}$> or equal to 2.5V**
**Figure 9: Maximum Forward Biased Safe Operating Area (Note F)**

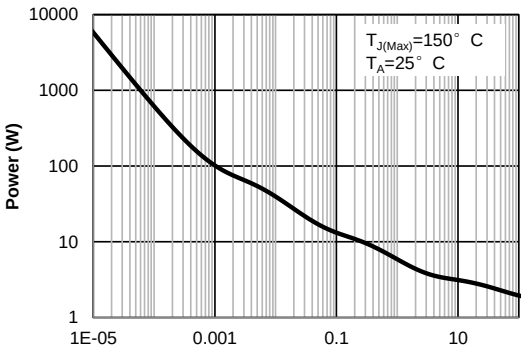



**Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note F)**

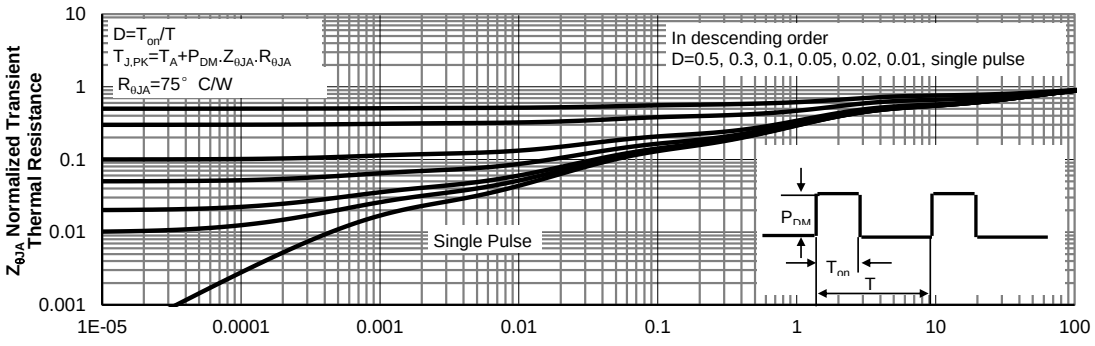



**Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)**

Figure A: Gate Charge Test Circuit & Waveforms

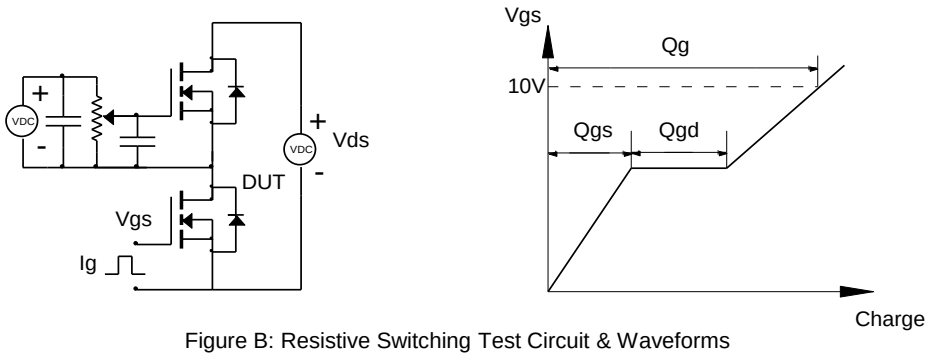



Figure B: Resistive Switching Test Circuit & Waveforms

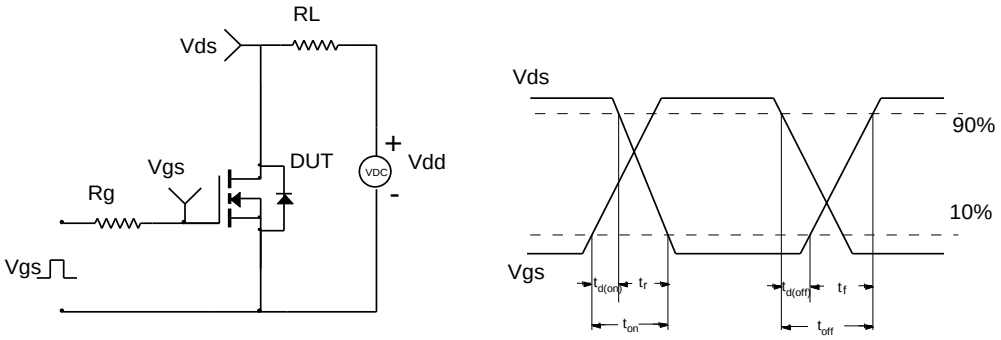



Figure C: Unclamped Inductive Switching (UIS) Test Circuit & Waveforms

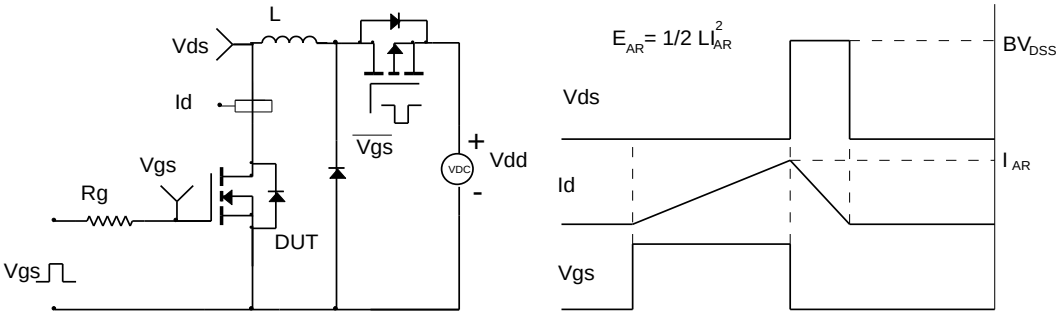
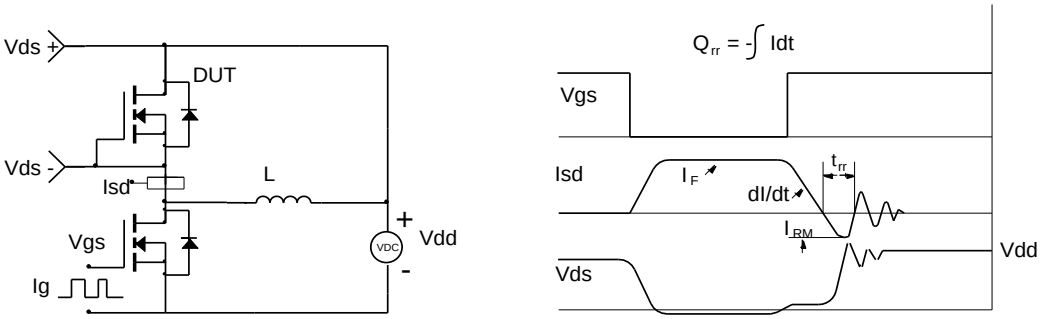



Figure D: Diode Recovery Test Circuit & Waveforms



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