AOE6930

30V Dual Asymmetric N-Channel AlphaMOS

General Description

- Bottom Source Technology
- Very Low $R_{DS(ON)}$
- Low Gate Charge
- High Current Capability
- RoHS and Halogen-Free Compliant

Applications

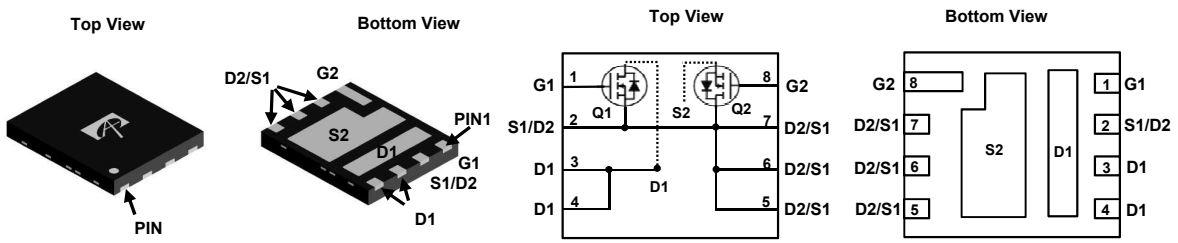
- DC/DC Converters in Computing, Servers, and POL
- Non-Isolated DC/DC Converters in Telecom and Industrial

Product Summary

	Q1	Q2
V_{DS}	30V	30V
I_D (at V_{GS}=10V)	22A	85A
$R_{DS(ON)}$ (at V_{GS}=10V)	< 4.3mΩ	< 0.83mΩ
$R_{DS(ON)}$ (at V_{GS}=4.5V)	< 7.0mΩ	< 1.05mΩ

100% UIS Tested
100% Rg Tested

DFN 5X6E



Orderable Part Number	Package Type	Form	Minimum Order Quantity
AOE6930	DFN 5x6E	Tape & Reel	3000

Absolute Maximum Ratings T_A=25°C unless otherwise noted

Parameter		Symbol	Max Q1	Max Q2	Units
Drain-Source Voltage		V_{DS}	30	30	V
Gate-Source Voltage		V_{GS}	±20	±12	V
Continuous Drain Current [G]	T_C=25°C	I_D	22	85	A
	T_C=100°C		22	85	
Pulsed Drain Current [C]		I_{DM}	88	340	
Continuous Drain Current	T_A=25°C	I_{DSM}	22 [G]	60	A
	T_A=70°C		19	48	
Avalanche Current [C]		I_{AS}	50	80	A
Avalanche energy	L=0.01mH [C]	E_{AS}	13	32	mJ
V_{DS} Spike	10µs	V_{SPIKE}	36	36	V
Power Dissipation [B]	T_C=25°C	P_D	24	75	W
	T_C=100°C		9.6	30	
Power Dissipation [A]	T_A=25°C	P_{DSM}	4.1	5	W
	T_A=70°C		2.6	3.2	
Junction and Storage Temperature Range		T_J, T_{STG}	-55 to 150		°C

Thermal Characteristics

Parameter		Symbol	Typ Q1	Typ Q2	Max Q1	Max Q2	Units
Maximum Junction-to-Ambient [A]	t ≤ 10s	$R_{\theta JA}$	23	20	30	25	°C/W
Maximum Junction-to-Ambient [A D]	Steady-State		45	40	60	50	°C/W
Maximum Junction-to-Case (Note)	Steady-State	$R_{\theta JC}$	4	1.25	5.2	1.65	°C/W

Note: Bottom S2, D1.

Q1 Electrical Characteristics (T_J=25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
STATIC PARAMETERS						
BV_{DSS}	Drain-Source Breakdown Voltage	ID=250µA, VGS=0V	30			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=30V, 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	1.3	1.7	2.1	V
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS}=10V, I_D=20A		3.5	4.3	mΩ
		T_J=125°C		5.0	6.2	
		V_{GS}=4.5V, I_D=20A		5.2	7.0	mΩ
g_{FS}	Forward Transconductance	V_{DS}=5V, I_D=20A		85		S
V_{SD}	Diode Forward Voltage	I_S=1A,V_{GS}=0V		0.7	1	V
I_S	Maximum Body-Diode Continuous Current [G]				22	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=15V, f=1MHz		1075		pF
C_{oss}	Output Capacitance			480		pF
C_{rss}	Reverse Transfer Capacitance			55		pF
R_g	Gate resistance	f=1MHz	0.2	1.0	2.0	Ω
SWITCHING PARAMETERS						
Q_g(10V)	Total Gate Charge	V_{GS}=10V, V_{DS}=15V, I_D=20A		15	25	nC
Q_g(4.5V)	Total Gate Charge			7	15	nC
Q_{gs}	Gate Source Charge			2.5		nC
Q_{gd}	Gate Drain Charge			2.5		nC
Q_{gs}	Gate Source Charge	V_{GS}=4.5V, V_{DS}=15V, I_D=20A		2.5		nC
Q_{gd}	Gate Drain Charge			2.5		nC
$t_{D(on)}$	Turn-On DelayTime	V_{GS}=10V, V_{DS}=15V, R_L=0.75Ω, R_{GEN}=3Ω		4.5		ns
t_r	Turn-On Rise Time			4		ns
$t_{D(off)}$	Turn-Off DelayTime			19		ns
t_f	Turn-Off Fall Time			3		ns
t_{rr}	Body Diode Reverse Recovery Time	I_F=20A, dI/dt=500A/µs		12.5		ns
Q_{rr}	Body Diode Reverse Recovery Charge	I_F=20A, dI/dt=500A/µs		21.5		nC

A. The value of $R_{\theta JA}$ is measured with the device mounted on 1in² 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 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. Single pulse width limited by junction temperature $T_{J(MAX)}$=150° 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 rating.
G. The maximum current rating is package limited.
H. These tests are performed with the device mounted on 1 in² FR-4 board with 2oz. Copper, in a still air environment with T_A=25° C.

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

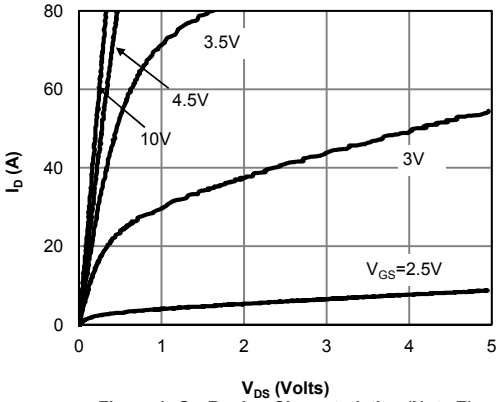


Figure 1: On-Region Characteristics (Note E)

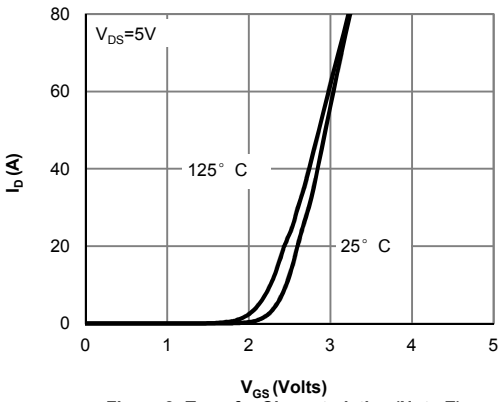


Figure 2: Transfer Characteristics (Note E)

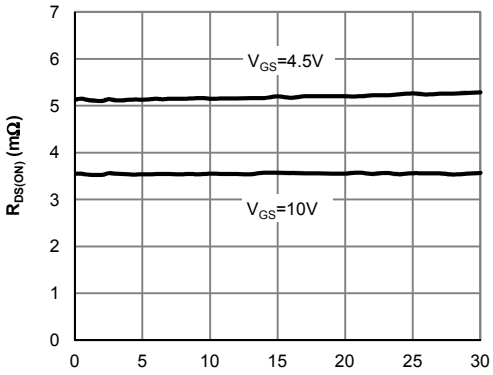


Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)

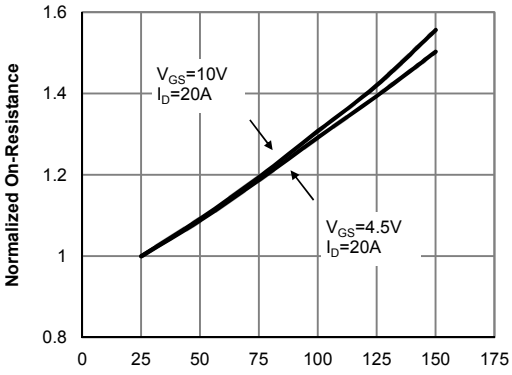


Figure 4: On-Resistance vs. Junction Temperature (Note E)

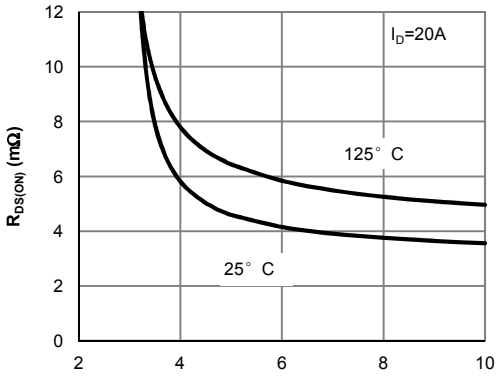


Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)

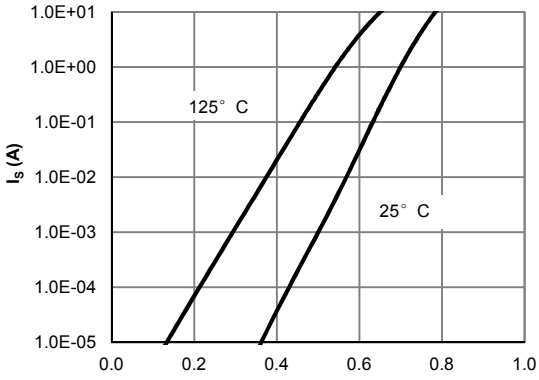


Figure 6: Body-Diode Characteristics (Note E)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

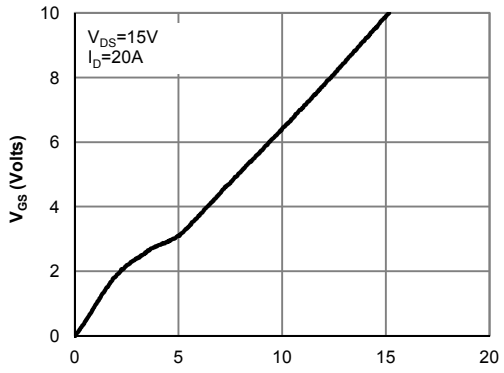


Figure 7: Gate-Charge Characteristics

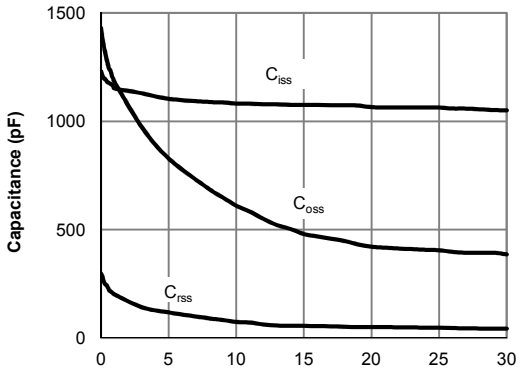
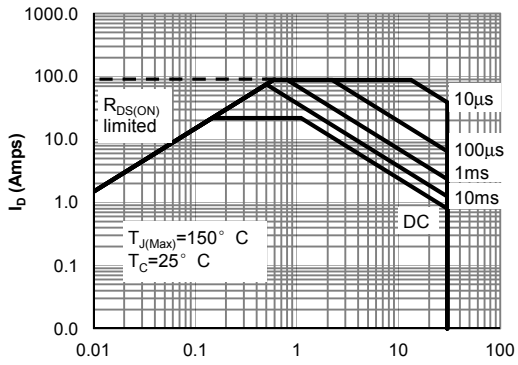


Figure 8: Capacitance Characteristics



V_{GS}> or equal to 4.5V

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

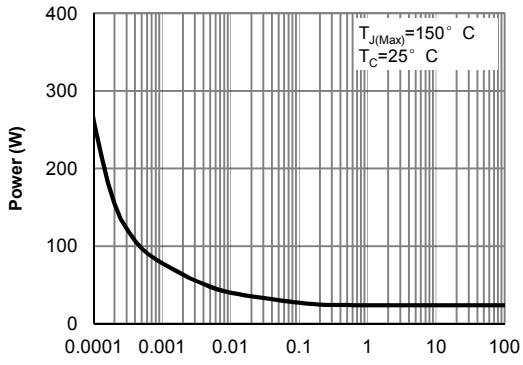


Figure 10: Single Pulse Power Rating Junction-to-Case (Note F)

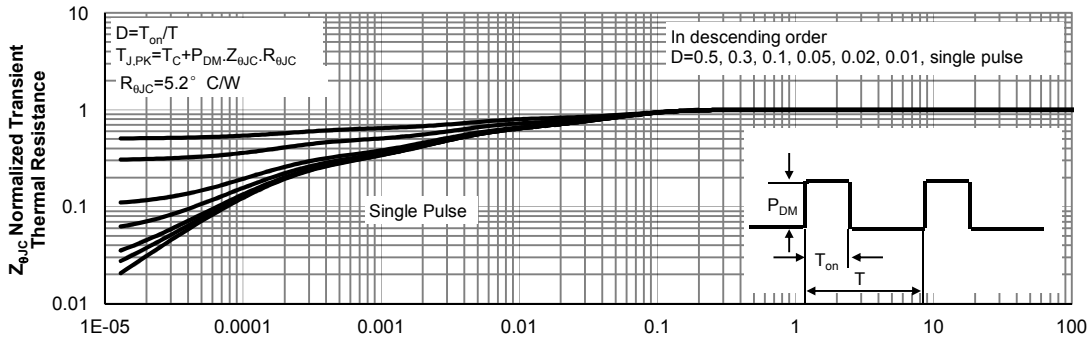


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

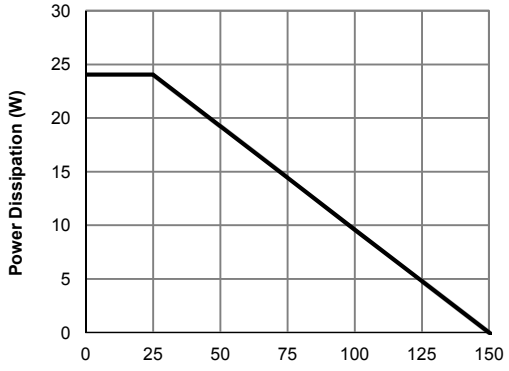


Figure 12: Power De-rating (Note F)

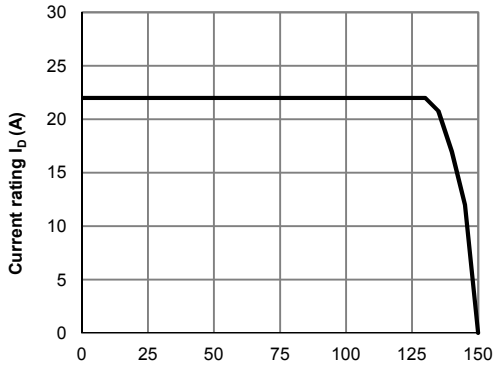


Figure 13: Current De-rating (Note F)

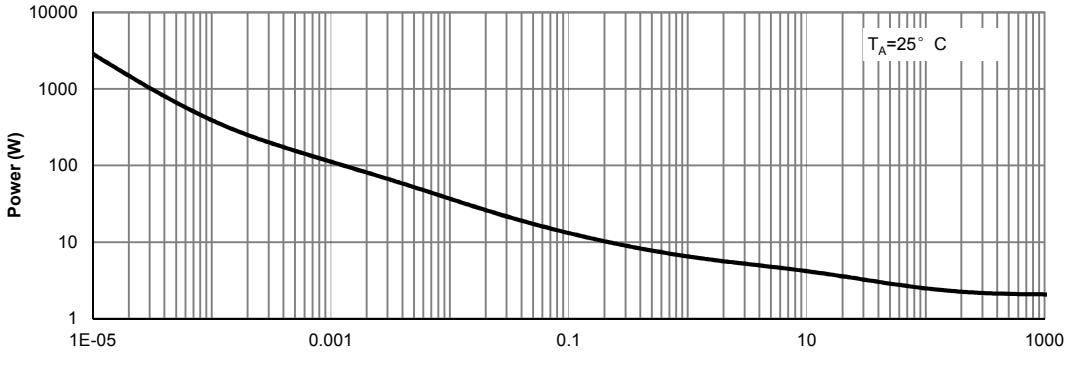


Figure 14: Single Pulse Power Rating Junction-to-Ambient (Note H)

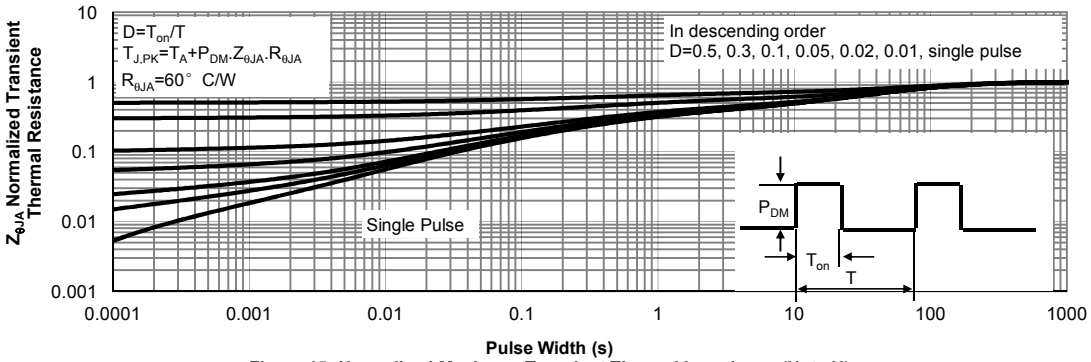


Figure 15: Normalized Maximum Transient Thermal Impedance (Note H)

Q2 Electrical Characteristics (T_J=25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
STATIC PARAMETERS						
BV_{DSS}	Drain-Source Breakdown Voltage	ID=250µA, VGS=0V	30			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=30V, V_{GS}=0V			1	µA
		T_J=55°C			5	
I_{GSS}	Gate-Body leakage current	V_{DS}=0V, V_{GS}=±12V			±100	nA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=$V_{GS,}$ I_D=250µA	1.2	1.5	1.9	V
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS}=10V, I_D=30A		0.65	0.83	mΩ
		T_J=125°C		0.95	1.2	
		V_{GS}=4.5V, I_D=30A		0.8	1.05	mΩ
g_{FS}	Forward Transconductance	V_{DS}=5V, I_D=20A		278		S
V_{SD}	Diode Forward Voltage	I_S=1A,V_{GS}=0V		0.65	1	V
I_S	Maximum Body-Diode Continuous Current [G]				85	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=15V, f=1MHz		5560		pF
C_{oss}	Output Capacitance			1670		pF
C_{rss}	Reverse Transfer Capacitance			200		pF
R_g	Gate resistance	f=1MHz	0.2	1.0	2.0	Ω
SWITCHING PARAMETERS						
Q_g(10V)	Total Gate Charge	V_{GS}=10V, V_{DS}=15V, I_D=20A		95	150	nC
Q_g(4.5V)	Total Gate Charge			42	65	nC
Q_{gs}	Gate Source Charge			11.5		nC
Q_{gd}	Gate Drain Charge			12		nC
Q_{gs}	Gate Source Charge	V_{GS}=4.5V, V_{DS}=15V, I_D=20A		11.5		nC
Q_{gd}	Gate Drain Charge			12		nC
$t_{D(on)}$	Turn-On DelayTime	V_{GS}=10V, V_{DS}=15V, R_L=0.75Ω, R_{GEN}=3Ω		12.5		ns
t_r	Turn-On Rise Time			27		ns
$t_{D(off)}$	Turn-Off DelayTime			66.5		ns
t_f	Turn-Off Fall Time			13		ns
t_{rr}	Body Diode Reverse Recovery Time	I_F=20A, dI/dt=500A/µs		23		ns
Q_{rr}	Body Diode Reverse Recovery Charge	I_F=20A, dI/dt=500A/µs		72.5		nC

A. The value of $R_{\theta JA}$ is measured with the device mounted on 1in² 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 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. Single pulse width limited by junction temperature $T_{J(MAX)}$=150° 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 rating.
G. The maximum current rating is package limited.
H. These tests are performed with the device mounted on 1 in² FR-4 board with 2oz. Copper, in a still air environment with T_A=25° C.

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

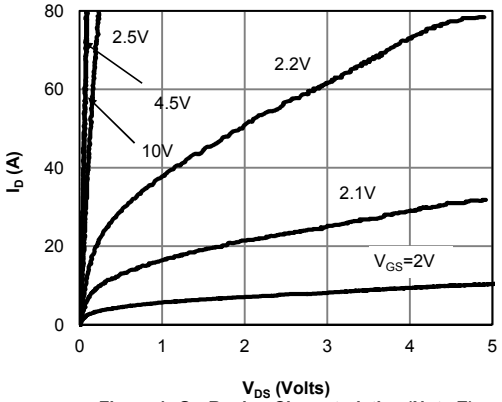


Figure 1: On-Region Characteristics (Note E)

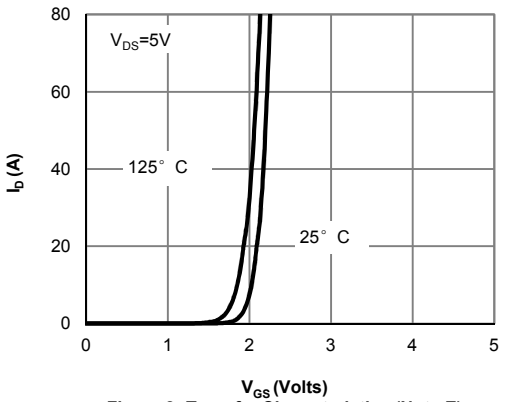


Figure 2: Transfer Characteristics (Note E)

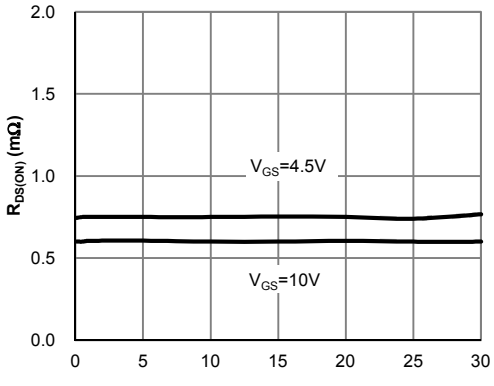


Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)

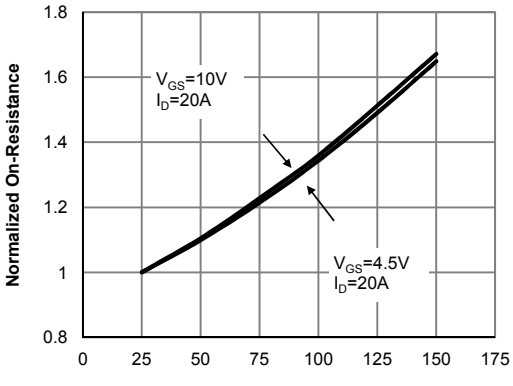


Figure 4: On-Resistance vs. Junction Temperature (Note E)

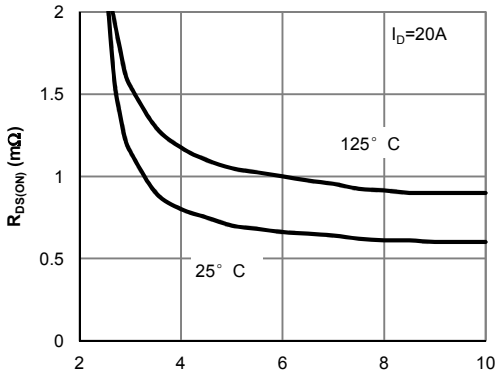


Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)

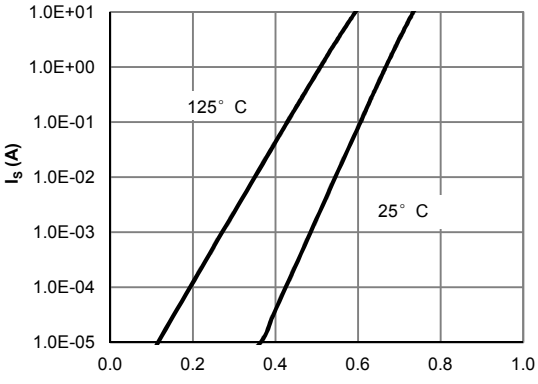


Figure 6: Body-Diode Characteristics (Note E)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

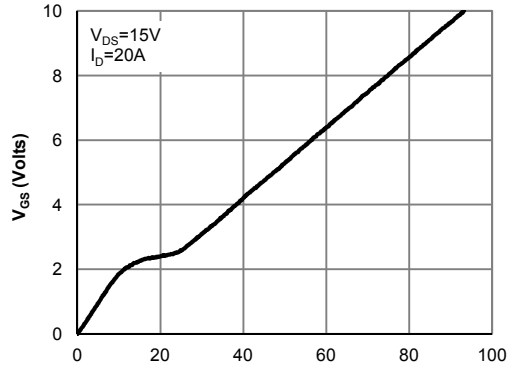


Figure 7: Gate-Charge Characteristics

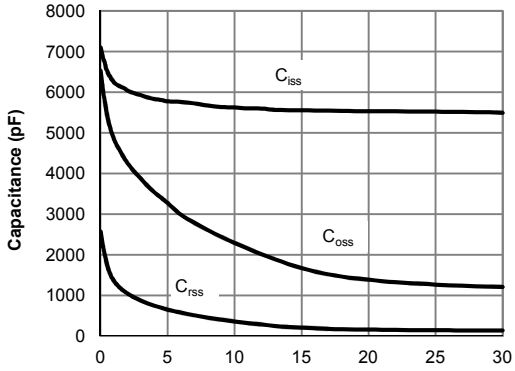


Figure 8: Capacitance Characteristics

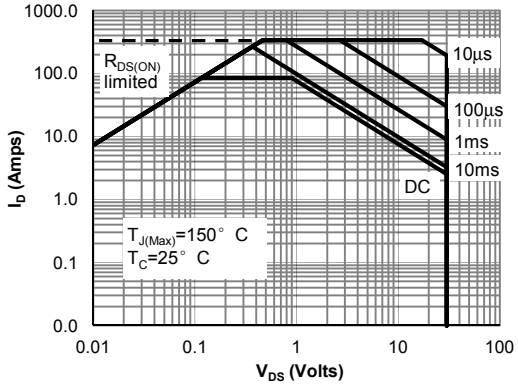


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

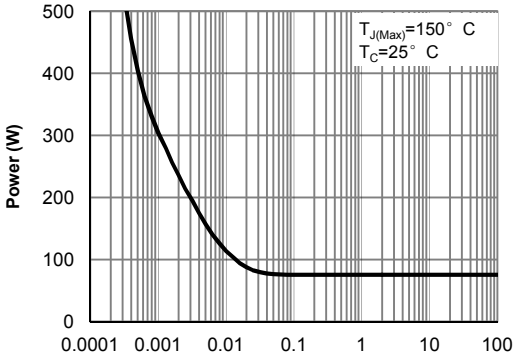


Figure 10: Single Pulse Power Rating Junction-to-Case (Note F)

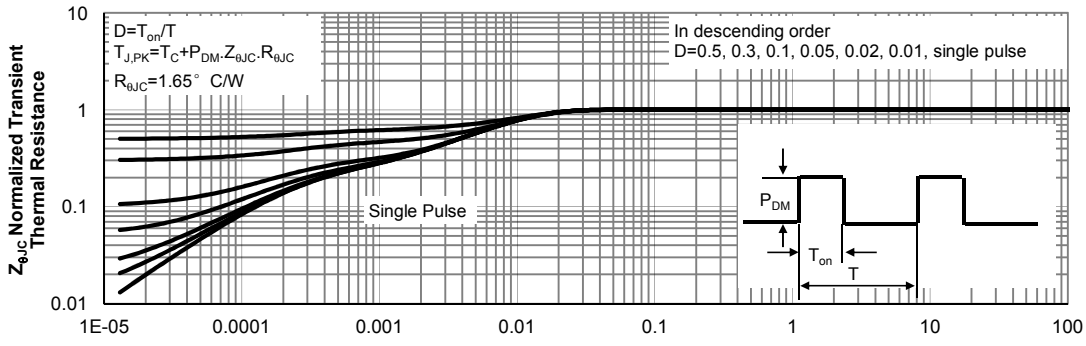


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

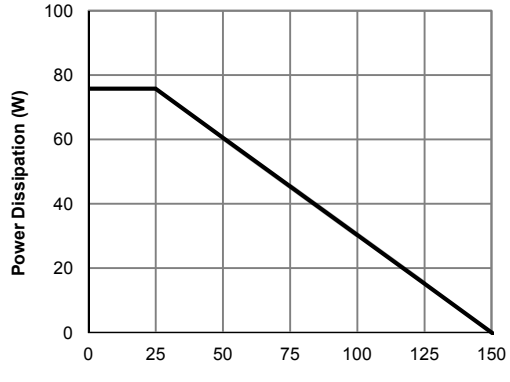


Figure 12: Power De-rating (Note F)

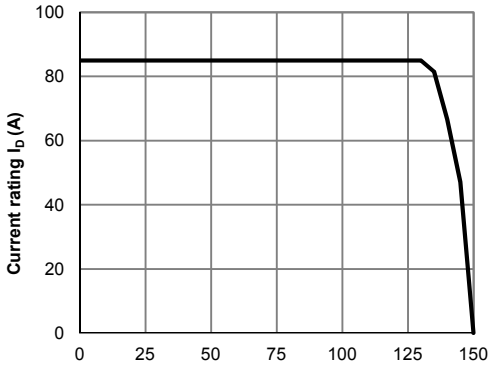


Figure 13: Current De-rating (Note F)

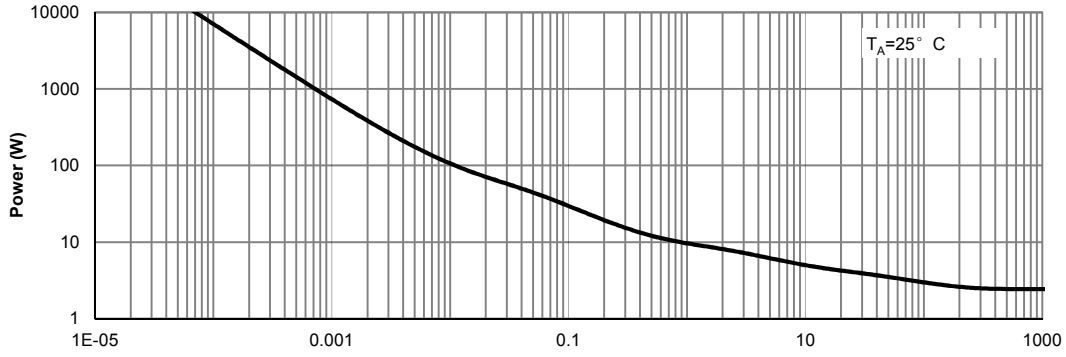


Figure 14: Single Pulse Power Rating Junction-to-Ambient (Note H)

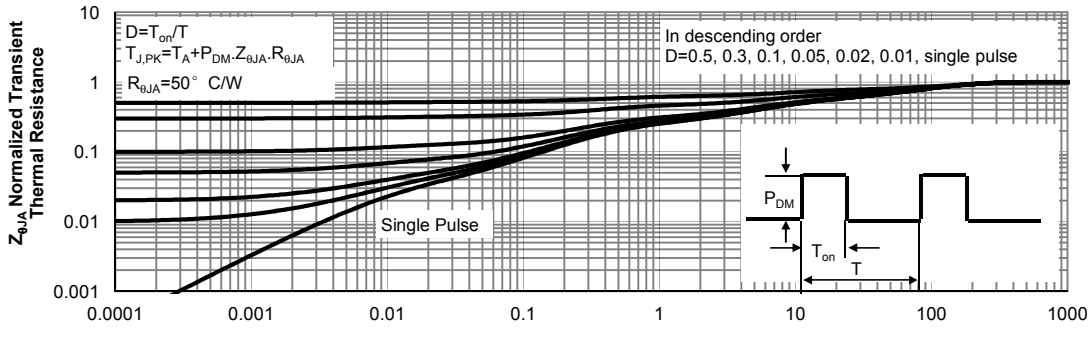


Figure 15: Normalized Maximum Transient Thermal Impedance (Note H)

Figure A: Gate Charge Test Circuit & Waveforms

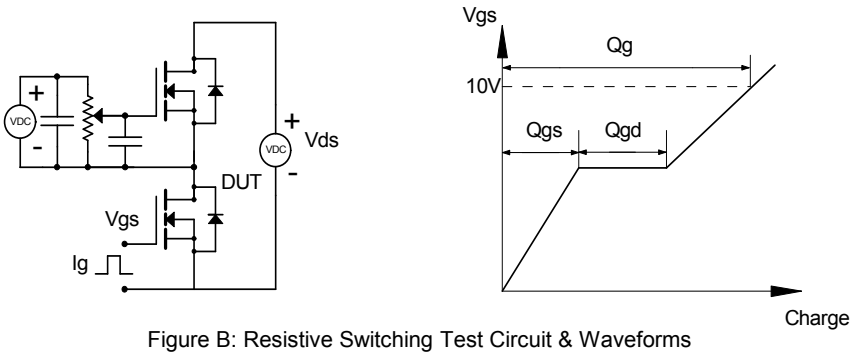


Figure B: Resistive Switching Test Circuit & Waveforms

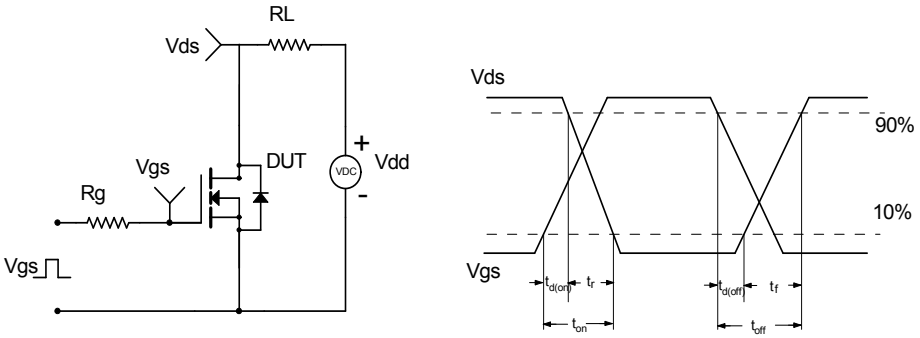


Figure C: Unclamped Inductive Switching (UIS) Test Circuit & Waveforms

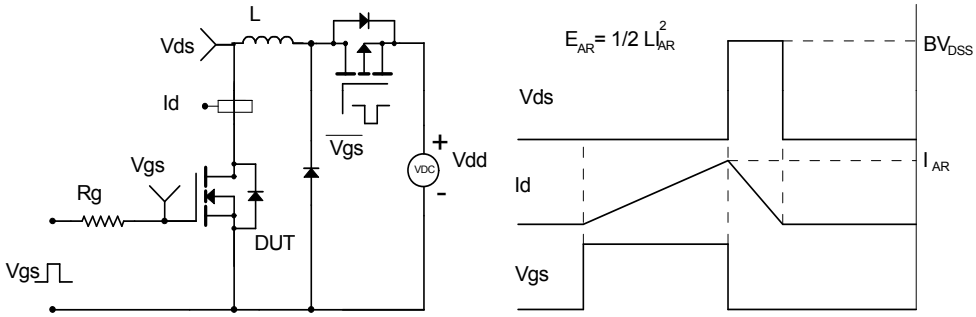
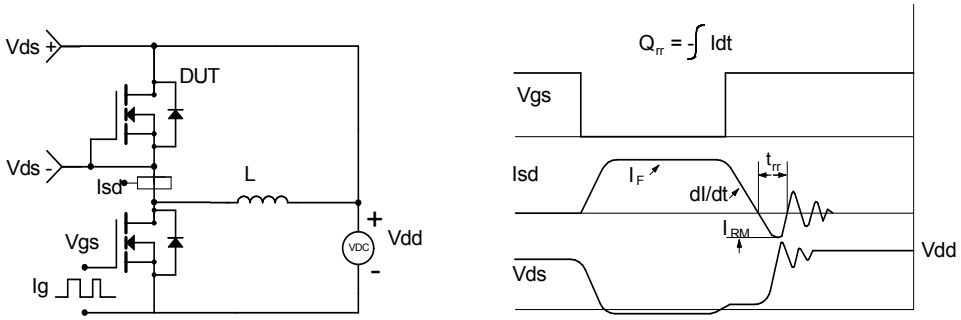


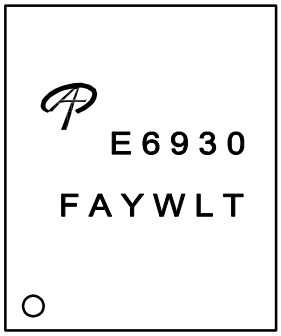
Figure D: Diode Recovery Test Circuit & Waveforms



ALPHA & OMEGA SEMICONDUCTOR

Document No.	PD-02322
Version	A
Title	AOE6930 Marking Description

DFN5X6 PACKAGE MARKING DESCRIPTION



Green product

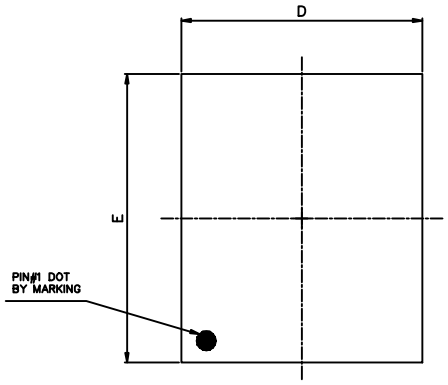
NOTE:
LOGO - AOS Logo
E6930 - Part number code
F - Fab code
A - Assembly location code
Y - Year code
W - Week code
L&T - Assembly lot code

PART NO.	DESCRIPTION	CODE
AOE6930	Green product	E6930

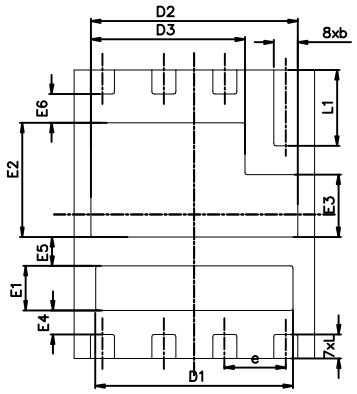
ALPHA & OMEGA SEMICONDUCTOR

Document No.	PO-00224
Version	A

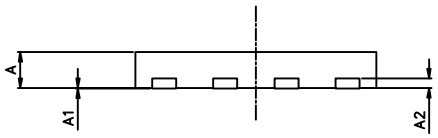
DFN5x6E_8L_EP2_S PACKAGE OUTLINE



TOP VIEW



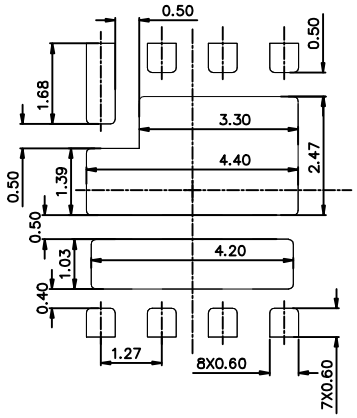
BOTTOM VIEW



SIDE VIEW

SYMBOL	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHS		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.700	0.750	0.850	0.028	0.030	0.034
A1	0.000	0.020	0.050	0.000	0.001	0.002
A2	0.150	0.200	0.250	0.006	0.008	0.010
D	4.900	5.000	5.100	0.193	0.197	0.201
E	5.900	6.000	6.100	0.232	0.236	0.240
D1	4.000	4.100	4.200	0.157	0.161	0.165
D2	4.200	4.300	4.400	0.165	0.169	0.173
D3	3.105	3.205	3.305	0.122	0.126	0.130
E1	0.830	0.930	1.030	0.033	0.037	0.041
E2	2.270	2.370	2.470	0.089	0.093	0.097
E3	1.195	1.295	1.395	0.047	0.051	0.055
E4	0.400	0.500	0.600	0.016	0.020	0.024
E5	0.500	0.600	0.700	0.020	0.024	0.028
E6	0.500	0.600	0.700	0.020	0.024	0.028
L	0.4	0.5	0.6	0.016	0.020	0.024
L1	1.475	1.575	1.675	0.058	0.062	0.066
e	1.27BSC			0.05BSC		
b	0.4	0.5	0.6	0.016	0.020	0.024

RECOMMENDED LAND PATTERN



UNIT: mm

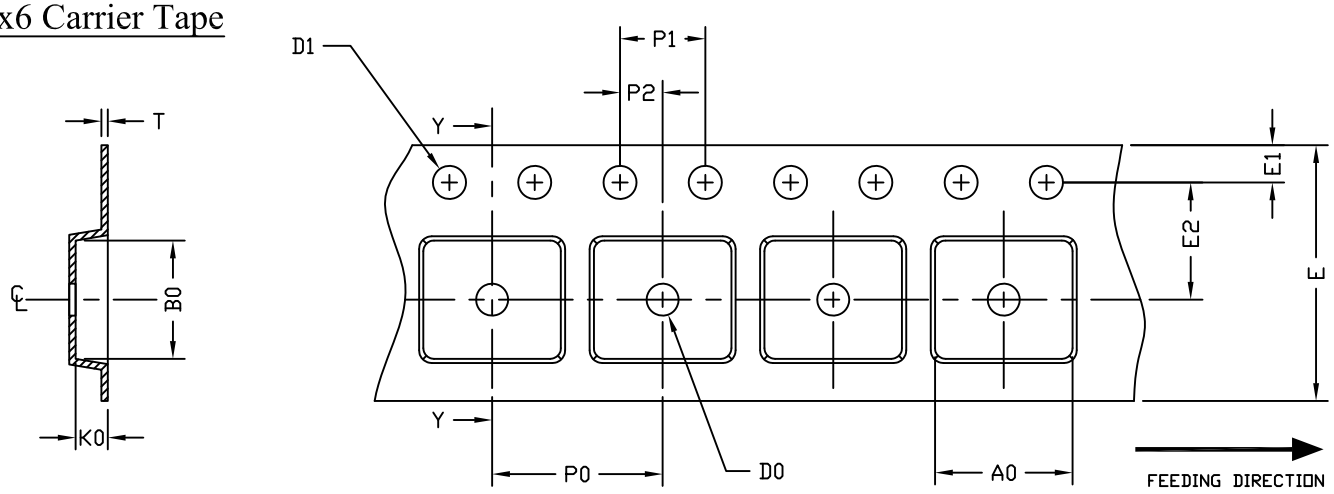
Note:

1. **CONTROLLING DIMENSION IS MILLIMETER.**
   CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.

ALPHA & OMEGA SEMICONDUCTOR

DFN5x6 Tape and Reel Data

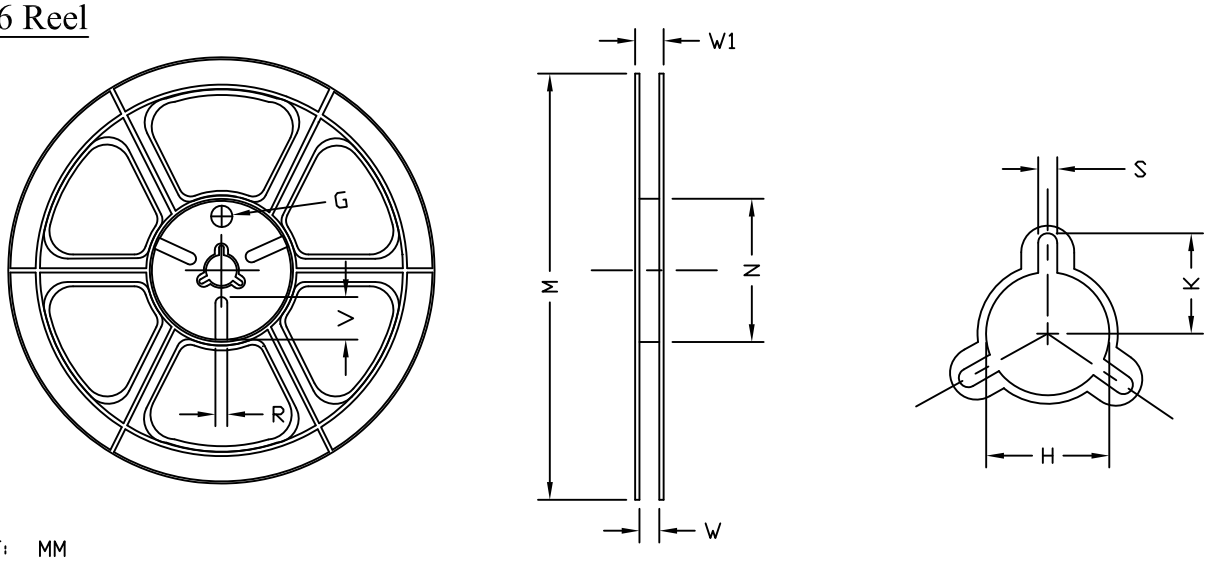
DFN5x6 Carrier Tape



UNIT: MM

PACKAGE	A0	B0	K0	D0	D1	E	E1	E2	P0	P1	P2	T
DFN5x6 (12 mm)	6.30 ±0.10	5.45 ±0.10	1.30 ±0.10	1.50 MIN.	1.55 ±0.05	12.00 ±0.30	1.75 ±0.10	5.50 ±0.10	8.00 ±0.10	4.00 ±0.10	2.00 ±0.10	0.30 ±0.05

DFN5x6 Reel



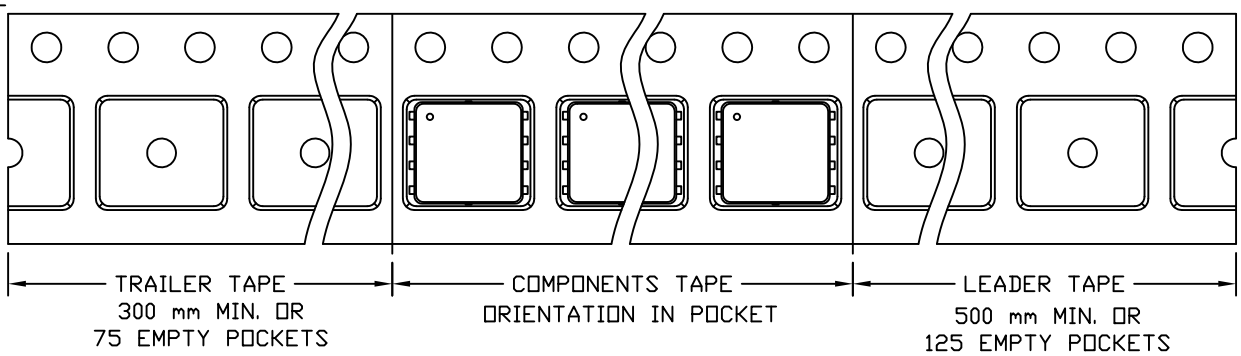
UNIT: MM

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	---	---	---

DFN5x6 Tape

Leader / Trailer & Orientation

Unit Per Reel: 3000pcs



ALPHA & OMEGA SEMICONDUCTOR

AOS Semiconductor
Product Reliability Report

AOE6930, rev A

Plastic Encapsulated Device

ALPHA & OMEGA Semiconductor, Inc

www.aosmd.com

ALPHA & OMEGA SEMICONDUCTOR

This AOS product reliability report summarizes the qualification result for AOE6930. 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 AOE6930 passes AOS quality and reliability requirements. The released product will be categorized by the process family and be routine monitored for continuously improving the product quality.

I. Reliability Stress Test Summary and Results

Test Item	Test Condition	Time Point	Total Sample Size	Number of Failures	Reference Standard
HTGB	**Temp = 150°C , Vgs=100% of Vgsmax**	**168 / 500 / 1000 hours**	**385 pcs**	**0**	**JESD22-A108**
HTRB	**Temp = 150°C , Vds=100% of Vdsmax**	**168 / 500 / 1000 hours**	**385 pcs**	**0**	**JESD22-A108**
Precondition (Note A)	**168hr 85°C / 85%RH + 3 cycle reflow@260°C**	**-**	**924 pcs**	**0**	**JESD22-A113**
HAST	**130°C , 85%RH, 33.3 psia, Vds = 80% of Vdsmax**	**96 hours**	**231 pcs**	**0**	**JESD22-A110**
Autoclave	**121°C , 100%RH 29.7psia**	**96 hours**	**231 pcs**	**0**	**JESD22-A102**
Temperature Cycle	**-65°C to 150°C , air to air,**	**1000 cycles**	**231 pcs**	**0**	**JESD22-A104**
HTSL	**Temp = 150°C**	**1000 hours**	**231 pcs**	**0**	**JESD22-A103**

Note: The reliability data presents total of available generic data up to the published date.
Note A: MSL (Moisture Sensitivity Level) 1 based on J-STD-020

II. Reliability Evaluation

FIT rate (per billion): 5.72
MTTF = 19946 years

The presentation of FIT rate for the individual product reliability is restricted by the actual burn-in sample size. 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)**] =** 5.72
MTTF = 10^9 / FIT = 19946 years

Chi² = Chi Squared Distribution, determined by the number of failures and confidence interval
N = Total Number of units from burn-in tests
H = Duration of burn-in 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	**259**	**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