ALPHA & OMEGA SEMICONDUCTOR

AO7413

20V P-Channel MOSFET

General Description

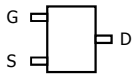
The AO7413 uses advanced trench technology to provide excellent $R_{DS(ON)}$, low gate charge and operation with gate voltages as low as 2.5V. This device is suitable for use as a load switch applications.

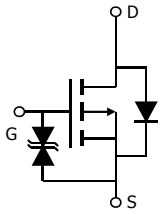
Product Summary

V_{DS}	-20V
I_D (at V_{GS}=-10V)	-1.4A
$R_{DS(ON)}$ (at V_{GS}= -10V)	< 113mΩ
$R_{DS(ON)}$ (at V_{GS}= -4.5V)	< 135mΩ
$R_{DS(ON)}$ (at V_{GS}= -2.5V)	< 180mΩ
Typical ESD protection	**HBM Class 2**

Green Product

SC-70 (SOT-323) Top View





Absolute Maximum Ratings T_A=25°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	T_A=25°C	I_D	-1.4	A
	T_A=70°C		-1.2	
Pulsed Drain Current [C]		I_{DM}	-13	
Power Dissipation [B]	T_A=25°C	P_D	0.35	W
	T_A=70°C		0.22	
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 ≤ 10s	$R_{\theta JA}$	300	360	°C/W
Maximum Junction-to-Ambient [A D]	Steady-State		350	425	°C/W
Maximum Junction-to-Lead	Steady-State	$R_{\theta JL}$	280	320	°C/W

Electrical Characteristics (T_J=25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
STATIC PARAMETERS						
BV_{DSS}	Drain-Source Breakdown Voltage	I_D=-250µA, V_{GS}=0V	-20			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=-20V, V_{GS}=0V			-1	µA
		T_J=55°C			-5	
I_{GSS}	Gate-Body leakage current	V_{DS}=0V, V_{GS}= ±12V			±10	µA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=V_{GS}, I_D=-250µA	-0.5	-0.85	-1.2	V
$I_{D(ON)}$	On state drain current	V_{GS}=-4.5V, V_{DS}=-5V	-13			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS}=-10V, I_D=-1.4A		94	113	mΩ
		T_J=125°C		130	160	
		V_{GS}=-4.5V, I_D=-1.3A		111	135	mΩ
		V_{GS}=-2.5V, I_D=-1.1A		150	180	mΩ
g_{FS}	Forward Transconductance	V_{DS}=-5V, I_D=-1.4A		5		S
V_{SD}	Diode Forward Voltage	I_S=-1A,V_{GS}=0V		-0.76	-1	V
I_S	Maximum Body-Diode Continuous Current				-1	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=-10V, f=1MHz	250	325	400	pF
C_{oss}	Output Capacitance		40	63	85	pF
C_{rss}	Reverse Transfer Capacitance		22	37	52	pF
R_g	Gate resistance	V_{GS}=0V, V_{DS}=0V, f=1MHz		11.2	17	Ω
SWITCHING PARAMETERS						
Q_g	Total Gate Charge	V_{GS}=-4.5V, V_{DS}=-10V, I_D=-1.4A		3.2	4.5	nC
Q_{gs}	Gate Source Charge			0.6		nC
Q_{gd}	Gate Drain Charge			0.9		nC
$t_{D(on)}$	Turn-On DelayTime	V_{GS}=-10V, V_{DS}=-10V, R_L=7.1Ω, R_{GEN}=3Ω		11		ns
t_r	Turn-On Rise Time			5.5		ns
$t_{D(off)}$	Turn-Off DelayTime			22		ns
t_f	Turn-Off Fall Time			8		ns
t_{rr}	Body Diode Reverse Recovery Time	I_F=-1.4A, dI/dt=100A/µs		6.1		ns
Q_{rr}	Body Diode Reverse Recovery Charge	I_F=-1.4A, dI/dt=100A/µs		1.4		nC

A. The value of $R_{\theta JA}$ is measured with the device mounted on 1in^2 FR-4 board with 2oz. Copper, in a still air environment with T_A =25° C. The value in any given application depends on the user's specific board design.
B. The power dissipation P_D is based on $T_{J(MAX)}$=150° C, using ≤ 10s junction-to-ambient thermal resistance.
C. Repetitive rating, pulse width limited by junction temperature $T_{J(MAX)}$=150° C. Ratings are based on low frequency and duty cycles to keep initialT_J=25° C.
D. The $R_{\theta JA}$ is the sum of the thermal impedance from junction to lead $R_{\theta JL}$ and lead to ambient.
E. The static characteristics in Figures 1 to 6 are obtained using <300µs 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 1in^2 FR-4 board with 2oz. Copper, assuming a maximum junction temperature of $T_{J(MAX)}$=150° C. The SOA curve provides a single pulse rating.

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

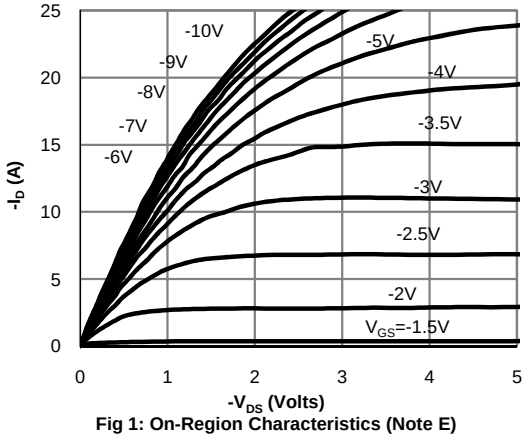


Fig 1: On-Region Characteristics (Note E)

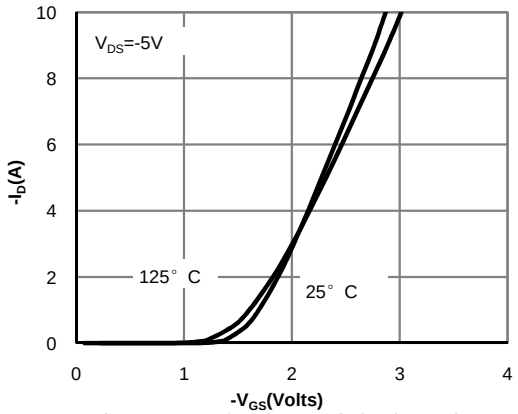


Figure 2: Transfer Characteristics (Note E)

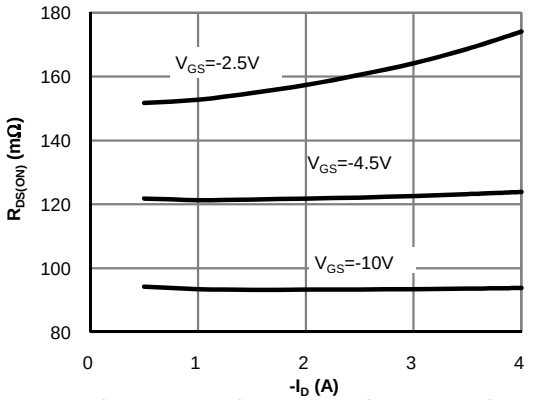


Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)

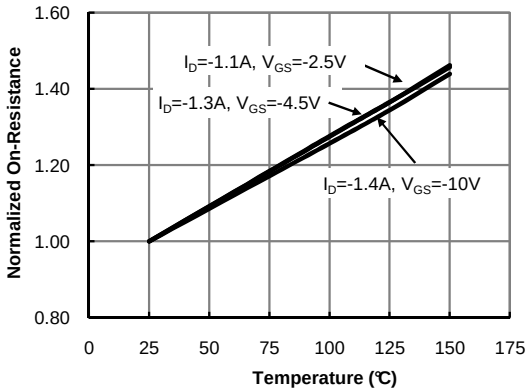


Figure 4: On-Resistance vs. Junction Temperature (Note E)

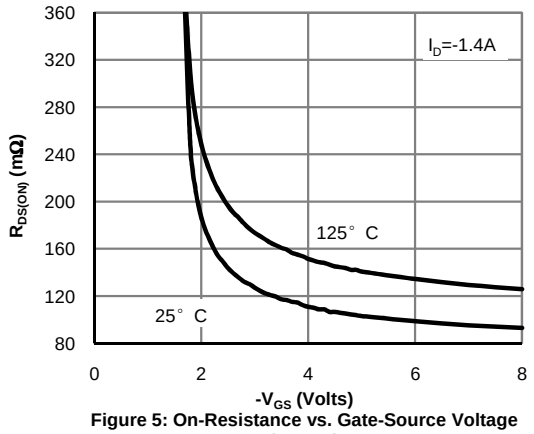


Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)

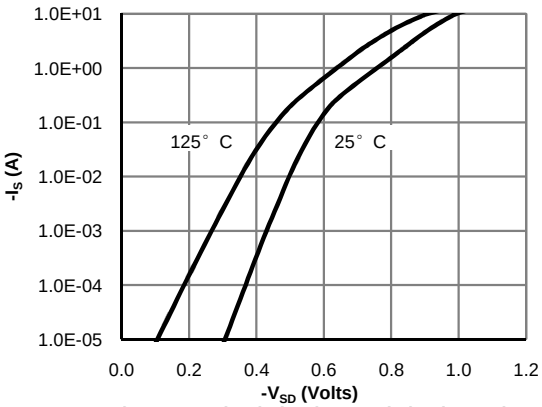


Figure 6: Body-Diode Characteristics (Note E)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

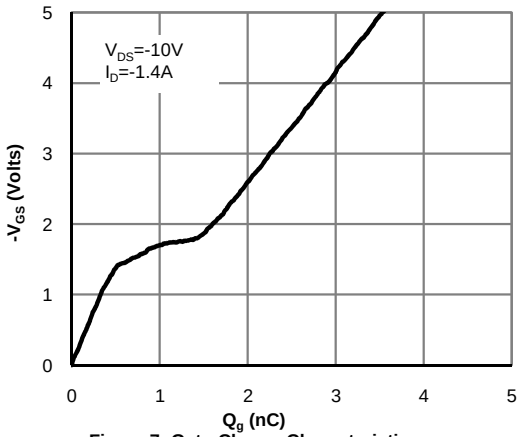


Figure 7: Gate-Charge Characteristics

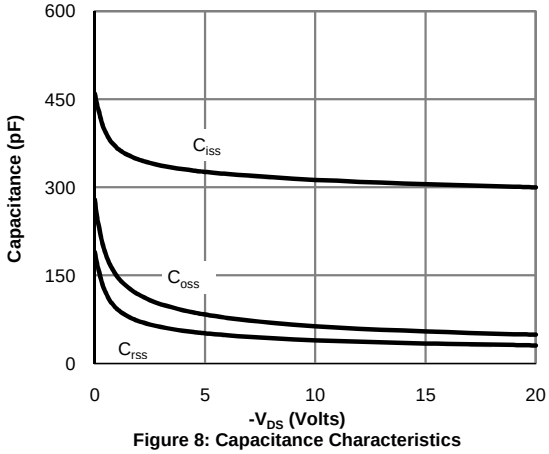


Figure 8: Capacitance Characteristics

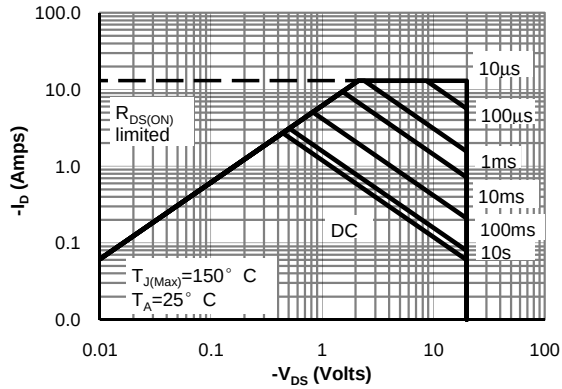


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

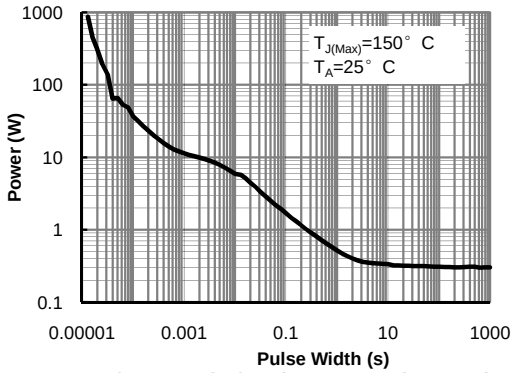


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note F)

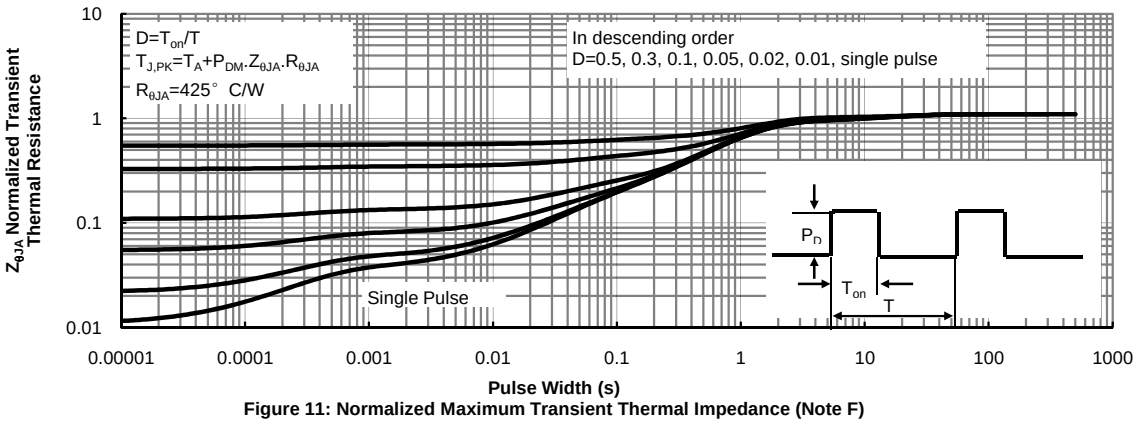
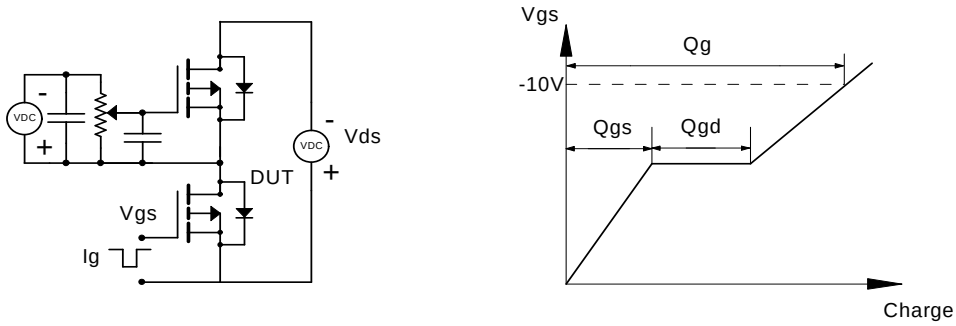
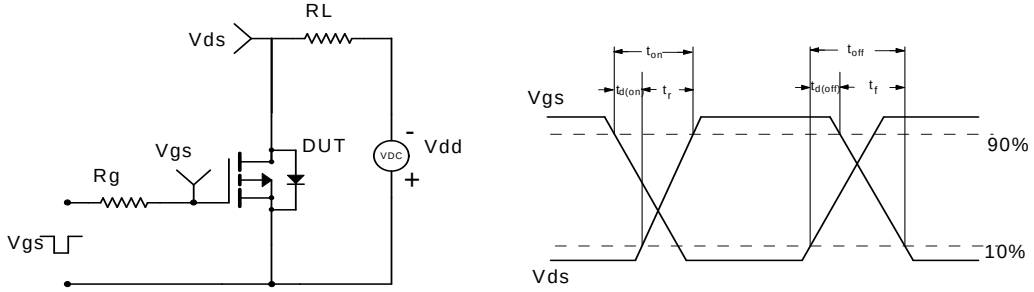
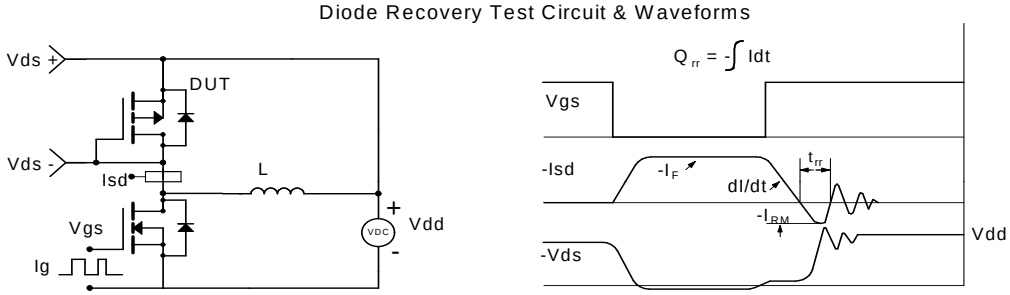


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms