# AO4704

## N-Channel Enhancement Mode Field Effect Transistor with Schottky Diode

### General Description

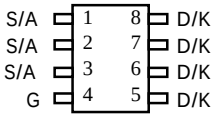
The AO4704 uses advanced trench technology to provide excellent $R_{DS(ON)}$, shoot-through immunity and body diode characteristics.This device is suitable for use as a synchronous switch in PWM applications. The co-packaged Schottky Diode boosts efficiency further. *AO4704 is Pb-free (meets ROHS & Sony 259 specifications). AO4704L is a Green Product ordering option. AO4704 and AO4704L are electrically identical.*

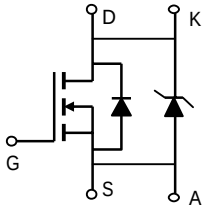
### Features

$V_{DS}$ (V) = 30V
$I_D$ = 13 A ($V_{GS}$ = 10V)
$R_{DS(ON)}$ < 11.5mΩ ($V_{GS}$ = 10V)
$R_{DS(ON)}$ < 13mΩ ($V_{GS}$ = 4.5V)

**SCHOTTKY**
VDS (V) = 30V, IF = 3A, VF<0.5V@1A

**SOIC-8**




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

| Parameter | | Symbol | MOSFET | Schottky | Units |
|---|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 30 | | V |
| Gate-Source Voltage | | $V_{GS}$ | ±12 | | V |
| Continuous Drain Current[A] | $T_A$=25°C | $I_D$ | 13 | | A |
| | $T_A$=70°C | | 10.4 | | |
| Pulsed Drain Current[B] | | $I_{DM}$ | 40 | | |
| Schottky reverse voltage | | $V_{KA}$ | | 30 | V |
| Continuous Forward Current[A] | $T_A$=25°C | $I_F$ | | 4.4 | A |
| | $T_A$=70°C | | | 3.2 | |
| Pulsed Diode Forward Current[B] | | $I_{FM}$ | | 30 | |
| Power Dissipation | $T_A$=25°C | $P_D$ | 3.1 | 3.1 | W |
| | $T_A$=70°C | | 2 | 2 | |
| Junction and Storage Temperature Range | | $T_J$, $T_{STG}$ | -55 to 150 | -55 to 150 | °C |

| **Thermal Characteristics** | | | | | |
|---|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Typ** | **Max** | **Units** |
| Maximum Junction-to-Ambient[A] | t ≤ 10s | $R_{\theta JA}$ | 28 | 40 | °C/W |
| Maximum Junction-to-Ambient[A] | Steady-State | | 54 | 75 | °C/W |
| Maximum Junction-to-Lead[C] | Steady-State | $R_{\theta JL}$ | 21 | 30 | °C/W |

| **Thermal Characteristics: Schottky** | | | | | |
|---|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Typ** | **Max** | **Units** |
| Maximum Junction-to-Ambient[A] | t ≤ 10s | $R_{\theta JA}$ | 36 | 40 | °C/W |
| Maximum Junction-to-Ambient[A] | Steady-State | | 67 | 75 | °C/W |
| Maximum Junction-to-Lead[C] | Steady-State | $R_{\theta JL}$ | 25 | 30 | °C/W |

A: The value of $R_{\theta JA}$ 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. 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 80 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 Schottky appears in parallel with the MOSFET body diode, even though it is a separate chip. Therefore, we provide the net forward drop, capacitance and recovery characteristics of the MOSFET and Schottky. However, the thermal resistance is specified for each chip separately.

Rev5: August 2005

**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. (Set by Schottky leakage) | $V_R$=30V | | 0.007 | 0.05 | mA |
| | | $V_R$=30V, $T_J$=125°C | | 3.2 | 10 | |
| | | $V_R$=30V, $T_J$=150°C | | 12 | 20 | |
| $I_{GSS}$ | 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 | 0.6 | 1.1 | 2 | V |
| $I_{D(ON)}$ | On state drain current | $V_{GS}$=4.5V, $V_{DS}$=5V | 40 | | | A |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}$=10V, ID=13A | | 9.1 | 11.5 | mΩ |
| | | $T_J$=125°C | | 13.3 | 16.5 | |
| | | $V_{GS}$=4.5V, $I_D$=12.2A | | 10.5 | 13 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$=5V, $I_D$=13A | 30 | 37 | | S |
| $V_{SD}$ | Diode + Schottky Forward Voltage | $I_S$=1A,$V_{GS}$=0V | | 0.45 | 0.5 | V |
| $I_S$ | Maximum Body-Diode + Schottky Continuous Current | | | | 5 | A |
| **DYNAMIC PARAMETERS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=15V, f=1MHz | | 3656 | 4050 | pF |
| $C_{oss}$ | Output Capacitance (FET+Schottky) | | | 322 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 168 | | pF |
| $R_g$ | Gate resistance | $V_{GS}$=0V, $V_{DS}$=0V, f=1MHz | | 0.86 | 1.1 | Ω |
| **SWITCHING PARAMETERS** | | | | | | |
| $Q_g$(4.5V) | Total Gate Charge | $V_{GS}$=10V, $V_{DS}$=15V, $I_D$=13A | | 30.5 | 36 | nC |
| $Q_{gs}$ | Gate Source Charge | | | 4.6 | | nC |
| $Q_{gd}$ | Gate Drain Charge | | | 8.6 | | nC |
| $t_{D(on)}$ | Turn-On DelayTime | $V_{GS}$=10V, $V_{DS}$=15V, $R_L$=1.1Ω, $R_{GEN}$=0Ω | | 6.2 | 9 | ns |
| $t_r$ | Turn-On Rise Time | | | 4.8 | 7 | ns |
| $t_{D(off)}$ | Turn-Off DelayTime | | | 55 | 75 | ns |
| $t_f$ | Turn-Off Fall Time | | | 7.3 | 11 | ns |
| $t_{rr}$ | Body Diode+Schottky Reverse Recovery Time | $I_F$=13A, dI/dt=100A/µs | | 20.3 | 25 | ns |
| $Q_{rr}$ | Body Diode+Schottky Reverse Recovery Charge | $I_F$=13A, dI/dt=100A/µs | | 8.4 | 12.5 | nC |

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## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

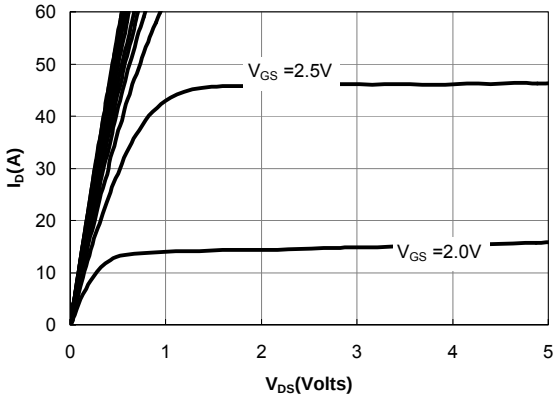


**Figure 1: On-Regions CharacteristiCS**

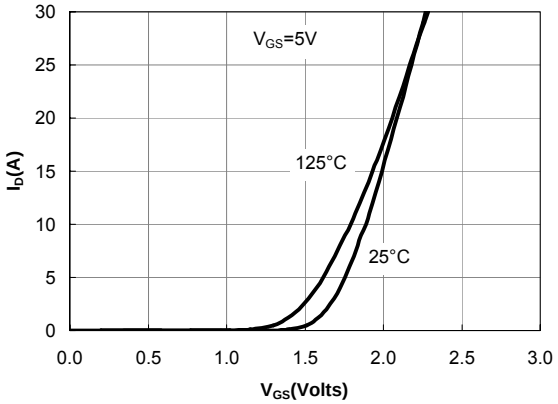


**Figure 2: Transfer Characteristics**

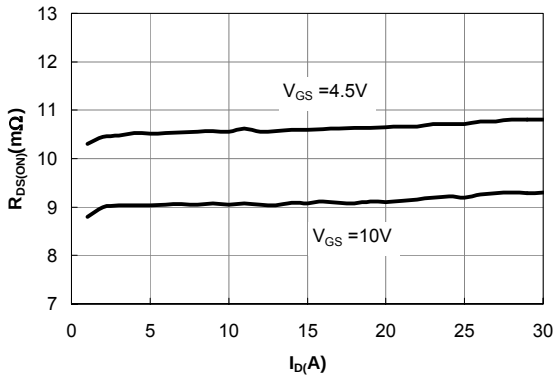


**Figure 3: On-Resistance vs. Drain Current and Gate Voltage**

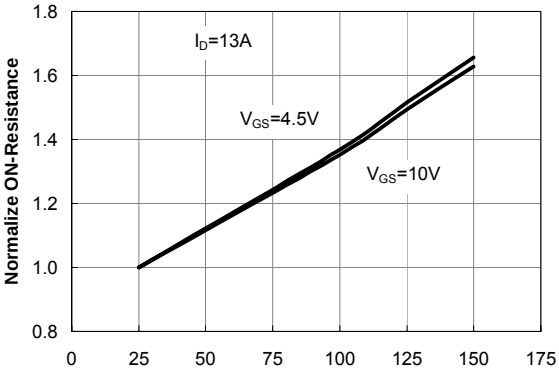


**Figure 4: On-Resistance vs. Junction Temperature**

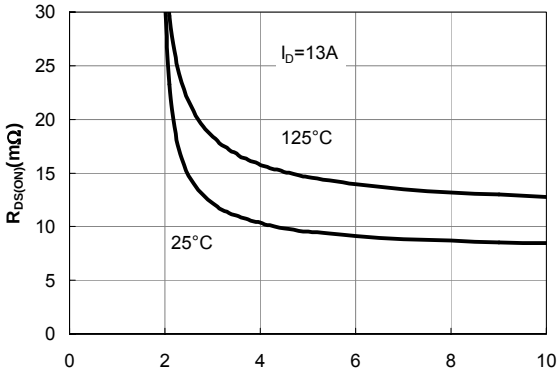


**Figure 5: On-Resistance vs. Gate-Source Voltage**

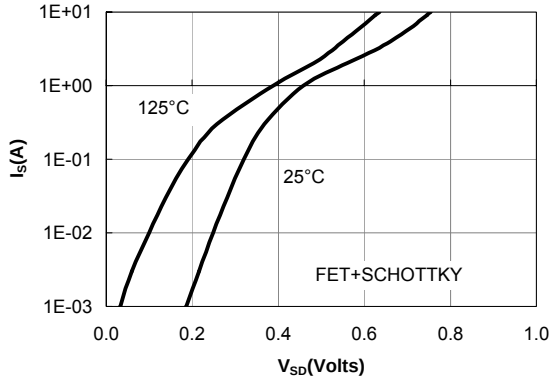


**Figure 6: Body-Diode Characteristics (Note F)**

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

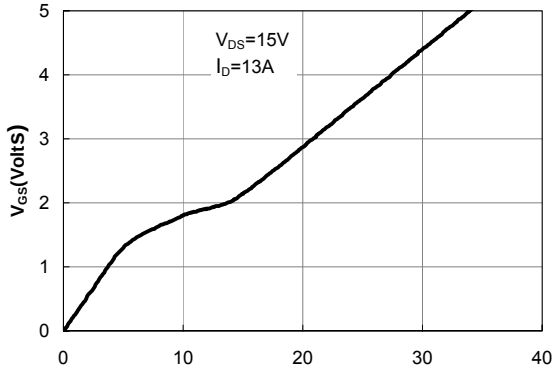


**Figure 7: Gate-Charge Characteristics**

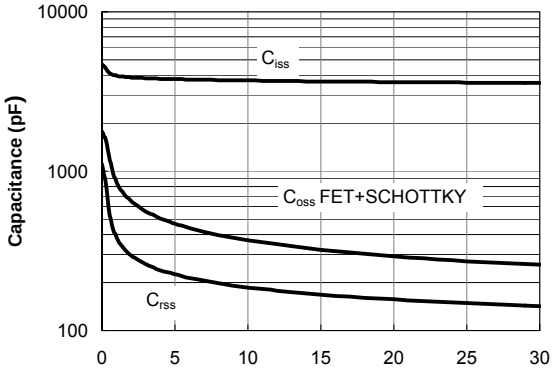


**Figure 8: Capacitance Characteristics**

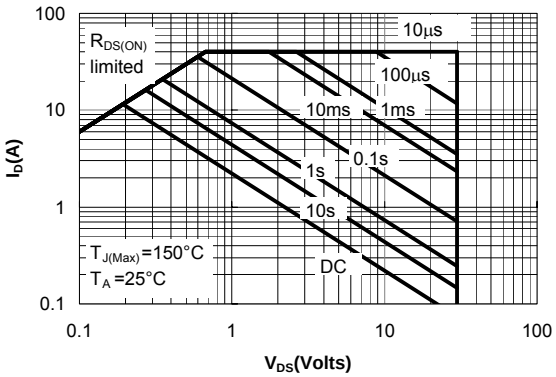


**Figure 9: Maximum Forward Biased Safe Operating Area (Note E)**

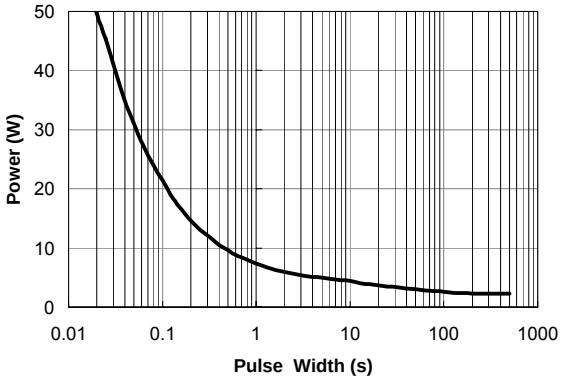


**Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)**

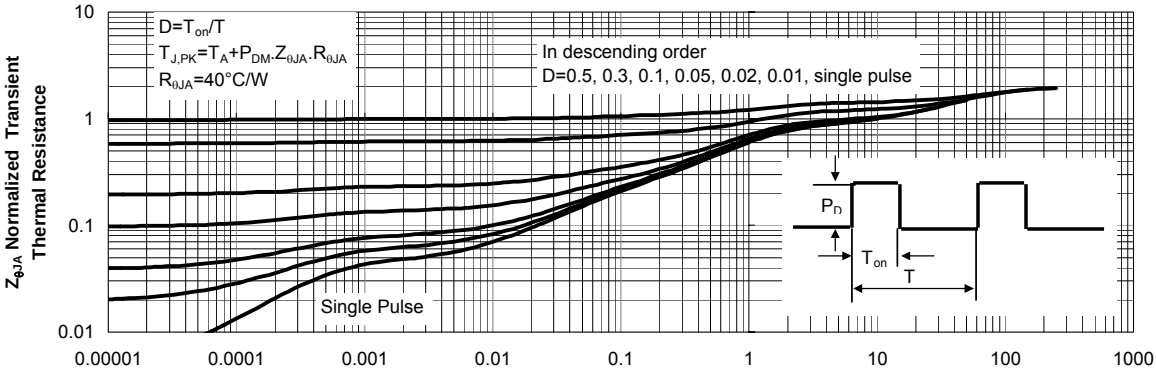


**Figure 11: Normalized Maximum Transient Thermal Impedence**