



**ALPHA & OMEGA**  
SEMICONDUCTOR



## 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.

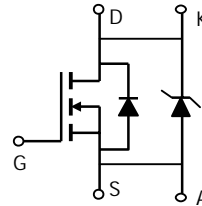
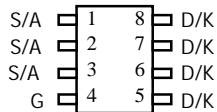
#### Features

$V_{DS}$  (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>	$I_D$	13		A
		10.4		
Pulsed Drain Current <sup>B</sup>	$I_{DM}$	40		
Schottky reverse voltage	$V_{KA}$		30	V
Continuous Forward Current <sup>A</sup>	$I_F$		4.4	A
			3.2	
Pulsed Diode Forward Current <sup>B</sup>	$I_{FM}$		30	
Power Dissipation	$P_D$	3.1	3.1	W
		2	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>	$t \leq 10s$	$R_{\theta JA}$	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	$R_{\theta JL}$	21	30	°C/W

Thermal Characteristics: Schottky					
Parameter		Symbol	Typ	Max	Units
Maximum Junction-to-Ambient <sup>A</sup>	$t \leq 10s$	$R_{\theta JA}$	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	$R_{\theta JL}$	25	30	°C/W

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

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Electrical Characteristics (T<sub>J</sub>=25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>STATIC PARAMETERS</b>						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	I <sub>D</sub> =250μA, V <sub>GS</sub> =0V	30			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current. (Set by Schottky leakage)	V <sub>R</sub> =30V		0.007	0.05	mA
		V <sub>R</sub> =30V, T <sub>J</sub> =125°C		3.2	10	
		V <sub>R</sub> =30V, T <sub>J</sub> =150°C		12	20	
I <sub>GSS</sub>	Gate-Body leakage current	V <sub>DS</sub> =0V, V <sub>GS</sub> = ±12V			100	nA
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> =V <sub>GS</sub> I <sub>D</sub> =250μA	0.6	1.1	2	V
I <sub>D(ON)</sub>	On state drain current	V <sub>GS</sub> =4.5V, V <sub>DS</sub> =5V	40			A
R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> =10V, I <sub>D</sub> =13A		9.1	11.5	mΩ
		T <sub>J</sub> =125°C		13.3	16.5	
		V <sub>GS</sub> =4.5V, I <sub>D</sub> =12.2A		10.5	13	mΩ
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> =5V, I <sub>D</sub> =13A	30	37		S
V <sub>SD</sub>	Diode + Schottky Forward Voltage	I <sub>S</sub> =1A, V <sub>GS</sub> =0V		0.45	0.5	V
I <sub>S</sub>	Maximum Body-Diode + Schottky Continuous Current				5	A
<b>DYNAMIC PARAMETERS</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> =0V, V <sub>DS</sub> =15V, f=1MHz		3656	4050	pF
C <sub>oss</sub>	Output Capacitance (FET+Schottky)			322		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			168		pF
R <sub>g</sub>	Gate resistance	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz		0.86	1.1	Ω
<b>SWITCHING PARAMETERS</b>						
Q <sub>g</sub> (4.5V)	Total Gate Charge	V <sub>GS</sub> =10V, V <sub>DS</sub> =15V, I <sub>D</sub> =13A		30.5	36	nC
Q <sub>gs</sub>	Gate Source Charge			4.6		nC
Q <sub>gd</sub>	Gate Drain Charge			8.6		nC
t <sub>D(on)</sub>	Turn-On DelayTime	V <sub>GS</sub> =10V, V <sub>DS</sub> =15V, R <sub>L</sub> =1.1Ω, R <sub>GEN</sub> =0Ω		6.2	9	ns
t <sub>r</sub>	Turn-On Rise Time			4.8	7	ns
t <sub>D(off)</sub>	Turn-Off DelayTime			55	75	ns
t <sub>f</sub>	Turn-Off Fall Time			7.3	11	ns
t <sub>rr</sub>	Body Diode+Schottky Reverse Recovery Time	I <sub>F</sub> =13A, dI/dt=100A/μs		20.3	25	ns
Q <sub>rr</sub>	Body Diode+Schottky Reverse Recovery Charge	I <sub>F</sub> =13A, dI/dt=100A/μs		8.4	12.5	nC

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## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

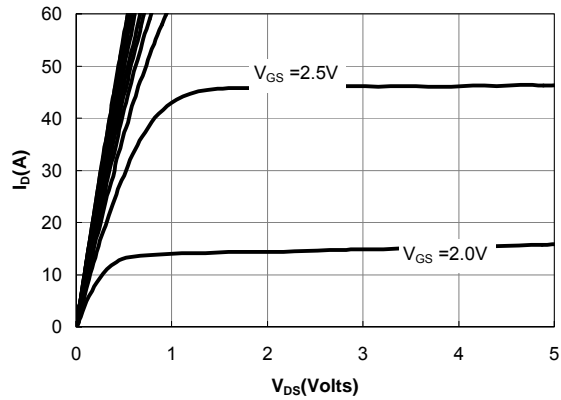


Figure 1: On-Regions Characteristics

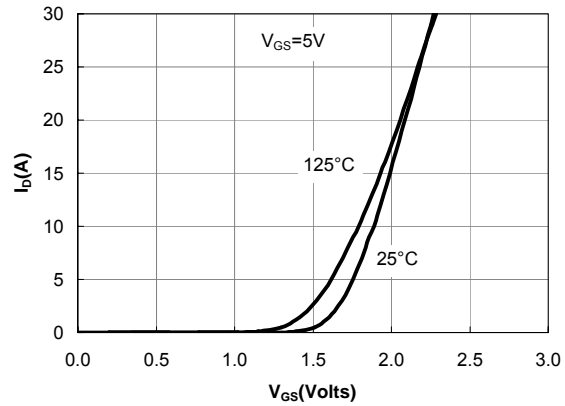


Figure 2: Transfer Characteristics

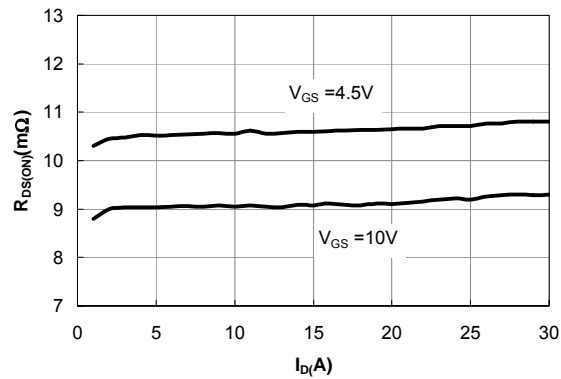


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

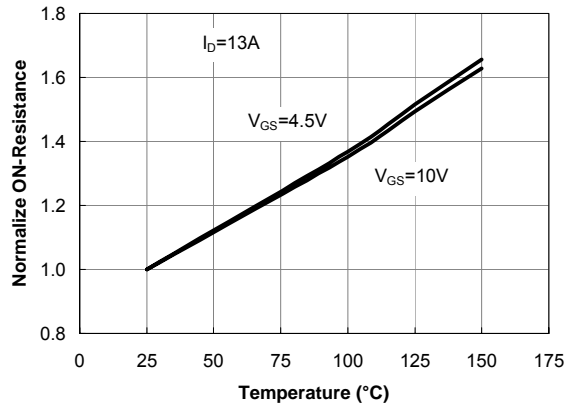


Figure 4: On-Resistance vs. Junction Temperature

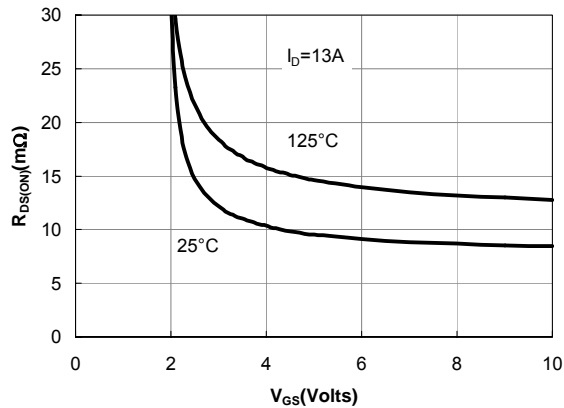
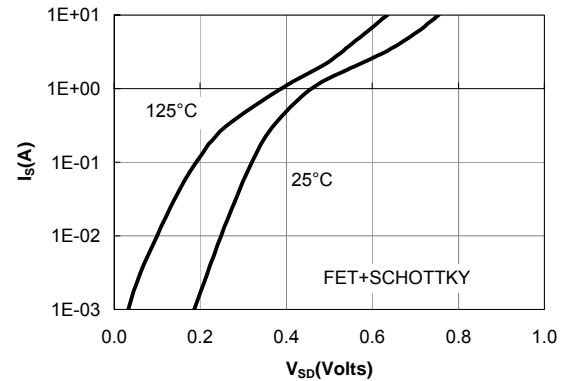


Figure 5: On-Resistance vs. Gate-Source Voltage

Figure 6: Body-Diode Characteristics  
(Note F)

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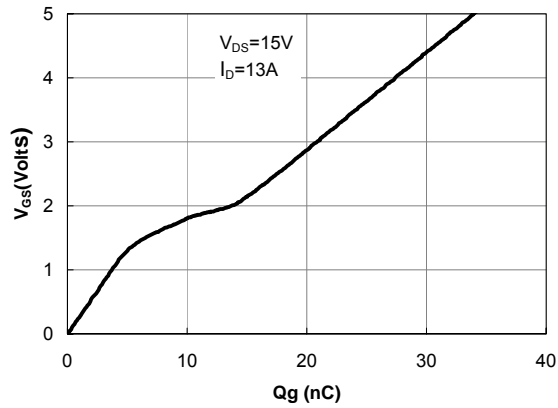


Figure 7: Gate-Charge Characteristics

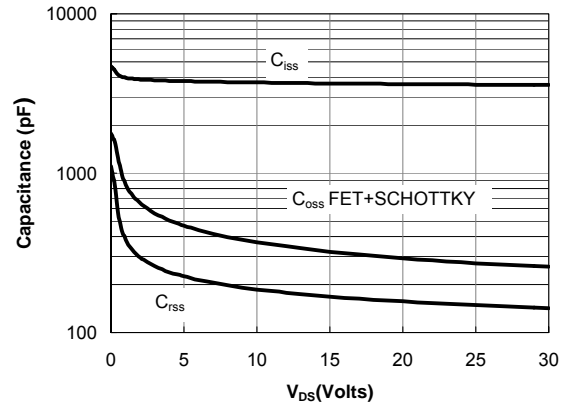


Figure 8: Capacitance Characteristics

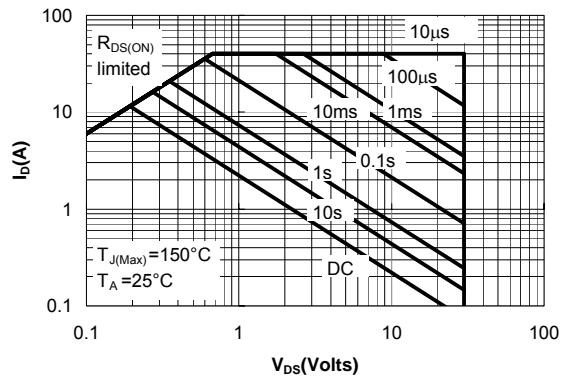


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

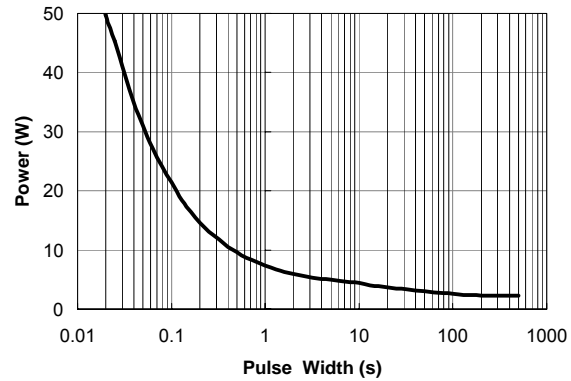


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

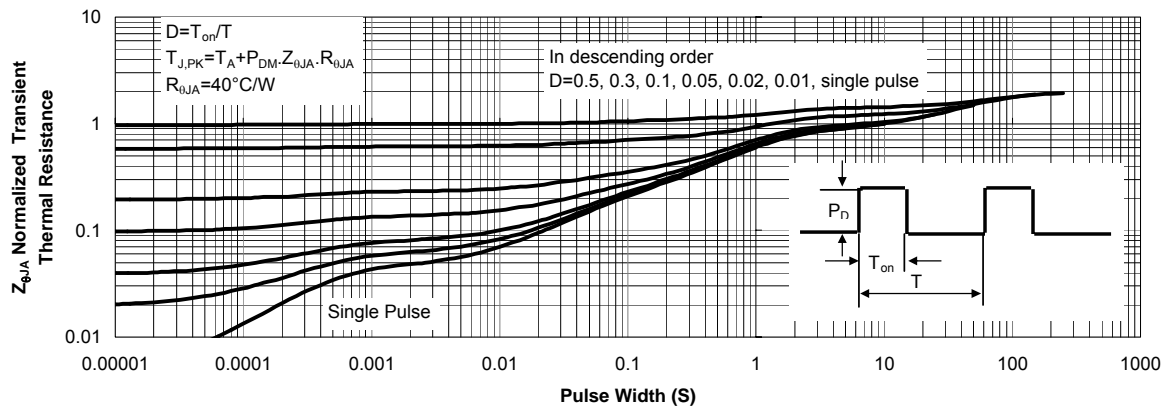


Figure 11: Normalized Maximum Transient Thermal Impedance