ALPHA & OMEGA SEMICONDUCTOR

AO3435

20V P-Channel MOSFET

General Description

The AO3435 uses advanced trench technology to provide excellent $R_{DS(ON)}$, low gate charge and operation with gate voltages as low as 1.5V. This device is suitable for use in buck convertor applications.

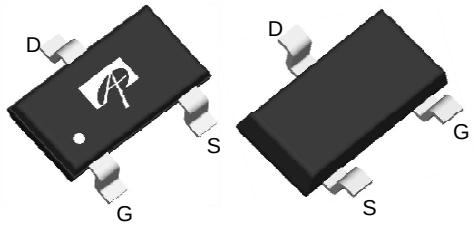
Product Summary

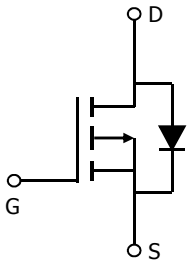
V_{DS} = -20V
I_D = -3.5A (V_{GS} = -4.5V)
$R_{DS(ON)}$ < 70mΩ (V_{GS} =- 4.5V)
$R_{DS(ON)}$ < 90mΩ (V_{GS} = -2.5V)
$R_{DS(ON)}$ < 110mΩ (V_{GS} = -1.8V)
$R_{DS(ON)}$ < 130mΩ (V_{GS} = -1.5V)

Green Product

SOT23

Top View **Bottom View**





Absolute Maximum Ratings T_A=25°C unless otherwise noted

Parameter		Symbol	10 Sec	Steady State	Units
Drain-Source Voltage		V_{DS}	-20		V
Gate-Source Voltage		V_{GS}	±8		V
Continuous Drain Current [A]	T_A=25°C	I_D	-3.5	-2.9	A
	T_A=70°C		-2.7	-2.3	
Pulsed Drain Current [B]		I_{DM}	-25		
Power Dissipation [A]	T_A=25°C	P_D	1.4	1	W
	T_A=70°C		0.9	0.6	
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]	Steady-State		100	125	°C/W
Maximum Junction-to-Lead [C]	Steady-State	$R_{\theta JL}$	63	80	°C/W

Electrical Characteristics (T_J=25℃ unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
STATIC PARAMETERS						
BV_{DSS}	Drain-Source Breakdown Voltage	I_D=-250µA, V_{GS}=0V	-20			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=-20V, V_{GS}=0V			-1	µA
		T_J=55℃			-5	
I_{GSS}	Gate-Body leakage current	V_{DS}=0V, V_{GS}=±8V			±100	nA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=V_{GS} I_D=-250µA	-0.5	-0.65	-1	V
$I_{D(ON)}$	On state drain current	V_{GS}=-4.5V, V_{DS}=-5V	-25			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS}=-4.5V, I_D=-3.5A		56	70	mΩ
		T_J=125℃		80	100	
		V_{GS}=-2.5V, I_D=-3.0A		70	90	mΩ
		V_{GS}=-1.8V, I_D=-2.0A		85	110	mΩ
		V_{GS}=-1.5V, I_D=-0.5A		100	130	mΩ
g_{FS}	Forward Transconductance	V_{DS}=-5V, I_D=-3.5A		15		S
V_{SD}	Diode Forward Voltage	I_S=-1A,V_{GS}=0V		-0.7	-1	V
I_S	Maximum Body-Diode Continuous Current				-1.4	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=-10V, f=1MHz		510	745	pF
C_{oss}	Output Capacitance			70		pF
C_{rss}	Reverse Transfer Capacitance			52		pF
R_g	Gate resistance	V_{GS}=0V, V_{DS}=0V, f=1MHz		18	23	Ω
SWITCHING PARAMETERS						
Q_g	Total Gate Charge	V_{GS}=-4.5V, V_{DS}=-10V, I_D=-3.5A		5.6	11	nC
Q_{gs}	Gate Source Charge			0.6		nC
Q_{gd}	Gate Drain Charge			1.8		nC
$t_{D(on)}$	Turn-On DelayTime	V_{GS}=-4.5V, V_{DS}=-10V, R_L=3Ω, R_{GEN}=6Ω		11		ns
t_r	Turn-On Rise Time			10		ns
$t_{D(off)}$	Turn-Off DelayTime			60		ns
t_f	Turn-Off Fall Time			30		ns
t_{rr}	Body Diode Reverse Recovery Time	I_F=-3.5A, dI/dt=100A/µs		17	49	ns
Q_{rr}	Body Diode Reverse Recovery Charge	I_F=-3.5A, dI/dt=100A/µs		4		nC

A: The value of $R_{\theta JA}$ is measured with the device mounted on 1 in^2 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. The current rating is based on the t ≤10s thermal resistance rating.
B: Repetitive rating, pulse width limited by junction temperature.
C. The $R_{\theta JA}$ is the sum of the thermal impedence from junction to lead $R_{\theta JL}$ and lead to ambient.
D. The static characteristics in Figures 1 to 6 are obtained using 300µs pulse width, duty cycle 0.5% max.
E. These tests are performed with the device mounted on 1 in^2 FR-4 board with 2oz. Copper, in a still air environment with T_A=25° C. The SOA curve provides a single pulse rating.

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

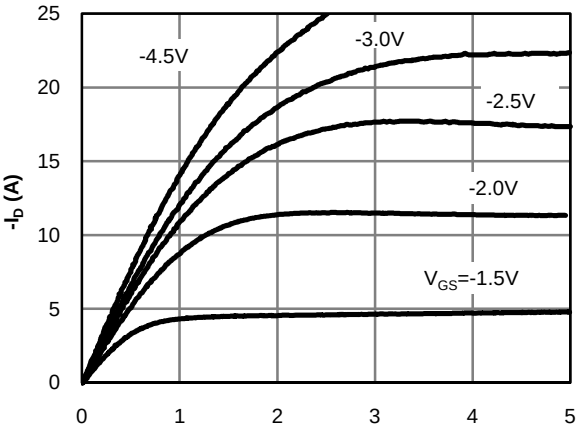


Figure 1: On-Region Characteristics

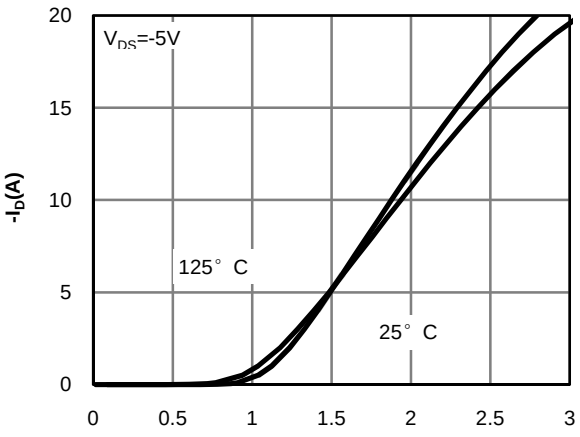


Figure 2: Transfer Characteristics

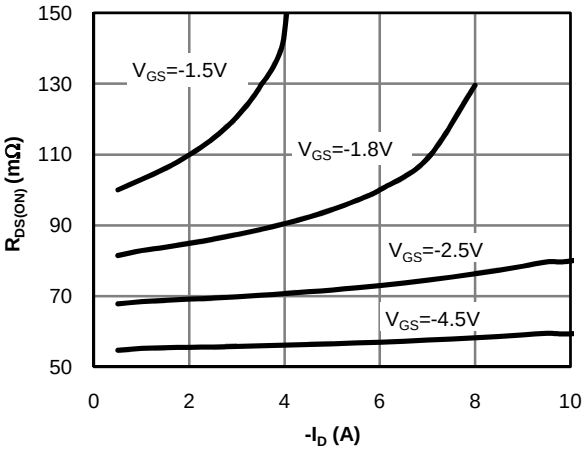


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

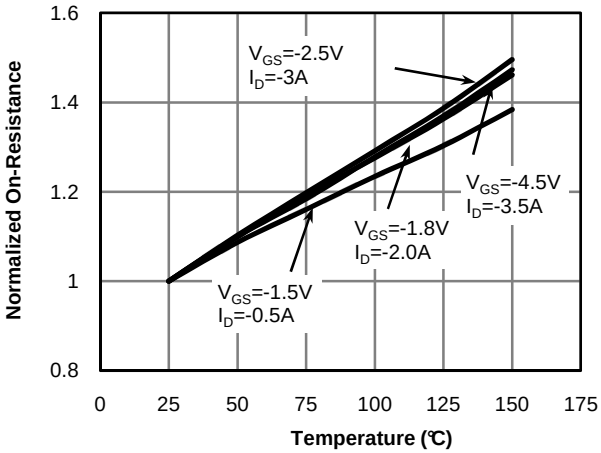


Figure 4: On-Resistance vs. Junction Temperature

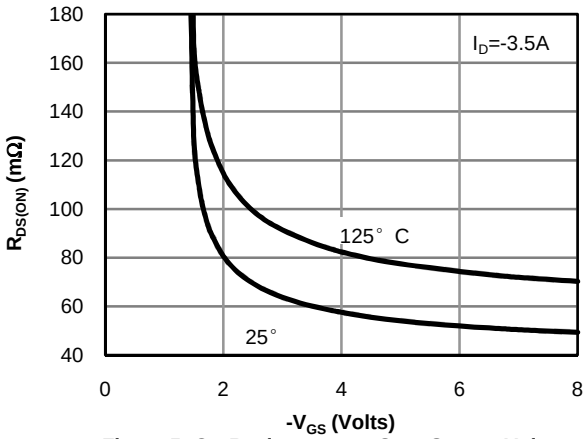


Figure 5: On-Resistance vs. Gate-Source Voltage

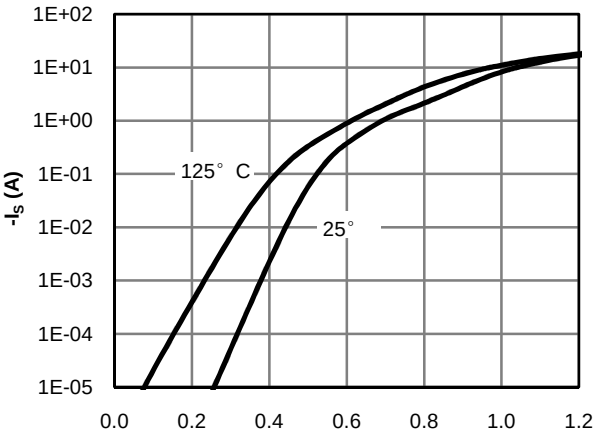


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

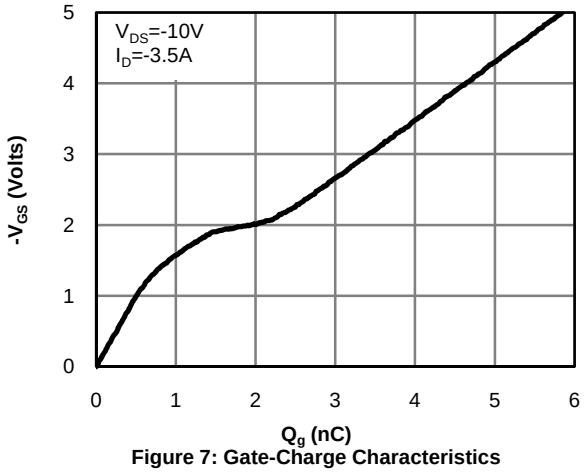


Figure 7: Gate-Charge Characteristics

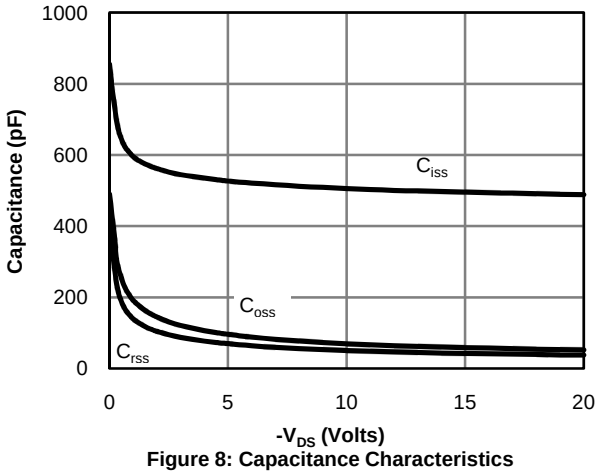


Figure 8: Capacitance Characteristics

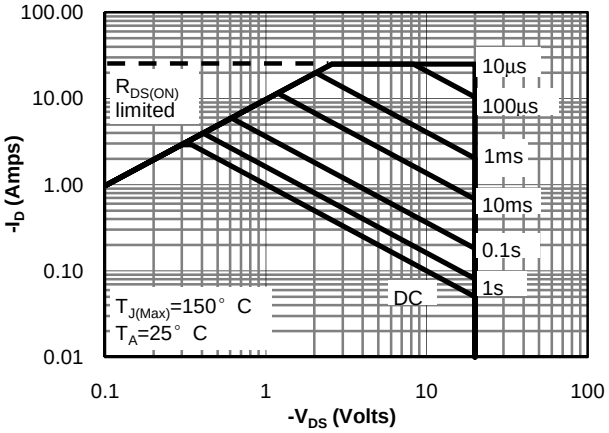


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

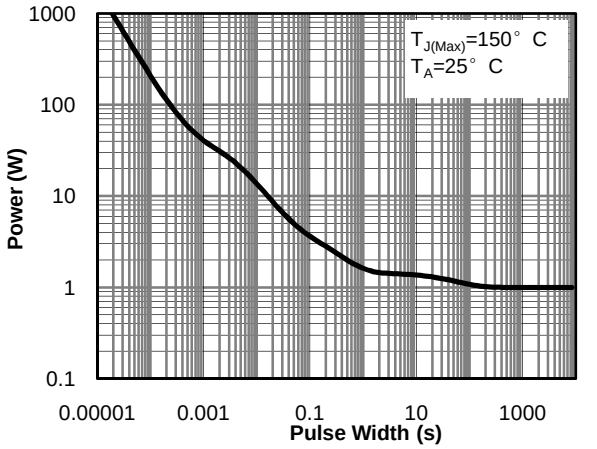


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

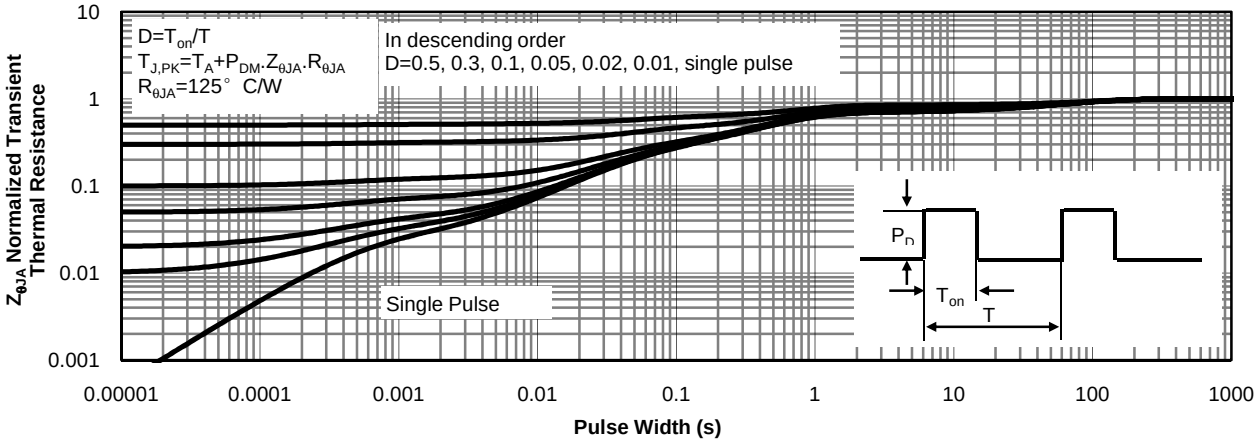
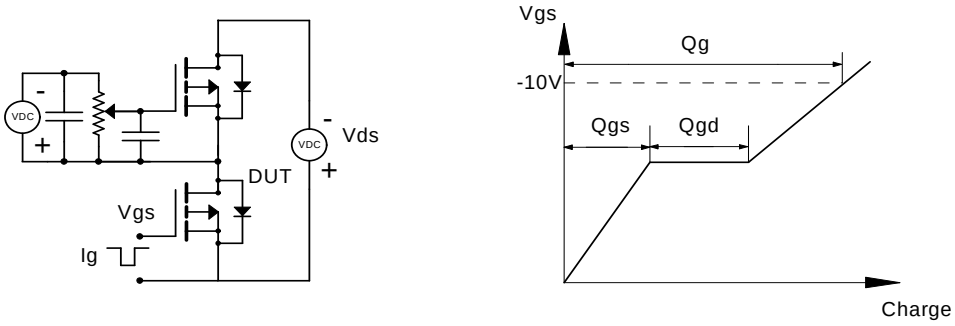
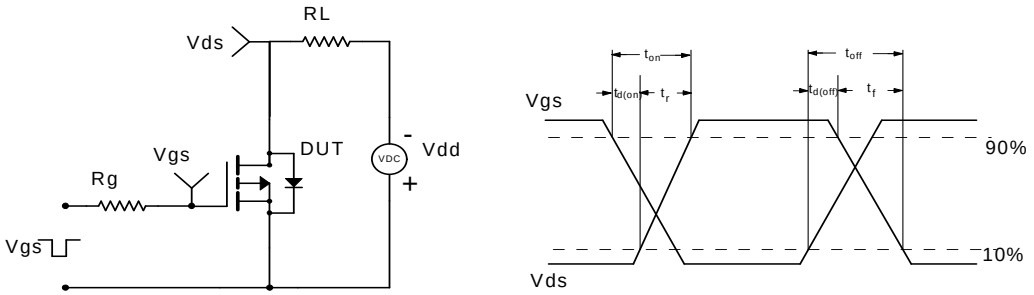


Figure 11: Normalized Maximum Transient Thermal Impedance (Note E)

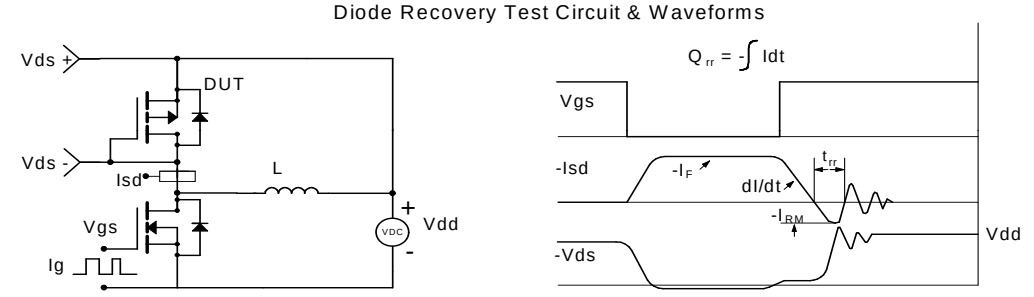
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



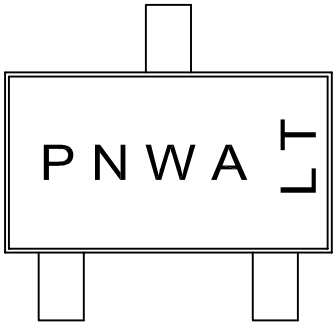
Diode Recovery Test Circuit & Waveforms



ALPHA & OMEGA SEMICONDUCTOR

Document No.	PD-00726
Version	B
Title	AO3435 Marking Description

SOT-23 PACKAGE MARKING DESCRIPTION

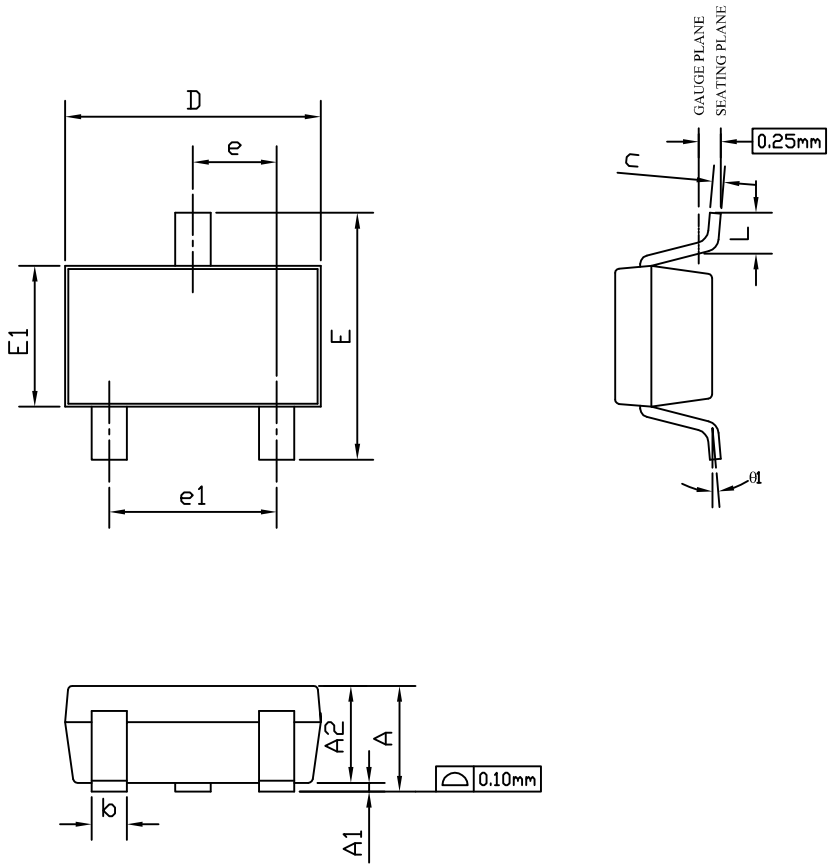


Green product

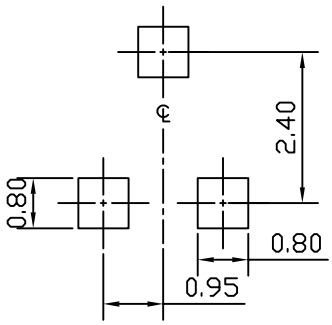
NOTE:
P - Package and product type
N - Last digital of product number
W - Week code
A - Assembly location code
L&T - Assembly lot code

PART NO.	DESCRIPTION	CODE (PN)
AO3435	Green product	B5
AO3435L	Green product	B5

SOT23 PACKAGE OUTLINE



RECOMMENDED LAND PATTERN



UNIT: mm

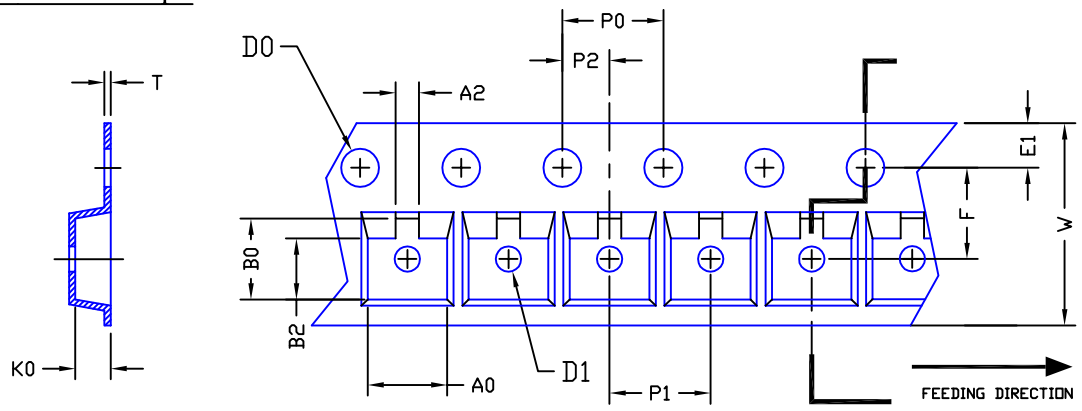
SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.85	——	1.25	0.033	——	0.049
A1	0.00	——	0.13	0.000	——	0.005
A2	0.70	1.00	1.15	0.028	0.039	0.045
b	0.30	0.40	0.50	0.012	0.016	0.020
c	0.08	0.13	0.20	0.003	0.005	0.008
D	2.80	2.90	3.10	0.110	0.114	0.122
E	2.60	2.80	3.00	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

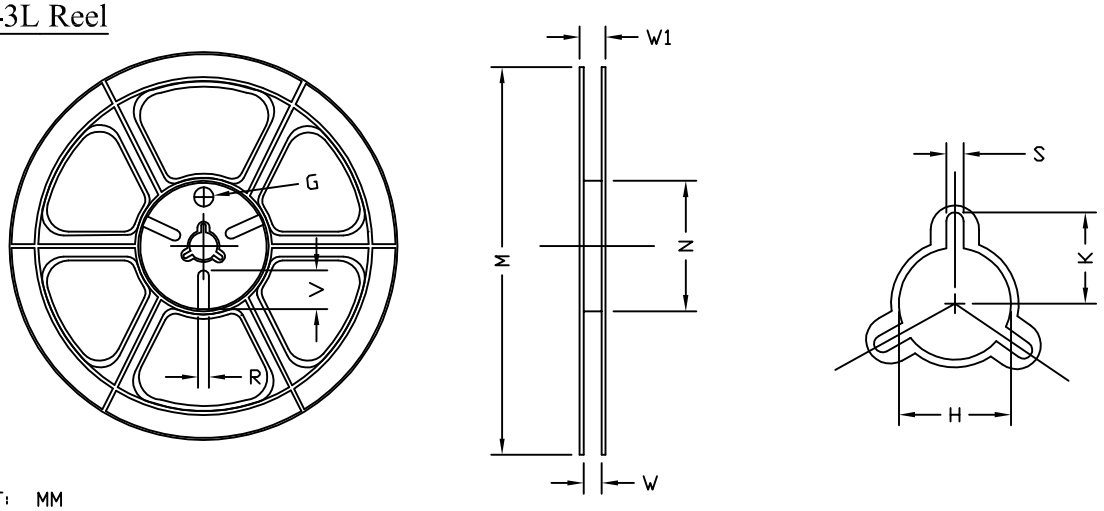
SOT23-3L Carrier Tape



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



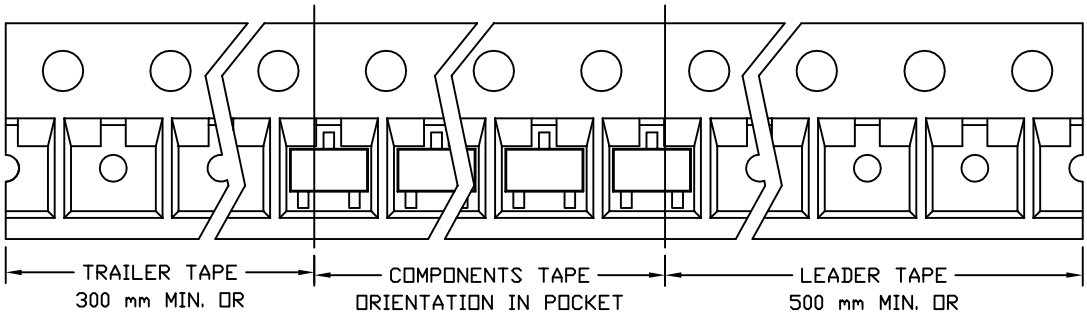
UNIT: MM

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



AOS Semiconductor
Product Reliability Report

AO3435, rev B

Plastic Encapsulated Device

ALPHA & OMEGA Semiconductor, Inc

www.aosmd.com

This AOS product reliability report summarizes the qualification result for AO3435. 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 AO3435 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.

Table of Contents:

I. Product Description:

The AO3435 uses advanced trench technology to provide excellent $R_{DS(ON)}$, low gate charge and operation with gate voltages as low as 1.5V. This device is suitable for use in buck convertor applications.

Details refer to the datasheet.

II. Die / Package Information:

	AO3435
Process	Standard sub-micron 20V P-Channel MOSFET
Package Type	SOT23
Lead Frame	Bare Cu
Die Attach	Ag Epoxy
Bond	Au wire & Cu wire
Mold Material	Epoxy resin with silica filler
Moisture Level	Up to Level 1

III. Reliability Stress Test Summary and Results

Test Item	Test Condition	Time Point	Total Sample Size*	Number of Failures	Reference Standard
MSL Precondition	168hr 85°C / 85%RH + 3 cycle reflow@260°C (MSL 1)	-	3927 pcs	0	JESD22-A113
HTGB	Temp = 150°C , Vgs=100% of Vgsmax	168 / 500 / 1000 hours	1155 pcs	0	JESD22-A108
HTRB	Temp = 150°C , Vds=80% of Vdsmax	168 / 500 / 1000 hours	1155 pcs	0	JESD22-A108
HAST	130°C , 85%RH, 33.3 psi, 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 , 29.7psi, RH=100%	96 hours	1155 pcs	0	JESD22-A102
Temperature Cycle	-65°C to 150°C , air to air,	250 / 500 / 1000 cycles	693 pcs	0	JESD22-A104
Power Cycling	Δ Tj = 100°C	15000 cycles	462 pcs	0	AEC Q101

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

IV. Reliability Evaluation

FIT rate (per billion): 2.69
MTTF = 42426 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)**] =** 2.69
MTTF = 10^9 / FIT = 42426 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