ALPHA & OMEGA SEMICONDUCTOR

AOTF8T50P

500V,8A N-Channel MOSFET

General Description

- Trench Power AlphaMOS-II technology
- Low $R_{DS(ON)}$
- Low Ciss and Crss
- High Current Capability
- RoHS and Halogen Free Compliant

Applications

- General Lighting for LED and CCFL
- AC/DC Power supplies for Industrial, Consumer, and Telecom

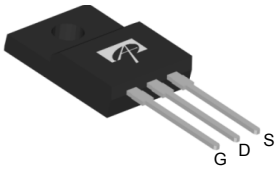
Product Summary

V_{DS} @ $T_{j,max}$	600V
I_{DM}	32A
$R_{DS(ON),max}$	< 0.81Ω
$Q_{g,typ}$	13nC
E_{oss} @ 400V	2.5µJ

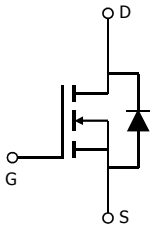
100% UIS Tested
100% R_g Tested

RoHS Compliant

Top View
TO-220F



AOTF8T50P



Orderable Part Number	Package Type	Form	Minimum Order Quantity
AOTF8T50P	TO-220F Pb Free	Tube	1000
AOTF8T50PL	TO-220F Green	Tube	1000

Absolute Maximum Ratings T_A=25°C unless otherwise noted

Parameter		Symbol	AOTF8T50P	AOTF8T50PL	Units
Drain-Source Voltage		V_{DS}	500		V
Gate-Source Voltage		V_{GS}	±30		V
Continuous Drain Current	T_C=25°C	I_D	8*	8*	A
	T_C=100°C		5.4*	5.4*	
Pulsed Drain Current [C]		I_{DM}	32		
Avalanche Current [C] L=1mH		I_{AR}	8		A
Repetitive avalanche energy [C]		E_{AR}	32		mJ
Single pulsed avalanche energy [G]		E_{AS}	421		mJ
MOSFET dv/dt ruggedness		dv/dt	50		V/ns
Peak diode recovery dv/dt [J]			15		
Power Dissipation [B]	T_C=25°C	P_D	38	28	W
	Derate above 25°C		0.3	0.2	W/°C
Junction and Storage Temperature Range		T_J, T_{STG}	-55 to 150		°C
Maximum lead temperature for soldering purpose, 1/8" from case for 5 seconds		T_L	300		°C

Thermal Characteristics

Parameter	Symbol	AOTF8T50P	AOTF8T50PL	Units
Maximum Junction-to-Ambient [A,D]	$R_{\theta JA}$	65	65	°C/W
Maximum Junction-to-Case	$R_{\theta JC}$	3.3	4.5	°C/W

* Drain current limited by maximum junction temperature.

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, T_J=25°C	500			V
		I_D=250µA, V_{GS}=0V, T_J=150°C		600		
BV_{DSS} /ΔTJ	Breakdown Voltage Temperature Coefficient	I_D=250µA, V_{GS}=0V		0.47		V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=500V, V_{GS}=0V			1	µA
		V_{DS}=400V, T_J=125°C			10	
I_{GSS}	Gate-Body leakage current	V_{DS}=0V, V_{GS}=±30V			±100	nA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=5V, I_D=250µA	3	3.9	5	V
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS}=10V, I_D=4A		0.6	0.81	Ω
g_{FS}	Forward Transconductance	V_{DS}=40V, I_D=4A		6.5		S
V_{SD}	Diode Forward Voltage	I_S=1A,V_{GS}=0V		0.76	1	V
I_S	Maximum Body-Diode Continuous Current				8	A
I_{SM}	Maximum Body-Diode Pulsed Current [C]				32	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=100V, f=1MHz		905		pF
C_{oss}	Output Capacitance			42		pF
$C_{o(er)}$	Effective output capacitance, energy related [H]	V_{GS}=0V, V_{DS}=0 to 400V, f=1MHz		31		pF
$C_{o(tr)}$	Effective output capacitance, time related [I]			56		pF
C_{rss}	Reverse Transfer Capacitance	V_{GS}=0V, V_{DS}=100V, f=1MHz		3.5		pF
R_g	Gate resistance	f=1MHz		2		Ω
SWITCHING PARAMETERS						
Q_g	Total Gate Charge	V_{GS}=10V, V_{DS}=400V, I_D=8A		13	19	nC
Q_{gs}	Gate Source Charge			4.4		nC
Q_{gd}	Gate Drain Charge			3.4		nC
$t_{D(on)}$	Turn-On DelayTime	V_{GS}=10V, V_{DS}=250V, I_D=8A, R_G=25Ω		23		ns
t_r	Turn-On Rise Time			33		ns
$t_{D(off)}$	Turn-Off DelayTime			34		ns
t_f	Turn-Off Fall Time			21		ns
t_{rr}	Body Diode Reverse Recovery Time	I_F=8A,dI/dt=100A/µs,V_{DS}=100V		340		ns
Q_{rr}	Body Diode Reverse Recovery Charge	I_F=8A,dI/dt=100A/µs,V_{DS}=100V		3.5		µC

A. The value of $R_{\theta JA}$ is measured with the device in a still air environment with T_A=25° C.
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 <300 ms 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. L=60mH, I_{AS}=3.75A, V_{DD}=150V, R_G=25Ω, Starting T_J=25° C.
H. $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% $V_{(BR)DSS}$.
I. $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% $V_{(BR)DSS}$.
J. I_{SD}≤I_D, di/dt≤200A/µs, V_{DD}=400V, T_J≤$T_{J(MAX)}$.

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

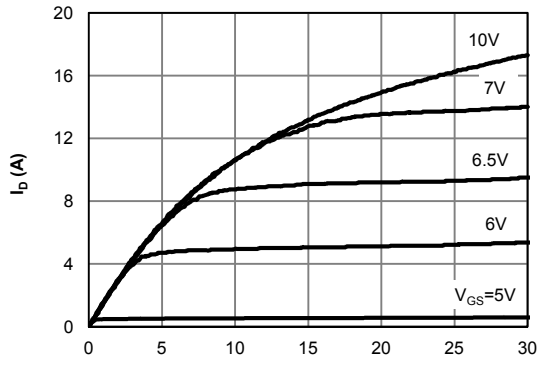


Figure 1: On-Region Characteristics

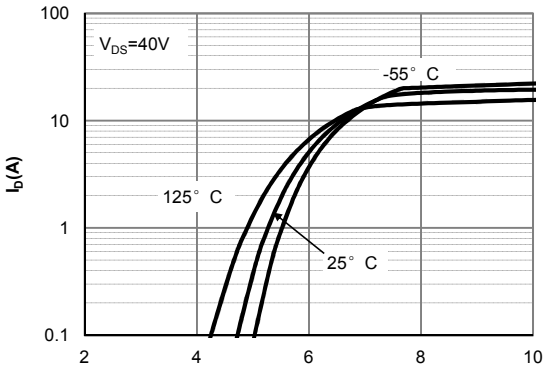


Figure 2: Transfer Characteristics

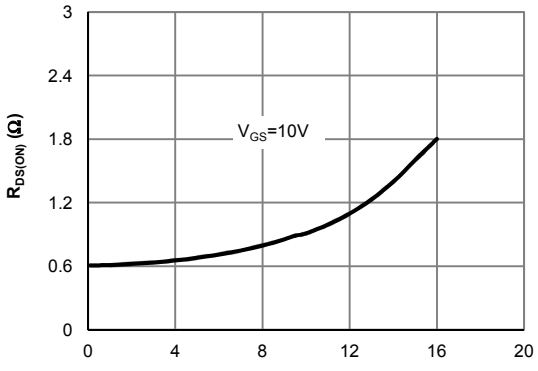


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

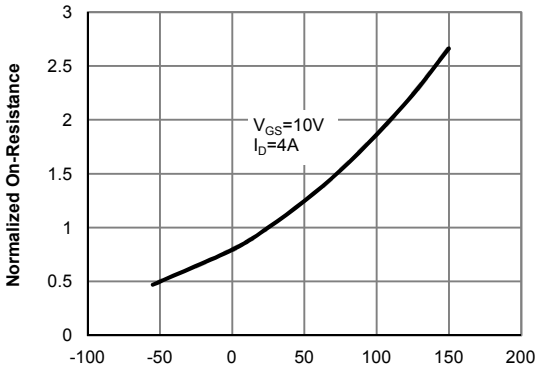


Figure 4: On-Resistance vs. Junction Temperature

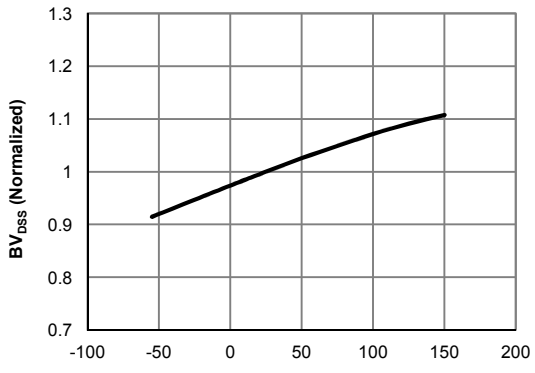


Figure 5: Break Down vs. Junction Temperature

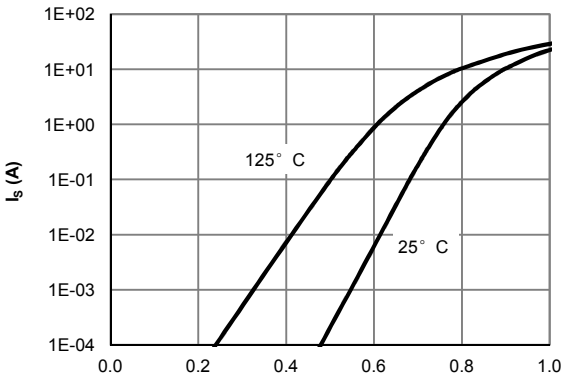


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

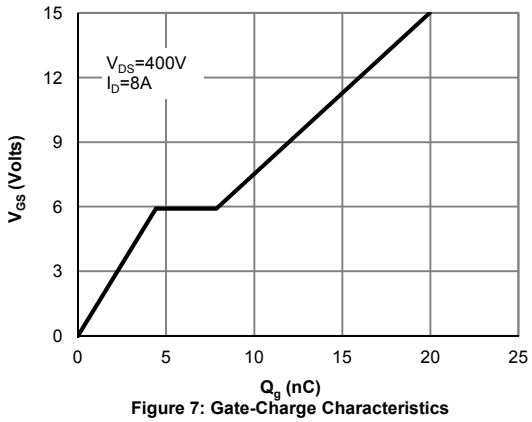


Figure 7: Gate-Charge Characteristics

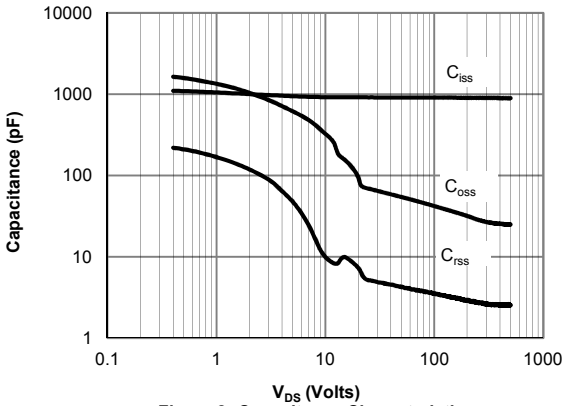


Figure 8: Capacitance Characteristics

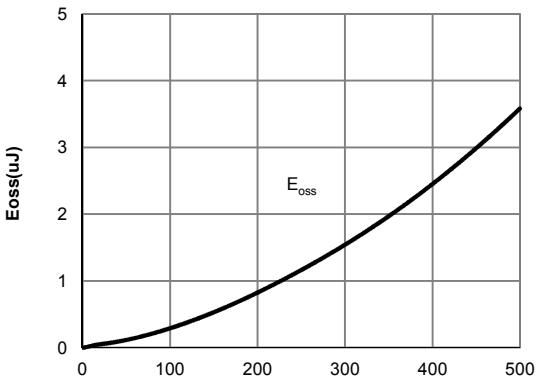


Figure 9: Coss stored Energy

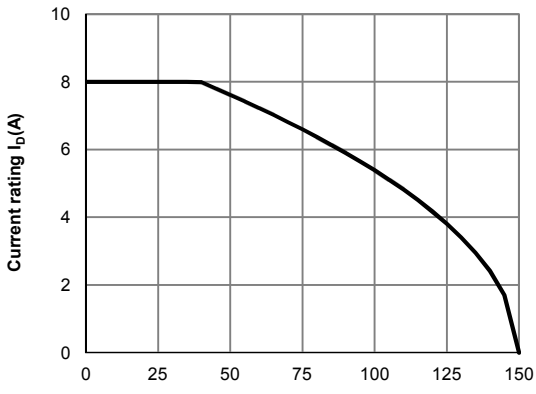


Figure 10: Current De-rating (Note F)

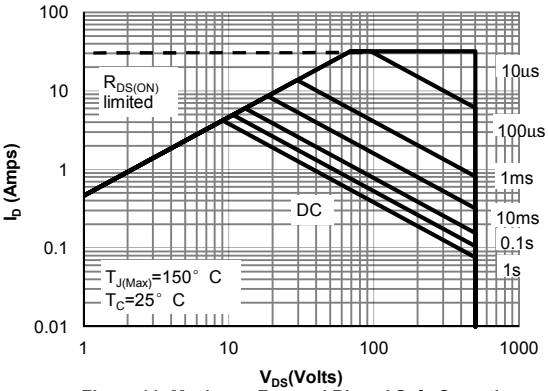


Figure 11: Maximum Forward Biased Safe Operating Area for TO-220F Pb Free (Note F)

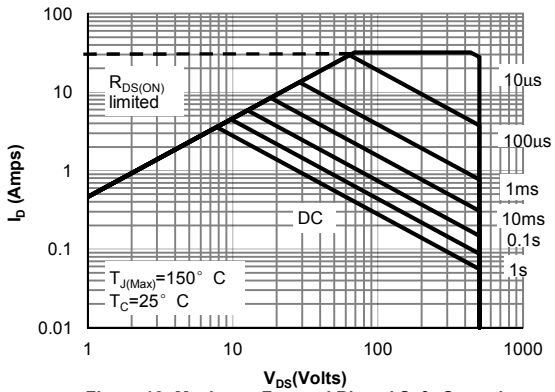


Figure 12: Maximum Forward Biased Safe Operating Area for TO-220F Green (Note F)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

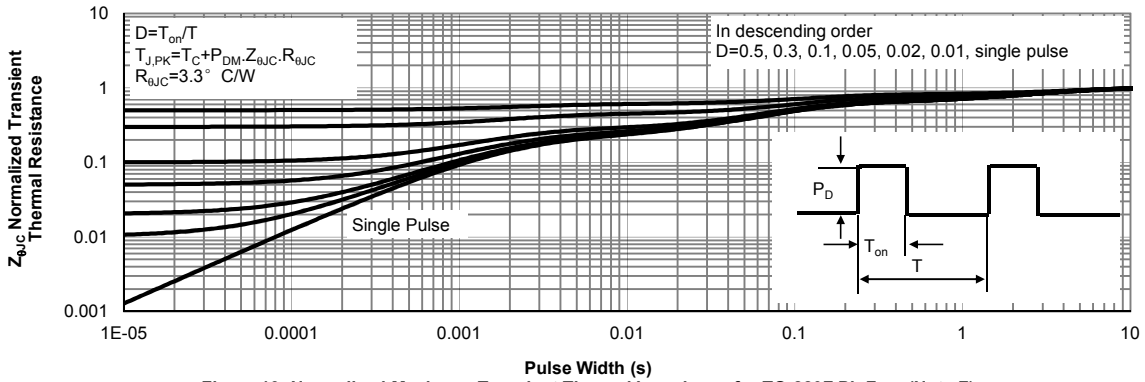


Figure 13: Normalized Maximum Transient Thermal Impedance for TO-220F Pb Free (Note F)

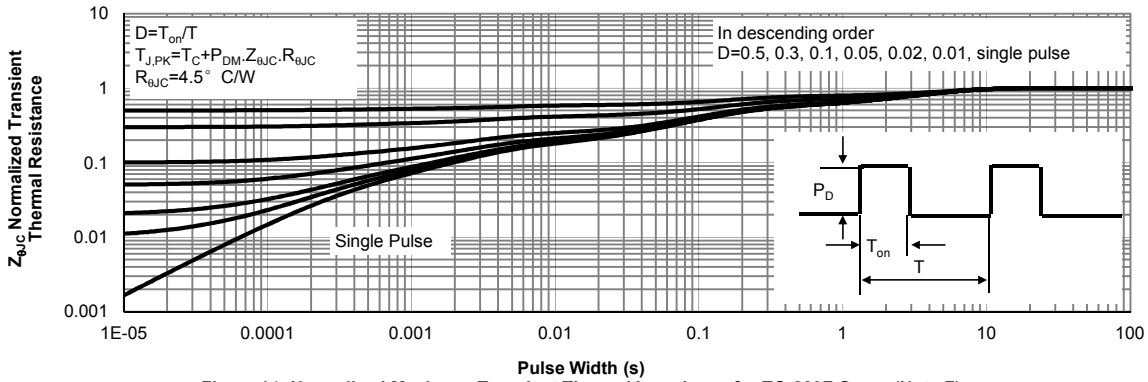
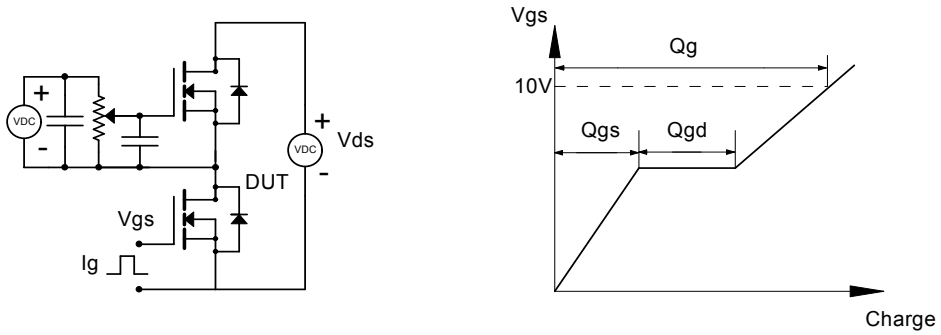
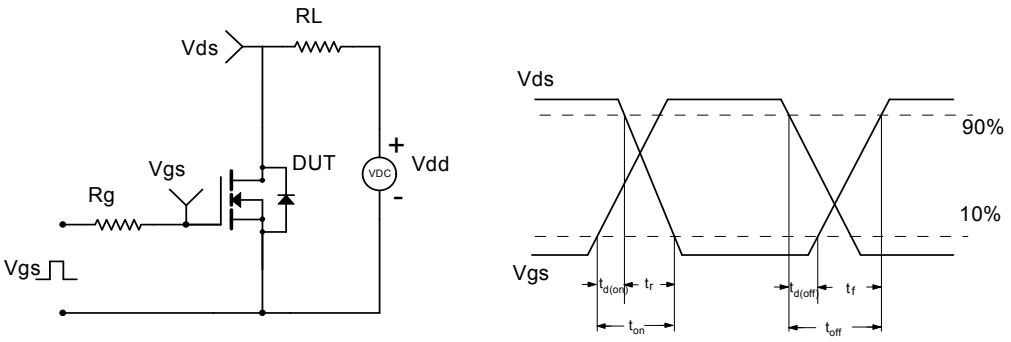


Figure 14: Normalized Maximum Transient Thermal Impedance for TO-220F Green (Note F)

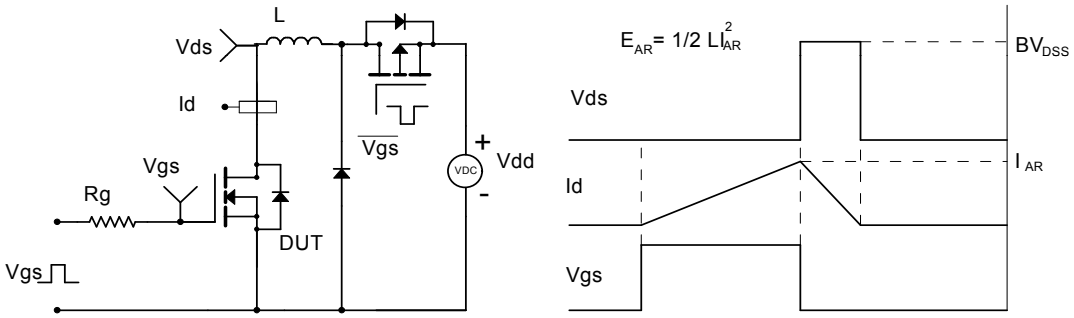
Gate Charge Test Circuit & Waveform



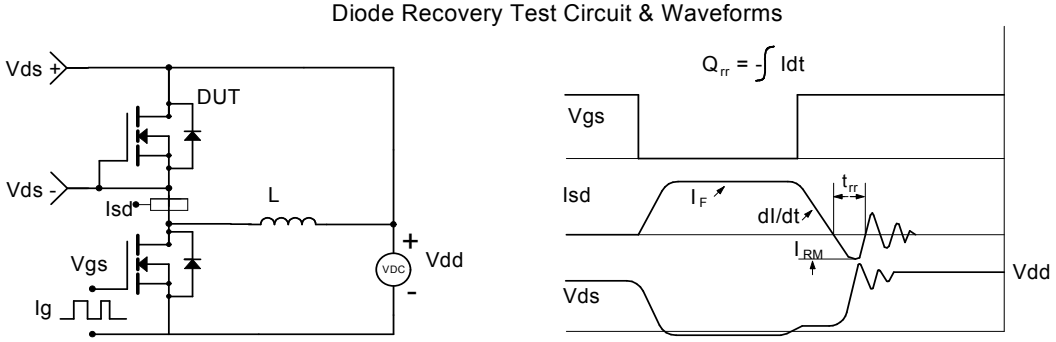
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



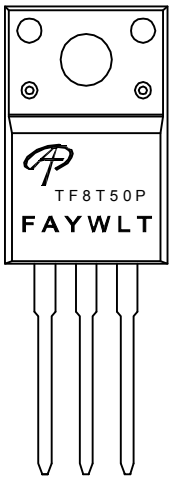
Diode Recovery Test Circuit & Waveforms



ALPHA & OMEGA SEMICONDUCTOR

Document No.	PD-02185
Version	A
Title	AOTF8T50P Marking Description

TO220F PACKAGE MARKING DESCRIPTION



Standard product

NOTE:

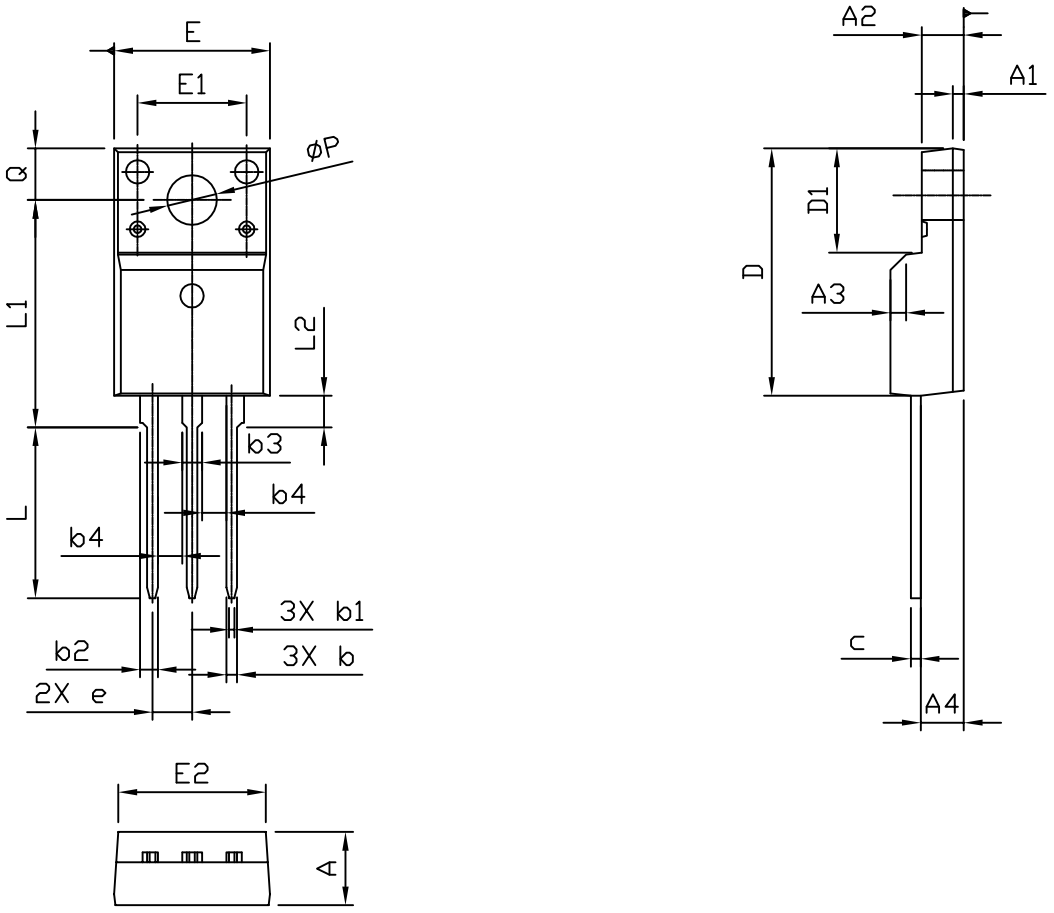
LOGO	- AOS Logo
TF8T50P	- Part number code
F	- Fab code
A	- Assembly location code
Y	- Year code
W	- Week code
L&T	- Assembly lot code

PART NO.	DESCRIPTION	CODE
AOTF8T50P	Standard product	TF8T50P

ALPHA & OMEGA SEMICONDUCTOR

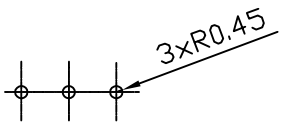
Document No.	PO-00059
Version	E

TO220F PACKAGE OUTLINE



SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	4.50	4.70	4.90	0.177	0.185	0.193
A1	---	0.70	---	---	0.028	---
A2	2.34	2.54	2.74	0.092	0.100	0.108
A3		1X45°			1X45°	
A4	2.66	2.76	2.86	0.105	0.106	0.113
b	0.59	0.69	0.79	0.023	0.027	0.031
b1	0.25	0.35	0.45	0.010	0.014	0.018
b2	1.14	1.24	1.29	0.045	0.049	0.051
b3	1.28	1.38	1.43	0.050	0.054	0.056
b4		1.40 MIN.			0.055 MIN.	
c	0.59	0.64	0.74	0.023	0.025	0.029
D	15.67	15.87	16.07	0.617	0.625	0.633
D1	6.48	6.68	6.88	0.255	0.263	0.271
e		2.54 BSC			0.100 BSC.	
E	9.96	10.16	10.36	0.392	0.400	0.408
E1	---	7.00	---	---	0.276	---
E2	9.26	9.46	9.66	0.365	0.372	0.380
L	10.76	10.96	11.16	0.424	0.431	0.439
L1	14.39	14.59	14.79	0.567	0.574	0.582
L2	1.70	2.03	2.20	0.067	0.080	0.087
Q	3.20	3.30	3.40	0.126	0.130	0.134
ØP	3.08	3.18	3.28	0.121	0.125	0.129

RECOMMENDATION OF HOLE PATTERN



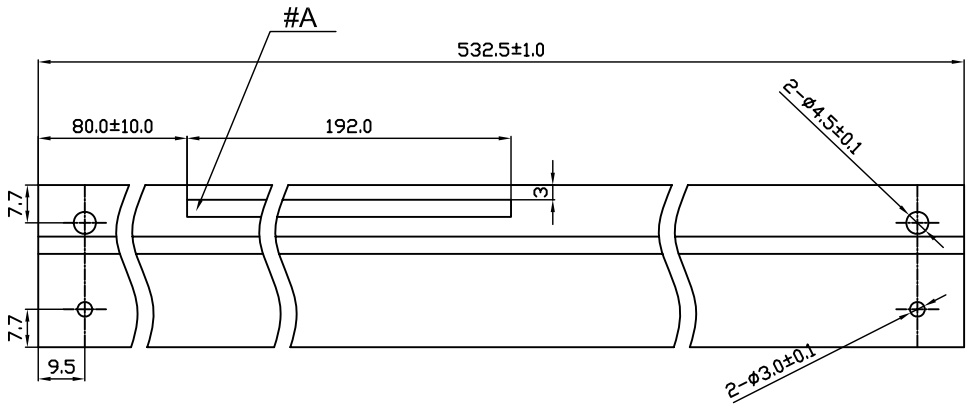
UNIT: mm

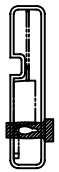
NOTE
1. PACKAGE BODY SIZES EXCLUDE MOLD FLASH AND GATE BURRS.
   MOLD FLASH SHOULD BE LESS THAN 6 MIL.
2. TOLERANCE 0.100 MILLIMETERS UNLESS OTHERWISE SPECIFIED.
3. CONTROLLING DIMENSION IS MILLIMETER.
   CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.

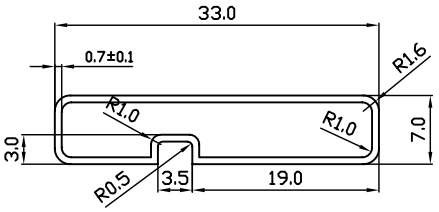
ALPHA & OMEGA SEMICONDUCTOR

REV.	DATE	DESCRIPTION	DRC.
A		NEW ISSUE	

TO220F/TO220FL PLASTIC TUBE DRAWING

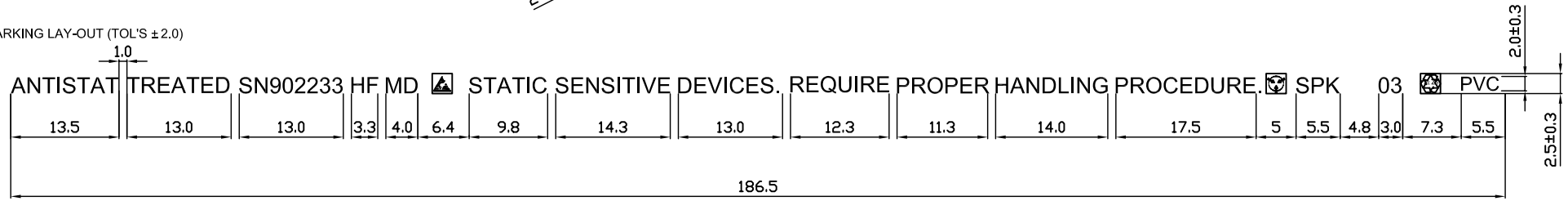






2:1

#A MARKING LAY-OUT (TOL'S ± 2.0)



2:1

NOTE

1. TUBE
   - MATERIAL : P.V.C
   - COLOR : TRANSPARENCY, RED, YELLOW
   - MARKING #A : 6 MONTHS, BLACK COLOR
     LETTER STYLE : Arial
   - CAMBAR : 1.5 MAX
2. PIN
   - MATERIAL: NYLON
   - COLOR : GREEN (ONE PIN MUST BE INSERTED IN LEFT-SIDE OF " ANTISTATIC~" AND ANOTHER PIN IS FREE.)
3. ALL UNSPECIFICATED SPECIFICATIONS FOLLOW TUBE GENERAL SPEC.
   UNSPECIFICATED TOLERANCE ± 0.2
4. PACKING Q'TY :

PKG	Q'TY(PCS)
TO220F/ TO220FL	50

ALPHA & OMEGA SEMICONDUCTOR		TITLE: TO220F/TO220FL TUBE DRAWING	
DRAWN BY	SIGNATURE		
APPROVED BY	SIGNATURE	UNIT: MM	PAGE: 1 OF 1
SCALE: N.T.S.	PROJECTION	DRAWING NUMBER: TR-00061	VENDOR CODE: N / REV.: A

AOS Semiconductor
Product Reliability Report

AOTF8T50P, rev B

Plastic Encapsulated Device

ALPHA & OMEGA Semiconductor, Inc

www.aosmd.com

Dec. 2017

ALPHA & OMEGA SEMICONDUCTOR

This AOS product reliability report summarizes the qualification result for AOTF8T50P. 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 AOTF8T50P 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	462 pcs	0	JESD22-A108
HTRB	Temp = 150°C , Vds=100% of Vdsmax	168 / 500 / 1000 hours	462 pcs	0	JESD22-A108
HAST	130°C , 85%RH, 33.3 psia, Vds = 80% of Vdsmax up to 42V	96 hours	693 pcs	0	JESD22-A110
H3TRB	85°C , 85%RH, Vds = 80% of Vdsmax up to 100V	1000 hours	693 pcs	0	JESD22-A101
Autoclave	121°C , 29.7psia, RH=100%	96 hours	924 pcs	0	JESD22-A102
Temperature Cycle	-65°C to 150°C , air to air,	1000cycles	924 pcs	0	JESD22-A104
HTSL	Temp = 150°C	1000 hours	693 pcs	0	JESD22-A103
IOL	Δ Tj = 100°C	8572 cycles	693 pcs	0	AEC Q101
Resistance to Solder Heat	Temp = 270°C	15 seconds	30 pcs	0	JESD22-B106

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

II. Reliability Evaluation

FIT rate (per billion): 3.82
MTTF = 29919 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)**] =** 3.82

MTTF = 10^9 / FIT = 29919 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