ALPHA & OMEGA SEMICONDUCTOR

AO4828

60V Dual N-Channel MOSFET

General Description

The AO4828 uses advanced trench technology to provide excellent $R_{DS(ON)}$ and low gate charge. This device is suitable for use as a load switch or in PWM applications.

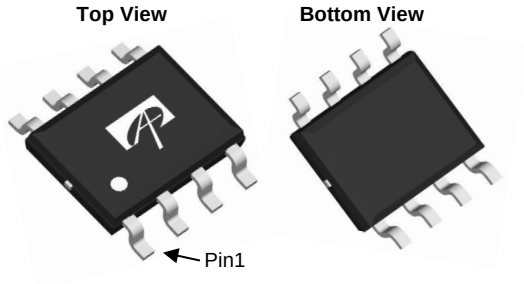
Features

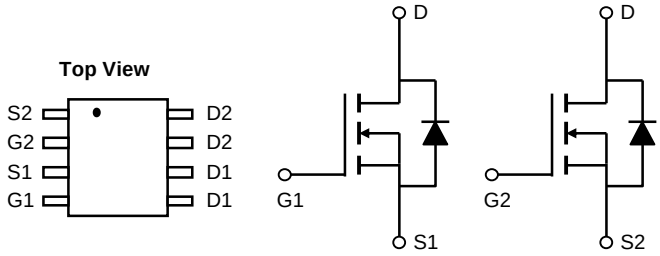
V_{DS} (V) = 60V
I_D = 4.5A (V_{GS} = 10V)
$R_{DS(ON)}$ < 56mΩ (V_{GS} = 10V)
$R_{DS(ON)}$ < 77mΩ (V_{GS} = 4.5V)

100% UIS tested
100% Rg tested

Green Product

SOIC-8





Absolute Maximum Ratings T_A=25°C unless otherwise noted

Parameter		Symbol	Maximum	Units
Drain-Source Voltage		V_{DS}	60	V
Gate-Source Voltage		V_{GS}	±20	V
Continuous Drain Current [AF]	T_A=25°C	I_D	4.5	A
	T_A=70°C		3.6	
Pulsed Drain Current [B]		I_{DM}	20	
Power Dissipation	T_A=25°C	P_D	2	W
	T_A=70°C		1.28	
Avalanche Current [B]		I_{AR}, I_{AS}	19	A
Repetitive avalanche energy 0.1mH [B]		E_{AR}, E_{AS}	18	mJ
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	$R_{\theta JA}$	48	62.5	°C/W
Maximum Junction-to-Ambient [A]	Steady-State		74	110	°C/W
Maximum Junction-to-Lead [C]	Steady-State	$R_{\theta JL}$	35	60	°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	60			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=60V, V_{GS}=0V			1	µA
		T_J=55°C			5	
I_{GSS}	Gate-Body leakage current	V_{DS}=0V, V_{GS}= ±20V			100	nA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=V_{GS} I_D=250µA	1	2.1	3	V
$I_{D(ON)}$	On state drain current	V_{GS}=10V, V_{DS}=5V	20			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS}=10V, I_D=4.5A		46	56	mΩ
		T_J=125°C		80	100	
		V_{GS}=4.5V, I_D=3A		64	77	mΩ
g_{FS}	Forward Transconductance	V_{DS}=5V, I_D=4.5A		11		S
V_{SD}	Diode Forward Voltage	I_S=1A,V_{GS}=0V		0.74	1	V
I_S	Maximum Body-Diode Continuous Current				3	A
I_{SM}	Pulsed Body Diode Current [B]				20	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=30V, f=1MHz		450	540	pF
C_{oss}	Output Capacitance			60		pF
C_{rss}	Reverse Transfer Capacitance			25		pF
R_g	Gate resistance	V_{GS}=0V, V_{DS}=0V, f=1MHz	1.3	1.65	2	Ω
SWITCHING PARAMETERS						
Q_g(10V)	Total Gate Charge	V_{GS}=10V, V_{DS}=30V, I_D=4.5A		8.5	10.5	nC
Q_g(4.5V)	Total Gate Charge			4.3	5.5	nC
Q_{gs}	Gate Source Charge			1.6		nC
Q_{gd}	Gate Drain Charge			2.2		nC
$t_{D(on)}$	Turn-On DelayTime	V_{GS}=10V, V_{DS}=30V, R_L=6.7Ω, R_{GEN}=3Ω		4.7		ns
t_r	Turn-On Rise Time			2.3		ns
$t_{D(off)}$	Turn-Off DelayTime			15.7		ns
t_f	Turn-Off Fall Time			1.9		ns
t_{rr}	Body Diode Reverse Recovery Time	I_F=4.5A, dI/dt=100A/µs		27.5	35	ns
Q_{rr}	Body Diode Reverse Recovery Charge	I_F=4.5A, dI/dt=100A/µs		32		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: Repetitive rating, pulse width limited by junction temperature.
C. The $R_{\theta JA}$ is the sum of the thermal impedence from junction to lead $R_{\theta JL}$ and lead to ambient.
D. The static characteristics in Figures 1 to 6 are obtained using <300 µs pulses, duty cycle 0.5% max.
E. 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. The SOA curve provides a single pulse rating.
F. The current rating is based on the t≤ 10s junction to ambient thermal resistance rating.
Rev8: May 2010

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

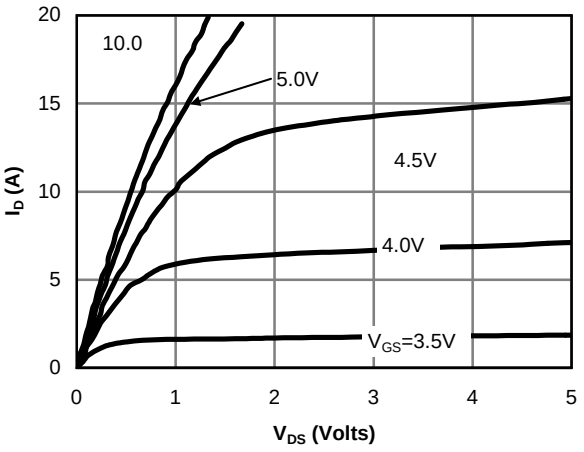


Fig 1: On-Region Characteristics

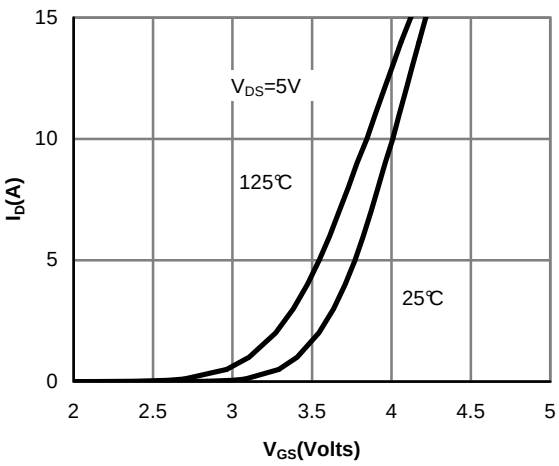


Figure 2: Transfer Characteristics

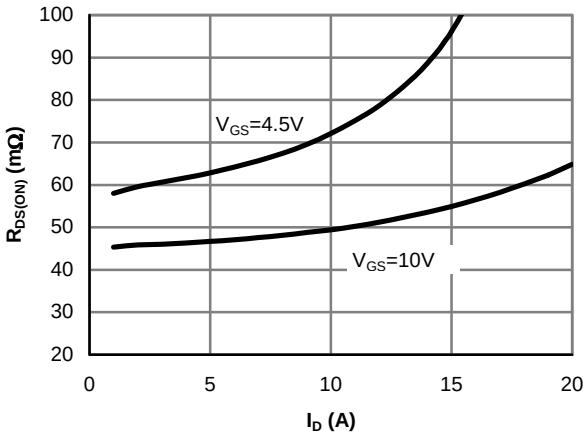


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

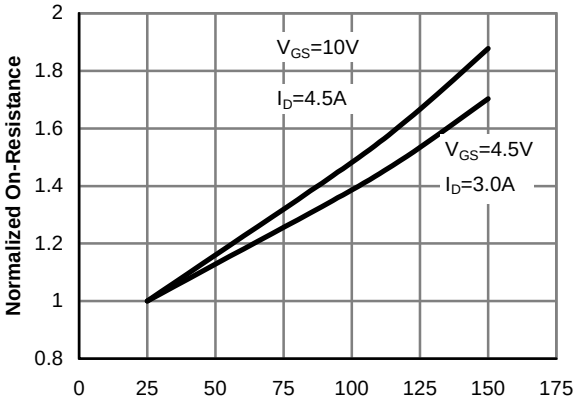


Figure 4: On-Resistance vs. Junction Temperature

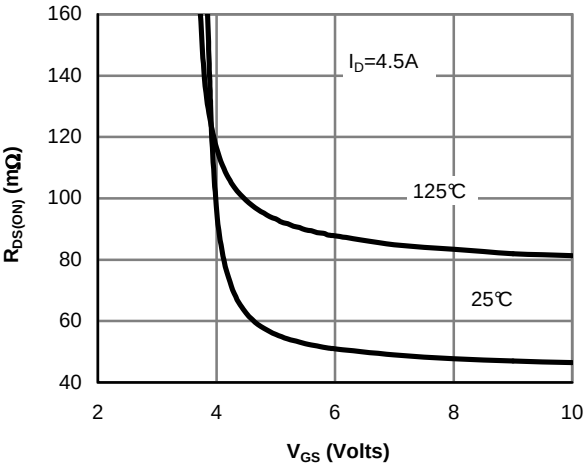


Figure 5: On-Resistance vs. Gate-Source Voltage

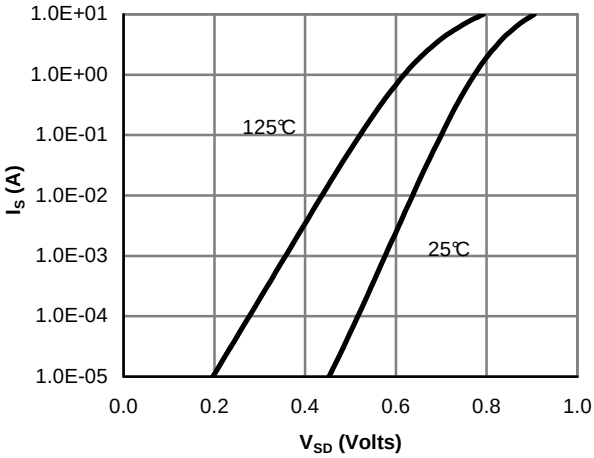


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

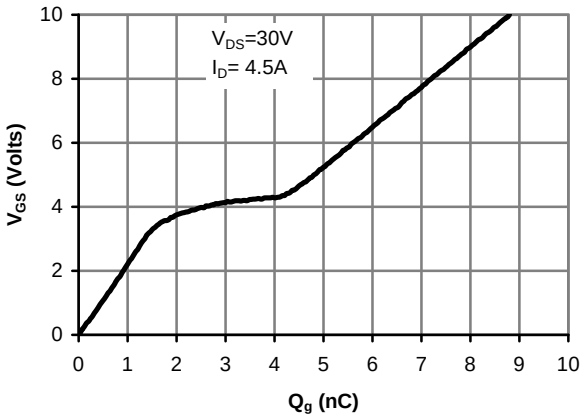


Figure 7: Gate-Charge Characteristics

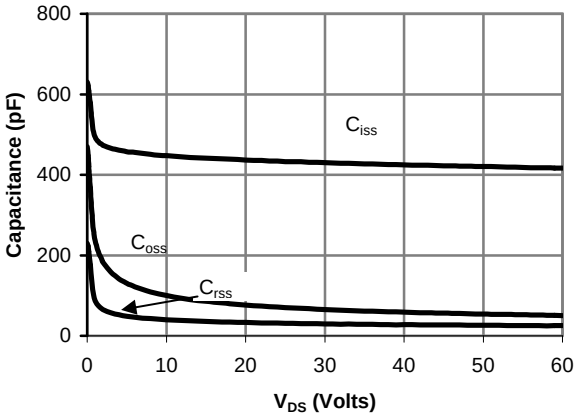


Figure 8: Capacitance Characteristics

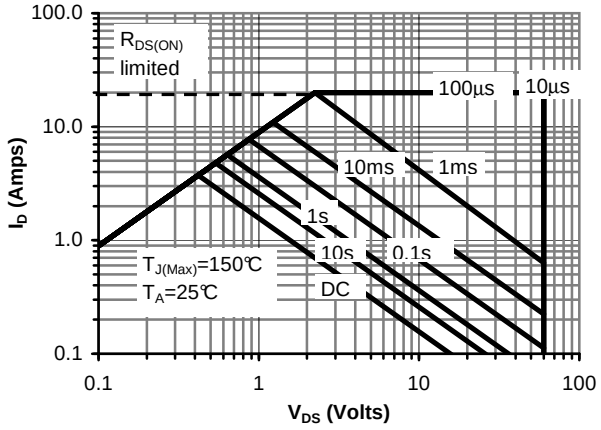


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

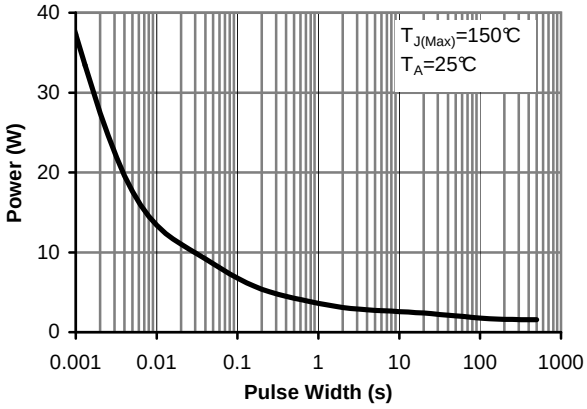


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

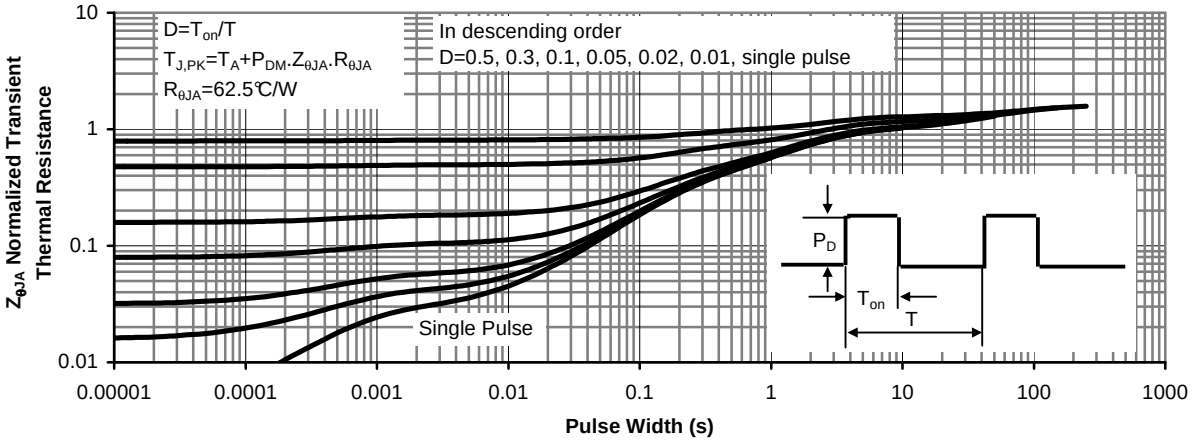
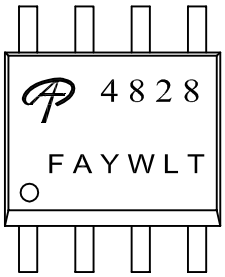


Figure 11: Normalized Maximum Transient Thermal Impedance

ALPHA & OMEGA SEMICONDUCTOR

Document No.	PD-00260
Version	D
Title	AO4828 Marking Description

SO-8 PACKAGE MARKING DESCRIPTION



Green product

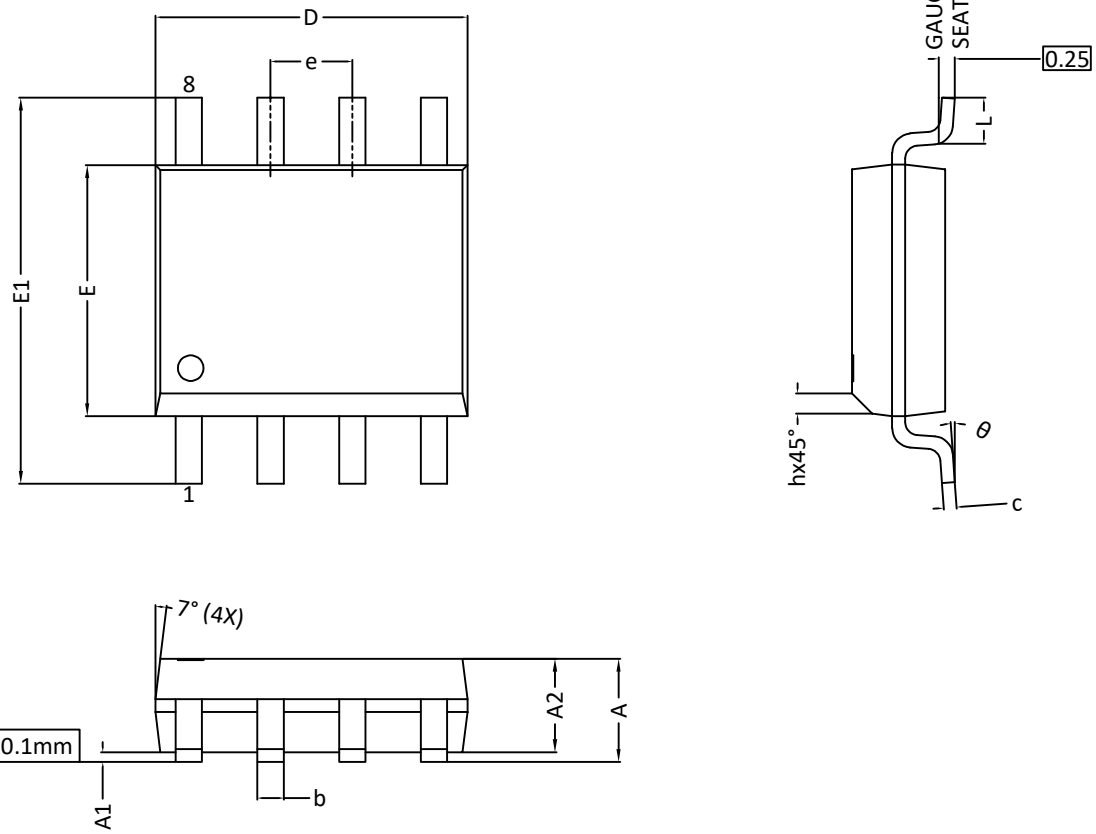
NOTE:
LOGO - AOS Logo
4828 - Part number code
F - Fab code
A - Assembly location code
Y - Year code
W - Week code
L&T - Assembly lot code

PART NO.	DESCRIPTION	CODE
AO4828	Green product	4828
AO4828L	Green product	4828

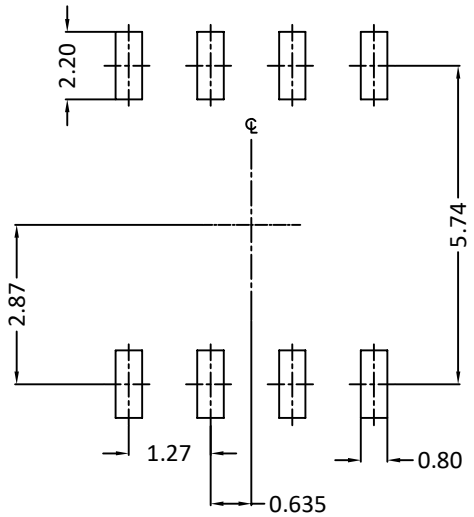
ALPHA & OMEGA SEMICONDUCTOR

Document No.	PO-00004
Version	L

SO8(SOP-8L) PACKAGE OUTLINE



RECOMMENDED LAND PATTERN



SYMBOLS	DIMENSION IN MM			DIMENSION IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.35	1.65	1.75	0.053	0.065	0.069
A1	0.10	0.15	0.25	0.004	0.006	0.010
A2	1.25	1.50	1.65	0.049	0.059	0.065
b	0.31	0.41	0.51	0.012	0.016	0.020
c	0.17	0.20	0.25	0.007	0.008	0.010
D	4.80	4.90	5.00	0.189	0.193	0.197
E	3.80	3.90	4.00	0.150	0.154	0.157
E1	5.80	6.00	6.20	0.228	0.236	0.244
e	1.27 BSC			0.050 BSC		
h	0.25	0.30	0.50	0.010	0.012	0.020
L	0.40	0.69	1.27	0.016	0.027	0.050
θ	0°	4°	8°	0°	4°	8°

UNIT: mm

NOTE
1. ALL DIMENSIONS ARE IN MILLMETERS.
2. DIMENSIONS ARE INCLUSIVE OF PLATING.
3. PACKAGE BODY SIZES EXCLUDE MOLD FLASH AND GATE BURRS.
   MOLD FLASH AT THE NON-LEAD SIDES SHOULD BE LESS THAN 6 MILS EACH.
4. DIMENSION L IS MEASURED IN GAUGE PLANE.
5. CONTROLLING DIMENSION IS MILLIMETER.
   CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.

ALPHA & OMEGA SEMICONDUCTOR

AOS Semiconductor Product Reliability Report

AO4828/AO4828L, rev B

Plastic Encapsulated Device

ALPHA & OMEGA Semiconductor, Inc

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Jan 12, 2006

ALPHA & OMEGA SEMICONDUCTOR

This AOS product reliability report summarizes the qualification result for AO4828. 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 AO4828 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:

The AO4828 uses advanced trench technology to provide excellent $R_{DS(ON)}$ and low gate charge. This device is suitable for use as a load switch or in PWM applications. Standard Product AO4828 is Pb-free (meets ROHS & Sony 259 specifications). AO4828L is a Green Product ordering option. AO4828 and AO4828L are electrically identical.

Absolute Maximum Ratings T_A=25°C unless otherwise noted				
Parameter		**Symbol**	**Maximum**	**Units**
Drain-Source Voltage		V_{DS}	60	V
Gate-Source Voltage		V_{GS}	±20	V
Continuous Drain Current	T_A=25°C	I_D	4.5	A
	T_A=70°C		3.6	
Pulsed Drain Current		I_{DM}	20	
Power Dissipation	T_A=25°C	P_D	2	W
	T_A=70°C		1.8	
Junction and Storage Temperature Range		T_J, T_{STG}	-55 to 150	°C

Thermal Characteristics					
Parameter		**Symbol**	**Typ**	**Max**	**Units**
Maximum Junction-to-Ambient	t ≤ 10s	$R_{\theta JA}$	48	62.5	°C/W
Maximum Junction-to-Ambient	Steady-State		74	110	°C/W
Maximum Junction-to-Lead	Steady-State	$R_{\theta JL}$	35	60	°C/W

II. Die / Package Information:

	AO4828	AO4828L (Green Compound)
Process	Standard sub-micron low voltage N channel process	Standard sub-micron low voltage N channel process
Package Type	SOIC-8	SOIC-8
Lead Frame	Copper with Solder Plate	Copper with Solder Plate
Die Attach	Ag epoxy	Ag epoxy
Bond wire	2 mils Au wire	2 mils Au wire
Mold Material	Epoxy resin with silica filler	Epoxy resin with silica filler
Filler % (Spherical/Flake)	90/10	100/0
Flammability Rating	UL-94 V-0	UL-94 V-0
Backside Metallization	Ti / Ni / Ag	Ti / Ni / Ag
Moisture Level	Up to Level 1 *	Up to Level 1*

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

III. Result of Reliability Stress for AO4828 (Standard) & AO4828L (Green)

Test Item	Test Condition	Time Point	Lot Attribution	Total Sample size	Number of Failures
Solder Reflow Precondition	**Standard: 1hr PCT+3 cycle reflow@260°C** **Green: 168hr 85°C /85%RH+3 cycle reflow@260°c**	**0hr**	**Standard: 49 lots** **Green: 16 lots**	**9625 pcs**	**0**
HTGB	**Temp = 150°C , Vgs=100% of Vgsmax**	**168 / 500 hrs** **1000 hrs**	**5 lots** **(note A*)**	**410 pcs** **77+5 pcs / lot**	**0**
HTRB	**Temp = 150°C , Vds=80% of Vdsmax**	**168 / 500 hrs** **1000 hrs**	**5 lots** **(note A*)**	**410 pcs** **77+5 pcs / lot**	**0**
HAST	**130 +/- 2°C , 85%RH, 33.3 psi, Vgs = 80% of Vgs max**	**100 hrs**	**Standard: 33 lots** **Green: 13 lots** **(note B**)**	**2530 pcs** **50+5 pcs / lot**	**0**
Pressure Pot	**121°C , 15+/-1 PSIG, RH=100%**	**96 hrs**	**Standard: 49 lots** **Green: 16 lots** **(note B**)**	**3575 pcs** **50+5 pcs / lot**	**0**
Temperature Cycle	**-65 to 150°C , air to air, 0.5hr per cycle**	**250 / 500 cycles**	**Standard: 49lots** **Green: 15 lots** **(note B**)**	**3520 pcs** **50+5 pcs / lot**	**0**

III. Result of Reliability Stress for AO4828 (Standard) & AO4828L (Green)

Continues

DPA	**Internal Vision** **Cross-section** **X-ray**	**NA**	**5** **5** **5**	**5** **5** **5**	**0**
CSAM		**NA**	**5**	**5**	**0**
Bond Integrity	**Room Temp** **150°c bake** **150°c bake**	**0hr** **250hr** **500hr**	**40** **40** **40**	**40 wires** **40 wires** **40 wires**	**0**
Solderability	**230°c**	**5 sec**	**15**	**15 leads**	**0**

Note A: The HTGB and HTRB reliability data presents total of available AO4828 and AO4828L burn-in data up to the published date.
Note B: The pressure pot, temperature cycle and HAST reliability data for AO4828 and AO4828L comes from the AOS generic package qualification data.

IV. Reliability Evaluation

FIT rate (per billion): 8.6
MTTF = 13273 years

In general, 500 hrs of HTGB, 150 deg C accelerated stress testing is equivalent to 15 years of lifetime at 55 deg C operating conditions (by applying the Arrhenius equation with an activation energy of 0.7eV and 60% of upper confidence level on the failure rate calculation). AOS reliability group also routinely monitors the product reliability up to 1000 hr at and performs the necessary failure analysis on the units failed for reliability test(s). The presentation of FIT rate for the individual product reliability is restricted by the actual burn-in sample size of the selected product (AO4828). 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 / **[** 2 (5×164) (500) (258) **]** = 8.6
MTTF = 10^9 / FIT = 1.16×10^8hrs = 13273years

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°C)
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 X 10^{-5} eV / K

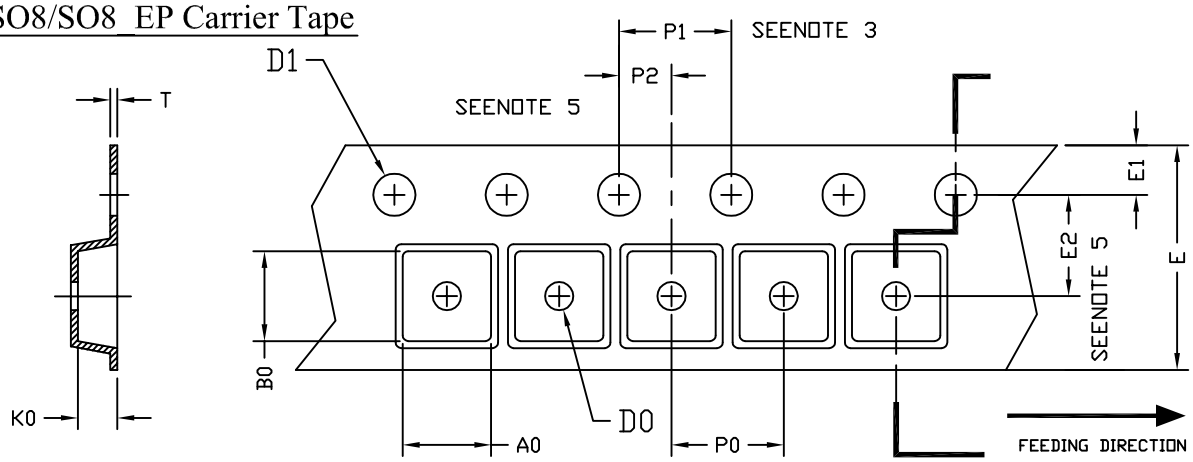
V. Quality Assurance Information

Acceptable Quality Level for outgoing inspection: **0.1%** for electrical and visual.
Guaranteed Outgoing Defect Rate: **< 25 ppm**
Quality Sample Plan: conform to **Mil-Std-105D**

ALPHA & OMEGA SEMICONDUCTOR

SO7/SO8/SO8_EP Tape and Reel Data

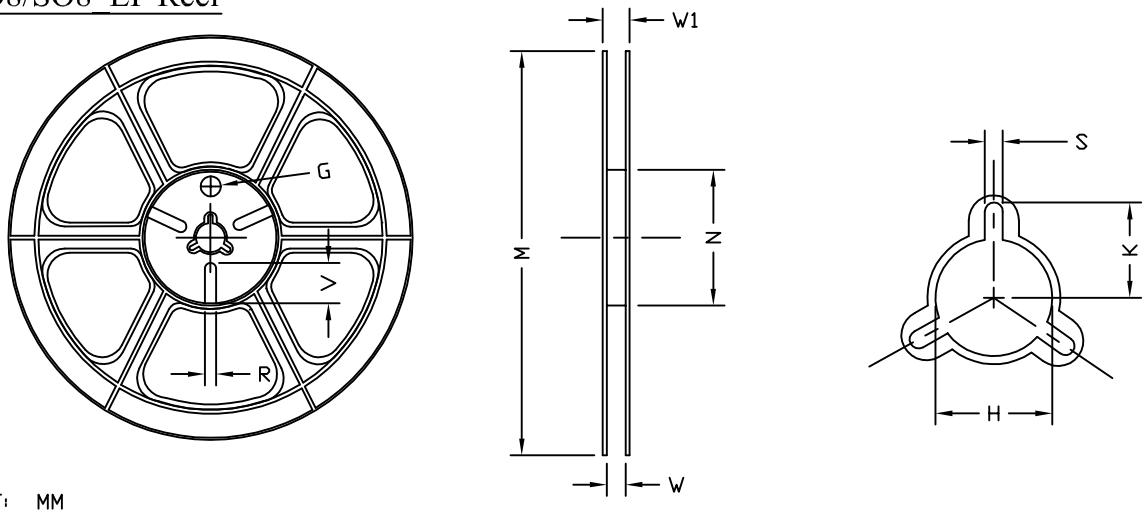
SO7/SO8/SO8_EP Carrier Tape



UNIT: MM

PACKAGE	A0	B0	K0	D0	D1	E	E1	E2	P0	P1	P2	T
SO7/SO-8 (12 mm)	6.40 ±0.10	5.20 ±0.10	2.10 ±0.10	1.60 ±0.10	1.50 +0.10	12.00 ±0.30	1.75 ±0.10	5.50 ±0.05	8.00 ±0.10	4.00 ±0.10	2.00 ±0.05	0.25 ±0.05

SO7/SO8/SO8_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	---	---	---

SO7/SO8/SO8_EP Tape

Leader / Trailer & Orientation

Unit Per Reel: 3000pcs