



**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.

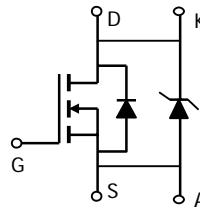
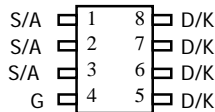
**Features**

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

**SCHOTTKY**

$V_{DS}$  (V) = 30V,  $I_F$  = 3A,  $V_F < 0.5V @ 1A$

**SOIC-8**



**Absolute Maximum Ratings  $T_A=25^\circ\text{C}$  unless otherwise noted**

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

Thermal Characteristics					
Parameter		Symbol	Typ	Max	Units
Maximum Junction-to-Ambient <sup>A</sup>	t ≤ 10s	R <sub>θJA</sub>	28	40	°C/W
Maximum Junction-to-Ambient <sup>A</sup>	Steady-State		54	75	°C/W
Maximum Junction-to-Lead <sup>C</sup>	Steady-State	R <sub>θJL</sub>	21	30	°C/W

Thermal Characteristics: Schottky					
Parameter		Symbol	Typ	Max	Units
Maximum Junction-to-Ambient <sup>A</sup>	t ≤ 10s	R <sub>θJA</sub>	36	40	°C/W
Maximum Junction-to-Ambient <sup>A</sup>	Steady-State		67	75	°C/W
Maximum Junction-to-Lead <sup>C</sup>	Steady-State	R <sub>θJL</sub>	25	30	°C/W

A: The value of R<sub>θJA</sub> is measured with the device mounted on 1in<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with T<sub>A</sub>=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<sub>θJA</sub> is the sum of the thermal impedance from junction to lead R<sub>θJL</sub> 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<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with T<sub>A</sub>=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

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.

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>STATIC PARAMETERS</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$I_D=250\mu\text{A}$ , $V_{GS}=0\text{V}$	30			V
$I_{DSS}$	Zero Gate Voltage Drain Current. (Set by Schottky leakage)	$V_R=30\text{V}$		0.007	0.05	mA
		$V_R=30\text{V}$ , $T_J=125^\circ\text{C}$		3.2	10	
		$V_R=30\text{V}$ , $T_J=150^\circ\text{C}$		12	20	
$I_{GSS}$	Gate-Body leakage current	$V_{DS}=0\text{V}$ , $V_{GS}=\pm 12\text{V}$			100	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}$ , $I_D=250\mu\text{A}$	0.6	1.1	2	V
$I_{D(ON)}$	On state drain current	$V_{GS}=4.5\text{V}$ , $V_{DS}=5\text{V}$	40			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS}=10\text{V}$ , $I_D=13\text{A}$		9.1	11.5	m $\Omega$
		$T_J=125^\circ\text{C}$		13.3	16.5	
		$V_{GS}=4.5\text{V}$ , $I_D=12.2\text{A}$		10.5	13	m $\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS}=5\text{V}$ , $I_D=13\text{A}$	30	37		S
$V_{SD}$	Diode + Schottky Forward Voltage	$I_S=1\text{A}$ , $V_{GS}=0\text{V}$		0.45	0.5	V
$I_S$	Maximum Body-Diode + Schottky Continuous Current				5	A
<b>DYNAMIC PARAMETERS</b>						
$C_{iss}$	Input Capacitance	$V_{GS}=0\text{V}$ , $V_{DS}=15\text{V}$ , $f=1\text{MHz}$		3656	4050	pF
$C_{oss}$	Output Capacitance (FET+Schottky)			322		pF
$C_{rss}$	Reverse Transfer Capacitance			168		pF
$R_g$	Gate resistance	$V_{GS}=0\text{V}$ , $V_{DS}=0\text{V}$ , $f=1\text{MHz}$		0.86	1.1	$\Omega$
<b>SWITCHING PARAMETERS</b>						
$Q_g(4.5\text{V})$	Total Gate Charge	$V_{GS}=10\text{V}$ , $V_{DS}=15\text{V}$ , $I_D=13\text{A}$		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	$V_{GS}=10\text{V}$ , $V_{DS}=15\text{V}$ , $R_L=1.1\Omega$ , $R_{GEN}=0\Omega$		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		$I_F=13\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$		20.3	25
$Q_{rr}$	Body Diode+Schottky Reverse Recovery Charge	$I_F=13\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$		8.4	12.5	nC

A: The value of  $R_{\theta JA}$  is measured with the device mounted on 1 in<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with  $T_A=25^\circ\text{C}$ . The value in any given application depends on the user's specific board design. The current rating is based on the  $t \leq 10\text{s}$  thermal resistance rating.

B: Repetitive rating, pulse width limited by junction temperature.

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 80  $\mu\text{s}$  pulses, duty cycle 0.5% max.

E: These tests are performed with the device mounted on 1 in<sup>2</sup> 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.

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.

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

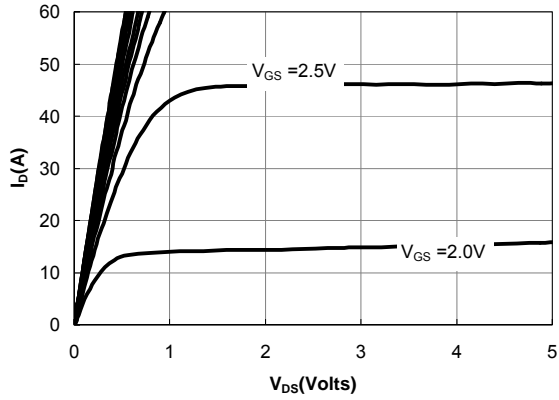


Figure 1: On-Regions Characteristics

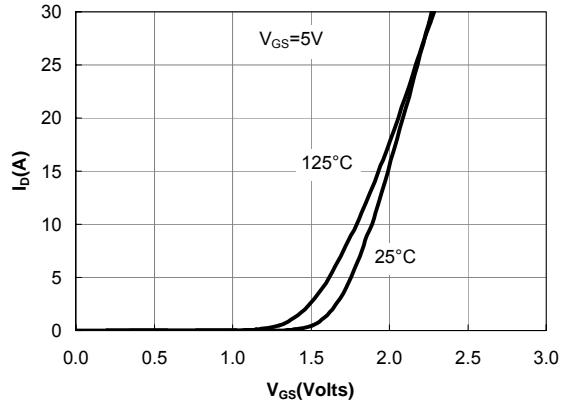


Figure 2: Transfer Characteristics

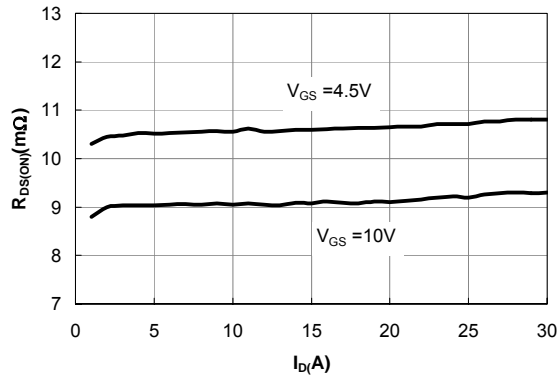


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

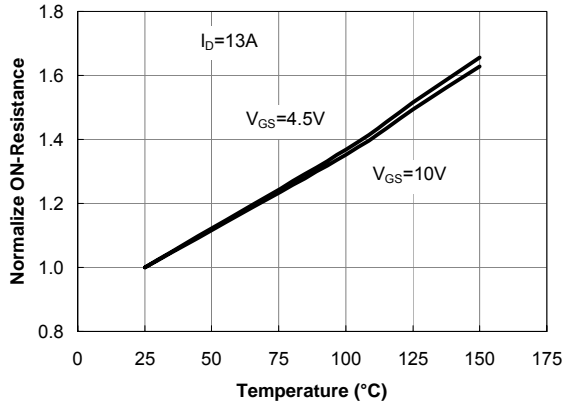


Figure 4: On-Resistance vs. Junction Temperature

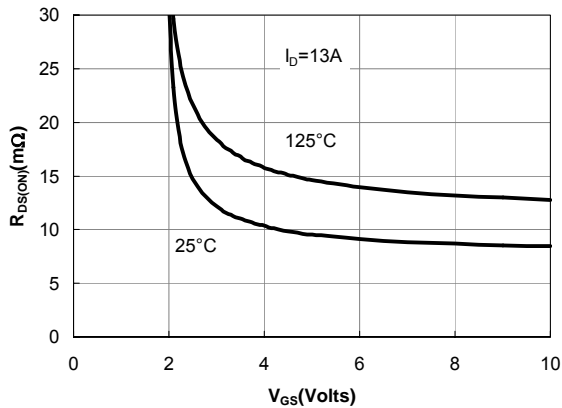


Figure 5: On-Resistance vs. Gate-Source Voltage

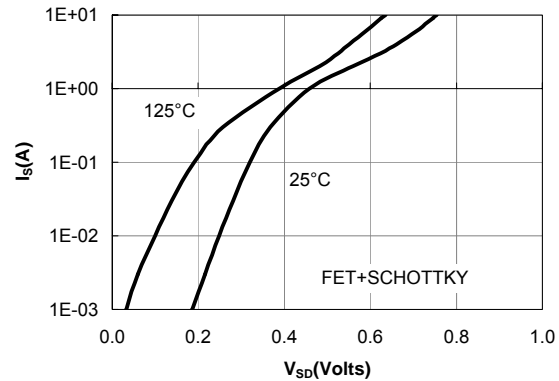


Figure 6: Body-Diode Characteristics (Note F)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

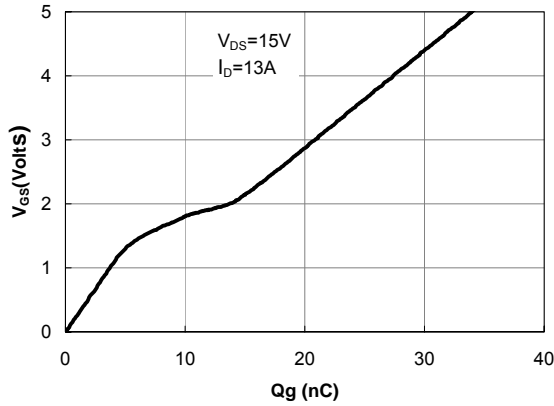


Figure 7: Gate-Charge Characteristics

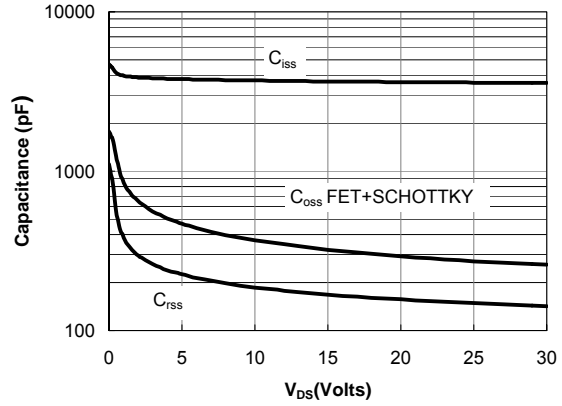


Figure 8: Capacitance Characteristics

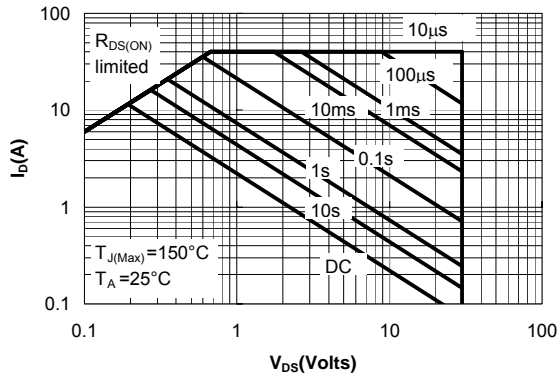


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

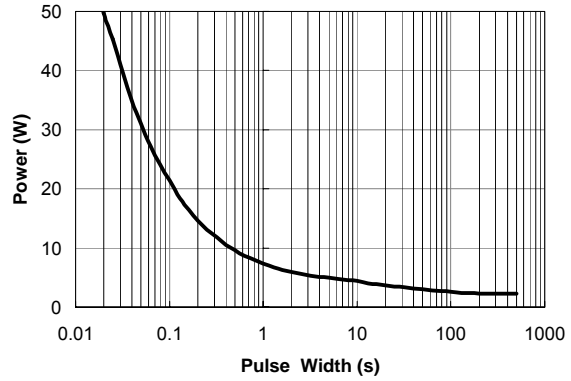


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

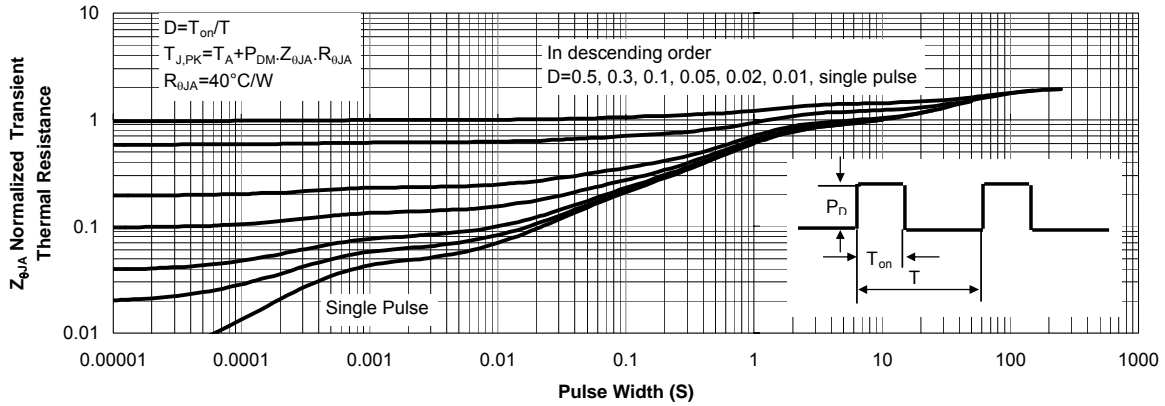


Figure 11: Normalized Maximum Transient Thermal Impedance