



AO5401E

P-Channel Enhancement Mode Field Effect Transistor

General Description

The AO5401E/L uses advanced trench technology to provide excellent $R_{DS(ON)}$, low gate charge and operation with gate voltages as low as 1.8V. This device is suitable for use as a load switch or in PWM applications. AO5401E and AO5401EL are electrically identical.

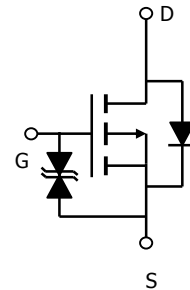
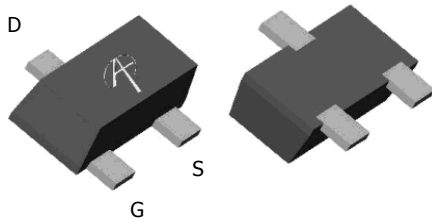
- RoHS compliant
- AO5401EL is Halogen Free

Features

- V_{DS} (V) = -20V
- I_D = -0.5 A (V_{GS} = -4.5V)
- $R_{DS(ON)} < 0.8\Omega$ (V_{GS} = -4.5V)
- $R_{DS(ON)} < 1\Omega$ (V_{GS} = -2.5V)
- $R_{DS(ON)} < 1.3\Omega$ (V_{GS} = -1.8V)

ESD PROTECTED!

SC89-3L
Top View



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

Parameter	Symbol	10 Sec	Steady State	Units	
Drain-Source Voltage	V_{DS}	-20		V	
Gate-Source Voltage	V_{GS}	± 8		V	
Continuous Drain Current ^{AF}	I_D	$T_A=25^\circ\text{C}$	-0.5	-0.5	A
		$T_A=70^\circ\text{C}$	-0.45	-0.40	
Pulsed Drain Current ^B	I_{DM}	-1			
Power Dissipation ^A	P_D	$T_A=25^\circ\text{C}$	0.38	0.28	W
		$T_A=70^\circ\text{C}$	0.24	0.18	
Junction and Storage Temperature Range	T_J, T_{STG}	-55 to 150		$^\circ\text{C}$	

Thermal Characteristics

Parameter	Symbol	Typ	Max	Units
Maximum Junction-to-Ambient ^A	$R_{\theta JA}$	275	330	$^\circ\text{C/W}$
Maximum Junction-to-Ambient ^A				
Maximum Junction-to-Lead ^C	$R_{\theta JL}$	300	350	$^\circ\text{C/W}$

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
STATIC PARAMETERS						
BV_{DSS}	Drain-Source Breakdown Voltage	$I_D=-250\mu\text{A}$, $V_{GS}=0\text{V}$	-20			V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS}=-20\text{V}$, $V_{GS}=0\text{V}$			1	μA
		$T_J=55^\circ\text{C}$			5	
I_{GSS}	Gate-Body leakage current	$V_{DS}=10\text{V}$, $V_{GS}=\pm 4.5\text{V}$			± 1	μA
		$V_{DS}=10\text{V}$, $V_{GS}=\pm 8\text{V}$			± 10	μA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}$, $I_D=-250\mu\text{A}$	-0.4	-0.5	-0.9	V
$I_{D(ON)}$	On state drain current	$V_{GS}=-4.5\text{V}$, $V_{DS}=-5\text{V}$	-1			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS}=-4.5\text{V}$, $I_D=-0.5\text{A}$		0.53	0.8	Ω
		$T_J=125^\circ\text{C}$		0.75	0.95	
		$V_{GS}=-2.5\text{V}$, $I_D=-0.5\text{A}$		0.72	1	Ω
		$V_{GS}=-1.8\text{V}$, $I_D=-0.3\text{A}$		0.95	1.3	Ω
g_{FS}	Forward Transconductance	$V_{DS}=-5\text{V}$, $I_D=-0.5\text{A}$		0.9		S
V_{SD}	Diode Forward Voltage	$I_S=-0.1\text{A}$, $V_{GS}=0\text{V}$		-0.66	-1	V
I_S	Maximum Body-Diode Continuous Current				-0.5	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	$V_{GS}=0\text{V}$, $V_{DS}=-10\text{V}$, $f=1\text{MHz}$		72	100	pF
C_{oss}	Output Capacitance			17		pF
C_{rss}	Reverse Transfer Capacitance			9		pF
SWITCHING PARAMETERS						
$t_{D(on)}$	Turn-On DelayTime	$V_{GS}=-4.5\text{V}$, $V_{DS}=-10\text{V}$, $R_L=50\Omega$, $R_{GEN}=3\Omega$		60.5		ns
t_r	Turn-On Rise Time			150		ns
$t_{D(off)}$	Turn-Off DelayTime			612		ns
t_f	Turn-Off Fall Time			436		ns
t_{rr}	Body Diode Reverse Recovery Time		$I_F=-0.5\text{A}$, $dI/dt=100\text{A}/\mu\text{s}$		27	35
Q_{rr}	Body Diode Reverse Recovery Charge	$I_F=-0.5\text{A}$, $dI/dt=100\text{A}/\mu\text{s}$		8.3		nC

A: The value of $R_{\theta JA}$ is measured with the device mounted on 1in² 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 6,12,14 are obtained using $<300 \mu\text{s}$ pulses, duty cycle 0.5% max.

E. These tests are performed with the device mounted on 1 in² 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

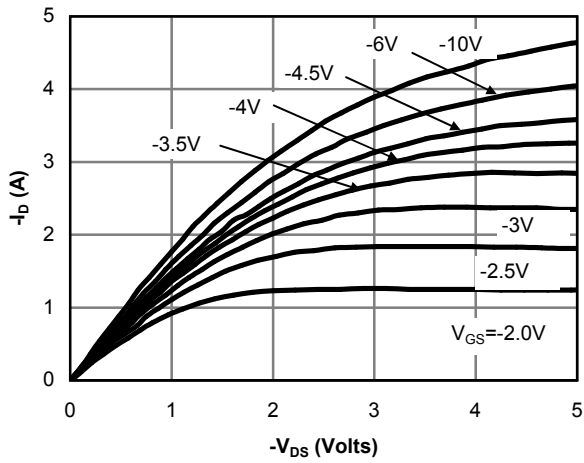


Figure 1: On-Region Characteristics

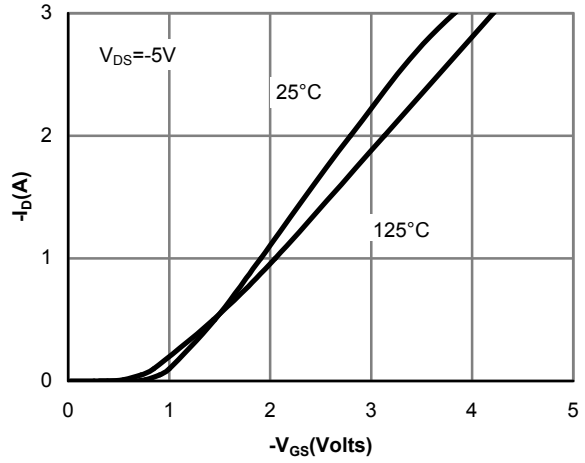


Figure 2: Transfer Characteristics

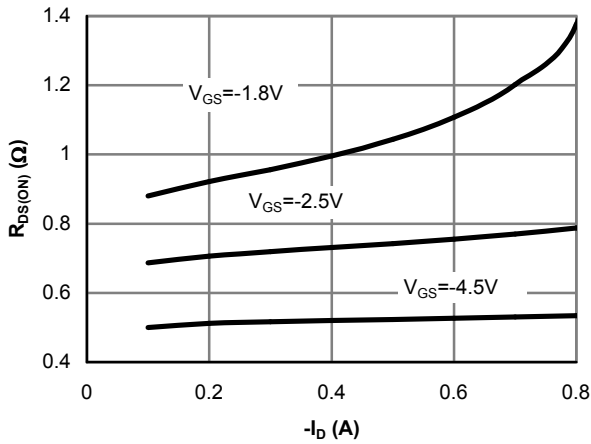


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

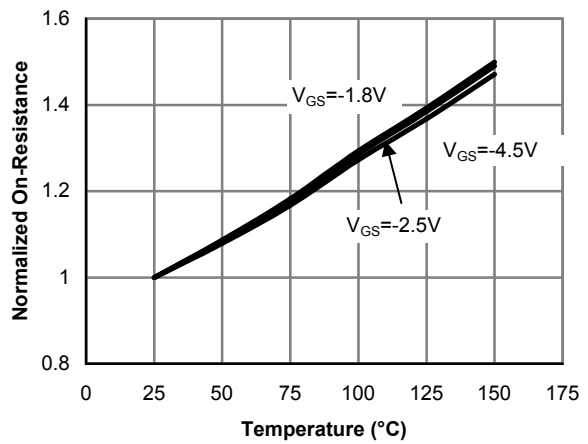


Figure 4: On-Resistance vs. Junction Temperature

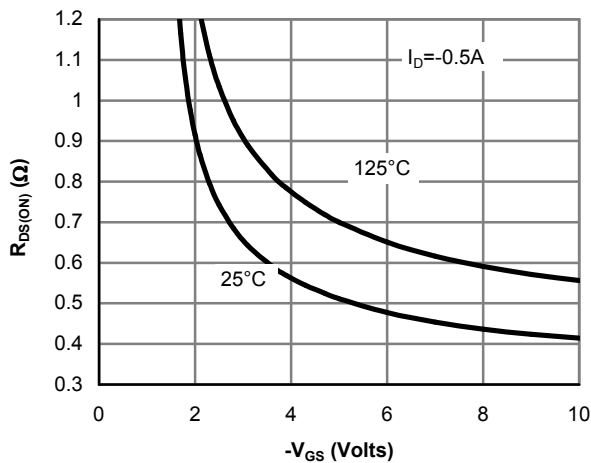


Figure 5: On-Resistance vs. Gate-Source Voltage

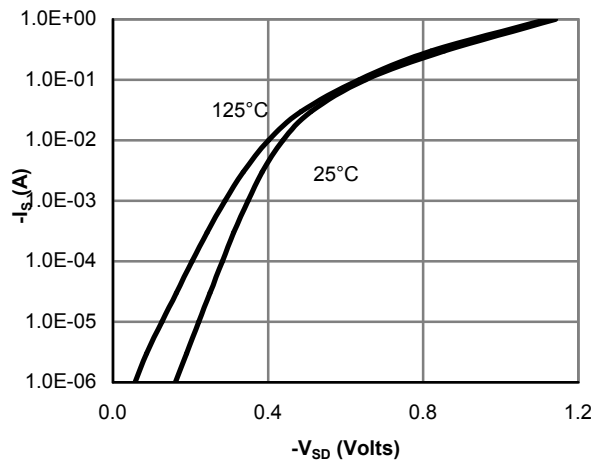


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

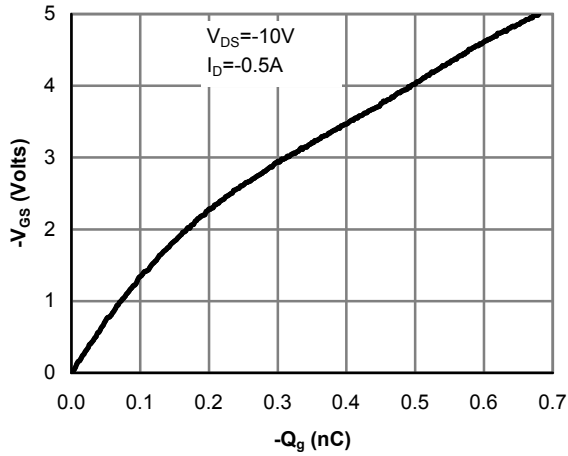


Figure 7: Gate-Charge Characteristics

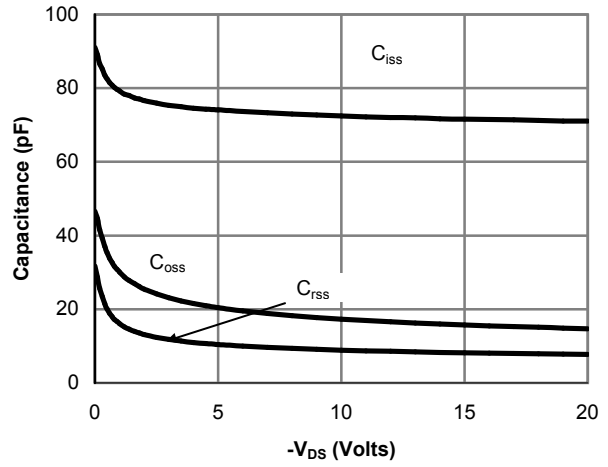


Figure 8: Capacitance Characteristics

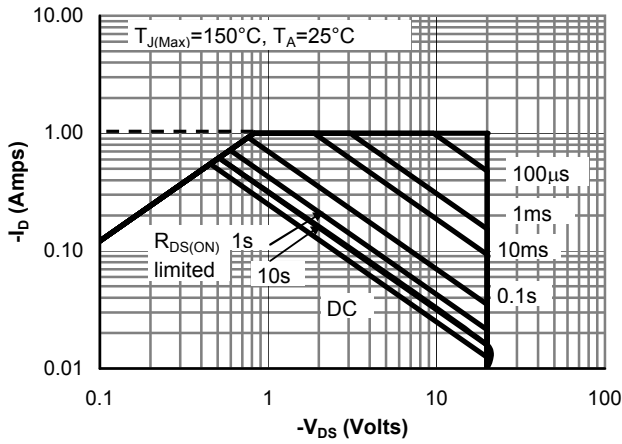


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

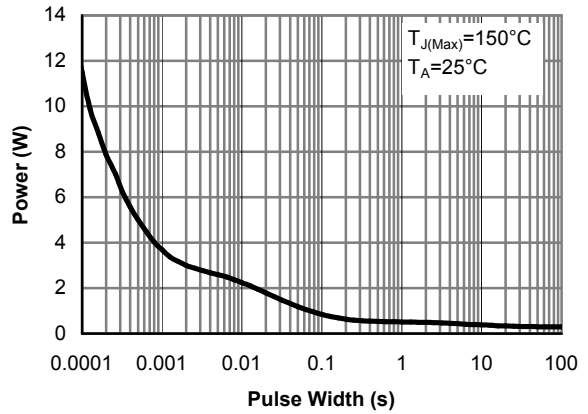


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

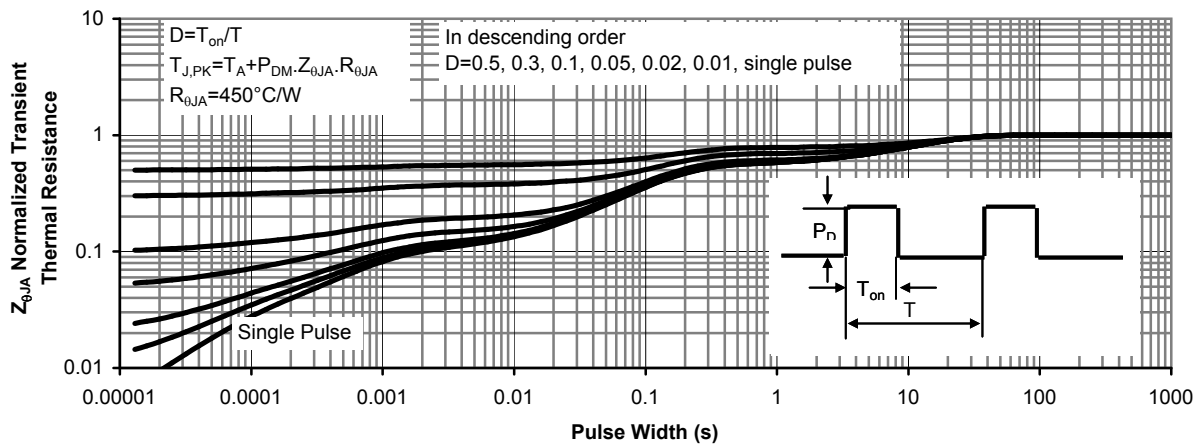
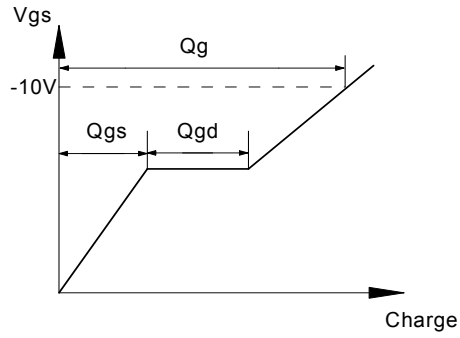
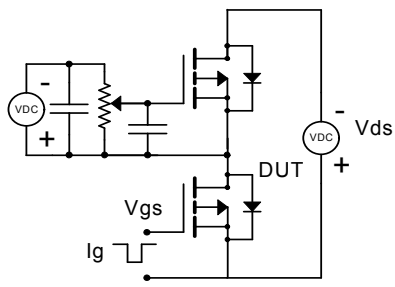
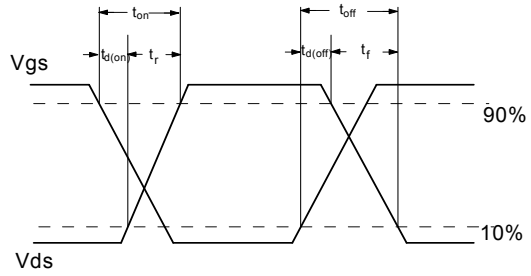
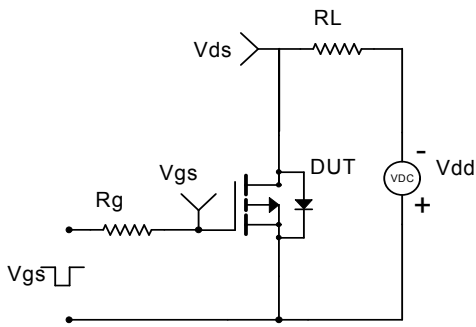


Figure 11: Normalized Maximum Transient Thermal Impedance

Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms

