

**High-performance HDMI™ Signal Switch w/ Integrated Side-band Signal Support**

**Features**

- 4-Differential Channel 2:1 Mux/DeMux + 2-Channel 2:1 Mux/DeMux
- Deep Color™ Support
- Data Rate: 4.0Gbps for high data channels
- Clock rate max support @ 340 MHz
- Supports both AC coupled and DC coupled signals
- Switching speed: 4ns
- Isolation: -40dB@1GHz for high-speed channels
- Integrated ESD protection; HBM ESD: 2KV per JEDEC Standard
- High-speed data bits; Contact Discharge ESD: 2KV per IEC61000-4-2 standard
- Side band signal bits: 2kV HBM
- Low bit-to-bit skew
- Enable/Disable time: 9ns
- Bidirectional
- Packaging (Pb-free & Green):
  - 48-pin BQSOP (B)

**Description**

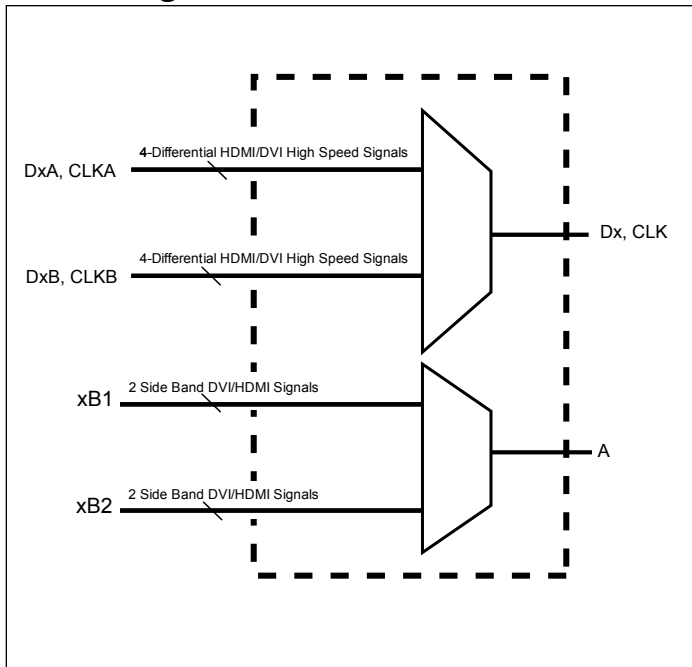
Diodes' PI3HDMI™ series of switch circuits are targeted for high-resolution video networks that are based on DVI/HDMI™ standards, and TMDS signal processing.

The PI3HDMI1210-A is a 2-to-1 HDMI™ Mux/DeMux Switch. The device multiplexes differential signals to one of two corresponding HDMI™ inputs. 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.

The maximum DVI/HDMI™ data rate of 4.0Gbps provides the resolution required by the next generation HDTV and PC graphics. Three differential channels are used for data (video signals for DVI or audio/video signals for HDMI™), and one differential channel is used for Clock for decoding the TMDS signals at the outputs.

PI3HDMI1210-A was designed specifically to meet ATC-'sink' requirements. Therefore, Diodes Incorporated recommends locating this switch at the sink to switch between multiple sources.

**Block Diagram**



**Pin Description**

V <sub>DD</sub> 33	1	48	D0+A
CP	2	47	D0-A
D0+	3	46	D1+A
D0-	4	45	D1-A
D1+	5	44	D2+A
D1-	6	43	D2-A
V <sub>DD</sub> 33	7	42	CLK+A
SEL	8	41	CLK-A
D2+	9	40	V <sub>DD</sub> 33
D2-	10	39	D0+B
CLK+	11	38	D0-B
CLK-	12	37	D1+B
GND	13	36	D1-B
V <sub>DD</sub> 33	14	35	D2+B
GND	15	34	D2-B
CP	16	33	CLK+B
GND	17	32	CLK-B
A0	18	31	V <sub>DD</sub> 33
GND	19	30	GND
A1	20	29	0B1
IN	21	28	0B2
V <sub>DD</sub> 50	22	27	1B1
EN	23	26	1B2
CP	24	25	GND

### Pin Description

Pin Name	Description
V <sub>DD</sub> 33	3.3V Power supply
CP	Tie this pin to GND via 0.1μF capacitor for optimal operation
V <sub>DD</sub> 50	5.0V Power supply
Dx	High Speed TMDS signal I/O
DxA, DxB	High Speed TMDS signal I/O
SEL	High Speed Signal Control
IN	Side Band Signal Control
Ax, xB1, xB2	Side Band Signal I/O
GND	GND pin
EN	Global Enable for Side Band Signals
CLK, CLKA/B	TMDS CLK signal I/O

### Truth Table

SEL(pin8)	Function <sup>(1)</sup>
L	CLK → CLKA
L	D <sub>x</sub> → D <sub>x</sub> A
H	D <sub>x</sub> → D <sub>x</sub> B
H	CLK → CLKB

EN(pin23)	IN(pin21)	Function <sup>(2)</sup>
L	L	A <sub>n</sub> → <sub>n</sub> B <sub>1</sub>
L	H	A <sub>n</sub> → <sub>n</sub> B <sub>2</sub>
H	X	A <sub>n</sub> = B <sub>1</sub> = <sub>n</sub> B <sub>2</sub> = H <sub>1</sub> -Z

Note:

1) x=0,1,2,3

2) n=0,1

### Maximum Ratings

(Above which useful life may be impaired. For user guidelines, not tested.)

Storage Temperature.....	-65°C to +150°C
DC Input Voltage for side band signals.....	-0.5V to 5.5V
DC Output Current.....	20mA
Power Dissipation.....	0.5W
Supply Voltage V <sub>DD33</sub> .....	-0.3V to 4.0V
Supply Voltage V <sub>DD50</sub> .....	-0.35V to 6.0V

**Note:**

Stresses greater than those listed under MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

### DC Power Supply Characteristics

Parameter	Description	Min.	Max.	Units
V <sub>DD33</sub>	3.3V Power Supply	3.0	3.6	V
V <sub>DD50</sub>	5.0 Power Supply	4.2	5.5	V

### DC Electrical Characteristics for Switching over Operating Range

(T<sub>A</sub> = -40°C to +85°C for high speed signals only)

Parameter	Description	Test Conditions	Min.	Typ <sup>(2)</sup>	Max.	Units
V <sub>IHSEL</sub> <sup>(3)</sup>	Input HIGH Voltage	Guaranteed HIGH level	2.8			V
V <sub>ILSEL</sub> <sup>(3)</sup>	Input LOW Voltage	Guaranteed LOW level	1.3		2.0	
V <sub>IKHS</sub>	Clamp Diode Voltage	V <sub>DD</sub> =Max., I <sub>IN</sub> =-18mA			0.9	

**Notes:**

- For Max. or Min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at T<sub>A</sub> = 25°C ambient and maximum loading.
- V<sub>IHSEL</sub> + V<sub>ILSEL</sub> are for SEL input only (pin 8)

### DC Electrical Characteristics for Switching over Operating Range

(T<sub>A</sub> = -40°C to +85°C) for side band signals only

Parameter	Description	Test Conditions	Min.	Typ <sup>(2)</sup>	Max.	Units
V <sub>IHIN</sub> <sup>(3)</sup>	Input HIGH Voltage	Guaranteed HIGH level	2.1			V
V <sub>ILIN</sub> <sup>(3)</sup>	Input LOW Voltage	Guaranteed LOW level			0.8	
V <sub>IKSB</sub> <sup>(4)</sup>	Clamp Diode Voltage	V <sub>DD</sub> =Max., I <sub>IN</sub> =-18mA			-0.5	
I <sub>IH</sub>	Input HIGH Current	V <sub>DD</sub> =Max., V <sub>IN</sub> =V <sub>DD</sub>			±5	μA
I <sub>IL</sub>	Input LOW Current	V <sub>DD</sub> =Max., V <sub>IN</sub> =GND			±5	

**Notes:**

- For Max. or Min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at T<sub>A</sub> = 25°C ambient and maximum loading.
- V<sub>IHIN</sub> + V<sub>ILIN</sub> are for IN input only.

## Power Supply Characteristics

Parameters	Description	Test Conditions <sup>(1)</sup>	Min.	Typ. <sup>(2)</sup>	Max.	Units
$I_{CC}$	Quiescent Power Supply Current	$V_{DD} = \text{Max.}, V_{IN} = V_{DD} \text{ or GND}$		11	15	mA

### Notes:

- For Max. or Min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at  $T_A = 25^\circ\text{C}$  ambient and maximum loading.

## Dynamic Electrical Characteristics Over the Operating Range ( $T_A = -40^\circ$ to $+85^\circ\text{C}$ )

Parameter	Description	Test Conditions	Min.	Typ. <sup>(3)</sup>	Max.	Units
$X_{TALK_{HS}}^{(1)}$	Crosstalk	See Fig. 1 for Measurement Setup, $f = 1.65\text{Gbps}$		-30		dB
$X_{TALK_{SB}}^{(2)}$		$f = 10\text{MHz}$		-62		
$O_{IRR_{HS}}^{(1)}$	OFF Isolation	See Fig. 2 for Measurement Setup, $f = 1.65\text{Gbps}$		-40		dB
$O_{IRR_{SB}}^{(2)}$		10MHz		-67		
$BW_{HS\ DATA}^{(1)}$	-3dB Bandwidth for HS data			2.3		GHz
$IL_{HS}^{(1)}$	Insertion Loss	@1.65 Gbps (8-bit deep color)		-0.87		dB
		@2.0625 Gbps (10-bit deep color)		-0.96		
		@2.475 Gbps (12-bit deep color)		-1.18		
		@3.3 Gbps (16-bit deep color)		-1.84		
$BW_{CLOCK}^{(4)}$	-3dB Bandwidth for CLK			1.7		GHz

### Notes:

- High-speed signal path only
- Side-band signal path only
- Typical values are @  $T_A = 25^\circ\text{C}$  ambient
- BW measured on CLK pins only (11, 12, 32, 33, 41 & 42)

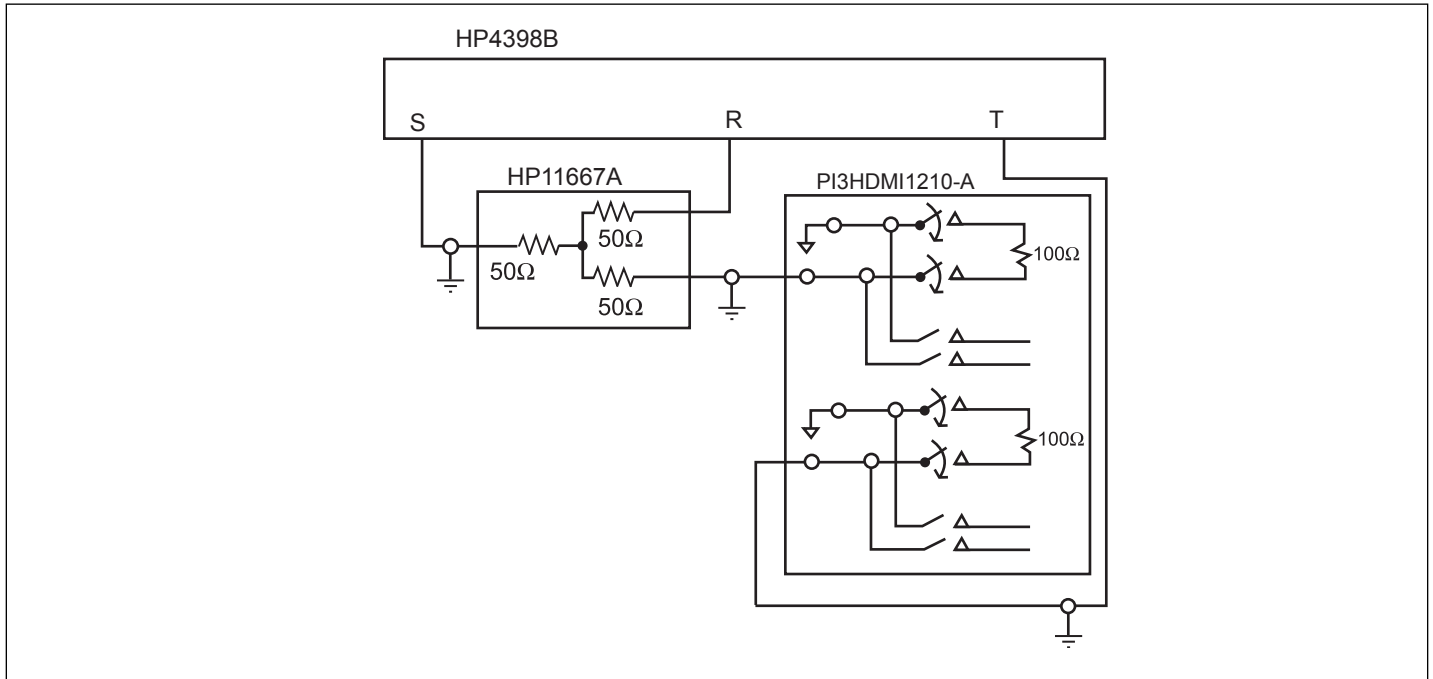
## Switching Characteristics

( $T_A = -40^\circ$  to  $+85^\circ\text{C}$ ,  $V_{DD33} = 3.3\text{V} \pm 10\%$ ,  $V_{DD50} = 5.0\text{V} \pm 10\%$ )

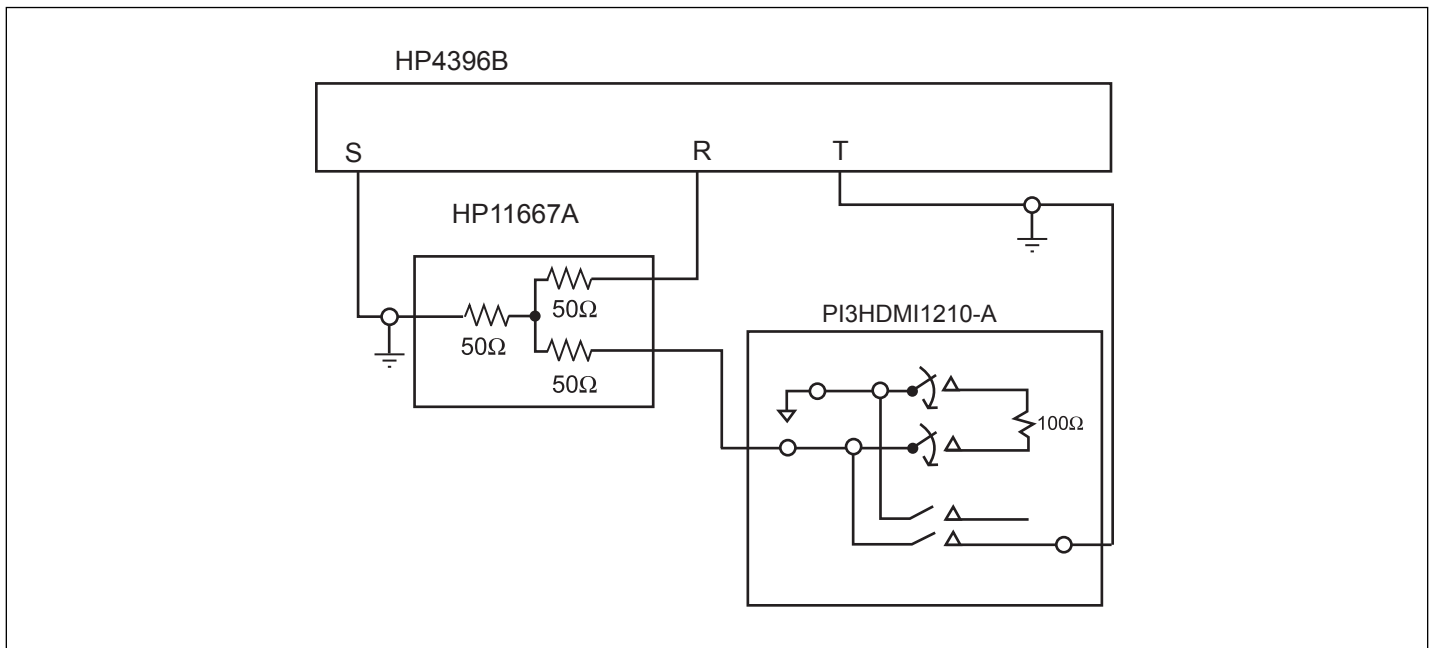
Parameter	Description	Min.	Typ. <sup>(2)</sup>	Max.	Units
$t_{PZH}, t_{PZL}$	Line Enable Time - SEL to $A_N, B_N$	0.5		8.0	ns
$t_{PHZ}, t_{PLZ}$	Line Disable Time - SEL to $A_N, B_N$	0.5		4.0	

### Notes:

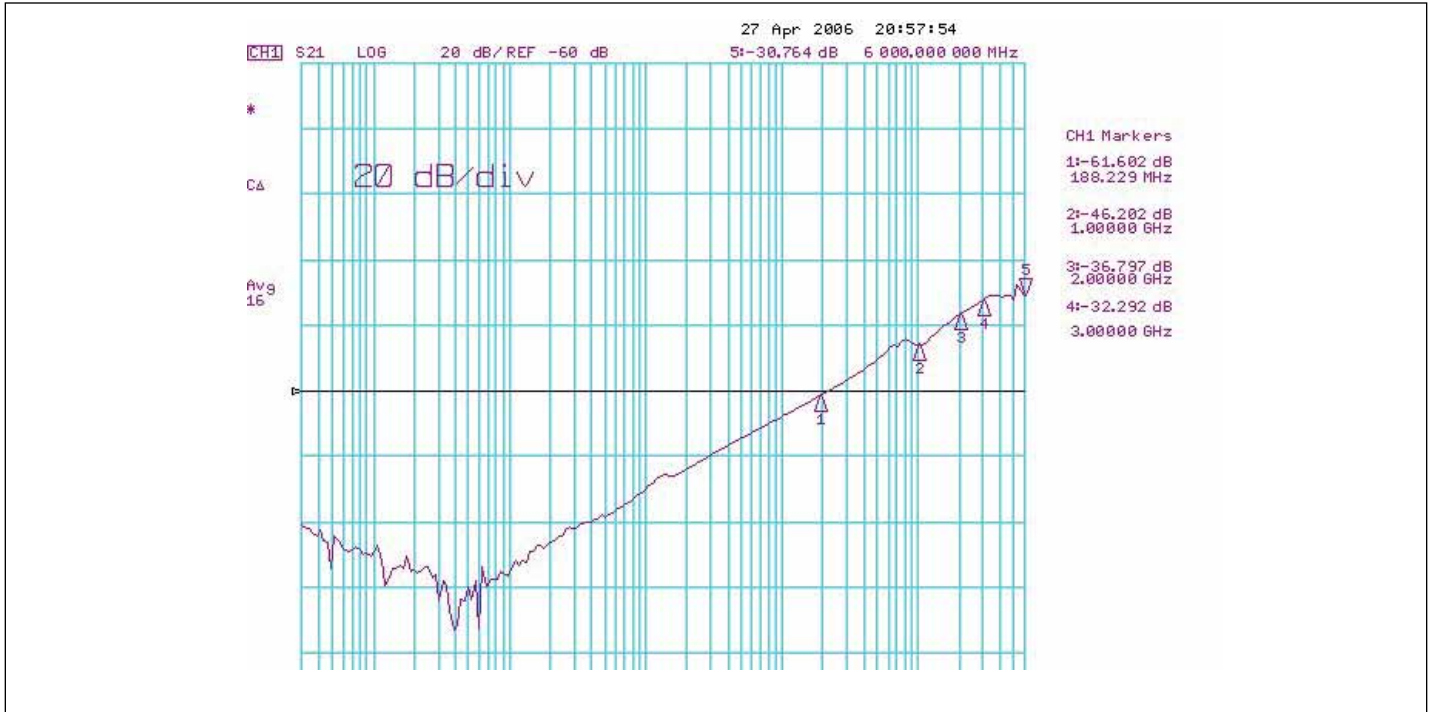
- For measurement setup, please see "Test Circuit For Electrical Characteristic" on page 6, and "Switching waveforms" on page 7



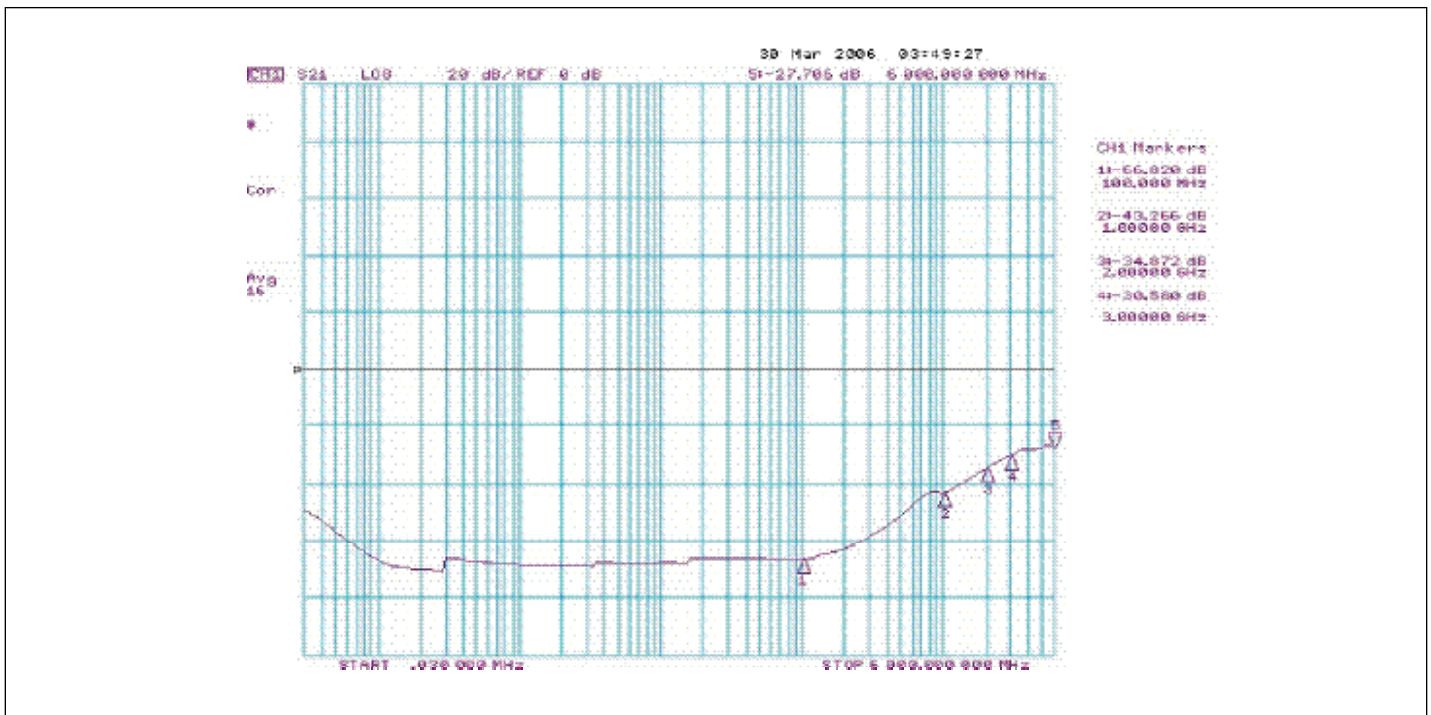
**Fig 1. Crosstalk Setup**



**Fig 2. Off-isolation setup**

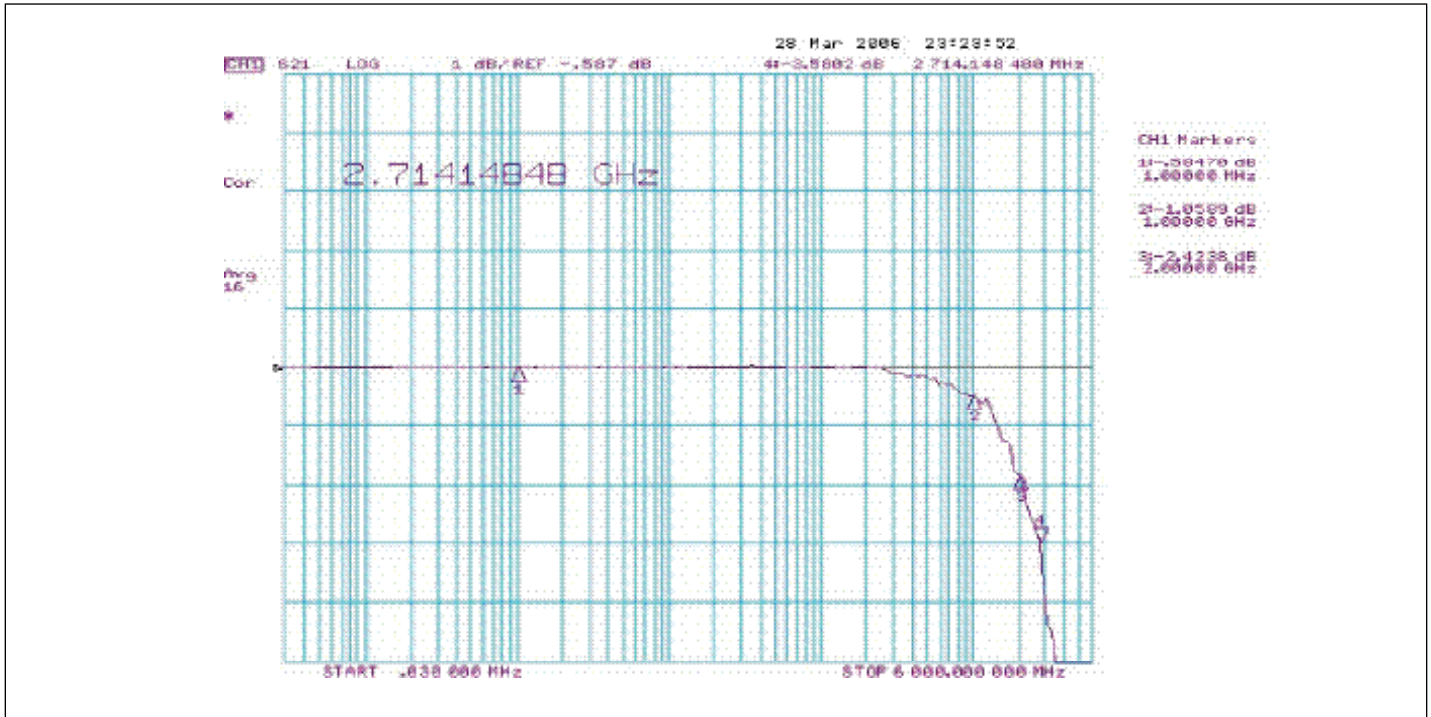


**Fig 3. Crosstalk for High-speed data signals only**



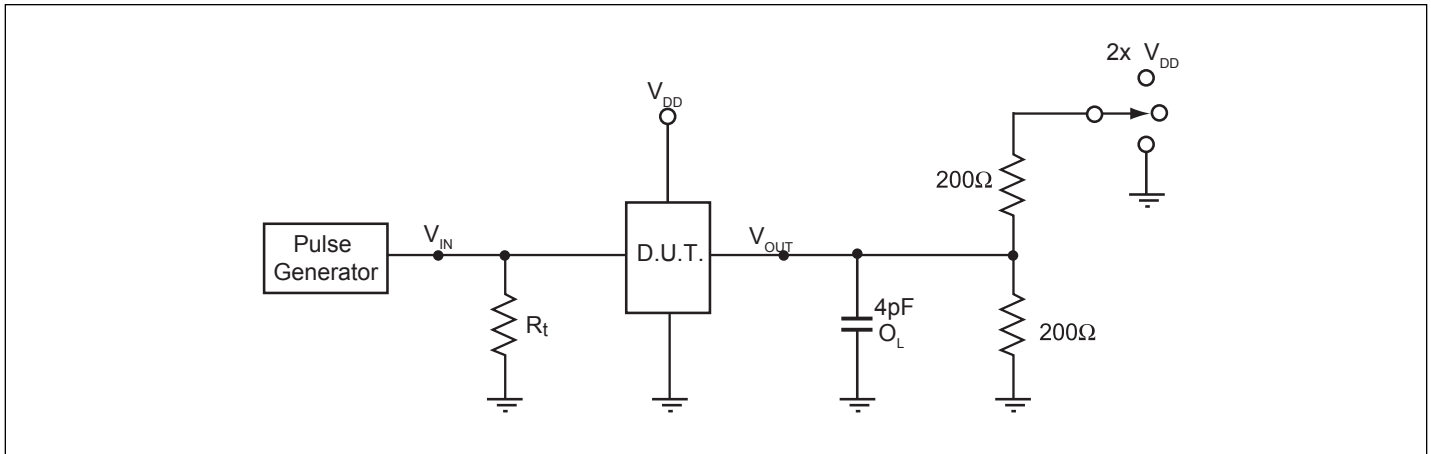
**Fig 4. Off Isolation for high-speed data signals only**

**PI3HDMI1210-A**



**Fig 5. Insertion loss for high-speed data signals only**

**Test Circuit for Electrical Characteristics<sup>(1)</sup>**



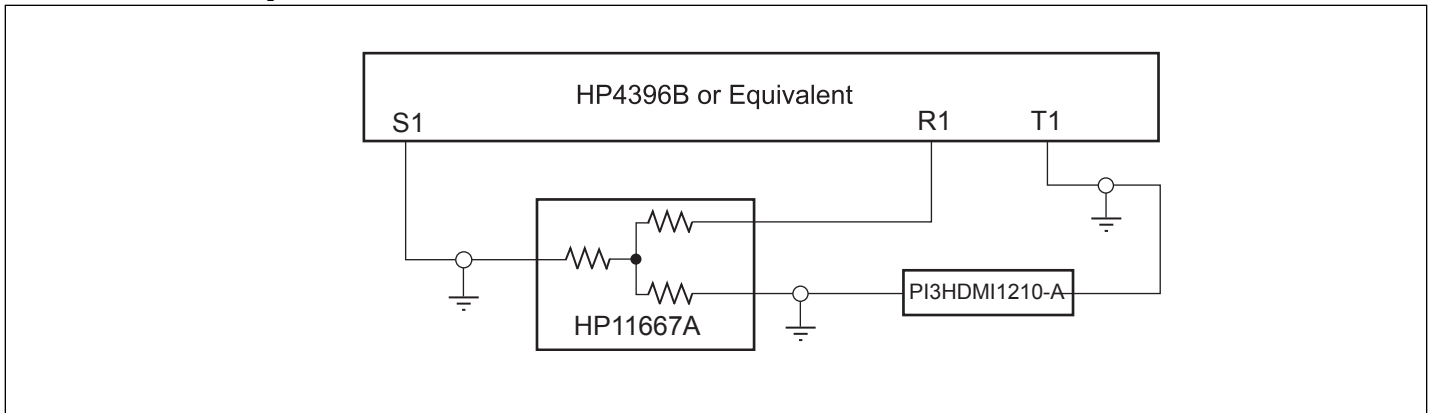
**Notes:**

1.  $C_L$  = Load capacitance: includes jig and probe capacitance.
2.  $R_T$  = Termination resistance: should be equal to  $Z_{OUT}$  of the Pulse Generator
3. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control.  
Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
4. All input impulses are supplied by generators having the following characteristics:  $PRR \leq \text{MHz}$ ,  $Z_O = 50\Omega$ ,  $t_R \leq 2.5\text{ns}$ ,  $t_F \leq 2.5\text{ns}$ .
5. The outputs are measured one at a time with one transition per measurement.

**Switch Positions**

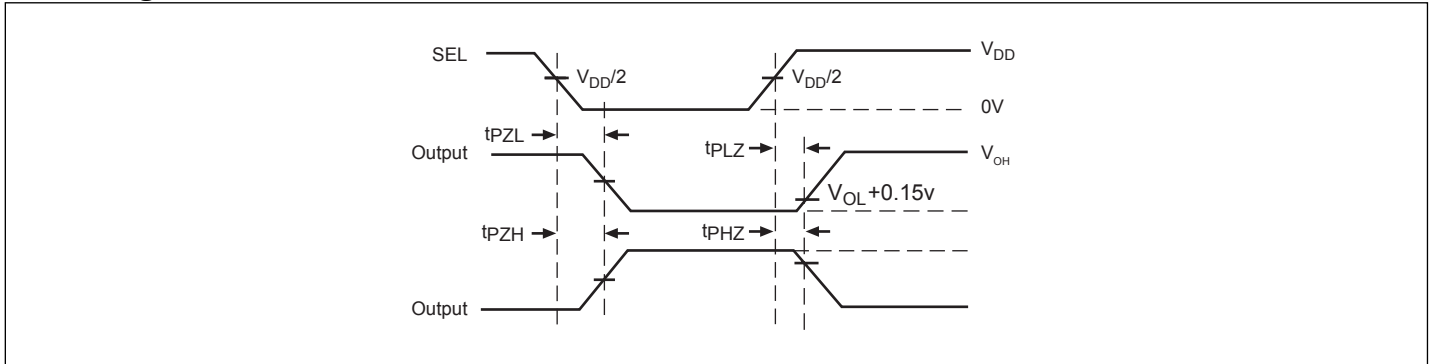
Test	Switch
$t_{PLZ}$ , $t_{PZL}$ (output on B-side)	2 x ( $V_{DD}$ )
$t_{PHZ}$ , $t_{PZH}$ (output on B-side)	GND
Prop Delay	Open

**Test Circuit for Dynamic Electrical Characteristics**

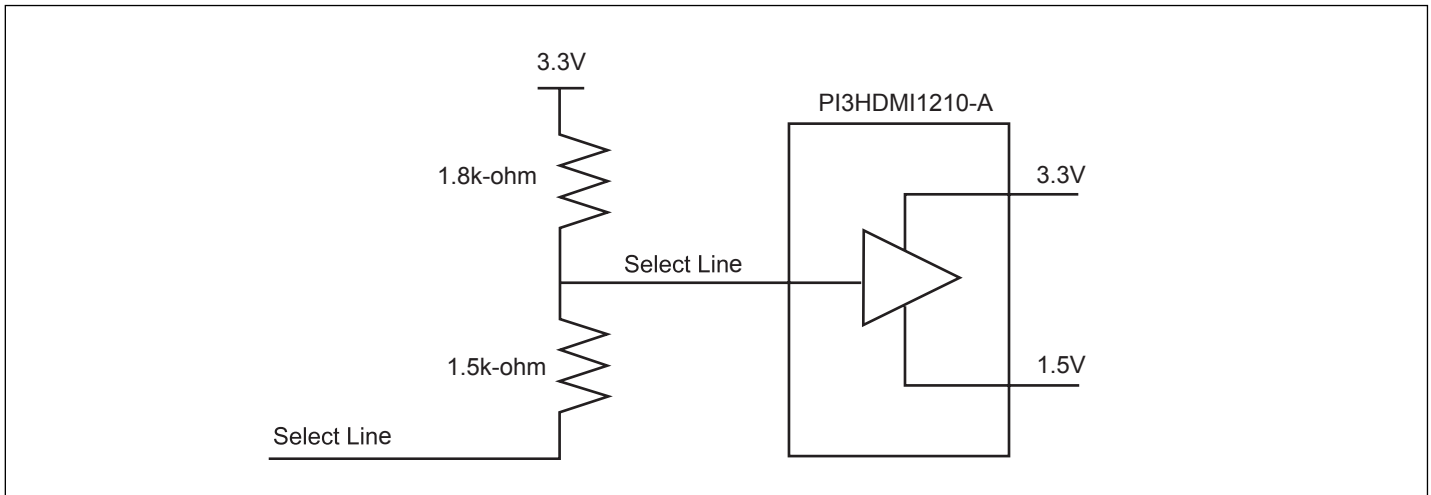




**Switching Waveforms**

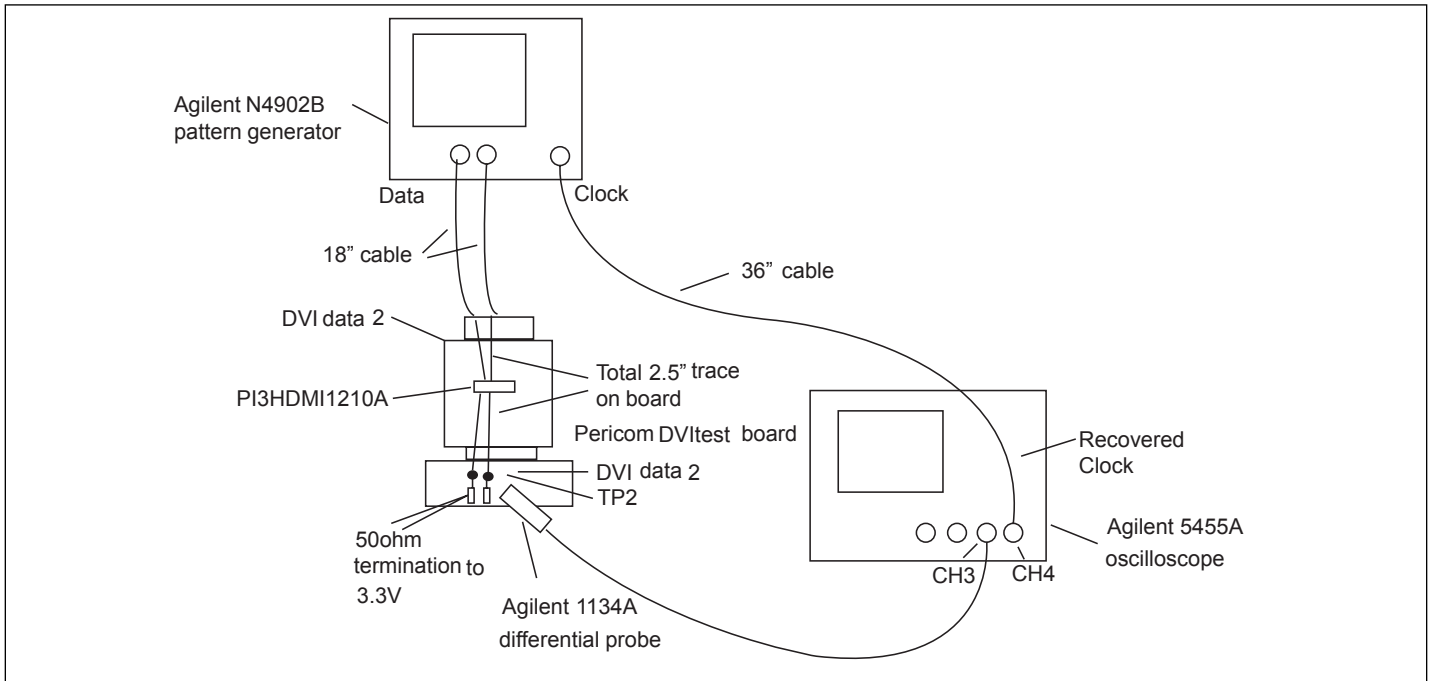


**Voltage Waveforms Enable and Disable Times**

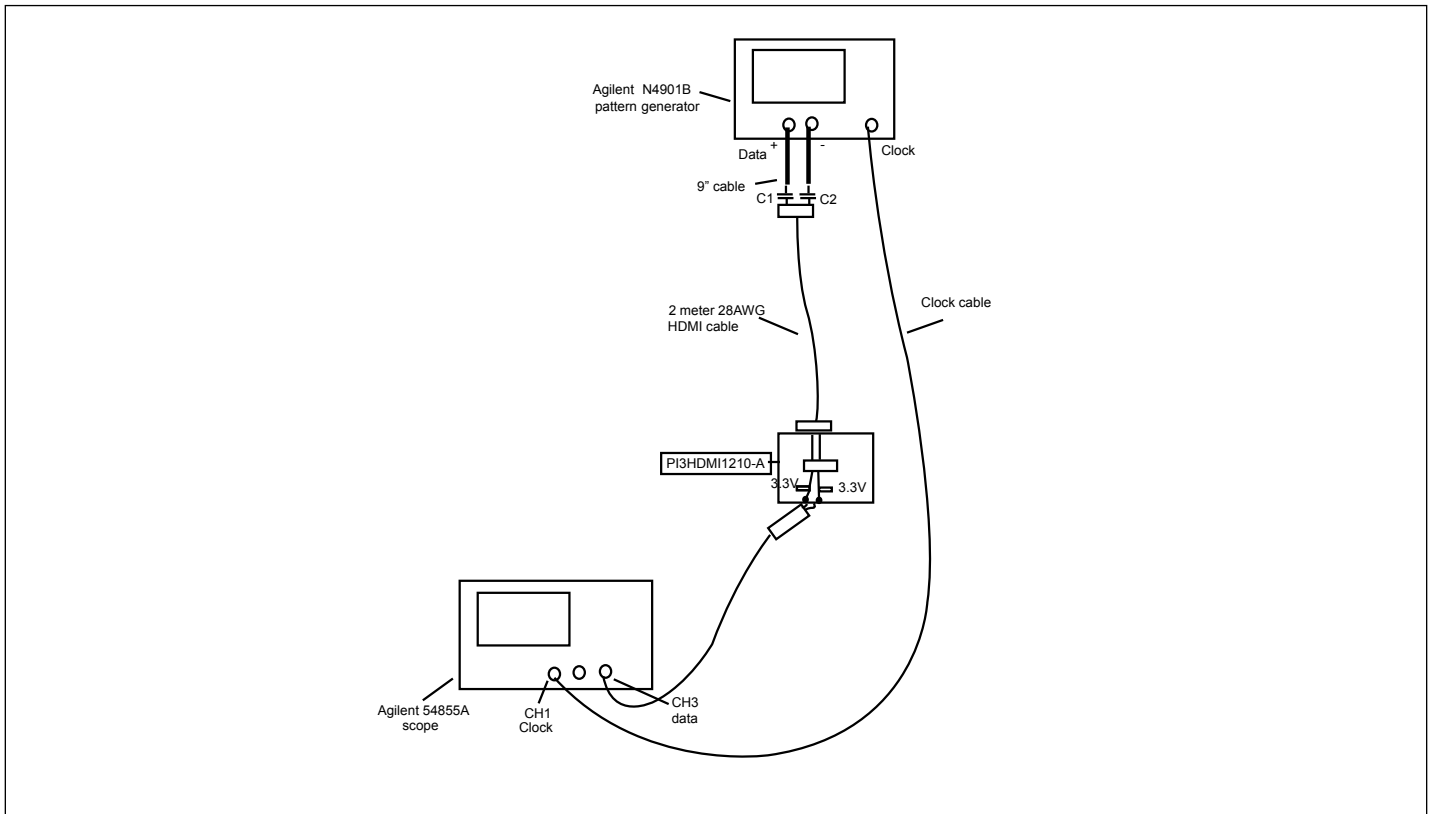


**Example of a circuit that needs to be connected to the SEL pin (8) of the PI3HDMI1210-A of our device**

**Application Test Results**



**Figure 6. TMD5 TP2 Tx eye compliance test setup**



**Figure 7. TMD5 TP3 Rx "switch at receiver" eye compliance test setup**

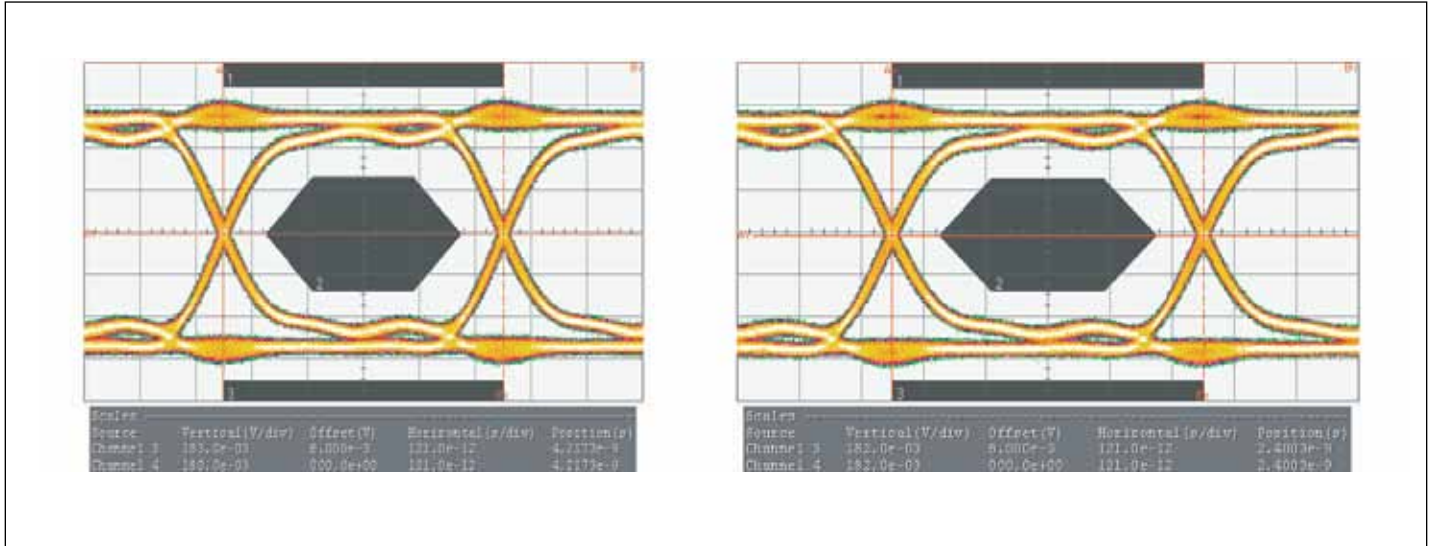


Figure 8. TP2 (Tx) eye-measurements (left is with switch, right is without switch), refer to figure 1 for the test set up

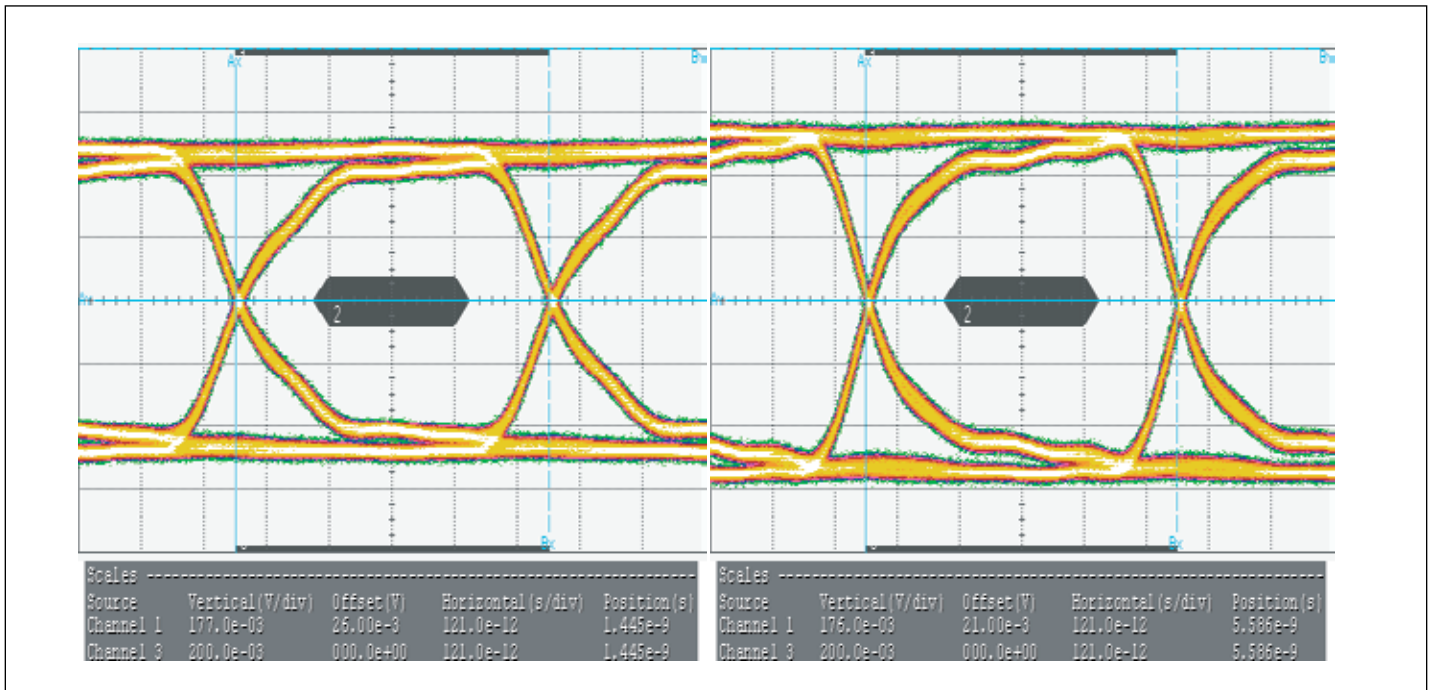
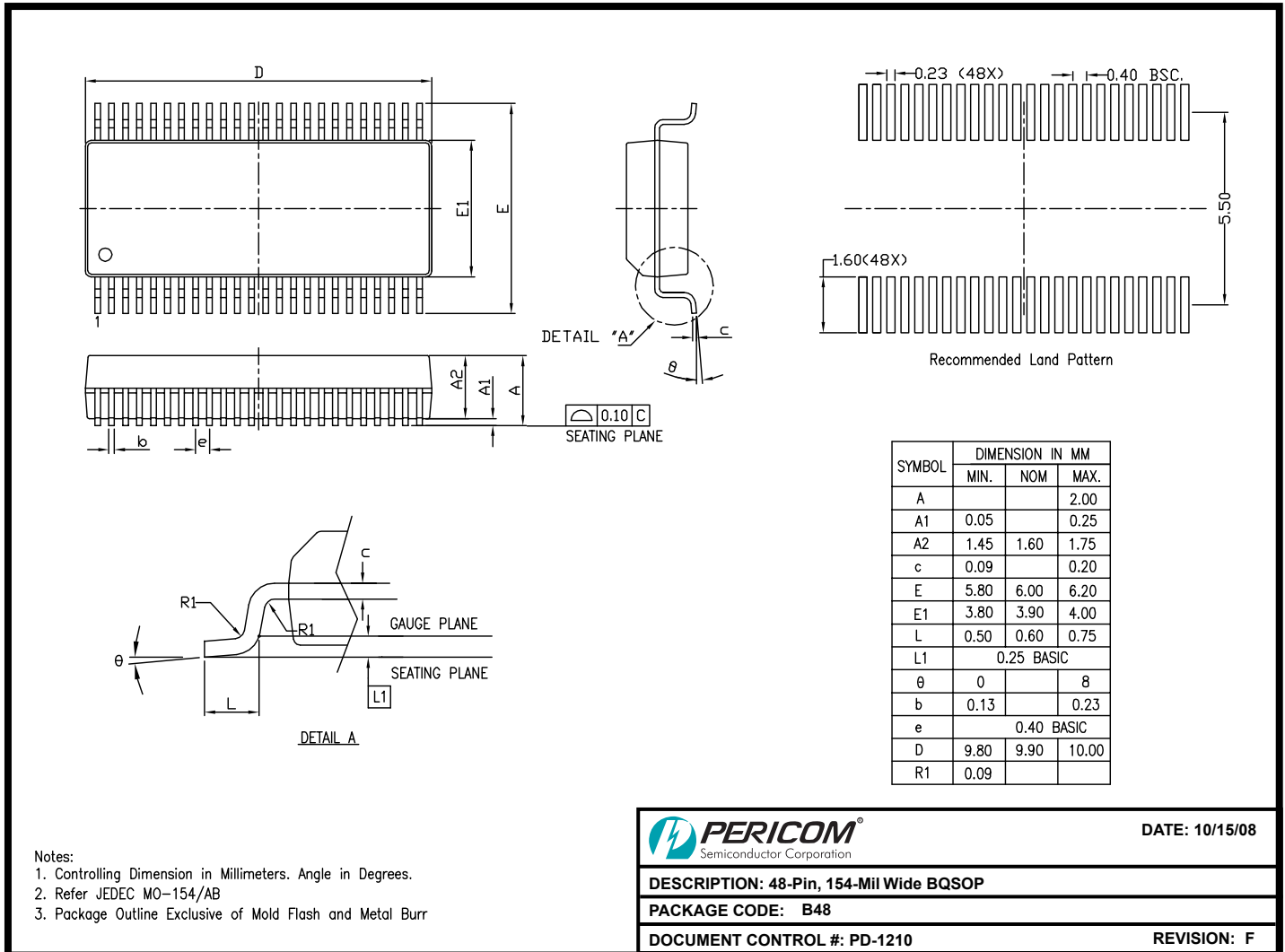


Figure 9. TP3 (Rx) - "Switch at receiver side" with 2-meter cable eye-measurements (left is with switch, right is without switch), refer to figure 2 for the test set up.

**Packaging Mechanical: 48-pin BQSOP (B)**



**Notes:**

1. Controlling Dimension in Millimeters. Angle in Degrees.
2. Refer JEDEC MO-154/AB
3. Package Outline Exclusive of Mold Flash and Metal Burr



DATE: 10/15/08

DESCRIPTION: 48-Pin, 154-Mil Wide BQSOP

PACKAGE CODE: B48

DOCUMENT CONTROL #: PD-1210

REVISION: F

08-0522

**For latest package info.**

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

**Ordering Information**

Ordering Code	Package Code	Package Description
PI3HDMI1210-ABEX	B	48-pin, 154-Mil Wide (BQSOP)

**Notes:**

- Thermal characteristics can be found on the company web site at [www.diodes.com/design/support/packaging/](http://www.diodes.com/design/support/packaging/)
- E = Pb-free and Green
- X suffix = Tape/Reel

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### Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: [info@moschip.ru](mailto:info@moschip.ru)

Skype отдела продаж:

moschip.ru

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