

### General Description

- Trench Power MOSFET technology
- Low  $R_{DS(ON)}$
- ESD Protected
- RoHS and Halogen-Free Compliant

### Applications

- System/Load Switch
- Battery Switch
- USB-PD Load Switch

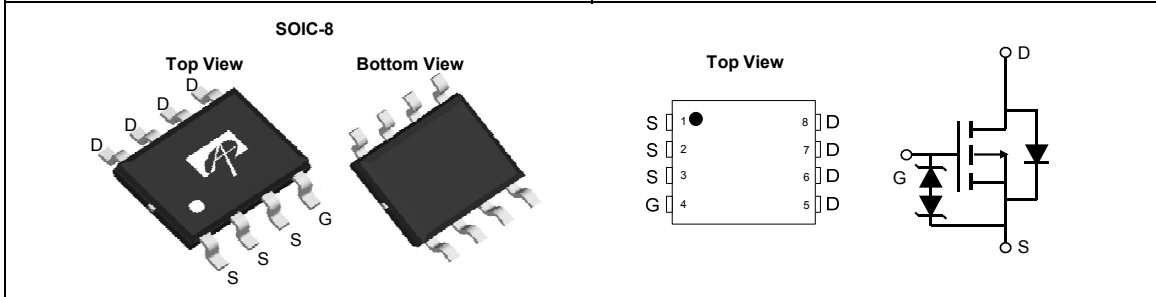
### Product Summary

$V_{DS}$	-30V
$I_D$ (at $V_{GS}=-10V$ )	-18.5A
$R_{DS(ON)}$ (at $V_{GS}=-10V$ )	< 5.8m $\Omega$
$R_{DS(ON)}$ (at $V_{GS}=-4.5V$ )	< 8.2m $\Omega$

### Typical ESD protection

**HBM Class 3B**

100% UIS Tested



Orderable Part Number	Package Type	Form	Minimum Order Quantity
AO4447A	SO-8	Tape & Reel	3000

### Absolute Maximum Ratings $T_A=25^\circ\text{C}$ unless otherwise noted

Parameter	Symbol	Maximum	Units
Drain-Source Voltage	$V_{DS}$	-30	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	V
Continuous Drain Current	$I_D$	$T_A=25^\circ\text{C}$	-18.5
		$T_A=70^\circ\text{C}$	-14.5
Pulsed Drain Current <sup>C</sup>	$I_{DM}$	-74	A
Avalanche Current <sup>C</sup>	$I_{AS}$	54	A
Avalanche energy	$E_{AS}$	146	mJ
Power Dissipation <sup>B</sup>	$P_D$	$T_A=25^\circ\text{C}$	3.1
		$T_A=70^\circ\text{C}$	2.0
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 <sup>A</sup>	$R_{\theta JA}$	31	40	$^\circ\text{C/W}$
Maximum Junction-to-Ambient <sup>A,D</sup>		59	75	$^\circ\text{C/W}$
Maximum Junction-to-Lead	$R_{\theta JL}$	16	24	$^\circ\text{C/W}$

**Electrical Characteristics (T<sub>J</sub>=25°C unless otherwise noted)**

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>STATIC PARAMETERS</b>						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	I <sub>D</sub> =-250μA, V <sub>GS</sub> =0V	-30			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> =-30V, V <sub>GS</sub> =0V T <sub>J</sub> =55°C			-1 -5	μA
I <sub>GSS</sub>	Gate-Body leakage current	V <sub>DS</sub> =0V, V <sub>GS</sub> =±16V			±10	μA
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =-250μA	-1.2	-1.7	-2.2	V
R <sub>DS(on)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> =-10V, I <sub>D</sub> =-18.5A T <sub>J</sub> =125°C		4.7	5.8	mΩ
		V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-16A		6.6	8.2	
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> =-5V, I <sub>D</sub> =-18.5A		65		S
V <sub>SD</sub>	Diode Forward Voltage	I <sub>S</sub> =-1A, V <sub>GS</sub> =0V		-0.66	-1	V
I <sub>S</sub>	Maximum Body-Diode Continuous Current				-4	A
<b>DYNAMIC PARAMETERS</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> =0V, V <sub>DS</sub> =-15V, f=1MHz		5020		pF
C <sub>oss</sub>	Output Capacitance			815		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			615		pF
R <sub>g</sub>	Gate resistance	f=1MHz		125	250	Ω
<b>SWITCHING PARAMETERS</b>						
Q <sub>g(10V)</sub>	Total Gate Charge	V <sub>GS</sub> =-10V, V <sub>DS</sub> =-15V, I <sub>D</sub> =-18.5A		93	130	nC
Q <sub>g(4.5V)</sub>	Total Gate Charge			46		
Q <sub>gs</sub>	Gate Source Charge			14		
Q <sub>gd</sub>	Gate Drain Charge			21		
t <sub>D(on)</sub>	Turn-On DelayTime	V <sub>GS</sub> =-10V, V <sub>DS</sub> =-15V, R <sub>L</sub> =0.8Ω, R <sub>GEN</sub> =3Ω		180		ns
t <sub>r</sub>	Turn-On Rise Time			280		
t <sub>D(off)</sub>	Turn-Off DelayTime			1400		
t <sub>f</sub>	Turn-Off Fall Time			830		
t <sub>rr</sub>	Body Diode Reverse Recovery Time	I <sub>F</sub> =-18.5A, di/dt=500A/μs		17		ns
Q <sub>rr</sub>	Body Diode Reverse Recovery Charge	I <sub>F</sub> =-18.5A, di/dt=500A/μs		53		nC

A. The value of R<sub>θJA</sub> is measured with the device mounted on 1in<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with T<sub>A</sub> =25° C. The value in any given application depends on the user's specific board design.

B. The power dissipation P<sub>D</sub> is based on T<sub>J(MAX)</sub>=150° C, using ≤ 10s junction-to-ambient thermal resistance.

C. Repetitive rating, pulse width limited by junction temperature T<sub>J(MAX)</sub>=150° C. Ratings are based on low frequency and duty cycles to keep initial T<sub>J</sub>=25° C.

D. The R<sub>θJA</sub> is the sum of the thermal impedance from junction to lead R<sub>θJL</sub> 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<sup>2</sup> FR-4 board with 2oz. Copper, assuming a maximum junction temperature of T<sub>J(MAX)</sub>=150° C. The SOA curve provides a single pulse rating.

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**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**

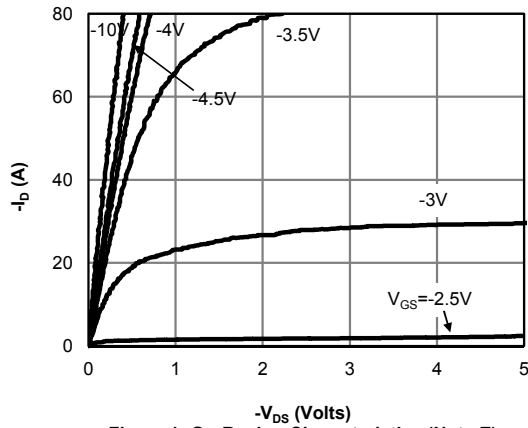


Figure 1: On-Region Characteristics (Note E)

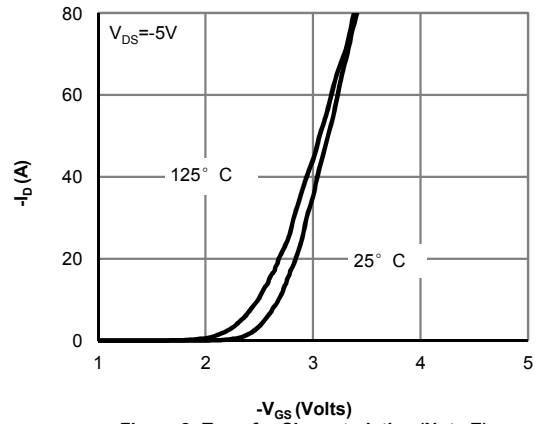


Figure 2: Transfer Characteristics (Note E)

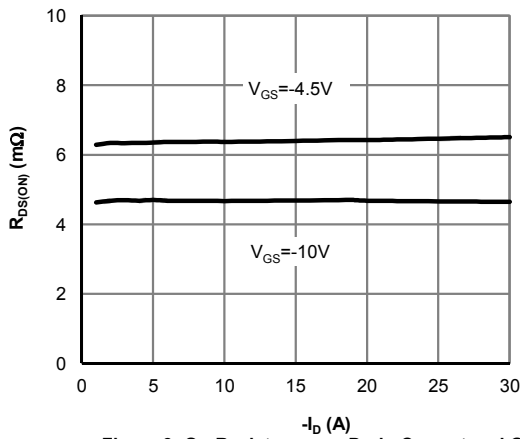


Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)

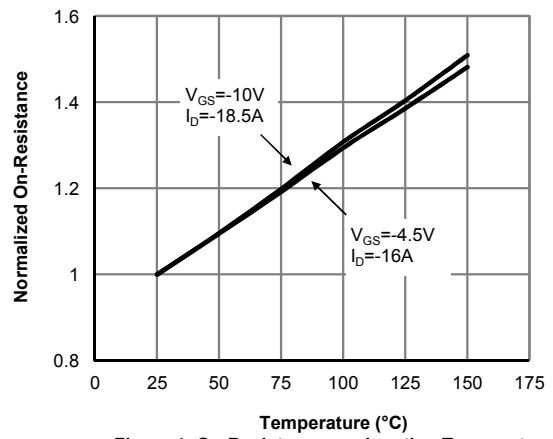


Figure 4: On-Resistance vs. Junction Temperature (Note E)

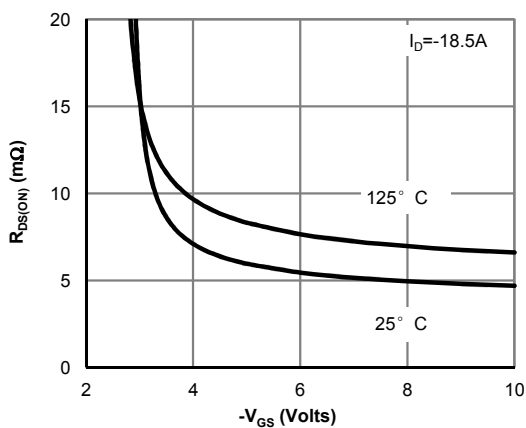


Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)

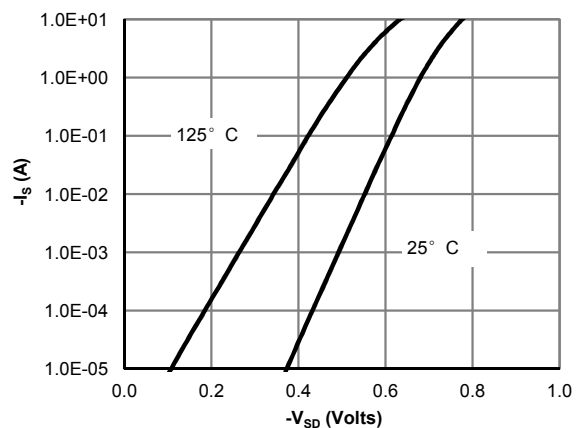
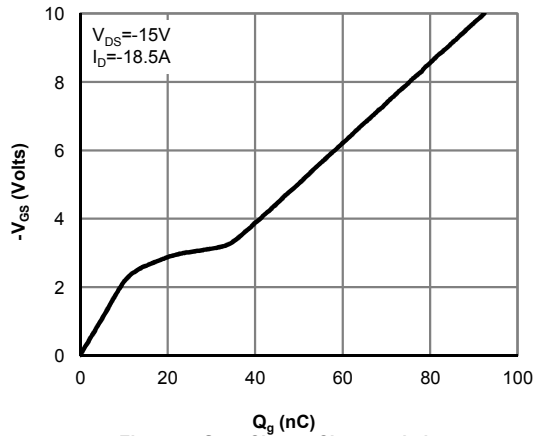
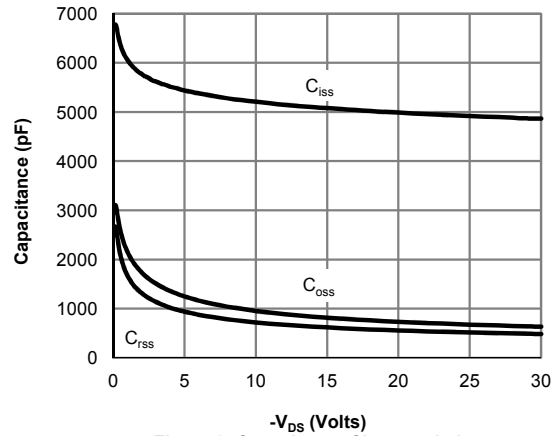


Figure 6: Body-Diode Characteristics (Note E)

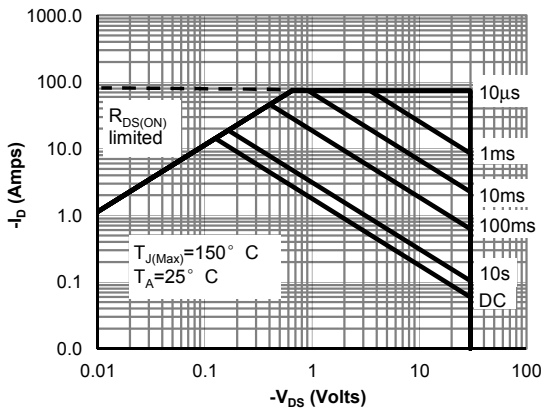
**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**



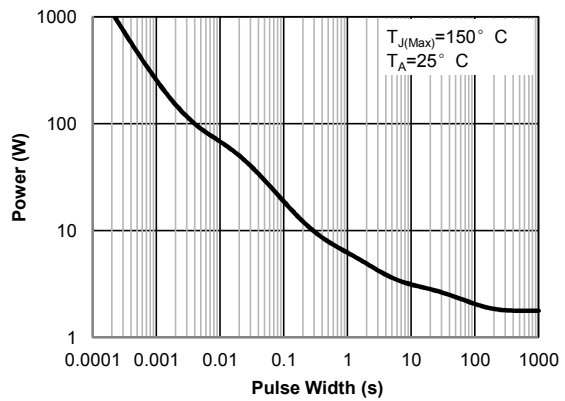
**Figure 7: Gate-Charge Characteristics**



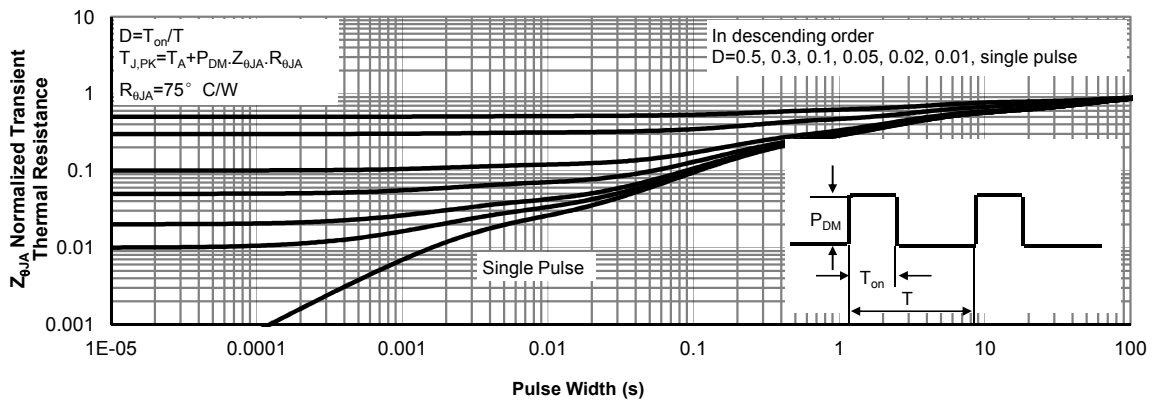
**Figure 8: Capacitance Characteristics**



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

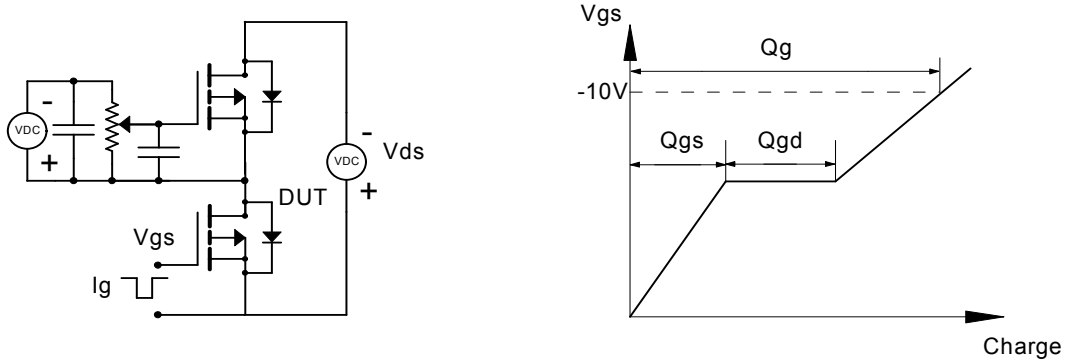


**Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note F)**

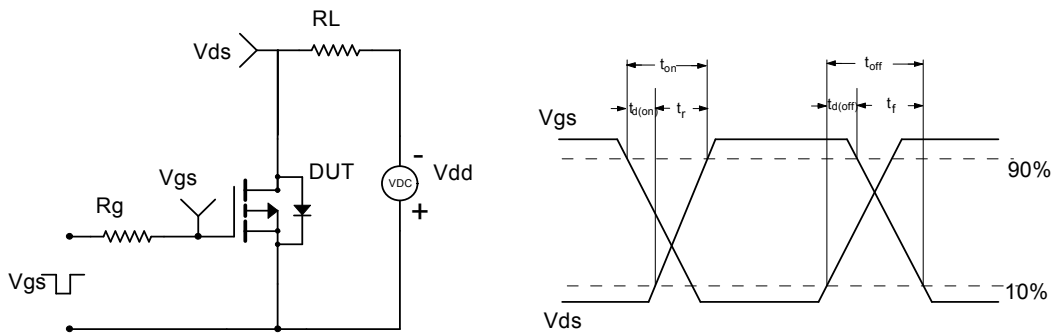


**Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)**

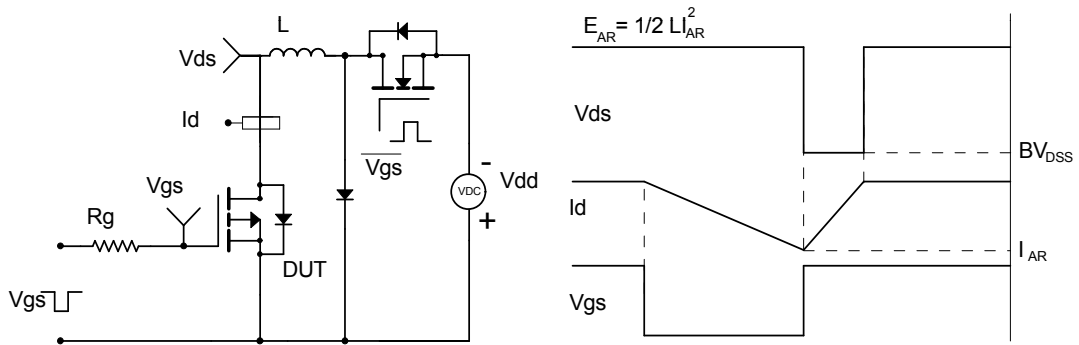
**Gate Charge Test Circuit & Waveform**



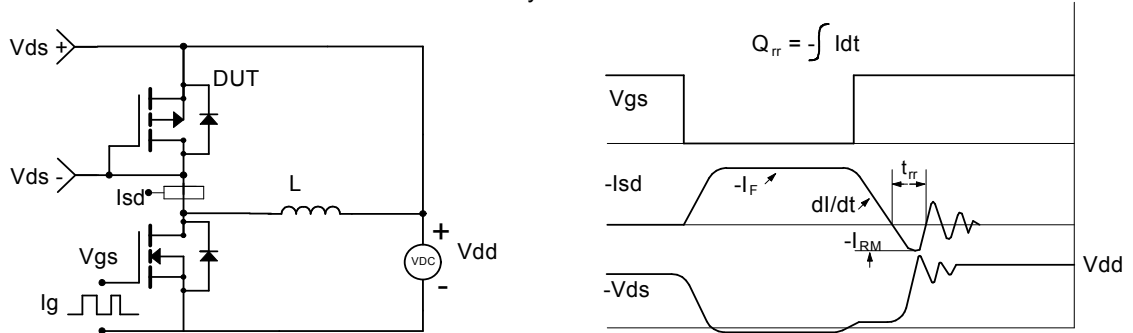
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching (UIS) Test Circuit & Waveforms**



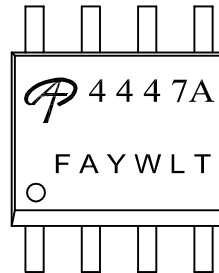
**Diode Recovery Test Circuit & Waveforms**





Document No.	PD-00869
Version	B
Title	AO4447A Marking Description

SO-8 PACKAGE MARKING DESCRIPTION



Green product

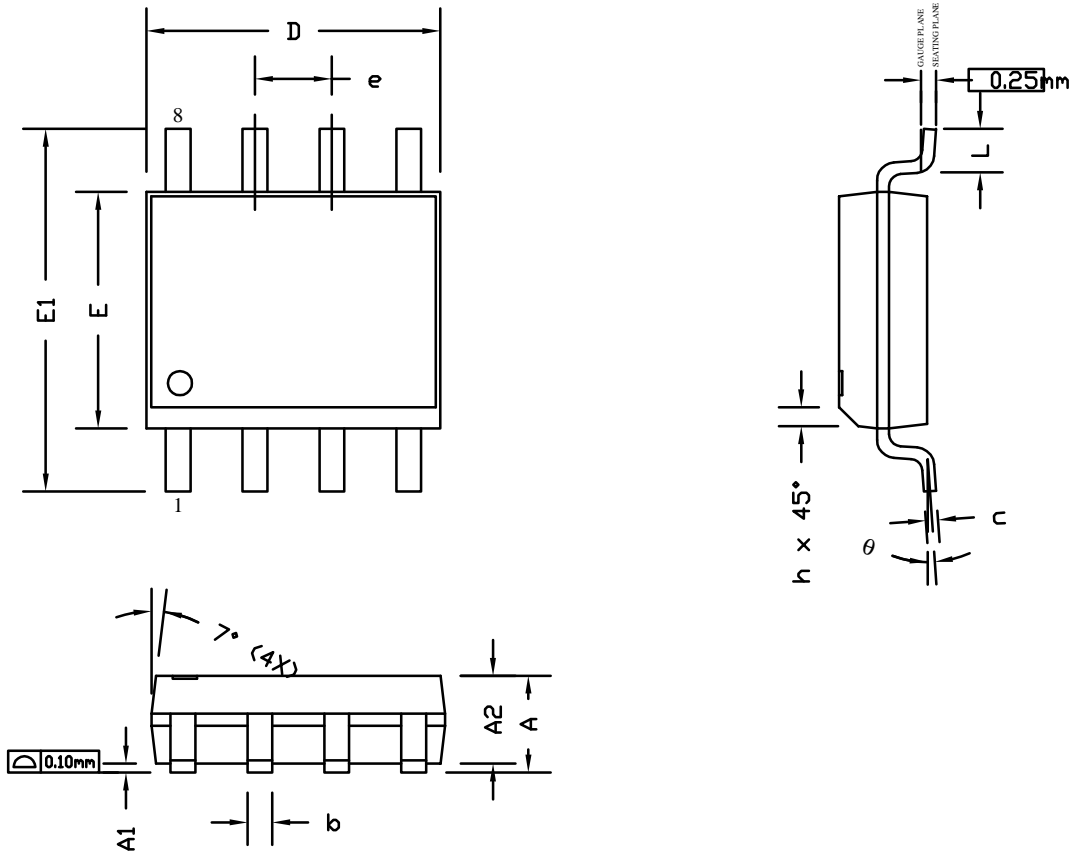
NOTE:

- LOGO - AOS Logo
- 4447A - Part number code
- F - Fab code
- A - Assembly location code
- Y - Year code
- W - Week code
- L&T - Assembly lot code

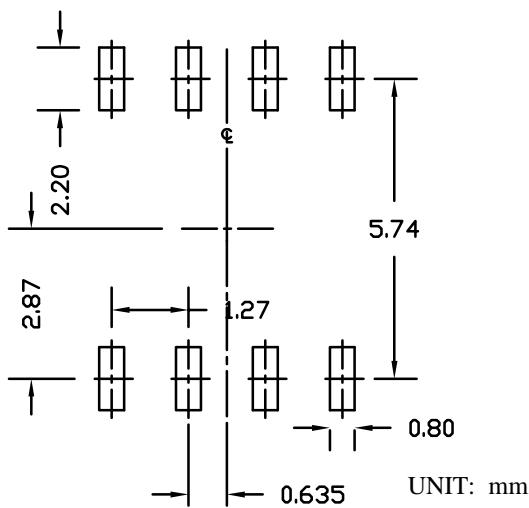
PART NO.	DESCRIPTION	CODE
AO4447A	Green product	4447A
AO4447AL	Green product	4447A



S08 PACKAGE OUTLINE



RECOMMENDED LAND PATTERN



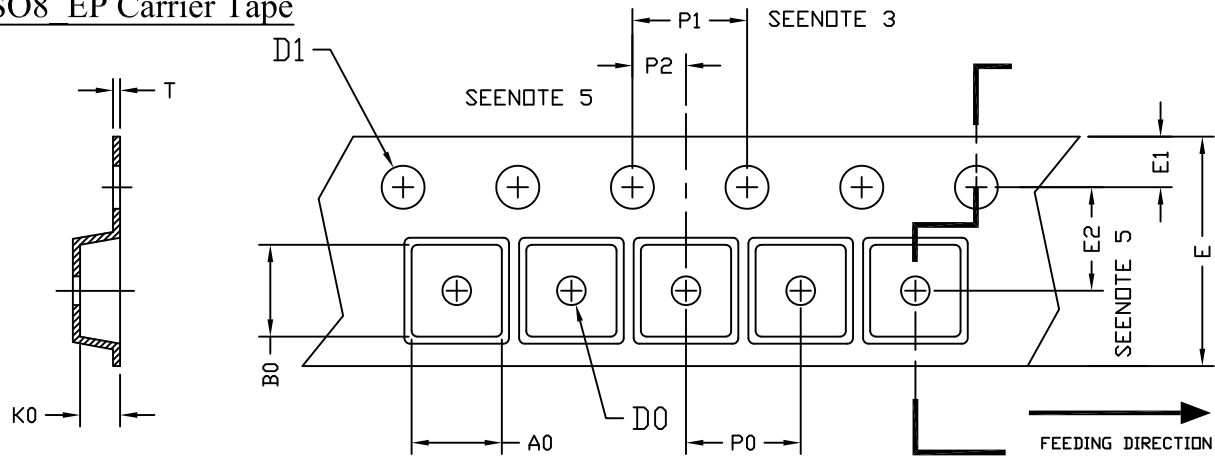
SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.35	1.65	1.75	0.053	0.065	0.069
A1	0.10	0.15	0.25	0.004	0.006	0.010
A2	1.25	1.50	1.65	0.049	0.059	0.065
b	0.31	0.41	0.51	0.012	0.016	0.020
c	0.17	0.20	0.25	0.007	0.008	0.010
D	4.80	4.90	5.00	0.189	0.193	0.197
E	3.80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

NOTE

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



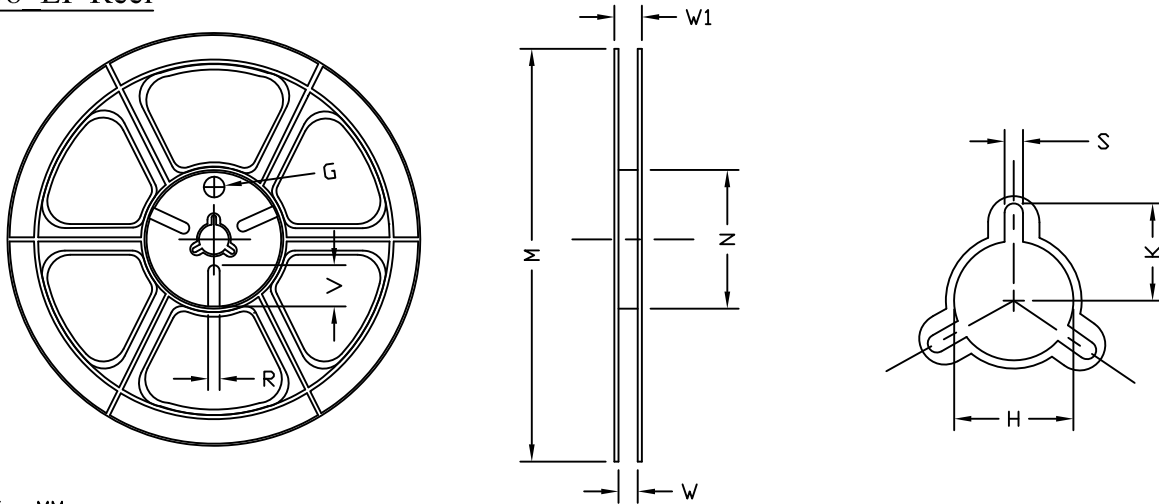
SO8/SO8 EP Carrier Tape



UNIT: MM

PACKAGE	A0	B0	K0	D0	D1	E	E1	E2	P0	P1	P2	T
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

SO8/SO8 EP Reel



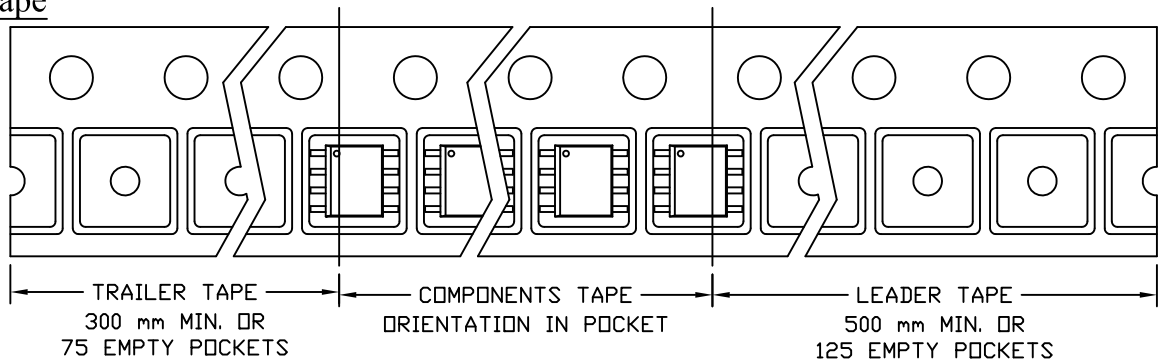
UNIT: MM

TAPE SIZE	REEL SIZE	M	N	W	W1	H	K	S	G	R	V
12 mm	φ330	φ330.00 ±0.50	φ97.00 ±0.10	13.00 ±0.30	17.40 ±1.00	φ13.00 +0.50 -0.20	10.60	2.00 ±0.50	---	---	---

SO8/SO8 EP Tape

Leader / Trailer  
& Orientation

Unit Per Reel:  
3000pcs







# ***AOS Semiconductor Product Reliability Report***

**AO4447A,** rev A

**Plastic Encapsulated Device**

**ALPHA & OMEGA Semiconductor, Inc**

**[www.aosmd.com](http://www.aosmd.com)**



This AOS product reliability report summarizes the qualification result for AO4447A. 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 AO4447A 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 AO4447A uses advanced trench technology to provide excellent  $R_{DS(ON)}$  with low gate charge. This device is ideal for load switch and battery protection applications.

- RoHS Compliant
- Halogen Free

Detailed information refers to datasheet.

## II. Die / Package Information:

	<b>AO4447A</b>
<b>Process</b>	Standard sub-micron Low voltage P channel
<b>Package Type</b>	8 lead SOIC
<b>Lead Frame</b>	Cu
<b>Die Attach</b>	Epoxy
<b>Bonding Wire</b>	Cu wire
<b>Mold Material</b>	Epoxy resin with silica filler
<b>MSL (moisture sensitive level)</b>	Level 1 based on J-STD-020

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

### III. Result of Reliability Stress for AO4447A

Test Item	Test Condition	Time Point	Lot Attribution	Total Sample size	Number of Failures	Standard
MSL Precondition	168hr 85°C /85%RH +3 cycle reflow@260°C	-	29 lots	3575pcs	0	JESD22-A113
HTGB	Temp = 150 °c, Vgs=100% of Vgsmax	168hrs 500 hrs 1000 hrs	1 lot 1 lot  (Note A*)	154pcs  77pcs / lot	0	JESD22-A108
HTRB	Temp = 150 °c, Vds=80% of Vdsmax	168hrs 500 hrs 1000 hrs	1 lot 1 lot  (Note A*)	154pcs  77pcs / lot	0	JESD22-A108
HAST	130 +/- 2°C, 85%RH, 33.3 psi, Vgs = 100% of Vgs max	100 hrs	16 lots  (Note A*)	880pcs  55 pcs / lot	0	JESD22-A110
Pressure Pot	121°C, 29.7psi, RH=100%	96 hrs	20 lots  (Note A*)	1100pcs  55 pcs / lot	0	JESD22-A102
Temperature Cycle	-65°C to 150°C, air to air	250 / 500 cycles	29 lots  (Note A*)	1595pcs  55 pcs / 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): 34**

**MTTF = 3311 years**

The presentation of FIT rate for the individual product reliability is restricted by the actual burn-in sample size of the selected product (AO4447A). Failure Rate Determination is based on JEDEC Standard JESD 85. FIT means one failure per billion device hours.

$$\text{Failure Rate} = \text{Chi}^2 \times 10^9 / [2 (N) (H) (Af)]$$

$$= 1.83 \times 10^9 / [2 \times (2 \times 77 \times 1680 + 2 \times 77 \times 500) \times 258] = 34$$

$$\text{MTTF} = 10^9 / \text{FIT} = 2.90 \times 10^7 \text{hrs} = 3311 \text{ years}$$

**Chi<sup>2</sup>** = 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
<b>Af</b>	<b>258</b>	<b>87</b>	<b>32</b>	<b>13</b>	<b>5.64</b>	<b>2.59</b>	<b>1</b>

**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<sup>-5</sup>eV / K