



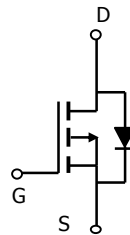
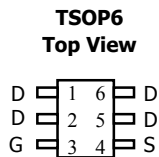
**AO6401A**  
**P-Channel Enhancement Mode Field Effect Transistor**

**General Description**

The AO6401A uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and operation with gate voltages as low as 2.5V. This device is suitable for use as a load switch or in PWM applications. AO6401A is Pb-free (meets ROHS & Sony 259 specifications).

**Features**

$V_{DS} = -30V$   
 $I_D = -5.0A$  ( $V_{GS} = -10V$ )  
 $R_{DS(ON)} < 44m\Omega$  ( $V_{GS} = -10V$ )  
 $R_{DS(ON)} < 55m\Omega$  ( $V_{GS} = -4.5V$ )  
 $R_{DS(ON)} < 82m\Omega$  ( $V_{GS} = -2.5V$ )



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

Parameter	Symbol	10 Sec	Steady State	Units	
Drain-Source Voltage	$V_{DS}$	-30		V	
Gate-Source Voltage	$V_{GS}$	$\pm 12$		V	
Continuous Drain Current <sup>A</sup>	$I_D$	$T_A=25^\circ C$	-5	-3.7	A
		$T_A=70^\circ C$	-3.7	-3.2	
Pulsed Drain Current <sup>B</sup>	$I_{DM}$	-25			
Power Dissipation <sup>A</sup>	$P_D$	$T_A=25^\circ C$	1.6	1.0	W
		$T_A=70^\circ C$	1.0	0.7	
Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 to 150		$^\circ C$	

**Thermal Characteristics**

Parameter	Symbol	Typ	Max	Units
Maximum Junction-to-Ambient <sup>A</sup>	$R_{\theta JA}$	58	80	$^\circ C/W$
Maximum Junction-to-Ambient <sup>A</sup>		Steady State	94	120
Maximum Junction-to-Lead <sup>C</sup>	$R_{\theta JL}$	37	50	$^\circ C/W$

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	$V_{DS} = -30\text{V}$ , $V_{GS} = 0\text{V}$ $T_J = 55^\circ\text{C}$			-1 -5	$\mu\text{A}$
$I_{GSS}$	Gate-Body leakage current	$V_{DS} = 0\text{V}$ , $V_{GS} = \pm 12\text{V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$ , $I_D = -250\mu\text{A}$	-0.5	-1	-1.5	V
$I_{D(ON)}$	On state drain current	$V_{GS} = -4.5\text{V}$ , $V_{DS} = -5\text{V}$	-25			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS} = -10\text{V}$ , $I_D = -5.0\text{A}$ $T_J = 125^\circ\text{C}$		35 49	44 62	$\text{m}\Omega$
		$V_{GS} = -4.5\text{V}$ , $I_D = -4.0\text{A}$		44	55	$\text{m}\Omega$
		$V_{GS} = -2.5\text{V}$ , $I_D = -3.5\text{A}$		66	82	$\text{m}\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = -5\text{V}$ , $I_D = -5.0\text{A}$		13		S
$V_{SD}$	Diode Forward Voltage	$I_S = -1\text{A}$ , $V_{GS} = 0\text{V}$		-0.73	-1	V
$I_S$	Maximum Body-Diode Continuous Current				-1.6	A
<b>DYNAMIC PARAMETERS</b>						
$C_{iss}$	Input Capacitance	$V_{GS} = 0\text{V}$ , $V_{DS} = -15\text{V}$ , $f = 1\text{MHz}$		943	1180	pF
$C_{oss}$	Output Capacitance			108		pF
$C_{rss}$	Reverse Transfer Capacitance			73		pF
$R_g$	Gate resistance	$V_{GS} = 0\text{V}$ , $V_{DS} = 0\text{V}$ , $f = 1\text{MHz}$	3	6	12	$\Omega$
<b>SWITCHING PARAMETERS</b>						
$Q_g$	Total Gate Charge	$V_{GS} = -4.5\text{V}$ , $V_{DS} = -15\text{V}$ , $I_D = -5\text{A}$		9.8	13	nC
$Q_{gs}$	Gate Source Charge			2.0		nC
$Q_{gd}$	Gate Drain Charge			3.3		nC
$t_{D(on)}$	Turn-On Delay Time	$V_{GS} = -10\text{V}$ , $V_{DS} = -15\text{V}$ , $R_L = 3\Omega$ , $R_{GEN} = 3\Omega$		5.2		ns
$t_r$	Turn-On Rise Time			6.8		ns
$t_{D(off)}$	Turn-Off Delay Time			42		ns
$t_f$	Turn-Off Fall Time			15		ns
$t_{rr}$	Body Diode Reverse Recovery Time	$I_F = -5\text{A}$ , $dI/dt = 100\text{A}/\mu\text{s}$		21	28	ns
$Q_{rr}$	Body Diode Reverse Recovery Charge	$I_F = -5\text{A}$ , $dI/dt = 100\text{A}/\mu\text{s}$		14.3		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  $T_A = 25^\circ\text{C}$ . 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  $< 300\mu\text{s}$  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

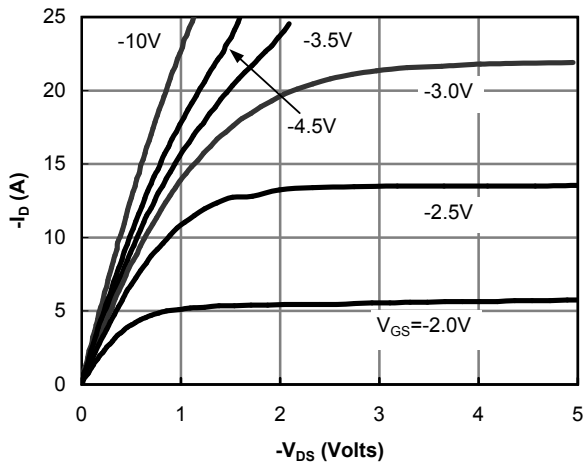


Figure 1: On-Region Characteristics

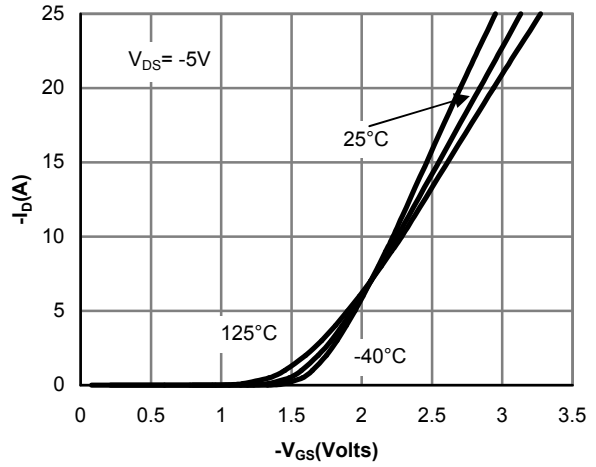


Figure 2: Transfer Characteristics

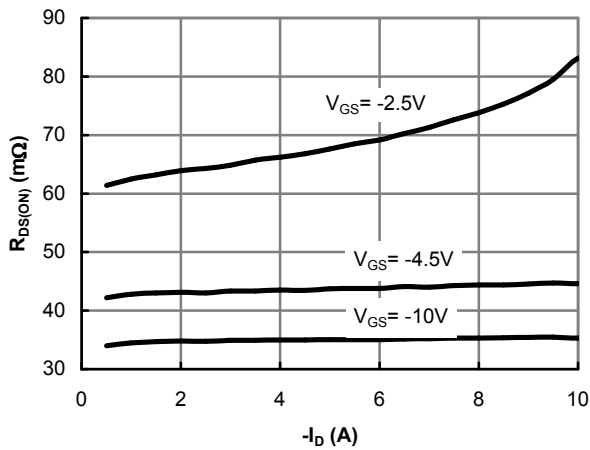


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

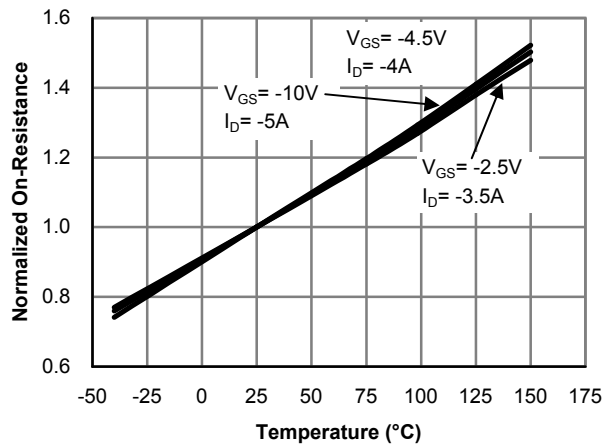


Figure 4: On-Resistance vs. Junction Temperature

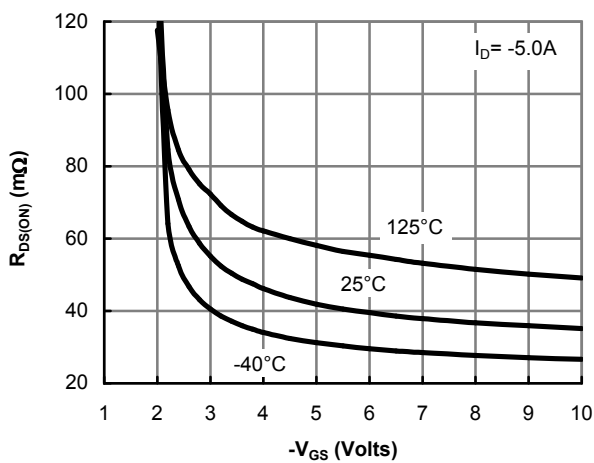


Figure 5: On-Resistance vs. Gate-Source Voltage

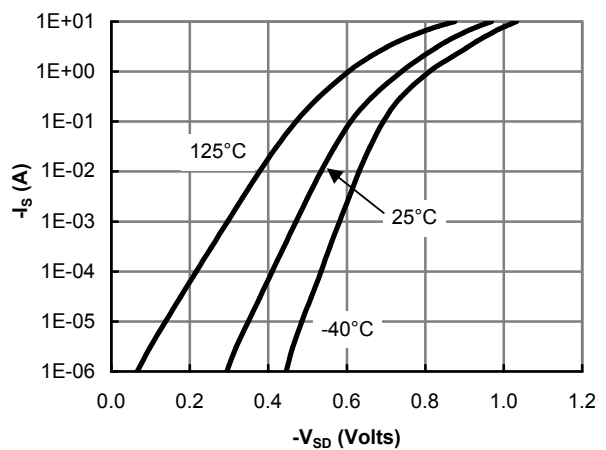


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

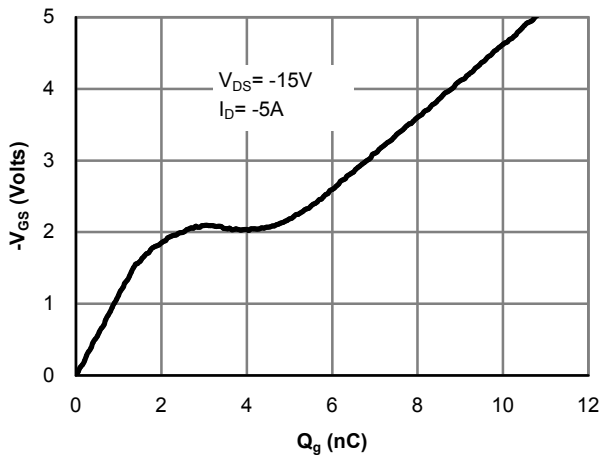


Figure 7: Gate-Charge Characteristics

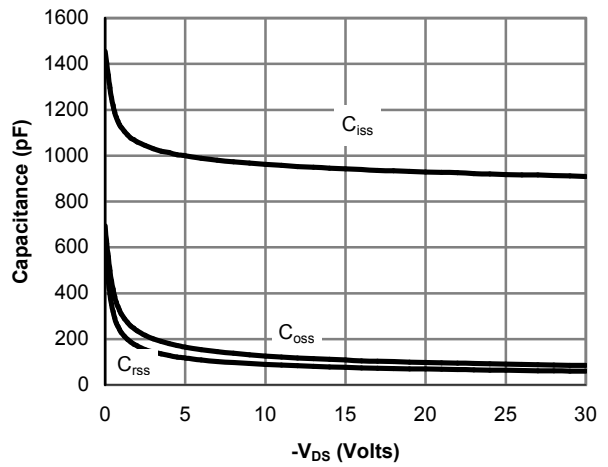


Figure 8: Capacitance Characteristics

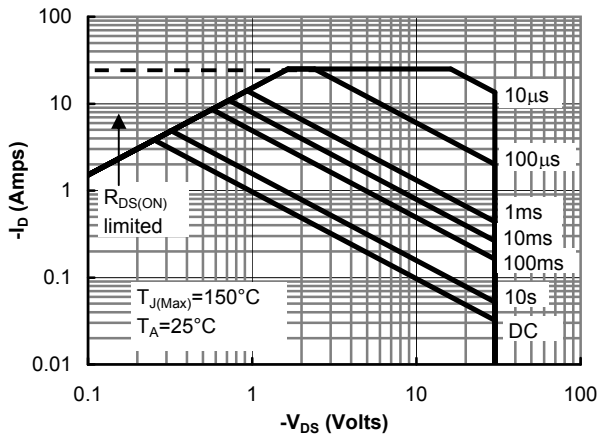


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

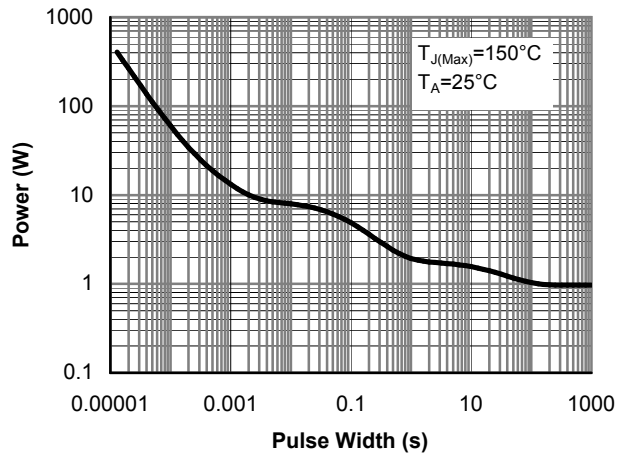


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

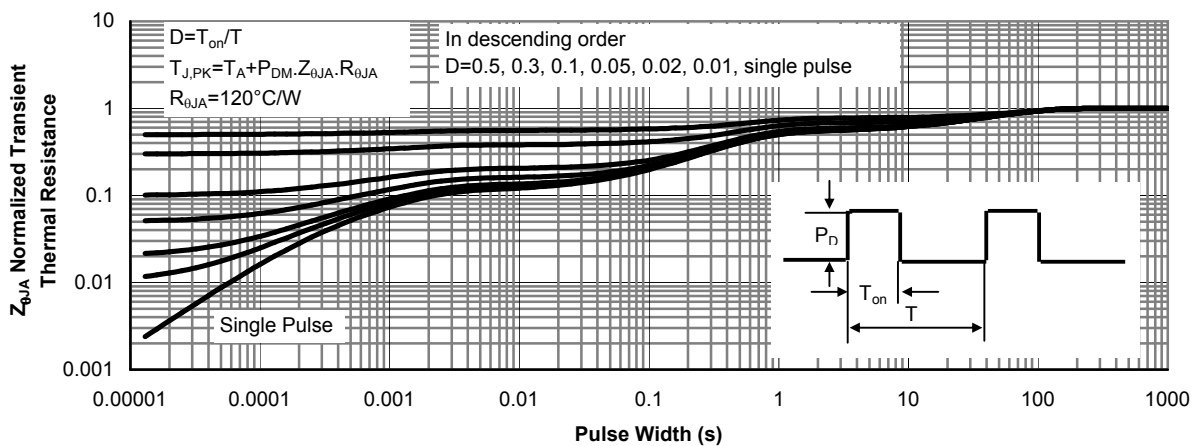


Figure 11: Normalized Maximum Transient Thermal Impedance (Note E)