



**AO3415**

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

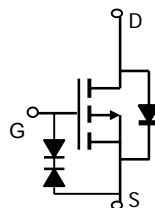
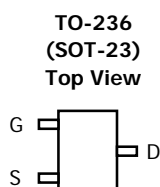


### General Description

The AO3415 uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and operation with gate voltages as low as 1.8V. This device is suitable for use as a load switch or in PWM applications. It is ESD protected. *AO3415 is Pb-free (meets ROHS & Sony 259 specifications). AO3415L is a Green Product ordering option. AO3415 and AO3415L are electrically identical.*

### Features

$V_{DS}$  (V) = -20V  
 $I_D$  = -4 A ( $V_{GS}$  = -4.5V)  
 $R_{DS(ON)} < 43m\Omega$  ( $V_{GS}$  = -4.5V)  
 $R_{DS(ON)} < 54m\Omega$  ( $V_{GS}$  = -2.5V)  
 $R_{DS(ON)} < 73m\Omega$  ( $V_{GS}$  = -1.8V)  
ESD Rating: 3000V HBM



### Absolute Maximum Ratings $T_A=25^\circ\text{C}$ unless otherwise noted

Parameter	Symbol	Maximum	Units
Drain-Source Voltage	$V_{DS}$	-20	V
Gate-Source Voltage	$V_{GS}$	$\pm 8$	V
Continuous Drain Current <sup>A</sup>	$I_D$	-4.0	A
$T_A=25^\circ\text{C}$		-3.5	
$T_A=70^\circ\text{C}$			
Pulsed Drain Current <sup>B</sup>	$I_{DM}$	-30	
Power Dissipation <sup>A</sup>	$P_D$	1.4	W
$T_A=25^\circ\text{C}$		0.9	
$T_A=70^\circ\text{C}$			
Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 to 150	$^\circ\text{C}$

### Thermal Characteristics

Parameter	Symbol	Typ	Max	Units
Maximum Junction-to-Ambient <sup>A</sup>	$R_{\theta JA}$	65	90	$^\circ\text{C/W}$
$t \leq 10s$				
Maximum Junction-to-Ambient <sup>A</sup>	$R_{\theta JA}$	85	125	$^\circ\text{C/W}$
Steady-State				
Maximum Junction-to-Lead <sup>C</sup>	$R_{\theta JL}$	43	60	$^\circ\text{C/W}$
Steady-State				

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	$I_D=-250\mu\text{A}$ , $V_{GS}=0\text{V}$	-20			V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=-16\text{V}$ , $V_{GS}=0\text{V}$ $T_J=55^{\circ}\text{C}$			-1 -5	$\mu\text{A}$
$I_{GSS}$	Gate-Body leakage current	$V_{DS}=0\text{V}$ , $V_{GS}=\pm 4.5\text{V}$			$\pm 1$	$\mu\text{A}$
		$V_{DS}=0\text{V}$ , $V_{GS}=\pm 8\text{V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}$ , $I_D=-250\mu\text{A}$	-0.3	-0.55	-1	
$I_{D(ON)}$	On state drain current	$V_{GS}=-4.5\text{V}$ , $V_{DS}=-5\text{V}$	-25			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS}=-4.5\text{V}$ , $I_D=-4\text{A}$ $T_J=125^{\circ}\text{C}$		35 48	43 60	$\text{m}\Omega$
		$V_{GS}=-2.5\text{V}$ , $I_D=-4\text{A}$		45	54	$\text{m}\Omega$
		$V_{GS}=-1.8\text{V}$ , $I_D=-2\text{A}$		56	73	$\text{m}\Omega$
		$V_{GS}=-1.5\text{V}$ , $I_D=-1\text{A}$		70		$\text{m}\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS}=-5\text{V}$ , $I_D=-4\text{A}$	8	16		S
$V_{SD}$	Diode Forward Voltage	$I_S=-1\text{A}$ , $V_{GS}=0\text{V}$		-0.78	-1	V
$I_S$	Maximum Body-Diode Continuous Current				-2.2	A
<b>DYNAMIC PARAMETERS</b>						
$C_{iss}$	Input Capacitance	$V_{GS}=0\text{V}$ , $V_{DS}=-10\text{V}$ , $f=1\text{MHz}$		1450		pF
$C_{oss}$	Output Capacitance			205		pF
$C_{rss}$	Reverse Transfer Capacitance			160		pF
$R_g$	Gate resistance	$V_{GS}=0\text{V}$ , $V_{DS}=0\text{V}$ , $f=1\text{MHz}$		6.5		$\Omega$
<b>SWITCHING PARAMETERS</b>						
$Q_g$	Total Gate Charge	$V_{GS}=-4.5\text{V}$ , $V_{DS}=-10\text{V}$ , $I_D=-4\text{A}$		17.2		nC
$Q_{gs}$	Gate Source Charge			1.3		nC
$Q_{gd}$	Gate Drain Charge			4.5		nC
$t_{D(on)}$	Turn-On DelayTime	$V_{GS}=-4.5\text{V}$ , $V_{DS}=-10\text{V}$ , $R_L=2.5\Omega$ , $R_{GEN}=3\Omega$		9.5		ns
$t_r$	Turn-On Rise Time			17		ns
$t_{D(off)}$	Turn-Off DelayTime			94		ns
$t_f$	Turn-Off Fall Time			35		ns
$t_{rr}$	Body Diode Reverse Recovery Time	$I_F=-4\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$		31		ns
$Q_{rr}$	Body Diode Reverse Recovery Charge	$I_F=-4\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$		13.8		nC

A: The value of  $R_{\theta JA}$  is measured with the device mounted on 1in<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with  $T_A=25^{\circ}\text{C}$ . The value in any a given application depends on the user's specific board design. The current rating is based on the  $\leq 10\text{s}$  thermal resistance rating.

B: Repetitive rating, pulse width limited by junction temperature.

C: The  $R_{\theta JA}$  is the sum of the thermal impedance from junction to lead  $R_{\theta JL}$  and lead to ambient.

D: The static characteristics in Figures 1 to 6,12,14 are obtained using 80 $\mu\text{s}$  pulses, duty cycle 0.5% max.

E: These tests are performed with the device mounted on 1 in<sup>2</sup> 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.

Rev 4. September 2005

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## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

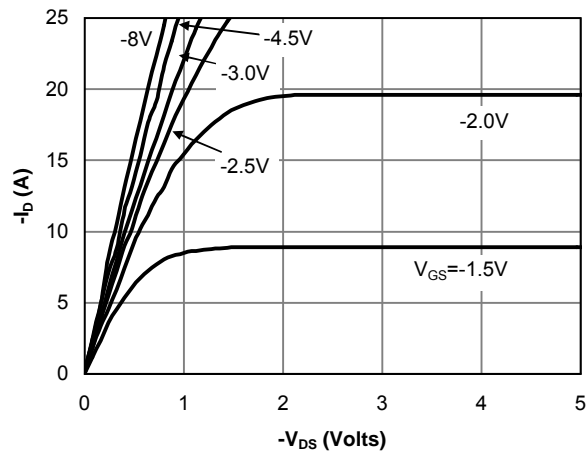


Fig 1: On-Region Characteristics

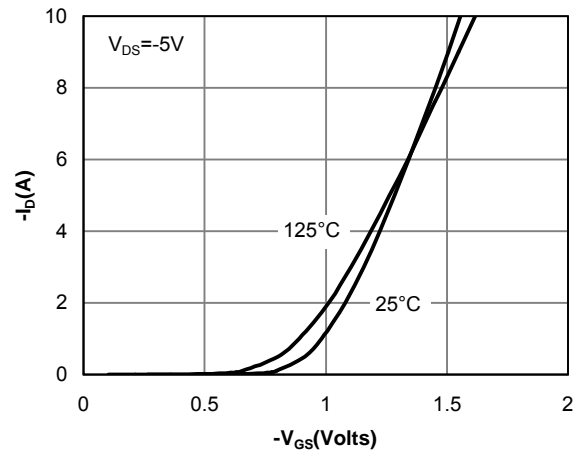


Figure 2: Transfer Characteristics

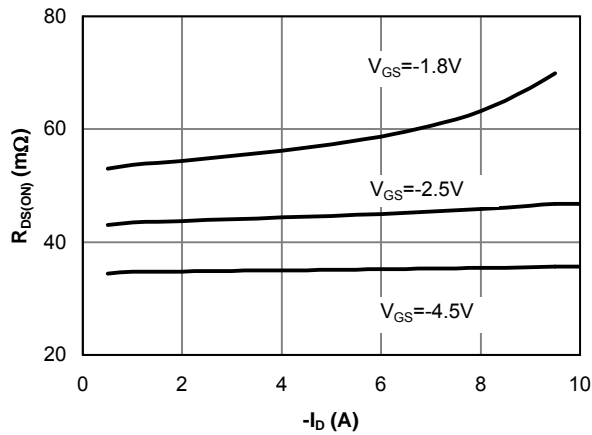


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

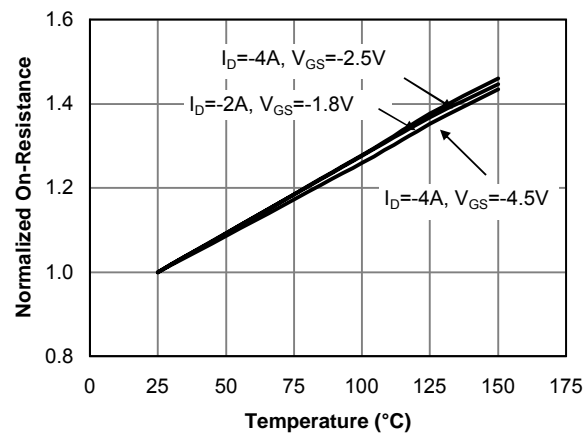


Figure 4: On-Resistance vs. Junction Temperature

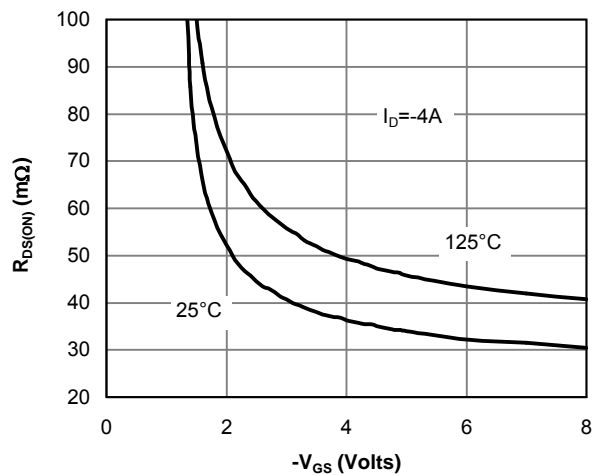


Figure 5: On-Resistance vs. Gate-Source Voltage

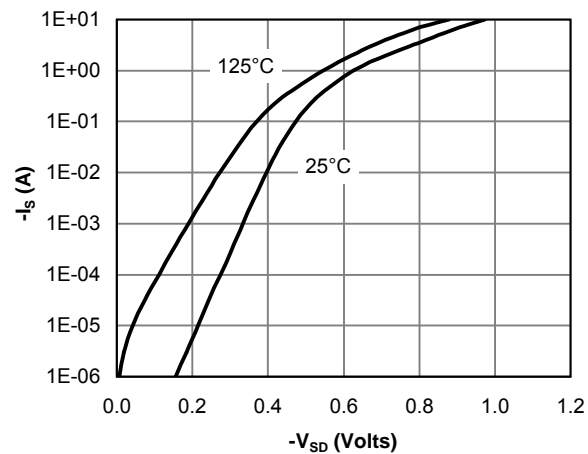


Figure 6: Body-Diode Characteristics

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

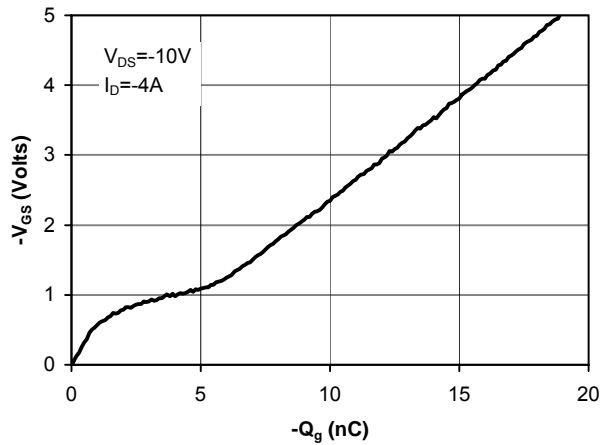


Figure 7: Gate-Charge Characteristics

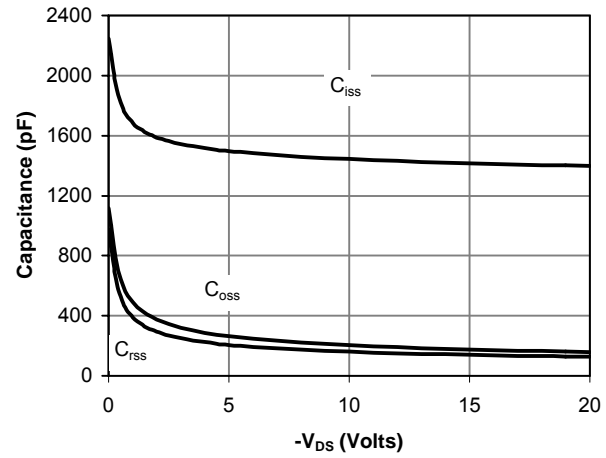


Figure 8: Capacitance Characteristics

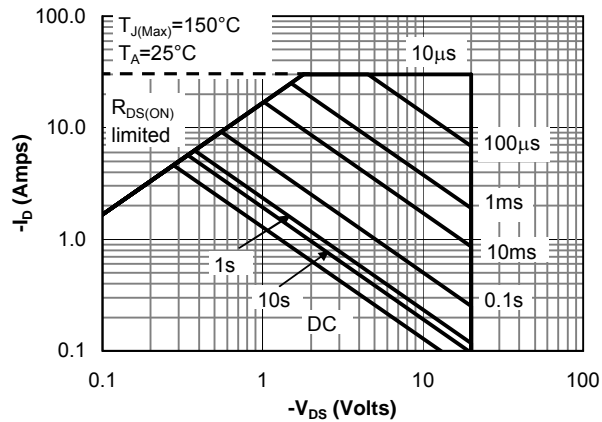


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

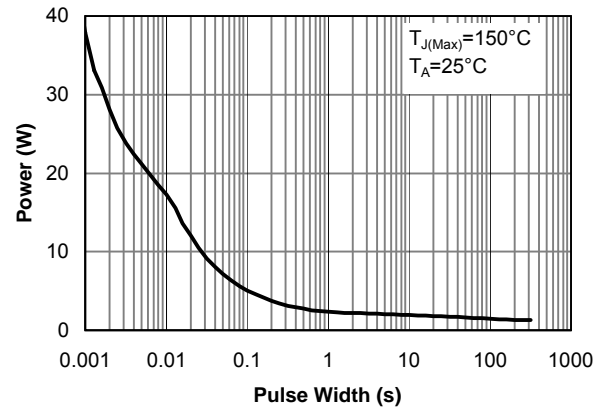


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

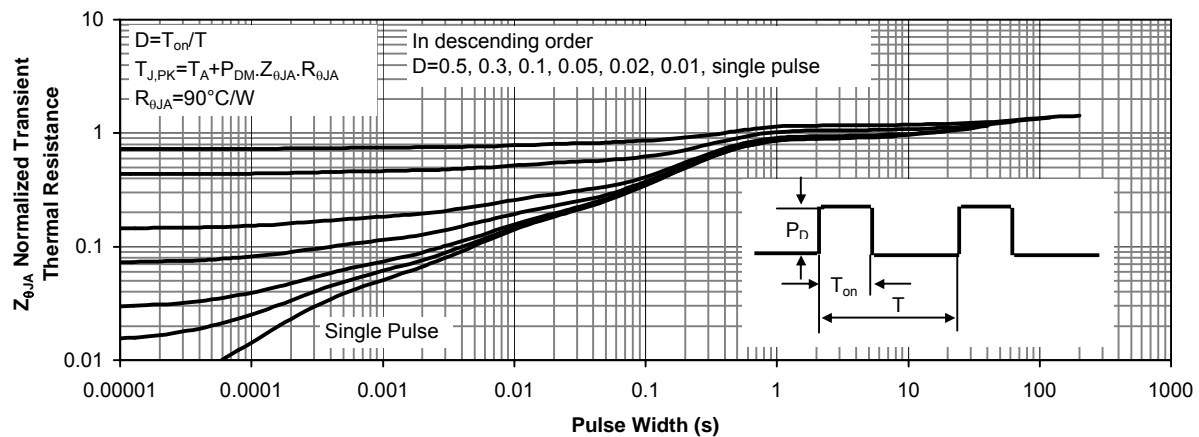
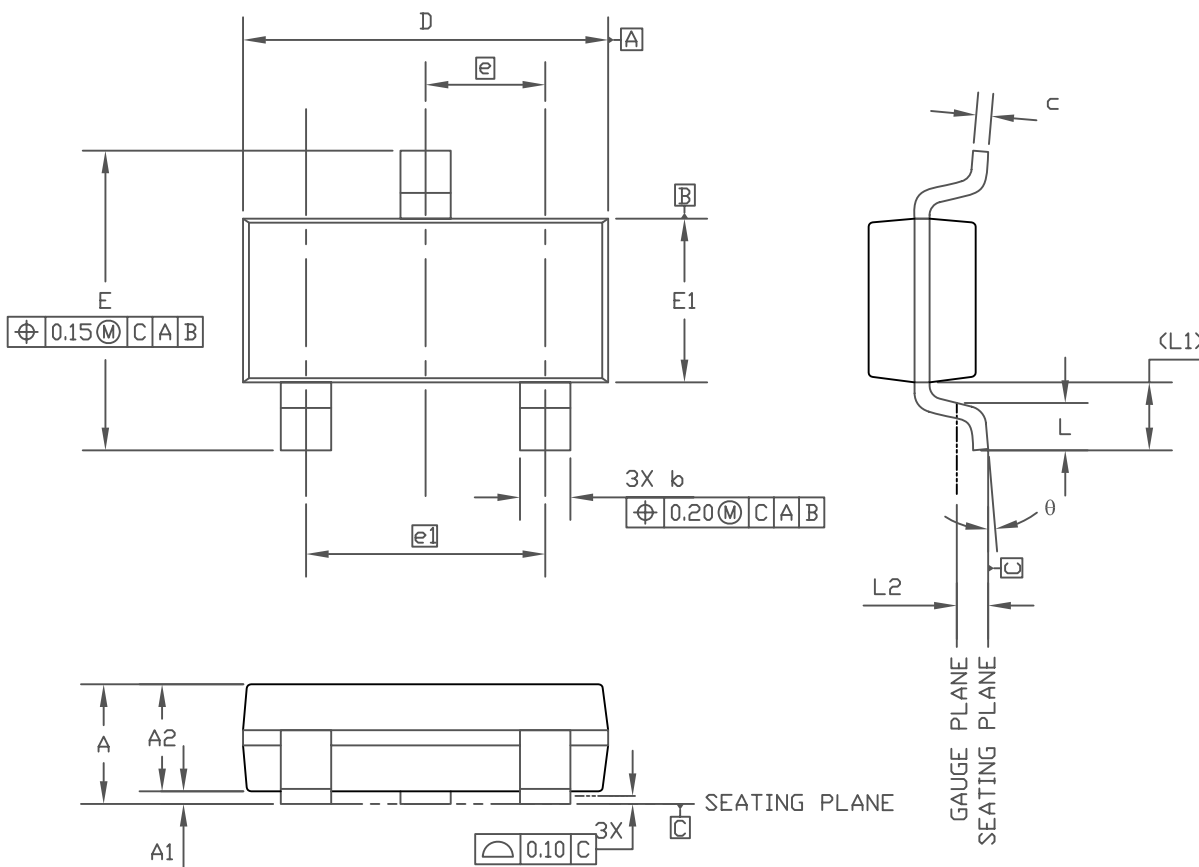


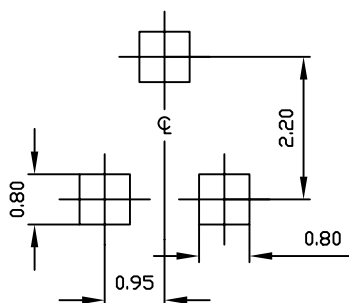
Figure 11: Normalized Maximum Transient Thermal Impedance



## SOT-23 STANDARD PACKAGE OUTLINE



### RECOMMENDED LAND PATTERN



UNIT: mm

SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.75	—	1.17	0.030	—	0.046
A1	0.05	—	0.15	0.002	—	0.006
A2	0.70	0.85	1.02	0.028	0.033	0.040
b	0.30	—	0.50	0.012	—	0.020
c	0.08	—	0.20	0.003	—	0.008
D	2.80	2.90	3.04	0.110	0.114	0.120
E	2.10	—	2.64	0.083	—	0.104
E1	1.20	1.30	1.40	0.047	0.051	0.055
e	0.95 BSC			0.037 BSC		
e1	1.90 BSC			0.075 BSC		
L	0.40	0.50	0.60	0.016	0.020	0.024
L1	0.54 REF			0.021 REF		
L2	0.25			0.010		
θ1	0°	—	8°	0°	—	8°

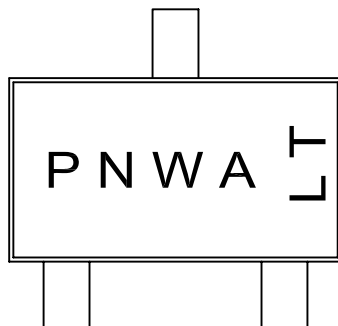
### NOTE

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. CONTROLLING DIMENSION IS MILLIMETER. CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.
3. DIMENSION D DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.25 mm PER END. DIMENSION E1 DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 mm PER SIDE.
4. THE PACKAGE TOP MAY BE SMALLER THAN THE PACKAGE BOTTOM. DIMENSIONS D AND E1 ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY EXCLUSIVE OF MOLD FLASH, TIE BAR BURRS, GATE BURRS AND INTERLEAD FLASH, BUT INCLUDING ANY MISMATCH BETWEEN THE TOP AND BOTTOM OF THE PLASTIC BODY.
5. FOLLOW JEDEC TO-236H AA.

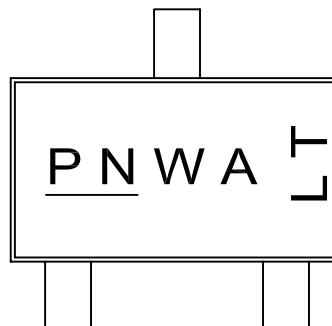


Document No.	PD-00120
Version	D
Title	AO3415 Marking Description

### SOT-23 PACKAGE MARKING DESCRIPTION



Standard product



Green product

**NOTE:**

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

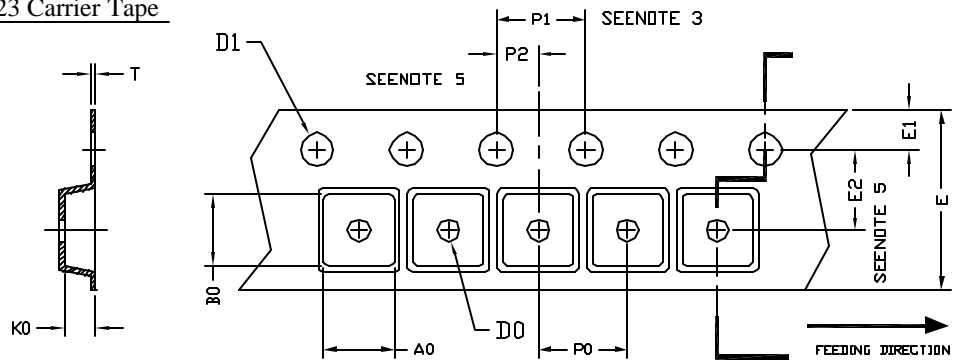
PART NO.	DESCRIPTION	CODE (PN)
AO3415	Standard product	AF
AO3415L	Green product	<u>AF</u>



**ALPHA & OMEGA**  
SEMICONDUCTOR, LTD.

## SOT-23 Tape and Reel Data

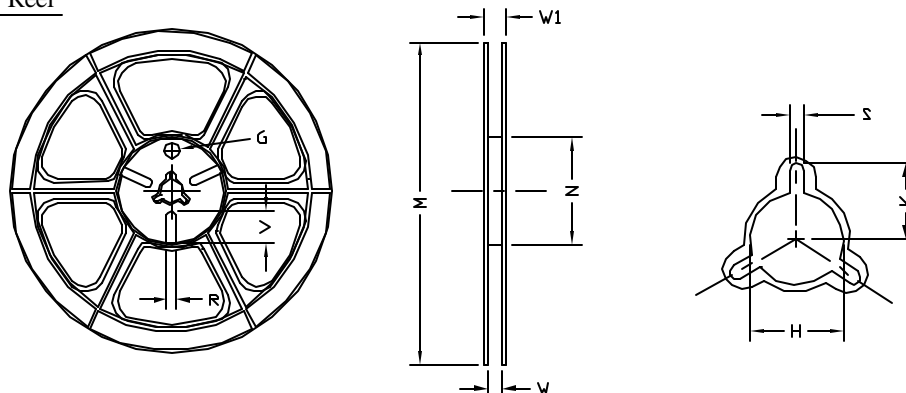
### SOT-23 Carrier Tape



UNIT: MM

PACKAGE	A0	B0	K0	D0	D1	E	E1	E2	P0	P1	P2	T
SOT-23 (8 mm)	3.15 ±0.10	3.20 ±0.10	1.40 ±0.10	1.00 MIN	1.30 ±0.10	8.00 ±0.30	1.75 ±0.10	3.50 ±0.05	4.00 ±0.10	4.00 ±0.10	2.00 ±0.05	0.25 ±0.05

### SOT-23 Reel



UNIT: MM

TAPE SIZE	REEL SIZE	M	N	W	W1	H	K	S	G	R	V
8 mm	φ180	φ180.00 ±0.50	φ60.50	9.00 ±0.30	11.40 ±1.00	φ13.00 +0.50 -0.20	10.60	2.00 ±0.50	φ9.00	5.00	18.00

### SOT-23 Tape

Leader / Trailer  
& Orientation

