

## High-performance HDMI 1.1 and 1.2 Compatible Signal Switch w/ Integrated Side-band Signal Support

### Features

- 4-Differential Channel 2:1 Mux/DeMux + 4-Channel 2:1 Mux/DeMux
- DVI, HDMI 1.1, 1.2 and 1.3 signal compatible
- Data Rate: 4.0Gbps for high speed channels
- Supports both AC coupled and DC coupled signals
- Switching speed: 4ns
- Isolation: -40dB@1GHz for high-speed channels
- Integrated ESD protection
- High-speed data bits: 12kV HBM  
8kV contact
- Side band signal bits: 2kV HBM
- Low bit-to-bit skew
- Enable/Disable time: 9ns
- Bidirectional
- Packaging (Pb-free & Green):  
—80-pin BQSOP (B)

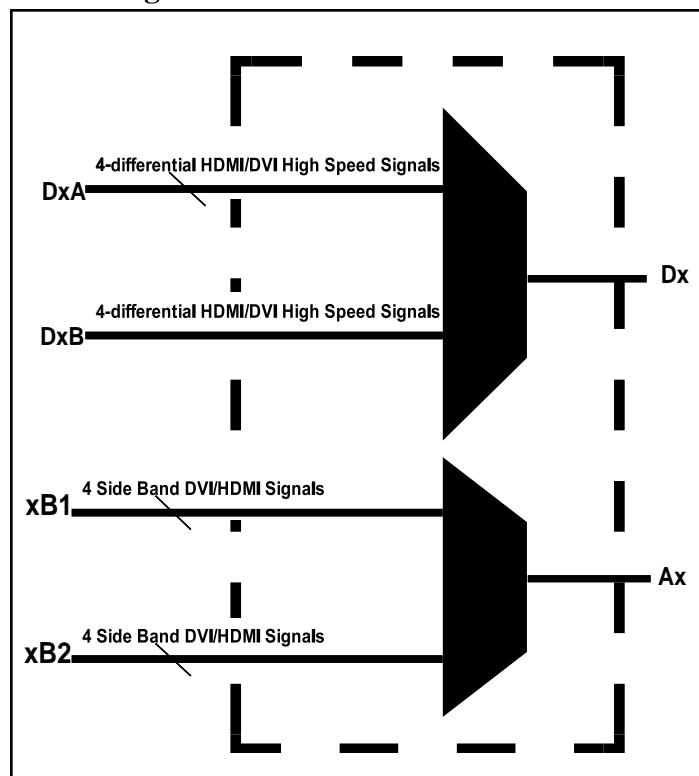
### Description

Pericom Semiconductor's PI3HDMI series of switch circuits are targeted for high-resolution video networks that are based on DVI/HDMI standards, and TMDS signal processing. The PI3HDMI1212 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.

Because of its passive bidirectional feature, this switch can be used either at the video drivers side or at the receiver side. For PC graphics applications, the device sits at the drivers side to switch between multiple display units such as PC LCD monitor, projector, TV, etc. For consumer video applications, the device sits at the receiver end to switch between the source components such as DVD, D-VHS, STB, etc.

### Block Diagram



### Pin Description

|                    |    |    |                    |
|--------------------|----|----|--------------------|
| CP                 | 1  | 80 | V <sub>DD</sub> 33 |
| V <sub>DD</sub> 33 | 2  | 79 | D0+A               |
| CP                 | 3  | 78 | D0-A               |
| V <sub>DD</sub> 33 | 4  | 77 | D1+A               |
| D0+                | 5  | 76 | D1-A               |
| D0-                | 6  | 75 | D2+A               |
| CP                 | 7  | 74 | D2-A               |
| D1+                | 8  | 73 | D3+A               |
| D1-                | 9  | 72 | D3-A               |
| V <sub>DD</sub> 33 | 10 | 71 | CP                 |
| SEL                | 11 | 70 | V <sub>DD</sub> 33 |
| CP                 | 12 | 69 | D0+B               |
| D2+                | 13 | 68 | D0-B               |
| D2-                | 14 | 67 | D1+B               |
| CP                 | 15 | 66 | D1-B               |
| D3+                | 16 | 65 | D2+B               |
| D3-                | 17 | 64 | D2-B               |
| V <sub>DD</sub> 33 | 18 | 63 | D3+B               |
| CP                 | 19 | 62 | D3-B               |
| V <sub>DD</sub> 33 | 20 | 61 | V <sub>DD</sub> 33 |
| V <sub>DD</sub> 33 | 21 | 60 | GND                |
| GND                | 22 | 59 | NC                 |
| NC                 | 23 | 58 | NC                 |
| CP                 | 24 | 57 | CP                 |
| NC                 | 25 | 56 | NC                 |
| V <sub>DD</sub> 33 | 26 | 55 | V <sub>DD</sub> 33 |
| GND                | 27 | 54 | GND                |
| NC                 | 28 | 53 | 0B1                |
| A0                 | 29 | 52 | 0B2                |
| V <sub>DD</sub> 50 | 30 | 51 | 1B1                |
| A1                 | 31 | 50 | 1B2                |
| GND                | 32 | 49 | GND                |
| A2                 | 33 | 48 | 2B1                |
| GND                | 34 | 47 | 2B2                |
| A3                 | 35 | 46 | 3B1                |
| IN                 | 36 | 45 | 3B2                |
| NC                 | 37 | 44 | NC                 |
| NC                 | 38 | 43 | NC                 |
| V <sub>DD</sub> 50 | 39 | 42 | V <sub>DD</sub> 50 |
| EN                 | 40 | 41 | GND                |

### Truth Table

| SEL(pin11) | Function <sup>(1)</sup> |
|------------|-------------------------|
| L          | $D_x \rightarrow D_xA$  |
| H          | $D_x \rightarrow D_xB$  |

| EN(pin40) | IN(pin36) | Function <sup>(2)</sup>             |
|-----------|-----------|-------------------------------------|
| L         | L         | $A_n \rightarrow {}_nB_1$           |
| L         | H         | $A_n \rightarrow {}_nB_2$           |
| H         | X         | $A_n = {}_nB_1 = {}_nB_2 = H_1 - Z$ |

Note:

1) x=0,1,2,3

2) n=0,1,2,3

### Pin Description

| Pin Name          | Description   |
|-------------------|---|
| V <sub>DD33</sub> | 3.3V Power supply   |
| CP                | Tie this pin to GND via 0.1μF capacitor for optimal operation |
| V <sub>DD50</sub> | 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                           |

### 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> .....      | 3.0V to 3.6V    |
| Supply Voltage V <sub>DD50</sub> .....      | 4.2V to 5.5V    |

**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>DD</sub> <sup>33</sup> | 3.3V Power Supply | 3.0  | 3.6  | V     |
| V <sub>DD</sub> <sup>50</sup> | 5.0 Power Supply  | 4.2  | 5.5  | V     |

### DC Electrical Characteristics for Switching over Operating Range

( $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ )

| Parameter         | Description         | Test Conditions                           | Min. | Typ <sup>(2)</sup> | Max. | Units |
|-------------------|---------------------|---|------|--------------------|------|-------|
| $V_{IHSEL}^{(3)}$ | Input HIGH Voltage  | Guaranteed HIGH level                     | 2.8  |                    |      | V     |
| $V_{ILSEL}^{(3)}$ | Input LOW Voltage   | Guaranteed LOW level                      |      |                    | 2.0  |       |
| $V_{IKHS}^{(4)}$  | Clamp Diode Voltage | $V_{DD}=\text{Max.}, I_{IN}=-18\text{mA}$ |      |                    | 0.9  |       |

**Notes:**

1. For Max. or Min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at  $T_A = 25^{\circ}\text{C}$  ambient and maximum loading.
3.  $V_{IHSEL} + V_{ILSEL}$  are for SEL input only (pin 11)
4. For High-speed signals only

### DC Electrical Characteristics for Switching over Operating Range

( $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ) for high speed signals only

| Parameter        | Description         | Test Conditions                           | Min. | Typ <sup>(2)</sup> | Max.    | Units         |
|------------------|---------------------|---|------|--------------------|---------|---------------|
| $V_{IHIN}^{(3)}$ | Input HIGH Voltage  | Guaranteed HIGH level                     | 2.1  |                    |         | V             |
| $V_{ILIN}^{(3)}$ | Input LOW Voltage   | Guaranteed LOW level                      |      |                    | 0.8     |               |
| $V_{IKHS}^{(4)}$ | Clamp Diode Voltage | $V_{DD}=\text{Max.}, I_{IN}=-18\text{mA}$ |      |                    | -0.9    |               |
| $I_{IH}$         | Input HIGH Current  | $V_{DD}=\text{Max.}, V_{IN}=V_{DD}$       |      |                    | $\pm 5$ | $\mu\text{A}$ |
| $I_{IL}$         | Input LOW Current   | $V_{DD}=\text{Max.}, V_{IN}=V_{SS}$       |      |                    | $\pm 5$ |               |

**Notes:**

1. For Max. or Min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at  $T_A = 25^{\circ}\text{C}$  ambient and maximum loading.
3.  $V_{IHIN} + V_{ILIN}$  are for IN input only.
4. For Side-speed signals only

**Power Supply Characteristics**

| Parameters      | Description                    | Test Conditions <sup>(1)</sup>   | Min. | Typ. <sup>(2)</sup> | Max. | Units |
|-----------------|--------------------------------|--|------|---------------------|------|-------|
| I <sub>CC</sub> | Quiescent Power Supply Current | V <sub>DD</sub> = Max., V <sub>IN</sub> = V <sub>DD</sub> or V <sub>SS</sub> |      | 11                  |      | mA    |

**Notes:**

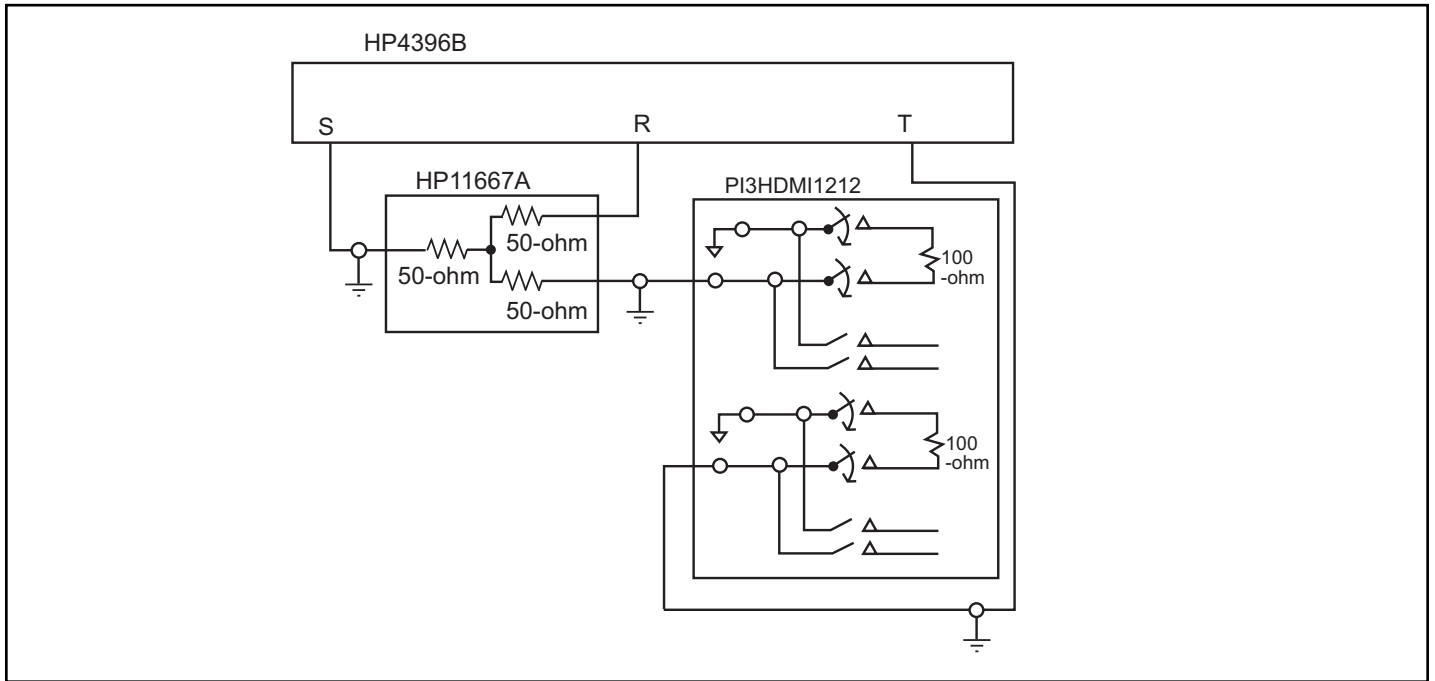
1. For Max. or Min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at T<sub>A</sub> = 25°C ambient and maximum loading.

**Dynamic Electrical Characteristics Over the Operating Range (T<sub>A</sub> = -40° to +85°C)**

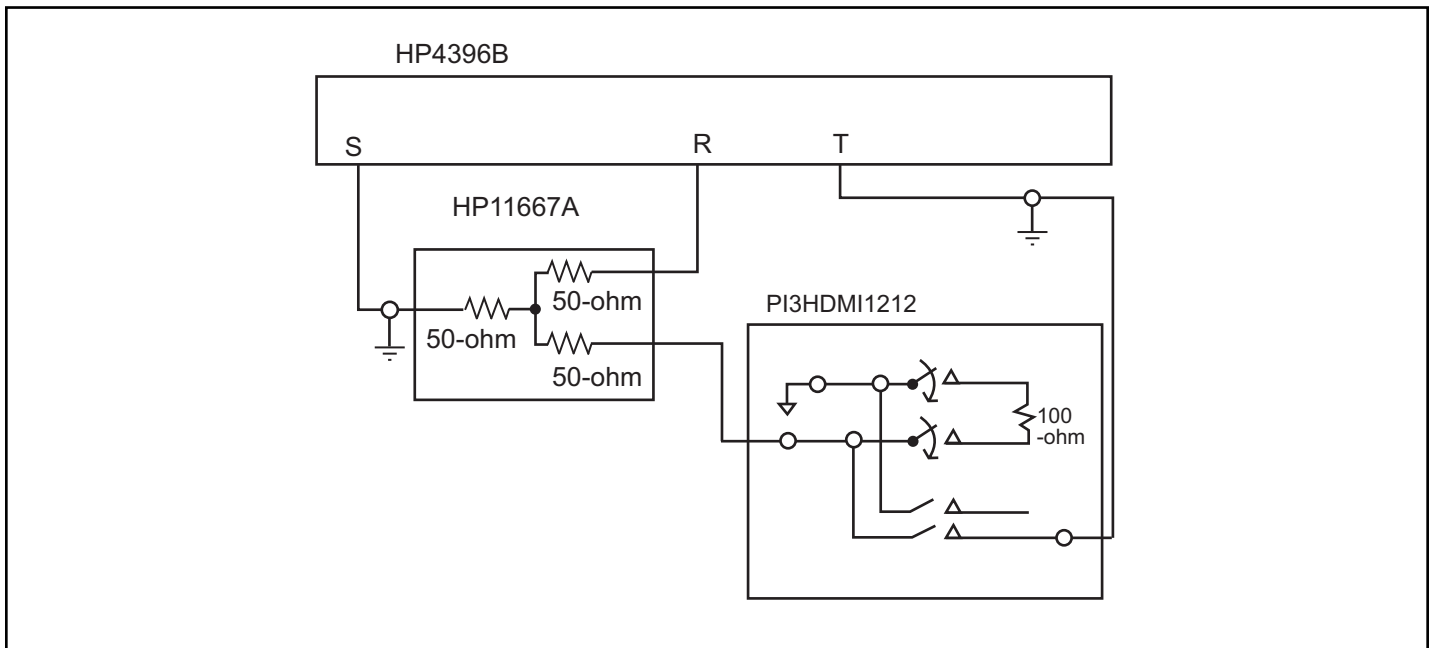
| Parameter                                     | Description    | Test Conditions                                   | Min. | Typ. <sup>(2)</sup> | Max. | Units |
|---|----------------|---|------|---------------------|------|-------|
| X <sub>TALK<sub>HS</sub></sub> <sup>(1)</sup> | Crosstalk      | See Fig. 1 for Measurement Setup,<br>f = 1.65Gbps |      | -45                 |      | dB    |
| X <sub>TALK<sub>SB</sub></sub> <sup>(2)</sup> |                | f = 250KHz  |      | -80                 |      |       |
| O <sub>IRR<sub>HS</sub></sub> <sup>(1)</sup>  | OFF Isolation  | See Fig. 2 for Measurement Setup,<br>f = 1.65Gbps |      | -40                 |      |       |
| O <sub>IRR<sub>SB</sub></sub> <sup>(2)</sup>  |                | 250KHz  |      | -56                 |      |       |
| BW <sub>HS</sub> <sup>(1)</sup>               | -3dB Bandwidth |   |      | 2.7                 |      | GHz   |
| IL <sub>HS</sub> <sup>(1)</sup>               | 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               |      |       |

**Notes:**

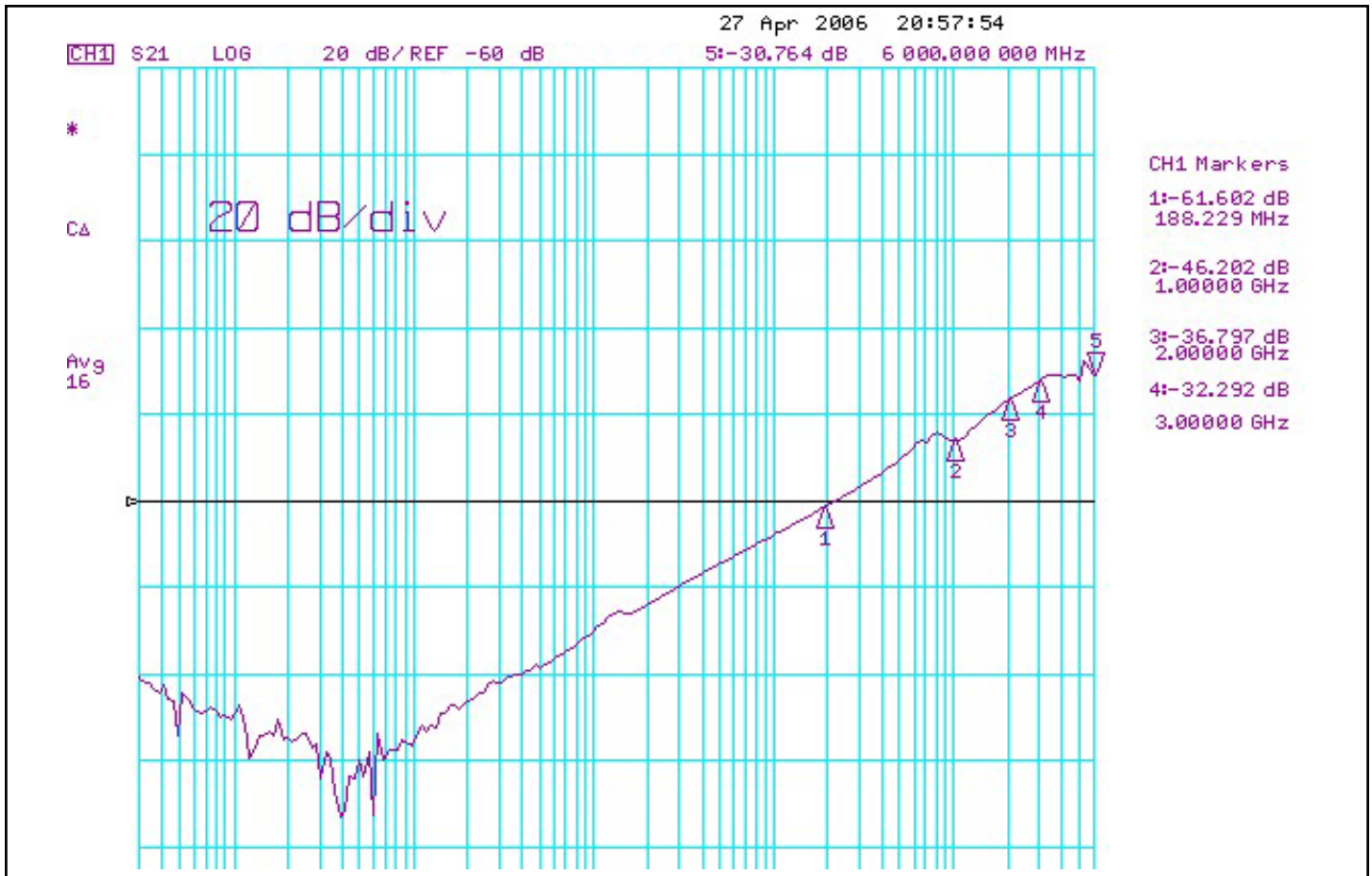
1. High-speed signal path only
2. Side-band signal path only
3. Typical values are @ T<sub>A</sub> = 25°C ambient



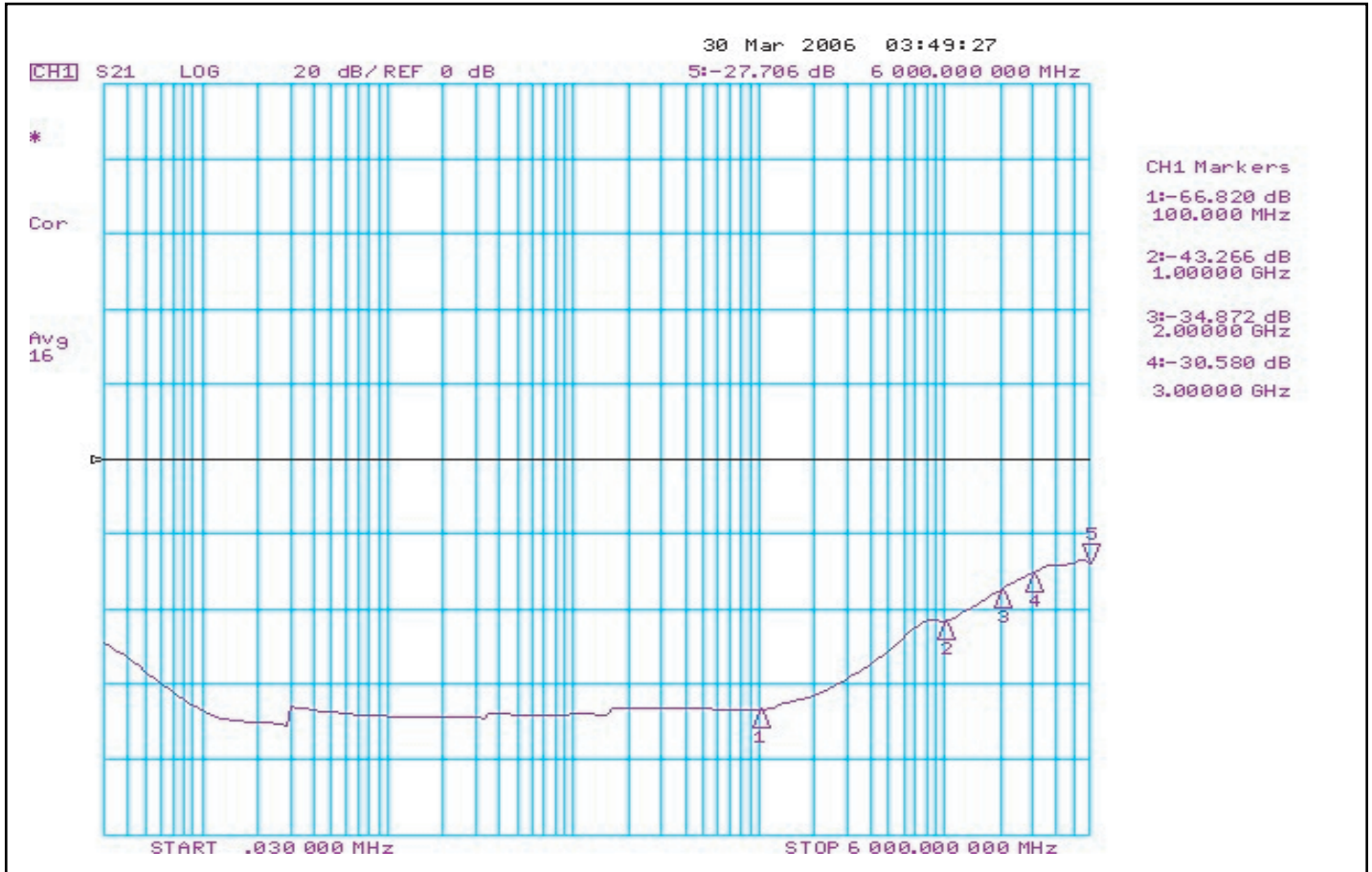
**Fig 1. Crosstalk Setup**



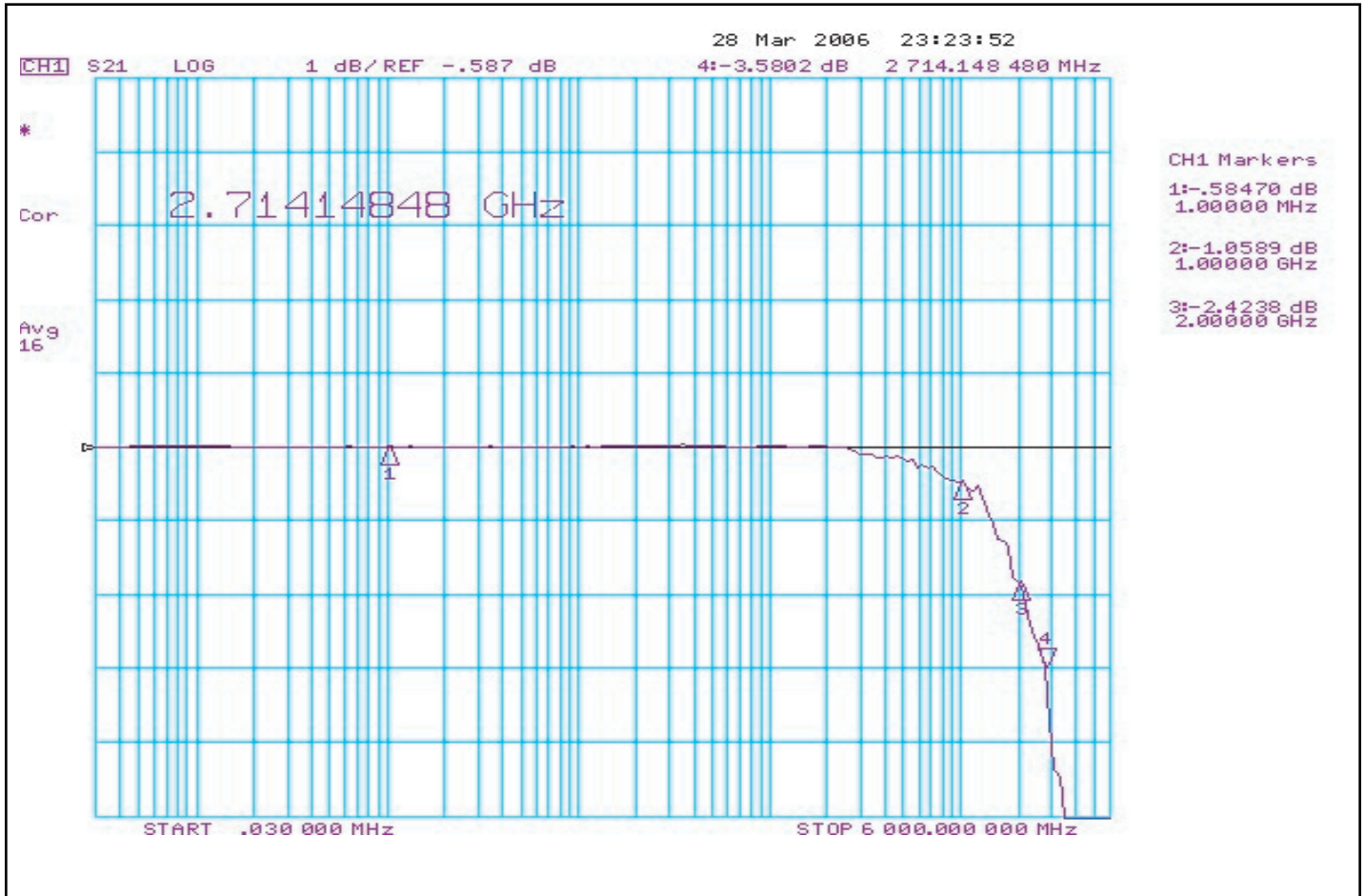
**Fig 2. Off-isolation setup**



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



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



**Fig 4. Insertion loss for high-speed signals only**

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

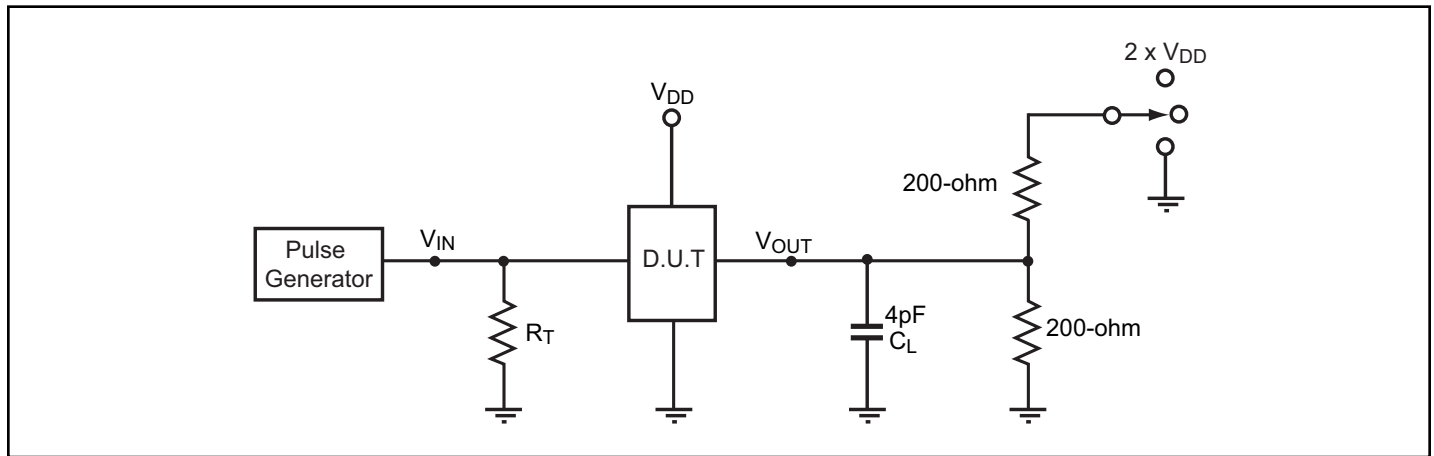
| Parameter  | Description  | Min. | Typ. <sup>(2)</sup> | Max. | Units |
|------------|--|------|---------------------|------|-------|
| tPZH, tPZL | Line Enable Time - SEL to A <sub>N</sub> , B <sub>N</sub>  | 0.5  |                     | 8.0  | ns    |
| tPHZ, tPLZ | Line Disable Time - SEL to A <sub>N</sub> , B <sub>N</sub> | 0.5  |                     | 4.0  |       |

**Notes:**

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



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



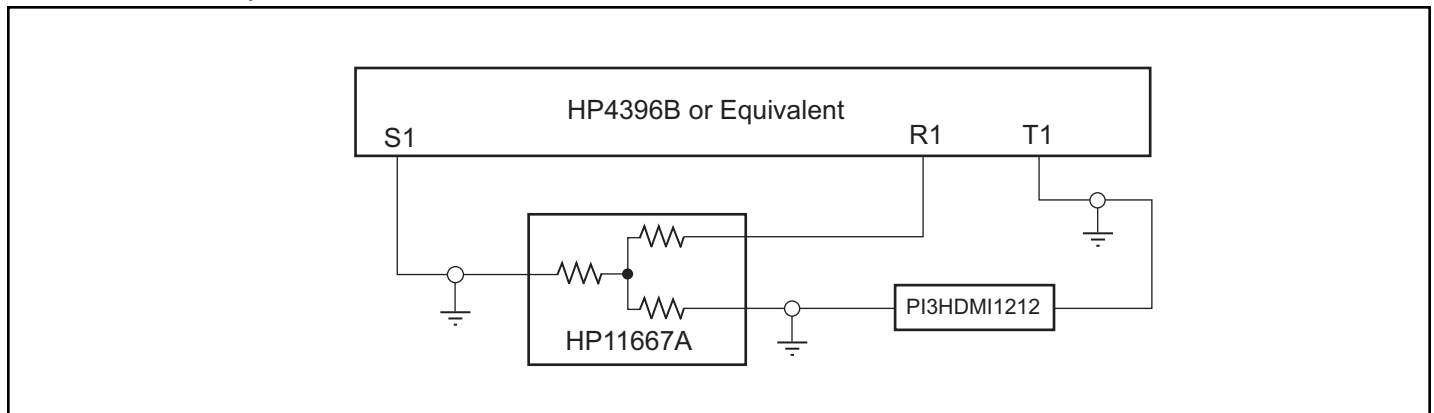
**Notes:**

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.

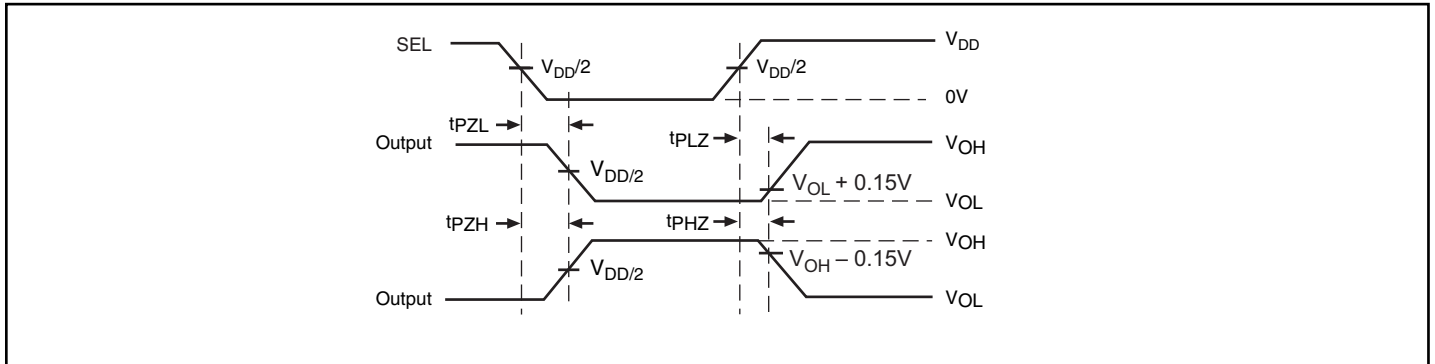
### Switch Positions

| Test                                     | Switch                |
|--|-----------------------|
| $t_{PLZ}$ , $t_{PZL}$ (output on B-side) | $2 \times (V_{DD33})$ |
| $t_{PHZ}$ , $t_{PZH}$ (output on B-side) | GND                   |
| Prop Delay                               | Open                  |

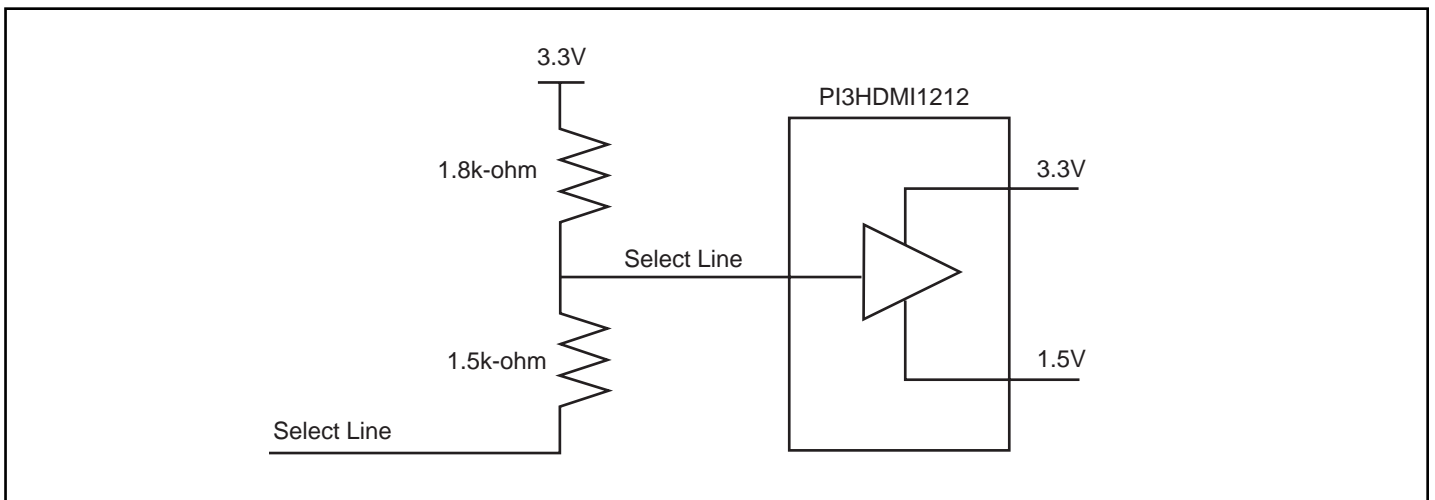
### Test Circuit for Dynamic Electrical Characteristics



**Switching Waveforms**

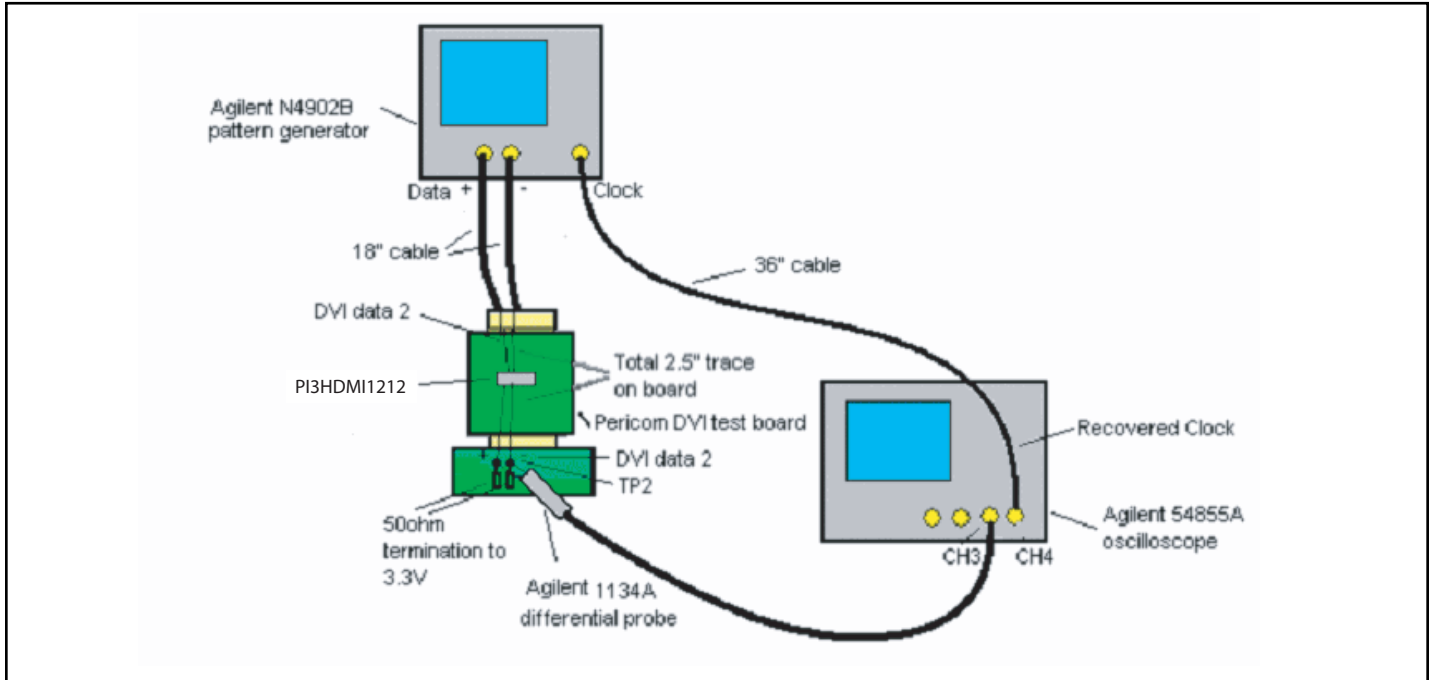


**Voltage Waveforms Enable and Disable Times**

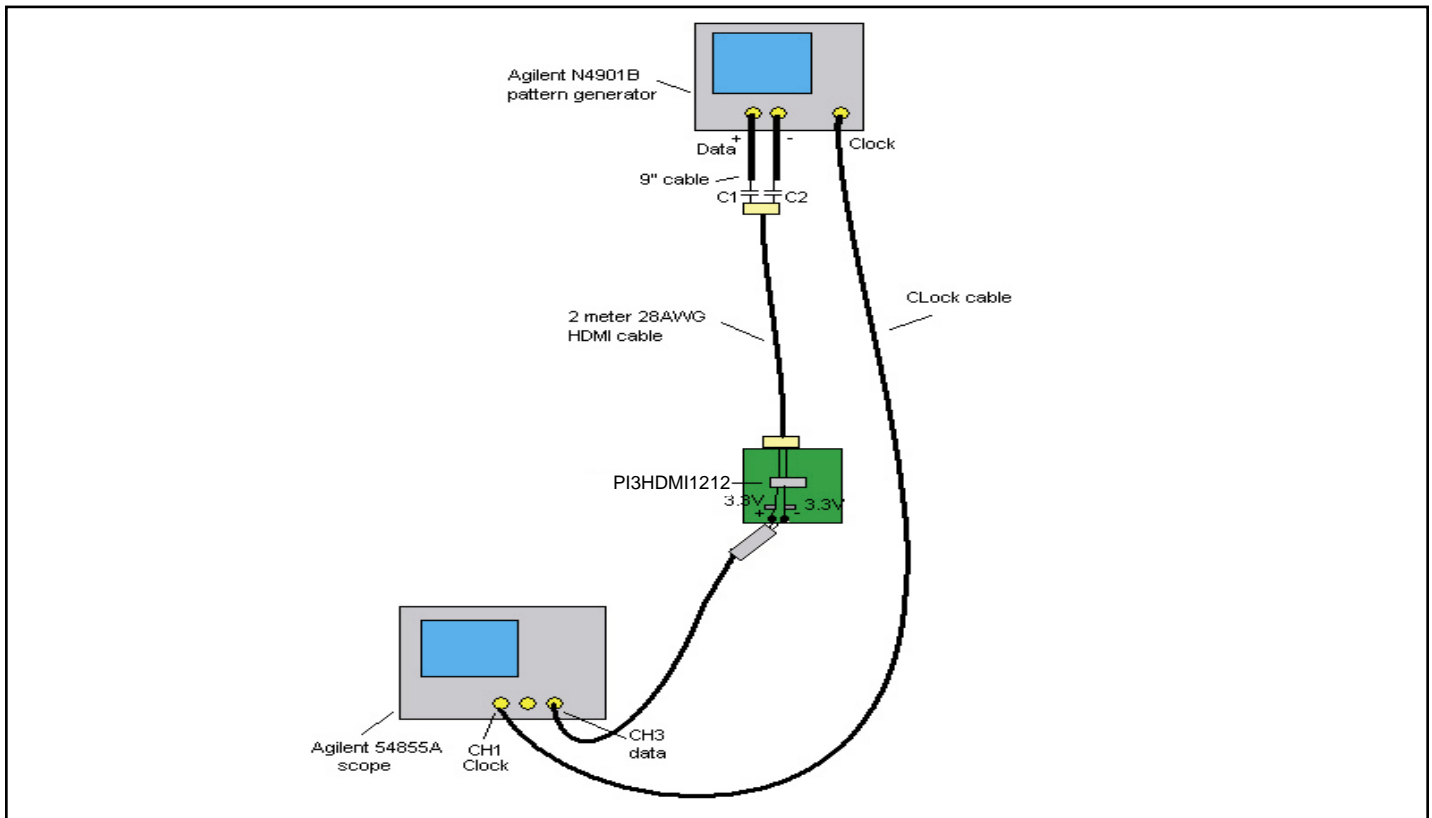


**Example of a circuit that needs to be connected to the SEL pin (11) of the PI3HDMI1212 of our device:**

**Application Test Results**



**Figure 1. TMD5 TP2 Tx eye compliance test setup**



**Figure 2. TMD5 TP3 Rx "switch at receiver" eye compliance test setup**

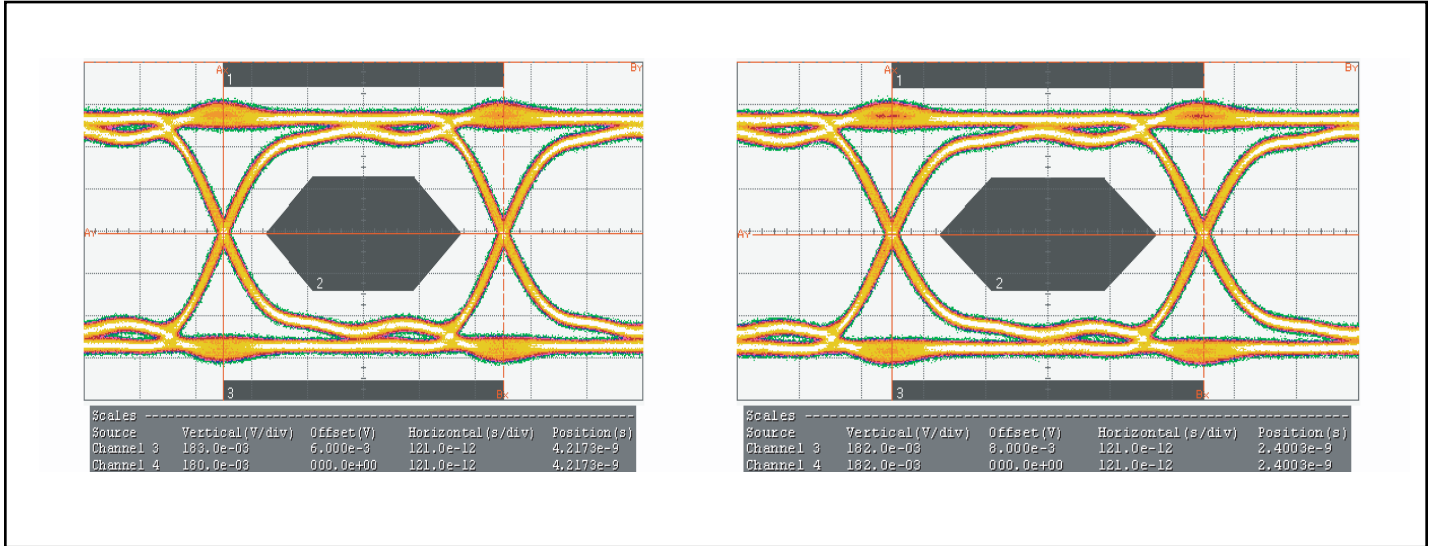


Figure 3. TP2 (Tx) eye-measurements (left is with switch, right is without switch), refer to figure 1 for the test set up

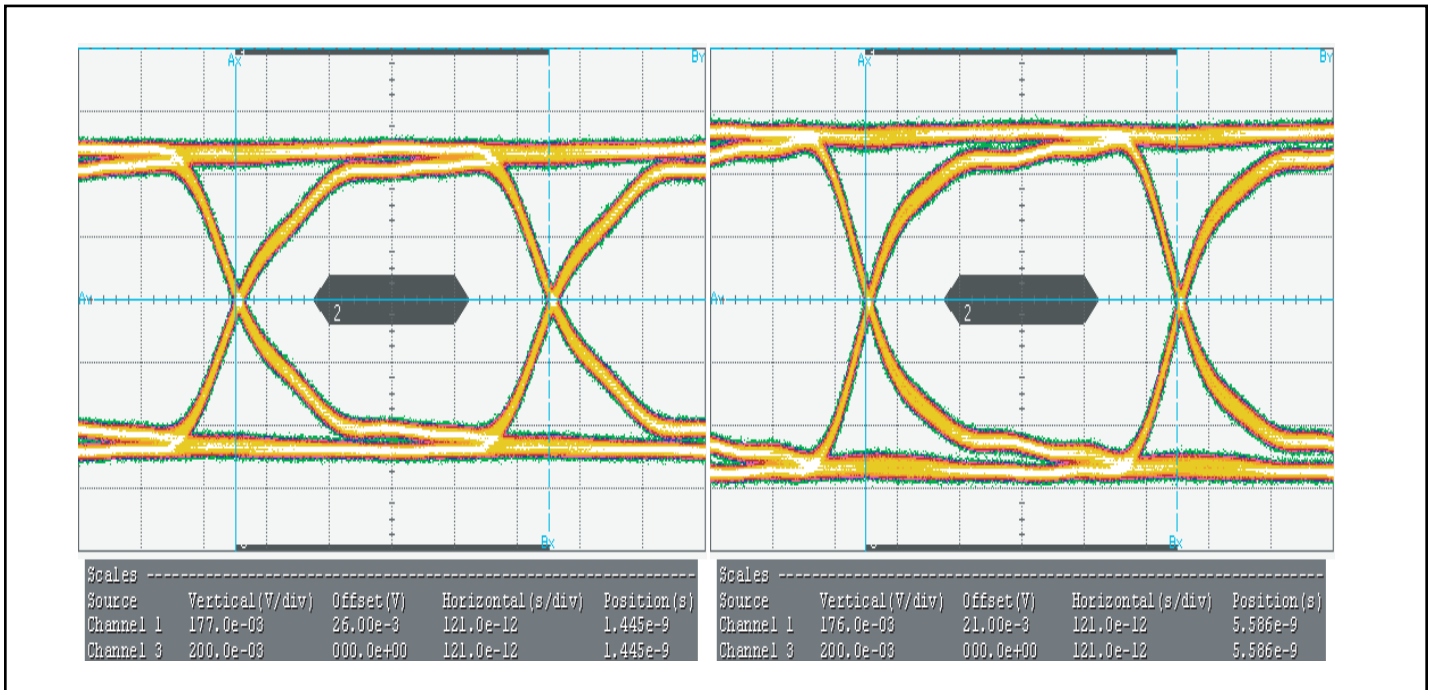
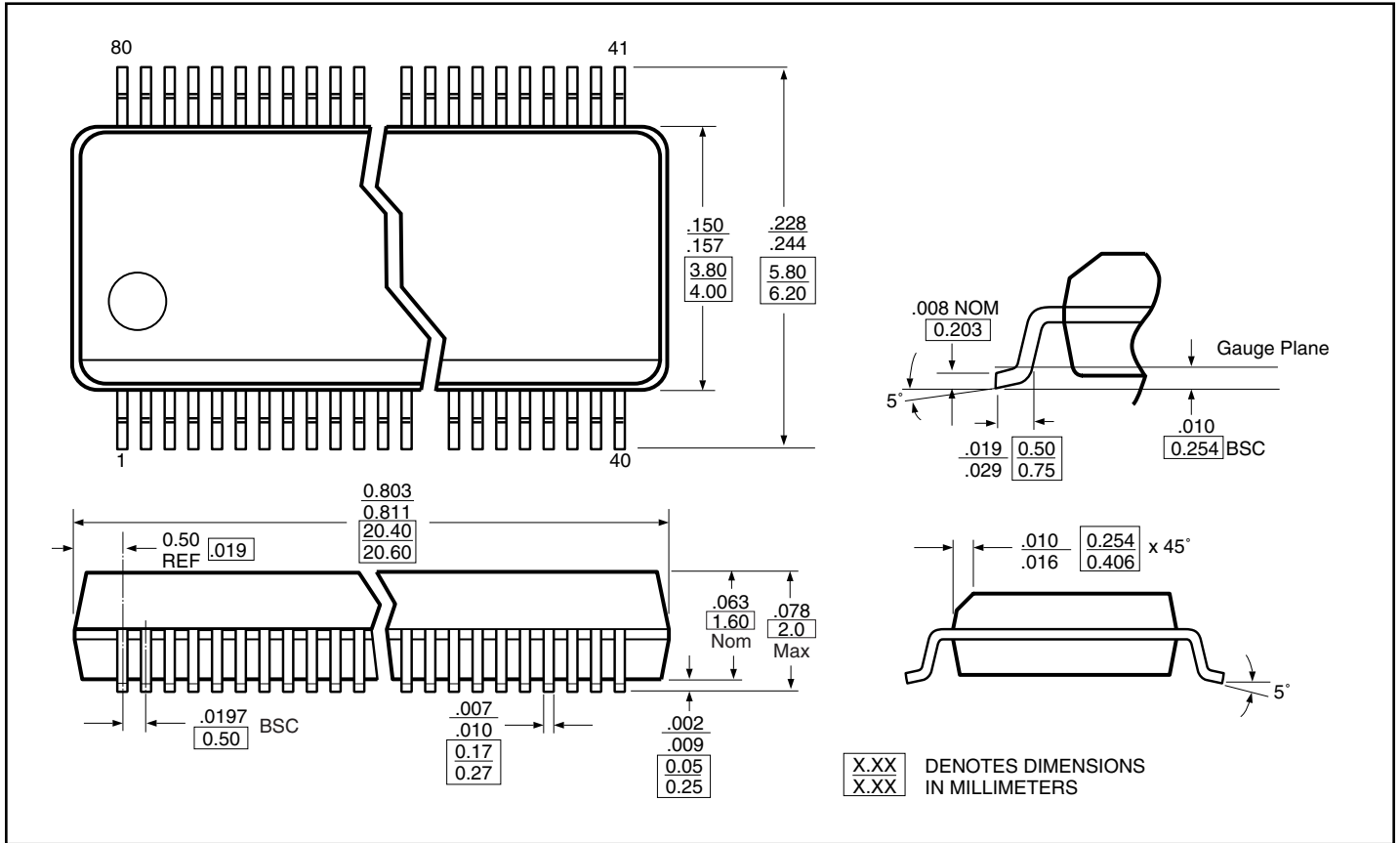


Figure 4. TP3 (Rx) - "Switch at receiver side" with 2-meter cable eye-measurements (left is with switch, right is without switch), refer to figure 2 for the test set up.

**Packaging Mechanical: 80-pin BQSOP (B)**



**Ordering Information**

| Ordering Code | Package Code | Package Description           |
|---------------|--------------|-------------------------------|
| PI3HDMI1212BE | B            | Pb-free & Green, 80-pin TSSOP |

**Notes:**

1. Thermal characteristics can be found on the company web site at [www.pericom.com/packaging/](http://www.pericom.com/packaging/)
2. E = Pb-free and Green
3. X Suffix = Tape/Reel