ALPHA & OMEGA SEMICONDUCTOR

AO3481

30V P-Channel MOSFET

General Description

The AO3481 uses advanced trench technology to provide excellent $R_{DS(ON)}$, low gate charge and operation gate voltages as low as 2.5V. This device is suitable for use as a load switch or other general applications.

• RoHS and Halogen-Free Compliant

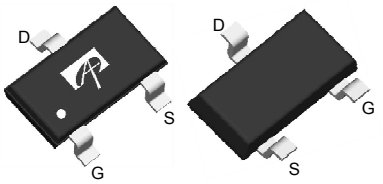
Product Summary

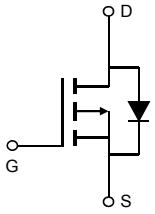
V_{DS}	-30V
I_D (at V_{GS}=-10V)	-4.0A
$R_{DS(ON)}$ (at V_{GS}=-10V)	< 50mΩ
$R_{DS(ON)}$ (at V_{GS} =-4.5V)	< 60mΩ
$R_{DS(ON)}$ (at V_{GS}=-2.5V)	< 85mΩ

Green Product

SOT23

Top View **Bottom View**





Absolute Maximum Ratings T_A=25°C unless otherwise noted

Parameter		Symbol	Maximum	Units
Drain-Source Voltage		V_{DS}	-30	V
Gate-Source Voltage		V_{GS}	±12	V
Continuous Drain Current	T_A=25°C	I_D	-4	A
	T_A=70°C		-3.2	
Pulsed Drain Current [C]		I_{DM}	-27	
Power Dissipation [B]	T_A=25°C	P_D	1.4	W
	T_A=70°C		0.9	
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	$R_{\theta JA}$	70	90	°C/W
Maximum Junction-to-Ambient [A D]	Steady-State		100	125	°C/W
Maximum Junction-to-Lead	Steady-State	$R_{\theta JL}$	63	80	°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	-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	-0.5	-0.9	-1.3	V
$I_{D(ON)}$	On state drain current	V_{GS}=-10V, V_{DS}=-5V	-27			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS}=-10V, I_D=-4.0A		41	50	mΩ
		T_J=125°C		62	75	
		V_{GS}=-4.5V, I_D=-3.5A		47	60	mΩ
		V_{GS}=-2.5V, I_D=-2.5A		60	85	mΩ
g_{FS}	Forward Transconductance	V_{DS}=-5V, I_D=-4.0A		17		S
V_{SD}	Diode Forward Voltage	I_S=-1A,V_{GS}=0V		-0.7	-1	V
I_S	Maximum Body-Diode Continuous Current				-2	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=-15V, f=1MHz		645		pF
C_{oss}	Output Capacitance			80		pF
C_{rss}	Reverse Transfer Capacitance			55		pF
R_g	Gate resistance	V_{GS}=0V, V_{DS}=0V, f=1MHz	4	7.8	12	Ω
SWITCHING PARAMETERS						
Q_g(10V)	Total Gate Charge	V_{GS}=-10V, V_{DS}=-15V, I_D=-4.0A		14	20	nC
Q_g(4.5V)	Total Gate Charge			7		nC
Q_{gs}	Gate Source Charge			1.5		nC
Q_{gd}	Gate Drain Charge			2.5		nC
$t_{D(on)}$	Turn-On DelayTime	V_{GS}=-10V, V_{DS}=-15V, R_L=3.75Ω, R_{GEN}=3Ω		6.5		ns
t_r	Turn-On Rise Time			3.5		ns
$t_{D(off)}$	Turn-Off DelayTime			41		ns
t_f	Turn-Off Fall Time			9		ns
t_{rr}	Body Diode Reverse Recovery Time	I_F=-4.0A, dI/dt=100A/µs		11		ns
Q_{rr}	Body Diode Reverse Recovery Charge	I_F=-4.0A, dI/dt=100A/µs		3.5		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 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 ≤ 10s junction-to-ambient thermal resistance.
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 initialT_J=25° C.
D. The $R_{\theta JA}$ is the sum of the thermal impedence from junction to lead $R_{\theta JL}$ 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 impedence which is measured with the device mounted on 1in² FR-4 board with 2oz. Copper, assuming a maximum junction temperature of $T_{J(MAX)}$=150° C. The SOA curve provides a single pulse rating.

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

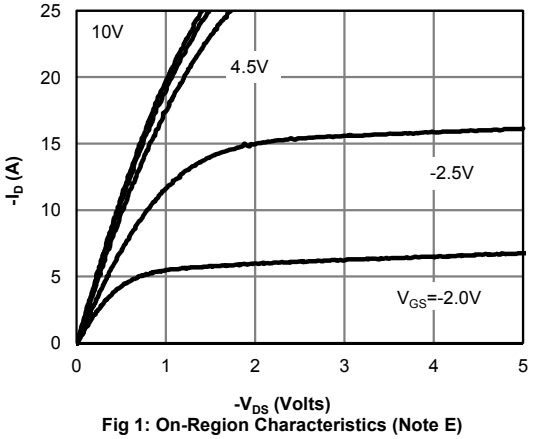


Fig 1: On-Region Characteristics (Note E)

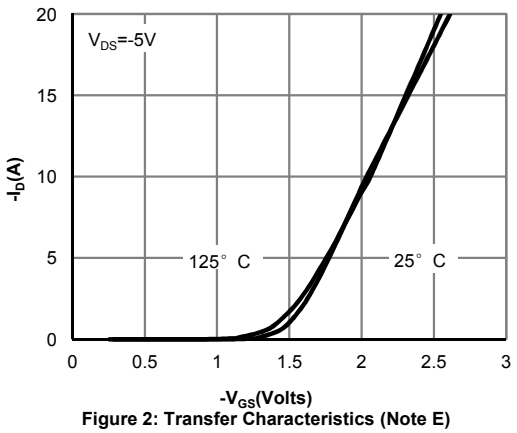


Figure 2: Transfer Characteristics (Note E)

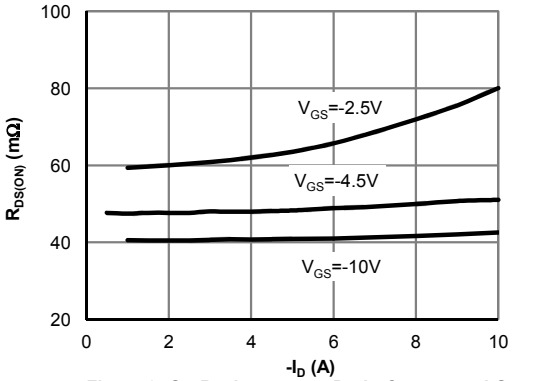


Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)

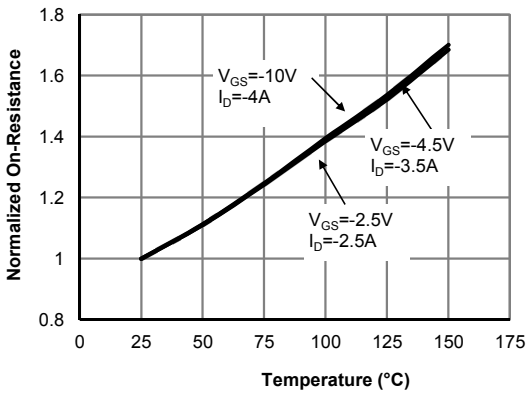


Figure 4: On-Resistance vs. Junction Temperature (Note E)

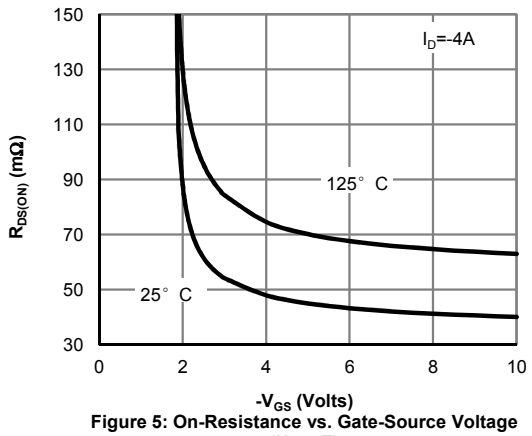


Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)

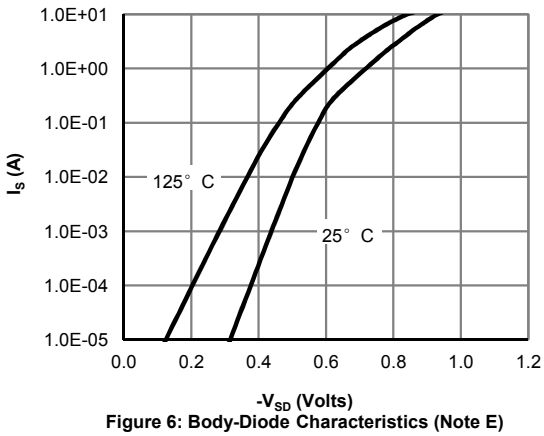


Figure 6: Body-Diode Characteristics (Note E)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

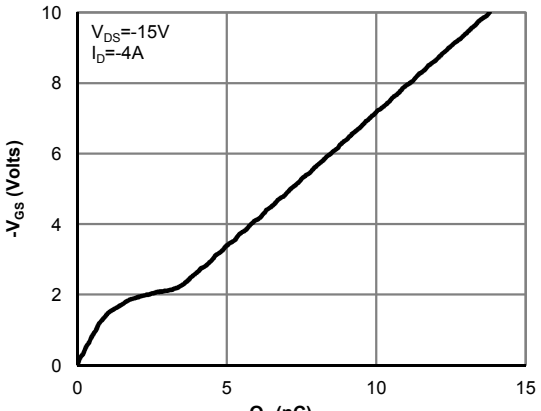


Figure 7: Gate-Charge Characteristics

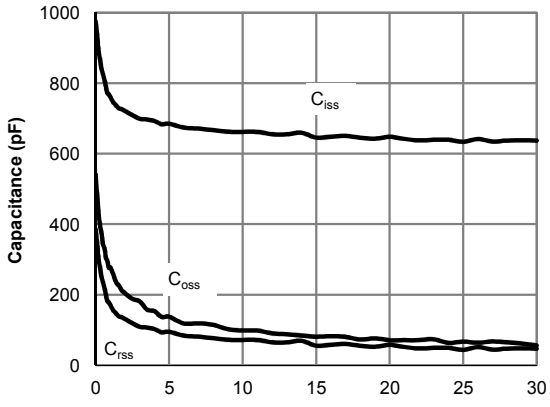


Figure 8: Capacitance Characteristics

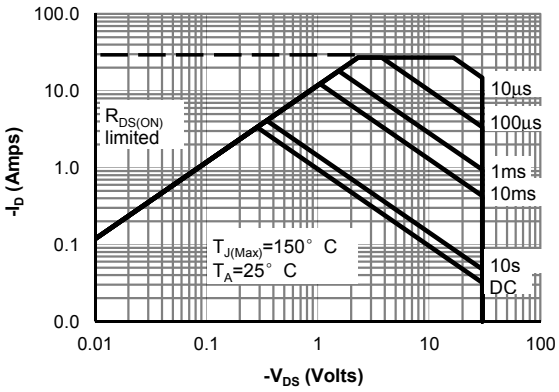


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

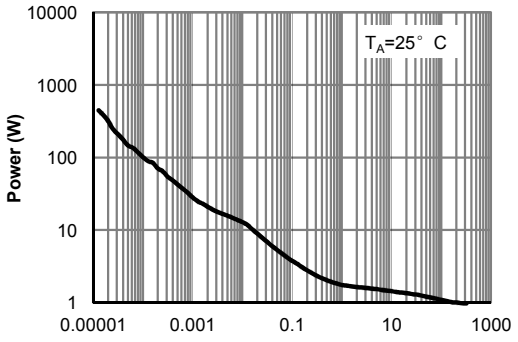


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note F)

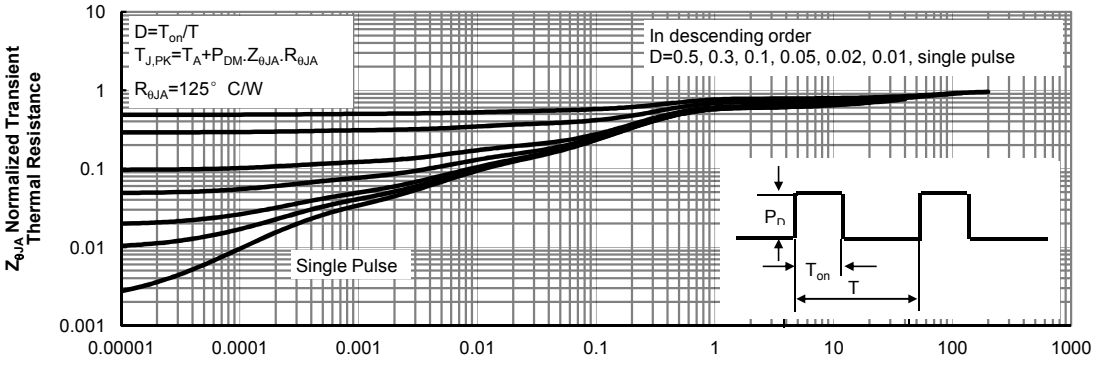
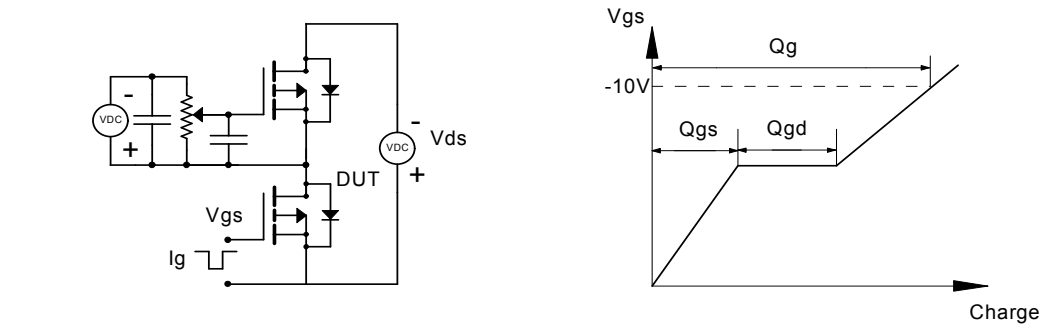
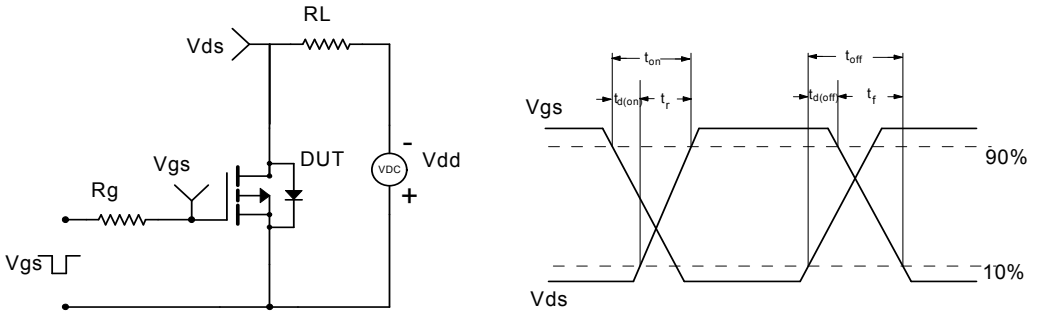


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

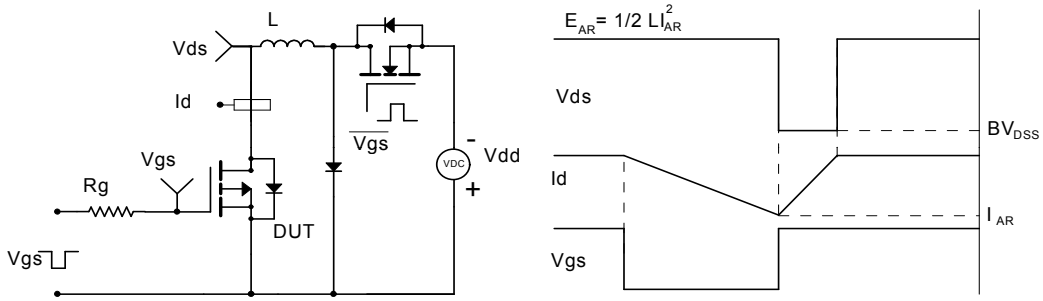
Gate Charge Test Circuit & Waveform



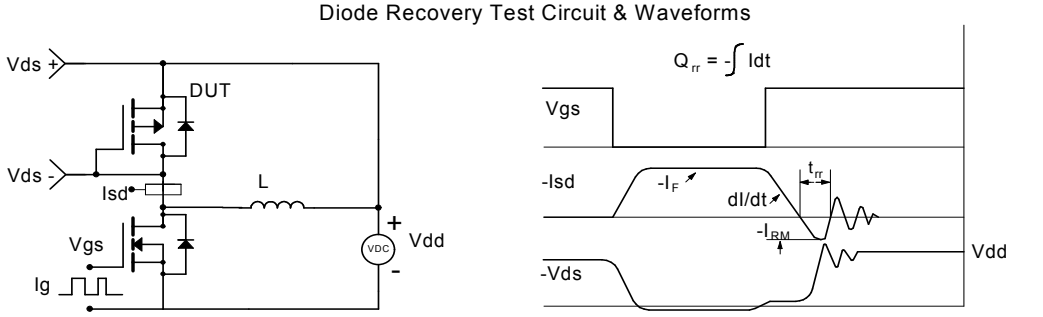
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



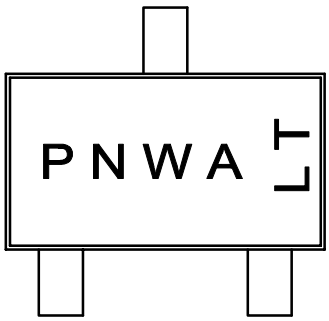
Diode Recovery Test Circuit & Waveforms



ALPHA & OMEGA SEMICONDUCTOR

Document No.	PD-02362
Version	A
Title	AO3481 Marking Description

SOT-23 PACKAGE MARKING DESCRIPTION



Green product

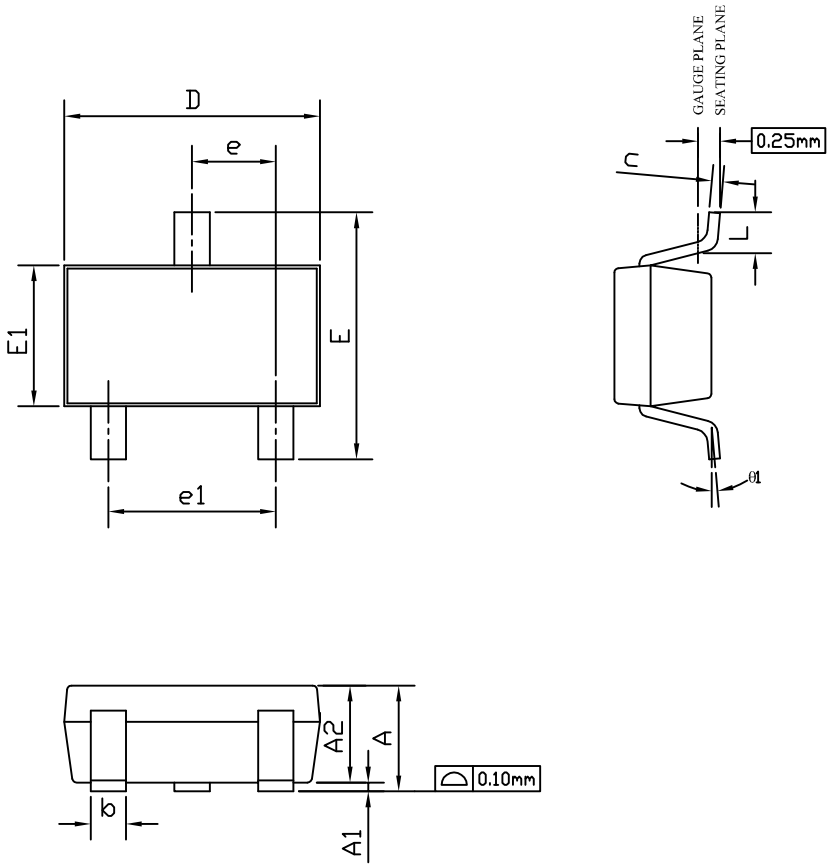
NOTE:
P - Package and product type
N - Last digital of product number
W - Week code
A - Assembly location code
L&T - Assembly lot code

PART NO.	DESCRIPTION	CODE (PN)
AO3481	Green product	CP

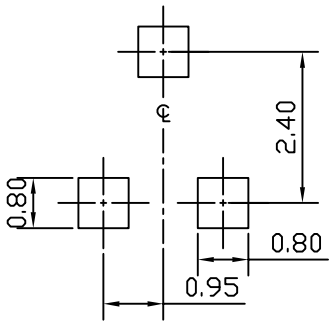
ALPHA & OMEGA SEMICONDUCTOR

Document No.	PO-00001
Version	L

SOT23 PACKAGE OUTLINE



RECOMMENDED LAND PATTERN



UNIT: mm

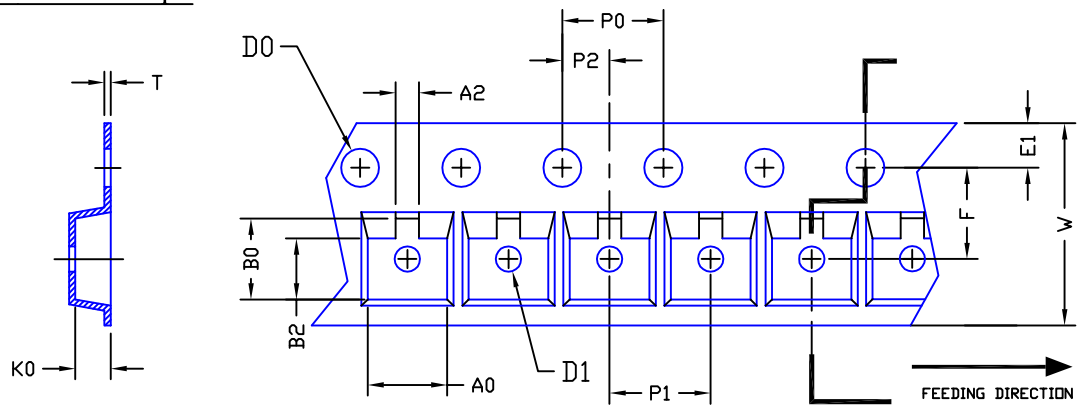
SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.85	——	1.25	0.033	——	0.049
A1	0.00	——	0.13	0.000	——	0.005
A2	0.70	1.00	1.15	0.028	0.039	0.045
b	0.30	0.40	0.50	0.012	0.016	0.020
c	0.08	0.13	0.20	0.003	0.005	0.008
D	2.80	2.90	3.10	0.110	0.114	0.122
E	2.60	2.80	3.00	0.102	0.110	0.118
E1	1.40	1.60	1.80	0.055	0.063	0.071
e	0.95 BSC			0.037 BSC		
e1	1.90 BSC			0.075 BSC		
L	0.30	——	0.60	0.012	——	0.024
θ1	0°	5°	8°	0°	5°	8°

NOTE
1. PACKAGE BODY SIZES EXCLUDE MOLD FLASH OR GATE BURRS.
   MOLD FLASH AT THE NON-LEAD SIDES SHOULD BE LESS THAN 5 MILS EACH.
2. TOLERANCE ±0.100 mm (4 mil) UNLESS OTHERWISE SPECIFIED.
3. DIMENSION L IS MEASURED IN GAUGE PLANE.
4. CONTROLLING DIMENSION IS MILLIMETER. CONVERTED INCH DIMENSIONS
   ARE NOT NECESSARILY EXACT.
5. ALL DIMENSIONS ARE IN MILLIMETERS.

ALPHA & OMEGA
SEMICONDUCTOR, LTD.

SOT23-3L Tape and Reel Data

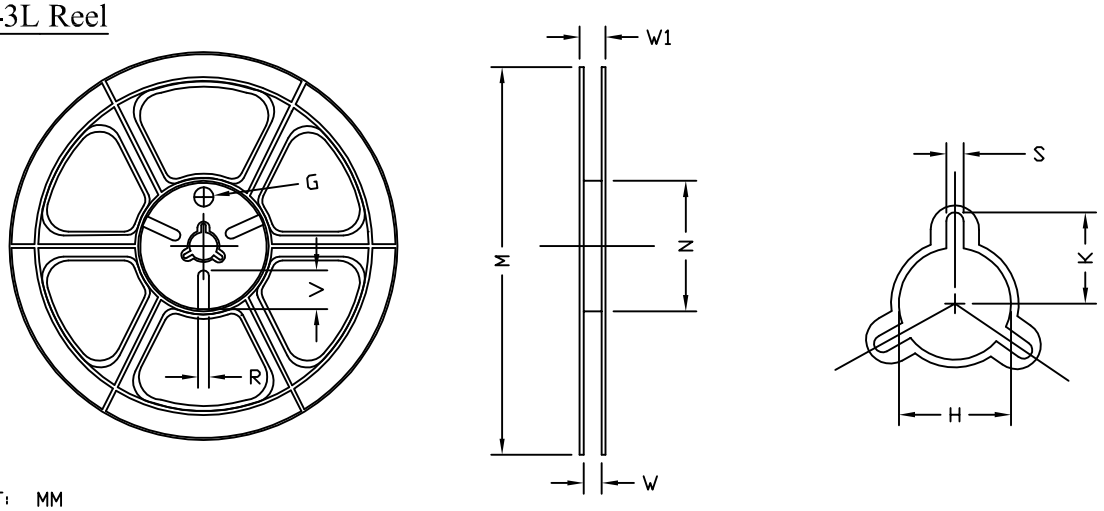
SOT23-3L Carrier Tape



UNIT: MM

PACKAGE	A0	B0	K0	D0	D1	W	E1	F	P0	P1	P2	T	A2	B2
SOT23-3L (8 mm)	3.05-3.40	3.00-3.38	1.20- 1.47	1.55 ±0.05	1.00 ±0.25	8.00 ±0.30	1.75 ±0.10	3.50 ±0.05	4.00 ±0.10	4.00 ±0.10	2.00 ±0.05	0.18 -0.25	0.84-1.24	2.29-2.69

SOT23-3L Reel



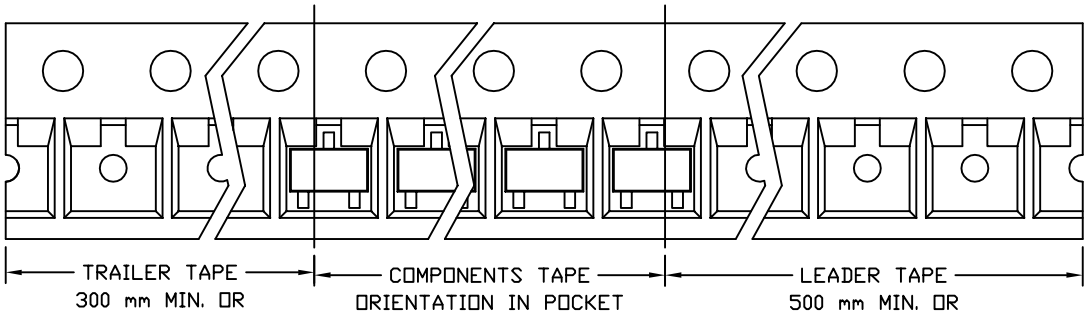
UNIT: MM

TAPE SIZE	REEL SIZE	M	N	W	W1	H	K	S	G	R	V
8 mm	ø178	ø178.00 ±1.00	ø54.00 ±0.50	9.00 ±0.30	11.40 ±1.00	ø13.00 +0.50 -0.20	10.60	2.00 ±0.50	ø9.00	5.00	18.00

SOT23-3L Tape

Leader / Trailer & Orientation

Unit Per Reel: 3000pcs



ALPHA & OMEGA SEMICONDUCTOR

This AOS product reliability report summarizes the qualification result for AO3481. 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 AO3481 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**	**924 pcs**	**0**	**JESD22-A108**
HTRB	**Temp = 150°C , Vds=80% of Vdsmax**	**168 / 500 / 1000 hours**	**924 pcs**	**0**	**JESD22-A108**
Precondition (Note A)	**168hr 85°C / 85%RH + 3 cycle reflow@260°C (MSL 1)**	**-**	**5082 pcs**	**0**	**JESD22-A113**
HAST	**130°C , 85%RH, 33.3 psia, Vds = 80% of Vdsmax**	**96 hours**	**924 pcs**	**0**	**JESD22-A110**
H3TRB	**85°C , 85%RH, Vds = 80% of Vdsmax**	**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,**	**1000 cycles**	**924 pcs**	**0**	**JESD22-A104**
HTSL	**Temp = 150°C**	**1000 hours**	**924 pcs**	**0**	**JESD22-A103**
Power Cycling	**Δ Tj = 100°C**	**15000 cycles**	**693 pcs**	**0**	**AEC Q101**

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): 1.91
MTTF = 59839 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)**] =** 1.91
MTTF = 10^9 / FIT = 59839 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

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