AOZ1331ADI

Dual Channel Smart Load Switch

General Description

The AOZ1331ADI is a dual channel load switch with typical 20mΩ on-resistance in a small package. It contains two n-channel MOSFETs for up to 5.5V input voltage operation and 6A current each channel with 2.5V to 5V bias supply. Each load switch is independently controlled by a low voltage control signal through ON1/ON2 pin.

The AOZ1331ADI integrates an internal 250Ω load resistor in each channel for quick output discharge when load switch is off. The optional external capacitor connected CT1/CT2 for output slew rate control.

The AOZ1331ADI is available in a 3mm x 2mm DFN-14L package with bottom thermal pad and is rated over a -40°C to +85°C ambient temperature range.

Features

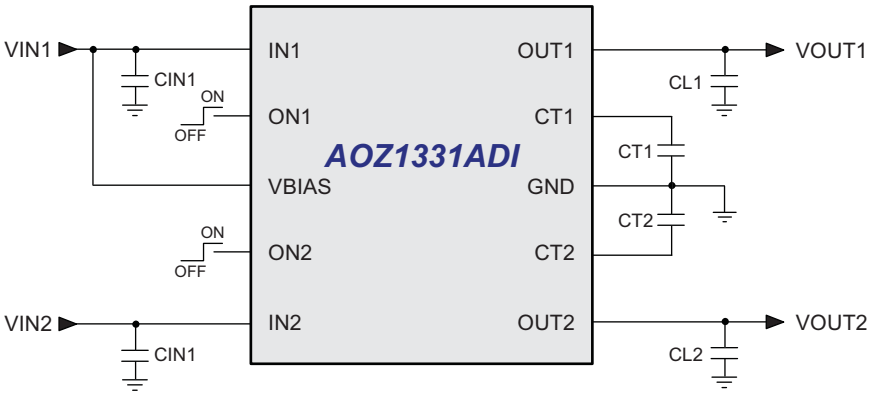
- 0.8V to 5.5V input voltage range
- 6A continuous current per channel
- Low $R_{DS(ON)}$ internal NFETs
  - 20mΩ at V_{BIAS} = 5V
- Low quiescent current
  - 80µA (both channels)
  - 60µA (single channel)
- Adjustable rise time
- 2.5V to 5V bias voltage
- Integrated quick output discharge resistor
- Thermally enhanced 3mm x 2mm DFN-14L package

Applications

- Portable computers
- Ultrabooks
- Tablet PC
- Set top boxes
- LCD TVs
- Telecom/Networking/Datacom
- SSD
- Consumer electronics

Green Product

Typical Application

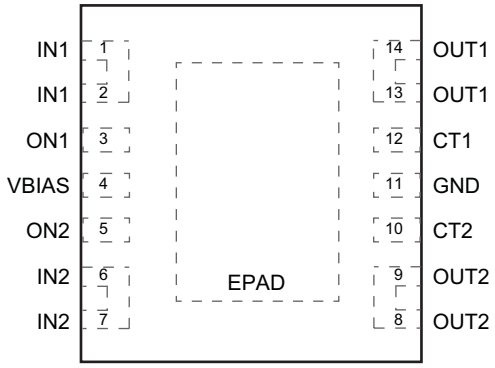


Ordering Information

Part Number	Temperature Range	Package	Environmental
AOZ1331ADI	-40°C to +85°C	3mm x 2mm DFN-14L	Green

All AOS products are offered in packages with Pb-free plating and compliant to RoHS standards.
Please visit www.aosmd.com/media/AOSGreenPolicy.pdf for additional information.

Pin Configuration

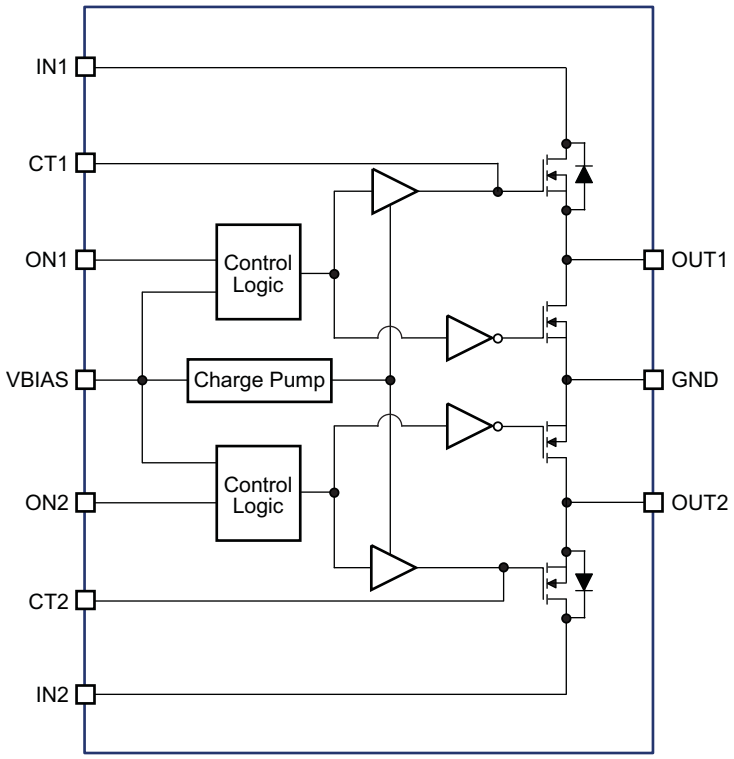


3mm x 2mm DFN-14
(Top View)

Pin Description

Pin Number	Pin Name	Pin Function
1, 2	IN1	Switch 1 Input. Bypass capacitor is recommended to minimize input voltage dip.
3	ON1	Enable Input of Switch 1. Switch 1 is on when ON1 is pulled high, and is off when ON1 is pulled low. Do not leave floating.
4	VBIAS	Bias Voltage. Power supply to this device. Recommended voltage range is 2.5V to 5.5V.
5	ON2	Enable Input of Switch 2. Switch 2 is on when ON2 is pulled high, and is off when ON2 is pulled low. Do not leave floating.
6, 7	IN2	Switch 2 Input. Bypass capacitor is recommended to minimize input voltage dip.
8, 9	OUT2	Switch 2 Output.
10	CT2	Slew rate control of switch 2.
11	GND	Ground.
12	CT1	Slew rate control of switch 1.
13, 14	OUT1	Switch 1 Output.
EPAD	Exposed Pad	The exposed bottom pad must be connected to GND.

Functional Block Diagram



Absolute Maximum Ratings

Exceeding the Absolute Maximum ratings may damage the device.

Parameter	Rating
IN1, IN2, VBIAS, ON1, ON2 to GND	-0.3V to 6V
OUT1, OUT2 to GND	-0.3V to 6V
Junction Temperature (T_J)	+150°C
Storage Temperature (T_S)	-65°C to +150°C
ESD Rating HBM/CDM	2kV/1kV

Recommend Operating Ratings

The device is not guaranteed to operate beyond the Maximum Operating Ratings.

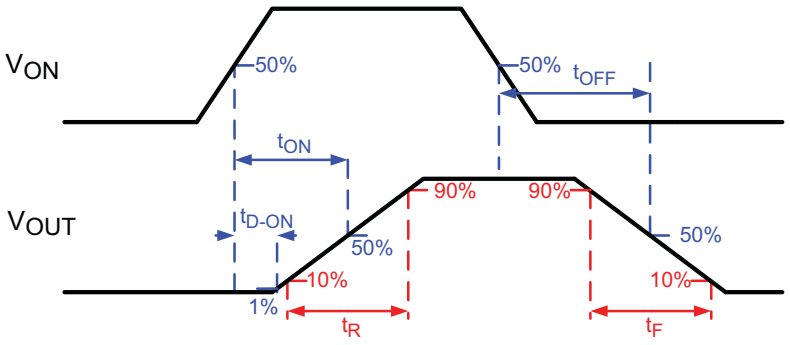
Parameter	Rating
Supply Voltage (V_{IN})	5.5V
Ambient Temperature (T_A)	-40°C to +85°C
Package Thermal Resistance 3x2 DFN-14 (Θ_{JC}) 3x2 DFN-14 (Θ_{JA})	 10°C/W 65°C/W

Electrical Characteristics

T_A = 25°C, V_{BIAS} = 5V, unless otherwise specified. Specifications in **BOLD** indicate a temperature range of -40°C to +85°C.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V_{INX}	IN Supply Voltage		0.8		5.5	V
V_{BIAS}	VBIAS Supply Voltage		2.5		5.5	V
$I_{D1, 2}$	Maximum Continuous Current	V_{INX} = V_{ONX} = 5V		6		A
$I_{PLS1, 2}$	Maximum Pulsed Switch Current	V_{INX} = V_{ONX} = 5V Pulse < 300µs, 2% Duty Cycle		8		A
I_{q2}	Quiescent Supply Current of V_{BIAS} (Two Channels)	I_{OUT1} = I_{OUT2} = 0V, $V_{IN1,2}$ = $V_{ON1,2}$ = 5V		80	120	µA
I_{q1}	Quiescent Supply Current of V_{BIAS} (Single Channel)	I_{OUT1} = I_{OUT2} = 0V, $V_{IN1,2}$ = V_{ON1} = 5V, V_{ON2} = 0V		60		µA
I_{OFF}	VBIAS Shutdown Supply Current	$V_{ON1,2}$ = 0V, $V_{OUT1,2}$ = 0V		1	2	µA
I_{INOFF}	IN1, IN2 Shutdown Supply Current (Single Channel)	V_{ONX} = 0V, V_{OUTX} = 0V, V_{INX} = 5V		2.1	8	µA
		V_{ONX} = 0V, V_{OUTX} = 0V, V_{INX} = 3.3V		0.3	3	
		V_{ONX} = 0V, V_{OUTX} = 0V, V_{INX} = 1.8V		0.07	2	
		V_{ONX} = 0V, V_{OUTX} = 0V, V_{INX} = 0.8V		0.04	1	
$I_{ON1, 2}$	ON1, 2 Leakage Current	$V_{ON1,2}$ = 5V			1	µA
$V_{ONH1, 2}$	ON1, 2 High Level Voltage	V_{INX} = 0.8V to 5V	1.2			V
$V_{ONL1, 2}$	ON1, 2 Low Level Voltage	V_{INX} = 0.8V to 5V			0.5	V
Switching ON Resistance						
R_{ON}	Switch ON-State Resistance	I_{OUTX} = -200mA V_{INX} = 0.8V to 5V		20	25	mΩ
R_{PD}	Output Pull-Down Resistance	I_{OUTX} = 15mA V_{INX} = 5V, V_{ONX} = 0V		250	300	Ω

Switching Characteristics

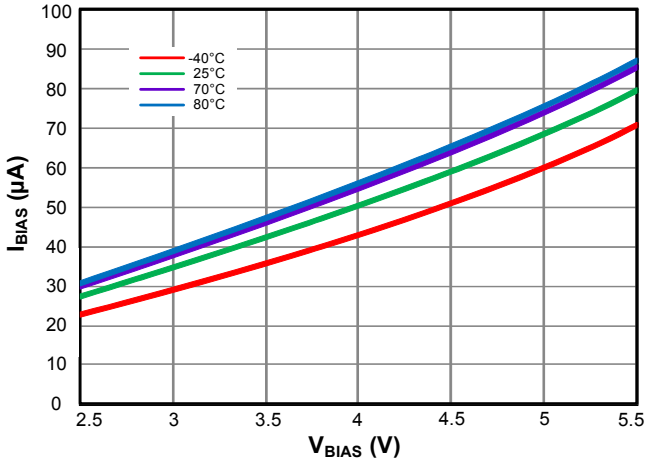


Test conditions: T_A = 25°C, C_{INX} = 1µF, C_{TX} = 1nF, C_{LX} = 0.1µF, R_{LX} = 10Ω (unless otherwise specified).

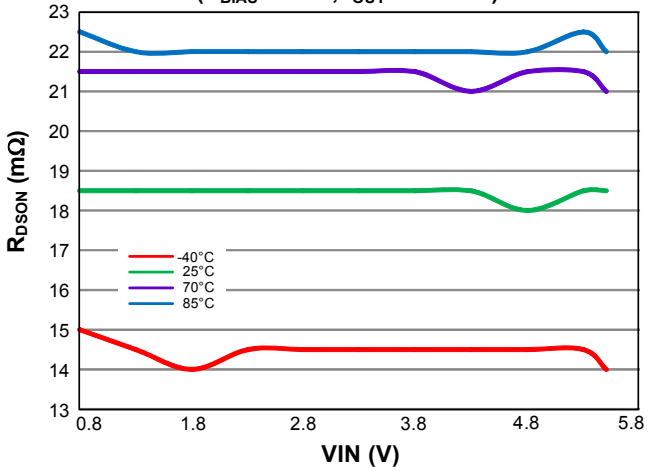
Symbol	Parameter	Min.	Typ.	Max.	Units
VINX = 5V, VBIAS = VONX = 5V					
t_{ON}	Turn-ON Time		1467		µs
t_{D-ON}	Turn-ON Delay time		350		
t_R	Turn-ON Rise Time		1705		
t_{OFF}	Turn-OFF Time		5.83		
t_F	Turn-OFF Fall Time		3.57		
VINX = 0.8V, VBIAS = VONX = 5V					
t_{ON}	Turn-ON Time		582		µs
t_{D-ON}	Turn-ON Delay time		329		
t_R	Turn-ON Rise Time		350		
t_{OFF}	Turn-OFF Time		91.2		
t_F	Turn-OFF Fall Time		13.2		
VINX = 2.5V, VBIAS = VONX = 2.5V					
t_{ON}	Turn-ON Time		2010		µs
t_{D-ON}	Turn-ON Delay time		446		
t_R	Turn-ON Rise Time		1985		
t_{OFF}	Turn-OFF Time		7.46		
t_F	Turn-OFF Fall Time		5.7		
VINX = 0.8V, VBIAS = VONX = 2.5V					
t_{ON}	Turn-ON Time		1220		µs
t_{D-ON}	Turn-ON Delay time		664		
t_R	Turn-ON Rise Time		760		
t_{OFF}	Turn-OFF Time		84.6		
t_F	Turn-OFF Fall Time		13.2		

Typical Characteristics

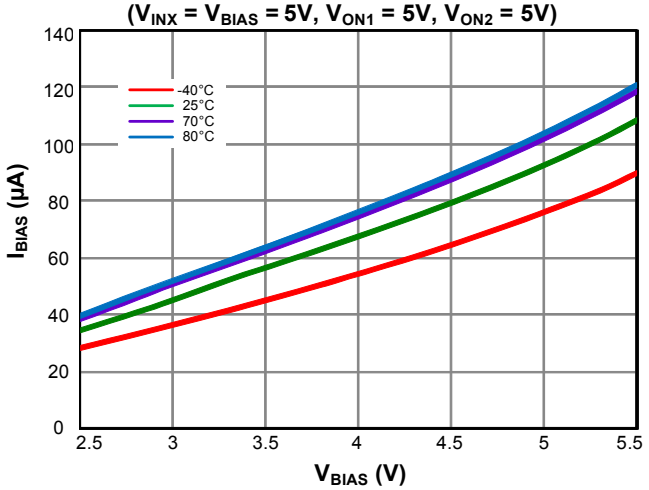
Quiescent Current vs. V_{BIAS} (Single Channel)
(V_{INX} = V_{BIAS} = 5V, V_{ON1} = 5V, V_{ON2} = 0V)



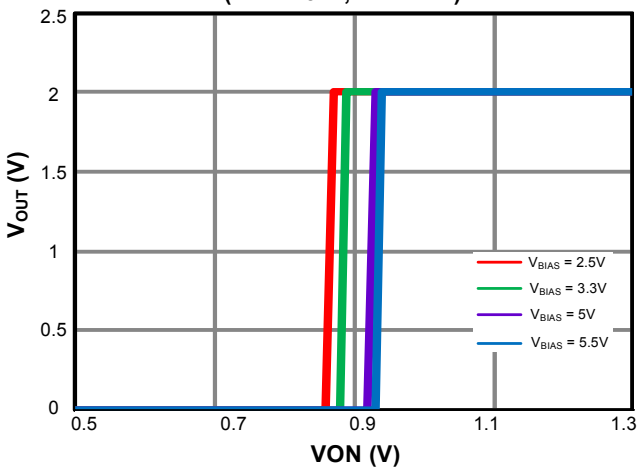
R_{DSON} vs. VIN
(V_{BIAS} = 5.5V, I_{OUT} = 200mA)



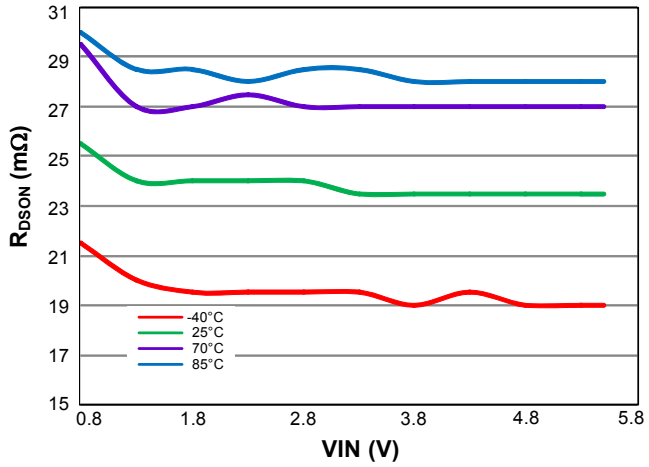
Quiescent Current vs. V_{BIAS} (Both Channels)
(V_{INX} = V_{BIAS} = 5V, V_{ON1} = 5V, V_{ON2} = 5V)



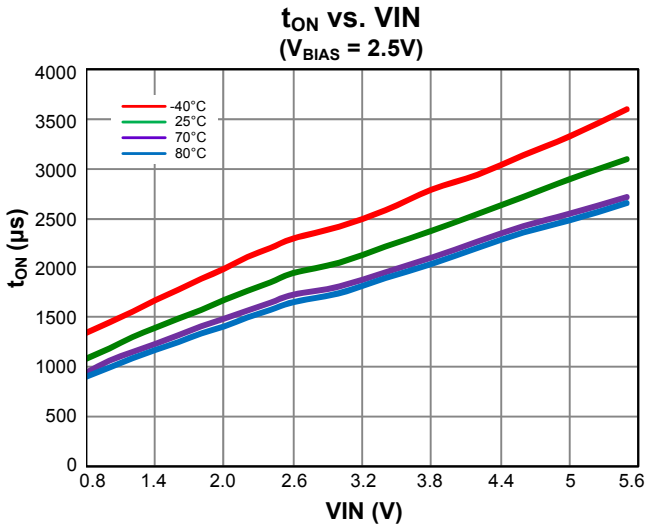
V_{OUT} vs. V_{ON}
(TA = 25°C, VIN = 2V)

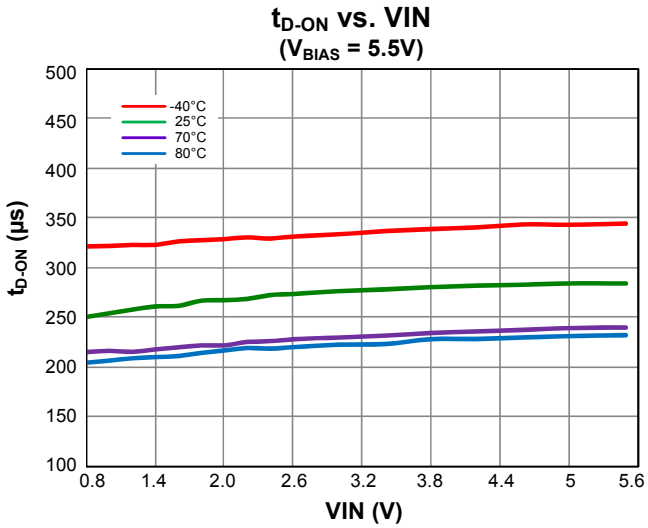


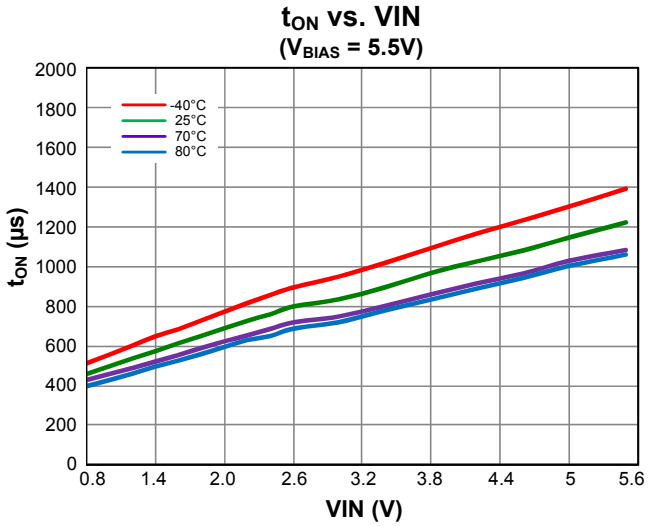
R_{DSON} vs. VIN
(V_{BIAS} = 2.5V, I_{OUT} = 200mA)

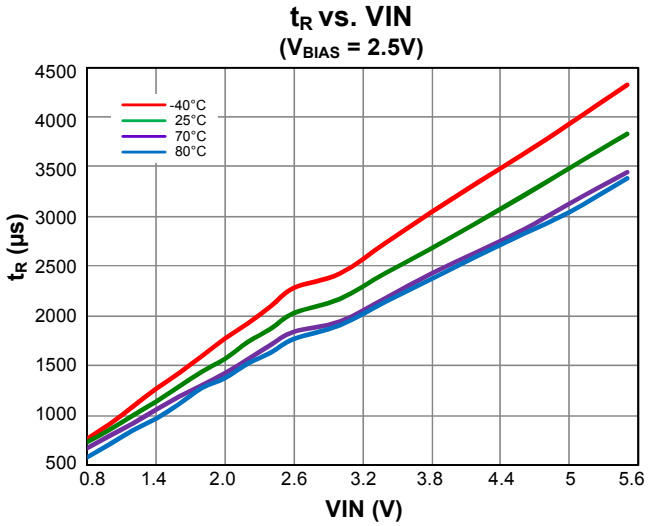


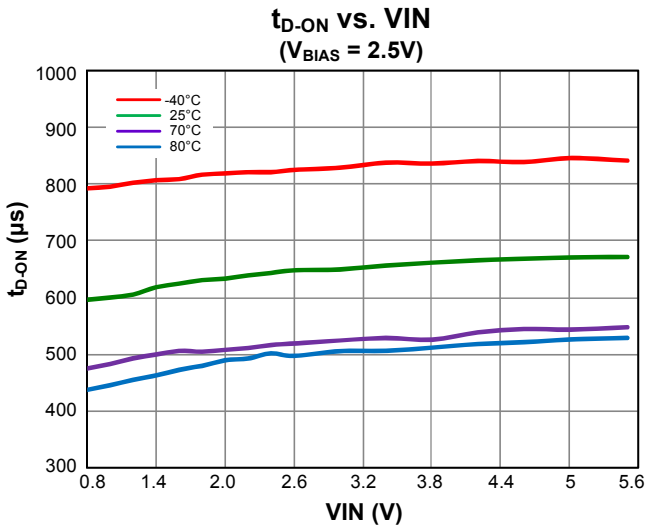
Typical Characteristics *(Continue)*

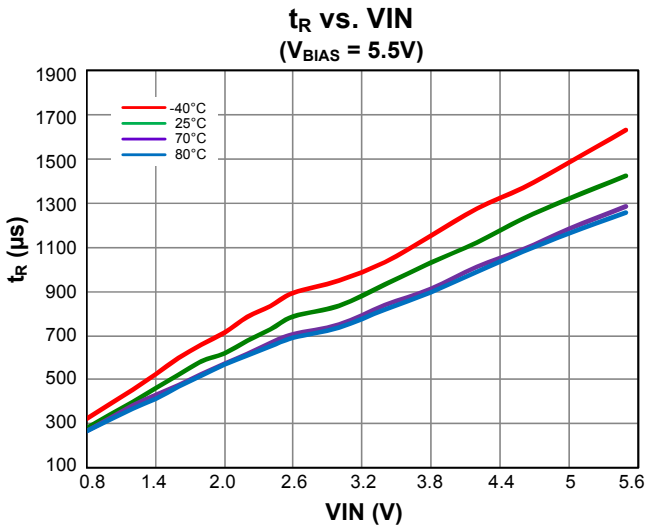




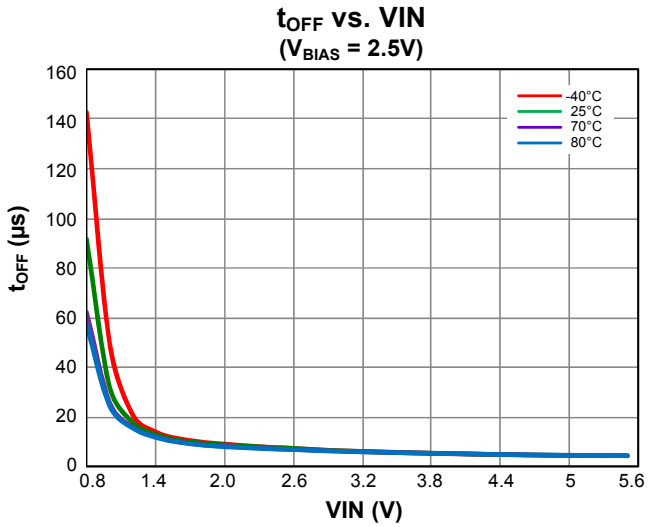


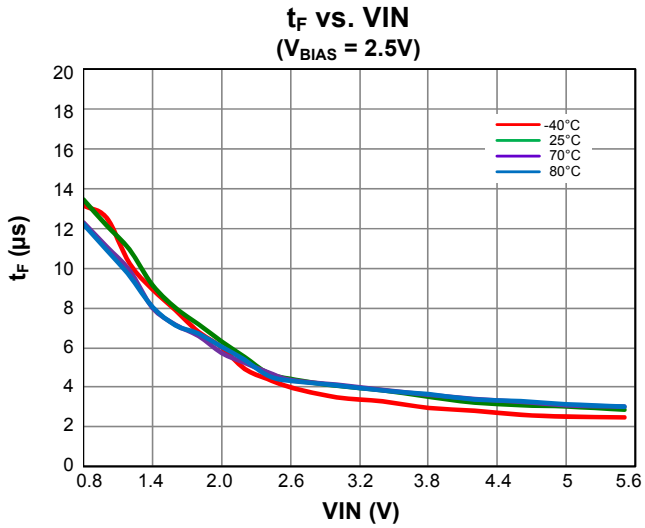


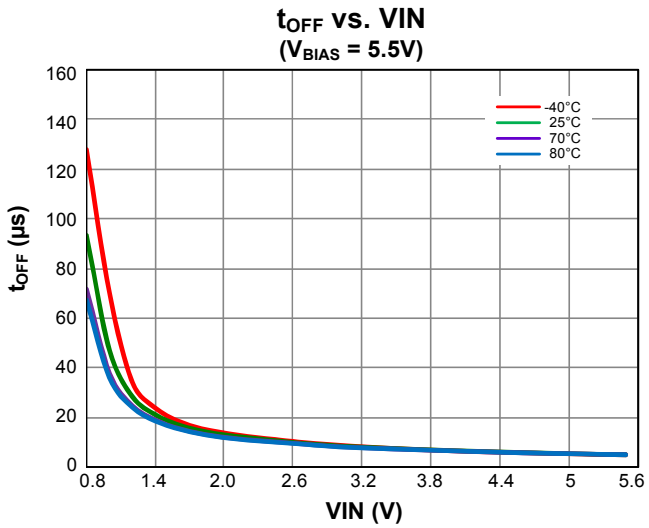


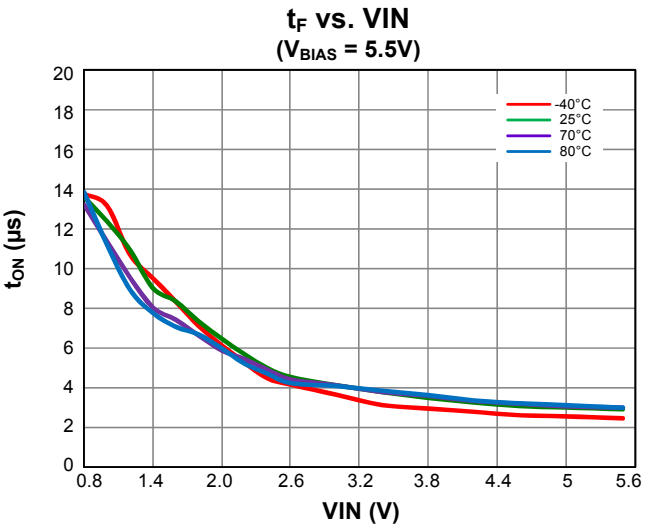


Typical Characteristics *(Continued)*





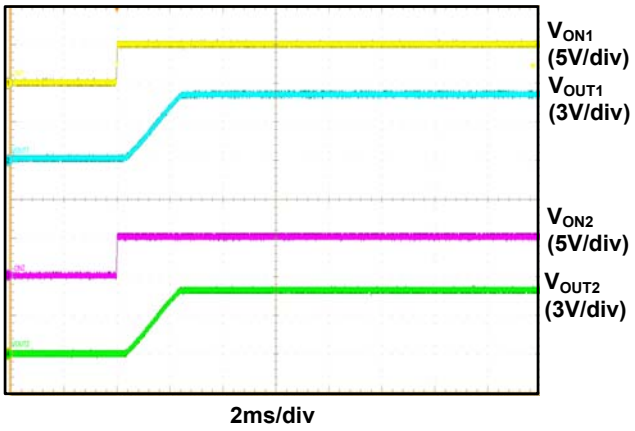




Functional Characteristic

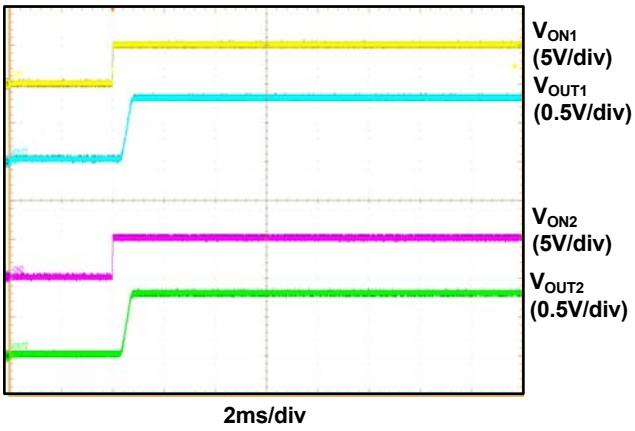
Turn-ON & Turn-ON Rise Times

(V_{INX} = 5V, V_{BIAS} = 5V, C_{INX} = 1µF, C_{TX} = 1nF, C_{LX} = 0.1µF, R_{LX} = 10Ω)



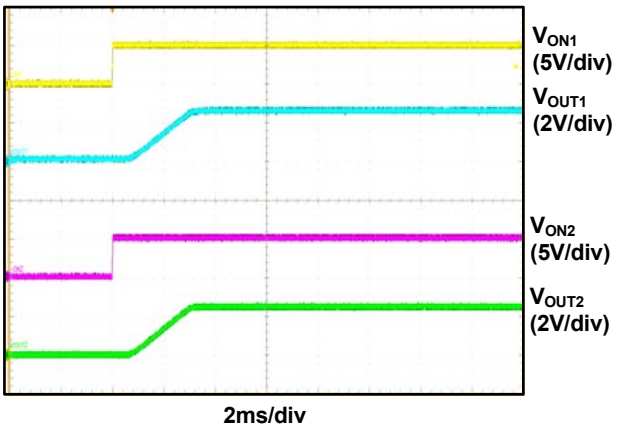
Turn-ON & Turn-ON Rise Times

(V_{INX} = 0.8V, V_{BIAS} = 5V, C_{INX} = 1µF, C_{TX} = 1nF, C_{LX} = 0.1µF, R_{LX} = 10Ω)



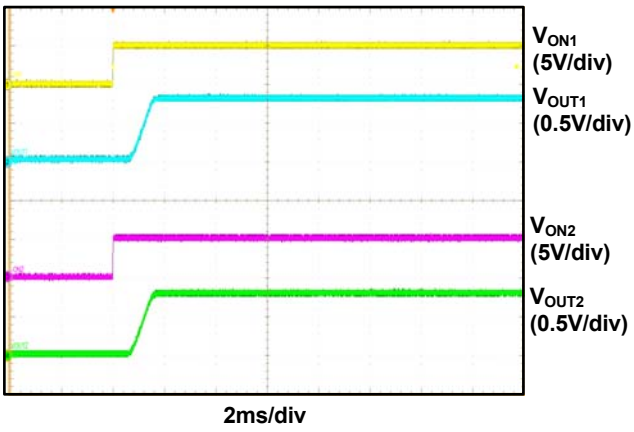
Turn-ON & Turn-ON Rise Times

(V_{INX} = 2.5V, V_{BIAS} = 2.5V, C_{INX} = 1µF, C_{TX} = 1nF, C_{LX} = 0.1µF, R_{LX} = 10Ω)



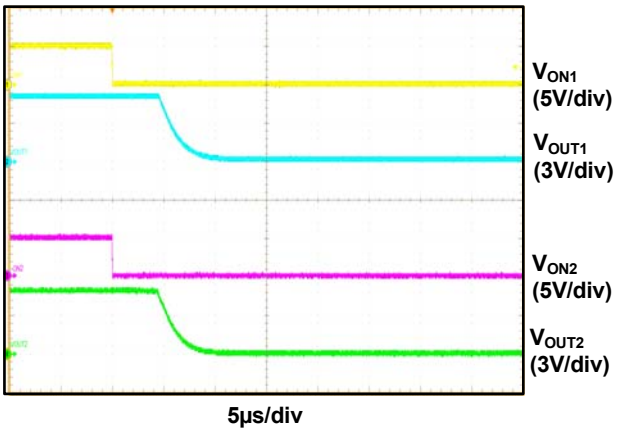
Turn-ON & Turn-ON Rise Times

(V_{INX} = 0.8V, V_{BIAS} = 2.5V, C_{INX} = 1µF, C_{TX} = 1nF, C_{LX} = 0.1µF, R_{LX} = 10Ω)



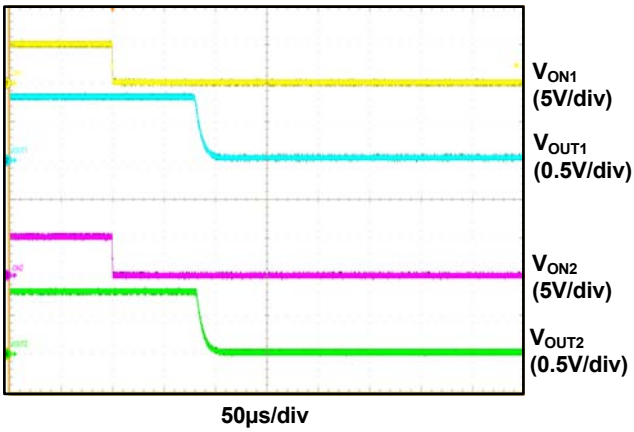
Turn-OFF & Turn-OFF Fall Times

(V_{INX} = 5V, V_{BIAS} = 5V, C_{INX} = 1µF, C_{TX} = 1nF, C_{LX} = 0.1µF, R_{LX} = 10Ω)



Turn-OFF & Turn-OFF Fall Times

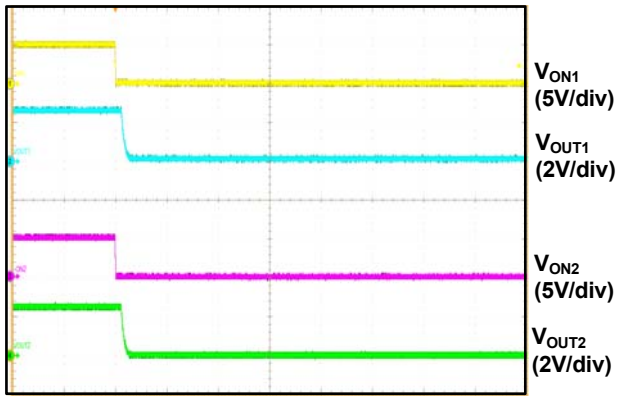
(V_{INX} = 0.8V, V_{BIAS} = 5V, C_{INX} = 1µF, C_{TX} = 1nF, C_{LX} = 0.1µF, R_{LX} = 10Ω)



Functional Characteristics *(Continued)*

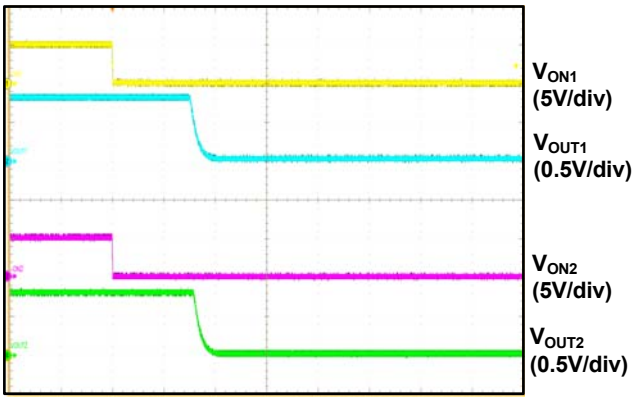
Turn-OFF & Turn-OFF Fall Times

(V_{INX} = 2.5V, V_{BIAS} = 2.5V, C_{INX} = 1µF, C_{TX} = 1nF, C_{LX} = 0.1µF, R_{LX} = 10Ω)



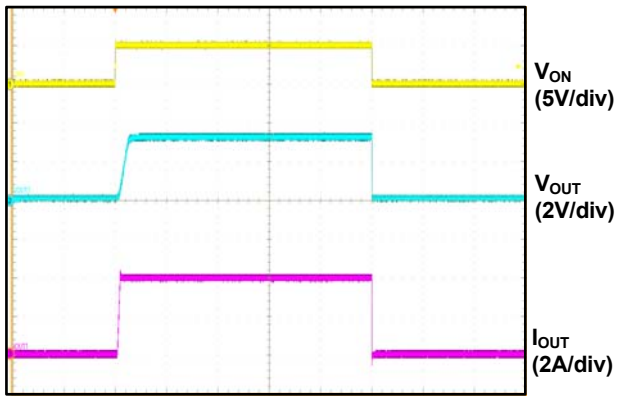
Turn-OFF & Turn-OFF Fall Times

(V_{INX} = 0.8V, V_{BIAS} = 2.5V, C_{INX} = 1µF, C_{TX} = 1nF, C_{LX} = 0.1µF, R_{LX} = 10Ω)



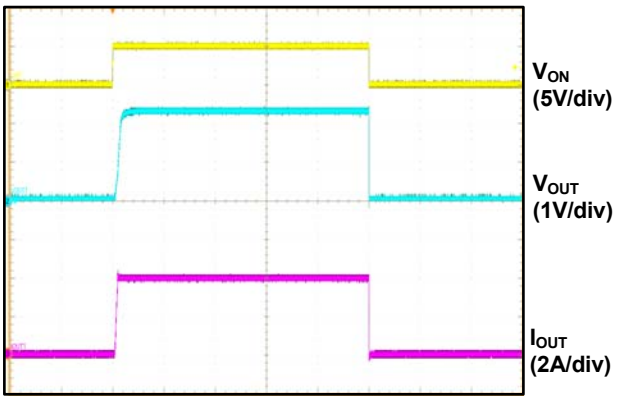
Turn-ON & Turn-OFF @ I_{OUT} = 6A

(V_{IN1} = 0.8V, V_{BIAS} = 5V, C_{IN1} = 4.7µF, C_{T1} = 1nF, C_{L1} = 4.7µF)



Turn-ON & Turn-OFF @ I_{OUT} = 6A

(V_{IN1} = 2.5V, V_{BIAS} = 5V, C_{IN1} = 4.7µF, C_{T1} = 1nF, C_{L1} = 4.7µF)



Detailed Description

ON/OFF Control

The AOZ1331ADI is enabled when the ON pin is on active high with 1.2V or above voltage. The device is disabled when the ON pin voltage is 0.5V or lower. The EN input is compatible with both TTL and CMOS logic.

Adjustable Rise Time

The slew rate of each channel can be adjusted individually by external capacitors connected to the corresponding CT and GND pins. Multiply the input voltage and the slew rate to obtain the rise time. The table below shows rise times, which are measured on a typical device at V_{BIAS} = 5V.

C_{TX} (pF)	Rise Time (µs) 10%~90%, C_{LX}=0.1µF, C_{INX}=1µF, R_{LX}=10Ω (Typical values at 25°C, 25V X7R 10% Ceramic Cap)						
	V_{INX}=5V	3.3V	1.8V	1.5V	1.2V	1.05V	0.8V
OPEN	72.5	57	43	40	37.5	34.5	31.5
220	432	316	193	165	141.5	128.5	106
470	876	610	363	311	261	235	190
1000	1630	1110	668	574	478	428	338
2200	3860	2580	1510	1295	1075	955	745
4700	8000	5540	3270	2780	2290	2050	1625
10000	18600	12600	7360	6300	5200	4560	3620

Applications Information

The basic AOZ1331ADI application circuit is shown in the first page. Component selection is explained below.

Input Capacitor Selection

A capacitor of 1µF or higher value is recommended to be place close to the IN pins of AOZ1331ADI. This capacitor can reduce the voltage drop caused by the in-rush current during the turn-on transient of the load switch. A higher value capacitor can be used to further reduce the voltage drop during high-current application.

Output Capacitor Selection

A capacitor of 0.1µF or higher value is recommended to be place between the OUT pins and GND. The switching times are affected by the capacitance. A larger capacitor makes the initial turn-on transient smoother. This capacitor must be large enough to supply a fast transient load in order to prevent the output from dropping.

Thermal Considerations

To ensure proper operation, the maximum junction temperature of the AOZ1331ADI should not exceed 150°C. Several factors attribute to the junction temperate rise: load current, MOSFET on-resistance, junction-to-ambient thermal resistance, and ambient temperature. The maximum load current can be determined by:

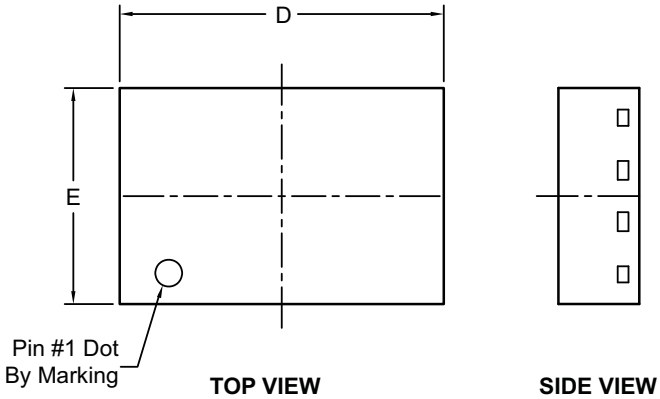
$$I_{LOAD(MAX)} = \sqrt{\frac{T_{J(MAX)} - T_C}{\Theta_{JC} \times R_{DSON}}}$$

It is noted that the maximum continuous load current is 6A.

Layout Guidelines

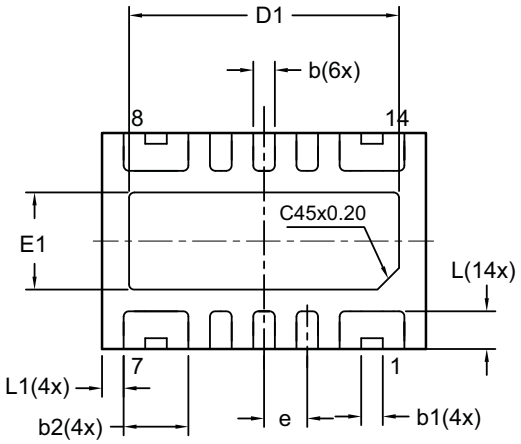
Good PCB is important for improving the thermal performance of AOZ1331ADI. Place the input and output bypass capacitors close to the IN and OUT pins. The input and output PCB traces should be as wide as possible for the given PCB space. Use a ground plane to enhance the power dissipation capability of the device.

Package Dimensions, DFN3x2A_14L, EP1_S

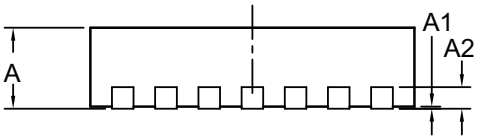


TOP VIEW

SIDE VIEW

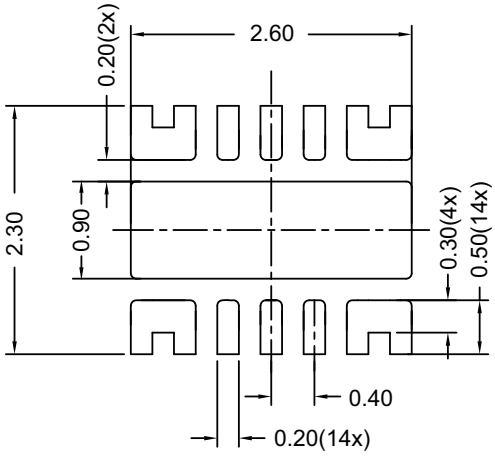


BOTTOM VIEW



SIDE VIEW

RECOMMENDED LAND PATTERN



Unit: mm

Dimensions in millimeters

Symbols	Min.	Typ.	Max.
A	0.70	0.75	0.80
A1	0.00	---	0.05
A2		0.2 REF	
E	1.90	2.00	2.10
E1	0.80	0.90	1.00
D	2.90	3.00	3.10
D1	2.40	2.50	2.60
L	0.30	0.35	0.40
L1	0.15	0.20	0.25
b	0.15	0.20	0.25
b1	0.15	0.20	0.25
b2	0.55	0.60	0.65
e		0.40 BSC	

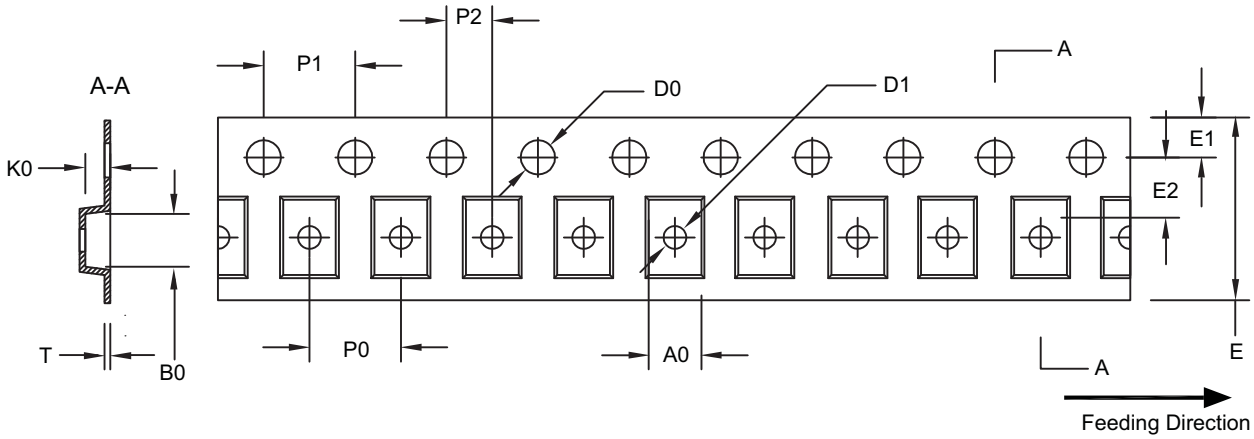
Dimensions in inches

Symbols	Min.	Typ.	Max.
A	0.028	0.030	0.031
A1	0.000	---	0.002
A2		0.008 REF	
E	0.075	0.079	0.083
E1	0.031	0.035	0.039
D	0.114	0.118	0.122
D1	0.094	0.098	0.102
L	0.012	0.014	0.016
L1	0.006	0.008	0.010
b	0.006	0.008	0.010
b1	0.006	0.008	0.010
b2	0.022	0.024	0.026
e		0.016 BSC	

Notes:
1. Controlling dimensions are in millimeters. Converted inch dimensions are not necessarily exact.
2. Tolerance is ±0.05, unless otherwise specified.
3. Radius on all corners is 0.152 (max), unless otherwise specified.
4. Package wrapage is 0.012 (max).
5. No plastic flash allowed on the top or bottom lead surface.
6. Pad planarity is ±0.102.
7. Crack between plastic body and lead is not allowed.

Tape and Reel Dimensions, DFN3x2A_14L, EP1_S

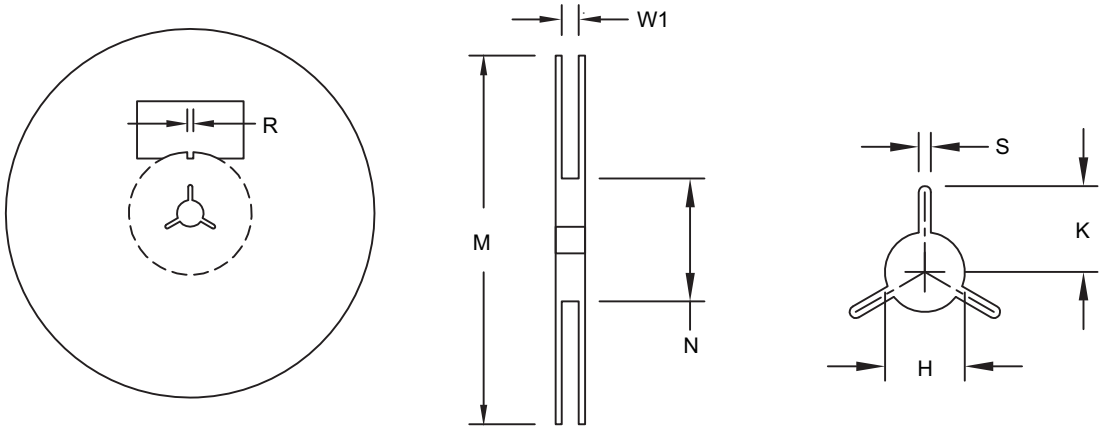
Carrier Tape



UNIT: MM

Package	A0	B0	K0	D0	D1	E	E1	E2	P0	P1	P2	T
PIC DFN3x2	2.20 ±0.10	3.20 ±0.10	1.03 ±0.10	1.50 +0.10 -0.0	1.00 +0.25 -0.0	8.00 +0.30 -0.1	1.75 ±0.10	3.50 ±0.05	4.00 ±0.10	4.00 ±0.10	2.00 ±0.05	0.23 ±0.02

Reel

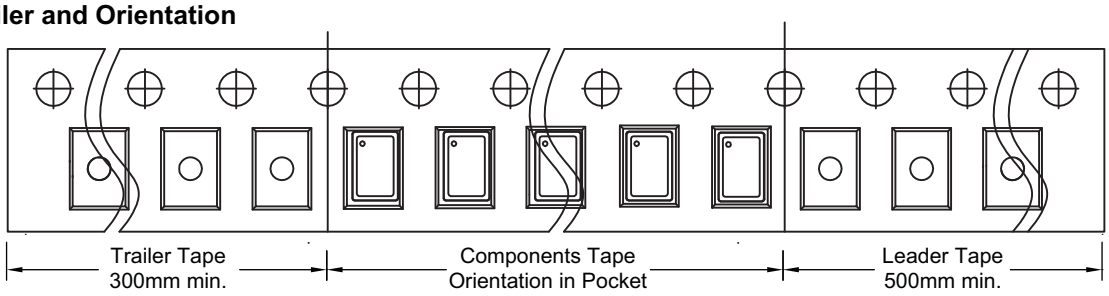


UNIT: MM

Tape Size	Reel Size	M	N	W1	H	S	K	R
8mm	Ø180	Ø180.00 ±0.50	60.00 ±0.50	8.40 +1.50 -0.0	13.00 ±0.20	1.50 MIN.	13.50 MIN.	3.00 ±0.50

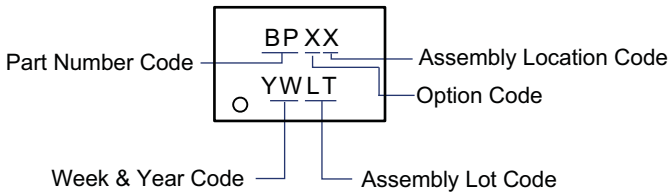
Leader/Trailer and Orientation

Unit Per Reel: 3000pcs



Package Marking

AOZ1331ADI
(DFN3x2-14)



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