ALPHA & OMEGA SEMICONDUCTOR

AOTL125A60

600V, αMOS5™ TOLL
for high density, high reliability SMPS

General Description

- Proprietary αMOS5™ technology
- Low $R_{DS(ON)}$
- Optimized switching parameters for better EMI performance
- Enhanced body diode for robustness and fast reverse recovery

Applications

- PFC and PWM stages (LLC, FSFB,TTF) of Server, Telecom, Industrial, UPS, and Solar Inverters

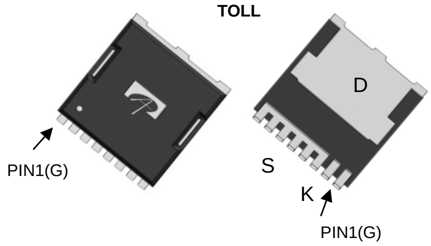
Product Summary

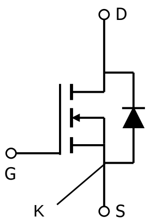
V_{DS} @ $T_{j,max}$	700V
I_{DM}	100A
$R_{DS(ON),max}$	< 0.125Ω
$Q_{g,typ}$	39nC
E_{oss} @ 400V	6.3µJ

100% UIS Tested
100% R_g Tested

Top View

TOLL





Orderable Part Number	Package Type	Form	Minimum Order Quantity
AOTL125A60	TOLL	Tape & Reel	2000

Absolute Maximum Ratings T_A=25°C unless otherwise noted

Parameter		Symbol	Maximum	Units
Drain-Source Voltage		V_{DS}	600	V
Gate-Source Voltage		V_{GS}	±20	V
Gate-Source Voltage (dynamic) AC(f>1Hz)		V_{GS}	±30	V
Continuous Drain Current	T_C=25°C	I_D	28	A
	T_C=100°C		18	
Pulsed Drain Current [C]		I_{DM}	100	
Continuous Drain Current	T_A=25°C	I_{DSM}	5.2	A
	T_A=70°C		4.2	
Avalanche Current [C]	L=1mH	I_{AR}	14.0	A
Repetitive avalanche energy [C]		E_{AR}	98	mJ
Single pulsed avalanche energy [G]		E_{AS}	555	mJ
MOSFET dv/dt ruggedness		dv/dt	100	V/ns
Diode reverse recovery V_{DS}=0 to 400V,I_F<=26A,Tj=25°C		dv/dt	20	V/ns
		di/dt	400	A/us
Power Dissipation [B]	T_C=25°C	P_D	312	W
	Derate above 25°C		2.5	W/°C
Power Dissipation [A]	T_A=25°C	P_{DSM}	8.3	W
	T_A=70°C		5.3	
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	Typical	Maximum	Units
Maximum Junction-to-Ambient [A]	t ≤ 10s	$R_{\theta JA}$	10	15	°C/W
Maximum Junction-to-Ambient [A,D]	Steady-State		40	50	°C/W
Maximum Junction-to-Case		$R_{\theta JC}$	0.3	0.4	°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, T_J=25°C	600			V
		I_D=250µA, V_{GS}=0V, T_J=150°C		700		
BV_{DSS} /ΔTJ	Breakdown Voltage Temperature Coefficient	I_D=250µA, V_{GS}=0V		0.51		V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=600V, V_{GS}=0V			1	µA
		V_{DS}=480V, T_J=125°C			10	
I_{GSS}	Gate-Body leakage current	V_{DS}=0V, V_{GS}=±20V			±100	nA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=5V, I_D=250µA	3.3	3.9	4.5	V
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS}=10V, I_D=14A		0.111	0.125	Ω
g_{FS}	Forward Transconductance	V_{DS}=10V, I_D=14A		21		S
V_{SD}	Diode Forward Voltage	I_S=14A,V_{GS}=0V		0.86	1.2	V
I_S	Maximum Body-Diode Continuous Current				28	A
I_{SM}	Maximum Body-Diode Pulsed Current [C]				100	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=100V, f=1MHz		2993		pF
C_{oss}	Output Capacitance			85		pF
$C_{o(er)}$	Effective output capacitance, energy related [H]	V_{GS}=0V, V_{DS}=0 to 480V, f=1MHz		73		pF
$C_{o(tr)}$	Effective output capacitance, time related [I]			305		pF
C_{rss}	Reverse Transfer Capacitance	V_{GS}=0V, V_{DS}=100V, f=1MHz		0.8		pF
R_g	Gate resistance	f=1MHz		2.3		Ω
SWITCHING PARAMETERS						
Q_g	Total Gate Charge	V_{GS}=10V, V_{DS}=480V, I_D=14A		39		nC
Q_{gs}	Gate Source Charge			19		nC
Q_{gd}	Gate Drain Charge			9		nC
$t_{D(on)}$	Turn-On DelayTime	V_{GS}=10V, V_{DS}=400V, I_D=14A, R_G=5Ω		39		ns
t_r	Turn-On Rise Time			34		ns
$t_{D(off)}$	Turn-Off DelayTime			56		ns
t_f	Turn-Off Fall Time			19		ns
t_{rr}	Body Diode Reverse Recovery Time	I_F=14A, dI/dt=100A/µs, V_{DS}=400V		375		ns
I_{rm}	Peak Reverse Recovery Current			34		A
Q_{rr}	Body Diode Reverse Recovery Charge			8		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 <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. L=60mH, I_{AS}=4.3A, 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% $V_{(BR)DSS}$.

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

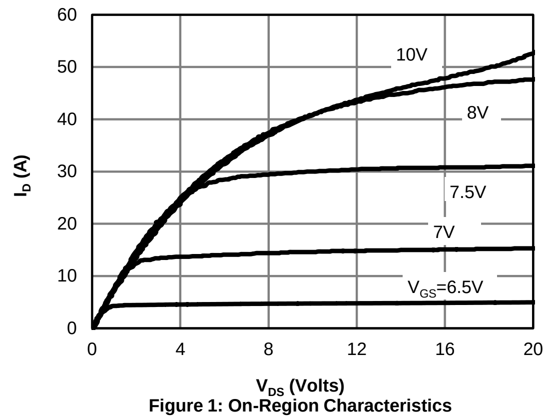


Figure 1: On-Region Characteristics

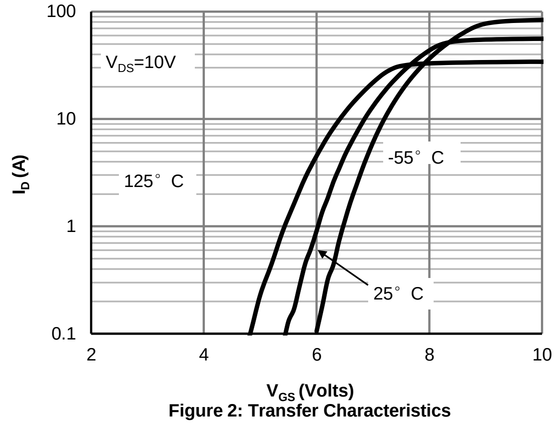


Figure 2: Transfer Characteristics

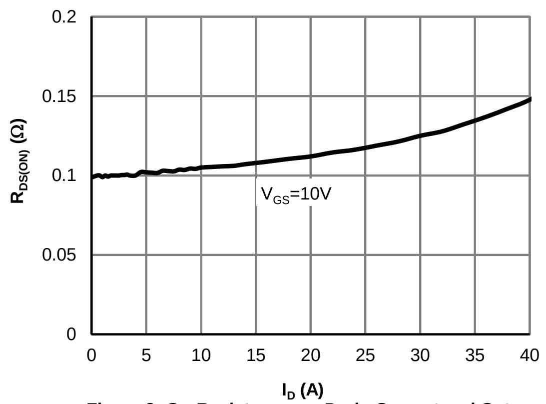


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

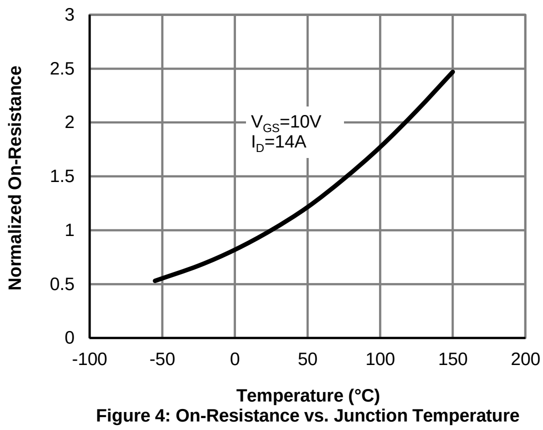


Figure 4: On-Resistance vs. Junction Temperature

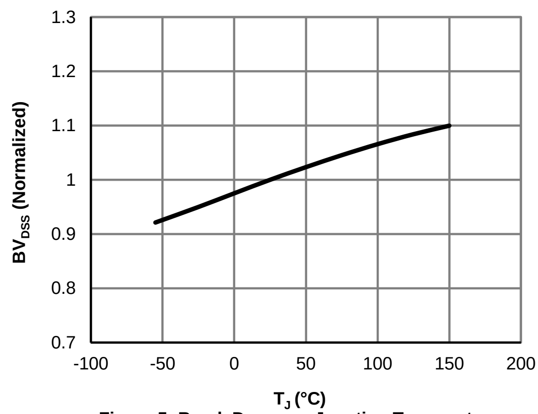


Figure 5: Break Down vs. Junction Temparature

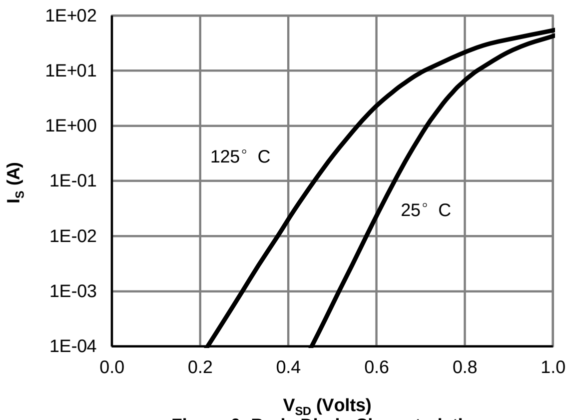


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

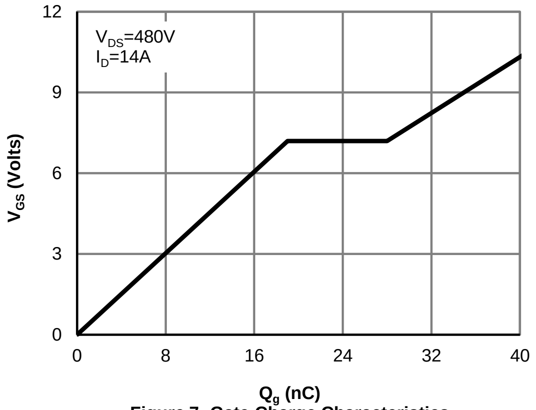


Figure 7: Gate-Charge Characteristics

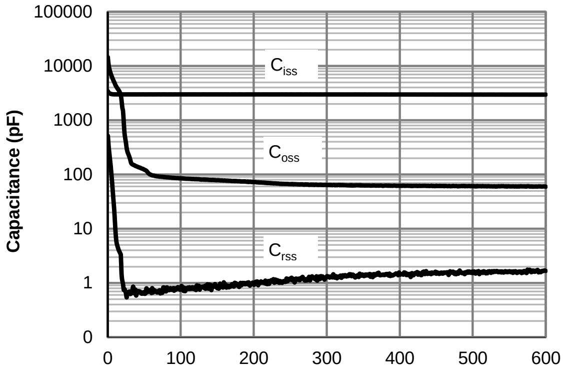


Figure 8: Capacitance Characteristics

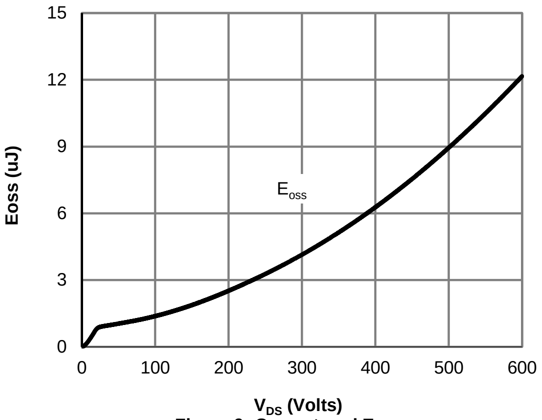


Figure 9: Coss stored Energy

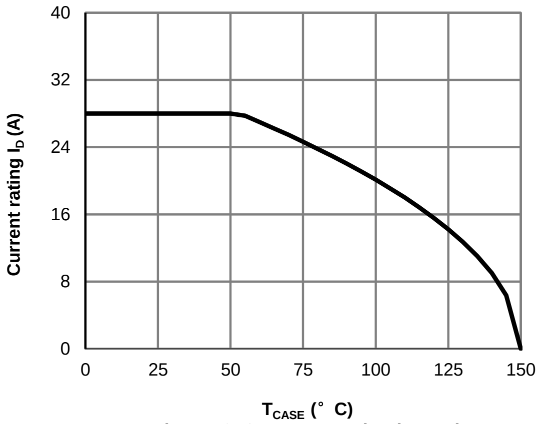


Figure 10: Current De-rating (Note F)

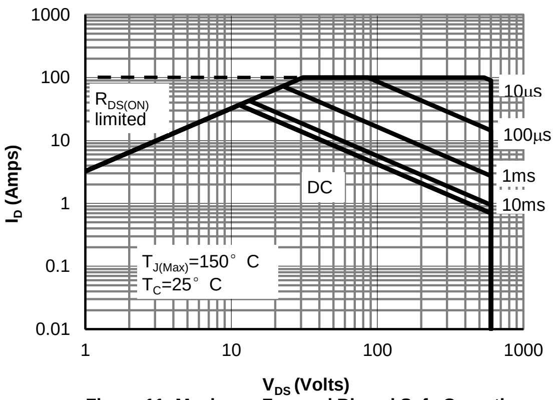


Figure 11: Maximum Forward Biased Safe Operating Area (Note F)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

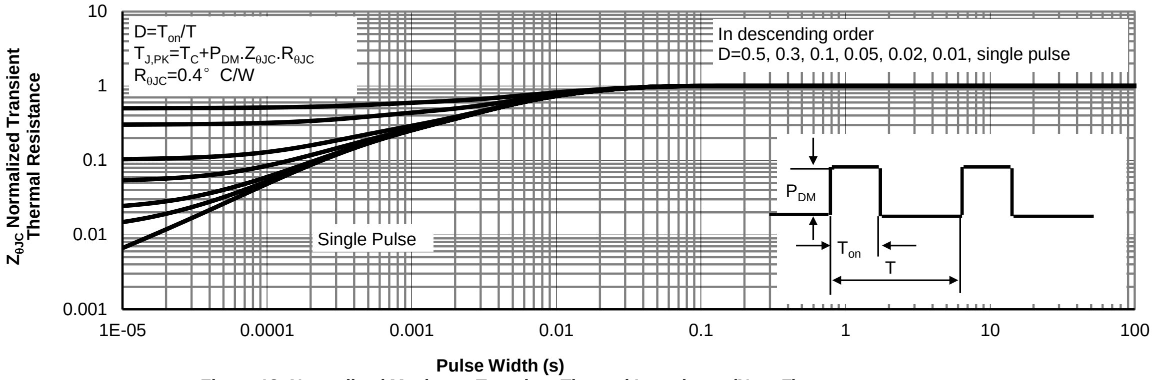
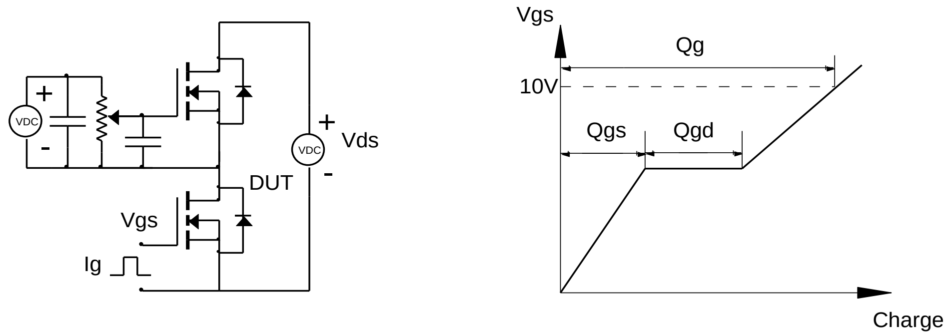
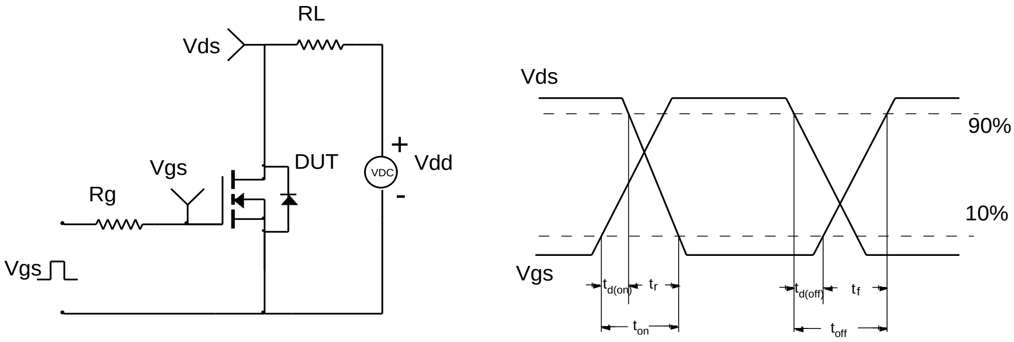


Figure 12: Normalized Maximum Transient Thermal Impedance (Note F)

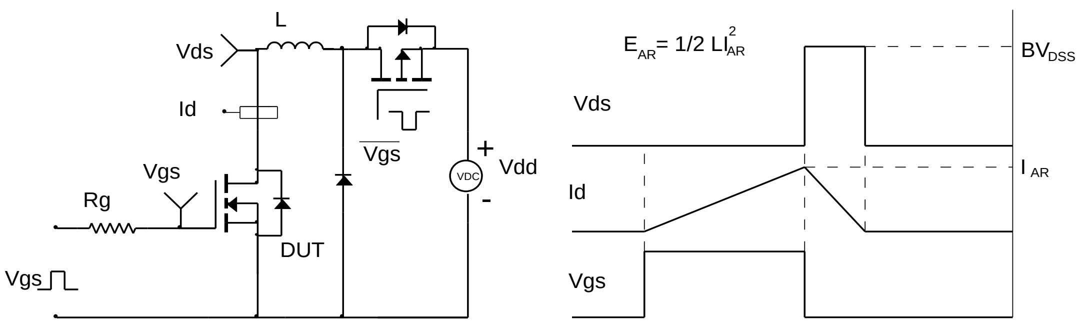
Gate Charge Test Circuit & Waveform



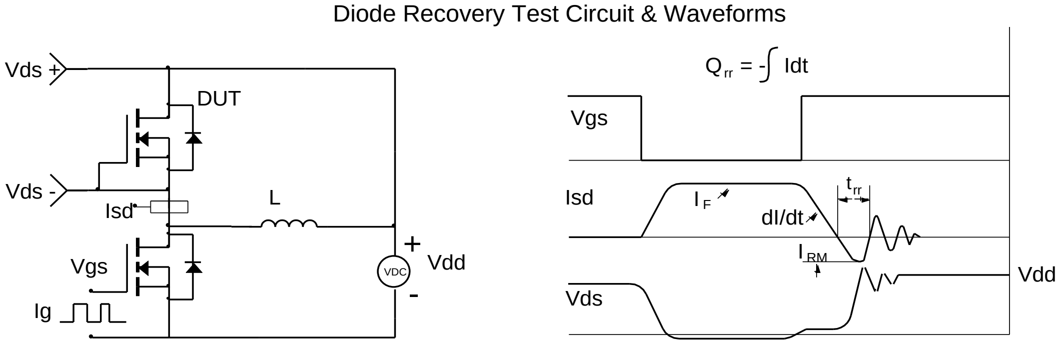
Resistive Switching Test Circuit & Waveforms



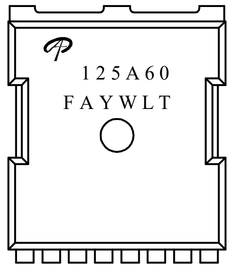
Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms



TOLL PACKAGE MARKING DESCRIPTION



Green product

NOTE:

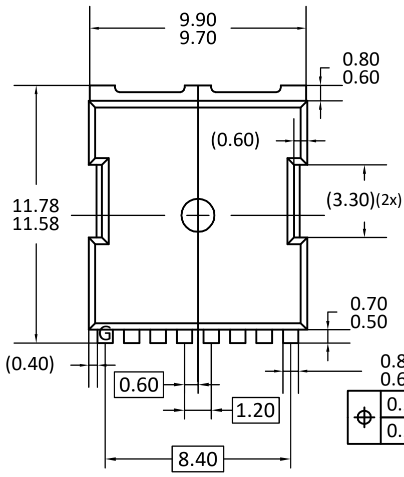
LOGO	- AOS Logo
125A60	- Part number code
F	- Fab code
A	- Assembly location code
Y	- Year code
W	- Week code
L&T	- Assembly lot code

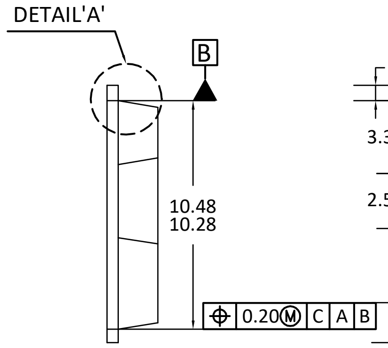
PART NO.	DESCRIPTION	CODE
AOTL125A60	Green product	125A60

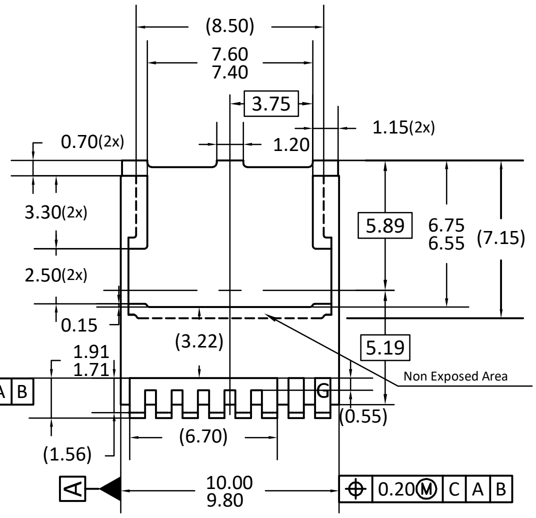
ALPHA & OMEGA
SEMICONDUCTOR

Document No.	PO-00251
Version	F

TOLL PACKAGE OUTLINE



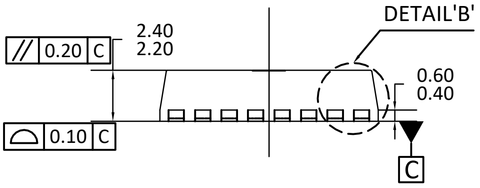




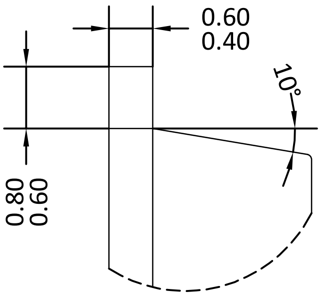
TOP VIEW

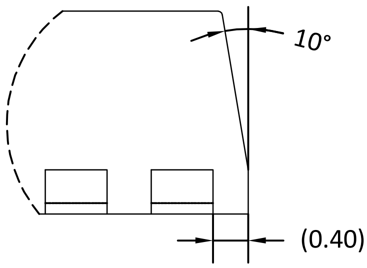
SIDE VIEW

BOTTOM VIEW



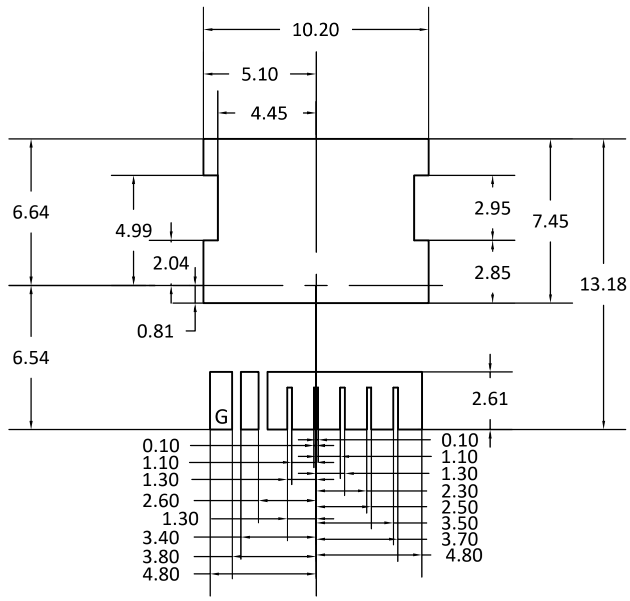
SIDE VIEW





DETAIL 'A'

DETAIL 'B'



UNIT: mm

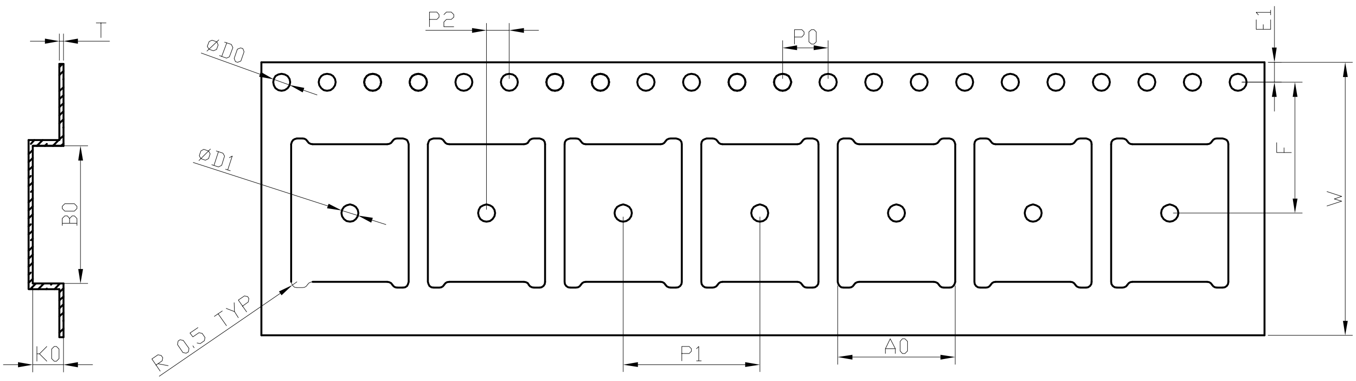
NOTE
A) PACKAGE BODY SIZES EXCLUDE MOLD FLASH AND GATE BURRS.
MOLD FLASH SHOULD BE LESS THAN 6 MIL.
B) TOLERANCE 0.100 MILLIMETERS UNLESS OTHERWISE SPECIFIED.
C) CONTROLLING DIMENSION IS MILLIMETER.
CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.
D) ( ) IS REFERENCE
E) THIS PACKAGE WAS QUALIFIED USING IR REFLOW PROCESS (JEDEC STANDARD). FOR USAGE IN OTHER SOLDERING PROCESSES, PLEASE CONTACT LOCAL AOS REPRESENTATIVES.

LAND PATTERN RECOMMENDATIONS

ALPHA & OMEGA
SEMICONDUCTOR

TOLL Tape and Reel Data

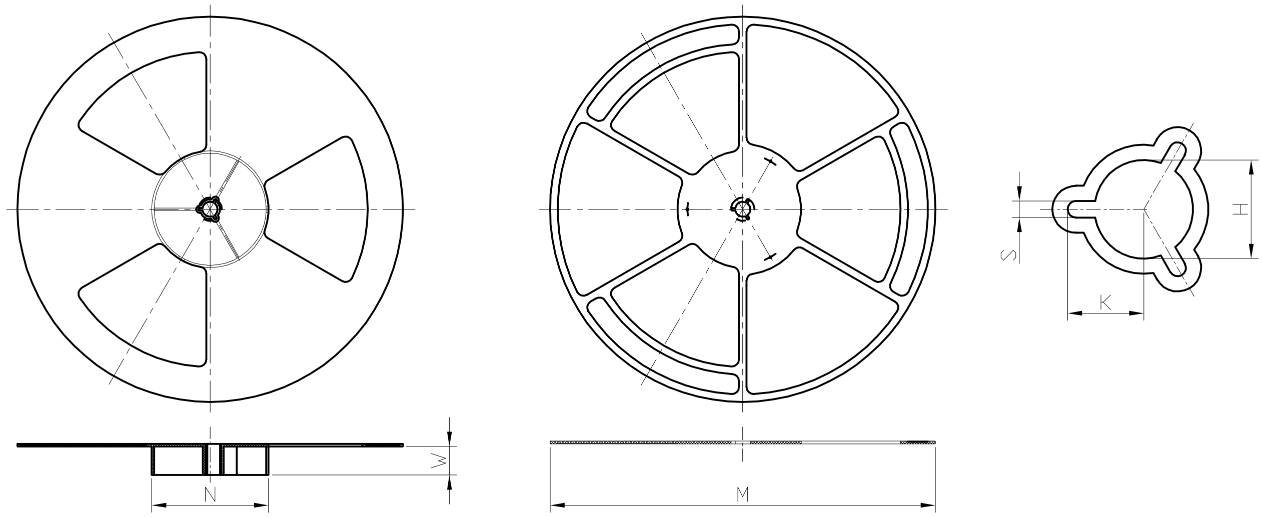
TOLL Carrier Tape



UNIT: MM

PACKAGE	A0	B0	K0	D0	D1	W	E1	F	P0	P1	P2	T
TOLL (24 MM)	10.30 ±0.10	12.10 ±0.10	2.60 ±0.10	1.50 +0.10	1.50 MIN.	24.00 ±0.30	1.75 ±0.10	11.50 ±0.10	4.00 ±0.10	12.00 ±0.10	2.00 ±0.10	0.35 ±0.04

TOLL Reel



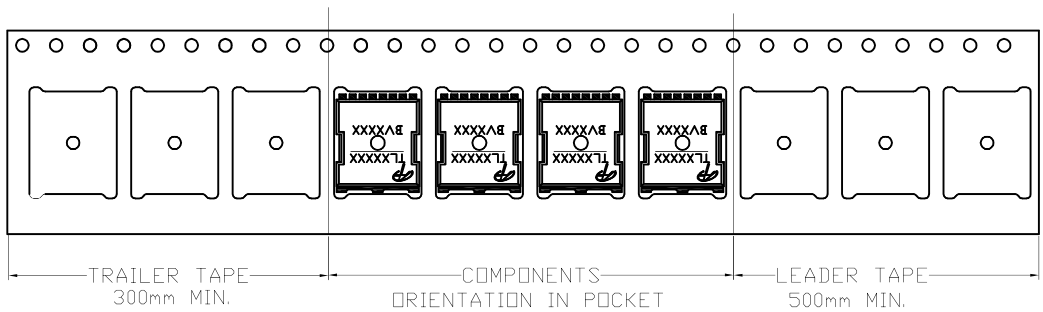
UNIT: MM

TAPE SIZE	REEL SIZE	M	N	W	H	K	S
24 mm	ø330	ø330.00 +0.25 −4.00	ø100.00 ±0.2	24.4 +2.0 −0.0	ø13.00 +0.50 −0.20	10.5 ±0.25	2.2 ±0.25

TOLL Tape

Leader / Trailer
& Orientation

Unit Per Reel:
2000pcs



Alpha & Omega Semiconductor
Product Reliability Report

AOTL125A60, rev A

Plastic Encapsulated Device

ALPHA & OMEGA Semiconductor, Inc

www.aosmd.com

Oct, 2020

ALPHA & OMEGA SEMICONDUCTOR

This AOS product reliability report summarizes the qualification result for AOTL125A60. 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 AOTL125A60 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	231 pcs	0	JESD22-A108
HTRB	Temp = 150°C , Vds=100% of Vdsmax	168 / 500 / 1000 hours	231 pcs	0	JESD22-A108
Precondition (Note A)	168hr 85°C / 85%RH + 3 cycle reflow@260°C (MSL 1)	-	1386 pcs	0	JESD22-A113
HAST	130°C , 85%RH, 33.3 psia, Vds = 80% of Vdsmax up to 42V	96 hours	231 pcs	0	JESD22-A110
H3TRB	85°C , 85%RH, Vds = 80% of Vdsmax up to 100V	1000 hours	231 pcs	0	JESD22-A101
Autoclave	121°C , 29.7psia, RH=100%	96 hours	231 pcs	0	JESD22-A102
Temperature Cycle	-55°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
IOL	∆ Tj = 100°C	15000 cycles	231 pcs	0	MIL-STD-750 Method 1037

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

II. Reliability Evaluation

FIT rate (per billion): 7.63
MTTF = 14960 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)**] =** 7.63

MTTF = 10^9 / FIT = 14960 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