ALPHA & OMEGA SEMICONDUCTOR, LTD.

Rev 3: Aug 2004

# AOD407, AOD407L (Green Product)
# P-Channel Enhancement Mode Field Effect Transistor

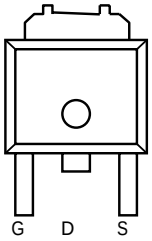
## General Description

The AOD407 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. AOD407L (Green Product) is offered in a lead-free package.

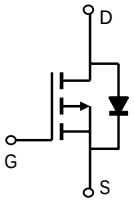
## Features

$V_{DS}$ (V) = -60V
$I_D$ = -12A
$R_{DS(ON)}$ < 115mΩ ($V_{GS}$ = -10V)
$R_{DS(ON)}$ < 150mΩ ($V_{GS}$ = -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 | | $V_{DS}$ | -60 | V |
| Gate-Source Voltage | | $V_{GS}$ | ±20 | V |
| Continuous Drain Current [G] | $T_C$=25°C | $I_D$ | -12 | A |
| | $T_C$=100°C | | -12 | |
| Pulsed Drain Current [C] | | $I_{DM}$ | -30 | |
| Avalanche Current [C] | | $I_{AR}$ | -12 | A |
| Repetitive avalanche energy L=0.1mH [C] | | $E_{AR}$ | 23 | mJ |
| Power Dissipation [B] | $T_C$=25°C | $P_D$ | 60 | W |
| | $T_C$=100°C | | 30 | |
| 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 [B] | Steady-State | $R_{\theta JC}$ | 1.9 | 2.5 | °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 | -60 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=-48V, $V_{GS}$=0V | | -0.003 | -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 | -1.5 | -2.1 | -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 | | 91 | 115 | mΩ |
| | | $T_J$=125°C | | 150 | | |
| | | $V_{GS}$=-4.5V, $I_D$=-8A | | 114 | 150 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$=-5V, $I_D$=-12A | | 12.8 | | S |
| $V_{SD}$ | Diode Forward Voltage | $I_S$=-1A,$V_{GS}$=0V | | -0.76 | -1 | V |
| $I_S$ | Maximum Body-Diode Continuous Current | | | | -12 | A |
| **DYNAMIC PARAMETERS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=-30V, f=1MHz | | 987 | 1184 | pF |
| $C_{oss}$ | Output Capacitance | | | 114 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 46 | | pF |
| $R_g$ | Gate resistance | $V_{GS}$=0V, $V_{DS}$=0V, f=1MHz | | 7 | 10 | Ω |
| **SWITCHING PARAMETERS** | | | | | | |
| $Q_g$(10V) | Total Gate Charge (10V) | $V_{GS}$=-10V, $V_{DS}$=-30V, $I_D$=-12A | | 15.8 | 20 | nC |
| $Q_g$(4.5V) | Total Gate Charge (4.5V) | | | 7.4 | 9 | nC |
| $Q_{gs}$ | Gate Source Charge | | | 3 | | nC |
| $Q_{gd}$ | Gate Drain Charge | | | 3.5 | | nC |
| $t_{D(on)}$ | Turn-On DelayTime | $V_{GS}$=-10V, $V_{DS}$=-30V, $R_L$=2.5Ω, $R_{GEN}$=3Ω | | 9 | | ns |
| $t_r$ | Turn-On Rise Time | | | 10 | | ns |
| $t_{D(off)}$ | Turn-Off DelayTime | | | 25 | | ns |
| $t_f$ | Turn-Off Fall Time | | | 11 | | ns |
| $t_{rr}$ | Body Diode Reverse Recovery Time | $I_F$=-12A, dI/dt=100A/µs | | 27.5 | 35 | ns |
| $Q_{rr}$ | Body Diode Reverse Recovery Charge | $I_F$=-12A, dI/dt=100A/µs | | 30 | | 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

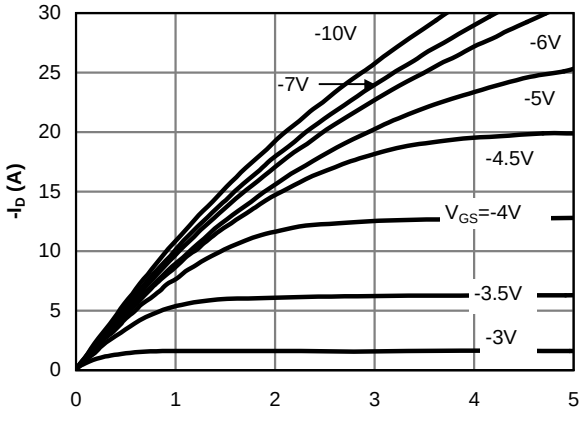



**Fig 1: On-Region Characteristics**

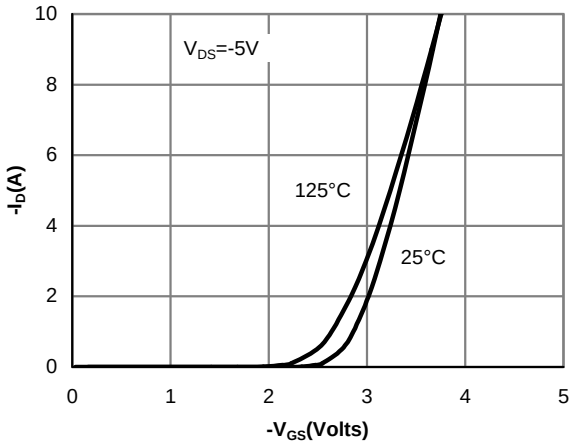



**Figure 2: Transfer Characteristics**

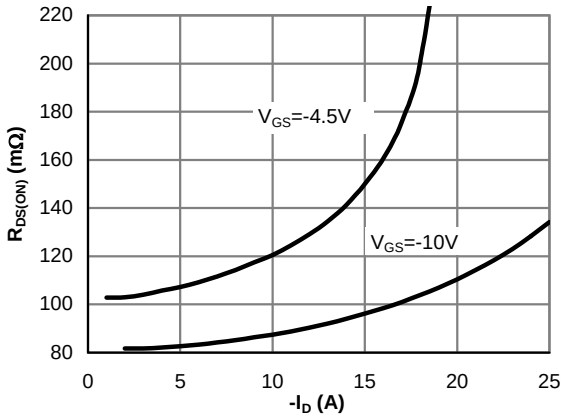



**Figure 3: On-Resistance vs. Drain Current and Gate Voltage**

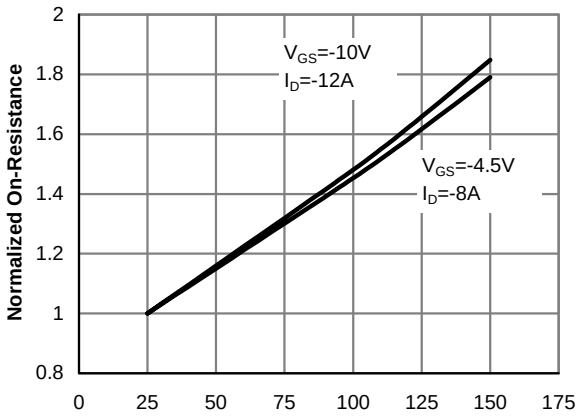



**Figure 4: On-Resistance vs. Junction Temperature**

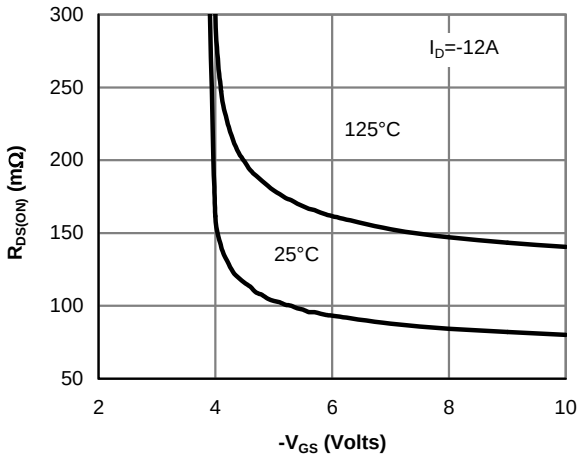



**Figure 5: On-Resistance vs. Gate-Source Voltage**

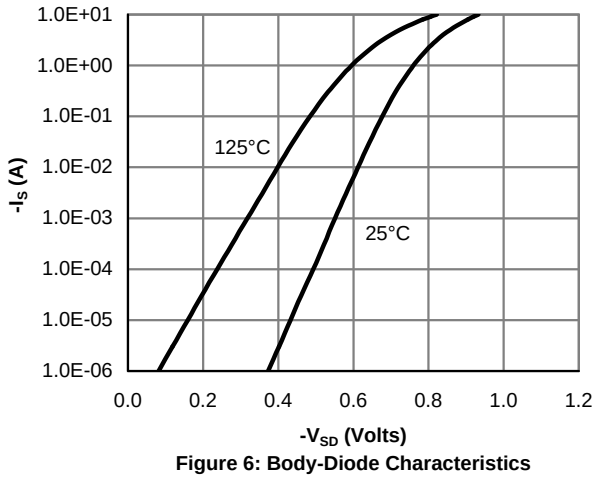



**Figure 6: Body-Diode Characteristics**

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

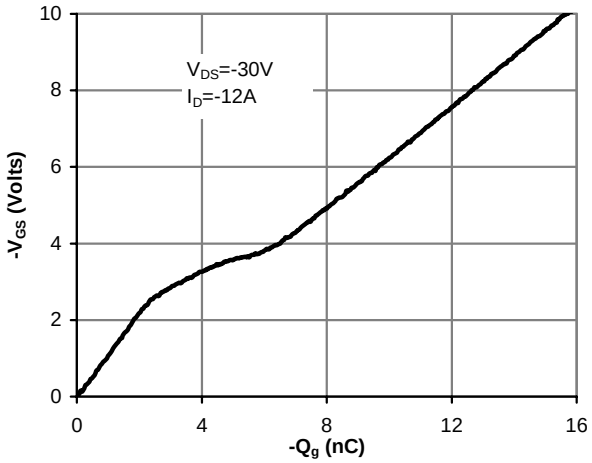



**Figure 7: Gate-Charge Characteristics**

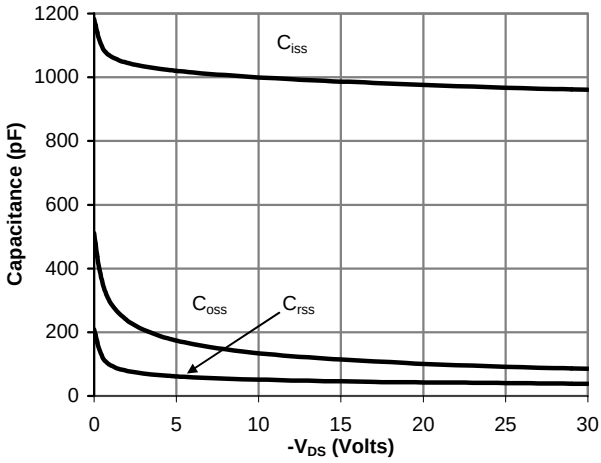



**Figure 8: Capacitance Characteristics**

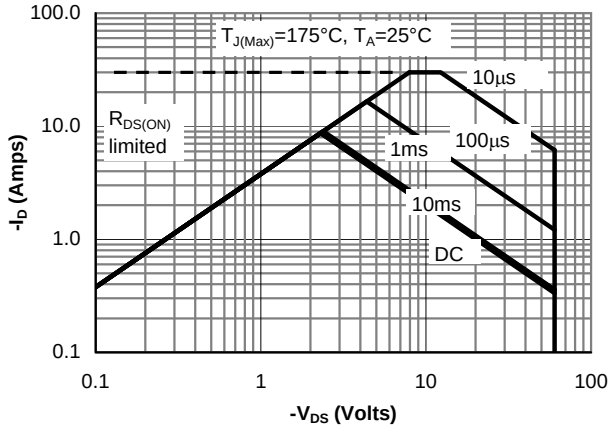



**Figure 9: Maximum Forward Biased Safe Operating Area (Note F)**

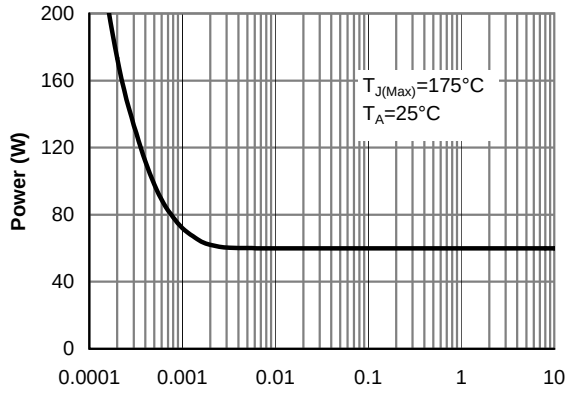



**Figure 10: Single Pulse Power Rating Junction-to-Case (Note F)**

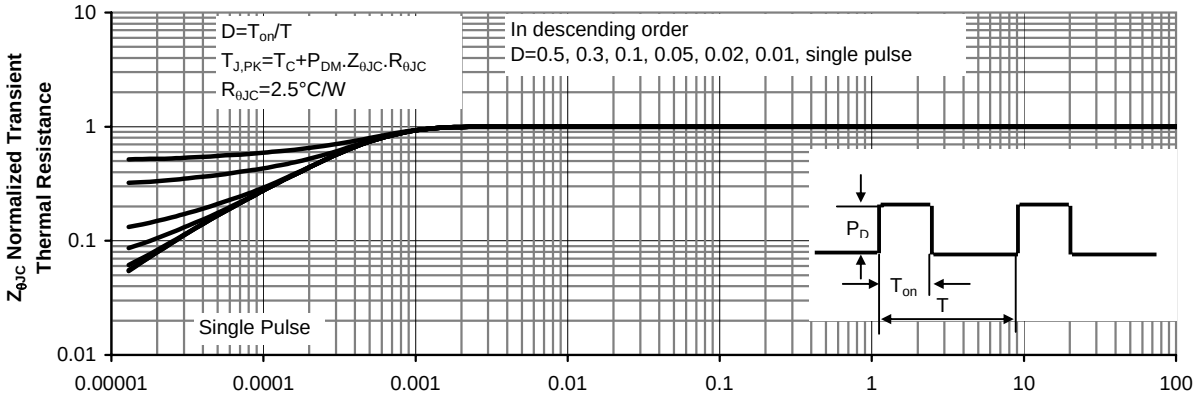



**Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)**

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

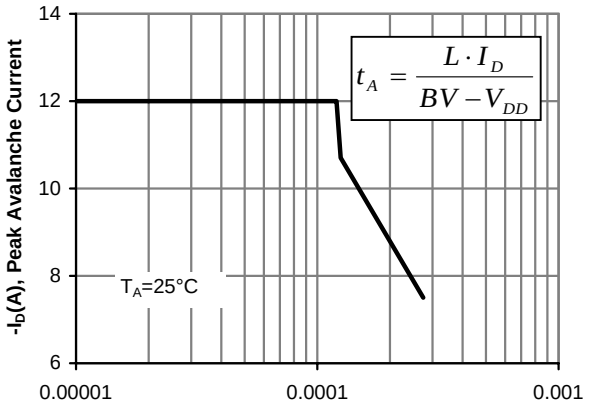



**Figure 12: Single Pulse Avalanche capability**

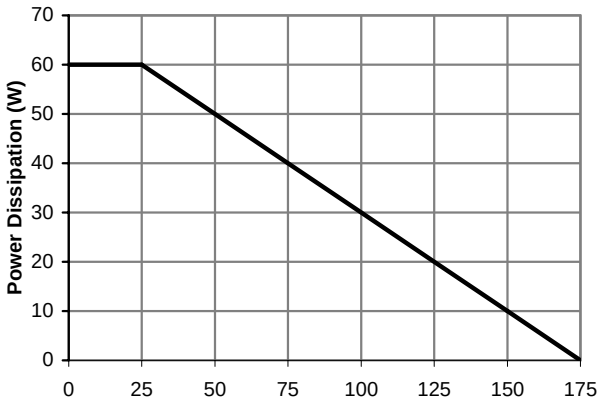



**Figure 13: Power De-rating (Note B)**

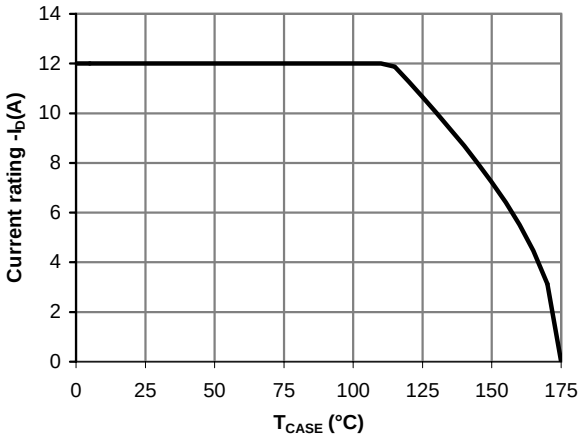



**Figure 14: Current De-rating (Note B)**

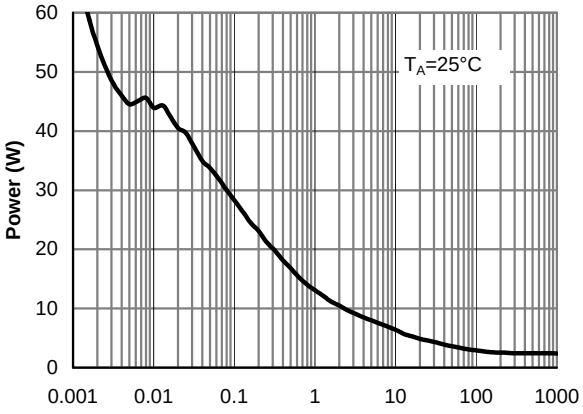



**Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note H)**

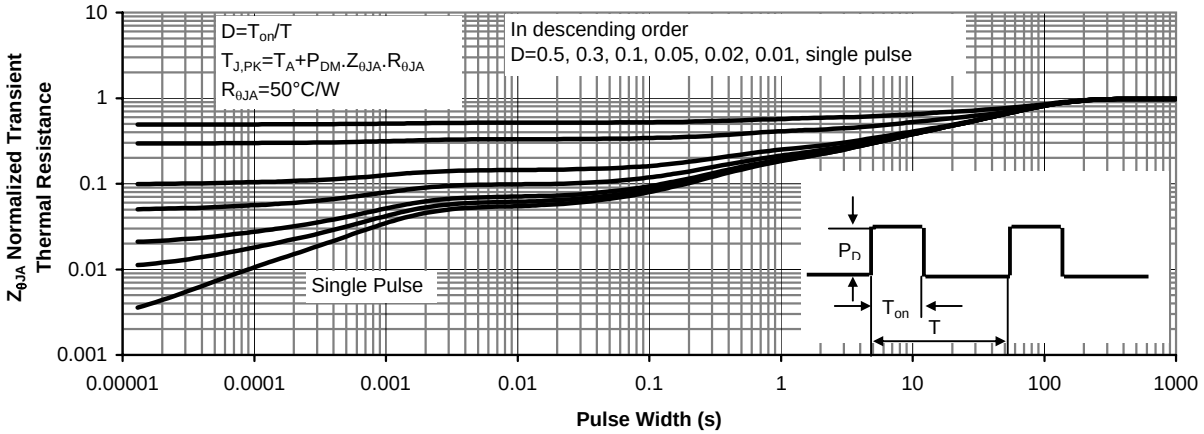
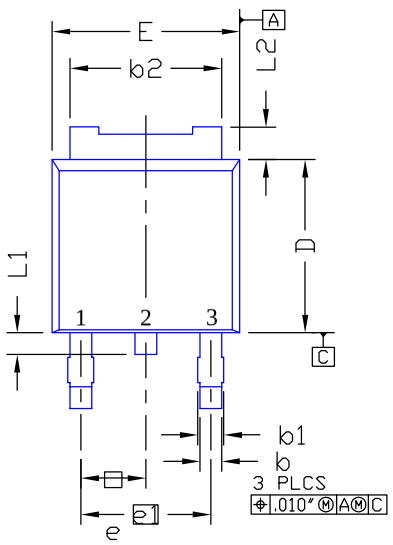
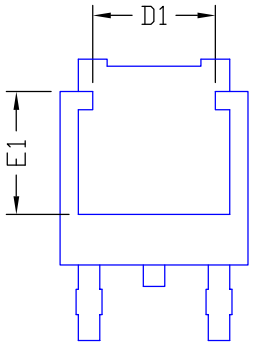
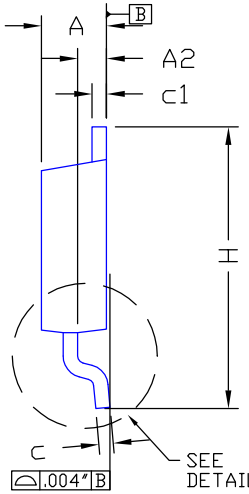
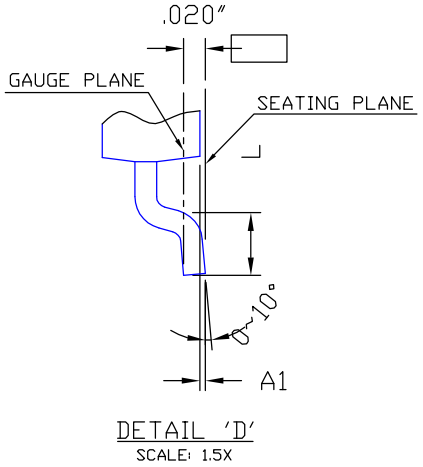



**Figure 11: Normalized Maximum Transient Thermal Impedance (Note H)**



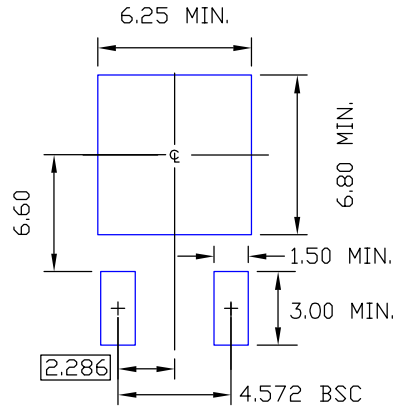




DETAIL 'D'
SCALE: 1.5X

NOTE
1. PACKAGE BODY SIZES EXCLUDE MOLD FLASH AND GATE BURRS
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. FOLLOWED FROM JEDEC TO-252 (AA)

| 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 | 4.45 | 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 |

RECOMMENDED LAND PATTERN




UNIT: mm

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

DECIMAL
X.X ±
X.XX ±
X.XXX ±

ANGULAR
±

INTERPRET DIM AND TOL PER ASME Y14.5M – 1994

PRINTING IS SCALED TO FIT DO NOT SCALE DRAWING

THIRD ANGLE PROJECTION

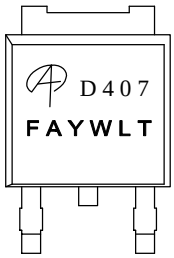
ALPHA & OMEGA SEMICONDUCTOR, LTD.

| | |
|---|---|
| Document No. | PD–00009 |
| Version | rev B |
| Title | DPAK TO–252 PACKAGE OUTLINE |

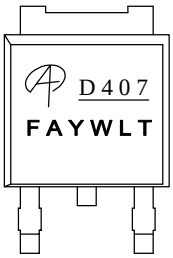
| Document No. | PD-00286 |
|---|---|
| Version | rev B |
| Title | AOD407 Marking Description |

**ALPHA & OMEGA**
*SEMICONDUCTOR, LTD.*

DPAK PACKAGE MARKING DESCRIPTION




Standard product




Green product

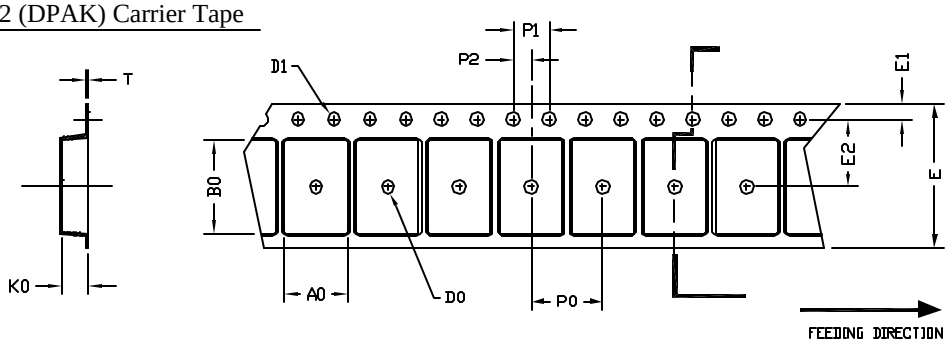
NOTE:
LOGO - AOS LOGO
D407 - PART NUMBER CODE.
F&A - FOUNDRY AND ASSEMBLY LOCATION
Y - YEAR CODE
W - WEEK CODE.
L T - ASSEMBLY LOT CODE

| PART NO. | DESCRIPTION | CODE |
|---|---|---|
| AOD407 | Standard product | D407 |
| AOD407L | Green product | D407 |

**ALPHA & OMEGA**
*SEMICONDUCTOR, LTD.*

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

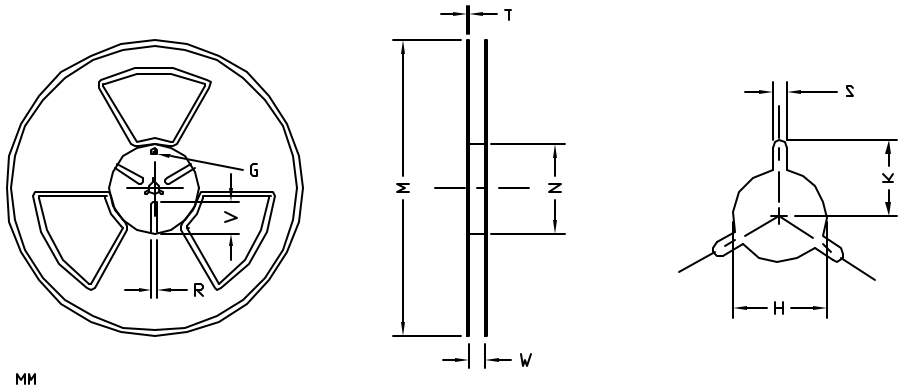
## TO-252 (DPAK) Carrier Tape




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