ALPHA & OMEGA SEMICONDUCTOR

AON7407

20V P-Channel MOSFET

General Description

The AON7407 combines advanced trench MOSFET technology with a low resistance package to provide extremely low $R_{DS(ON)}$. This device is ideal for load switch and battery protection applications.

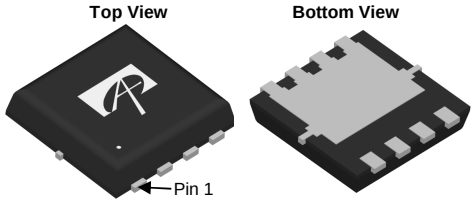
Product Summary

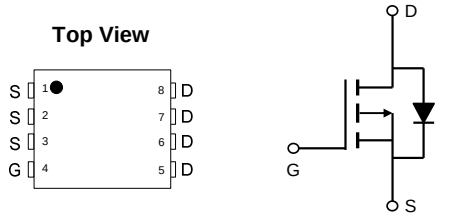
V_{DS}	-20V
I_D (at V_{GS}=-4.5V)	-40A
$R_{DS(ON)}$ (at V_{GS} =-4.5V)	< 9.5mΩ
$R_{DS(ON)}$ (at V_{GS} =-2.5V)	< 12.5mΩ
$R_{DS(ON)}$ (at V_{GS} =-1.8V)	< 18mΩ

100% UIS Tested
100% R_g Tested

Green Product

DFN 3x3_EP





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}	±8	V
Continuous Drain Current [G]	T_C=25°C	I_D	-40	A
	T_C=100°C		-29	
Pulsed Drain Current [C]		I_{DM}	-100	
Continuous Drain Current	T_A=25°C	I_{DSM}	-14.5	A
	T_A=70°C		-11.5	
Avalanche Current [C]		I_{AS}, I_{AR}	-40	A
Avalanche energy L=0.1mH [C]		E_{AS}, E_{AR}	80	mJ
Power Dissipation [B]	T_C=25°C	P_D	29	W
	T_C=100°C		12	
Power Dissipation [A]	T_A=25°C	P_{DSM}	3.1	W
	T_A=70°C		2	
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	$R_{\theta JA}$	30	40	°C/W
Maximum Junction-to-Ambient [A D]	Steady-State		60	75	°C/W
Maximum Junction-to-Case	Steady-State	$R_{\theta JC}$	3.5	4.2	°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}= ±8V			±100	nA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=V_{GS}, I_D=-250µA	-0.3	-0.55	-0.9	V
$I_{D(ON)}$	On state drain current	V_{GS}=-4.5V, V_{DS}=-5V	-100			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS}=-4.5V, I_D=-14A		7.6	9.5	mΩ
		T_J=125°C		10.5	13.5	
		V_{GS}=-2.5V, I_D=-13A		9.3	12.5	mΩ
		V_{GS}=-1.8V, I_D=-11A		11.4	18	mΩ
g_{FS}	Forward Transconductance	V_{DS}=-5V, I_D=-14A		72		S
V_{SD}	Diode Forward Voltage	I_S=-1A,V_{GS}=0V		-0.52	-1	V
I_S	Maximum Body-Diode Continuous Current				-35	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=-10V, f=1MHz	2795	3495	4195	pF
C_{oss}	Output Capacitance		365	528	690	pF
C_{rss}	Reverse Transfer Capacitance		255	425	595	pF
R_g	Gate resistance	V_{GS}=0V, V_{DS}=0V, f=1MHz		2.8	5.6	Ω
SWITCHING PARAMETERS						
Q_g	Total Gate Charge	V_{GS}=-4.5V, V_{DS}=-10V, I_D=-14A	35	44	53	nC
Q_{gs}	Gate Source Charge			9		nC
Q_{gd}	Gate Drain Charge			11		nC
$t_{D(on)}$	Turn-On DelayTime	V_{GS}=-4.5V, V_{DS}=-10V, R_L=0.75Ω, R_{GEN}=3Ω		18		ns
t_r	Turn-On Rise Time			32		ns
$t_{D(off)}$	Turn-Off DelayTime			136		ns
t_f	Turn-Off Fall Time			59		ns
t_{rr}	Body Diode Reverse Recovery Time	I_F=-14A, dI/dt=500A/µs	26	33	40	ns
Q_{rr}	Body Diode Reverse Recovery Charge	I_F=-14A, dI/dt=500A/µs	80	100	120	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 Power dissipation P_{DSM} is based on $R_{\theta JA}$ t ≤ 10s value and the maximum allowed junction temperature of 150°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 junction-to-case thermal resistance, and is more useful in setting the upper dissipation limit for cases where additional heatsinking is used.

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 initial T_J =25°C.

D. The $R_{\theta JA}$ is the sum of the thermal impedance from junction to case $R_{\theta JC}$ and case 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-case thermal impedance which is measured with the device mounted to a large heatsink, assuming a maximum junction temperature of $T_{J(MAX)}$=150°C. The SOA curve provides a single pulse ratin g.

G. The maximum current rating is package limited.

H. These tests are performed with the device mounted on 1 in^2 FR-4 board with 2oz. Copper, in a still air environment with T_A=25°C.

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

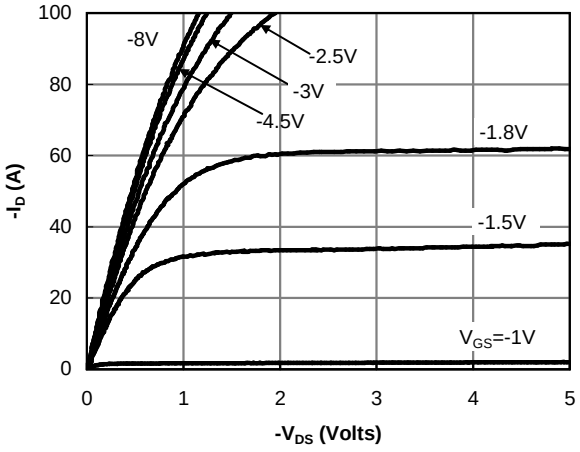


Fig 1: On-Region Characteristics (Note E)

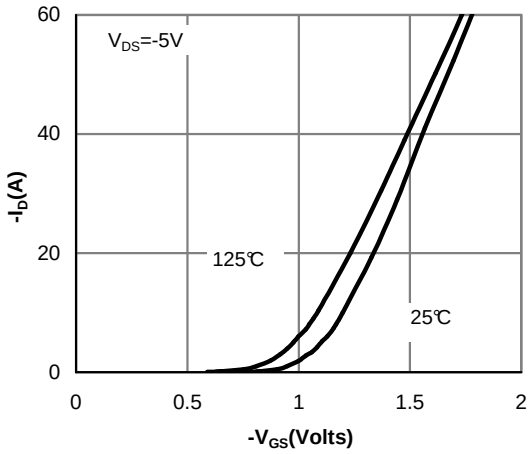


Figure 2: Transfer Characteristics (Note E)

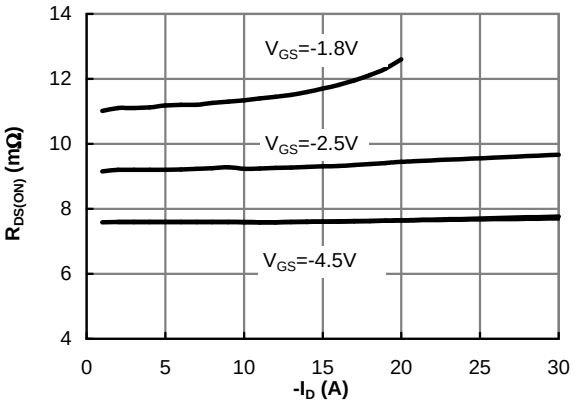


Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)

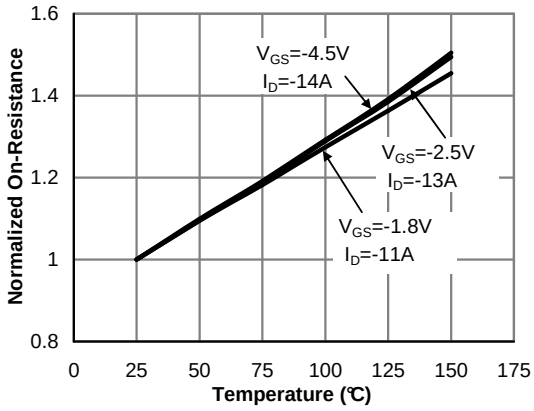


Figure 4: On-Resistance vs. Junction Temperature (Note E)

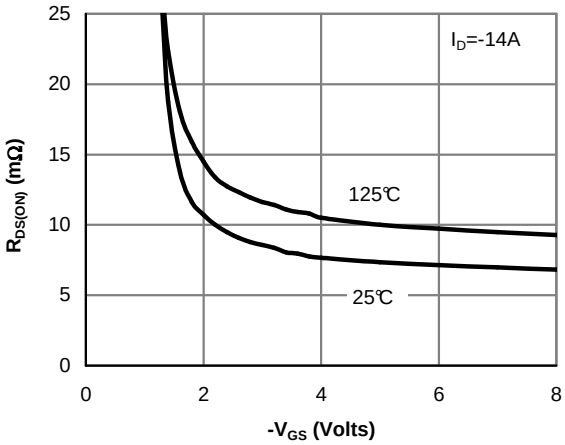


Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)

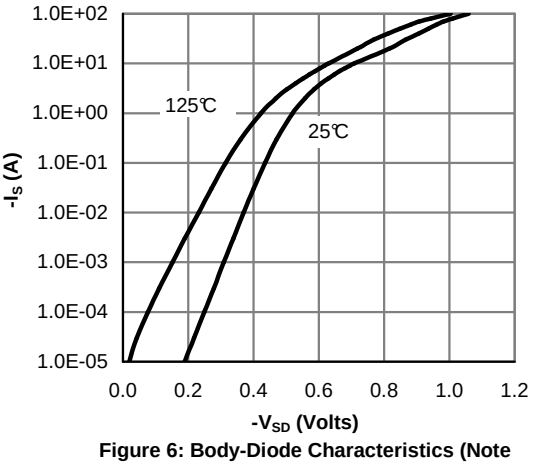


Figure 6: Body-Diode Characteristics (Note E)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

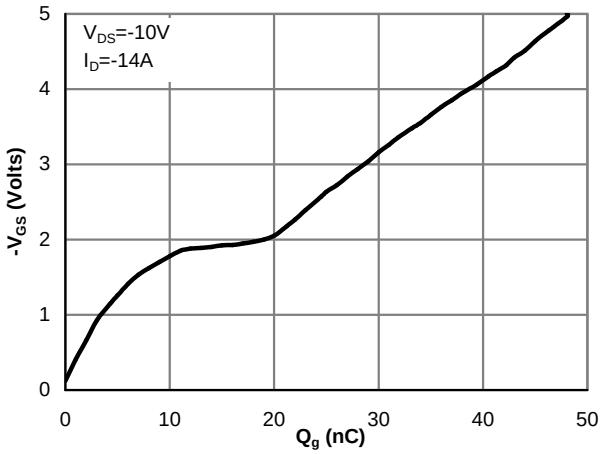


Figure 7: Gate-Charge Characteristics

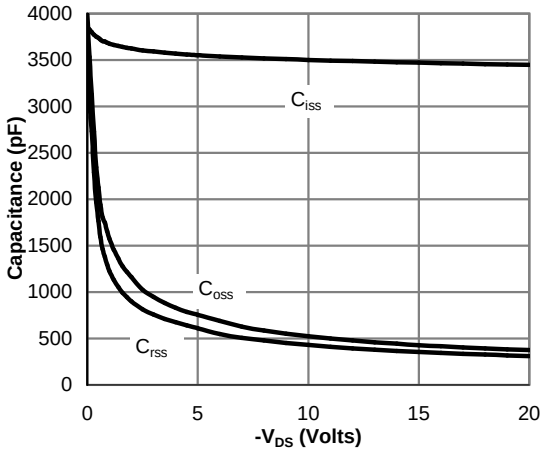


Figure 8: Capacitance Characteristics

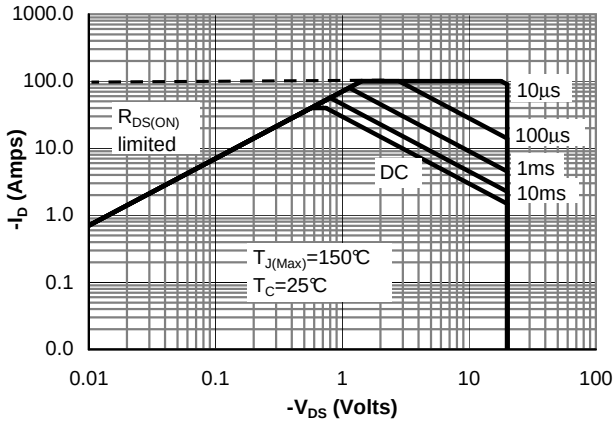


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

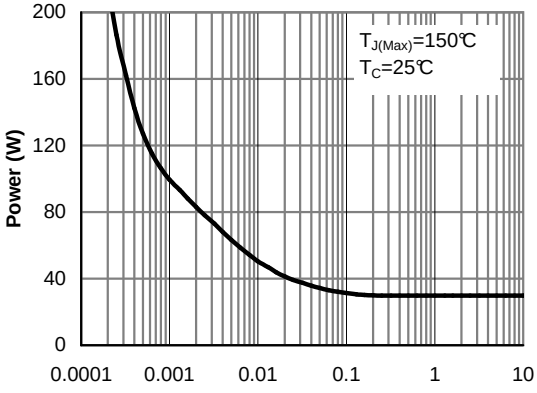


Figure 10: Single Pulse Power Rating Junction-to-Case (Note F)

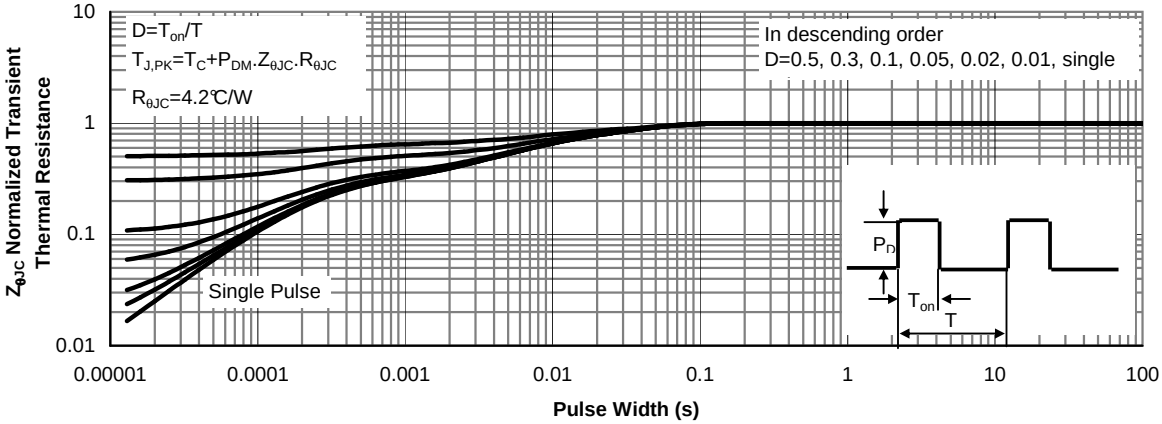


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

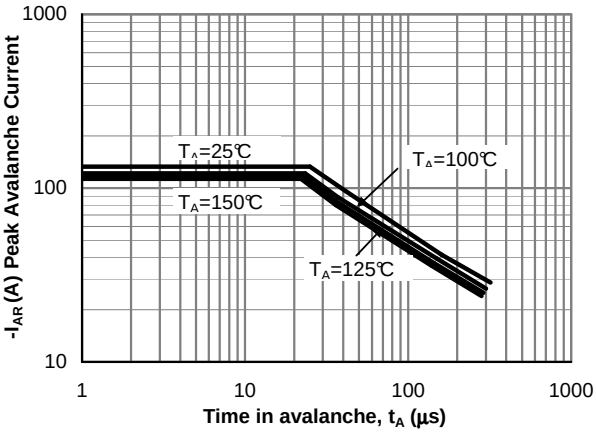


Figure 12: Single Pulse Avalanche capability (Note C)

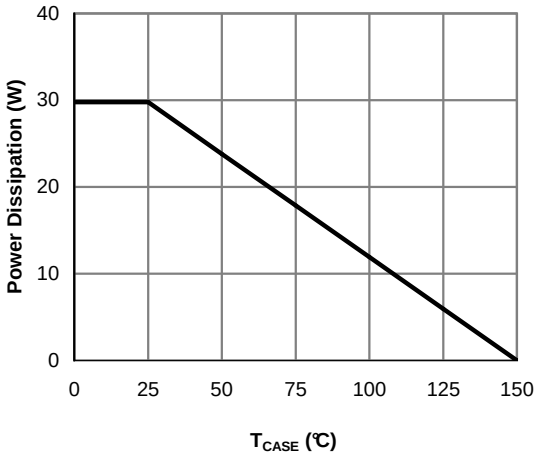


Figure 13: Power De-rating (Note F)

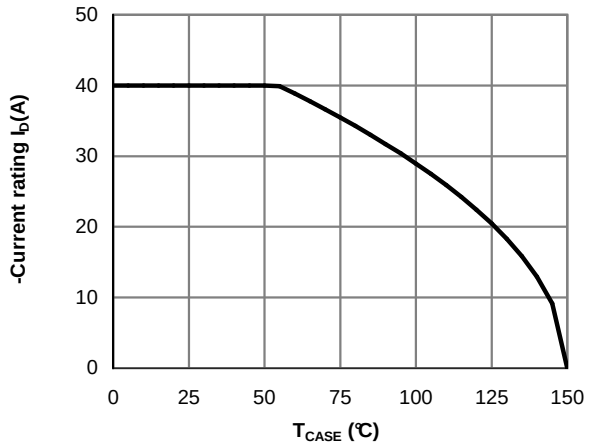


Figure 14: Current De-rating (Note F)

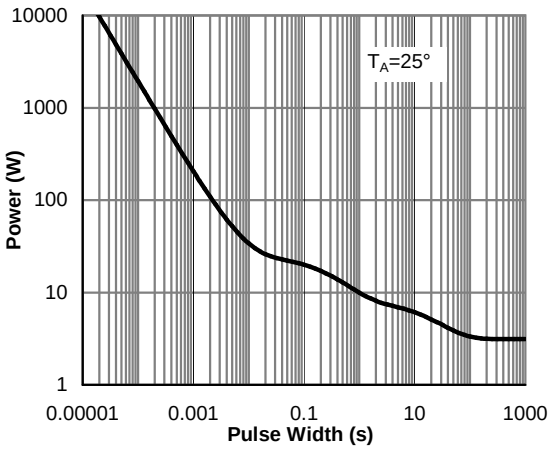


Figure 15: Single Pulse Power Rating Junction-to-Ambient (Note H)

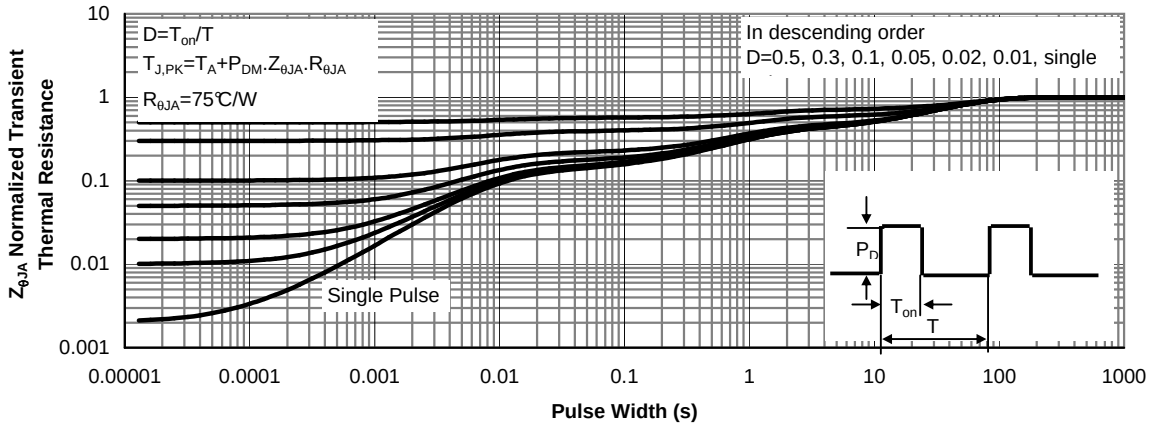
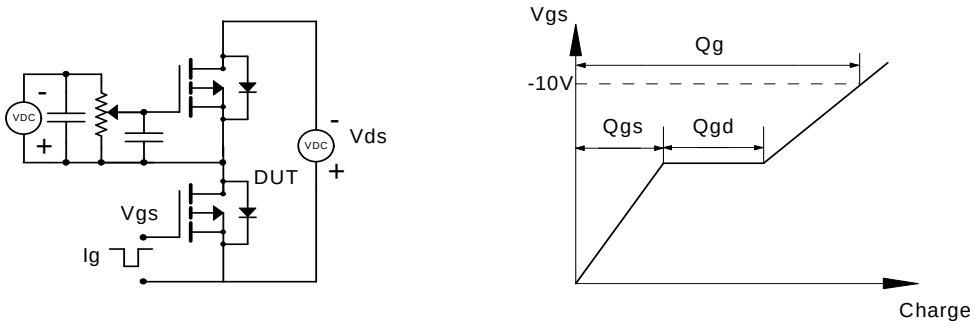
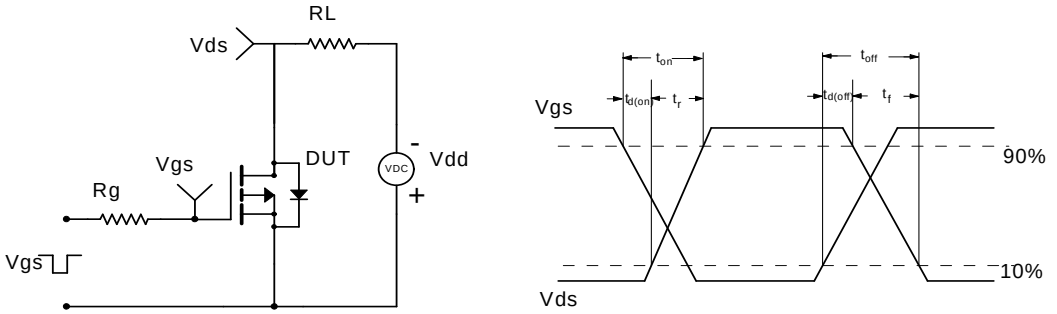


Figure 16: Normalized Maximum Transient Thermal Impedance (Note H)

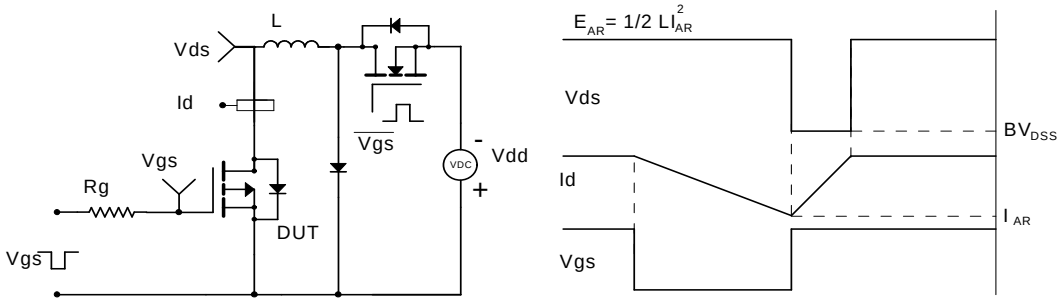
Gate Charge Test Circuit & Waveform



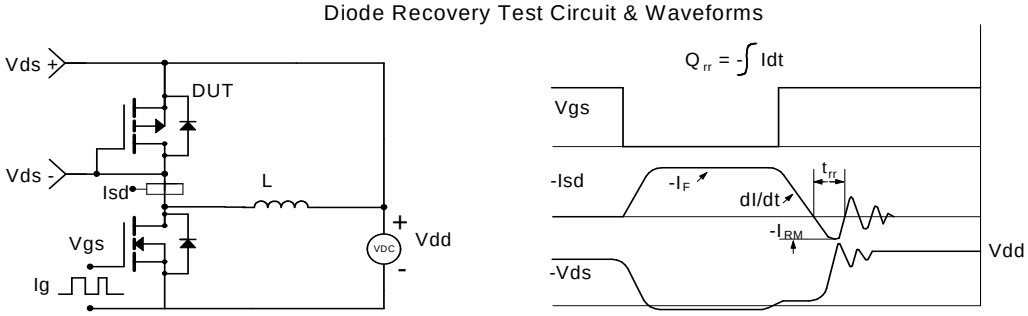
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



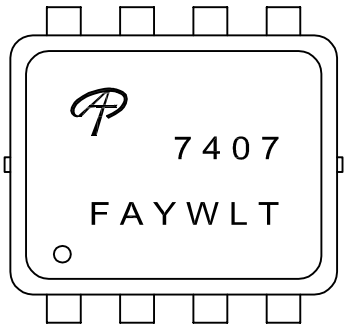
Diode Recovery Test Circuit & Waveforms



ALPHA & OMEGA SEMICONDUCTOR

Document No.	PD-01495
Version	A
Title	AON7407 Marking Description

DFN3X3 PACKAGE MARKING DESCRIPTION



Green product

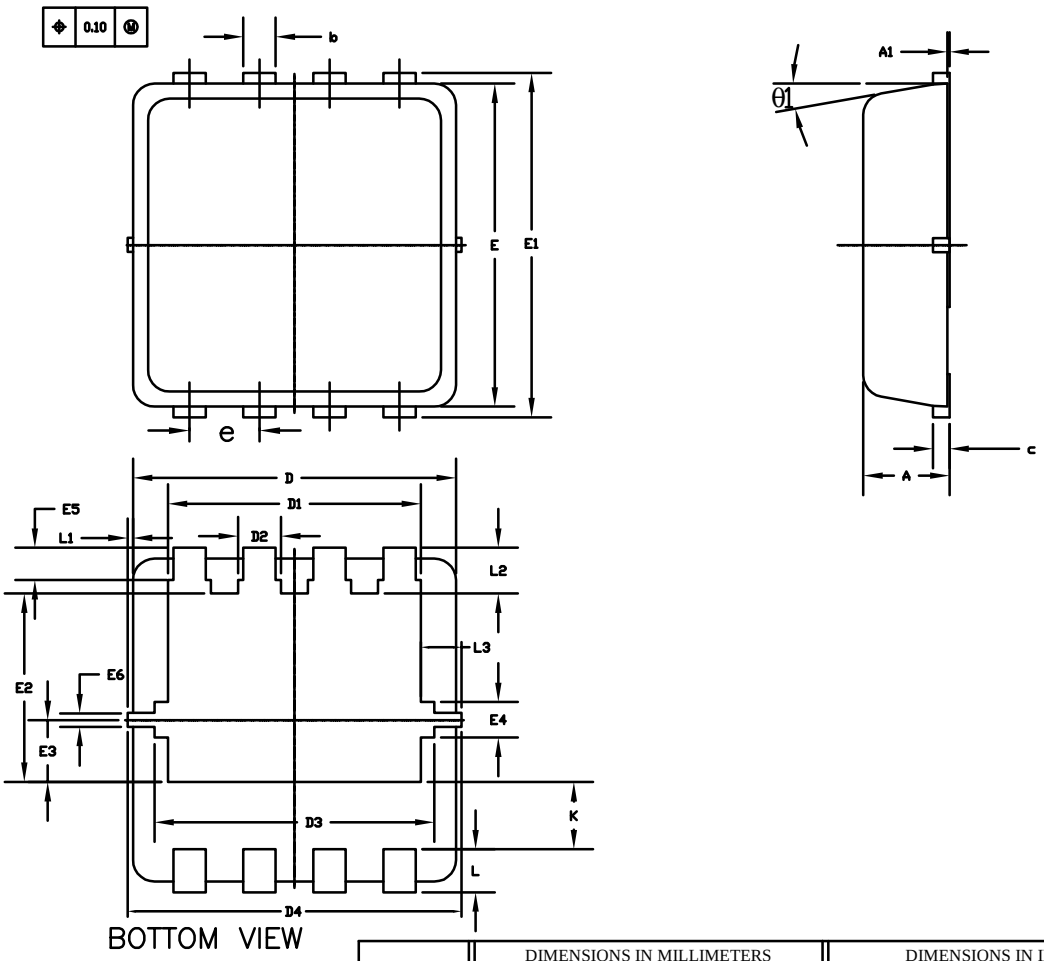
NOTE:
LOGO - AOS Logo
7407 - Part number code
F - Fab code
A - Assembly location code
Y - Year code
W - Week code
L&T - Assembly lot code

PART NO.	DESCRIPTION	CODE
AON7407	Green product	7407
AON7407L	Green product	7407

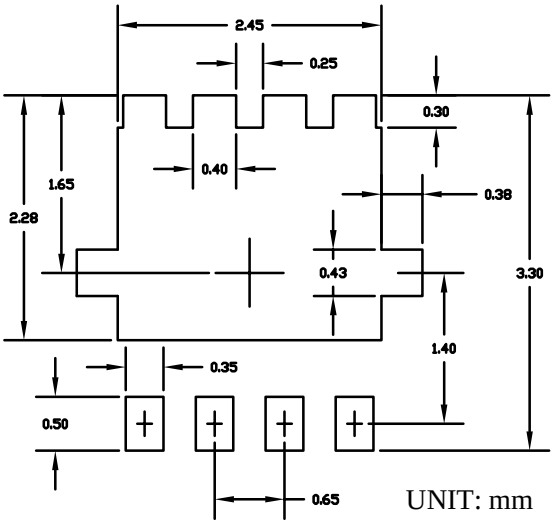
ALPHA & OMEGA SEMICONDUCTOR

Document No.	PO-00047
Version	G

DFN3x3A_8L_EP1_P PACKAGE OUTLINE



RECOMMENDED LAND PATTERN



UNIT: mm

SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.70	0.80	0.90	0.028	0.031	0.035
A1	0.00	0.025	0.05	0.000	0.001	0.002
b	0.24	0.30	0.35	0.009	0.012	0.014
c	0.10	0.15	0.25	0.004	0.006	0.010
D	2.90	3.00	3.10	0.114	0.118	0.122
D1	2.25	2.35	2.45	0.089	0.093	0.097
D2	0.30	0.40	0.50	0.012	0.016	0.020
D3	2.50	2.60	2.70	0.098	0.102	0.106
D4	3.00	3.10	3.20	0.118	0.122	0.126
E	2.90	3.00	3.10	0.114	0.118	0.122
E1	3.10	3.20	3.30	0.122	0.126	0.130
E2	1.65	1.75	1.85	0.065	0.069	0.073
E3	0.48	0.58	0.68	0.019	0.023	0.027
E4	0.23	0.33	0.43	0.009	0.013	0.017
E5	0.20	0.30	0.40	0.008	0.012	0.016
E6	0.075	0.125	0.175	0.003	0.005	0.007
e	0.60	0.65	0.70	0.024	0.026	0.028
K	0.52	0.62	0.72	0.020	0.024	0.028
L	0.30	0.40	0.50	0.012	0.016	0.020
L1	0	0.05	0.10	0	0.002	0.004
L2	0.33	0.43	0.53	0.013	0.017	0.021
L3	0.275	0.375	0.475	0.011	0.015	0.019
θ1	0°	10°	12°	0°	10°	12°

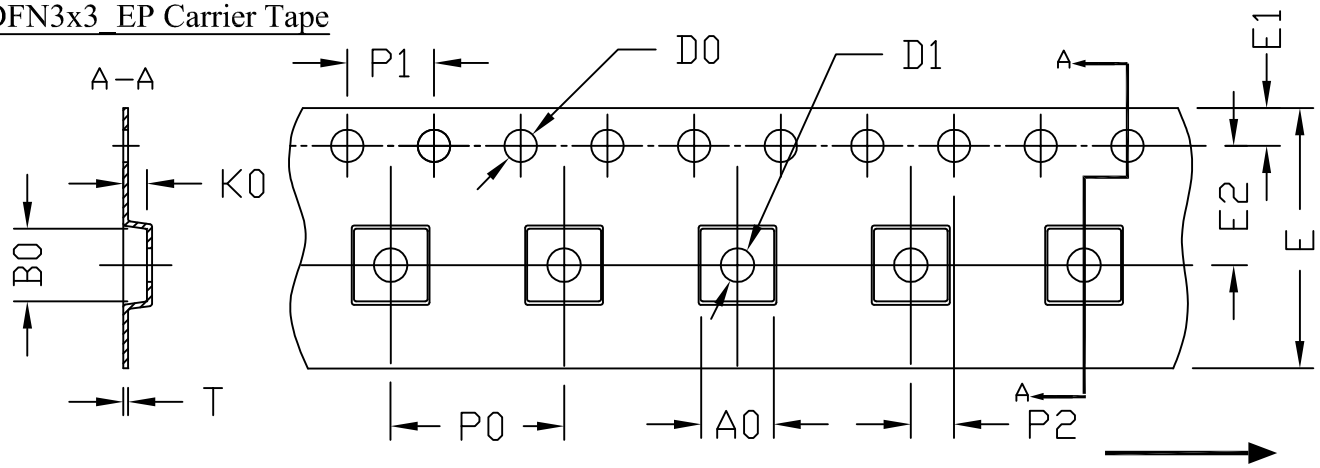
NOTE

1. PACKAGE DIMENSION IS EXCLUSIVE OF MOLD GATE BURR
2. PACKAGE DIMENSION IS EXCLUSIVE OF MOLD FLASH AND CUTTING BURR
3. CONTROLLING DIMENSION IS MILLIMETER.
   CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.

ALPHA & OMEGA
SEMICONDUCTOR, LTD.

DFN3x3_EP Tape and Reel Data

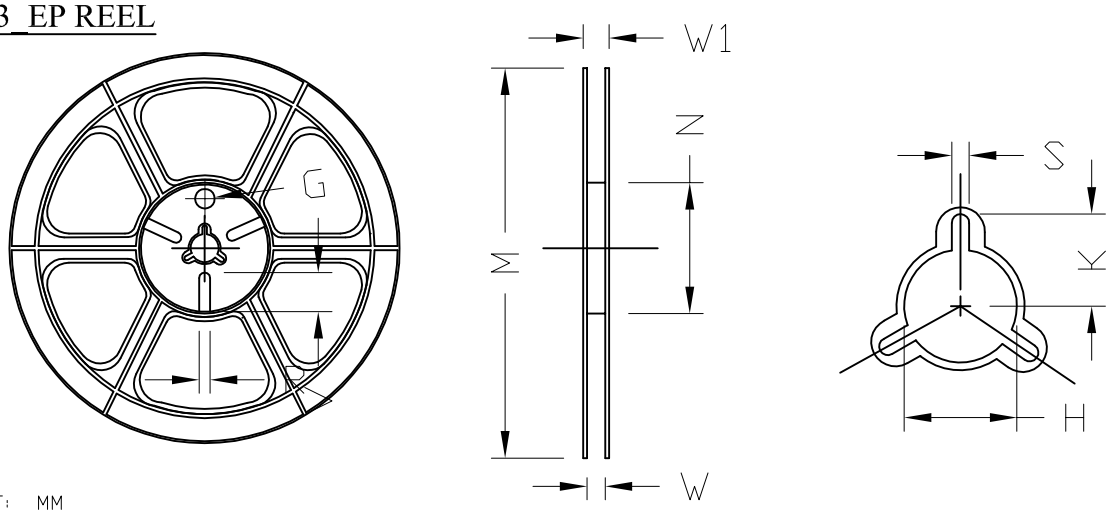
DFN3x3_EP Carrier Tape



UNIT: MM

PACKAGE	A0	B0	K0	D0	D1	E	E1	E2	P0	P1	P2	T
DFN3x3_EP	3.40 ±0.10	3.35 ±0.10	1.10 ±0.10	1.50 +0.10 −0	1.50 +0.10 −0	12.00 ±0.30	1.75 ±0.10	5.50 ±0.05	8.00 ±0.10	4.00 ±0.10	2.00 ±0.05	0.30 ±0.05

DFN3x3_EP REEL



UNIT: MM

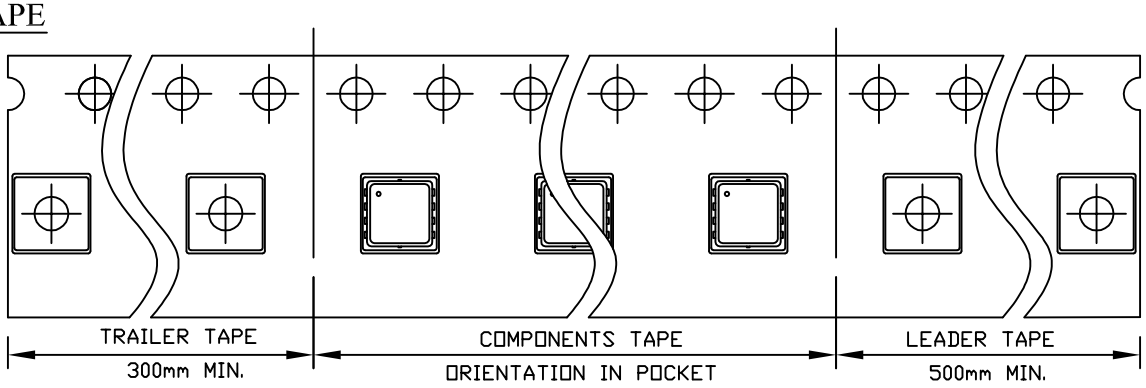
TAPE SIZE	REEL SIZE	M	N	W	W1	H	K	S	G	R	V
12 mm	ø330	ø330.00 ±0.50	ø97.00 ±0.10	13.00 ±0.30	17.40 ±1.00	ø13.00 +0.50 −0.20	10.60	2.00 ±0.50	---	---	---

DFN3x3_EP TAPE

Leader / Trailer
& Orientation

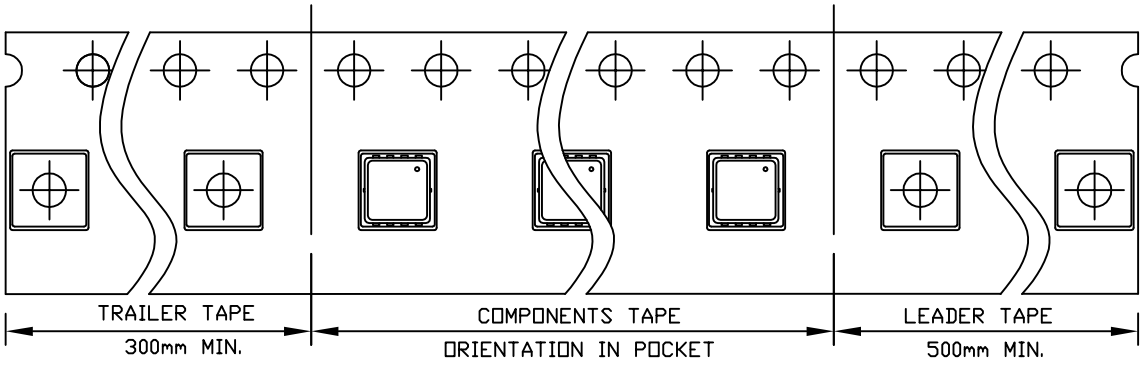
MOS

Unit Per Reel:
5000pcs



PIC

Unit Per Reel:
5000pcs



AOS Semiconductor
Product Reliability Report

AON7407, rev A

Plastic Encapsulated Device

ALPHA & OMEGA Semiconductor, Inc

www.aosmd.com

This AOS product reliability report summarizes the qualification result for AON7407. Accelerated environmental tests are performed on a specific sample size, and then followed by electrical test at end point. Review of final electrical test result confirms that AON7407 passes AOS quality and reliability requirements. The released product will be categorized by the process family and be monitored on a quarterly basis for continuously improving the product quality.

Table of Contents:

I. Product Description
II. Package and Die information
III. Environmental Stress Test Summary and Result
IV. Reliability Evaluation

I. Product Description:

The AON7407 combines advanced trench MOSFET technology with a low resistance package to provide extremely low $R_{DS(ON)}$. This device is ideal for load switch and battery protection applications.

-RoHS Compliant
- Halogen Free

Detailed information refers to datasheet.

II. Die / Package Information:

	AON7407
Process	Standard sub-micron Low voltage P channel
Package Type	DFN 3x3A
Lead Frame	Cu
Die Attach	Ag epoxy
Bonding Wire	Cu wire
Mold Material	Epoxy resin with silica filler
MSL (moisture sensitive level)	Level 1 based on J-STD-020

Note * based on information provided by assembler and mold compound supplier

ALPHA & OMEGA SEMICONDUCTOR

III. Result of Reliability Stress for AON7407

Test Item	Test Condition	Time Point	Lot Attribution	Total Sample size	Number of Failures	Standard
MSL Precondition	168hr 85℃ /85%RH +3 cycle reflow@260℃	-	11 lots	1815pcs	0	JESD22-A113
HTGB	Temp = 150 °c, Vgs=100% of Vgsmax	168hrs 500 hrs 1000 hrs	1 lot (Note A*)	77pcs 77pcs / lot	0	JESD22-A108
HTRB	Temp = 150 °c, Vds=80% of Vdsmax	168hrs 500 hrs 1000 hrs	1 lot (Note A*)	77pcs 77pcs / lot	0	JESD22-A108
HAST	130 +/- 2°c, 85%RH, 33.3 psi, Vgs = 100% of Vgs max	100 hrs	11 lots (Note A*)	605pcs 55pcs / lot	0	JESD22-A110
Pressure Pot	121°c, 29.7psi, RH=100%	96 hrs	11 lots (Note A*)	605pcs 55pcs / lot	0	JESD22-A102
Temperature Cycle	-65°c to 150°c, air to air	250 / 500 cycles	11 lots (Note A*)	605pcs 55pcs / lot	0	JESD22-A104

Note A: The reliability data presents total of available generic data up to the published date.

IV. Reliability Evaluation

FIT rate (per billion): 137
MTTF = 833 years

The presentation of FIT rate for the individual product reliability is restricted by the actual burn-in sample size of the selected product (AON7407). Failure Rate Determination is based on JEDEC Standard JESD 85. FIT means one failure per billion hours.

Failure Rate = $Chi^2 \times 10^9$ **/ [**2 (N) (H) (Af)**]** = 1.83×10^9 **/ [**2x 2x77x168 x258**]** = 137
MTTF = 10^9 / FIT = 7.30×10^6hrs = 833 years

Chi² = Chi Squared Distribution, determined by the number of failures and confidence interval
N = Total Number of units from HTRB and HTGB tests
H = Duration of HTRB/HTGB testing
Af = Acceleration Factor from Test to Use Conditions (Ea = 0.7eV and Tuse = 55℃)
Acceleration Factor [Af**]** = **Exp** [Ea / **k** (1/Tj u – 1/Tj s)]

Acceleration Factor ratio list:

	55 deg C	70 deg C	85 deg C	100 deg C	115 deg C	130 deg C	150 deg C
Af	258	87	32	13	5.64	2.59	1

Tj s = Stressed junction temperature in degree (Kelvin), K = C+273.16
Tj u = The use junction temperature in degree (Kelvin), K = C+273.16
K = Boltzmann's constant, 8.617164×10^{-5}eV / K