

## General Description

The AOZ6186 is a low-voltage high-speed Double-Pole, Double-Throw (DPDT) switch for switching between two USB 2.0 (480 Mbps) sources. The device features very low on capacitance (5 pF typ.) and is designed to operate from a single 1.65 V to 4.5 V supply. The AOZ6186 features an ultra-low on resistance (7  $\Omega$  typ.), and low power consumption. The device also features fast switching and guaranteed Break-Before-Make (BBM) switching, assuring the switches never short the driver.

## Features

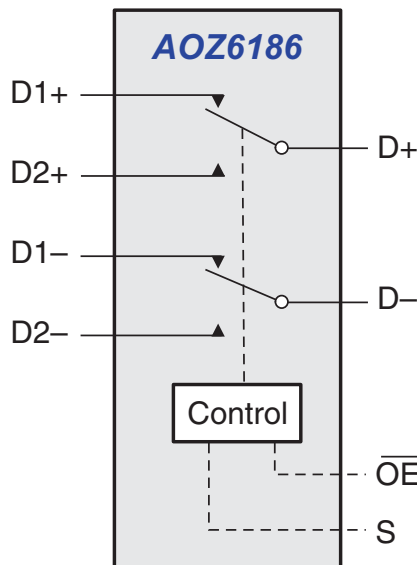
- Low On Resistance ( $R_{ON}$ ) for 3.6 V supply (7  $\Omega$ )
- Low On Capacitance ( $C_{ON}$ ) for 3.6 V supply (5 pF)
- Over-voltage tolerance (OVT) on all data ports up to 5.5 V
- QFN-10: 1.8 mm x 1.4 mm x 0.55 mm
- Broad 1.65 V to 4.50 V  $V_{CC}$  operating range
- Wide -3 dB bandwidth: 960 MHz typ.

## Applications

- Cell phone
- PDA
- Portable media player



## Typical Application



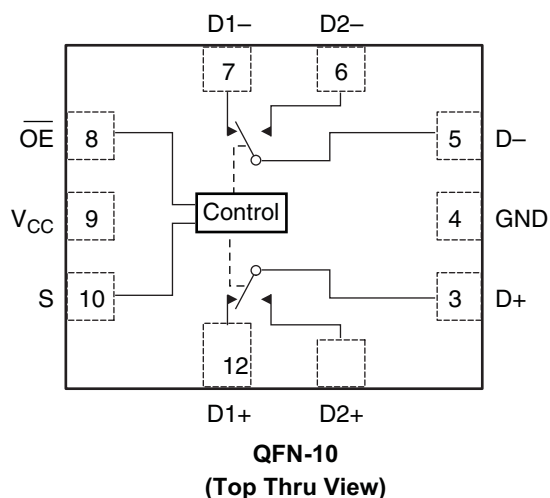
## Ordering Information

Part Number	Ambient Temperature Range	Package	Environmental
AOZ6186QT	-40 °C to +85 °C	QFN-10	Green Product



AOS Green Products use reduced levels of Halogens, and are also RoHS compliant. Please visit [www.aosmd.com/web/quality/rohs\\_compliant.jsp](http://www.aosmd.com/web/quality/rohs_compliant.jsp) for additional information.

## Pin Configuration



## Pin Description

Pin Name	Function
S	Control Input
$\overline{\text{OE}}$	Output Enable
D1+, D1-, D2+, D2-, D+, D-	Data Ports

## Truth Table

$\overline{\text{OE}}$	S	D1+, D1-	D2+, D2-
1	X	Off	Off
0	0	On	Off
0	1	Off	On

## Absolute Maximum Ratings

Exceeding the Absolute Maximum Ratings may damage the device.

Symbol	Parameter	Rating	
$V_{CC\text{ Su}}$	Supply Voltage	-0.5 V to +5.5 V	
$V_S\text{ Swi}$	Switch Voltage	-0.5 V to $V_{CC} + 0.3\text{ V}$	
$V_{IN}$	Input Voltage	-0.5 V to +4.6 V	
$I_{IK}$	Minimum Input Diode Current	-50 mA	
$I_{SW\text{ Swit}}$	Switch Current	100 mA	
$T_{STG}$	Storage Temperature Range	-65 °C to +150 °C	
$T_J$	Maximum Junction Temperature	+150 °C	
$T_L$	Lead Temperature (Soldering, 10 seconds)	+260 °C	
ESD	Human Body Model	All Pins	3000 V
		I/O to GND	5000 V
		Power to GND	5000 V

## Maximum Operating Conditions

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

Symbol	Parameter	Rating
$V_{CC}$ Supply	y Voltage	1.65 V to 4.5 V
$V_{IN}$	Control Input Voltage <sup>(1)</sup>	0 V to $V_{CC}$
$V_{SW}$	Switch Input Voltage	0 V to $V_{CC}$
$T_A$	Operating Temperature	-40 °C to +85 °C

**Note:**

1. Unused inputs must be held HIGH or LOW. They may not float.

## DC Electrical Characteristics

Unless otherwise indicated, specifications indicate a temperature range of -40 °C to +85 °C.

All typical values are at 25 °C unless otherwise specified.

Symbol	Parameter	Conditions	$V_{CC}$ (V)	Min.	Typ.	Max.	Units
$V_{CL}$	Clamp Voltage	$I_{IN} = -18$ mA	3.0			-1.2	V
$V_{IH}$	Input Voltage HIGH		4.3	1.4			V
			2.7 to 3.6	1.3			
			2.3 to 2.7	1.1			
			1.65 to 1.95	0.9			
$V_{IL}$	Input Voltage LOW		4.3			0.7	V
			2.7 to 3.6			0.5	
			2.3 to 2.7			0.4	
			1.65 to 1.95			0.4	
$I_{IN}$	Control Input Leakage	$V_{IN} = 0$ V to $V_{CC}$	1.65 to 4.5	-1.0		1.0	$\mu$ A
$I_{OZ}$	Off State Leakage	$V_{IN} = 0$ V to $V_{CC}$	1.65 to 4.5	-1.0		1.0	$\mu$ A
$I_{OFF}$	Power OFF Leakage Current (I/O ports)	$V_{IN} = 0$ V to $V_{CC}$	0	-1.0		1.0	$\mu$ A
$R_{ON}$	On-Resistance	$I_{ON} = 8$ mA, $V_{IN} = 0$ V to 0.4 V	4.3		7	10	$\Omega$
			2.7 to 3.6		9	12	
			2.3 to 2.7		12	16	
$\Delta R_{ON}$	On-Resistance Matching	$I_{ON} = 8$ mA, $V_{IN} = 0$ V to 0.4 V	4.3		0.6		$\Omega$
			2.7 to 3.6		0.6		
			2.3 to 2.7		0.6		
$R_{FLAT} (ON)$	On-Resistance Flatness	$I_{ON} = 8$ mA, $V_{IN} = 0$ V to 0.4 V	4.3		0.4		$\Omega$
			2.7 to 3.6		1.5		
			2.3 to 2.7		1.8		
$I_{CC}$	Quiescent Supply Current	$I_{OUT} = 0$ mA	4.3			1.0	$\mu$ A
$I_{CCT}$	Increase in $I_{CC}$ per Input Control Voltage	$V_{Control} = 2.6$ V	4.3		3.0	7.0	$\mu$ A
		$V_{Control} = 1.8$ V			7.0	15.0	

## AC Electrical Characteristics

Unless otherwise indicated, specifications indicate a temperature range of -40 °C to +85 °C.

All typical values are at 25 °C unless otherwise specified.

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	Min.	Typ.	Max.	Units
t <sub>ON</sub>	Turn-On Time	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF	3.6 to 4.3		18	35	ns
			2.7 to 3.6		21	45	
			2.3 to 2.7		36	65	
			1.65 to 1.95		80	120	
t <sub>OFF</sub>	Turn-Off Time	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF	3.6 to 4.3		11	30	ns
			2.7 to 3.6		11	40	
			2.3 to 2.7		14	55	
			1.65 to 1.95		59	100	
t <sub>PD</sub>	Propagation Delay	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF	1.65 to 4.5		0.25		ns
t <sub>BBM</sub>	Break-Before-Make	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF	1.65 to 4.5		6.2		ns
O <sub>IRR</sub>	Off Isolation	R <sub>L</sub> = 50 Ω, f = 240 MHz	1.65 to 4.5		-36		dB
X <sub>TALK</sub>	Crosstalk	R <sub>L</sub> = 50 Ω, f = 240 MHz	1.65 to 4.5		-40		dB
BW	-3 dB Bandwidth	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 0 pF	1.65 to 4.5		960		MHz

## USB Hi-Speed AC Electrical Characteristics

Unless otherwise indicated, specifications indicate a temperature range of -40 °C to +85 °C.

All typical values are at 25 °C unless otherwise specified.

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	Min.	Typ.	Max.	Units
t <sub>SK</sub>	Skew of Opposite Transitions of the Same Output	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF	1.65 to 4.5		20		ps
t <sub>J</sub>	Total Jitter	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, t <sub>r</sub> = t <sub>f</sub> = 500 ps (10% to 90%), f = 480MHz, PRBS = 2 <sup>15</sup> - 1	1.65 to 4.5		200		ps

## Capacitance

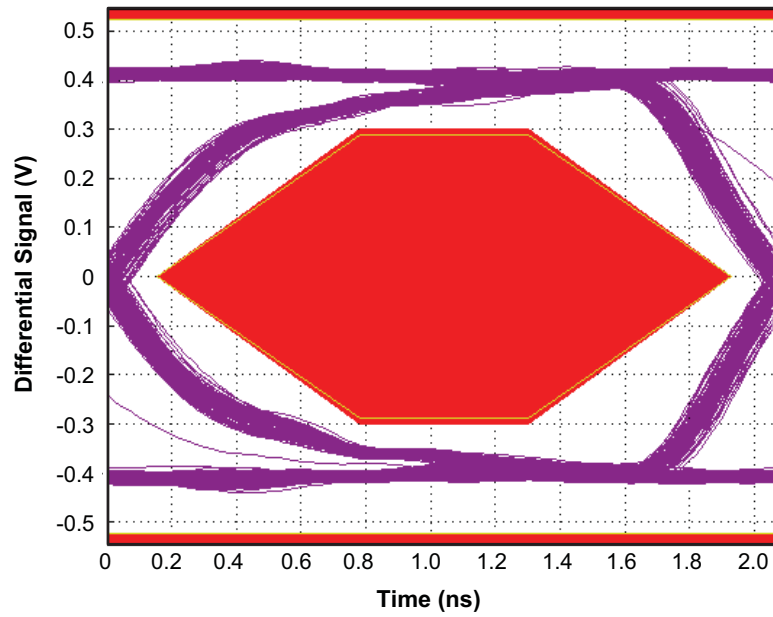
Unless otherwise indicated, specifications indicate a temperature range of -40 °C to +85 °C.

All typical values are at 25 °C unless otherwise specified.

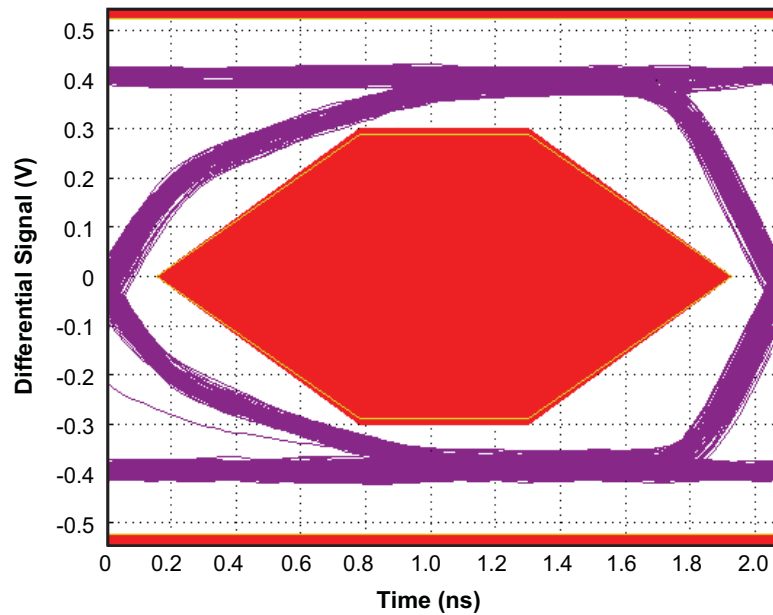
Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	Min.	Typ.	Max.	Units
C <sub>IN</sub>	Control Pin Input Capacitance	1 MHz	3.3		1.7		pF
		10 MHz			1.7		
C <sub>ON</sub>	D+/D- On Capacitance	$\overline{OE} = 0V, f = 1 \text{ MHz}$	3.3		4.7		
		$\overline{OE} = 0V, f = 10 \text{ MHz}$			5.0		
C <sub>OFF</sub>	HSD1n/HSD2n Off Capacitance	$\overline{OE} = V_{CC}, f = 1 \text{ MHz}$	3.3		1.8		
		$\overline{OE} = 0V, f = 10 \text{ MHz}$			2.0		

## Eye Patterns

480-Mbps USB Signal Without AOZ6186QT

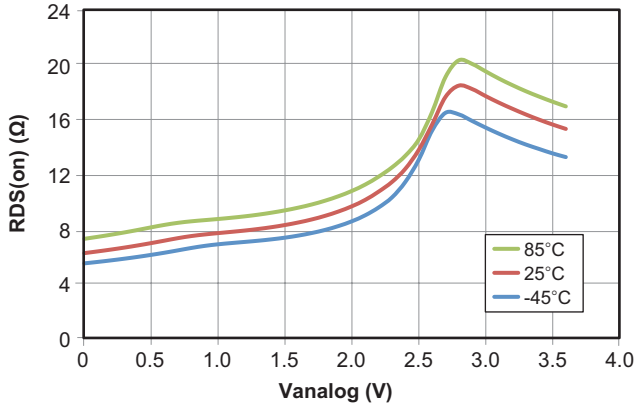


480-Mbps USB Signal With AOZ6186QT

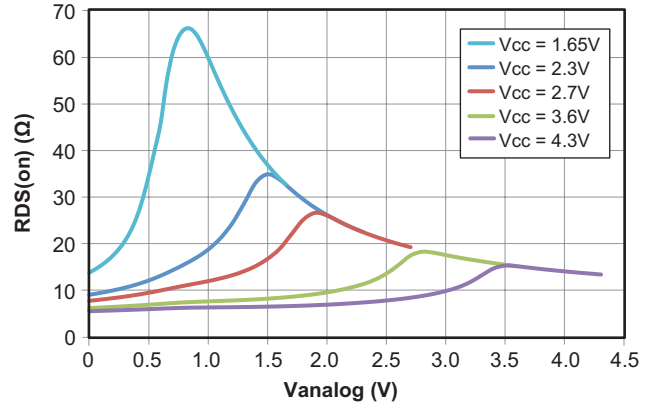


### Typical Performance Characteristics

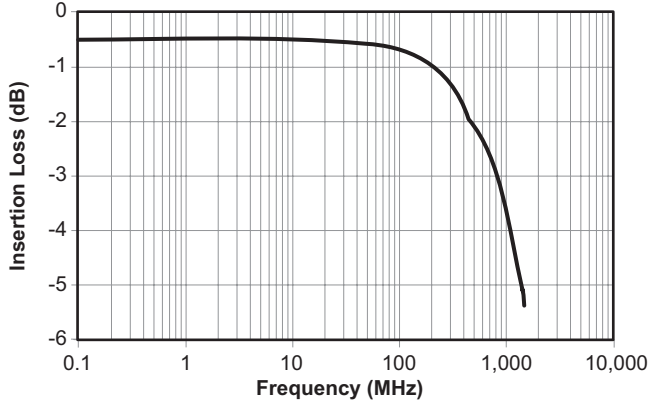
**RDS(on) vs. Analog Voltage**  
(V<sub>cc</sub> = 3.6V)



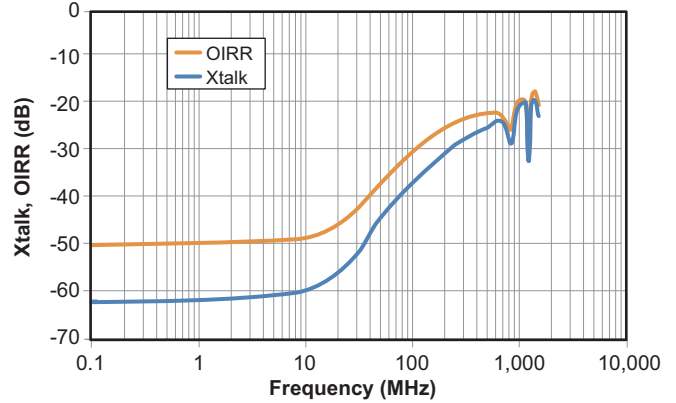
**RDS(on) vs. Analog Voltage**  
(at 25°C)



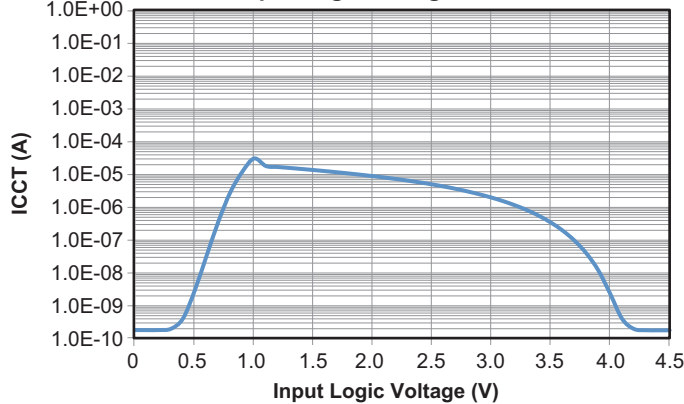
**Insertion Loss vs. Frequency**



**Xtalk and Off Isolation vs. Frequency**



**Input Logic Voltage vs. ICCT**



## AC Loading and Waveforms

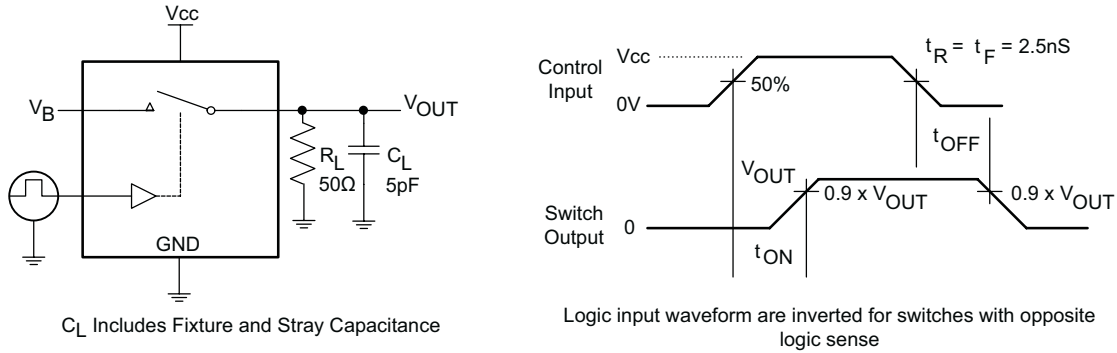


Figure 1. Turn-On/Turn-Off Timing

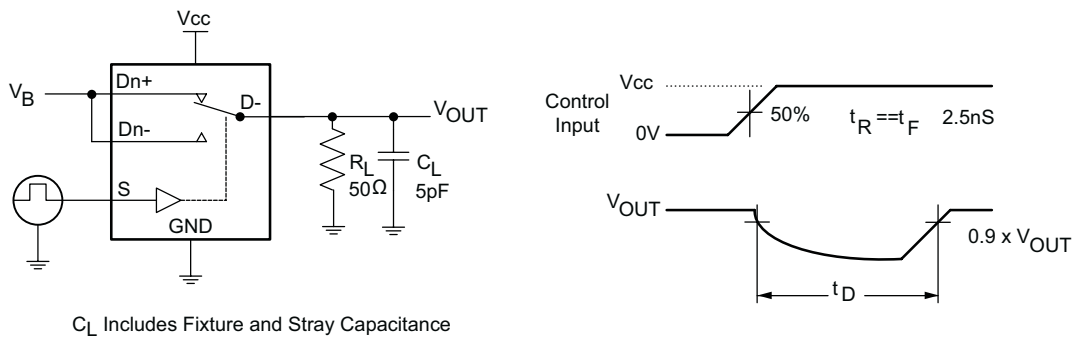


Figure 2. Break-Before-Make Timing

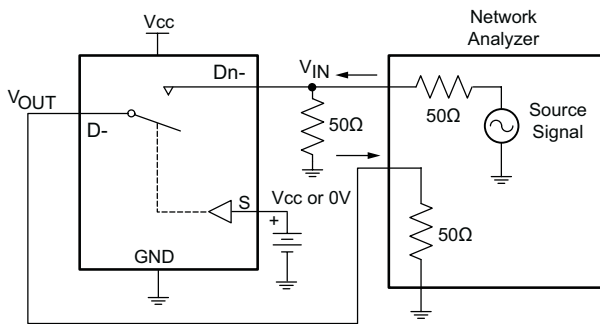


Figure 3. Off Isolation

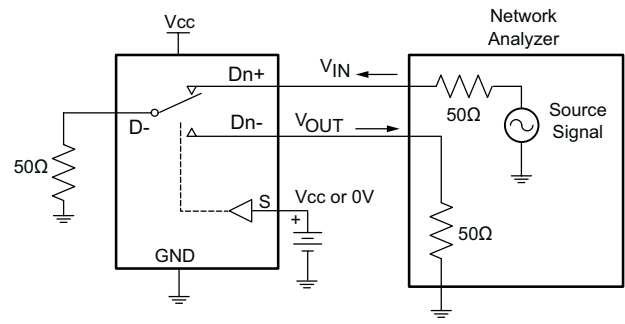


Figure 4. Crosstalk

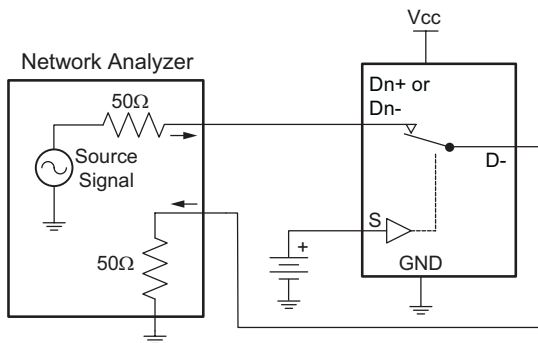


Figure 5. Bandwidth

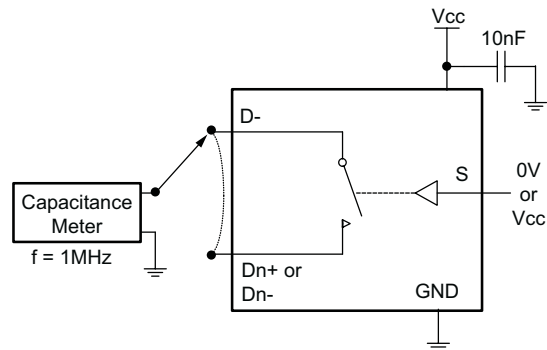
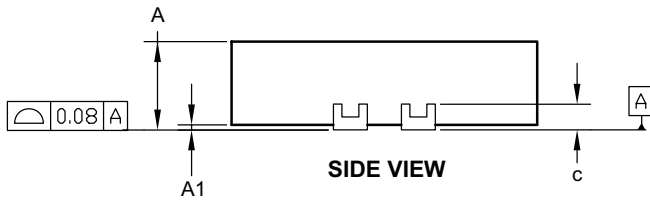
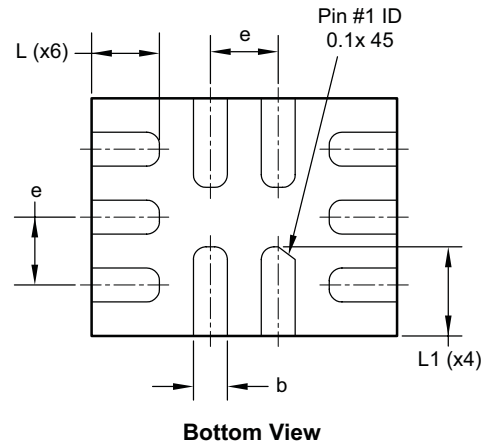
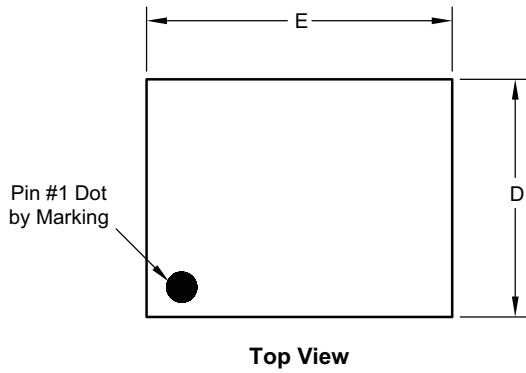
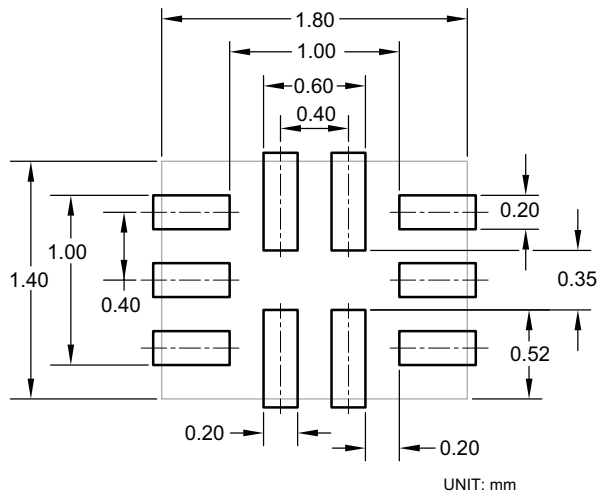


Figure 6. ON/Off Capacitance Measurement

Package Dimensions, QFN 1.8x1.4, 10L



RECOMMENDED LAND PATTERN



Dimensions in millimeters

Symbols	Min.	Nom.	Max.
A	0.50	0.55	0.60
A1	0.00	—	0.05
b	0.15	0.20	0.25
c	0.152 REF.		
D	1.35	1.40	1.45
E	1.75	1.80	1.85
e	0.40 BSC		
L	0.35	0.40	0.45
L1	0.475	0.525	0.575

Dimensions in inches

Symbols	Min.	Nom.	Max.
A	0.020	0.022	0.024
A1	0.000	—	0.002
b	0.006	0.008	0.010
c	0.006 REF.		
D	0.053	0.055	0.057
E	0.069	0.071	0.073
e	0.016 BSC		
L	0.014	0.016	0.018
L1	0.019	0.021	0.023

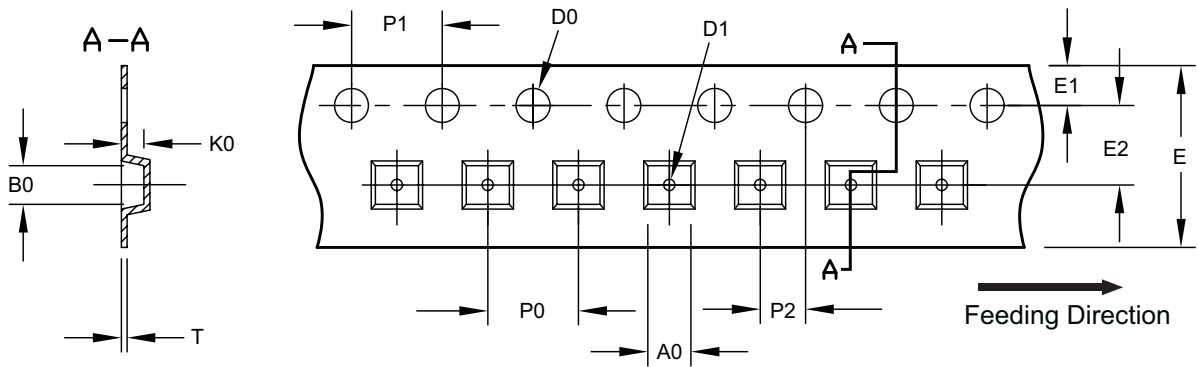
Notes:

- Controlling dimension is millimeter. Converted inch dimensions are not necessarily exact.



### Tape and Reel Dimensions, QFN 1.8x1.4, 10L

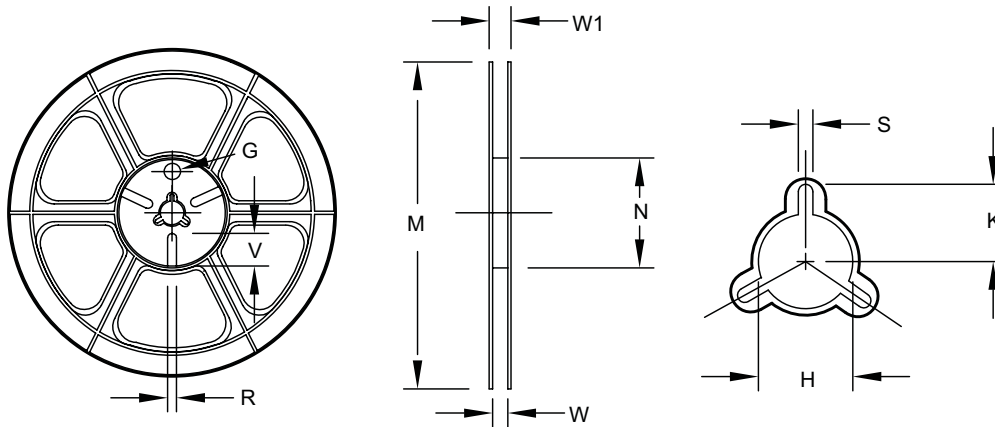
#### Carrier Tape



UNIT: mm

Package	A0	B0	K0	D0	D1	E	E1	E2	P0	P1	P2	T
QFN 1.8 x 1.4	1.90 ±0.05	1.70 ±0.05	1.00 ±0.05	1.50 +0.10/-0	0.50 ±0.05	8.00 +0.20/-0.10	1.75 ±0.10	3.50 ±0.05	4.00 ±0.10	4.00 ±0.10	2.00 ±0.05	0.254 ±0.02

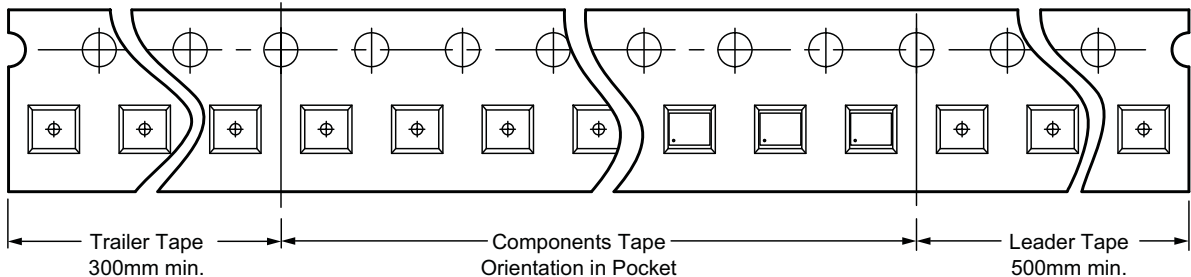
#### Reel



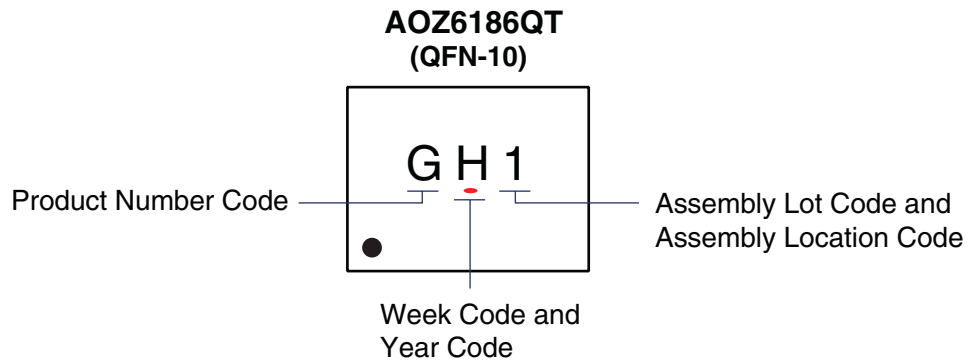
UNIT: mm

Tape Size	Reel Size	M	N	W	W1	H	K	S	G	R	V
8mm	ø178	ø178.0 ±1.0	ø70.5 ±1.0	9.0 ±0.5	11.8 ±1.1	ø13.0 +0.5/-0.2	10.25 ±0.1	2.4 ±0.1	ø9.8	N/A	N/A

#### Leader/Trailer and Orientation



**Part Marking**



**This datasheet contains preliminary data; supplementary data may be published at a later date. Alpha & Omega Semiconductor reserves the right to make changes at any time without notice.**

**LIFE SUPPORT POLICY**

ALPHA & OMEGA SEMICONDUCTOR PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS.

As used herein:

- |                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>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.</p> | <p>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.</p> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|