



**ALPHA & OMEGA**  
SEMICONDUCTOR, LTD

**AOD438**

**N-Channel Enhancement Mode Field Effect Transistor**



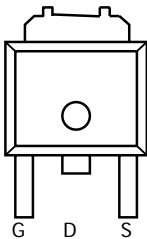
**General Description**

The AOD438 uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and low gate resistance. This device is ideally suited for use as a low side switch in CPU core power conversion. *Standard Product AOD438 is Pb-free (meets ROHS & Sony 259 specifications). AOD438L is a Green Product ordering option. AOD438 and AOD438L are electrically identical.*

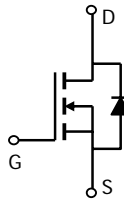
**Features**

$V_{DS}$  (V) = 30V  
 $I_D$  = 85A  
 $R_{DS(ON)} < 3.5m\Omega$  ( $V_{GS} = 10V$ )  
 $R_{DS(ON)} < 5.5m\Omega$  ( $V_{GS} = 4.5V$ )

TO-252  
D-PAK



Top View  
Drain Connected  
to Tab



**Absolute Maximum Ratings  $T_A=25^\circ C$  unless otherwise noted**

Parameter	Symbol	Maximum	Units
Drain-Source Voltage	$V_{DS}$	30	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	V
Continuous Drain Current <sup>B,G</sup>	$I_D$	$T_C=25^\circ C^G$	A
		$T_C=100^\circ C^B$	
Pulsed Drain Current	$I_{DM}$	200	
Avalanche Current <sup>C</sup>	$I_{AR}$	30	A
Repetitive avalanche energy $L=0.1mH^C$	$E_{AR}$	112	mJ
Power Dissipation <sup>B</sup>	$P_D$	$T_C=25^\circ C$	W
		$T_C=100^\circ C$	
Power Dissipation <sup>A</sup>	$P_{DSM}$	$T_A=25^\circ C$	W
		$T_A=70^\circ C$	
Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 to 175	$^\circ C$

**Thermal Characteristics**

Parameter	Symbol	Typ	Max	Units
Maximum Junction-to-Ambient <sup>A</sup>	$R_{\theta JA}$	14.2	20	$^\circ C/W$
Maximum Junction-to-Ambient <sup>A</sup>		Steady-State	39	50
Maximum Junction-to-Case <sup>C</sup>	$R_{\theta JC}$	0.8	1.5	$^\circ C/W$

Electrical Characteristics ( $T_J=25^\circ\text{C}$  unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>STATIC PARAMETERS</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$I_D=250\mu\text{A}$ , $V_{GS}=0\text{V}$	30			V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=24\text{V}$ , $V_{GS}=0\text{V}$ $T_J=55^\circ\text{C}$			1 5	$\mu\text{A}$
$I_{GSS}$	Gate-Body leakage current	$V_{DS}=0\text{V}$ , $V_{GS}=\pm 20\text{V}$			100	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}$ , $I_D=250\mu\text{A}$	1	1.8	3	V
$I_{D(ON)}$	On state drain current	$V_{GS}=10\text{V}$ , $V_{DS}=5\text{V}$	85			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS}=10\text{V}$ , $I_D=20\text{A}$ $T_J=125^\circ\text{C}$		2.8 4.4	3.5 5.5	$\text{m}\Omega$
		$V_{GS}=4.5\text{V}$ , $I_D=20\text{A}$		4.4	5.5	$\text{m}\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS}=5\text{V}$ , $I_D=20\text{A}$		106		S
$V_{SD}$	Diode Forward Voltage	$I_S=1\text{A}$ , $V_{GS}=0\text{V}$		0.72	1	V
$I_S$	Maximum Body-Diode Continuous Current				85	A
<b>DYNAMIC PARAMETERS</b>						
$C_{iss}$	Input Capacitance			3200	3840	pF
$C_{oss}$	Output Capacitance	$V_{GS}=0\text{V}$ , $V_{DS}=15\text{V}$ , $f=1\text{MHz}$		590		pF
$C_{rss}$	Reverse Transfer Capacitance			414		pF
$R_g$	Gate resistance	$V_{GS}=0\text{V}$ , $V_{DS}=0\text{V}$ , $f=1\text{MHz}$		0.54	0.7	$\Omega$
<b>SWITCHING PARAMETERS</b>						
$Q_g(10\text{V})$	Total Gate Charge			63	76	nC
$Q_g(4.5\text{V})$	Total Gate Charge	$V_{GS}=4.5\text{V}$ , $V_{DS}=15\text{V}$ , $I_D=20\text{A}$		33	40	nC
$Q_{gs}$	Gate Source Charge			8.6		nC
$Q_{gd}$	Gate Drain Charge			17.6		nC
$t_{D(on)}$	Turn-On Delay Time			12		ns
$t_r$	Turn-On Rise Time	$V_{GS}=10\text{V}$ , $V_{DS}=15\text{V}$ , $R_L=0.75\Omega$ , $R_{GEN}=3\Omega$		15.5		ns
$t_{D(off)}$	Turn-Off Delay Time			40		ns
$t_f$	Turn-Off Fall Time			14		ns
$t_{rr}$	Body Diode Reverse Recovery Time	$I_F=20\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$		34	41	ns
$Q_{rr}$	Body Diode Reverse Recovery Charge	$I_F=20\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$		30		nC

A: The value of  $R_{\theta JA}$  is measured with the device mounted on a  $1\text{in}^2$  FR-4 board with 2oz. Copper, in a still air environment with  $T_A=25^\circ\text{C}$ . The Power dissipation  $P_{DSM}$  is based on steady-state  $R_{\theta JA}$  and the maximum allowed junction temperature of  $150^\circ\text{C}$ . The value in any a given application depends on the user's specific board design, and the maximum temperature of  $175^\circ\text{C}$  may be used if the PCB or heatsink allows it.

B: The power dissipation  $P_D$  is based on  $T_{J(MAX)}=175^\circ\text{C}$ , using junction-to-case thermal resistance, and is more useful in setting the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

C: Repetitive rating, pulse width limited by junction temperature  $T_{J(MAX)}=175^\circ\text{C}$ .

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  $<300\ \mu\text{s}$  pulses, duty cycle 0.5% max.

F: These tests are performed with the device mounted on a  $1\text{in}^2$  FR-4 board with 2oz. Copper, in a still air environment with  $T_A=25^\circ\text{C}$ . The SOA curve provides a single pulse rating.

G: The maximum current rating is limited by the package current capability.

Rev 2: July 2005

THIS PRODUCT HAS BEEN DESIGNED AND QUALIFIED FOR THE CONSUMER MARKET. APPLICATIONS OR USES AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS ARE NOT AUTHORIZED. AOS DOES NOT ASSUME ANY LIABILITY ARISING OUT OF SUCH APPLICATIONS OR USES OF ITS PRODUCTS. AOS RESERVES THE RIGHT TO IMPROVE PRODUCT DESIGN, FUNCTIONS AND RELIABILITY WITHOUT NOTICE.

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

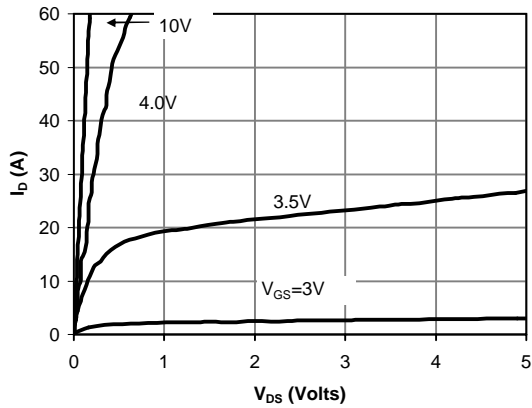


Fig 1: On-Region Characteristics

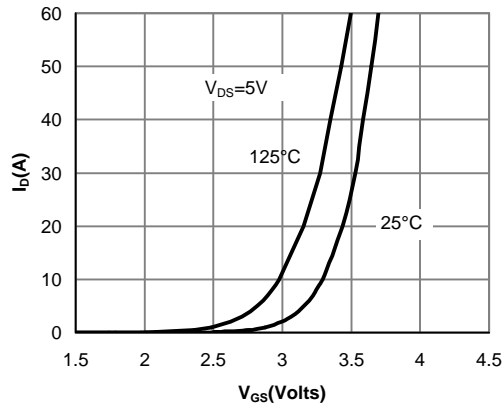


Figure 2: Transfer Characteristics

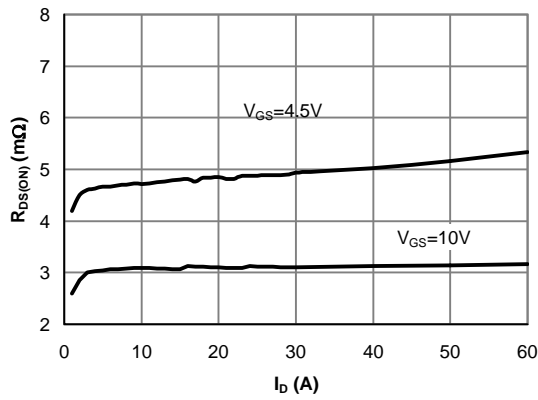


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

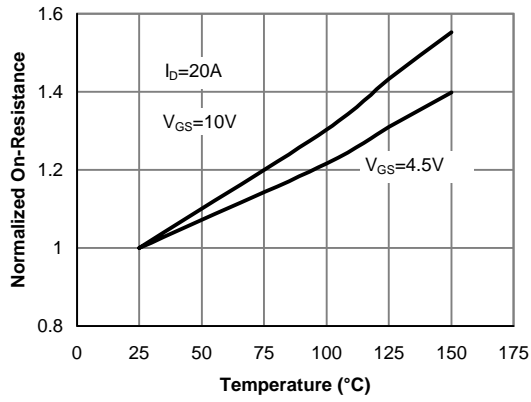


Figure 4: On-Resistance vs. Junction Temperature

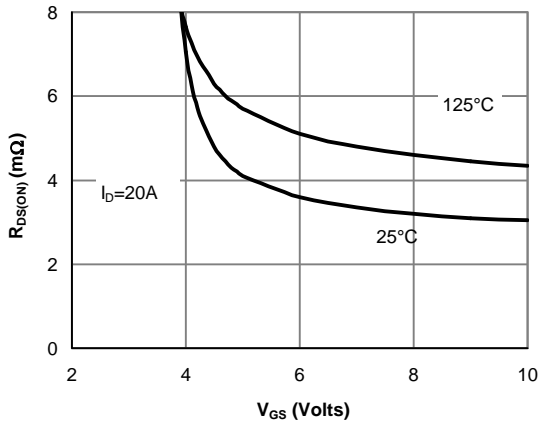


Figure 5: On-Resistance vs. Gate-Source Voltage

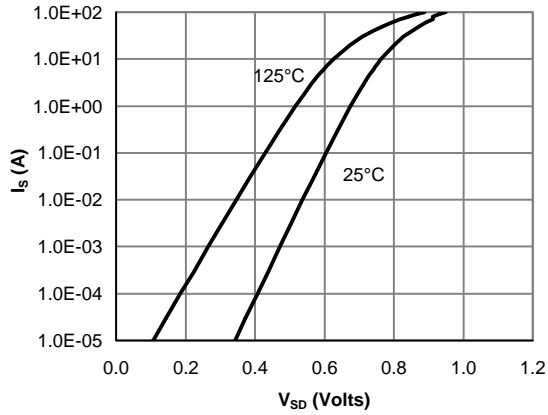


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

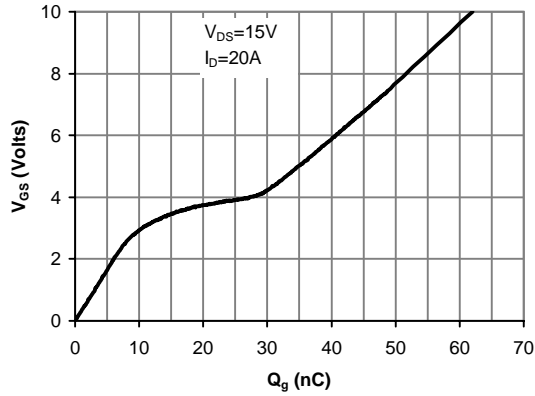


Figure 7: Gate-Charge Characteristics

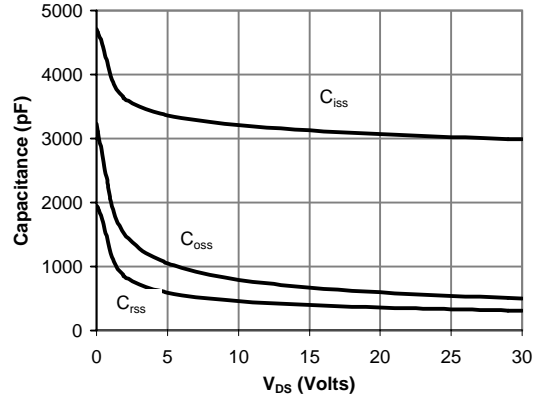


Figure 8: Capacitance Characteristics

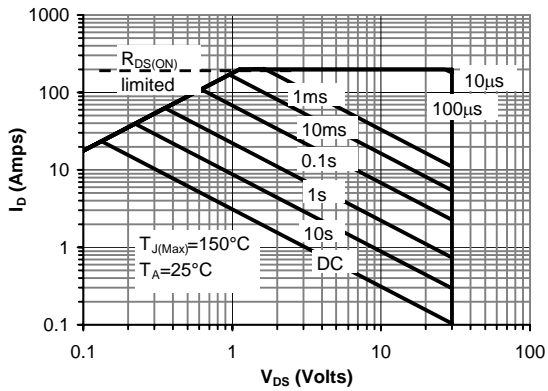


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

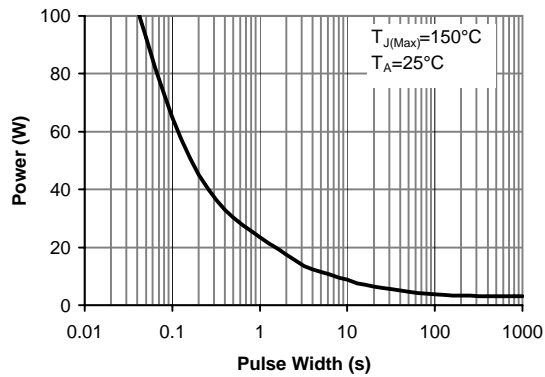


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note F)

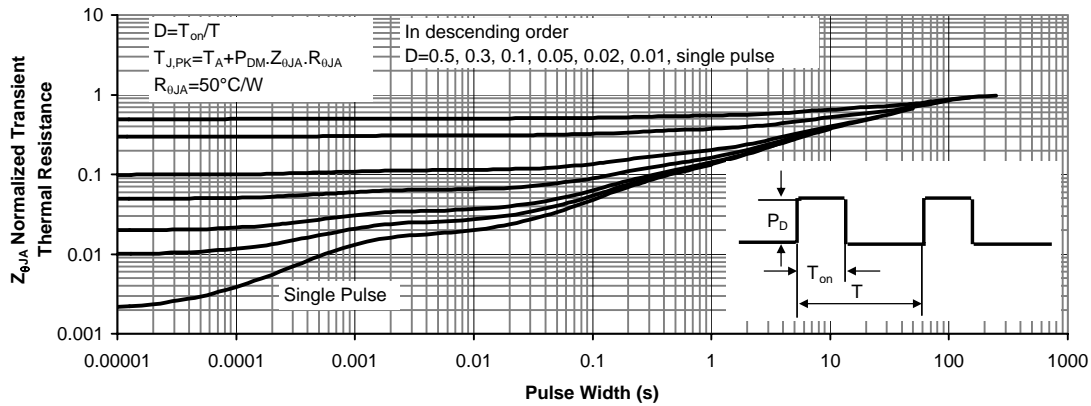


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

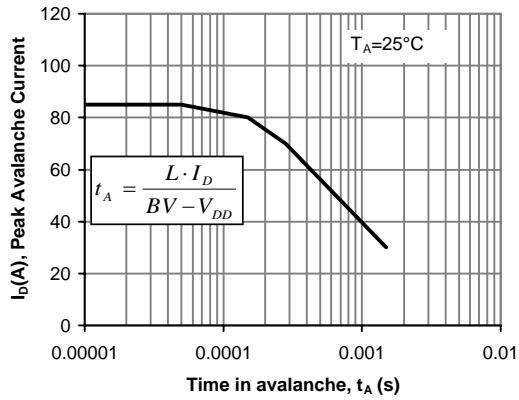


Figure 12: Single Pulse Avalanche capability

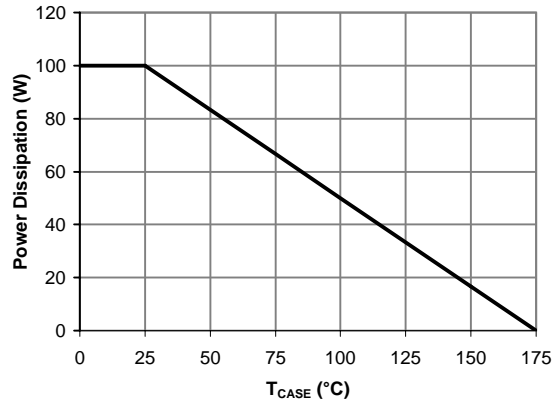


Figure 13: Power De-rating (Note B)

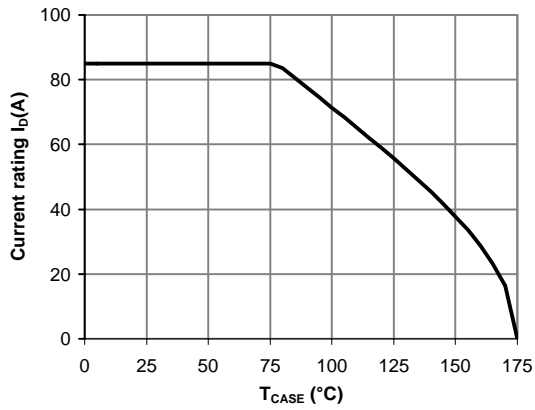
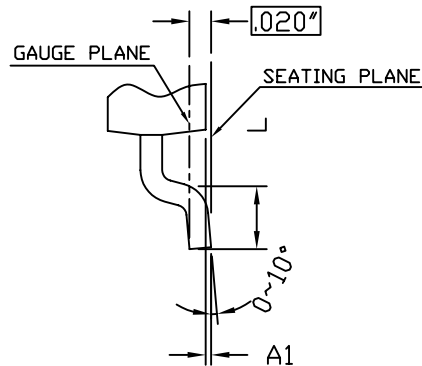
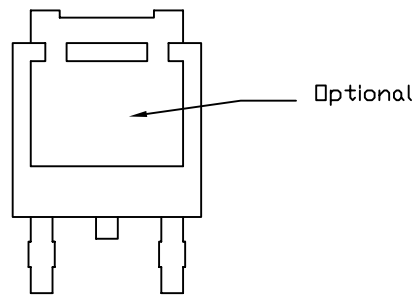
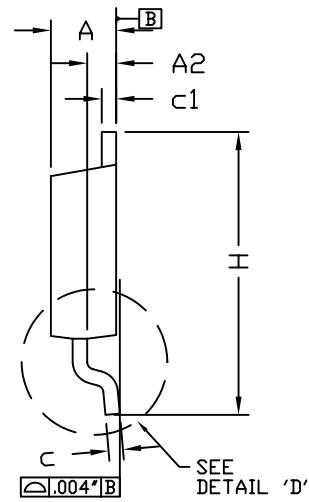
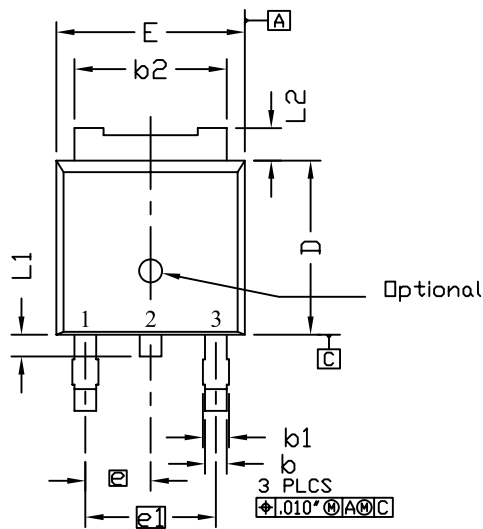


Figure 14: Current De-rating (Note B)

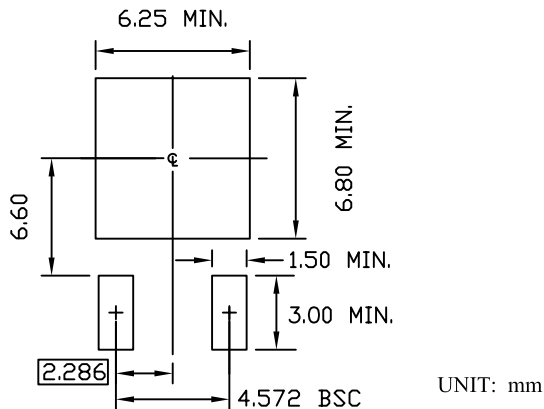


### DPAK TO-252 PACKAGE OUTLINE



**DETAIL 'D'**  
SCALE: 1.5X

#### RECOMMENDED LAND PATTERN



SYMBOL	DIMENSION IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	2.184	2.286	2.388	0.086	0.090	0.094
A1	0.000	----	0.127	0.000	----	0.005
A2	0.889	----	1.143	0.035	----	0.045
b	0.635	0.762	0.889	0.025	0.030	0.035
b1	0.762	----	1.143	0.030	----	0.045
b2	4.953	----	5.461	0.195	----	0.215
c	0.450	0.508	0.610	0.018	0.020	0.024
c1	0.450	----	0.610	0.018	----	0.024
D	5.969	6.096	6.223	0.235	0.240	0.245
E	6.350	6.604	6.731	0.250	0.260	0.265
e	2.286 BSC.			0.090 BSC.		
e1	4.572 BSC.			0.180 BSC.		
H	9.398	----	10.414	0.370	----	0.410
L	1.270	----	2.032	0.050	----	0.080
L1	0.635	----	1.016	0.025	----	0.040
L2	0.889	----	1.270	0.035	----	0.050

**NOTE**

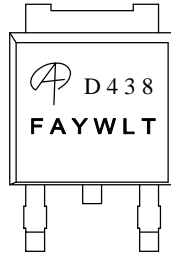
1. PACKAGE BODY SIZES EXCLUDE MOLD FLASH AND GATE BURRS. MOLD FLASH SHOULD BE LESS THAN 6 MILS.
2. DIMENSION L IS MEASURED IN GAGE PLANE
3. TOLERANCE 0.10 mm UNLESS OTHERWISE SPECIFIED
4. CONTROLLING DIMENSION IS MILLIMETER. CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.
5. REFER TO JEDEC TO-252 (AA)



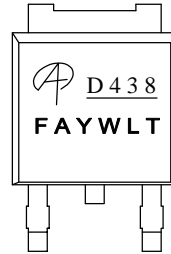
**ALPHA & OMEGA**  
SEMICONDUCTOR, LTD.

Document No.	PD-00149
Version	rev D
Title	AOD438 Marking Description

DPAK PACKAGE MARKING DESCRIPTION



Standard product



Green product

NOTE:  
LOGO - AOS LOGO  
D438 - PART NUMBER CODE.  
F&A - FOUNDRY AND ASSEMBLY LOCATION  
Y - YEAR CODE  
W - WEEK CODE.  
L T - ASSEMBLY LOT CODE

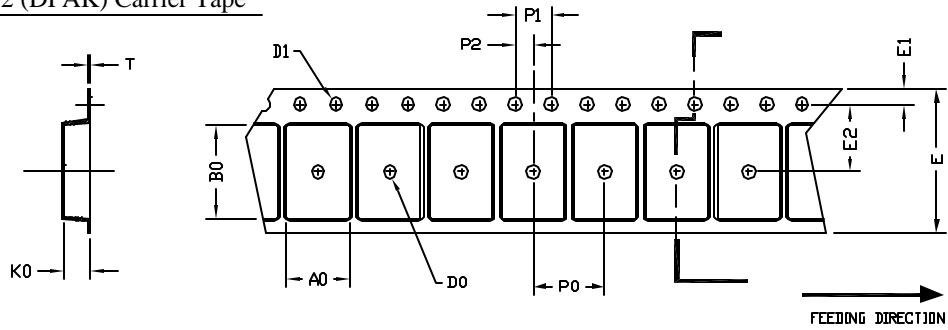
PART NO.	DESCRIPTION	CODE
AOD438	Standard product	D438
AOD438L	Green product	<u>D438</u>



**ALPHA & OMEGA**  
SEMICONDUCTOR, LTD.

**TO-252 (DPAK)**  
Tape and Reel Data

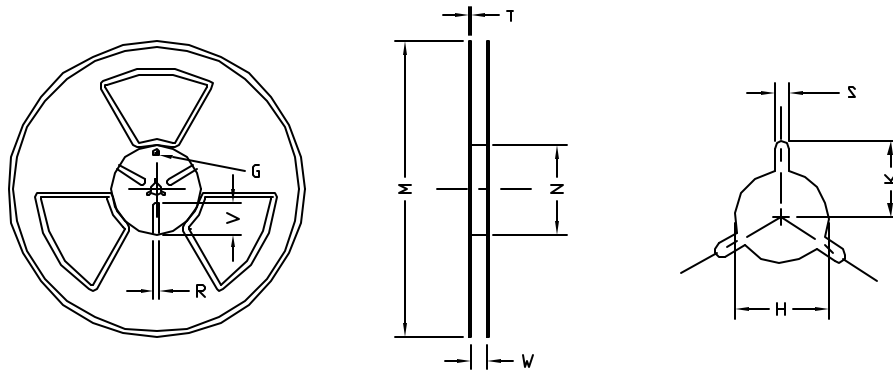
TO-252 (DPAK) Carrier Tape



UNIT: MM

PACKAGE	A0	B0	K0	D0	D1	E	E1	E2	P0	P1	P2	T
TO-252(DPAK) (16 mm)	6.90 ±0.10	10.50 ±0.10	2.70 ±0.10	1.50 ±0.10	1.50 MIN.	16.00 ±0.10	1.75 ±0.10	7.50 ±0.10	8.00 ±0.10	4.00 ±0.10	2.00 ±0.10	0.30 ±0.05

TO-252 (DPAK) Reel



UNIT: MM

TAPE SIZE	REEL SIZE	M	N	W	T	H	K	S	G	R	V
16 mm	φ330	φ330.00 ±0.10	φ99.50 ±0.10	17.50 ±0.50	2.30	φ13.50 ±0.10	10.60	2.50 ±0.10	---	---	---

TO-252 (DPAK)

Leader / Trailer  
& Orientation

