



ALPHA & OMEGA
SEMICONDUCTOR

AO3401
30V P-Channel MOSFET

General Description

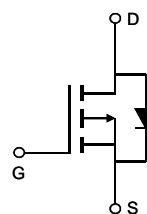
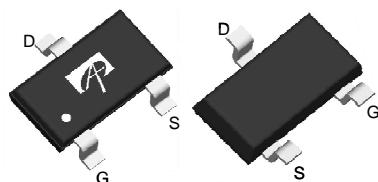
The AO3401 uses advanced trench technology to provide excellent $R_{DS(ON)}$, low gate charge and operation with gate voltages as low as 2.5V. This device is suitable for use as a load switch or in PWM applications.

Product Summary

V_{DS}	-30V
I_D (at $V_{GS}=-10V$)	-4.0A
$R_{DS(ON)}$ (at $V_{GS}=-10V$)	< 50mΩ
$R_{DS(ON)}$ (at $V_{GS}=-4.5V$)	< 60mΩ
$R_{DS(ON)}$ (at $V_{GS}=-2.5V$)	< 85mΩ



SOT23
Top View Bottom View



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}	± 12	V
Continuous Drain Current Current	I_D	-4	A
		-3.2	
Pulsed Drain Current ^C	I_{DM}	-27	
Power Dissipation ^B	P_D	1.4	W
		0.9	
Junction and Storage Temperature Range	T_J, T_{STG}	-55 to 150	°C

Thermal Characteristics

Parameter	Symbol	Typ	Max	Units
Maximum Junction-to-Ambient ^A $t \leq 10\text{s}$	$R_{\theta JA}$	70	90	°C/W
Maximum Junction-to-Ambient ^{A,D} Steady-State		100	125	°C/W
Maximum Junction-to-Lead	$R_{\theta JL}$	63	80	°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	$I_D=-250\mu\text{A}, V_{GS}=0\text{V}$	-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	μA
I_{GSS}	Gate-Body leakage current	$V_{DS}=0\text{V}, V_{GS}=\pm 12\text{V}$			± 100	nA
$V_{\text{GS(th)}}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D=-250\mu\text{A}$	-0.5	-0.9	-1.3	V
$I_{\text{D(ON)}}$	On state drain current	$V_{GS}=-10\text{V}, V_{DS}=5\text{V}$	-27			A
$R_{\text{DS(ON)}}$	Static Drain-Source On-Resistance	$V_{GS}=-10\text{V}, I_D=-4.0\text{A}$ $T_J=125^\circ\text{C}$	41	50		$\text{m}\Omega$
		$V_{GS}=-4.5\text{V}, I_D=-3.7\text{A}$	62	75		$\text{m}\Omega$
		$V_{GS}=-2.5\text{V}, I_D=-2\text{A}$	47	60		$\text{m}\Omega$
g_{FS}	Forward Transconductance	$V_{DS}=-5\text{V}, I_D=-4.0\text{A}$		17		S
V_{SD}	Diode Forward Voltage	$I_S=1\text{A}, V_{GS}=0\text{V}$		-0.7	-1	V
I_{S}	Maximum Body-Diode Continuous Current				-2	A
I_{SM}	Pulsed Body-Diode Current ^B				-27	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	$V_{GS}=0\text{V}, V_{DS}=-15\text{V}, f=1\text{MHz}$		645		pF
C_{oss}	Output Capacitance			80		pF
C_{rss}	Reverse Transfer Capacitance			55		pF
R_g	Gate resistance	$V_{GS}=0\text{V}, V_{DS}=0\text{V}, f=1\text{MHz}$	4	7.8	12	Ω
SWITCHING PARAMETERS						
$Q_g(10\text{V})$	Total Gate Charge	$V_{GS}=-10\text{V}, V_{DS}=-15\text{V}, I_D=-4.0\text{A}$		14		nC
$Q_g(4.5\text{V})$	Total Gate Charge			7		nC
Q_{gs}	Gate Source Charge			1.5		nC
Q_{gd}	Gate Drain Charge			2.5		nC
$t_{\text{D(on)}}$	Turn-On Delay Time	$V_{GS}=-10\text{V}, V_{DS}=-15\text{V}, R_L=3.75\Omega, R_{\text{GEN}}=3\Omega$		6.5		ns
t_r	Turn-On Rise Time			3.5		ns
$t_{\text{D(off)}}$	Turn-Off Delay Time			41		ns
t_f	Turn-Off Fall Time			9		ns
t_{rr}	Body Diode Reverse Recovery Time	$I_F=-4.0\text{A}, dI/dt=100\text{A}/\mu\text{s}$		11		ns
Q_{rr}	Body Diode Reverse Recovery Charge	$I_F=-4.0\text{A}, dI/dt=100\text{A}/\mu\text{s}$		3.5		nC

A. The value of R_{vJA} 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.

B. The power dissipation P_D is based on $T_{J(\text{MAX})}=150^\circ\text{C}$, using $\leq 10\text{s}$ junction-to-ambient thermal resistance.

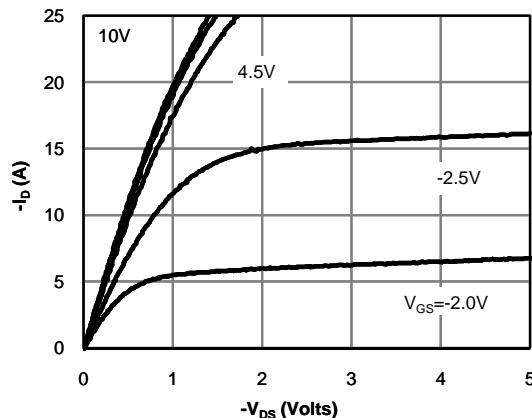
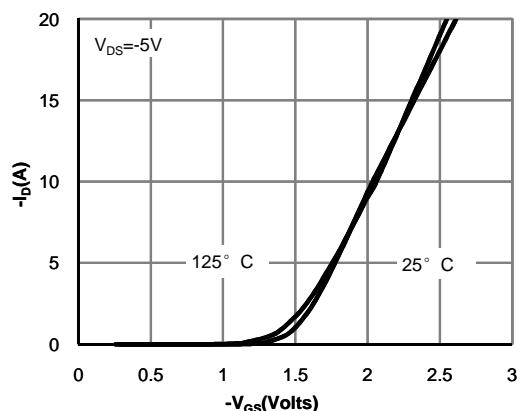
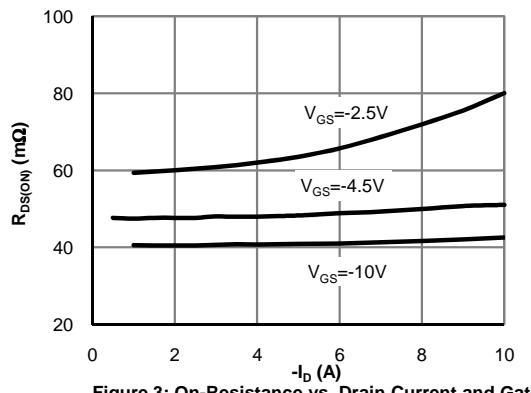
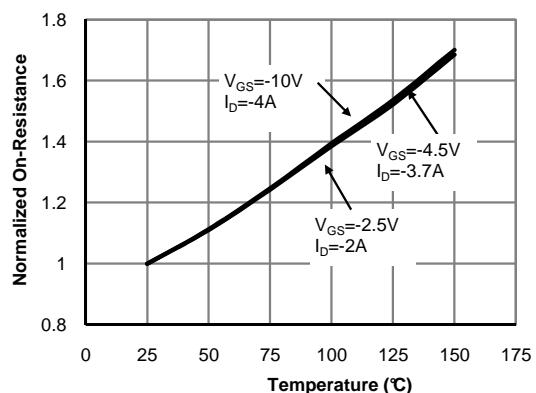
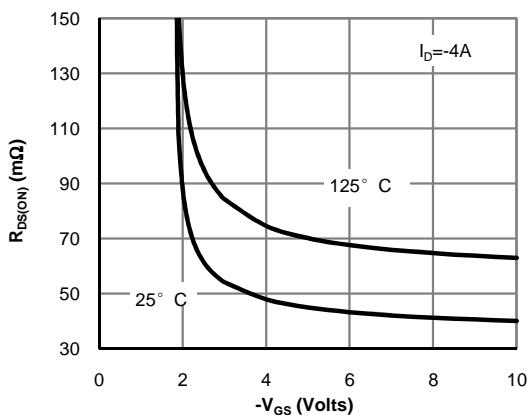
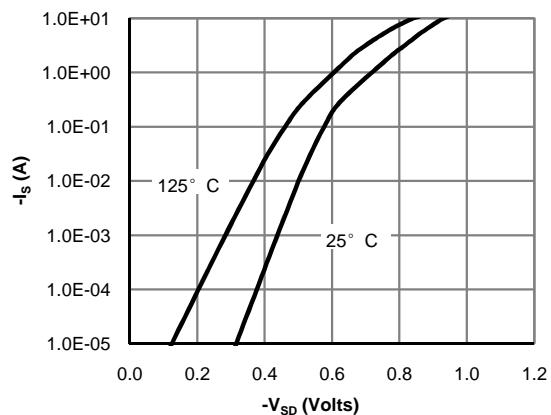
C. Repetitive rating, pulse width limited by junction temperature $T_{J(\text{MAX})}=150^\circ\text{C}$. Ratings are based on low frequency and duty cycles to keep initial $T_J=25^\circ\text{C}$.

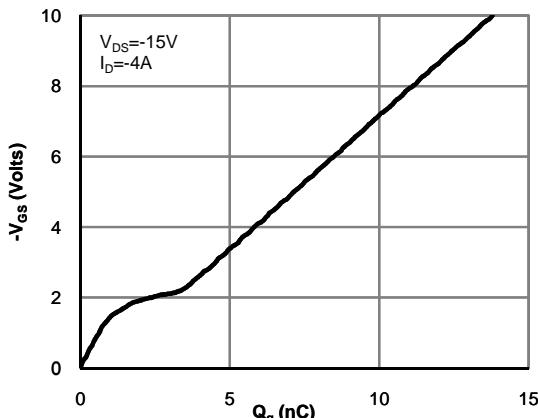
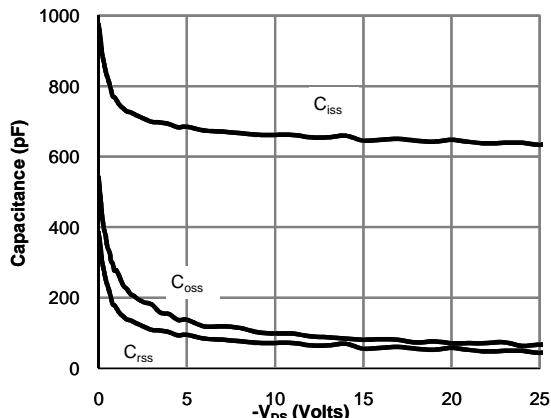
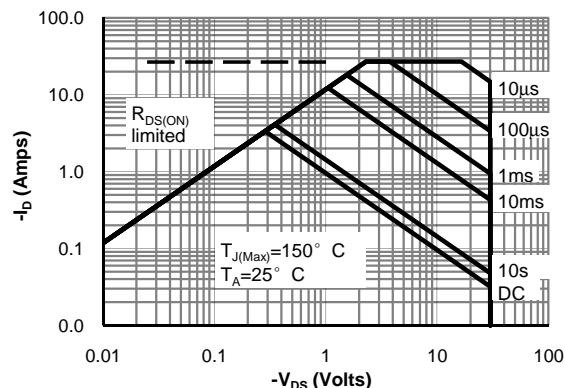
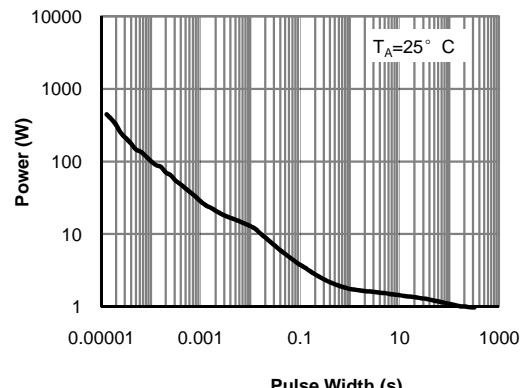
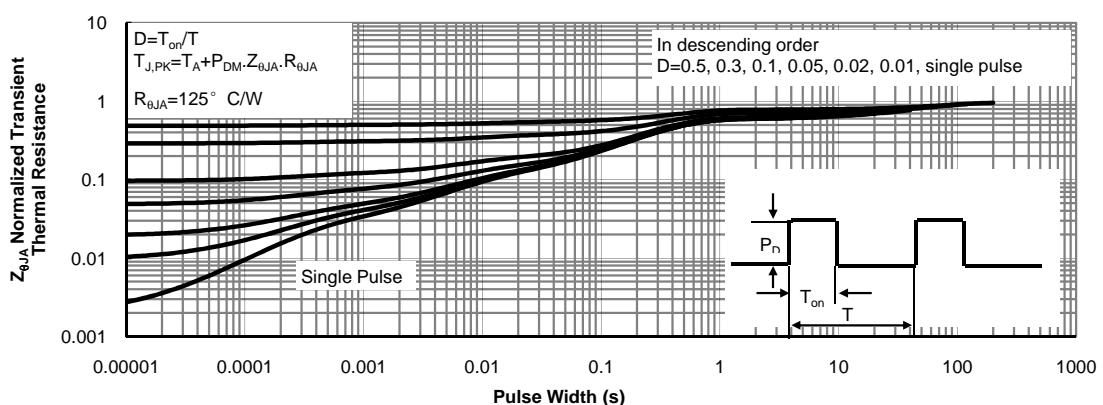
D. The R_{vJA} is the sum of the thermal impedance from junction to lead R_{vJL} and lead to ambient.

E. The static characteristics in Figures 1 to 6 are obtained using $<300\mu\text{s}$ pulses, duty cycle 0.5% max.

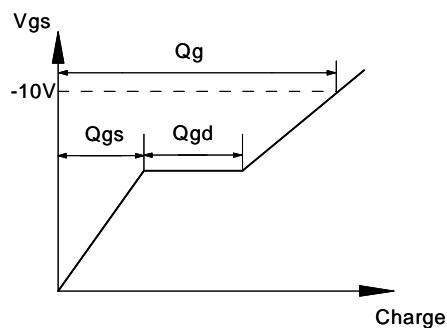
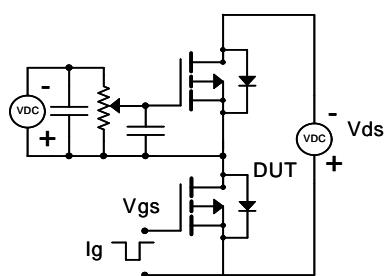
F. These curves are based on the junction-to-ambient thermal impedance which is measured with the device mounted on 1in² FR-4 board with 2oz. Copper, assuming a maximum junction temperature of $T_{J(\text{MAX})}=150^\circ\text{C}$. The SOA curve provides a single pulse rating.

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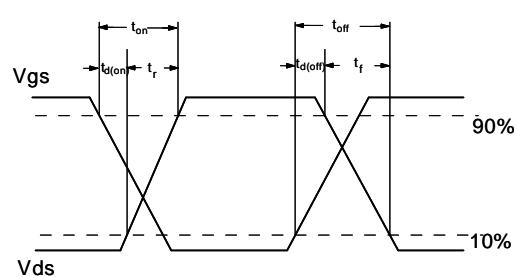
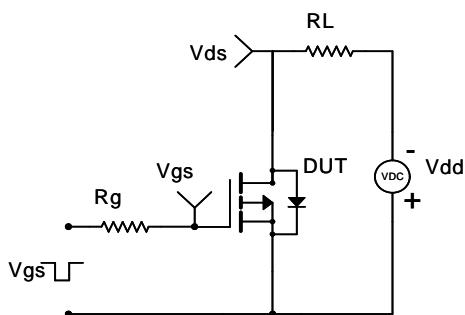
TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

Fig 1: On-Region Characteristics (Note E)

Figure 2: Transfer Characteristics (Note E)

Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)

Figure 4: On-Resistance vs. Junction Temperature (Note E)

Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)

Figure 6: Body-Diode Characteristics (Note E)

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 F)

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

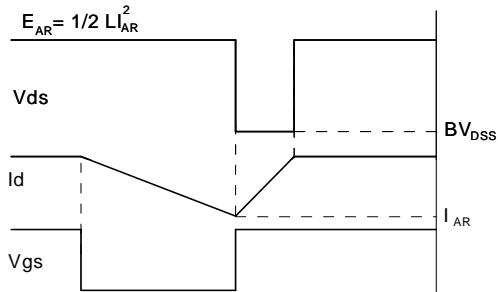
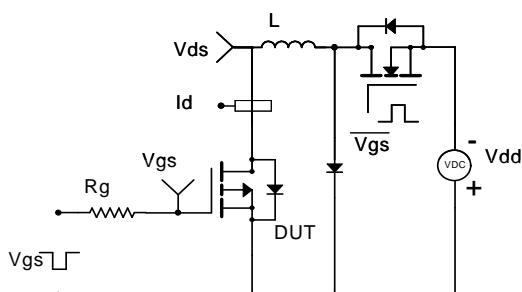
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms

