


**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).

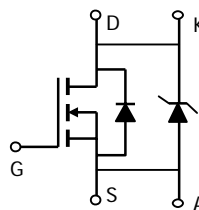
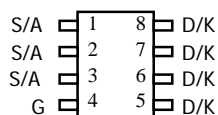
**Features**

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

**SCHOTTKY**

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

**UIS TESTED!**  
**Rg, Ciss, Coss, Crss Tested**

**SOIC-8**

**Absolute Maximum Ratings  $T_A=25^\circ C$  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>AF</sup>	$I_D$	$T_A=25^\circ C$	13	A
		$T_A=70^\circ C$	10.4	
Pulsed Drain Current <sup>B</sup>	$I_{DM}$	40		
Schottky reverse voltage	$V_{KA}$		30	V
Continuous Forward Current <sup>AF</sup>	$I_F$	$T_A=25^\circ C$	4.4	A
		$T_A=70^\circ C$	3.2	
Pulsed Diode Forward Current <sup>B</sup>	$I_{FM}$		30	
Power Dissipation	$P_D$	$T_A=25^\circ C$	3.1	W
		$T_A=70^\circ C$	2	
Avalanche Current <sup>B</sup>	$I_{AR}$	20		A
Repetitive avalanche energy 0.3mH <sup>B</sup>	$E_{AR}$	60		mJ
Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 to 150	-55 to 150	$^\circ C$

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 2 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.

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 <300 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<sub>A</sub>=25°C. The SOA curve provides a single pulse rating.

F: The current rating is based on the t ≤ 10s junction to ambient thermal resistance rating.

G: 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 ( $T_J=25^\circ\text{C}$  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	235	pF
$R_g$	Gate resistance	$V_{GS}=0\text{V}$ , $V_{DS}=0\text{V}$ , $f=1\text{MHz}$	0.4	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

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

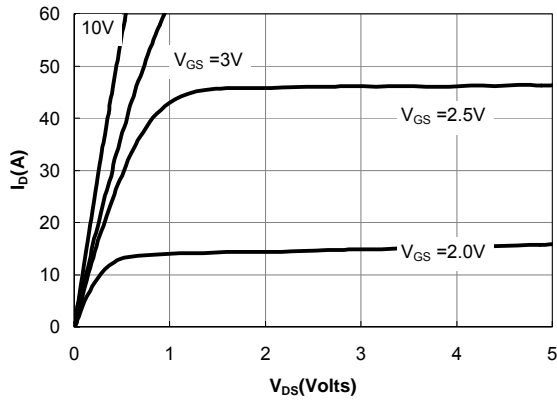


Figure 1: On-Regions Characteristics

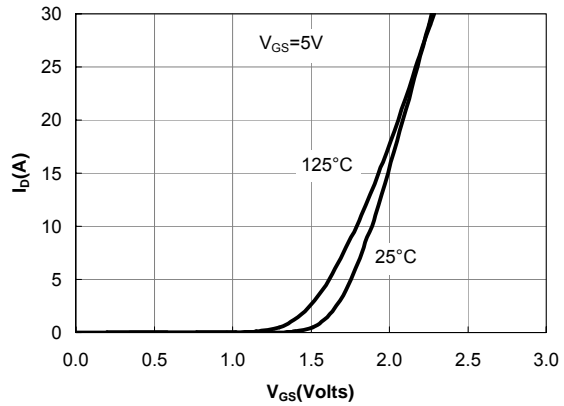


Figure 2: Transfer Characteristics

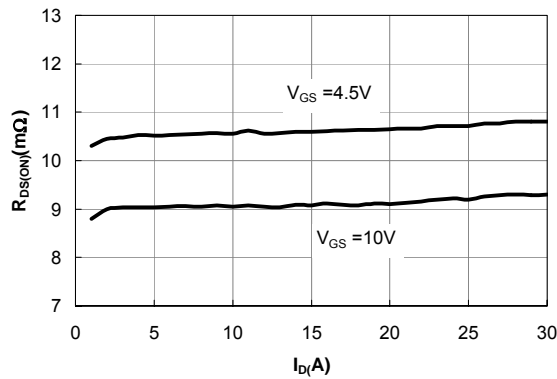


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

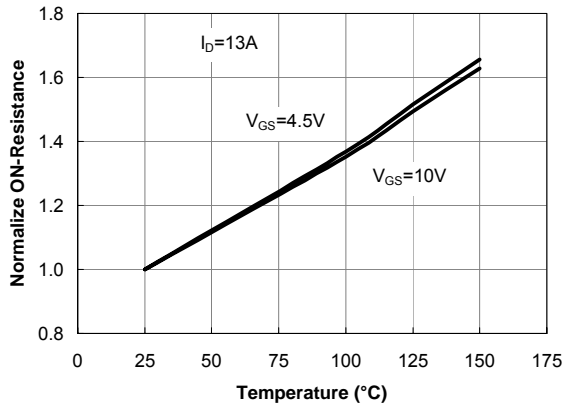


Figure 4: On-Resistance vs. Junction Temperature

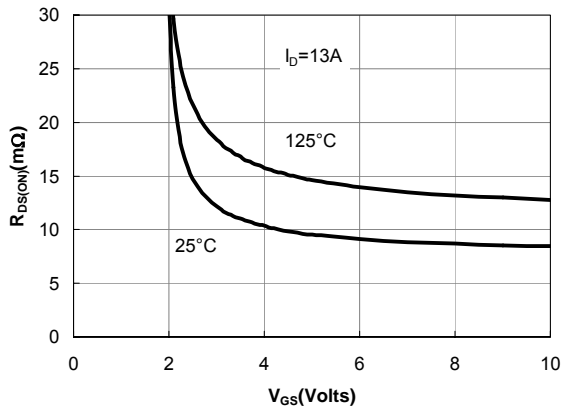


Figure 5: On-Resistance vs. Gate-Source Voltage

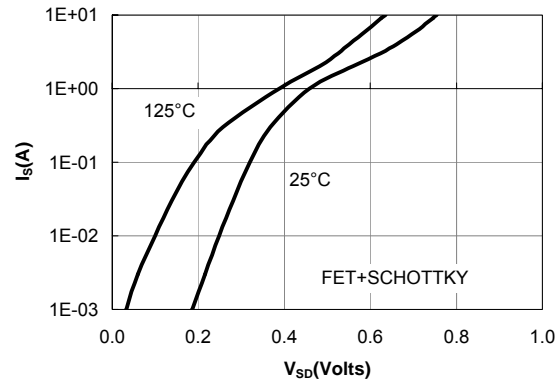


Figure 6: Body-Diode Characteristics (Note F)

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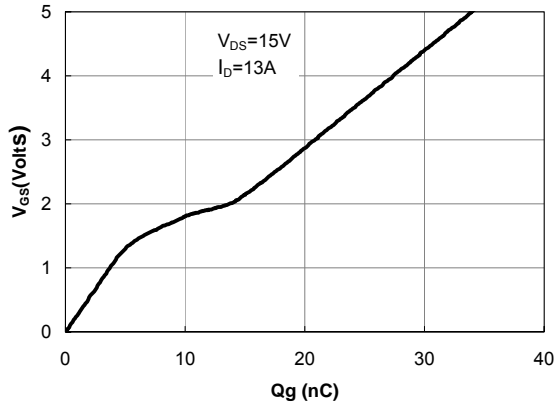


Figure 7: Gate-Charge Characteristics

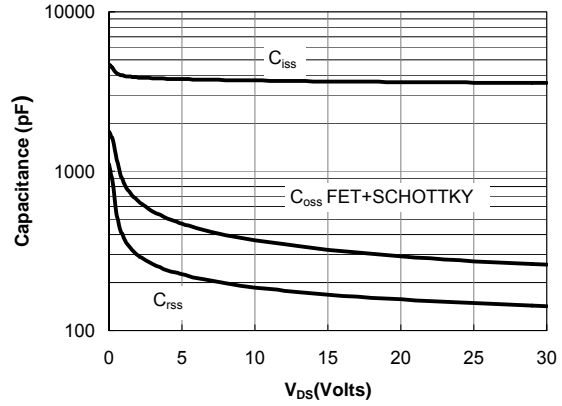


Figure 8: Capacitance Characteristics

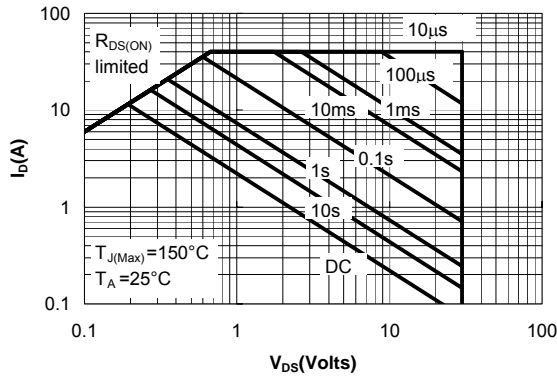


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

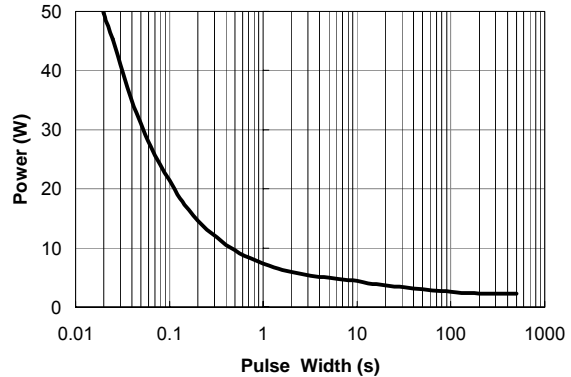


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

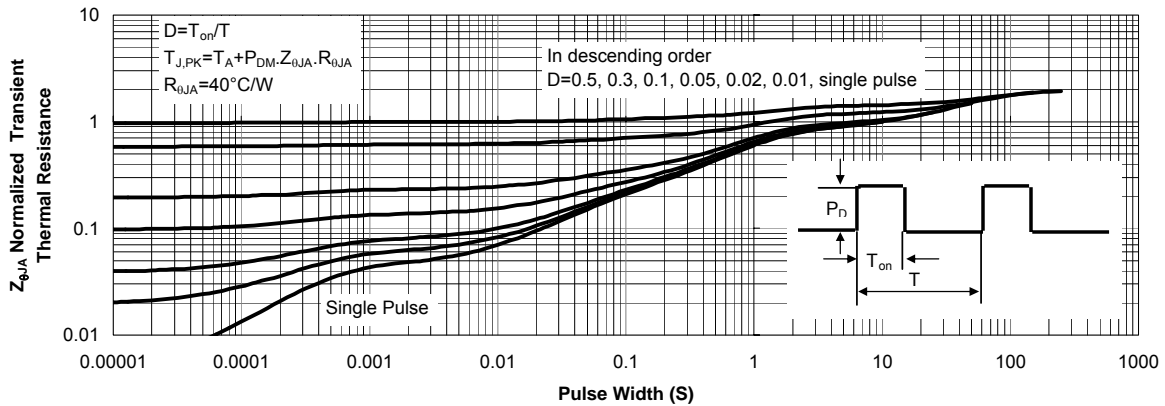


Figure 11: Normalized Maximum Transient Thermal Impedance