

**PI3CSW12**

**High-Speed I3C 1:2 Multiplexer/DeMultiplexer Switch with Signal Enable**

**Description**

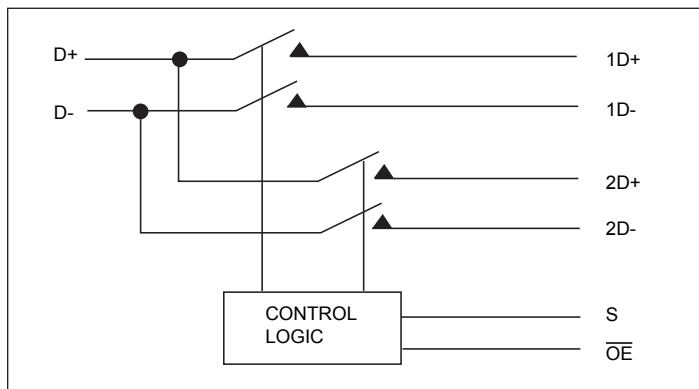
The PI3CSW12 is a high-bandwidth switch specially designed for the switching of high-speed I3C signals in communication and server applications, such as servers, workstations, and notebooks with hubs or controllers with limited I3C I/Os. The wide bandwidth (1.6GHz) of this switch allows signals to pass with minimum edge and phase distortion.

The device multiplexes differential outputs from a I3C host device to one of two corresponding outputs. The switch is bidirectional and offers little or no attenuation of the high-speed signals at the outputs. It is designed for low bit-to-bit skew and high channel-to-channel noise isolation, and is compatible with various standards, such as high-speed I3C (up to 30Mbps).

**Application(s)**

- Routing I3C Signals
- Routing Mobile Industry Processor Interface (MIPI) Signals

**Block Diagram**



**Truth Table**

S	$\overline{OE}$	Function
X	H	Disconnect
L	L	D = 1D
H	L	D = 2D

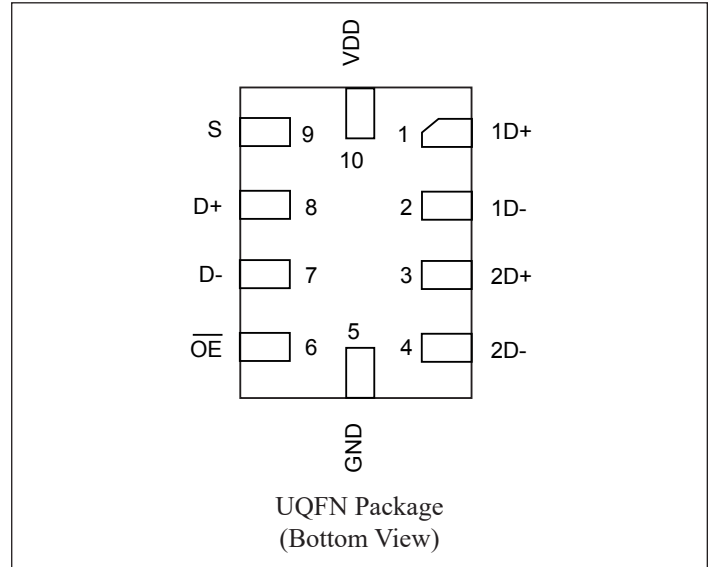
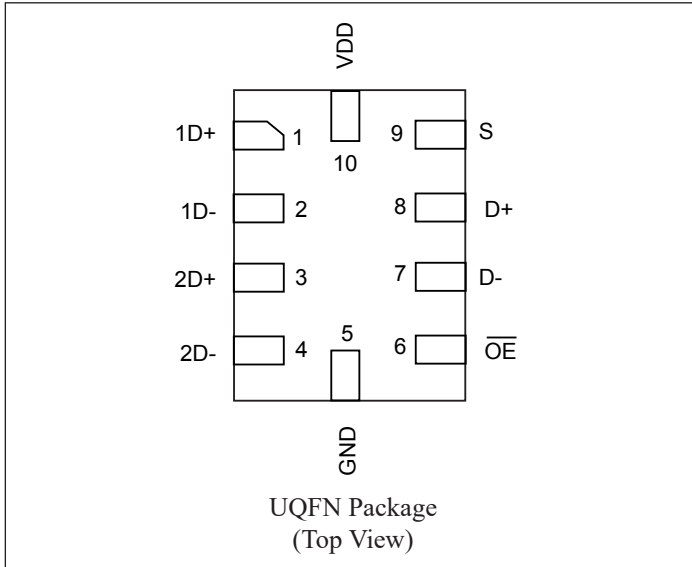
**Features**

- $V_{DD}$  Operation at 2.5V and 3.3V
- $V_{I/O}$  Accepts Signals Up to 5.5V
- 1.8V Compatible Control-Pin Inputs
- Low-Power Mode When  $\overline{OE}$  Is Disabled (2 $\mu$ A)
- $r_{ON} = 6\Omega$  Maximum
- $\Delta r_{ON} = 0.2\Omega$  Typical
- $C_{io(on)} = 4pF$  Typical
- Supports Over Voltage Protection
- Low Power Consumption (50 $\mu$ A Maximum)
- ESD Performance
  - IO Pins
  - 12KV HBM
  - 1KV CDM
  - +/-8KV Contact Discharge (IEC61000-4-2)
  - VDD, GND, S,  $\overline{OE}$  Pins
  - 4KV HBM
  - 1KV CDM
- High Bandwidth (1.6GHz Typical)
- Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)
- Halogen- and Antimony-Free. "Green" Device (Note 3)
- For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/104/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please [contact us](https://www.diodes.com/quality/product-definitions/) or your local Diodes representative.
- Packaging (Pb-free & Green):
  - 10-contact, UQFN (ZUA)

**Notes:**

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See <https://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

## Pin Configuration



## Pin Description

Name	Description
$\overline{OE}$	Active LOW, Output enable
S	Select input
D	COM port
nD	I/O for I3C data path (port 1 and port 2)

## Absolute Maximum Ratings<sup>(1)</sup>

Over operating free-air temperature range (unless otherwise noted)

V <sub>DD</sub> Supply Voltage Range	-0.5V to 4.6V
V <sub>IN</sub> Control Input Voltage Range <sup>(2, 3)</sup>	-0.5V to 5.5V
V <sub>I/O</sub> Switch I/O Voltage Range <sup>(2, 3, 4)</sup>	-0.5V to 5.5V
I <sub>IK</sub> Control Input Clamp Current (V <sub>IN</sub> < 0)	-50mA
I <sub>I/O</sub> I/O Port Clamp Current (V <sub>I/O</sub> < 0)	-50mA
I <sub>I/O</sub> ON-state Switch Current <sup>(5)</sup>	±120mA
Continuous Current through V <sub>DD</sub> or GND	±100mA
θ <sub>JA</sub> Package Thermal Impedance	
TLLGA Package	48.7°C/W
TDFN Package	243°C/W
T <sub>stg</sub> Storage Temperature Range	-65 to 150°C
T <sub>j</sub> Junction Temperature	125°C

### Notes:

- Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- All voltages are with respect to ground, unless otherwise specified.
- The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
- VI and VO are used to denote specific conditions for VI/O.
- II and IO are used to denote specific conditions for II/O.
- The package thermal impedance is calculated in accordance with JESD 51-7.

## Recommended Operating Conditions<sup>(1)</sup>

Symbol	Description	Parameter	Min.	Max.	Unit
V <sub>DD</sub>	Supply voltage		2.3	3.6	V
V <sub>IH</sub>	High-level control input voltage	V <sub>DD</sub> = 2.3V to 2.7V	1.3		
		V <sub>DD</sub> = 2.7V to 3.6V	1.4		
V <sub>IL</sub>	Low-level control input voltage	V <sub>DD</sub> = 2.3V to 2.7V		0.6	
		V <sub>DD</sub> = 2.7V to 3.6V		0.6	
V <sub>I/O</sub>	Data input/output voltage		0	4.6	
T <sub>A</sub>	Operating free-air temperature		-40	85	°C

### Note:

- All unused control inputs of the device must be held at V<sub>DD</sub> or GND to ensure proper device operation.

## Electrical Characteristics

Over operating free-air temperature range (unless otherwise noted)

Parameter	Testing Conditions	Min.	Typ.	Max.	Unit
V <sub>IK</sub>	V <sub>DD</sub> = 3.6V, 2.7V, I <sub>I</sub> = -18mA			-1.2	V
I <sub>IN</sub>	Control Inputs V <sub>DD</sub> = 3.6V, 2.7V, 0V, V <sub>IN</sub> = 0V to 3.6V			±1	µA
I <sub>OZ</sub> <sup>(3)</sup>	V <sub>DD</sub> = 3.6V, 2.7V, V <sub>IN</sub> = V <sub>DD</sub> or GND, V <sub>O</sub> = 0V to 3.6V, V <sub>I</sub> = 0V, Switch OFF			±1	µA
I <sub>(OFF)</sub>	V <sub>DD</sub> = 0V	V <sub>I/O</sub> = 0V to 3.6V		±2	µA
		V <sub>I/O</sub> = 0V to 2.7V		±1	µA
I <sub>CC</sub>	V <sub>DD</sub> = 3.6V, 2.7V, V <sub>IN</sub> = V <sub>DD</sub> or GND, I <sub>I/O</sub> = 0V, Switch ON or OFF		25	50	µA
I <sub>CC</sub> (low power mode)	V <sub>DD</sub> = 3.6V, 2.7V, V <sub>IN</sub> = V <sub>DD</sub> or GND, Switch disabled, ( $\overline{\text{OE}}$ in high state)			4	µA

Parameter	Testing Conditions	Min.	Typ.	Max.	Unit		
DI <sub>CC</sub> <sup>(4)</sup>	Control Inputs	V <sub>DD</sub> = 2.7V, S sweeps from 1.4V to 3.3V, OE/ = 0V		15	μA		
		V <sub>DD</sub> = 2.7V, OE/ sweeps from 1.4V to 3.3V, S = 0V		0.75	μA		
C <sub>IN</sub>	Control Inputs	V <sub>DD</sub> = 3.3V, 2.5V, V <sub>IN</sub> = 3.3V or 0V		1	2	pF	
C <sub>io(OFF)</sub>	V <sub>DD</sub> = 3.3V, 2.5V, V <sub>IN</sub> = 3.3V or 0V, Switch OFF		2	3	pF		
C <sub>io(ON)</sub>	V <sub>DD</sub> = 3.3V, 2.5V, V <sub>IN</sub> = 3.3V or 0V, Switch ON		4		pF		
r <sub>ON</sub> <sup>(5)</sup>	V <sub>DD</sub> = 3V, 2.3V	V <sub>I</sub> = 0V, I <sub>O</sub> = 30mA		4	Ω		
		V <sub>I</sub> = 2.4V, I <sub>O</sub> = -15mA		6			
Dr <sub>ON</sub> <sup>(6)</sup>	V <sub>DD</sub> = 3V, 2.3V	V <sub>I</sub> = 0V, I <sub>O</sub> = 30mA		0.2	Ω		
		V <sub>I</sub> = 1.7V, I <sub>O</sub> = -15mA		0.2			
r <sub>ON(flat)</sub>	V <sub>DD</sub> = 3V, 2.3V	V <sub>I</sub> = 0V, I <sub>O</sub> = 30mA		1	Ω		
		V <sub>I</sub> = 1.7V, I <sub>O</sub> = -15mA		1			
V <sub>pass</sub>	V <sub>DD</sub> = 2.5 - 3.3V	V <sub>IN</sub> > 3.8V, I <sub>O</sub> = 10uA		2.8	3.8	4.2	V

**Notes:**

- V<sub>IN</sub> and I<sub>IN</sub> refer to control inputs. V<sub>I</sub>, V<sub>O</sub>, I<sub>I</sub>, and I<sub>O</sub> refer to data pins.
- All typical values are at V<sub>DD</sub> = 3.3 V (unless otherwise noted), T<sub>A</sub> = 25°C.
- For I/O ports, the parameter IOZ includes the input leakage current.
- This is the increase in supply current for each input that is at the specified TTL voltage level, rather than V<sub>DD</sub> or GND.
- Measured by the voltage drop between the input and output terminals at the indicated current through the switch. ON-state resistance is determined by the lower of the voltages of the two terminals.
- Dr<sub>on</sub> is delta Ron between channels

## Dynamic Electrical Characteristics

 Over operating range, T<sub>A</sub> = -40°C to 85°C, V<sub>DD</sub> = 3.3 V ± 10%, GND = 0V

Symbol	Parameter	Test Conditions	Typ. <sup>(1)</sup>	Unit
X <sub>TALK</sub>	Crosstalk	R <sub>L</sub> = 50Ω, f = 250MHz	-40	dB
		R <sub>L</sub> = 50Ω, f = 50MHz	-55	
O <sub>IRR</sub>	OFF isolation	R <sub>L</sub> = 50Ω, f = 250MHz	-41	
BW	Bandwidth (-3 dB)	R <sub>L</sub> = 50Ω	1.6	GHz

**Note:**

- For Max or Min conditions, use the appropriate value specified under Electrical Characteristics for the applicable device type.

## Switching Characteristics

 Over operating range, T<sub>A</sub> = -40°C to 85°C, V<sub>DD</sub> = 3.3 V ± 10%, GND = 0V

Symbol	Parameter	Min.	Typ. <sup>(1)</sup>	Max.	Unit
t <sub>pd</sub>	Propagation Delay <sup>(2,3)</sup>		0.25		ns
t <sub>ON</sub>	Line enable time	S to D, nD		125	ns
		OE to D, nD		100	

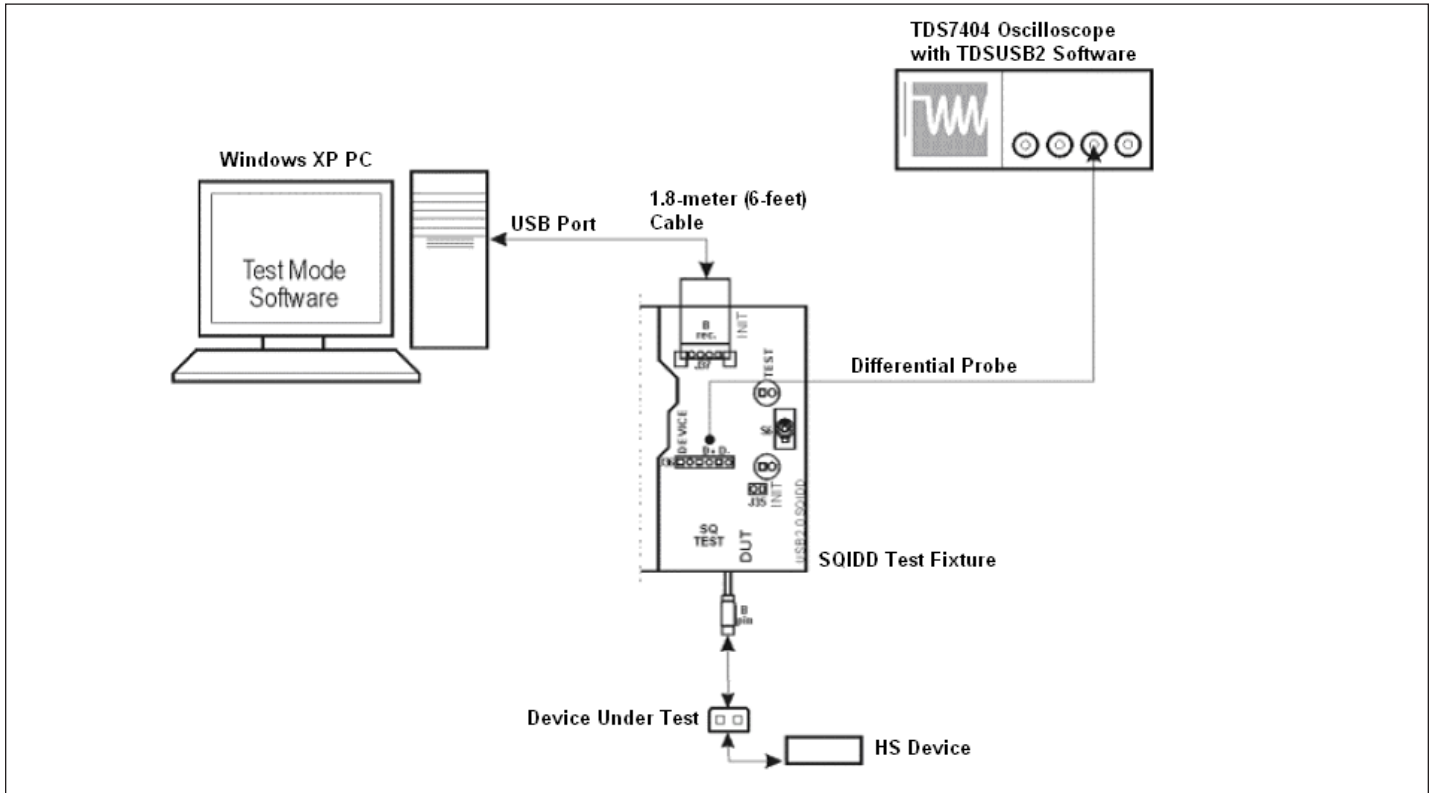
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Symbol	Parameter	Min.	Typ. <sup>(1)</sup>	Max.	Unit
t <sub>OFF</sub>	Line disable time	S to D, nD		12	ns
		$\overline{\text{OE}}$ to D, nD		12	
t <sub>SK(O)</sub>	Output skew between center port to any other port <sup>(2)</sup>		0.1	0.2	ns
t <sub>SK(P)</sub>	Skew between opposite transitions of the same output (t <sub>PHL</sub> – t <sub>PLH</sub> ) <sup>(2)</sup>		0.1	0.2	ns
t <sub>VPASS</sub>	OVP response time		53		ns

**Notes:**

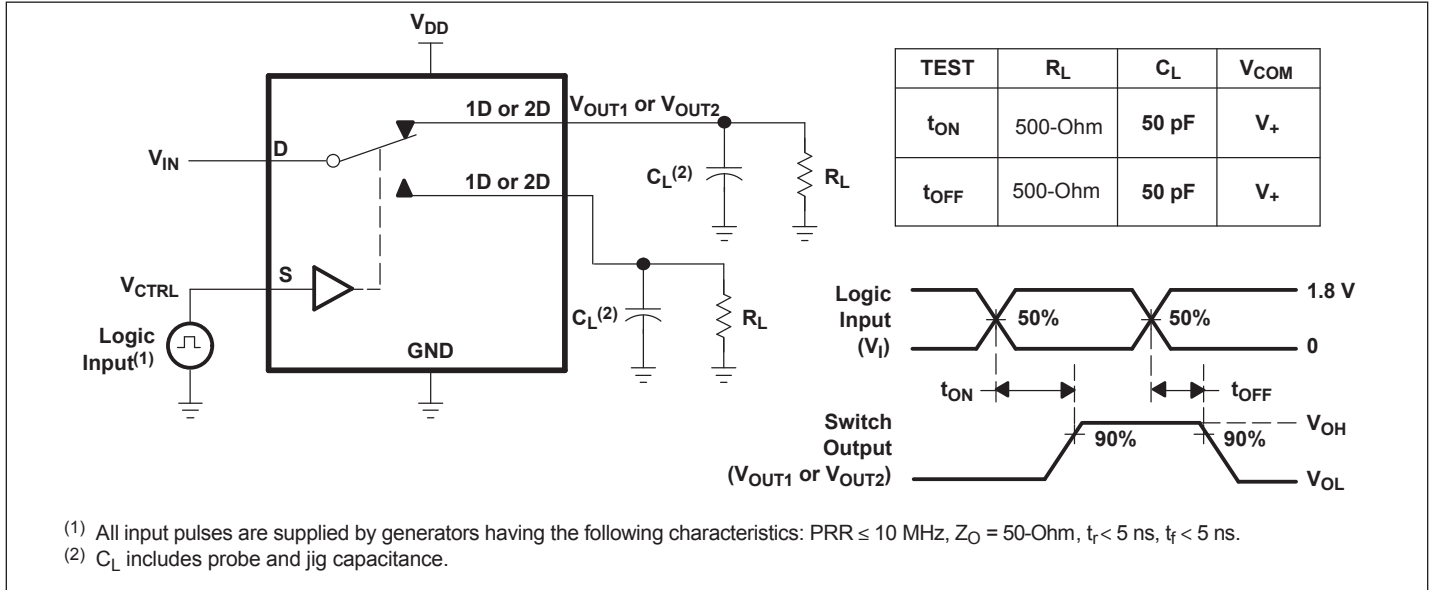
1. For Max or Min conditions, use the appropriate value specified under Electrical Characteristics for the applicable device type.
2. Specified by design
3. The switch contributes no propagation delay other than the RC delay of the on resistance of the switch and the load capacitance. The time constant for the switch alone is of the order of 0.25 ns for 10-pF load. Since this time constant is much smaller than the rise/fall times of typical driving signals, it adds very little propagation delay to the system. Propagation delay of the bus switch, when used in a system, is determined by the driving circuit on the driving side of the switch and its interactions with the load on the driven side.

**Application Information**

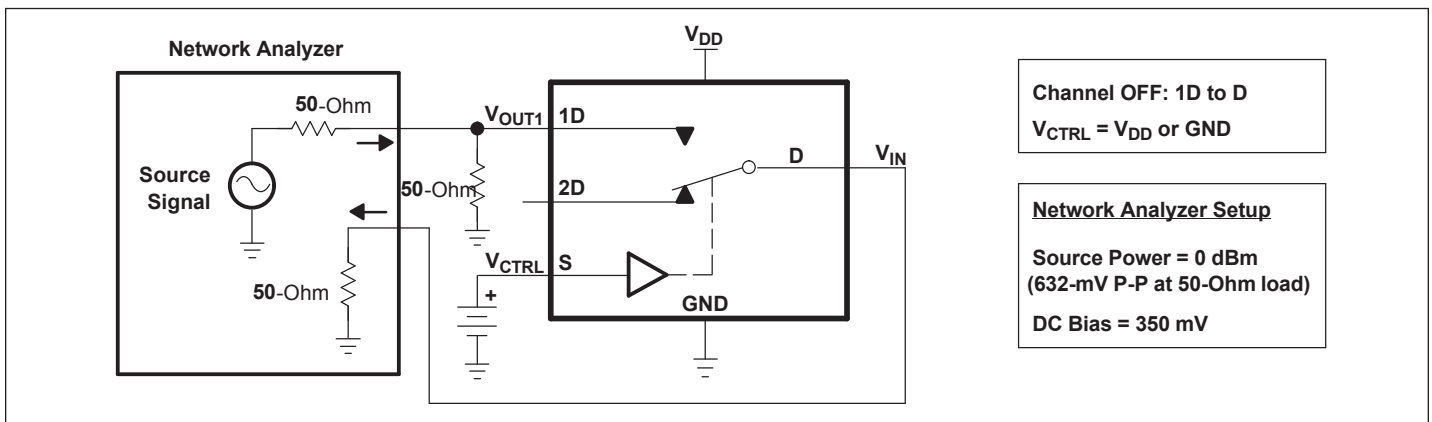


**Figure 1. HS Eye Test Setup**

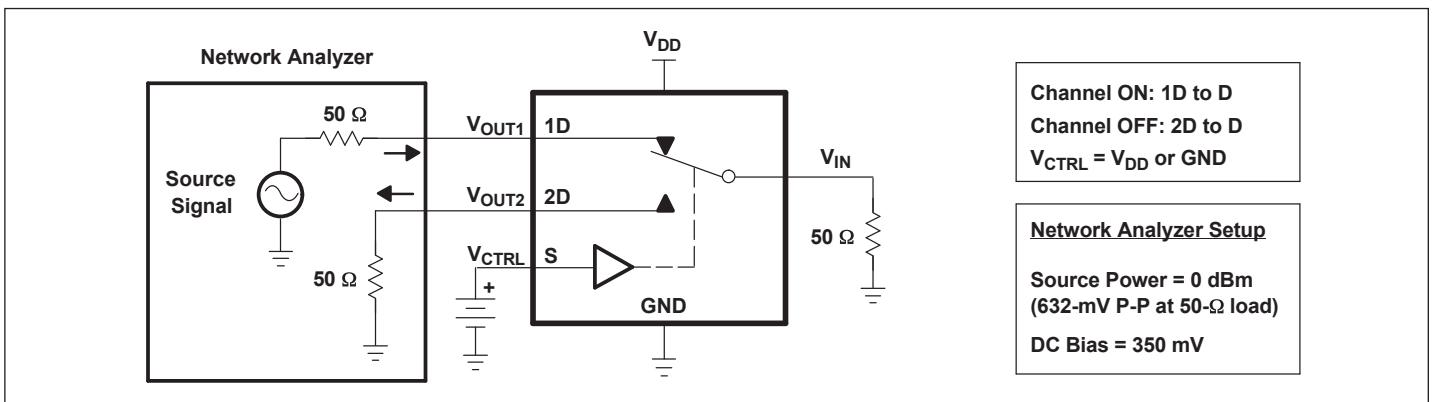
**Parameter Measurement Information**



**Figure 2. Turn-On (t<sub>ON</sub>) and Turn-Off Time (t<sub>OFF</sub>)**

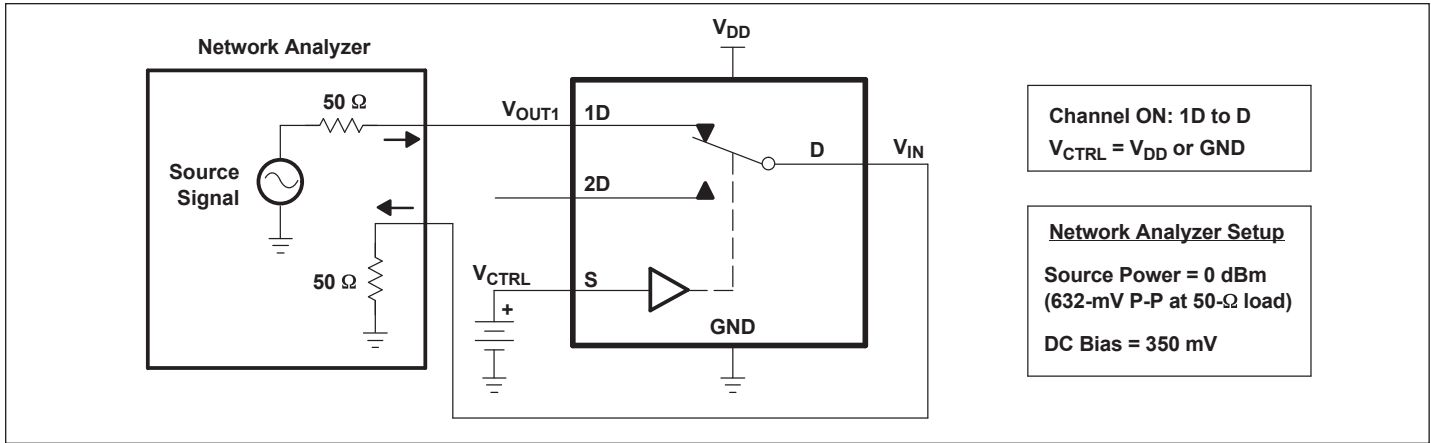


**Figure 3. OFF Isolation (O<sub>ISO</sub>)**

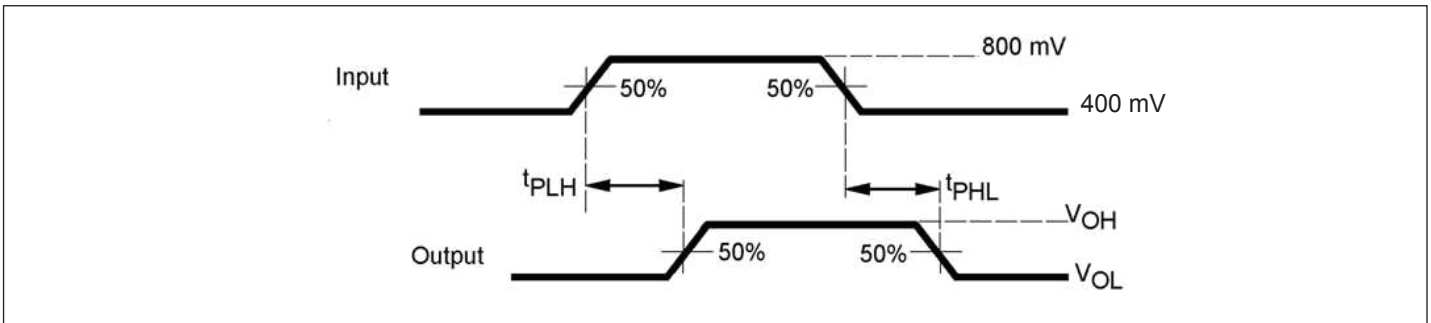


**Figure 4. Crosstalk (X<sub>TALK</sub>)**

**PI3CSW12**



**Figure 5. Bandwidth (BW)**



**Figure 6. Propagation Delay**



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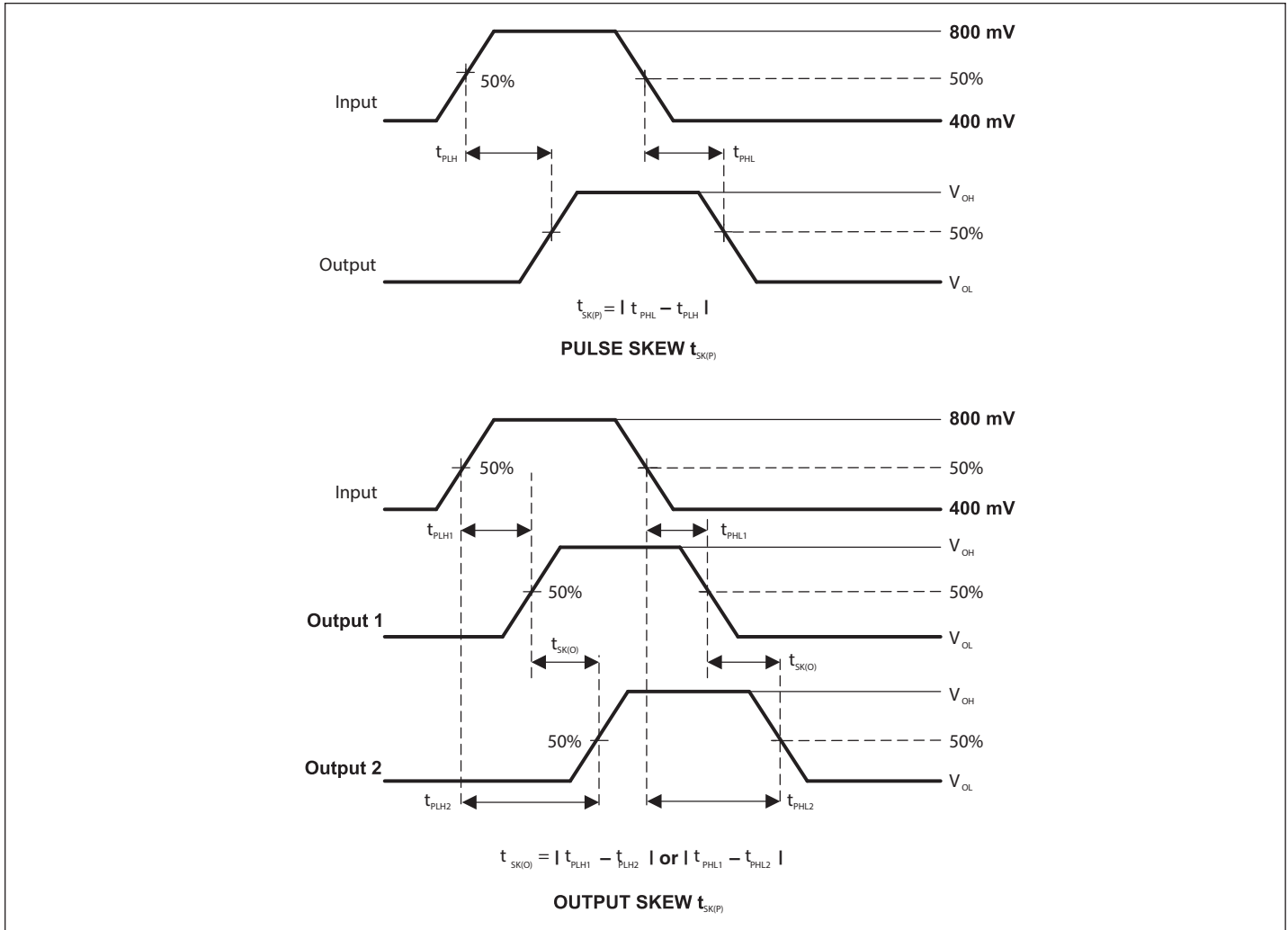


Figure 7. Skew Test

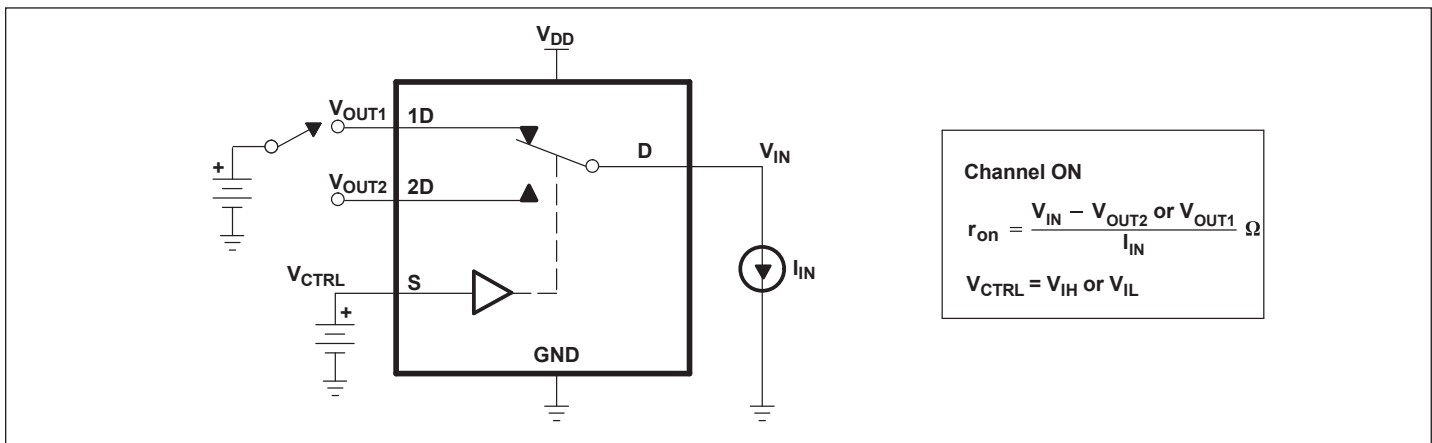
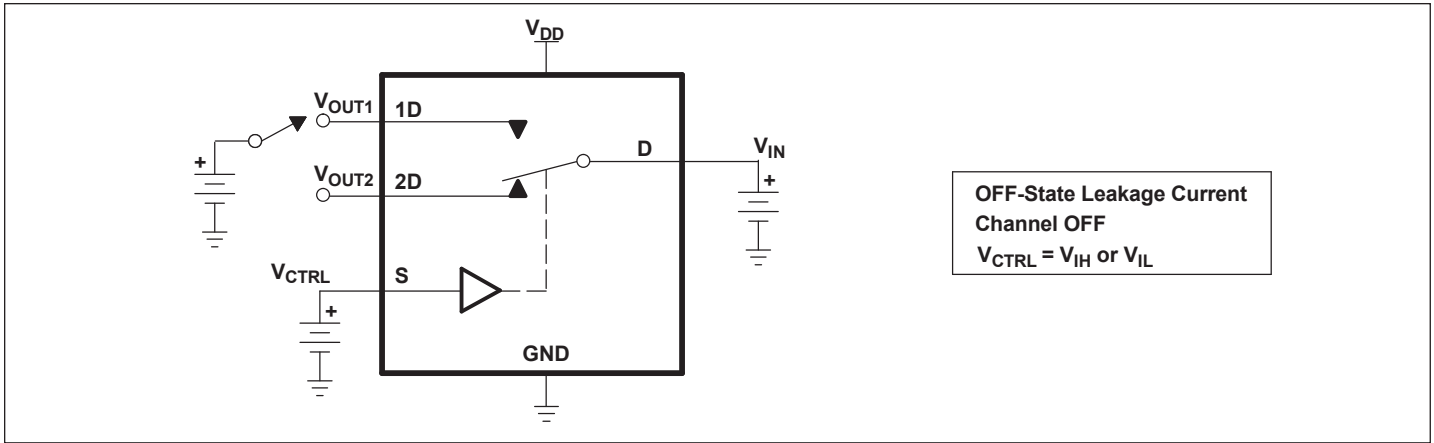
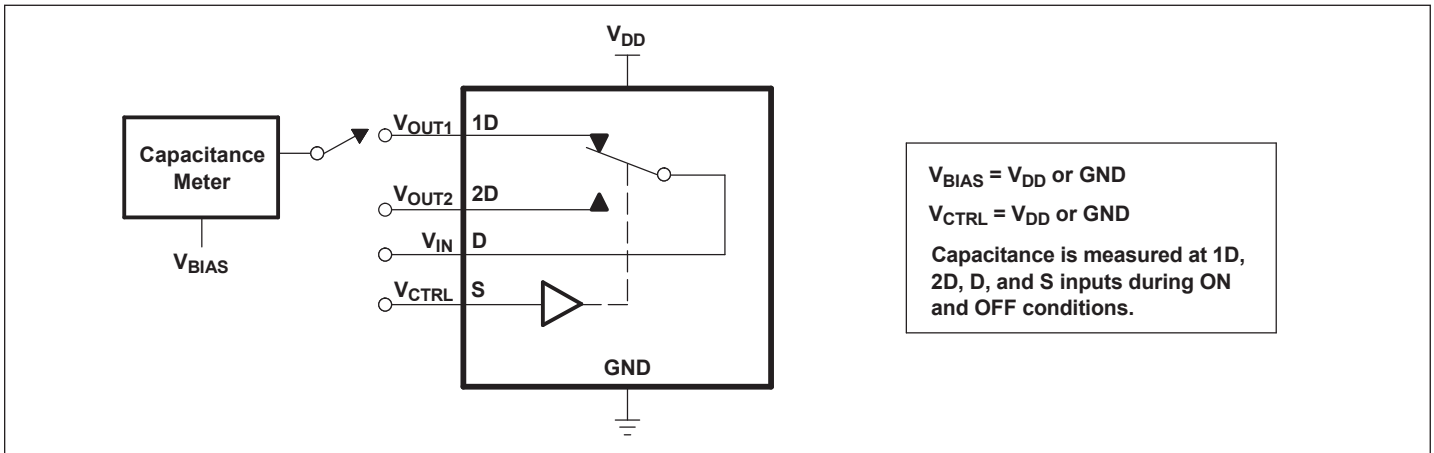


Figure 8. ON-State Resistance ( $r_{on}$ )

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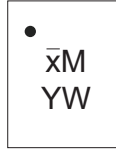


**Figure 9. OFF-State Leakage Current**



**Figure 10. Capacitance**

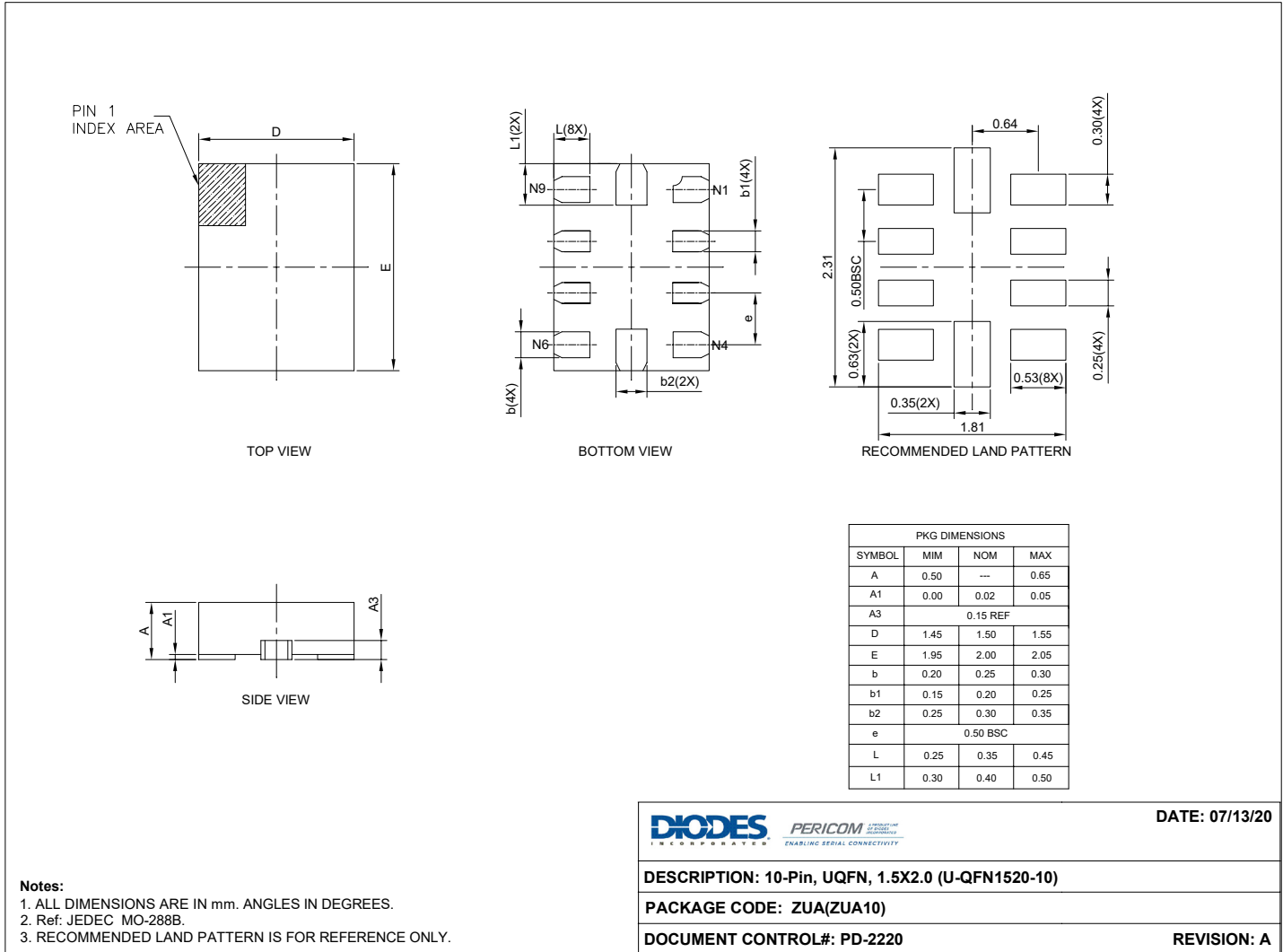
## Part Marking



xM: PI3CSW12ZUAE  
Y: Date Code (Year)  
W: Date Code (Workweek)  
Bar above "X" denotes Pb-free and green

## Packaging Mechanical

### 10-UQFN (ZUA)



For latest package info.

please check: <http://www.diodes.com/design/support/packaging/pericom-packaging/packaging-mechanicals-and-thermal-characteristics/>

## Ordering Information

Ordering Number	Package Code	Package Description	Pin 1 Orientation
PI3CSW12ZUAEX	ZUA	10-Pin, 1.5 x 2.0 (UQFN) (U-QFN 1520-10)	Top Left
PI3CSW12ZUAEX-7R	ZUA	10-Pin, 1.5 x 2.0 (UQFN) (U-QFN 1520-10)	Bottom Left

**Notes:**

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See <https://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
4. E = Pb-free and Green
5. X suffix = Tape/Reel

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