



ALPHA & OMEGA
SEMICONDUCTOR

AO4456

N-Channel Enhancement Mode Field Effect Transistor

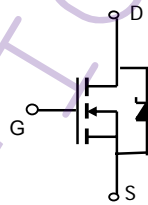
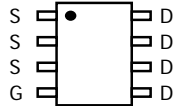


General Description

The AO4456 uses advanced trench technology with a monolithically integrated Schottky diode to provide excellent $R_{DS(ON)}$ and low gate charge. This device is suitable for use as a low side FET in SMPS, load switching and general purpose applications. *Standard Product AO4456 is Pb-free (meets ROHS & Sony 259 specifications). AO4456 is a Green Product ordering option. AO4456 and AO4456 are electrically identical.*

Features

$V_{DS} (V) = 30V$
 $I_D = 20A (V_{GS} = 10V)$
 $R_{DS(ON)} < 4.6m\Omega (V_{GS} = 10V)$
 $R_{DS(ON)} < 5.6m\Omega (V_{GS} = 4.5V)$



Absolute Maximum Ratings $T_A=25^\circ C$ unless otherwise noted

| Parameter | Symbol | Maximum | Units |
|--|----------------|------------------|------------|
| Drain-Source Voltage | V_{DS} | 30 | V |
| Gate-Source Voltage | V_{GS} | ± 12 | V |
| Continuous Drain Current ^A | I_{DSM} | $T_A=25^\circ C$ | 20 |
| | | $T_A=70^\circ C$ | 16 |
| Pulsed Drain Current ^B | I_{DM} | 120 | |
| Power Dissipation | P_{DSM} | $T_A=25^\circ C$ | 3.1 |
| | | $T_A=70^\circ C$ | 2.0 |
| Junction and Storage Temperature Range | T_J, T_{STG} | -55 to 150 | $^\circ C$ |

Thermal Characteristics

| Parameter | Symbol | Typ | Max | Units |
|--|-----------------|-----|-----|--------------|
| Maximum Junction-to-Ambient ^A | $R_{\theta JA}$ | 31 | 40 | $^\circ C/W$ |
| $t \leq 10s$ | | | | |
| Maximum Junction-to-Ambient ^A | $R_{\theta JA}$ | 59 | 75 | $^\circ C/W$ |
| Steady-State | | | | |
| Maximum Junction-to-Lead ^C | $R_{\theta JL}$ | 16 | 24 | $^\circ C/W$ |

Electrical Characteristics ($T_J=25^\circ\text{C}$ unless otherwise noted)

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|-----------------------------|--|--|-----|------------|------------|---------------|
| STATIC PARAMETERS | | | | | | |
| BV_{DSS} | Drain-Source Breakdown Voltage | $I_D=1\text{mA}, V_{GS}=0\text{V}$ | 30 | | | V |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS}=24\text{V}, V_{GS}=0\text{V}$ $T_J=125^\circ\text{C}$ | | 0.008 9 | 0.1 20 | mA |
| I_{GSS} | Gate-Body leakage current | $V_{DS}=0\text{V}, V_{GS}=\pm 12\text{V}$ | | | 0.1 | μA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}=V_{GS}, I_D=250\mu\text{A}$ | 1.4 | 1.8 | 2.4 | V |
| $I_{D(ON)}$ | On state drain current | $V_{GS}=10\text{V}, V_{DS}=5\text{V}$ | 120 | | | A |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}=10\text{V}, I_D=20\text{A}$ $T_J=125^\circ\text{C}$ | | 3.8 5.9 | 4.6 7.4 | m Ω |
| | | $V_{GS}=4.5\text{V}, I_D=20\text{A}$ | | 4.5 | 5.6 | m Ω |
| g_{FS} | Forward Transconductance | $V_{DS}=5\text{V}, I_D=20\text{A}$ | | 112 | | S |
| V_{SD} | Diode Forward Voltage | $I_S=1\text{A}, V_{GS}=0\text{V}$ | | 0.37 | 0.5 | V |
| I_S | Maximum Body-Diode + Schottky Continuous Current | | | | 5 | A |
| DYNAMIC PARAMETERS | | | | | | |
| C_{iss} | Input Capacitance | | | 6430 | 7716 | pF |
| C_{oss} | Output Capacitance | $V_{GS}=0\text{V}, V_{DS}=15\text{V}, f=1\text{MHz}$ | | 756 | | pF |
| C_{rss} | Reverse Transfer Capacitance | | | 352 | | pF |
| R_g | Gate resistance | $V_{GS}=0\text{V}, V_{DS}=0\text{V}, f=1\text{MHz}$ | | 0.9 | 1.4 | Ω |
| SWITCHING PARAMETERS | | | | | | |
| $Q_g(10\text{V})$ | Total Gate Charge | | | 96 | 115 | |
| $Q_g(4.5\text{V})$ | Total Gate Charge | $V_{GS}=10\text{V}, V_{DS}=15\text{V}, I_D=20\text{A}$ | | 44 | 53 | nC |
| Q_{gs} | Gate Source Charge | | | 17 | | nC |
| Q_{gd} | Gate Drain Charge | | | 13 | | nC |
| $t_{D(on)}$ | Turn-On Delay Time | | | 17.5 | | ns |
| t_r | Turn-On Rise Time | $V_{GS}=10\text{V}, V_{DS}=15\text{V}, R_L=0.75\Omega,$ $R_{GEN}=3\Omega$ | | 10 | | ns |
| $t_{D(off)}$ | Turn-Off Delay Time | | | 56 | | ns |
| t_f | Turn-Off Fall Time | | | 10.5 | | ns |
| t_{rr} | Body Diode Reverse Recovery Time | $I_F=20\text{A}, dI/dt=300\text{A}/\mu\text{s}$ | | 20 | 25 | ns |
| Q_{rr} | Body Diode Reverse Recovery Charge | $I_F=20\text{A}, dI/dt=300\text{A}/\mu\text{s}$ | | 26 | | nC |

A: The value of $R_{\theta JA}$ is measured with the device in a still air environment with $T_A=25^\circ\text{C}$. The power dissipation P_{DSM} and current rating I_{DSM} are based on $T_J(\text{MAX})=150^\circ\text{C}$, using $t \leq 10\text{s}$ junction-to-ambient thermal resistance.

B: Repetitive rating, pulse width limited by junction temperature $T_J(\text{MAX})=150^\circ\text{C}$.

C: The $R_{\theta JA}$ is the sum of the thermal impedance from junction to lead $R_{\theta JL}$ and lead to ambient.

D: The static characteristics in Figures 1 to 6 are obtained using $<300\text{ms}$ 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 $T_A=25^\circ\text{C}$. The SOA curve provides a single pulse rating.

Rev1: June 2006

THIS PRODUCT HAS BEEN DESIGNED AND QUALIFIED FOR THE CONSUMER MARKET. APPLICATIONS OR USES AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS ARE NOT AUTHORIZED. AOS DOES NOT ASSUME ANY LIABILITY ARISING OUT OF SUCH APPLICATIONS OR USES OF ITS PRODUCTS. AOS RESERVES THE RIGHT TO IMPROVE PRODUCT DESIGN, FUNCTIONS AND RELIABILITY WITHOUT NOTICE.

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

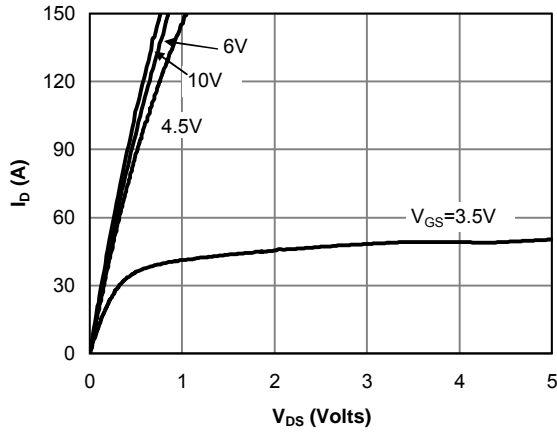


Fig 1: On-Region Characteristics

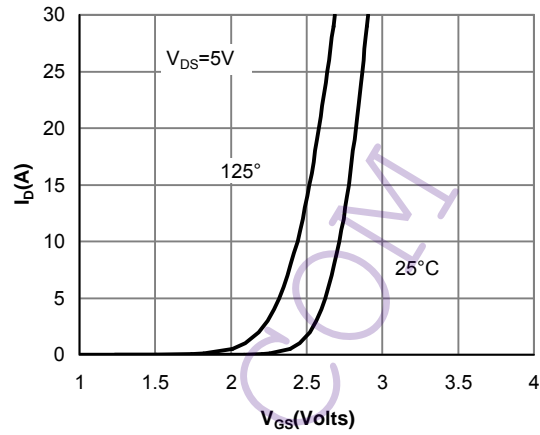


Figure 2: Transfer Characteristics

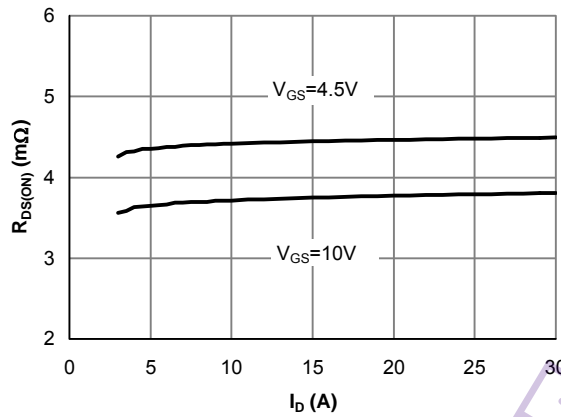


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

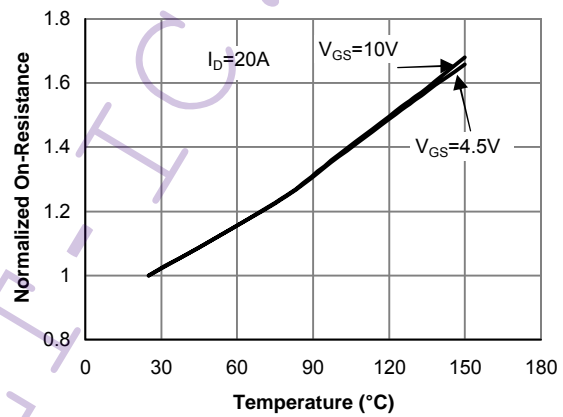


Figure 4: On-Resistance vs. Junction Temperature

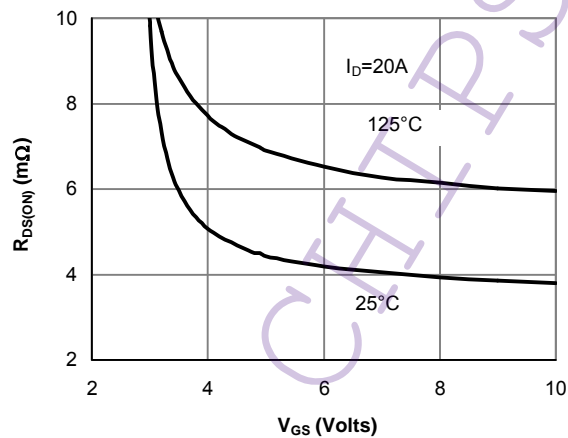


Figure 5: On-Resistance vs. Gate-Source Voltage

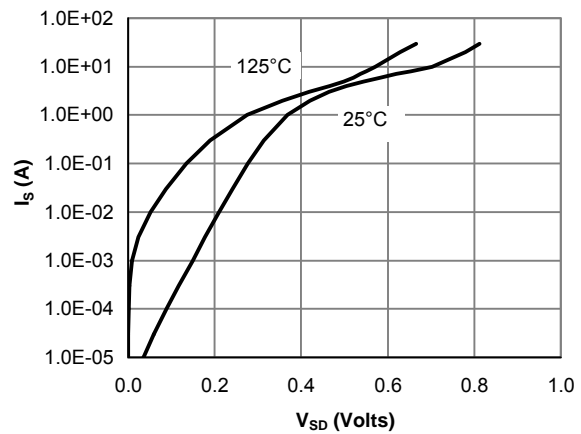


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

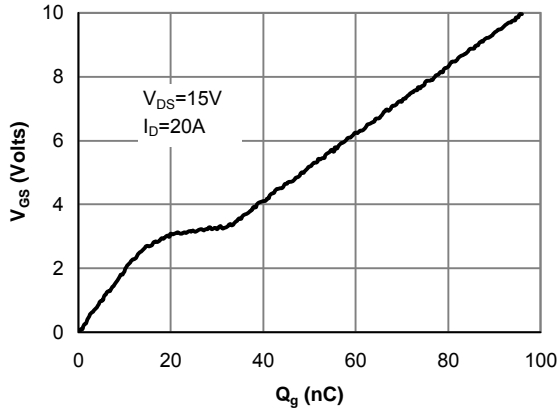


Figure 7: Gate-Charge Characteristics

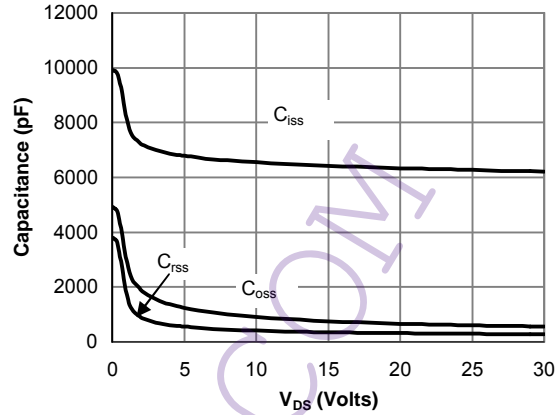


Figure 8: Capacitance Characteristics

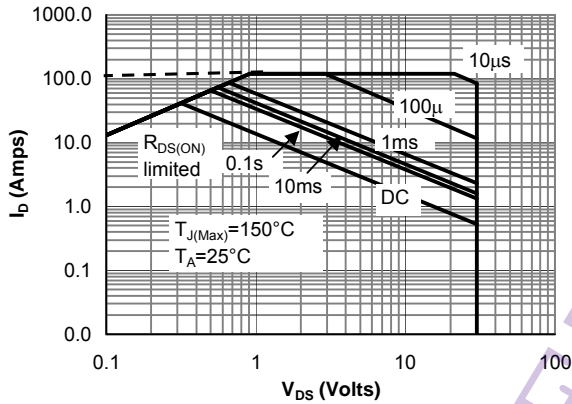


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

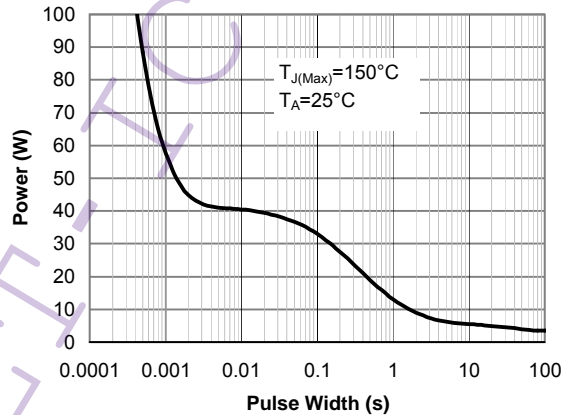


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

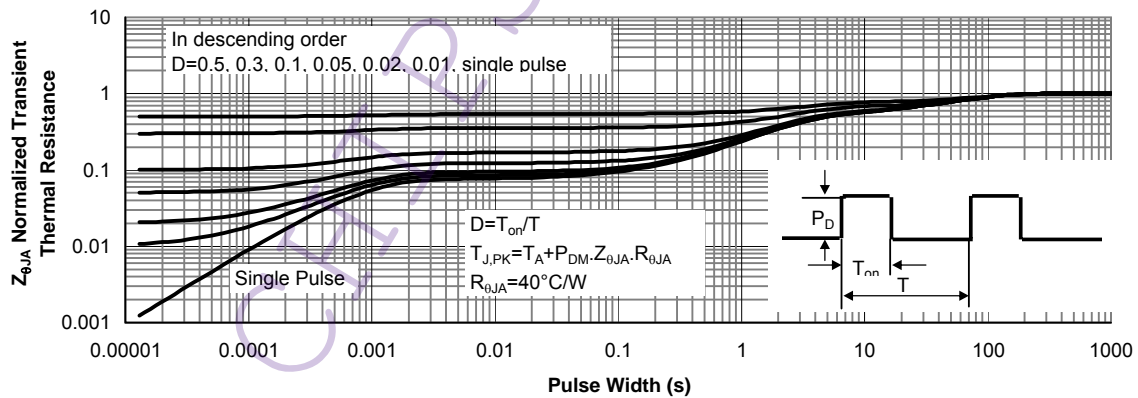


Figure 11: Normalized Maximum Transient Thermal Impedance (Note E)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

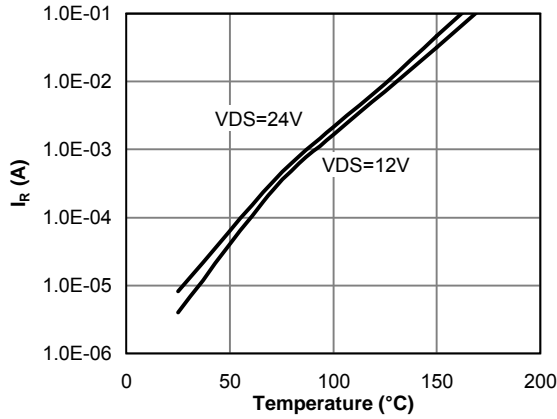


Figure 12: Diode Reverse Leakage Current vs. Junction Temperature

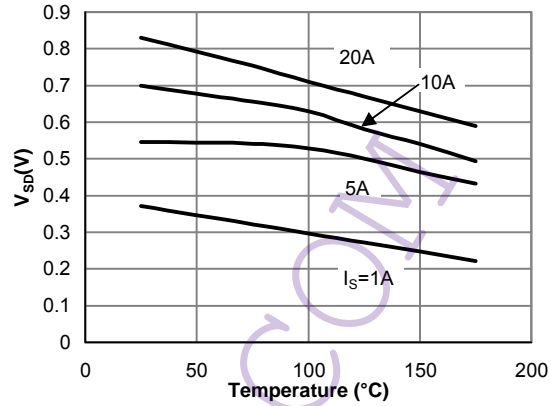


Figure 13: Diode Forward voltage vs. Junction Temperature

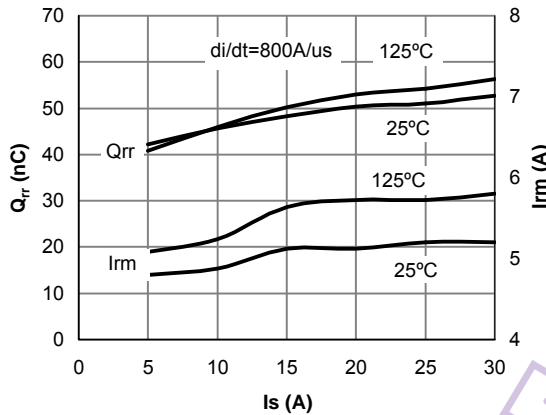


Figure 14: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current

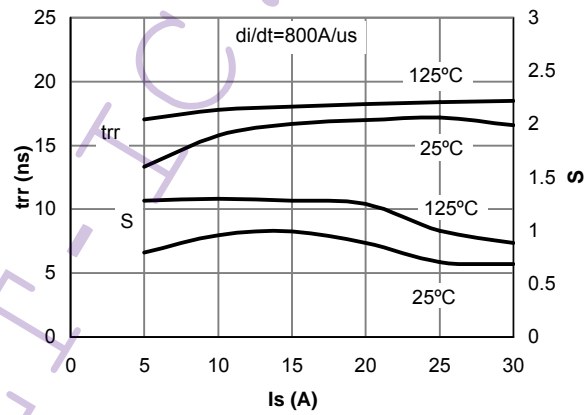


Figure 15: Diode Reverse Recovery Time and Soft Coefficient vs. Conduction Current

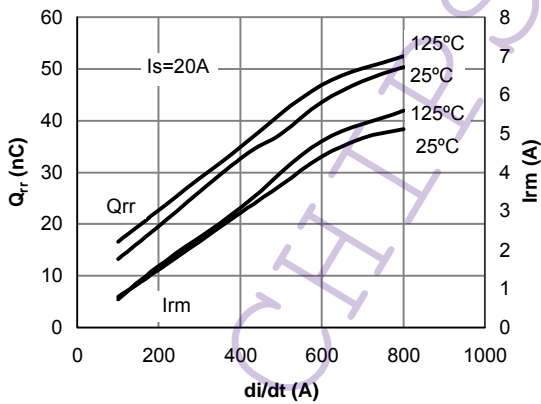


Figure 16: Diode Reverse Recovery Charge and Peak Current vs. di/dt

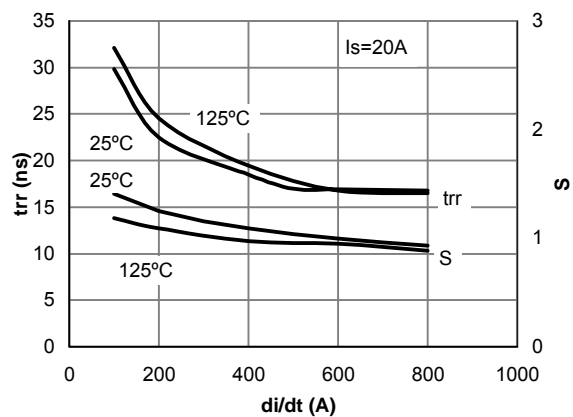


Figure 17: Diode Reverse Recovery Time and Soft Coefficient vs. di/dt