ALPHA & OMEGA SEMICONDUCTOR, LTD.

Mar. 2005

AOD413, AOD413L (Lead-Free)
P-Channel Enhancement Mode Field Effect Transistor

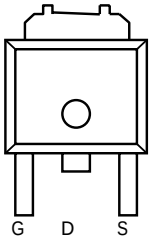
General Description

The AOD413 uses advanced trench technology to provide excellent $R_{DS(ON)}$, low gate charge and low gate resistance. With the excellent thermal resistance of the DPAK package, this device is well suited for high current load applications. AOD413L is offered in a lead-free package.

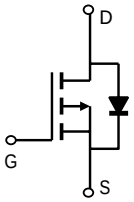
Features

V_{DS} (V) = -40V
I_D = -12A
$R_{DS(ON)}$ < 45mΩ (V_{GS} = -10V)
$R_{DS(ON)}$ < 63mΩ (V_{GS} = -4.5V)

TO-252
D-PAK



Top View
Drain Connected to Tab



Absolute Maximum Ratings T_A=25°C unless otherwise noted

Parameter		Symbol	Maximum	Units
Drain-Source Voltage		V_{DS}	-40	V
Gate-Source Voltage		V_{GS}	±20	V
Continuous Drain Current [B,G]	T_A=25°C [G]	I_D	-12	A
	T_A=100°C [G]		-12	
Pulsed Drain Current		I_{DM}	-30	
Avalanche Current [C]		I_{AR}	-12	A
Repetitive avalanche energy L=0.1mH [C]		E_{AR}	30	mJ
Power Dissipation [B]	T_C=25°C	P_D	50	W
	T_C=100°C		25	
Power Dissipation [A]	T_A=25°C	P_{DSM}	2.5	W
	T_A=70°C		1.6	
Junction and Storage Temperature Range		T_J, T_{STG}	-55 to 175	°C

Thermal Characteristics

Parameter		Symbol	Typ	Max	Units
Maximum Junction-to-Ambient [A]	t ≤ 10s	$R_{\theta JA}$	16.7	25	°C/W
Maximum Junction-to-Ambient [A]	Steady-State		40	50	°C/W
Maximum Junction-to-Case [C]	Steady-State	$R_{\theta JL}$	2.5	3	°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	-40			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=-32V, V_{GS}=0V			-1	µA
		T_J=55°C			-5	
I_{GSS}	Gate-Body leakage current	V_{DS}=0V, V_{GS}=±20V			±100	nA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=V_{GS} I_D=-250µA	-1	-1.8	-3	V
$I_{D(ON)}$	On state drain current	V_{GS}=-10V, V_{DS}=-5V	-30			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS}=-10V, I_D=-12A		36	45	mΩ
		T_J=125°C		56	70	
		V_{GS}=-4.5V, I_D=-8A		51	63	mΩ
g_{FS}	Forward Transconductance	V_{DS}=-5V, I_D=-12A		16		S
V_{SD}	Diode Forward Voltage	I_S=-1A,V_{GS}=0V		-0.75	-1	V
I_S	Maximum Body-Diode Continuous Current				-12	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=-20V, f=1MHz		657		pF
C_{oss}	Output Capacitance			143		pF
C_{rss}	Reverse Transfer Capacitance			63		pF
R_g	Gate resistance	V_{GS}=0V, V_{DS}=0V, f=1MHz		6.5		Ω
SWITCHING PARAMETERS						
Q_g(10V)	Total Gate Charge (10V)	V_{GS}=-10V, V_{DS}=-20V, I_D=-12A		14.1		nC
Q_g(4.5V)	Total Gate Charge (4.5V)			7		nC
Q_{gs}	Gate Source Charge			2.2		nC
Q_{gd}	Gate Drain Charge			4.1		nC
$t_{D(on)}$	Turn-On DelayTime	V_{GS}=-10V, V_{DS}=-20V, R_L=1.7Ω, R_{GEN}=3Ω		8		ns
t_r	Turn-On Rise Time			12.2		ns
$t_{D(off)}$	Turn-Off DelayTime			24		ns
t_f	Turn-Off Fall Time			12.5		ns
t_{rr}	Body Diode Reverse Recovery Time	I_F=-12A, dI/dt=100A/µs		23.2		ns
Q_{rr}	Body Diode Reverse Recovery Charge	I_F=-12A, dI/dt=100A/µs		18.2		nC

A: The value of R qJA is measured with the device mounted on 1in 2 FR-4 board with 2oz. Copper, in a still air environment with T A =25°C. The Power dissipation PDSM is based on R qJA and the maximum allowed junction temperature of 150°C. The value in any a given application depends on the user's specific board design, and the maximum temperature fo 175°C may be used if the PCB allows it.
B. The power dissipation PD is based on TJ(MAX)=175°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 TJ(MAX)=175°C.
D. The R qJA is the sum of the thermal impedence from junction to case R qJC 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 impedence which is measured with the device mounted to a large heatsink, assuming a maximum junction temperature of TJ(MAX)=175°C.
G. The maximum current rating is limited by bond-wires.
H. These tests are performed with the device mounted on 1 in 2 FR-4 board with 2oz. Copper, in a still air environment with TA=25°C. The SOA curve provides a single pulse rating.

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

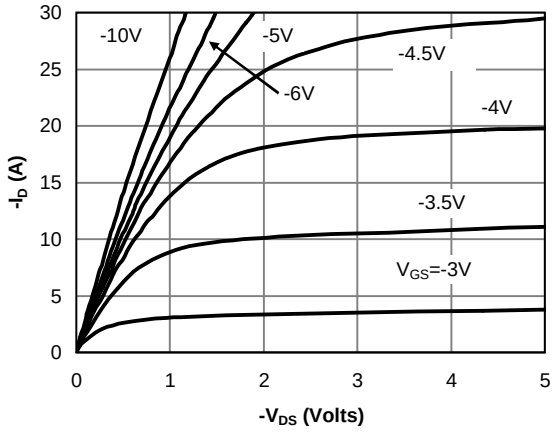


Fig 1: On-Region Characteristics

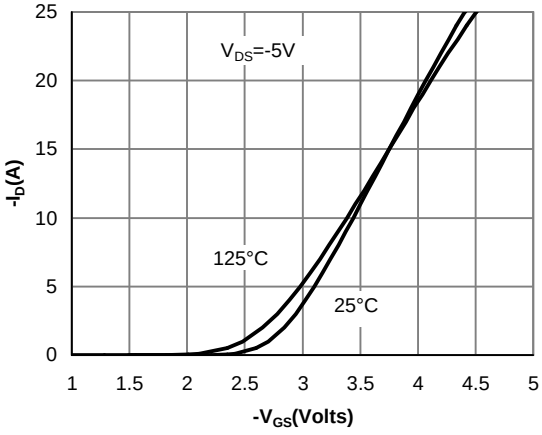


Figure 2: Transfer Characteristics

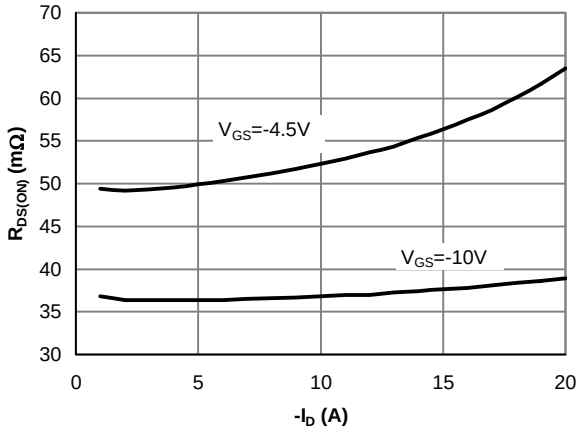


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

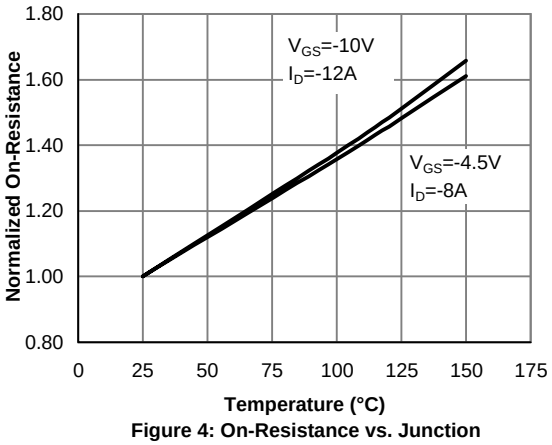


Figure 4: On-Resistance vs. Junction Temperature

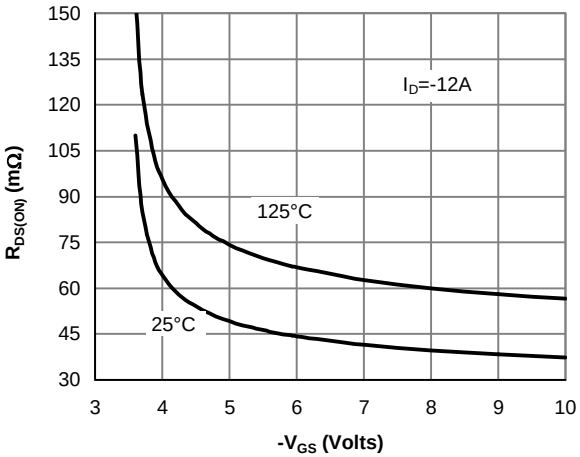


Figure 5: On-Resistance vs. Gate-Source Voltage

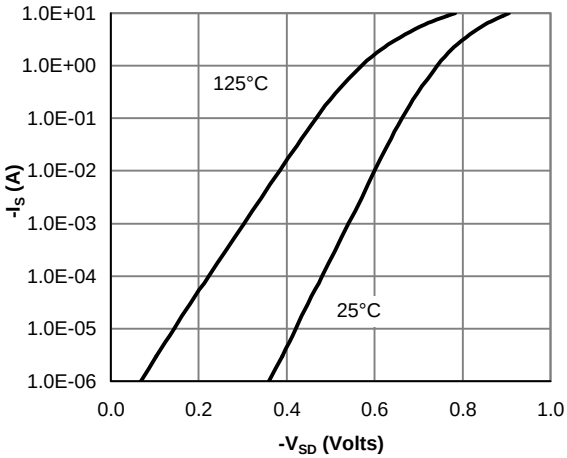


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

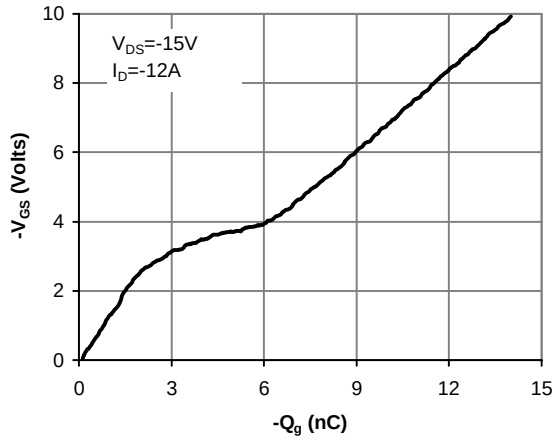


Figure 7: Gate-Charge Characteristics

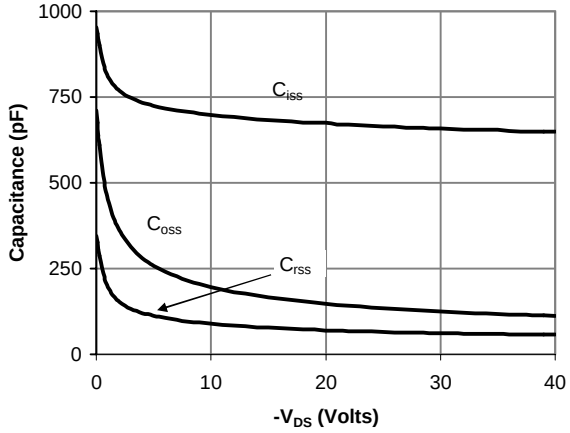


Figure 8: Capacitance Characteristics

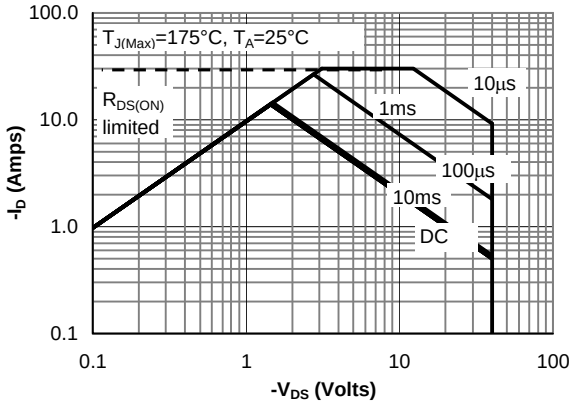


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

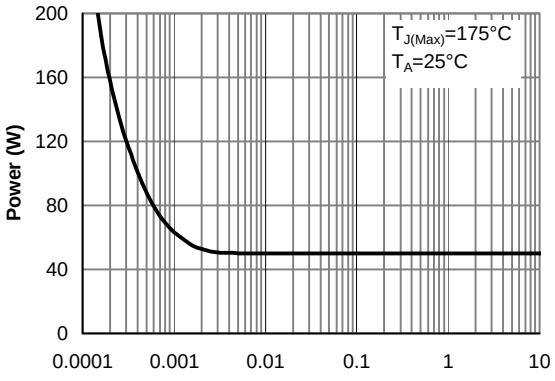


Figure 10: Single Pulse Power Rating Junction-to-Case (Note F)

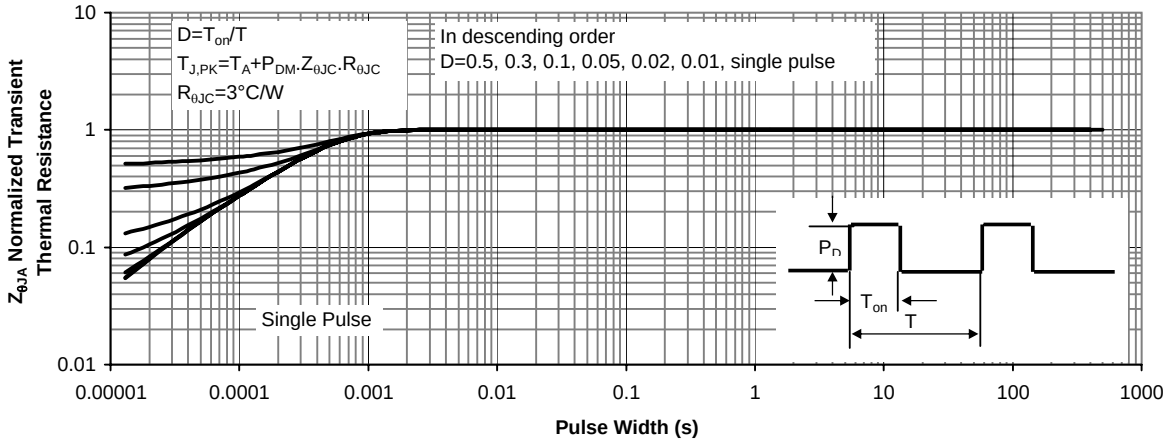


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

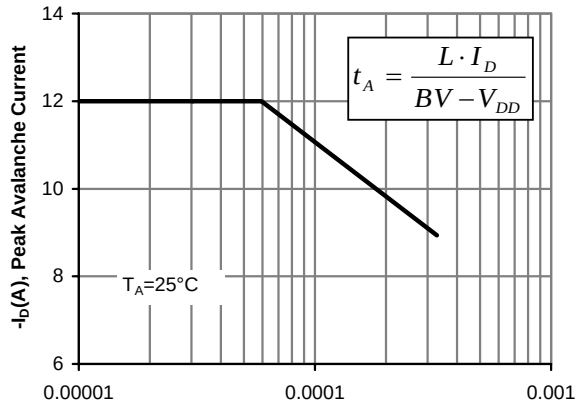


Figure 12: Single Pulse Avalanche capability

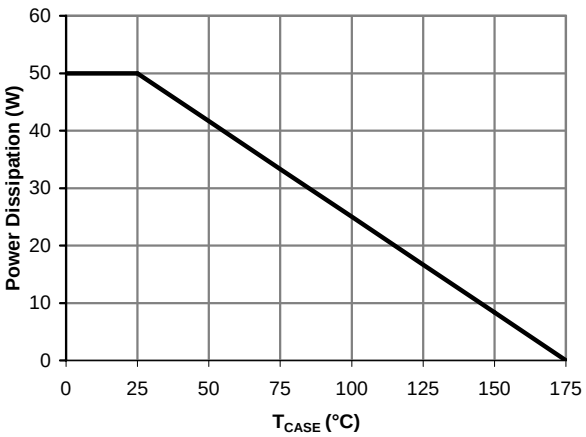


Figure 13: Power De-rating (Note B)

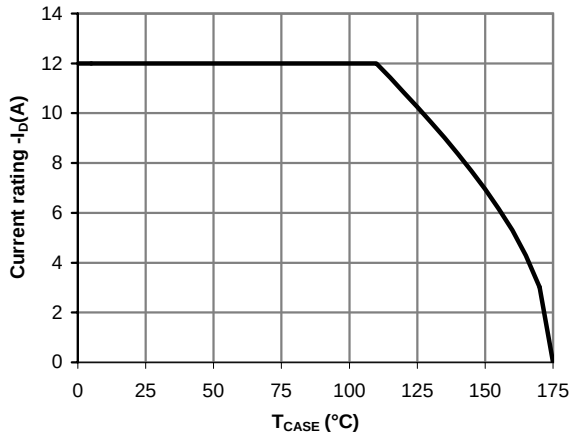


Figure 14: Current De-rating (Note B)

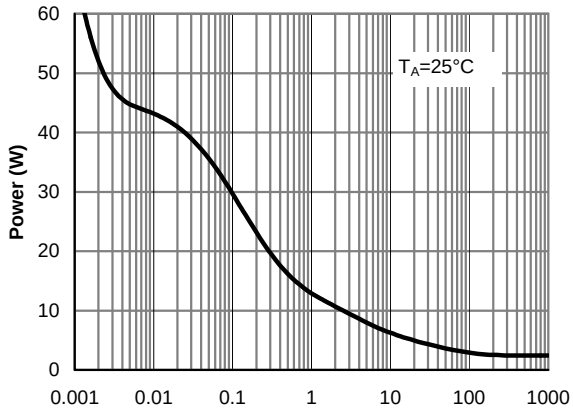


Figure 15: Single Pulse Power Rating Junction-to-Ambient (Note H)

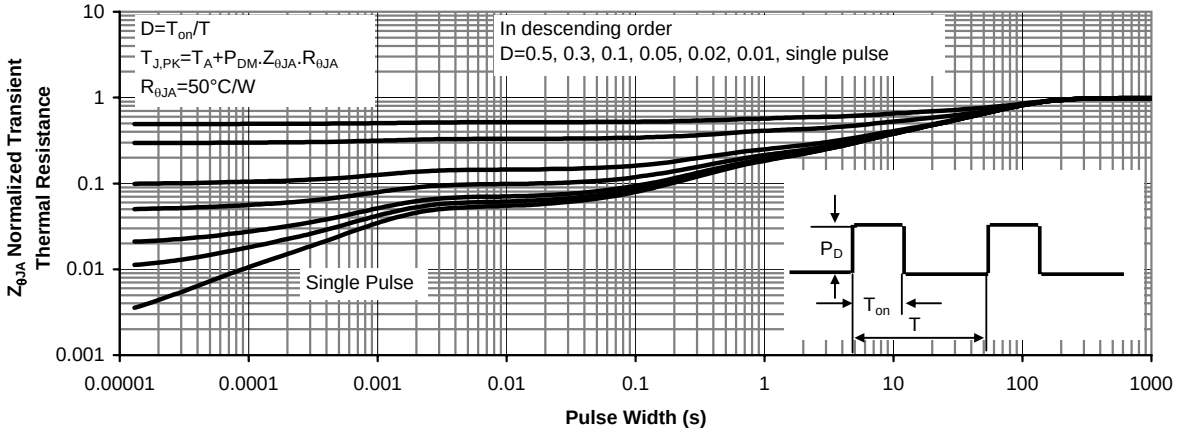


Figure 16: Normalized Maximum Transient Thermal Impedance (Note H)

Document No.	PD-00301
Version	rev B
Title	AOD413 Marking Description

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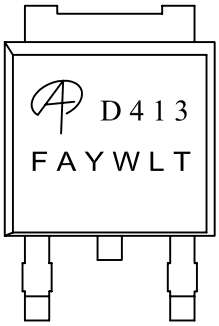
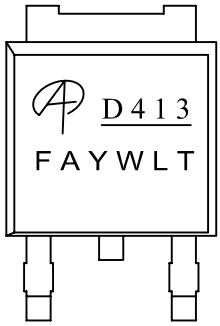
DPAK PACKAGE MARKING DESCRIPTION



Standard product



Green product

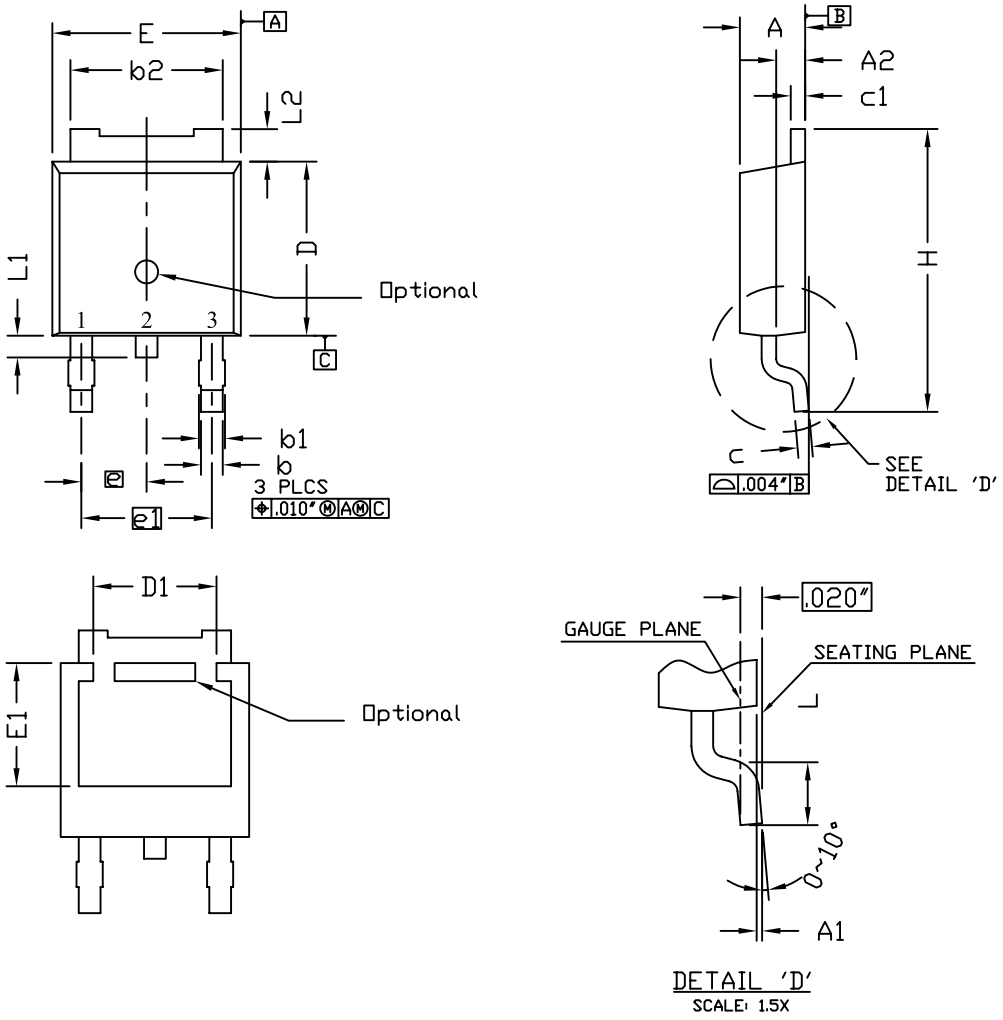
NOTE:
LOGO - AOS logo
D413 - Part number code
F&A - Assembly location
Y - Year code
W - Week code
L&T - Assembly lot code

PART NO.	DESCRIPTION	CODE
AOD413	Standard product	D413
AOD413L	Green product	D413

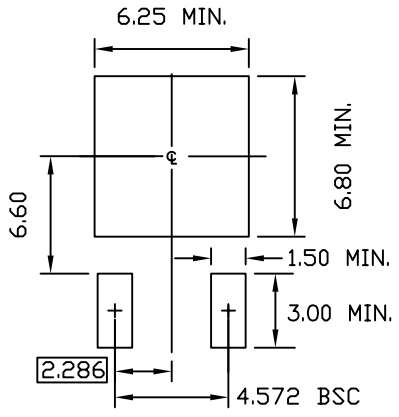
ALPHA & OMEGA
SEMICONDUCTOR, LTD.

Document No.	PD-00009
Version	rev E

DPAK TO-252 PACKAGE OUTLINE



RECOMMENDED LAND PATTERN



UNIT: mm

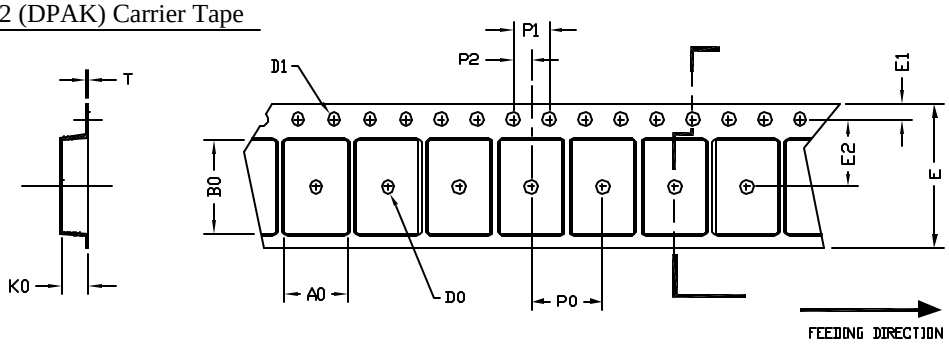
SYMBOL	DIMENSION IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	2.235	2.286	2.388	0.088	0.090	0.094
A1	0.000	----	0.102	0.000	----	0.004
A2	0.889	----	1.143	0.035	----	0.045
b	0.686	0.762	0.889	0.027	0.030	0.035
b1	0.889	----	1.143	0.035	----	0.045
b2	5.207	----	5.461	0.205	----	0.215
c	0.457	0.508	0.559	0.018	0.020	0.022
c1	0.483	----	0.584	0.019	----	0.023
D	5.969	6.096	6.223	0.235	0.240	0.245
D1	4.318	----	5.334	0.170	----	0.210
E	6.477	6.604	6.731	0.255	0.260	0.265
E1	4.318	----	----	0.170	----	----
e	2.286 BSC.			0.090 BSC.		
e1	4.572 BSC.			0.180 BSC.		
H	9.779	----	10.414	0.385	----	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.

TO-252 (DPAK)
Tape and Reel Data

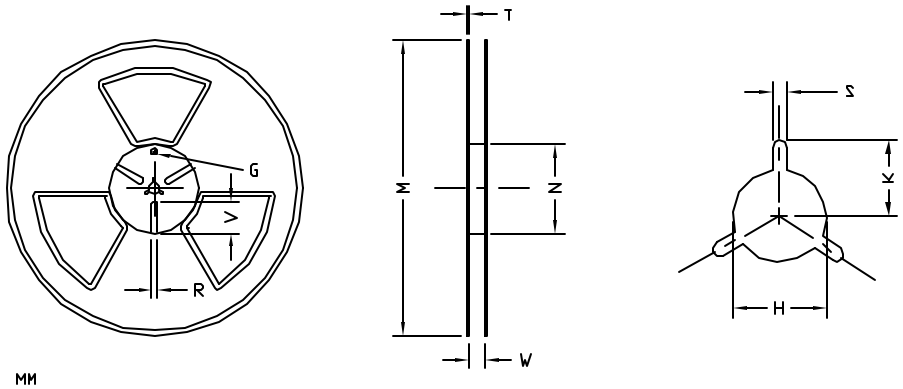
TO-252 (DPAK) Carrier Tape



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	ø330	ø330.00 ±0.10	ø99.50 ±0.10	17.50 ±0.50	2.30	ø13.50 ±0.10	10.60	2.50 ±0.10	---	---	---

TO-252 (DPAK)

Leader / Trailer & Orientation