AOZ1336DI

Single Channel Smart Load Switch

General Description

The AOZ1336DI is a single channel load switch with typical 27mΩ on-resistance in a small package. It contains an n-channel MOSFET for up to 5.5V input voltage operation and 4A current channel with 2.5V to 5V bias supply. The load switch is independently controlled by a low voltage control signal through ON pin.

The AOZ1336DI integrates an internal 220Ω load resistor for quick output discharge when load switch is off. The optional external capacitor connected CT for output slew rate control.

The AOZ1336DI is available in a 2mm x 2mm DFN-8L package with bottom thermal pad and is rated over -40°C to +85°C ambient temperature range.

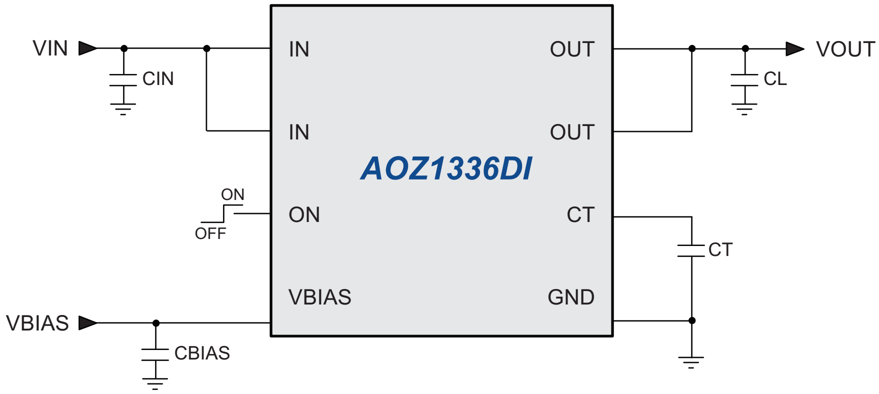
Features

- 0.8V to 5.5V input voltage range
- 4A continuous current
- Low $R_{DS(ON)}$ internal NFETs
  – 27mΩ at V_{BIAS} = 2.5V to 5V & $V_{BIAS} \geq V_{IN}$
- 50μA low quiescent current
- Adjustable rise time
- 2.5V to 5V bias voltage
- Integrated quick output discharge resistor
- Thermal shutdown
- Thermally enhanced 2mm x 2mm DFN-8L package

Applications

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

Typical Application

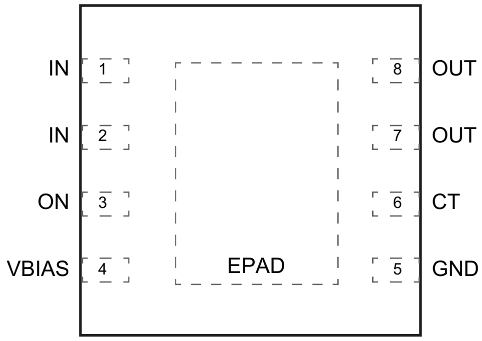


Ordering Information

Part Number	Temperature Range	Package	Environmental
AOZ1336DI	-40°C to +85°C	2mm x 2mm DFN-8L	Green

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

Pin Configuration



2mm x 2mm DFN-8
(Top View)

Pin Description

Pin Number	Pin Name	Pin Function
1, 2	IN	Load Switch Input. Bypass IN and GND with ceramic capacitor.
3	ON	Enable Input. Load switch is on when ON is pulled high. Load switch is off when ON is pulled low.
4	VBIAS	Supply input for the device.
5	GND	Ground.
6	CT	Load switch slew rate control.
7, 8	OUT	Load switch output.
EPAD	Exposed Pad	The exposed bottom pad must be connected to GND.

Absolute Maximum Ratings

Exceeding the Absolute Maximum ratings may damage the device.

Parameter	Rating
IN, ON, VBIAS, OUT 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 2x2 DFN-8 (Θ_{JC}) 2x2 DFN-8 (Θ_{JA})	 12°C/W 90°C/W

Electrical Characteristics

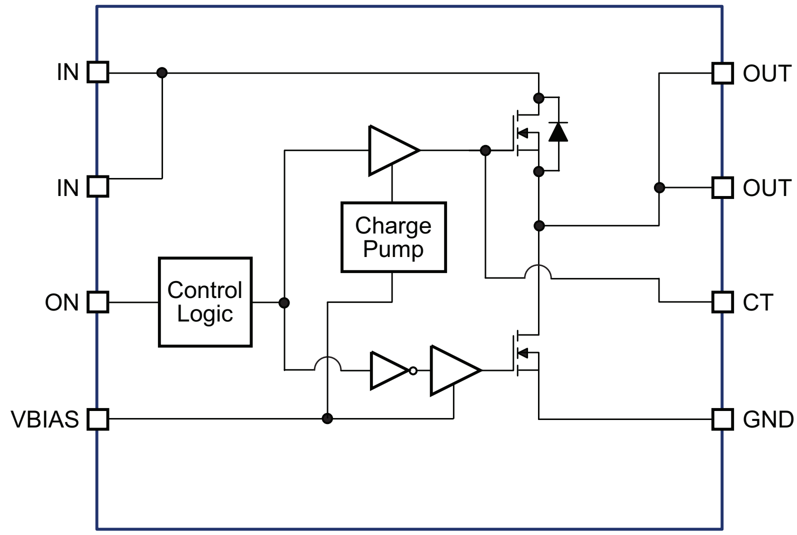
T_A = 25°C, V_{BIAS} = 5V, unless otherwise specified. Specifications in **BOLD** indicate a temperature range of -40°C to +85°C.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V_{IN}	IN Supply Voltage		0.8		V_{BIAS}	V
V_{BIAS}	VBIAS Supply Voltage		2.5		5.5	V
I_q	Quiescent Supply Current of V_{BIAS}	I_{OUT} = 0V, V_{ON} = 0V, V_{IN} = V_{ON} = 5V		50	75	µA
I_{OFF}	VBIAS Shutdown Supply Current	V_{ON} = 0V, V_{OUT} = 0V		1	2	µA
I_D	Maximum Continuous Current	V_{IN} = V_{ON} = 5V		4		A
I_{PLS}	Maximum Pulsed Switch Current	V_{IN} = V_{ON} = 5V Pulse < 300µs, 2% Duty Cycle		6		A
I_{INOFF}	IN Shutdown Supply Current	V_{ON} = 0V, V_{OUT} = 0V, V_{IN} = 5V		2.1	8	µA
		V_{ON} = 0V, V_{OUT} = 0V, V_{IN} = 3.3V		0.3	3	
		V_{ON} = 0V, V_{OUT} = 0V, V_{IN} = 1.8V		0.07	2	
		V_{ON} = 0V, V_{OUT} = 0V, V_{IN} = 0.8V		0.04	1	
I_{ON}	ON Leakage Current	V_{ON} = 5V			1	µA
V_{ONH}	ON High Level Voltage	V_{IN} = 0.8V to 5V	1.2			V
V_{ONL}	ON Low Level Voltage	V_{IN} = 0.8V to 5V			0.5	V
	Thermal Shutdown Threshold	T_J rising		180(1)		°C
		T_J falling		130		
Switching ON Resistance						
R_{ON}	Switch ON-State Resistance	I_{OUT} = -200mA, V_{IN} = 0.8V to 5V		27	33(2)	mΩ
R_{PD}	Output Pull-Down Resistance	I_{OUT} = 15mA, V_{IN} = 5V, V_{ON} = 0V		220	300	Ω

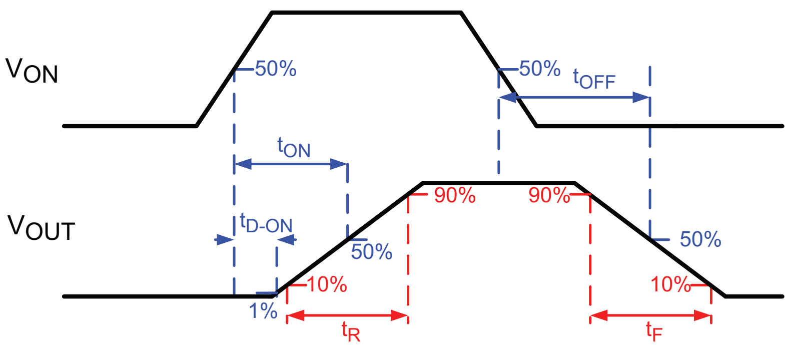
Notes:

1. Guarantee by design
2. Greater on-resistance if V_{IN} > V_{BIAS}

Functional Block



Switching Characteristics

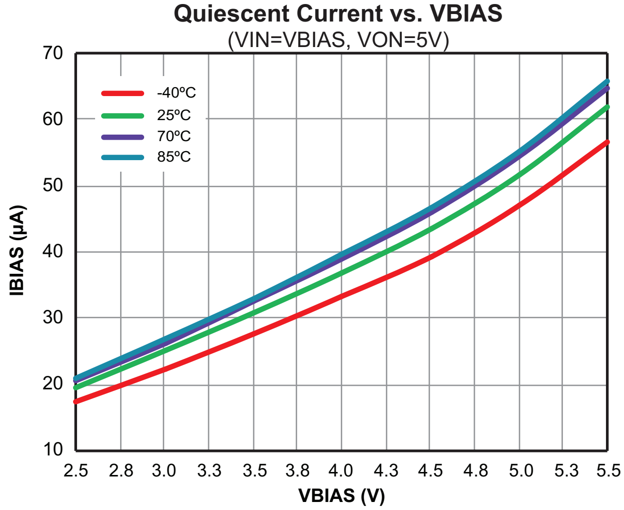


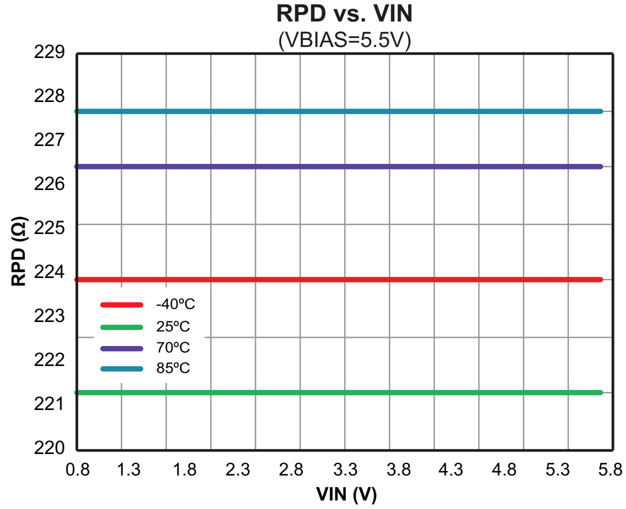
Test conditions: T_A = 25°C, C_{IN} = 1μF, C_T = 1nF, C_L = 0.1μF, R_L = 10Ω (unless otherwise specified).

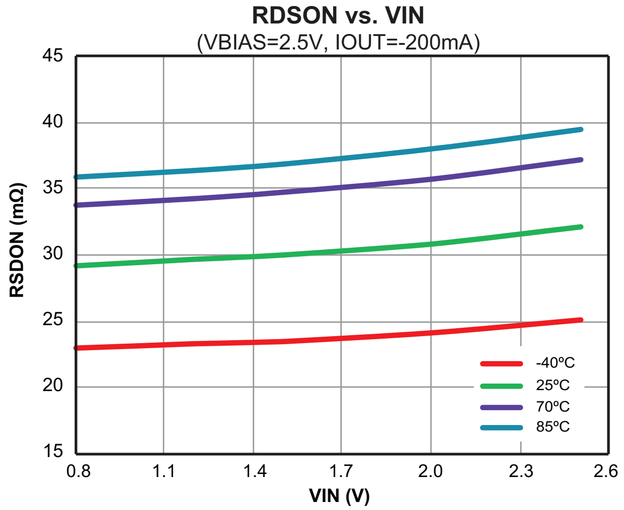
Symbol	Parameter	Min.	Typ.	Max.	Units
VIN = 5V, VBIAS = VON = 5V					
t_{ON}	Turn-ON Time		1420		μs
t_{D-ON}	Turn-ON Delay time		450		
t_R	Turn-ON Rise Time		1740		
t_{OFF}	Turn-OFF Time		7.7		
t_F	Turn-OFF Fall Time		2.5		
VIN = 0.8V, VBIAS = VON = 5V					
t_{ON}	Turn-ON Time		620		μs
t_{D-ON}	Turn-ON Delay time		450		
t_R	Turn-ON Rise Time		280		
t_{OFF}	Turn-OFF Time		89		
t_F	Turn-OFF Fall Time		10		

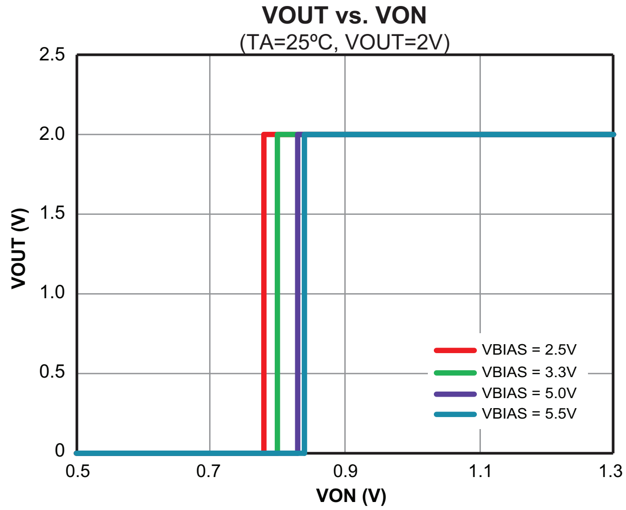
Symbol	Parameter	Min.	Typ.	Max.	Units
VIN = 2.5V, VBIAS = VON = 2.5V					
t_{ON}	Turn-ON Time		2100		μs
t_{D-ON}	Turn-ON Delay time		780		
t_R	Turn-ON Rise Time		2200		
t_{OFF}	Turn-OFF Time		8		
t_F	Turn-OFF Fall Time		2.5		
VIN = 0.8V, VBIAS = VON = 2.5V					
t_{ON}	Turn-ON Time		1250		μs
t_{D-ON}	Turn-ON Delay time		730		
t_R	Turn-ON Rise Time		750		
t_{OFF}	Turn-OFF Time		76		
t_F	Turn-OFF Fall Time		10		

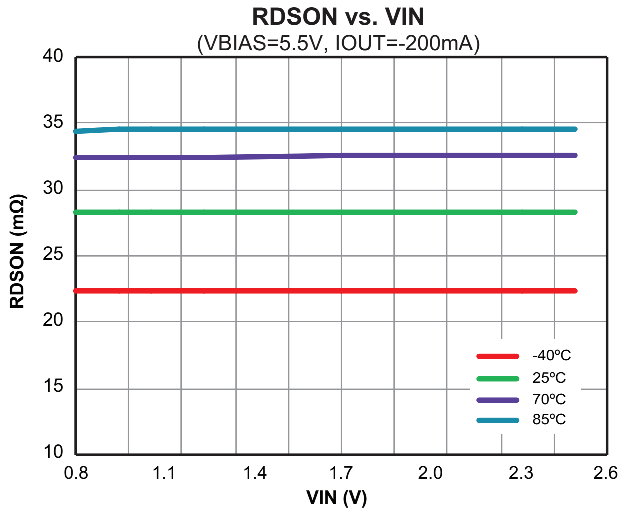
Typical Characteristics



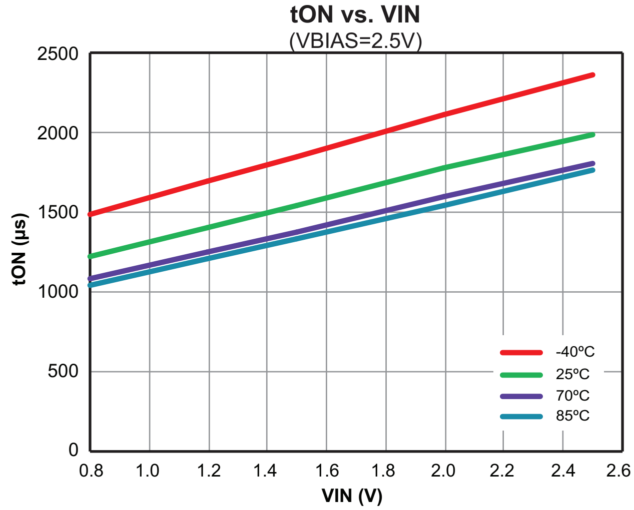


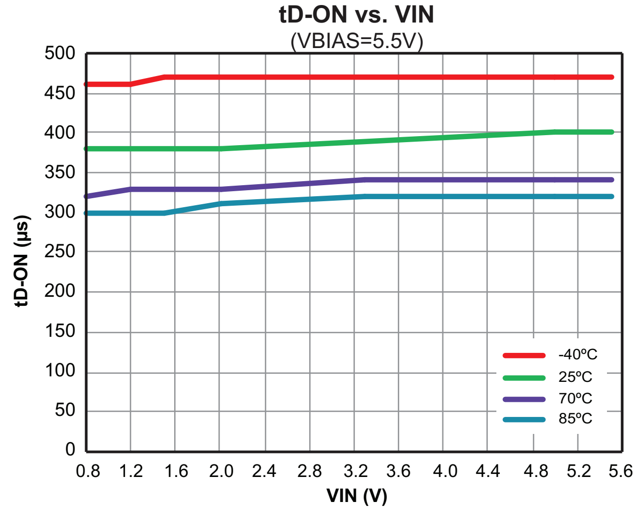


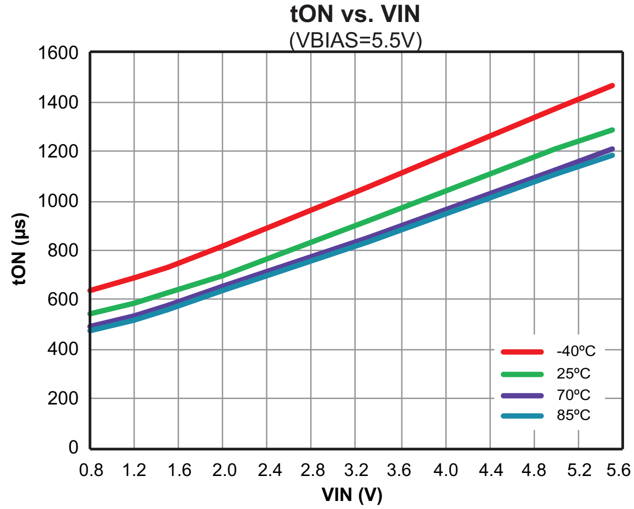


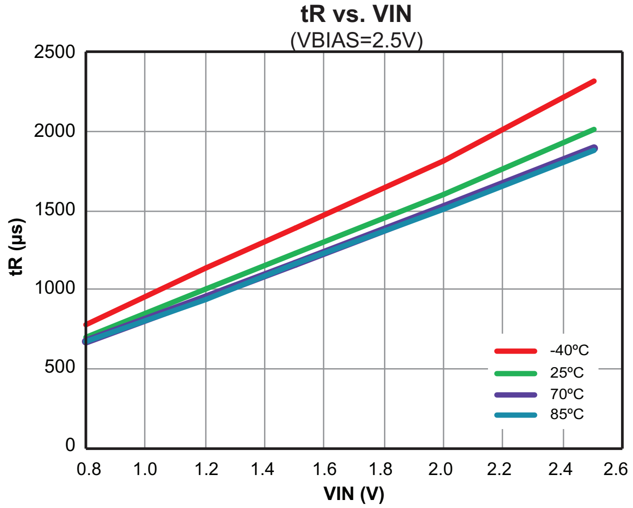


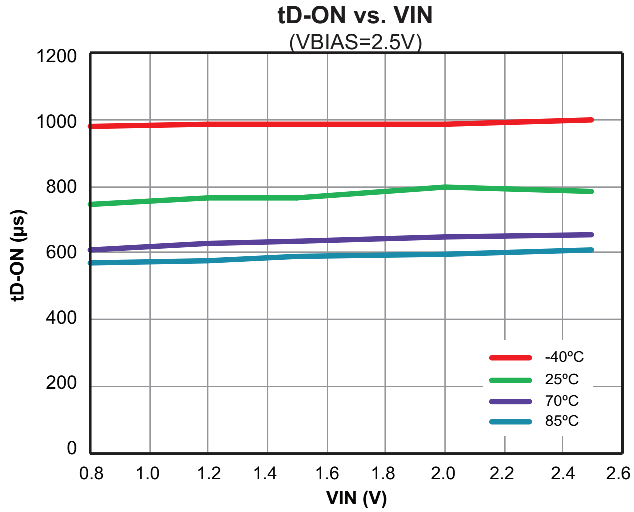
Typical Characteristics (Continued)

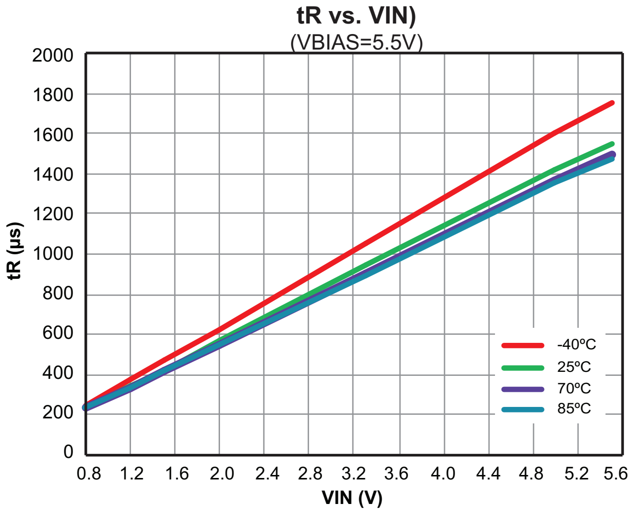




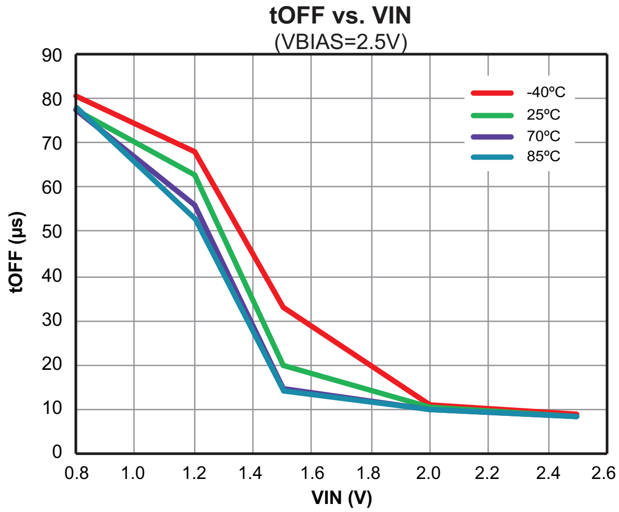


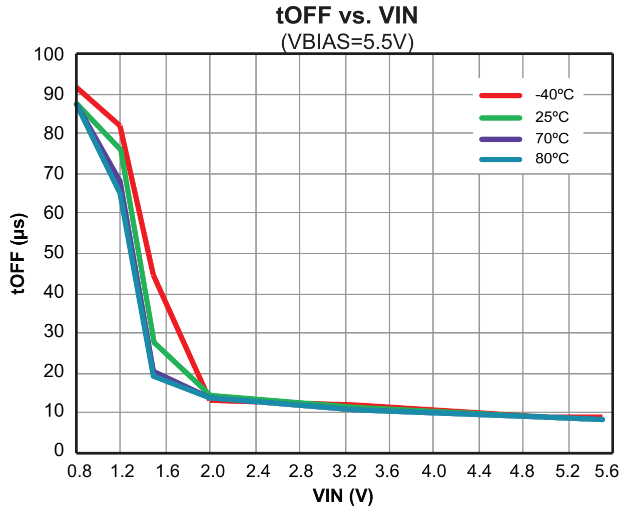


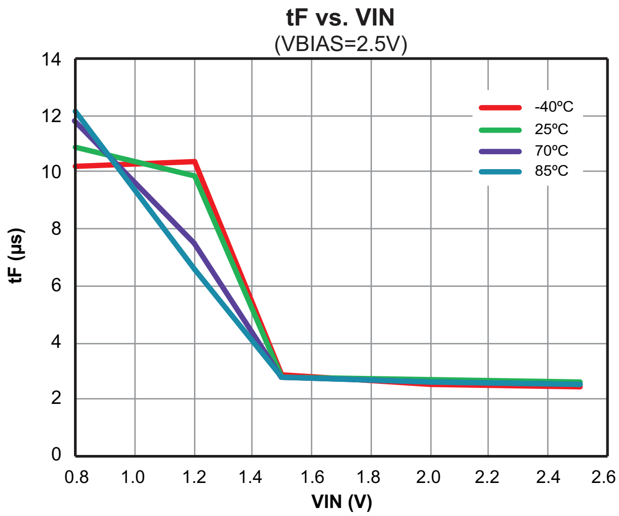


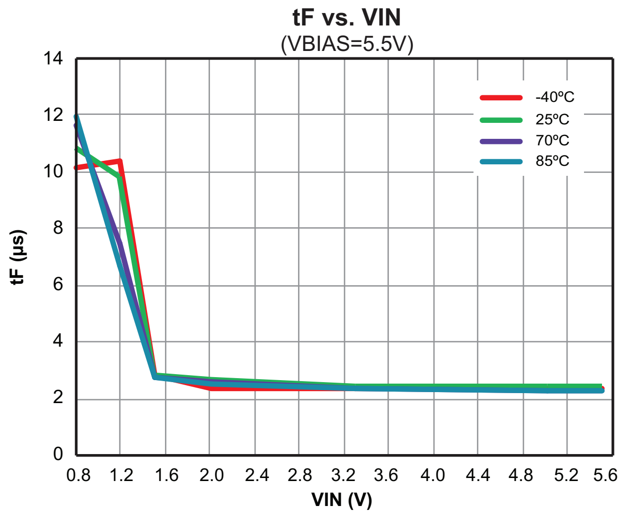


Typical Characteristics (Continued)



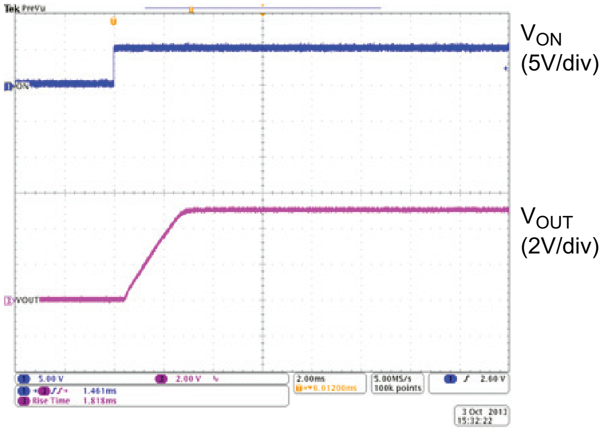




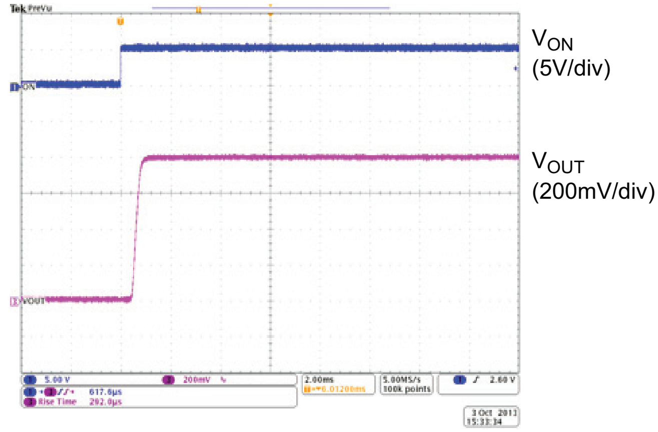


Functional Characteristics

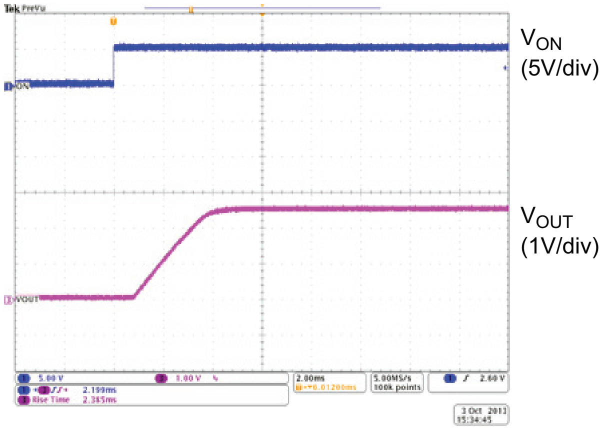
Turn-ON & Turn-ON Rise Times
(V_{IN}=5V, V_{BIAS}=5V, C_{IN}=1µF, C_T=1nF, C_L=0.1µF, R_L=10Ω)



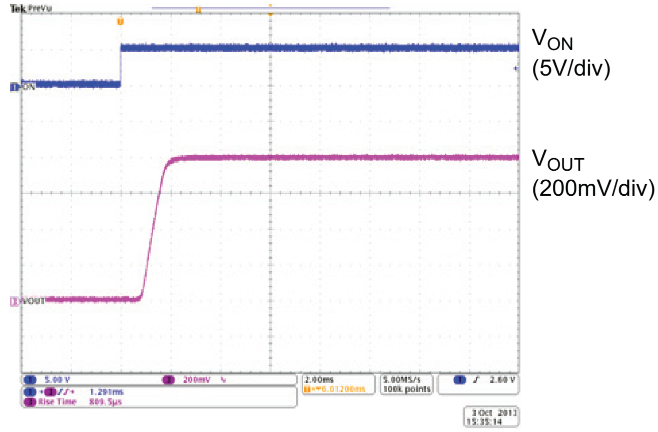
Turn-ON & Turn-ON Rise Times
(V_{IN}=0.8V, V_{BIAS}=5V, C_{IN}=1µF, C_T=1nF, C_L=0.1µF, R_L=10Ω)



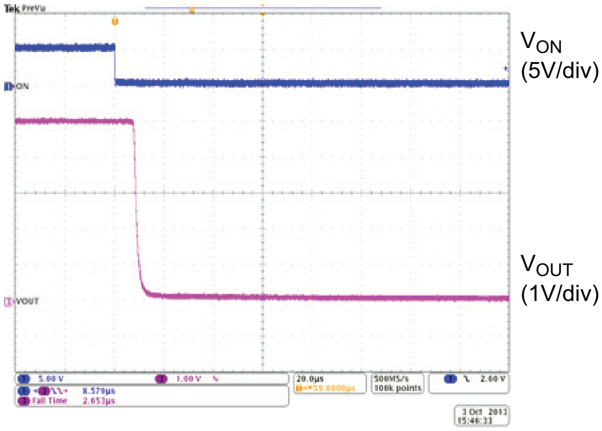
Turn-ON & Turn-ON Rise Times
(V_{IN}=2.5V, V_{BIAS}=2.5V, C_{IN}=1µF, C_T=1nF, C_L=0.1µF, R_L=10Ω)



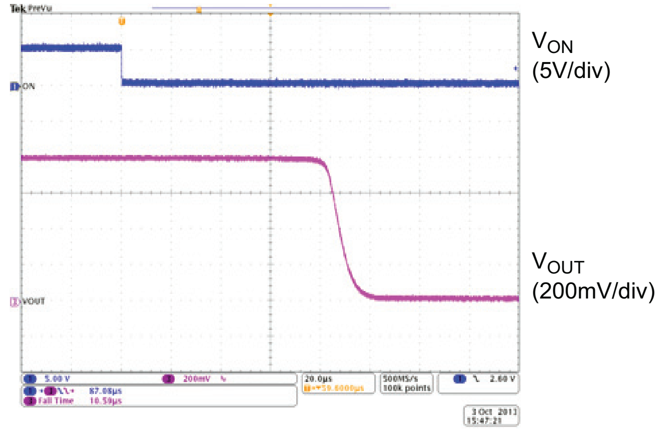
Turn-ON & Turn-ON Rise Times
(V_{IN}=0.8V, V_{BIAS}=2.5V, C_{IN}=1µF, C_T=1nF, C_L=0.1µF, R_L=10Ω)



Turn-OFF & Turn-OFF Fall Times
(V_{IN}=5V, V_{BIAS}=5V, C_{IN}=1µF, C_T=1nF, C_L=0.1µF, R_L=10Ω)



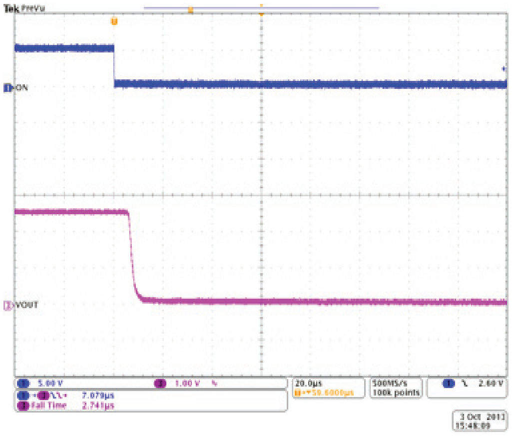
Turn-OFF & Turn-OFF Fall Times
(V_{IN}=0.8V, V_{BIAS}=5V, C_{IN}=1µF, C_T=1nF, C_L=0.1µF, R_L=10Ω)



Functional Characteristics (Continued)

Turn-OFF Fall Times

(V_{IN}=2.5V, V_{BIAS}=2.5V, C_{IN}=1µF, C_T=1nF, C_L=0.1µF, R_L=10Ω)

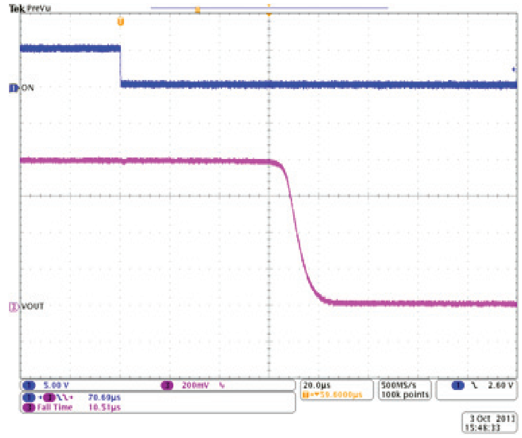


V_{ON} (5V/div)

V_{OUT} (1V/div)

Turn-OFF Fall Times

(V_{IN}=0.8V, V_{BIAS}=2.5V, C_{IN}=1µF, C_T=1nF, C_L=0.1µF, R_L=10Ω)

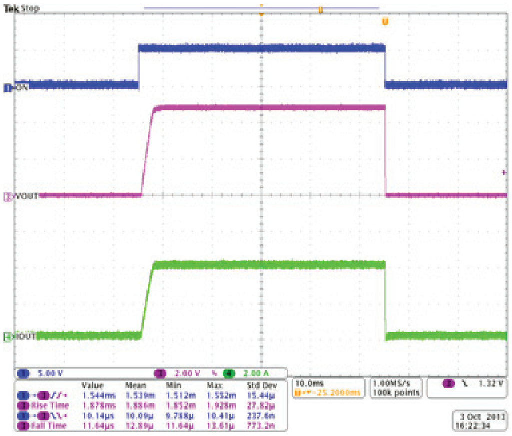


V_{ON} (5V/div)

V_{OUT} (200mV/div)

Turn-ON & Turn-OFF @ I_{OUT} = 4A

(V_{IN}=5V, V_{BIAS}=5V, C_{IN}=4.7µF, C_L=4.7µF)



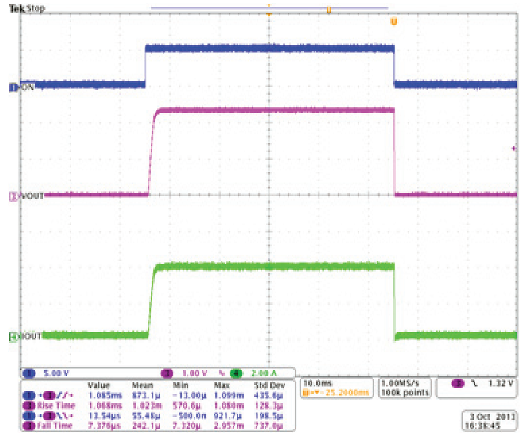
V_{ON} (5V/div)

V_{OUT} (2V/div)

I_{OUT} (2A/div)

Turn-ON & Turn-OFF @ I_{OUT} = 4A

(V_{IN}=2.5V, V_{BIAS}=5V, C_{IN}=4.7µF, C_L=4.7µF)



V_{ON} (5V/div)

V_{OUT} (1V/div)

I_{OUT} (2A/div)

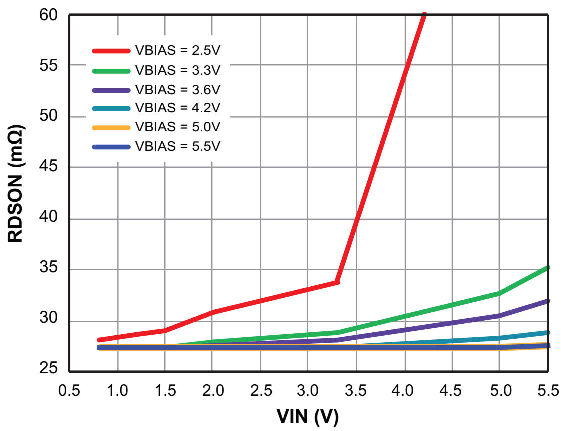
Detailed Description

ON/OFF Control

The AOZ1336DI 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.

VBIAS Voltage Range

For optimal on-resistance of load switch, make sure $V_{IN} \le V_{BIAS}$ and V_{BIAS} is within the voltage range from 2.5V to 5.5V. On-resistance of load switch will be higher if $V_{IN} > V_{BIAS}$. Resistance curves of a typical sample device at different V_{BIAS} and different V_{IN} are shown as below.



Adjustable Rise Time

The slew rate of VOUT can be adjusted 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_T (pF)	Rise Time (µs) 10%~90%, C_L=0.1µF, C_{IN}1µF, R_L=10Ω (Typical values at 25°C, 25V X7R 10% Ceramic Cap)						
	V_{IN}=5V	3.3V	1.8V	1.5V	1.2V	1.05V	0.8V
0	58	42	33	29	26	24	22
220	372	226	130	104	91	81	66
470	740	486	255	198	169	148	115
1000	1607	1021	570	452	366	322	252
2200	3532	2447	1351	1139	904	785	664
4700	7275	4708	2802	2277	1920	1663	1286
10000	16640	10700	6372	5176	4425	3868	3098

Applications Information

The basic AOZ1336DI 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 AOZ1336DI. 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 AOZ1336DI 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:

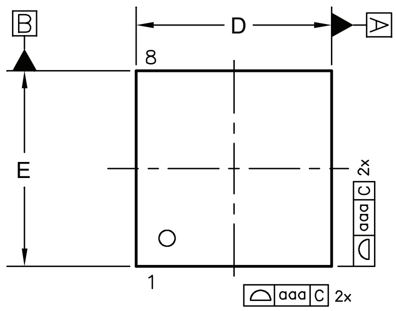
$$I_{LOAD(MAX)} = \sqrt{\frac{T_{J(MAX)} - T_C}{\Theta_{JC} \times R_{DSON}}}$$

It is noted that the maximum continuous load current is 4A.

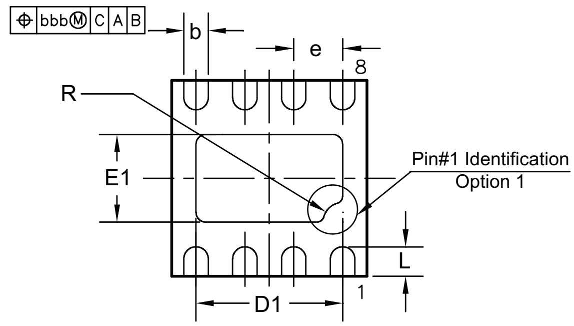
Layout Guidelines

Good PCB is important for improving the thermal performance of AOZ1336DI. 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.

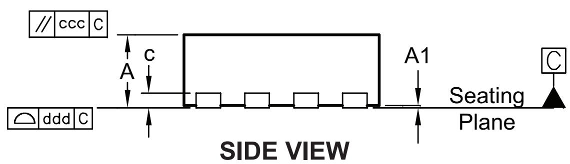
Package Dimensions, DFN2x2_8L



TOP VIEW

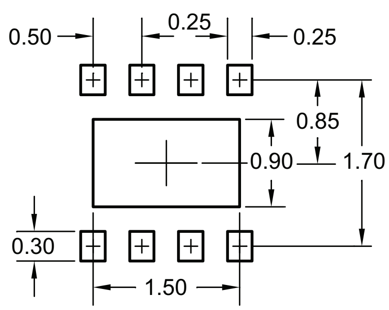


BOTTOM VIEW



SIDE VIEW

RECOMMENDED LAND PATTERN



UNIT: mm

Dimensions in millimeters

Symbols	Min.	Nom.	Max.
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
b	0.18	0.25	0.30
c		0.20 REF	
D	1.90	2.00	2.10
D1	1.10	1.50	1.60
E	1.90	2.00	2.10
E1	0.50	0.90	1.00
e		0.50 BSC	
L	0.20	0.30	0.40
R		0.20	
aaa		0.15	
bbb		0.10	
ccc		0.10	
ddd		0.08	

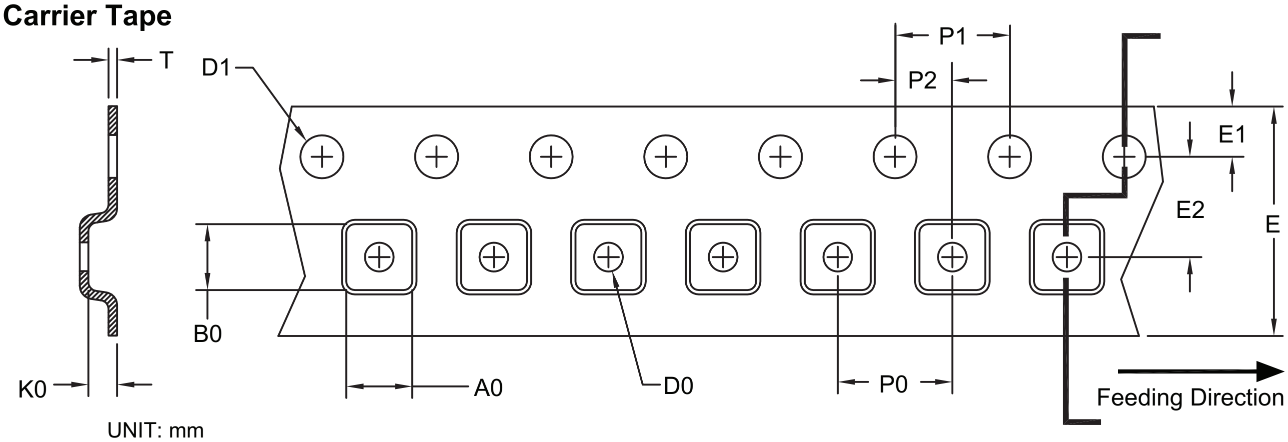
Dimensions in inches

Symbols	Min.	Nom.	Max.
A	0.028	0.030	0.031
A1	0.000	0.001	0.002
b	0.007	0.010	0.012
c		0.008 REF	
D	0.075	0.079	0.083
D1	0.043	0.059	0.063
E	0.075	0.079	0.083
E1	0.020	0.035	0.039
e		0.020 BSC	
L	0.008	0.012	0.016
R		0.008	
aaa		0.006	
bbb		0.004	
ccc		0.004	
ddd		0.003	

Notes:
1. Dimensions and tolerances conform to ASME Y14.5M-1994.
2. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.
3. Dimension b applied to metallized terminal and is measured between 0.10mm and 0.30mm from the terminal tip. If the terminal has the optional radius on the other end of the terminal, dimension b should not be measured in that radius area.
4. Coplanarity ddd applies to the terminals and all other bottom surface metallization.

Tape and Reel Dimensions, DFN2x2_8L

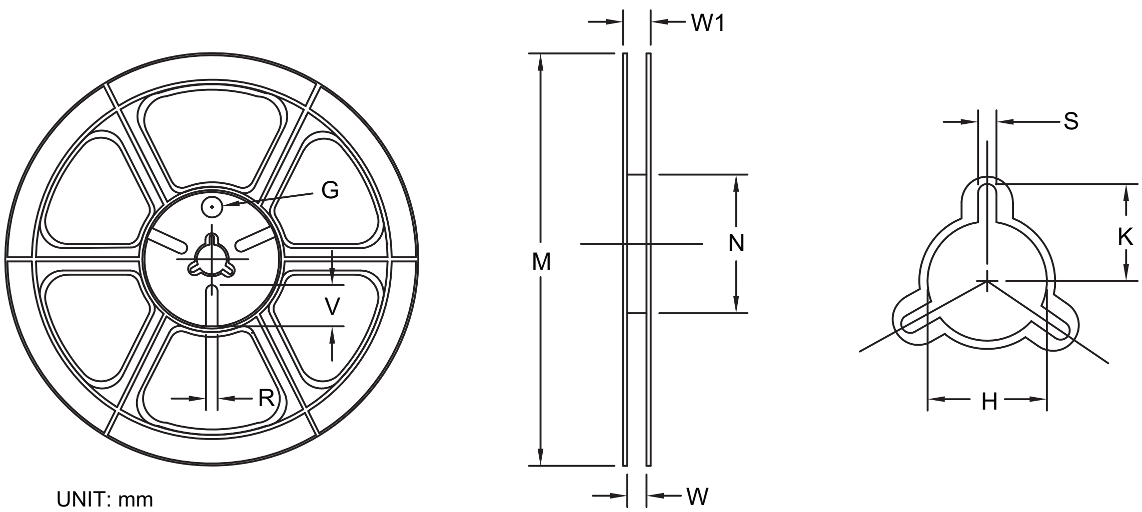
Carrier Tape



UNIT: mm

Package	A0	B0	K0	D0	D1	E	E1	E2	P0	P1	P2	T
DFN 2x2	2.30 ±0.20	2.30 ±0.20	1.00 ±0.20	1.00 MIN.	1.50 +0.10/-0.0	8.00 +0.30/-0.10	1.75 ±0.10	3.50 ±0.05	4.00 ±0.20	4.00 ±0.20	2.00 ±0.05	0.30 ±0.05

Reel

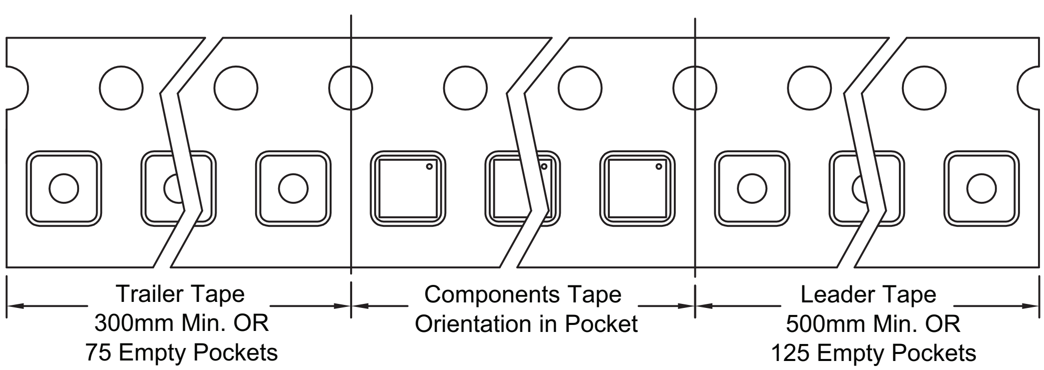


UNIT: mm

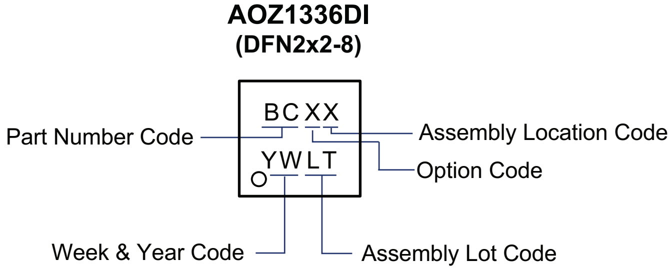
Tape Size	Reel Size	M	N	W	W1	H	K	S	G	R	V
8mm	ø178	ø178.00 ±1.00	ø70.50 ±1.00	9.00 ±0.50	11.80 ±1.10	ø13.00 +0.5/-0.2	10.25 ±0.20	2.40 ±0.10	ø9.80	N/A	N/A

Leader / Trailer & Orientation

Unit Per Reel:
3000pcs



Package Marking



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1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.

2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.