

## General Description

The AO6404 uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and operation with gate voltages as low as 1.8V while retaining a 12V  $V_{GS(MAX)}$  rating. It is ESD protected. Standard Product AO6404 is Pb-free (meets ROHS & Sony 259 specifications). AO6404L is a Green Product ordering option. AO6404 and AO6404L are electrically identical.

## Features

$V_{DS}$  (V) = 20V

$I_D$  = 8.6A ( $V_{GS}$  = 10V)

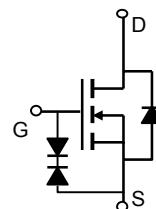
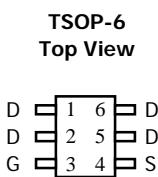
$R_{DS(ON)}$  < 17mΩ ( $V_{GS}$  = 10V)

$R_{DS(ON)}$  < 18mΩ ( $V_{GS}$  = 4.5V)

$R_{DS(ON)}$  < 24mΩ ( $V_{GS}$  = 2.5V)

$R_{DS(ON)}$  < 33mΩ ( $V_{GS}$  = 1.8V)

ESD Rating: 2000V HBM



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

Parameter	Symbol	Maximum	Units
Drain-Source Voltage	$V_{DS}$	20	V
Gate-Source Voltage	$V_{GS}$	$\pm 12$	V
Continuous Drain Current <sup>A</sup>	$I_D$	8.6	A
$T_A=70^\circ\text{C}$		6.8	
Pulsed Drain Current <sup>B</sup>	$I_{DM}$	30	
Power Dissipation <sup>A</sup>	$P_D$	2	W
$T_A=70^\circ\text{C}$		1.28	
Junction and Storage Temperature Range	$T_J$ , $T_{STG}$	-55 to 150	°C

### Thermal Characteristics

Parameter	Symbol	Typ	Max	Units
Maximum Junction-to-Ambient <sup>A</sup>	$R_{\theta JA}$	45	62.5	°C/W
Steady-State		70	110	°C/W
Maximum Junction-to-Lead <sup>C</sup>	$R_{\theta JL}$	33	50	°C/W

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>STATIC PARAMETERS</b>						
$\text{BV}_{\text{DSS}}$	Drain-Source Breakdown Voltage	$I_D=250\mu\text{A}, V_{GS}=0\text{V}$	20			V
$I_{\text{DSS}}$	Zero Gate Voltage Drain Current	$V_{DS}=16\text{V}, V_{GS}=0\text{V}$ $T_J=55^\circ\text{C}$		10	25	$\mu\text{A}$
$I_{GSS}$	Gate-Body leakage current	$V_{DS}=0\text{V}, V_{GS}=\pm 10\text{V}$		10		$\mu\text{A}$
$\text{BV}_{\text{GSO}}$	Gate-Source Breakdown Voltage	$V_{DS}=0\text{V}, I_G=\pm 250\mu\text{A}$	$\pm 12$			V
$V_{GS(\text{th})}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D=250\mu\text{A}$	0.5	0.75	1	V
$I_{D(\text{ON})}$	On state drain current	$V_{GS}=4.5\text{V}, V_{DS}=5\text{V}$	30			A
$R_{DS(\text{ON})}$	Static Drain-Source On-Resistance	$V_{GS}=10\text{V}, I_D=8.5\text{A}$ $T_J=125^\circ\text{C}$	13.4	17		$\text{m}\Omega$
		$V_{GS}=4.5\text{V}, I_D=5\text{A}$	16	20		$\text{m}\Omega$
		$V_{GS}=2.5\text{V}, I_D=4\text{A}$	14.8	18		$\text{m}\Omega$
		$V_{GS}=1.8\text{V}, I_D=3\text{A}$	18.8	24		$\text{m}\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS}=5\text{V}, I_D=8\text{A}$	25.5	33		$\text{m}\Omega$
$V_{SD}$	Diode Forward Voltage	$I_S=1\text{A}, V_{GS}=0\text{V}$	36		1	V
$I_S$	Maximum Body-Diode Continuous Current		0.73		2.9	A
<b>DYNAMIC PARAMETERS</b>						
$C_{iss}$	Input Capacitance	$V_{GS}=0\text{V}, V_{DS}=10\text{V}, f=1\text{MHz}$		1810		$\text{pF}$
$C_{oss}$	Output Capacitance			232		$\text{pF}$
$C_{rss}$	Reverse Transfer Capacitance			200		$\text{pF}$
$R_g$	Gate resistance	$V_{GS}=0\text{V}, V_{DS}=0\text{V}, f=1\text{MHz}$		1.6		$\Omega$
<b>SWITCHING PARAMETERS</b>						
$Q_g$	Total Gate Charge	$V_{GS}=4.5\text{V}, V_{DS}=10\text{V}, I_D=8.5\text{A}$		17.9		$\text{nC}$
$Q_{gs}$	Gate Source Charge			1.5		$\text{nC}$
$Q_{gd}$	Gate Drain Charge			4.7		$\text{nC}$
$t_{D(\text{on})}$	Turn-On Delay Time	$V_{GS}=10\text{V}, V_{DS}=10\text{V}, R_L=1.2\Omega, R_{\text{GEN}}=3\Omega$		2.5		$\text{ns}$
$t_r$	Turn-On Rise Time			7.2		$\text{ns}$
$t_{D(\text{off})}$	Turn-Off Delay Time			49		$\text{ns}$
$t_f$	Turn-Off Fall Time			10.8		$\text{ns}$
$t_{rr}$	Body Diode Reverse Recovery Time		$I_F=8.5\text{A}, dI/dt=100\text{A}/\mu\text{s}$	22		$\text{ns}$
$Q_{rr}$	Body Diode Reverse Recovery Charge	$I_F=8.5\text{A}, dI/dt=100\text{A}/\mu\text{s}$		9.8		$\text{nC}$

A: The value of  $R_{\text{QJA}}$  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  $R_{\text{QJA}}$  is the sum of the thermal impedance from junction to lead  $R_{\text{QUL}}$  and lead to ambient.

D. The static characteristics in Figures 1 to 6,12,14 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.

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## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

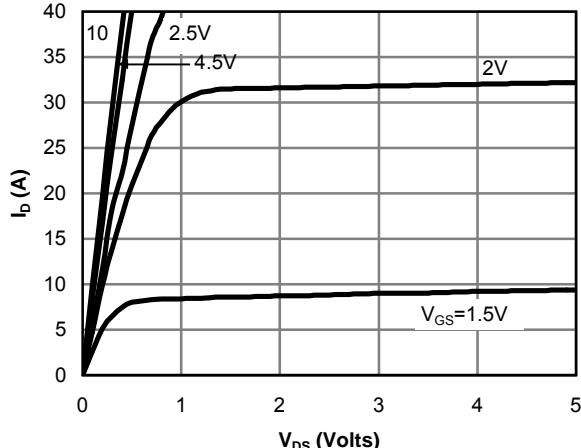


Fig 1: On-Region Characteristics

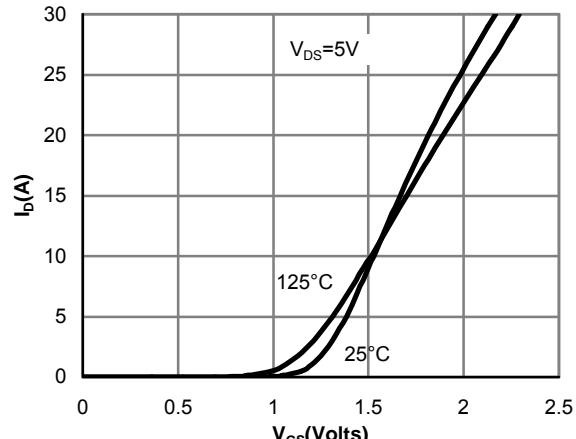


Figure 2: Transfer Characteristics

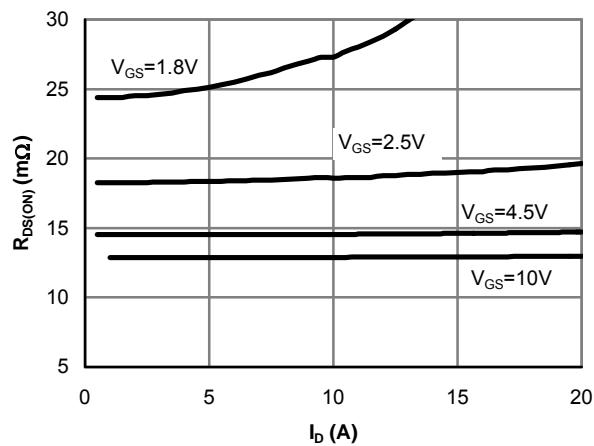


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

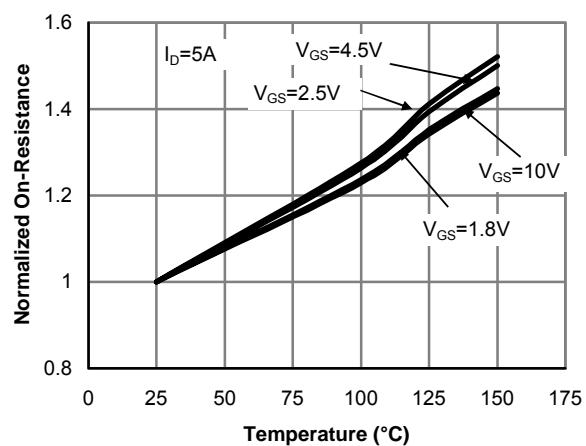


Figure 4: On-Resistance vs. Junction Temperature

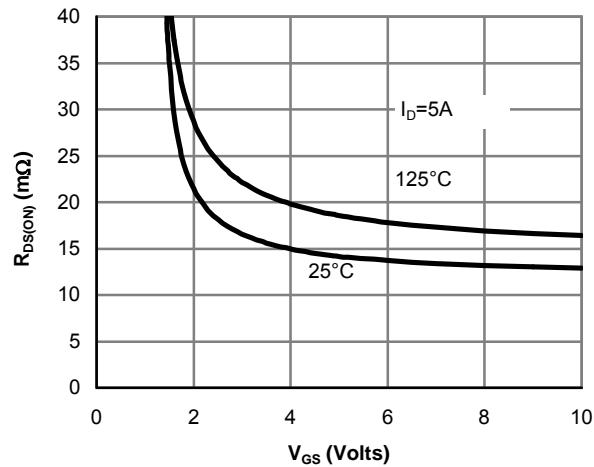


Figure 5: On-Resistance vs. Gate-Source Voltage

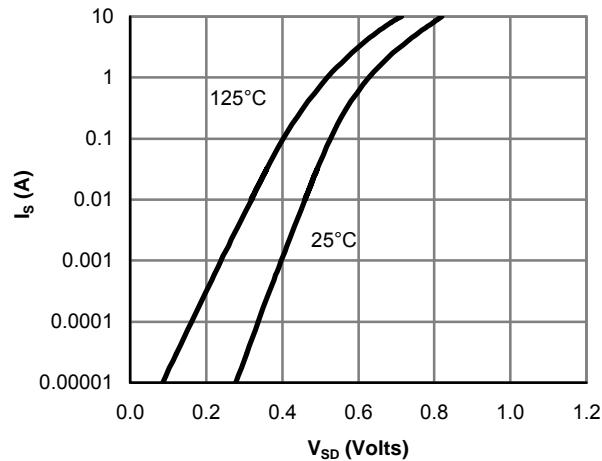


Figure 6: Body-Diode Characteristics

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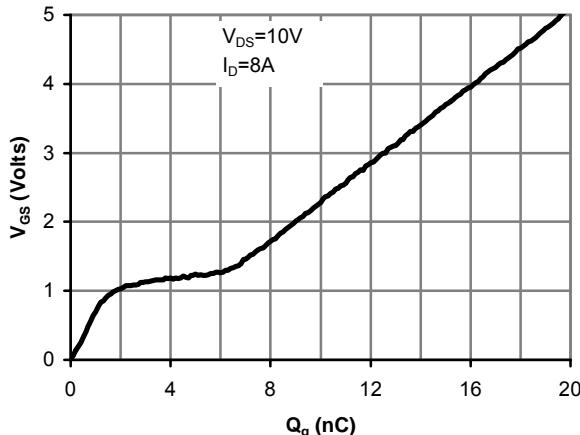


Figure 7: Gate-Charge Characteristics

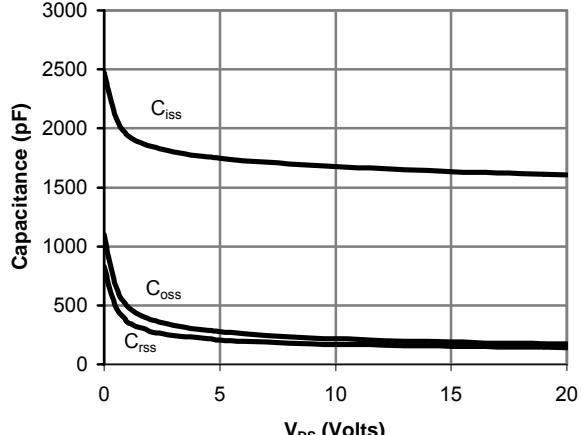


Figure 8: Capacitance Characteristics

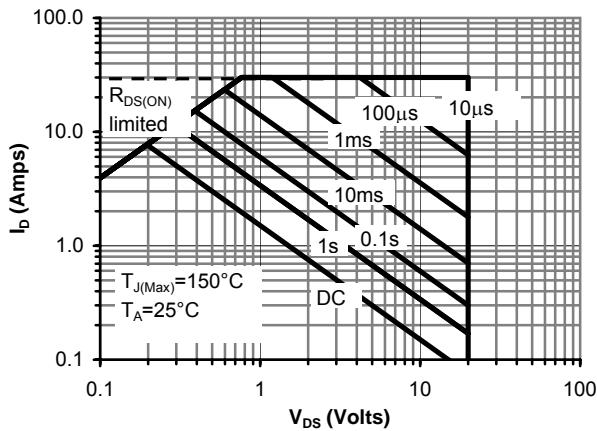


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

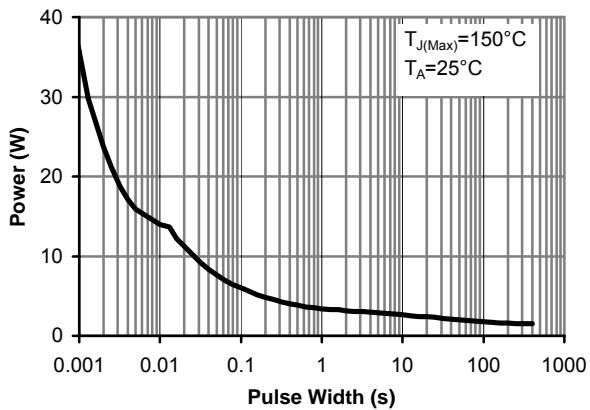


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

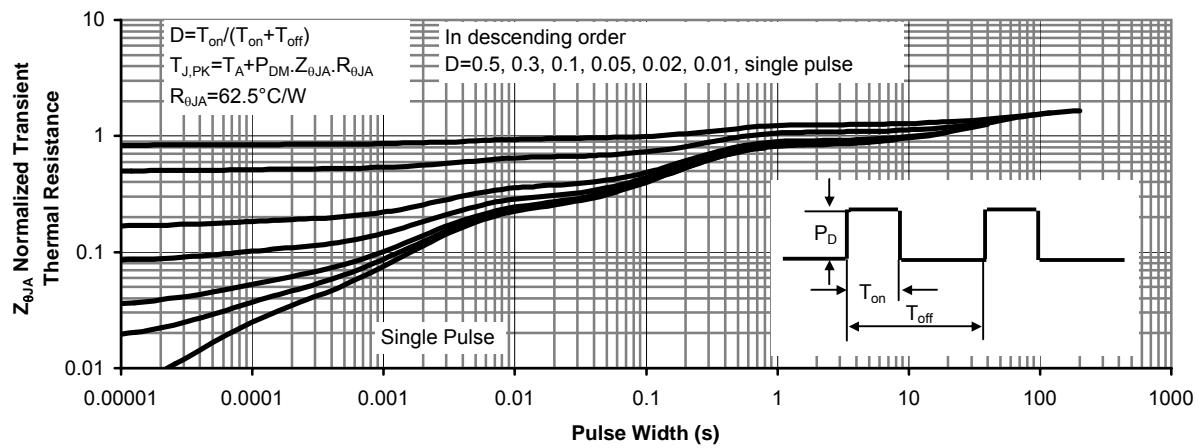


Figure 11: Normalized Maximum Transient Thermal Impedance