ALPHA & OMEGA SEMICONDUCTOR
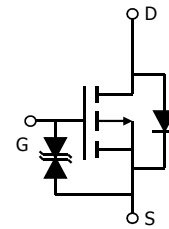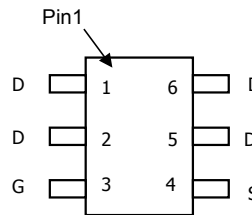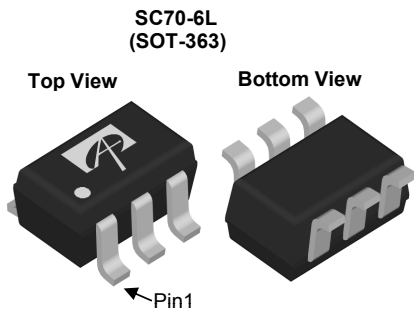
AO7415
20V P-Channel MOSFET

General Description

The AO7415 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)	-2A
$R_{DS(ON)}$ (at V_{GS}= -10V)	< 100mΩ
$R_{DS(ON)}$ (at V_{GS}= -4.5V)	< 125mΩ
$R_{DS(ON)}$ (at V_{GS}= -2.5V)	< 170mΩ

Typical ESD protection   **HBM Class 2**

Green Product

**SC70-6L
(SOT-363)**

Top View   Bottom View

Pin1

D	1	6	D
D	2	5	D
G	3	4	S

Pin1

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	-2	A
	T_A=70°C		-1.6	
Pulsed Drain Current [C]		I_{DM}	-13	
Power Dissipation [B]	T_A=25°C	P_D	0.63	W
	T_A=70°C		0.4	
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	$R_{\theta JA}$	160	200	°C/W
Maximum Junction-to-Ambient [A D]	Steady-State		180	220	°C/W
Maximum Junction-to-Lead	Steady-State	$R_{\theta JL}$	130	160	°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$_D$=-2A			80	100	mΩ
			T$_J$=125°C		115		
		V$_{GS}$=-4.5V, I$_D$=-1.3A			98	125	mΩ
		V$_{GS}$=-2.5V, I$_D$=-1.0A			130	170	mΩ
g$_{FS}$	Forward Transconductance	V$_{DS}$=-5V, I$_D$=-2A			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$_D$=-2A			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$_L$=5Ω, 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$_F$=-2A, dI/dt=100A/µs			6.1		ns
Q$_{rr}$	Body Diode Reverse Recovery Charge	I$_F$=-2A, dI/dt=100A/µs			1.4		nC

A. The value of R$_{θJA}$ 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$_{θJA}$ is the sum of the thermal impedance from junction to lead R$_{θJL}$ and lead to ambient.
E. The static characteristics in Figures 1 to 6 are obtained using <300µs pulses, duty cycle 0.5% max.
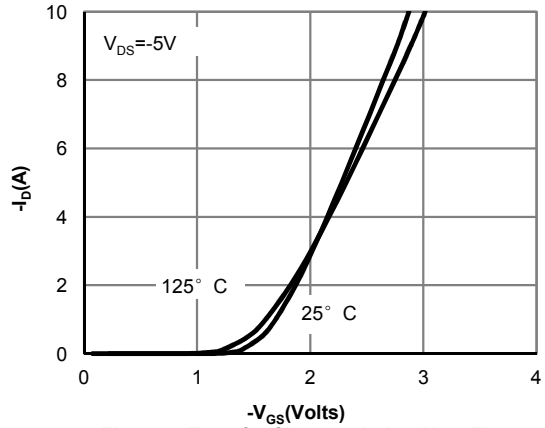F. These curves are based on the junction-to-ambient thermal impedance which is measured with the device mounted on 1in^2 FR-4 board with 2oz. Copper, assuming a maximum junction temperature of T$_{J(MAX)}$=150° C. The SOA curve provides a single pulse rating.

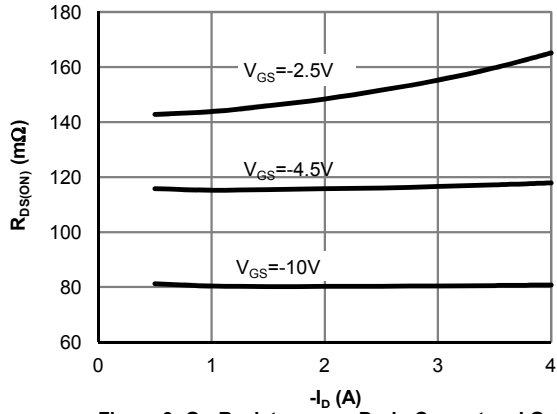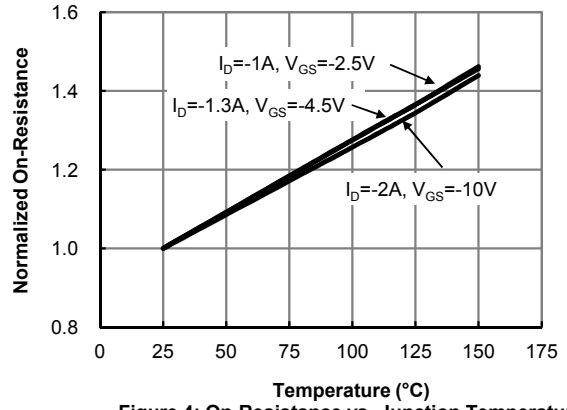## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS
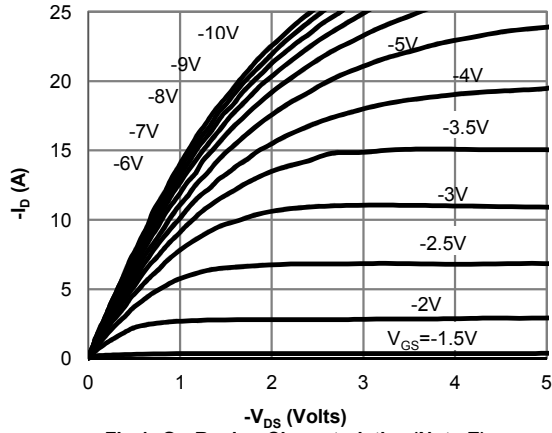
Fig 1: On-Region Characteristics (Note E)
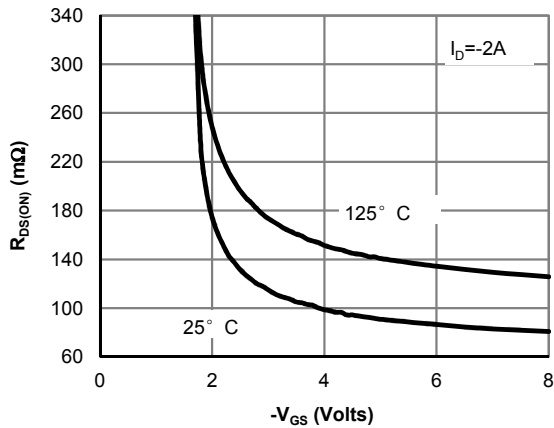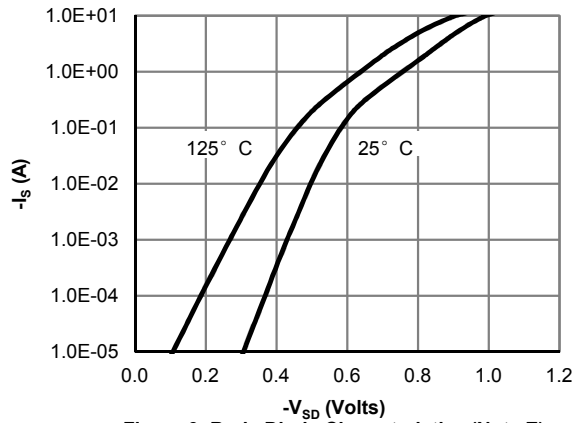
Figure 2: Transfer Characteristics (Note E)

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

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

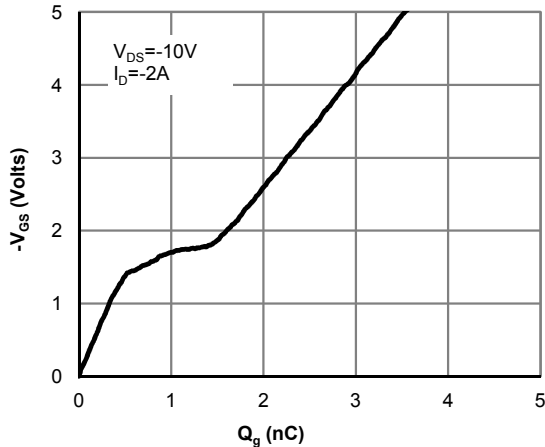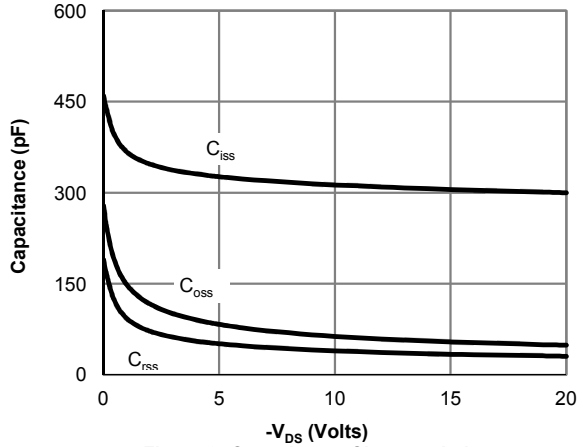Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)

Figure 6: Body-Diode Characteristics (Note E)

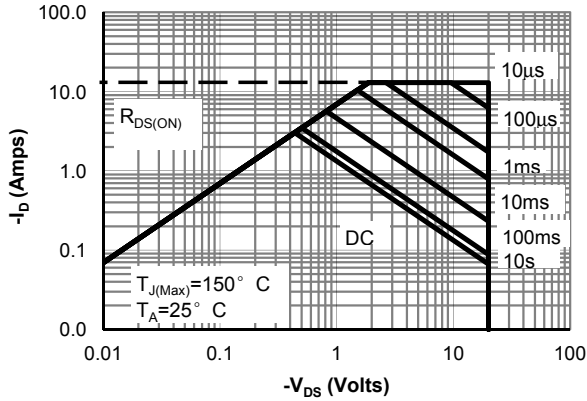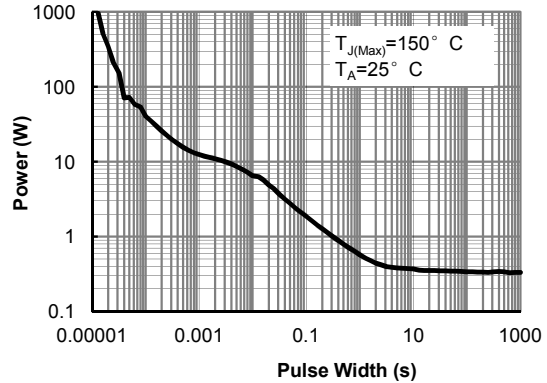## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

V_{DS}=-10V
I_D=-2A

Figure 7: Gate-Charge Characteristics

C_{iss}

C_{oss}

C_{rss}

Figure 8: Capacitance Characteristics

$R_{DS(ON)}$

10μs

100μs

1ms

10ms

100ms
10s

DC

$T_{J(Max)}$=150°C
T_A=25°C

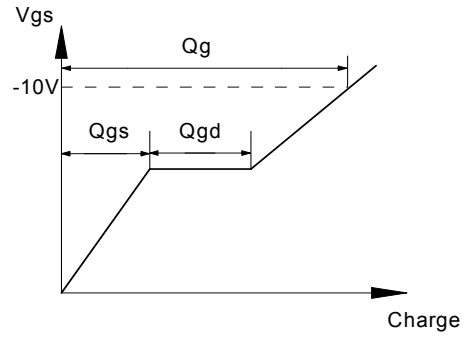**Figure 9: Maximum Forward Biased Safe Operating Area (Note F)**

$T_{J(Max)}$=150°C
T_A=25°C

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

D=T_{on}/T
$T_{J,PK}$=T_A+P_{DM}·$Z_{\theta JA}$·$R_{\theta JA}$
$R_{\theta JA}$=220°C/W

In descending order
D=0.5, 0.3, 0.1, 0.05, 0.02, 0.01, single pulse
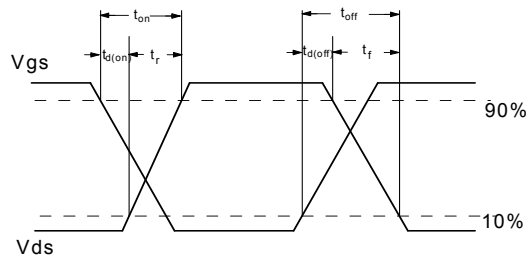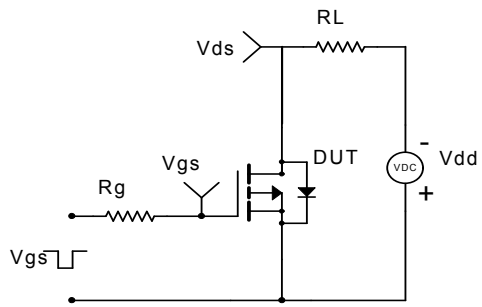
Single Pulse

P_D

T_{on}

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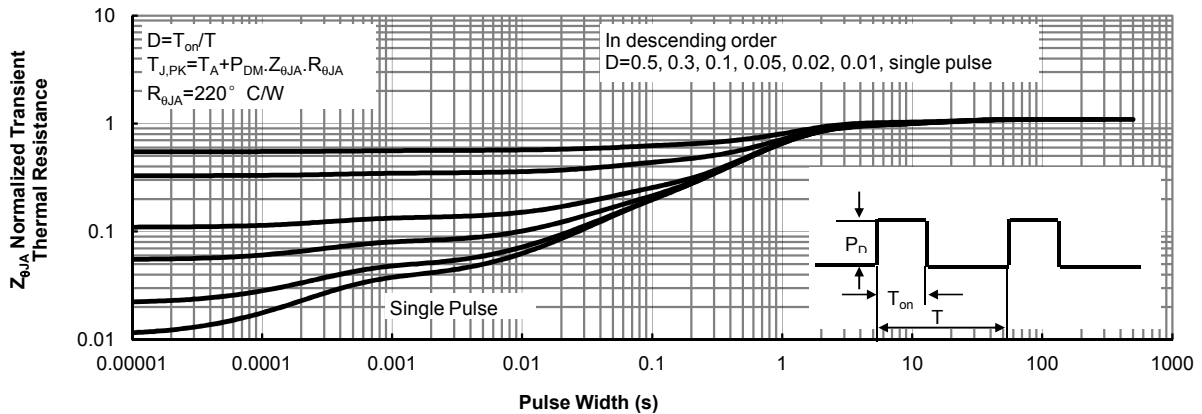
Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

Gate Charge Test Circuit & Waveform
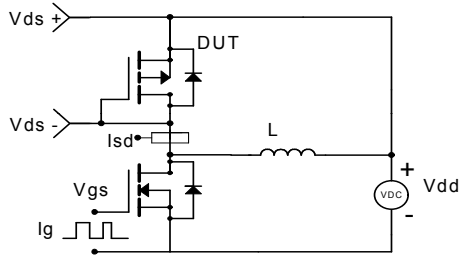
VDC

DUT

Vds

Vgs

Ig

Vgs

-10V

Qg

Qgs

Qgd

Charge
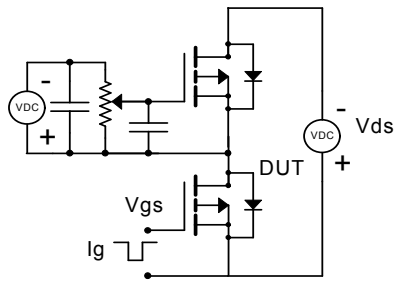
Resistive Switching Test Circuit & Waveforms

RL

Vds

Rg

Vgs

DUT

Vdd

Vgs

t_{on}

t_{off}

$t_{d(on)}$

t_r

$t_{d(off)}$

t_f

Vgs

90%

Vds

10%

Diode Recovery Test Circuit & Waveforms

Vds +

DUT

Vds -

Isd

L

Vdd

Vgs

Ig

$Q_{rr} = \int Idt$

Vgs

-Isd

$-I_F$

dI/dt

t_{rr}

$-I_{RM}$

-Vds

Vdd
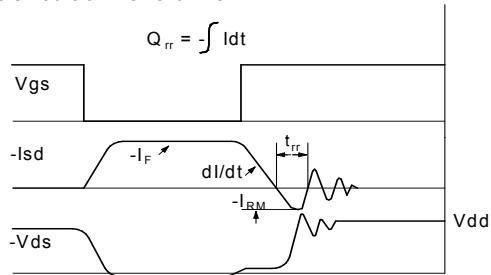
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