



ALPHA & OMEGA
SEMICONDUCTOR



AO7413

P-Channel Enhancement Mode Field Effect Transistor

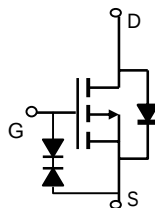
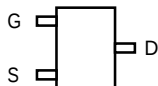
General Description

The AO7413 uses advanced trench technology to provide excellent $R_{DS(ON)}$, low gate charge, and operation with gate voltages as low as 1.8V, in the small SOT323 footprint. It can be used for a wide variety of applications, including load switching, low current inverters and low current DC-DC converters. It is ESD protected to 2KV HBM. Standard Product AO7413 is Pb-free (meets ROHS & Sony 259 specifications). AO7413L is a Green Product ordering option. AO7413 and AO7413L are electrically identical.

Features

V_{DS} (V) = -20V
 I_D = -1.4A (V_{GS} = -10V)
 $R_{DS(ON)} < 113m\Omega$ (V_{GS} = -10V)
 $R_{DS(ON)} < 135m\Omega$ (V_{GS} = -4.5V)
 $R_{DS(ON)} < 180m\Omega$ (V_{GS} = -2.5V)

SC-70
(SOT-323)
Top View



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}	± 12	V
Continuous Drain Current ^A	I_D	-1.4	A
$T_A=25^\circ\text{C}$			
$T_A=70^\circ\text{C}$		-1.2	
Pulsed Drain Current ^B	I_{DM}	-3	
Power Dissipation ^A	P_D	0.35	W
$T_A=25^\circ\text{C}$			
$T_A=70^\circ\text{C}$		0.22	
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	$R_{\theta JA}$	300	360	$^\circ\text{C/W}$
$t \leq 10\text{s}$				
Maximum Junction-to-Ambient ^A	$R_{\theta JA}$	350	425	$^\circ\text{C/W}$
Steady-State				
Maximum Junction-to-Lead ^C	$R_{\theta JL}$	280	320	$^\circ\text{C/W}$
Steady-State				

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	$V_{DS}=-16\text{V}$, $V_{GS}=0\text{V}$ $T_J=55^{\circ}\text{C}$			-0.5 -2.5	μA
I_{GSS}	Gate-Body leakage current	$V_{DS}=0\text{V}$, $V_{GS}=\pm 10\text{V}$ $V_{DS}=0\text{V}$, $V_{GS}=\pm 12\text{V}$			± 1 ± 10	μA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}$, $I_D=-250\mu\text{A}$	-0.7	-0.9	-1.4	V
$I_{D(ON)}$	On state drain current	$V_{GS}=-4.5\text{V}$, $V_{DS}=-5\text{V}$	-15			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS}=-10\text{V}$, $I_D=-1.4\text{A}$ $T_J=125^{\circ}\text{C}$		94 130	113 160	$\text{m}\Omega$
		$V_{GS}=-4.5\text{V}$, $I_D=-1.3\text{A}$		111	135	$\text{m}\Omega$
		$V_{GS}=-2.5\text{V}$, $I_D=-1.1\text{A}$		150	180	$\text{m}\Omega$
g_{FS}	Forward Transconductance	$V_{DS}=-5\text{V}$, $I_D=-1.4\text{A}$		5		S
V_{SD}	Diode Forward Voltage	$I_S=-1\text{A}$, $V_{GS}=0\text{V}$		-0.84	-0.95	V
I_S	Maximum Body-Diode Continuous Current				0.6	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	$V_{GS}=0\text{V}$, $V_{DS}=-10\text{V}$, $f=1\text{MHz}$		512	620	pF
C_{oss}	Output Capacitance			77		pF
C_{rss}	Reverse Transfer Capacitance			62		pF
R_g	Gate resistance	$V_{GS}=0\text{V}$, $V_{DS}=0\text{V}$, $f=1\text{MHz}$		9.2	13	Ω
SWITCHING PARAMETERS						
Q_g	Total Gate Charge	$V_{GS}=-4.5\text{V}$, $V_{DS}=-10\text{V}$, $I_D=-1.4\text{A}$		4.9	6	nC
Q_{gs}	Gate Source Charge			3.5		nC
Q_{gd}	Gate Drain Charge			3.7		nC
$t_{D(on)}$	Turn-On DelayTime	$V_{GS}=-4.5\text{V}$, $V_{DS}=-10\text{V}$, $R_L=7.1\Omega$, $R_{GEN}=3\Omega$		11	13	ns
t_r	Turn-On Rise Time			8	10	ns
$t_{D(off)}$	Turn-Off DelayTime			34	41	ns
t_f	Turn-Off Fall Time			12	15	ns
t_{rr}	Body Diode Reverse Recovery Time	$I_F=-1.4\text{A}$, $dI/dt=100\text{A}/\mu\text{s}$		12.9	16	ns
Q_{rr}	Body Diode Reverse Recovery Charge	$I_F=-1.4\text{A}$, $dI/dt=100\text{A}/\mu\text{s}$		3.9	5	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 $\leq 10\text{s}$ 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 80 μs 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

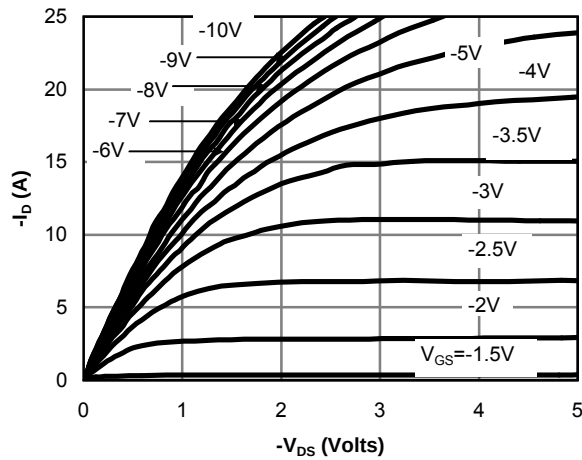


Fig 1: On-Region Characteristics

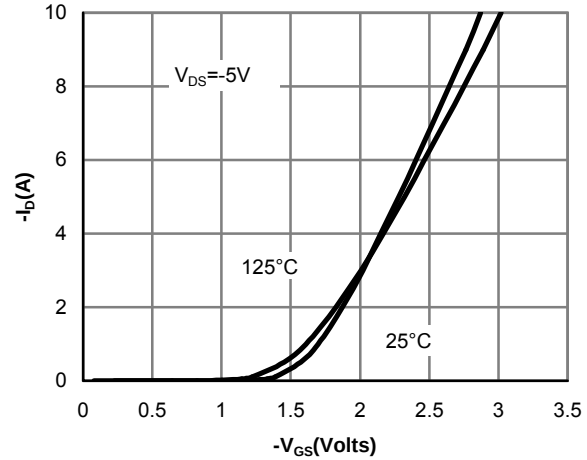


Figure 2: Transfer Characteristics

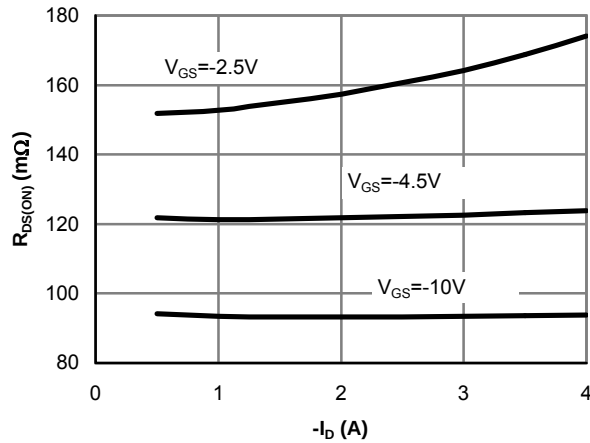


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

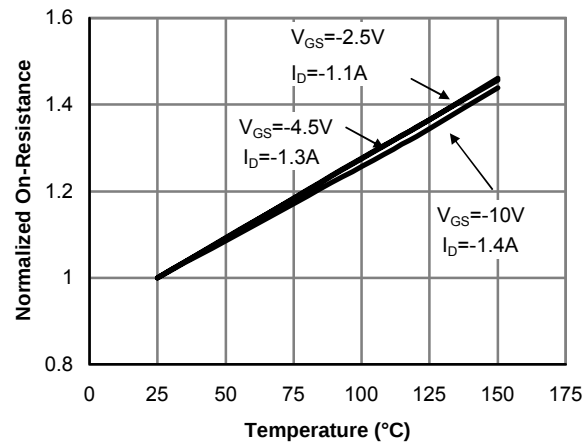


Figure 4: On-Resistance vs. Junction Temperature

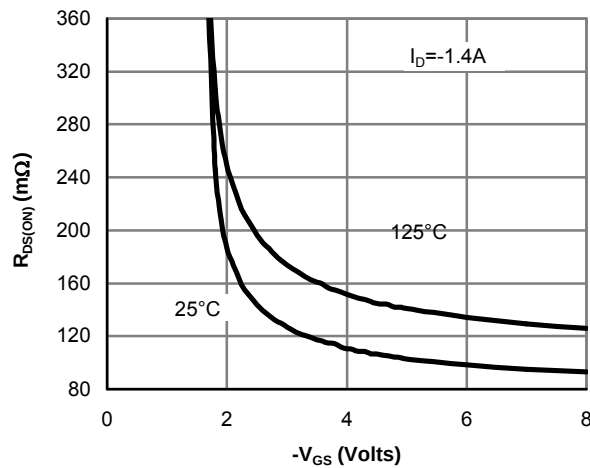


Figure 5: On-Resistance vs. Gate-Source Voltage

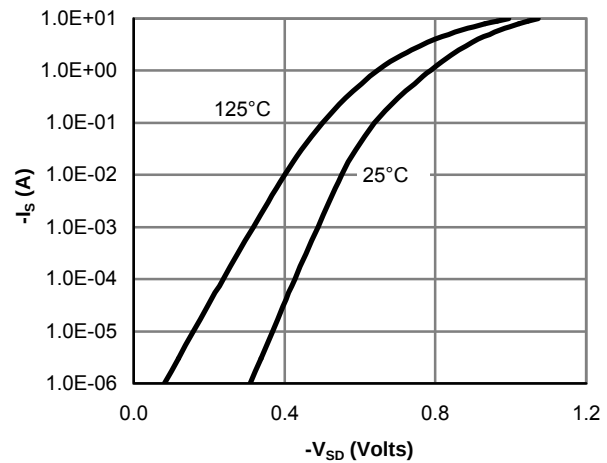


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

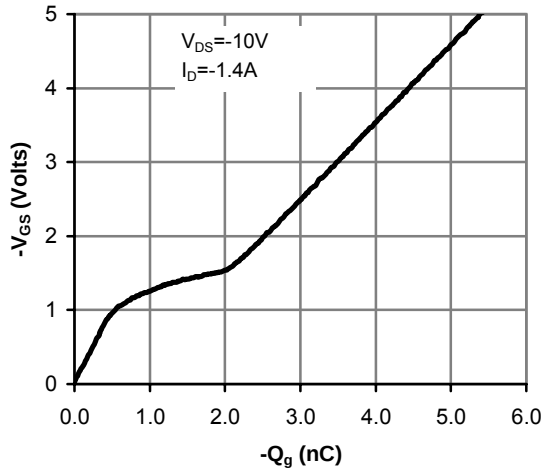


Figure 7: Gate-Charge Characteristics

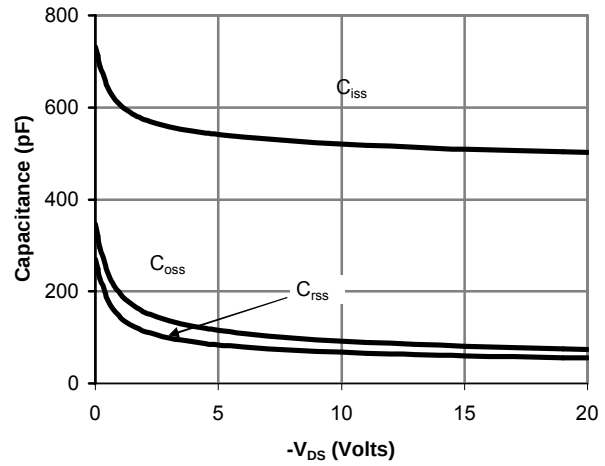


Figure 8: Capacitance Characteristics

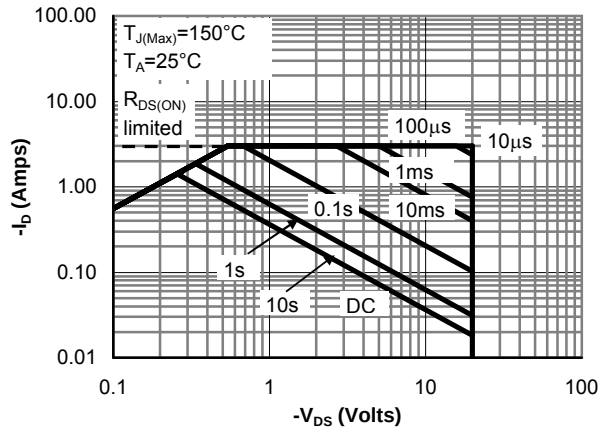


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

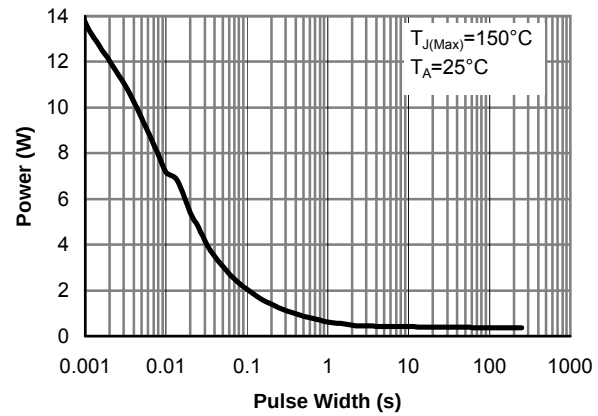


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

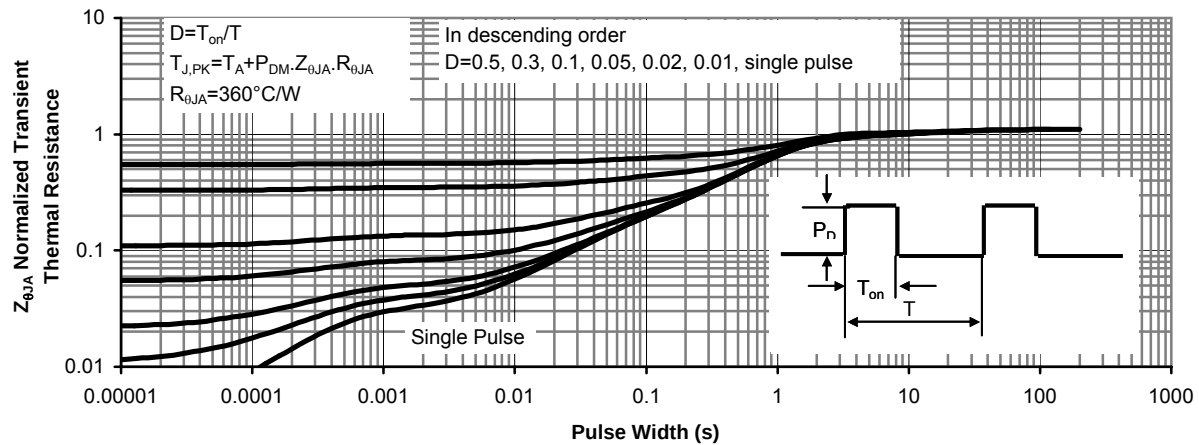


Figure 11: Normalized Maximum Transient Thermal Impedance