

## AO3401A

### P-Channel Enhancement Mode Field Effect Transistor

#### General Description

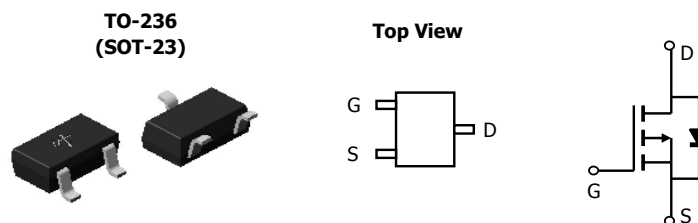
The AO3401A/L uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and operation gate voltages as low as 2.5V. This device is suitable for use as a load switch or other general applications. AO3401A and AO3401AL are electrically identical.

- RoHS Compliant
- AO3401AL is Halogen Free

#### Features

- $V_{DS}$  (V) = -30V
- $I_D$  = -4.3A ( $V_{GS}$  = -10V)
- $R_{DS(ON)} < 46m\Omega$  ( $V_{GS}$  = -10V)
- $R_{DS(ON)} < 55m\Omega$  ( $V_{GS}$  = -4.5V)
- $R_{DS(ON)} < 80m\Omega$  ( $V_{GS}$  = -2.5V)

***R<sub>g</sub>, C<sub>iss</sub>, C<sub>oss</sub>, C<sub>rss</sub> Tested***



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

Parameter	Symbol	Maximum	Units
Drain-Source Voltage	$V_{DS}$	-30	V
Gate-Source Voltage	$V_{GS}$	$\pm 12$	V
Continuous Drain Current <sup>A,F</sup>	$T_A=25^\circ\text{C}$	-4.3	A
	$T_A=70^\circ\text{C}$	-3.8	
Pulsed Drain Current <sup>B</sup>	$I_{DM}$	-25	
Power Dissipation <sup>A</sup>	$T_A=25^\circ\text{C}$	1.4	W
	$T_A=70^\circ\text{C}$	0.9	
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 <sup>AF</sup>	$R_{\theta JA}$	65	90	$^\circ\text{C}/\text{W}$
Maximum Junction-to-Ambient <sup>A</sup>		Steady-State	85	125
Maximum Junction-to-Lead <sup>C</sup>	$R_{\theta JL}$	43	80	$^\circ\text{C}/\text{W}$

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	$V_{DS}=V_{GS}$ , $I_D=-250\mu\text{A}$	-0.6	-1	-1.3	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	$V_{GS}=-10\text{V}$ , $I_D=-4.3\text{A}$ $T_J=125^\circ\text{C}$		36	44	$\text{m}\Omega$
		$V_{GS}=-4.5\text{V}$ , $I_D=-3.5\text{A}$		44	55	
		$V_{GS}=-2.5\text{V}$ , $I_D=-2.5\text{A}$		62	80	$\text{m}\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS}=-5\text{V}$ , $I_D=-4.3\text{A}$		13		S
$V_{SD}$	Diode Forward Voltage	$I_S=-1\text{A}$ , $V_{GS}=0\text{V}$		-0.75	-1	V
$I_S$	Maximum Body-Diode Continuous Current				-2	A
<b>DYNAMIC PARAMETERS</b>						
$C_{iss}$	Input Capacitance	$V_{GS}=0\text{V}$ , $V_{DS}=-15\text{V}$ , $f=1\text{MHz}$		933	1200	pF
$C_{oss}$	Output Capacitance		108		pF	
$C_{rss}$	Reverse Transfer Capacitance		81		pF	
$R_g$	Gate resistance	$V_{GS}=0\text{V}$ , $V_{DS}=0\text{V}$ , $f=1\text{MHz}$		6	9	$\Omega$
<b>SWITCHING PARAMETERS</b>						
$Q_g$	Total Gate Charge	$V_{GS}=-4.5\text{V}$ , $V_{DS}=-15\text{V}$ , $I_D=-4.3\text{A}$		9.3	12.2	nC
$Q_{gs}$	Gate Source Charge		1.5		nC	
$Q_{gd}$	Gate Drain Charge		3.7		nC	
$t_{D(on)}$	Turn-On DelayTime	$V_{GS}=-10\text{V}$ , $V_{DS}=-15\text{V}$ , $R_L=3.5\Omega$ , $R_{GEN}=6\Omega$		5.2		ns
$t_r$	Turn-On Rise Time		6.8		ns	
$t_{D(off)}$	Turn-Off DelayTime		42		ns	
$t_f$	Turn-Off Fall Time		15		ns	
$t_{rr}$	Body Diode Reverse Recovery Time		$I_F=-4.3\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$		21	28
$Q_{rr}$	Body Diode Reverse Recovery Charge	$I_F=-4.3\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$		14.3		nC

A: The value of  $R_{\theta JA}$  is measured with the device mounted on  $1\text{in}^2$  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.

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  $1\text{in}^2$  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.

F: The current rating is based on the  $t \leq 10\text{s}$  thermal resistance rating.

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

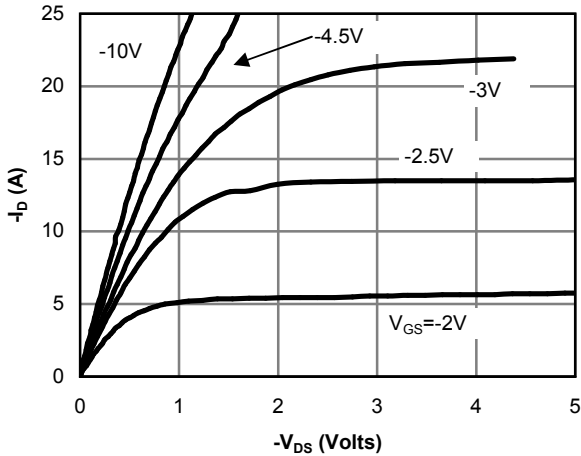


Figure 1: On-Region Characteristics

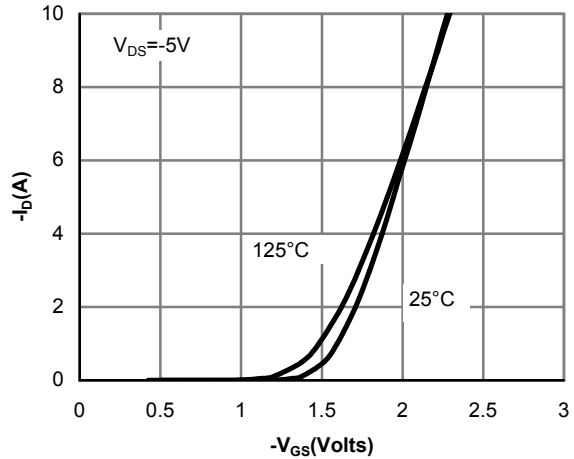


Figure 2: Transfer Characteristics

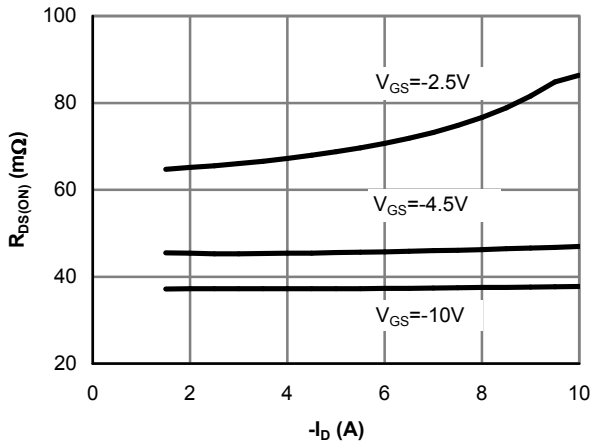


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

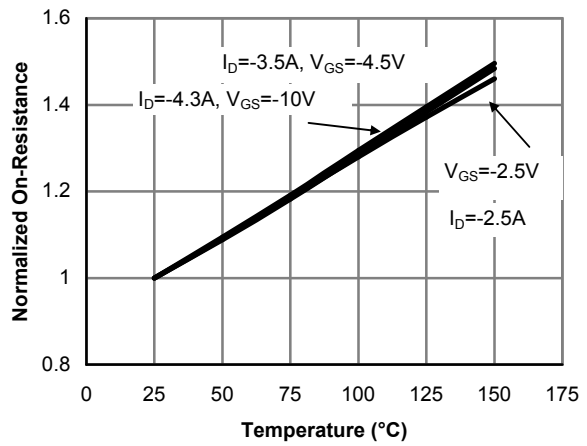


Figure 4: On-Resistance vs. Junction Temperature

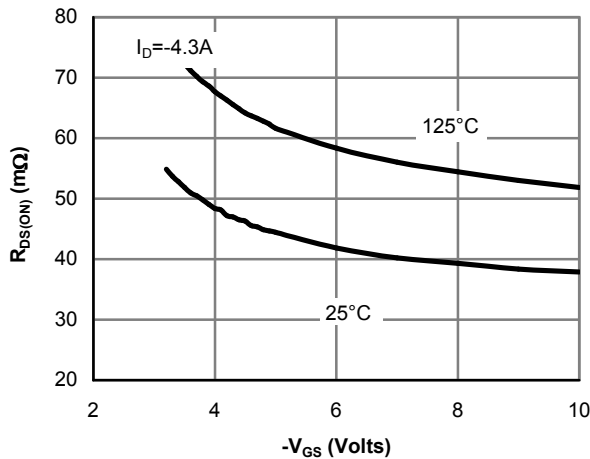


Figure 5: On-Resistance vs. Gate-Source Voltage

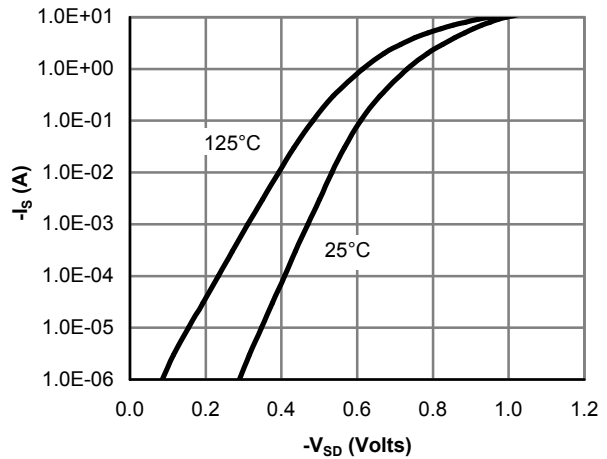


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

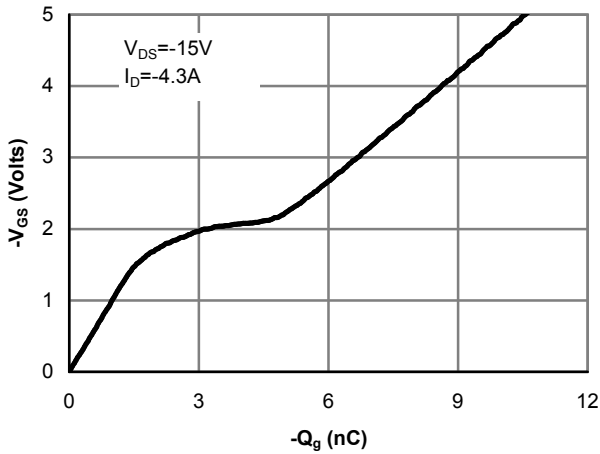


Figure 7: Gate-Charge Characteristics

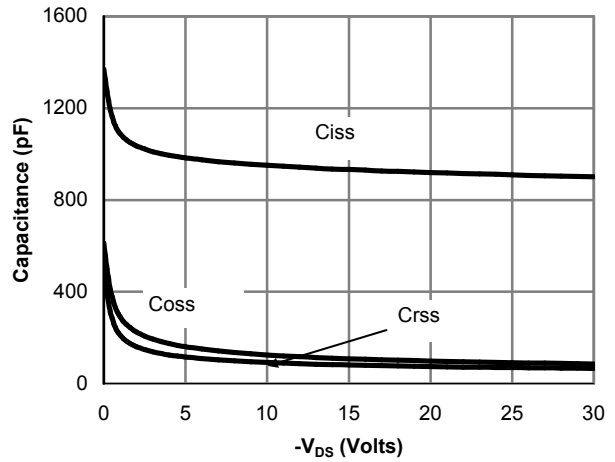


Figure 8: Capacitance Characteristics

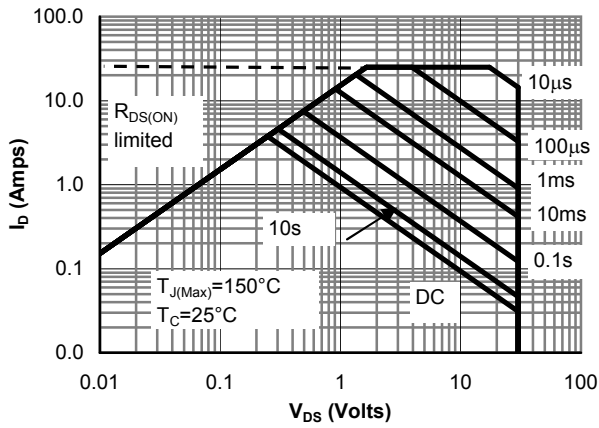


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

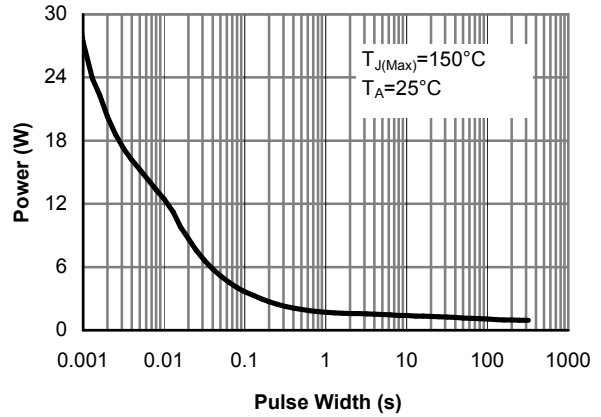


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

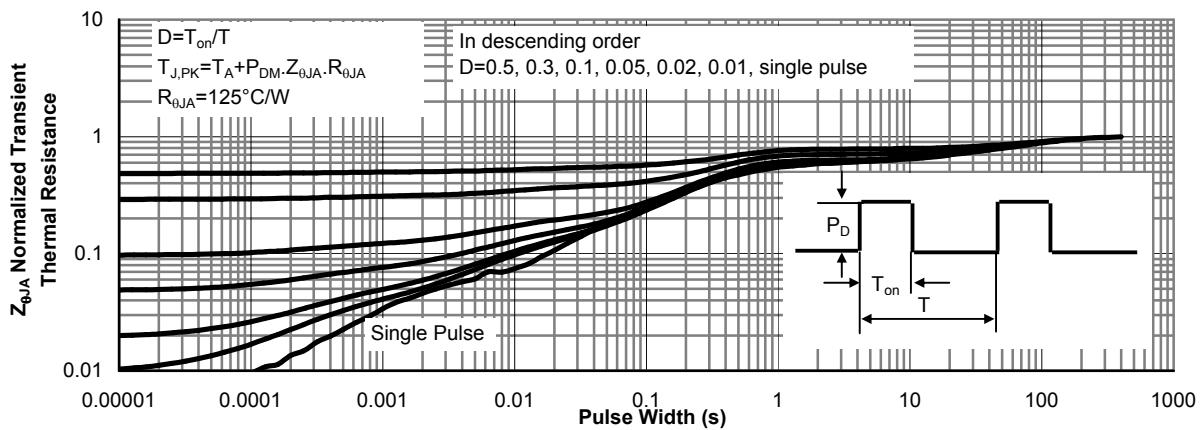
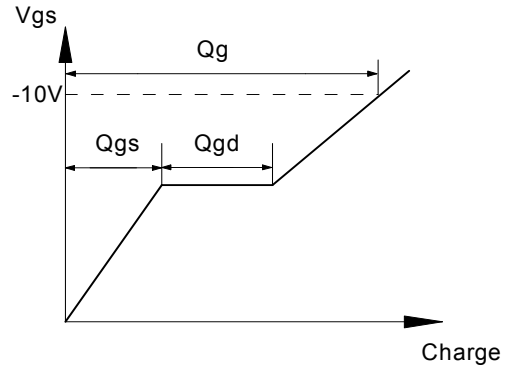
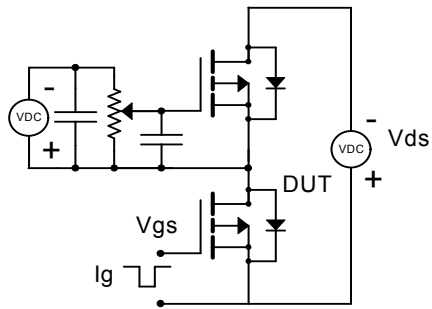
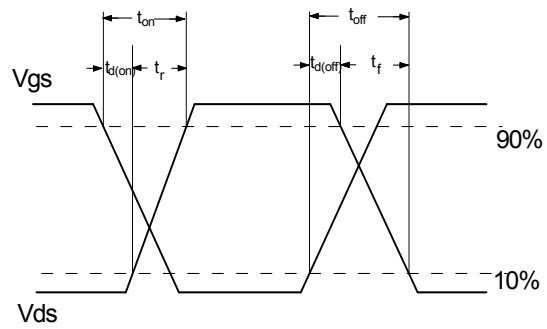
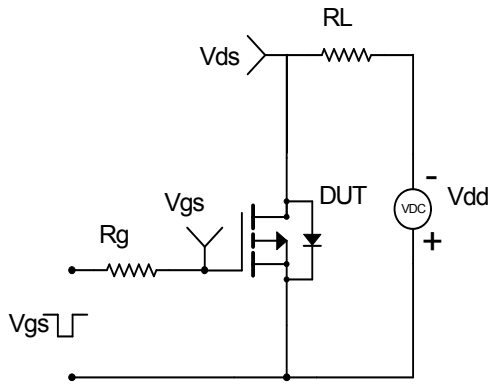


Figure 11: Normalized Maximum Transient Thermal Impedance

Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms

