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# Low On-Resistance, 3.3V High-Bandwidth 3-Port, 4:1 Mux/DeMux VideoSwitch

## Features

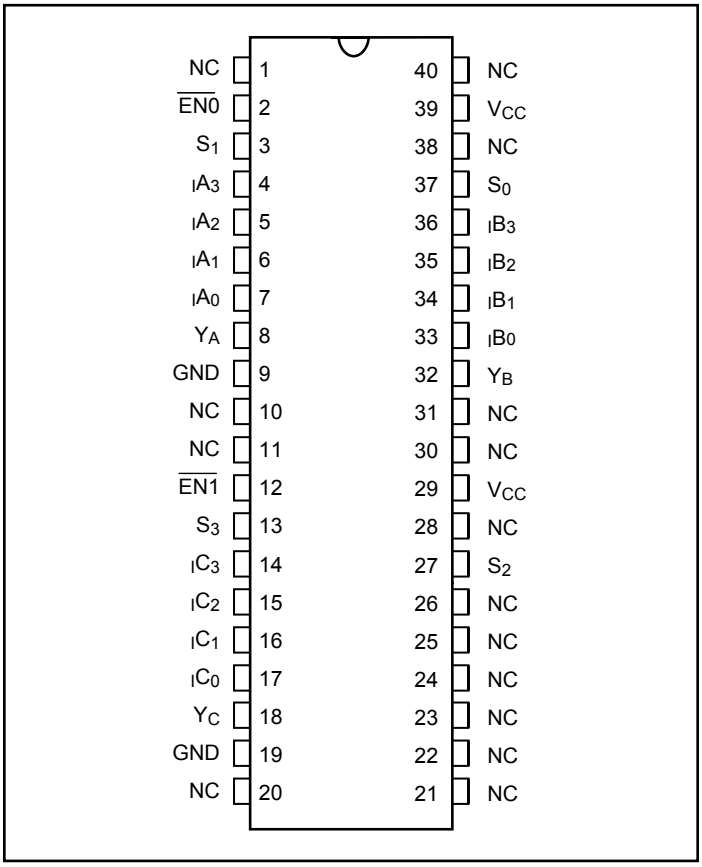
- Near-Zero propagation delay
- 5Ω switches connect inputs to outputs
- High signal passing bandwidth (375MHz)
- Beyond Rail-to-Rail switching
- 5V I/O tolerant with 3.3V supply
- 2.5V and 3.3V supply voltage operation
- Hot insertion capable
- Low Crosstalk ($X_{TALK}$ = -60dB Typ.)
- Low Off-Isolation ($O_{IRR}$ = -60db Typ.)
- Industrial operating temperature: -40ºC to +85ºC
- 2KV ESD Protection (human body model)
- Latch-up performance >250mA per JESD17
- Packaging (Pb-free & greeen available):
  – 40-Pin 150-mil wide plastic BQSOP(B)

## Description

The PI3V314 is a true bi-directional 3-Port 4:1 multiplexer/demultiplexer with Hi-Z outputs that is recommended for both RGB and composite video switching applications. With the increased 4:1 channels, multiple components, such as VCR, DVD, PC1, PC2 and etc. can be put on the video networks. The VideoSwitch can be driven from a current output RAMDAC or voltage output composite video source.

Low On-Resistance, Low Crosstalk, Low OFF Isolation and wide bandwidth features make it ideal for video and other applications. Industry leading advantages include a near zero propagation delay, resulting from its low channel resistance and I/O capacitance. The switch is bi-directional and offers little or no attenuation of the high-speed signals at the outputs. The device also has exceptional high current capability which is far greater than most analog switches offered today. The PI3V314 offers a high-performance (375 MHz), low-cost solution to switch between video sources.

## Pin Configuration




**Notes:**
1. N.C = No internal connection

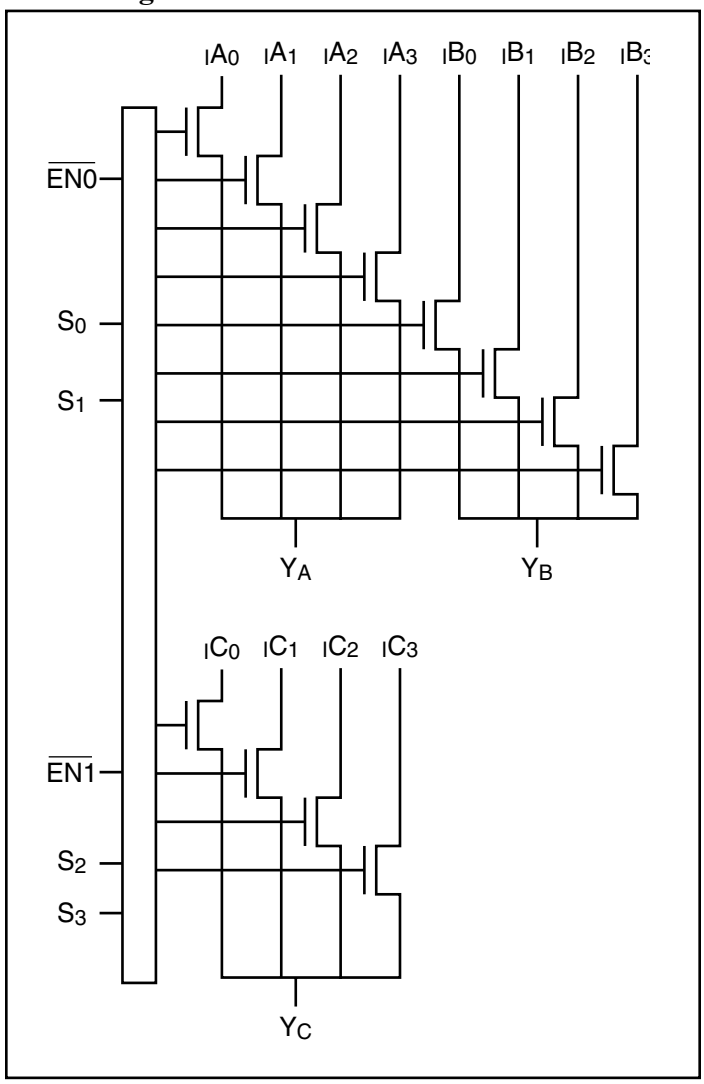
## Applications

- Projection TV and LCD TV
- Video consumer applications
- Analog video signal processing

## Pin Description

| Pin Name | Description |
|---|---|
| $I A_N$, $I B_N$ | Data Inputs |
| $S_{0-3}$ | Select Inputs |
| $\overline{EN_0}$ to $\overline{EN_1}$ | Enable |
| $Y_A$ to $Y_C$ | Data Outputs |
| GND | Ground |
| $V_{CC}$ | Power |

## Block Diagram




**Notes:**
1. For video applications: In order to control Muxing and DeMuxing of all the 12 to 3 channels with the same control plane, the following connectoins need to be made on the board:
   a. $\overline{EN0}$ and $\overline{EN1}$ need to be tied together
   b. S1 and S3 need to be tied together
   c. S0 and S2 need to be tied together

## Truth Table 1(1)

| Enable | Select | | | |
|---|---|---|---|---|
| $\overline{EN_0}$ | $S_1$ | $S_0$ | $Y_A/Y_B$ | Function |
| H | X | X | Hi-Z | Disable |
| L | L | L | I0 | S1-S0 = 0 |
| L | L | H | I1 | S1-S0 = 1 |
| L | H | L | I2 | S1-S0 = 2 |
| L | H | H | I3 | S1-S0 = 3 |

## Truth Table 2(1)

| Enable | Select | | | |
|---|---|---|---|---|
| $\overline{EN_1}$ | $S_3$ | $S_2$ | $Y_C$ | Function |
| H | X | X | Hi-Z | Disable |
| L | L | L | I0 | S3-S2 = 0 |
| L | L | H | I1 | S3-S2 = 1 |
| L | H | L | I2 | S3-S2 = 2 |
| L | H | H | I3 | S3-S2 = 3 |

**Notes:**
1. H=High Voltage Level; L=Low Voltage Level

## Maximum Ratings

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

| | |
|---|---|
| Storage Temperature | –65°C to +150°C |
| Ambient Temperature with Power Applied | –40°C to +85°C |
| Supply Voltage to Ground Potential | –0.5V to +4.6V |
| DC Input Voltage | –0.5V to +6.0V |
| DC Output Current | 120mA |
| Power Dissipation | 0.5W |

**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 Electrical Characteristics, 3.3V Supply (Over the Operating Range, $T_A$ = –40°C to +85°C, $V_{CC}$ = 3.3V ± 10%)

| Parameters | Description | Test Conditions(1) | Min. | Typ(2) | Max. | Units |
|---|---|---|---|---|---|---|
| $V_{IH}$ | Input HIGH Voltage | Guaranteed Logic HIGH Level | 2.0 | | | V |
| $V_{IL}$ | Input LOW Voltage | Guaranteed Logic LOW Level | –0.5 | | 0.8 | |
| $V_{IK}$ | Clamp Diode Voltage | $V_{CC}$ = Min., $I_{IN}$ = –18 mA | | -1.3 | –1.8 | |
| $I_{IH}$ | Input HIGH Current | $V_{CC}$ = Max., $V_{IN}$ = $V_{CC}$ | | | ±1 | µA |
| $I_{IL}$ | Input LOW Current | $V_{CC}$ = Max., $V_{IN}$ = GND | | | ±1 | |
| $I_{OZH}$ | High Impedance Output Current | 0 ≤ Y, In ≤ $V_{CC}$ | | | ±1 | |
| $R_{ON}$ | Switch On-Resistance(3) | $V_{CC}$ = Min., $V_{IN}$ = 0V, $I_{ON}$ = 48 mA or -64mA | | 4 | 6 | Ω |
| | | $V_{CC}$ = Min., $V_{IN}$ = 3.6V, $I_{ON}$ = -15 mA | | 5 | 8 | |

## DC Electrical Characteristics, 2.5V Supply (Over Operating Range, $T_A$ = –40°C to +85°C, $V_{CC}$ = 2.5V ± 10%)

| Parameters(5) | Description | Test Conditions(1) | Min. | Typ.(2) | Max. | Units |
|---|---|---|---|---|---|---|
| $V_{IH}$ | Input HIGH Voltage | Guaranteed Logic HIGH Level | 1.8 | | $V_{CC}$ + 0.3 | V |
| $V_{IL}$ | Inout LOW Voltage | Guaranteed Logic LOW Level | –0.3 | | 0.8 | |
| $V_{IK}$ | Clamp Diode Voltage | $V_{CC}$ = Max., $I_{IN}$ = –6mA | | –0.7 | –1.8 | |
| $I_{IH}$ | Input HIGH Current | $V_{CC}$ = Max., $V_{IN}$ = $V_{CC}$ | | | ±1 | µA |
| $I_{IL}$ | Input LOW Current | $V_{CC}$ = Max., $V_{IN}$ = GND | | | ±1 | |
| $I_{OZH}$ | High Impedance Current | 0 ≤ Y, In ≤ $V_{CC}$ | | | ±1 | |
| $R_{ON}$ | Switch On-Resistance(3) | $V_{CC}$ = Min., $V_{IN}$ = 0V, $I_{ON}$ = –48mA | | 6 | 8 | Ω |
| | | $V_{CC}$ = Min., $V_{IN}$ = 2.25V, $I_{ON}$ = -15mA | | 7 | 14 | |

**Notes:**
1. For Max. or Min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at $V_{CC}$ = 3.3V, $T_A$ = 25°C ambient and maximum loading.
3. Measured by the voltage drop between Y and In pin at indicated current through the switch. On-Resistance is determined by the lower of the voltages on the two (Y, In) pins.

## Capacitance ($T_A$ = 25°C f = 1 MHz)

| Parameters[2] | Description | Test Conditions | Typ.[1] | Units |
|---|---|---|---|---|
| $C_{IN}$ | Input Capacitance | $V_{IN}$ = 0V | 3.0 | pF |
| $C_{OFF(IN)}$ | In Capacitance, Switch Off | | 3.5 | |
| $C_{OFF(Y)}$ | Y Capacitance, Switch Off | | 12 | |
| $C_{ON}$ | Y/In Capacitance, Switch On | | 15.0 | |

**Notes:**
1. Typical values are at $V_{CC}$ = 3.3V, $T_A$ = 25°C ambient and maximum loading.
2. This parameter is determined by device characterization but is not production tested.

## Power Supply Characteristics

| Parameters | Description | Test Conditions[1] | Min. | Typ.[2] | Max. | Units |
|---|---|---|---|---|---|---|
| $I_{CC}$ | Quiescent Power Supply Current | $V_{CC}$ = 3.6V, $V_{IN}$ = GND or $V_{CC}$ | | | 1.6 | mA |

**Notes:**
1. For Max. or Min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device.
2. Typical values are at $V_{CC}$ = 3.3V, +25°C ambient.

## Dynamic Electrical Characteristics Over the Operating Range ($T_A$ = -40º to +85º, $V_{CC}$ = 3.3V ± 10%)

| Parameter | Description | Test Condition | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| $X_{TALK}$ | Crosstalk | See Test Diagram (10 MHz) | | -60 | | dB |
| $O_{IRR}$ | Off-Isolation | See Test Diagram (10 MHz) | | -60 | | |
| BW | -3dB Bandwidth | See Test Diagram ($C_L$ = 0pF) | | 375 | | MHz |

## Switching Characteristics over 3.3V Operating Range

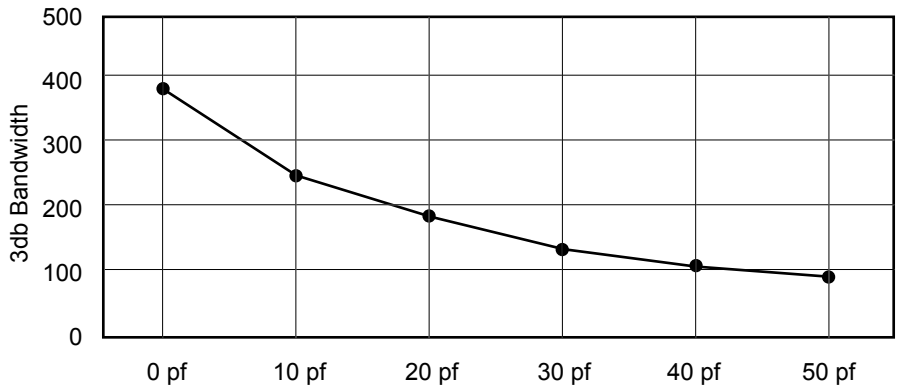
| Parameters | Description | Conditions[1] | Com. | | Units |
|---|---|---|---|---|---|
| | | | Min. | Max. | |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay[2,3] Y to In, In to Y | See Test Diagram | | 0.3 | ns |
| $t_{PZH}$<br>$t_{PZL}$ | Enable Time S or $\overline{EN}$ to Y or In | See Test Diagram | 1.5 | 9.0 | |
| $t_{PHZ}$<br>$t_{PLZ}$ | Disable Time S or $\overline{EN}$ to Y or In | | 1.5 | 9.0 | |

## Switching Characteristics over 2.5V Operating Range

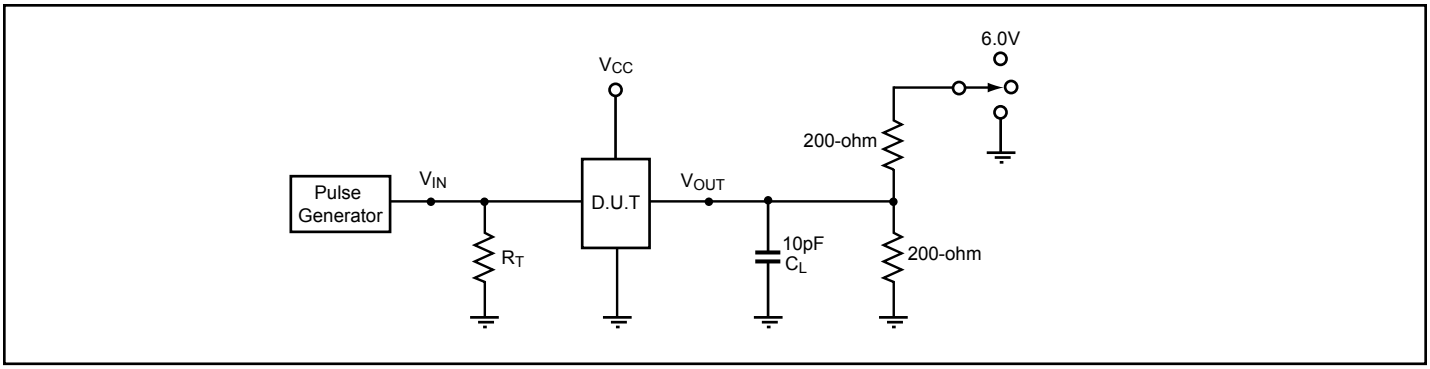
| Parameters | Description | Conditions[1] | Com. | | Units |
|---|---|---|---|---|---|
| | | | Min. | Max. | |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay[2,3] Y to In, In to Y | See Test Diagram | | 0.3 | ns |
| $t_{PZH}$<br>$t_{PZL}$ | Enable Time S or $\overline{EN}$ to Y or In | See Test Diagram | 1.5 | 15.0 | |
| $t_{PHZ}$<br>$t_{PLZ}$ | Disable Time S or $\overline{EN}$ to Y or In | | 1.5 | 12.0 | |

**Notes:**
1. See test circuit and waveforms.
2. This parameter is guaranteed but not tested on Propagation Delays.
3. The switch contributes no propagational 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 0.30ns for 10pF load. Since this time constant is much smaller than the rise/fall times of typical driving signals, it adds very little propagational delay to the system. Propagational delay of the switch when used in a system is determined by the driving circuit on the driving side of the switch and its interaction with the load on the driven side.

## Bandwidth vs Capacitance



## Test Circuit for Electrical Characteristics(1)

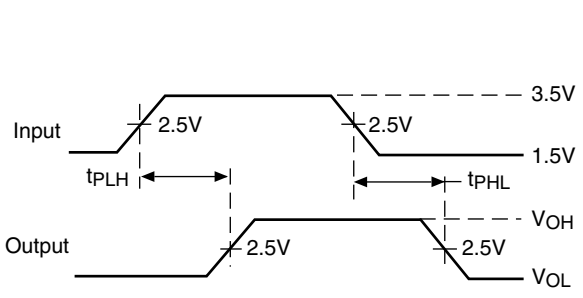


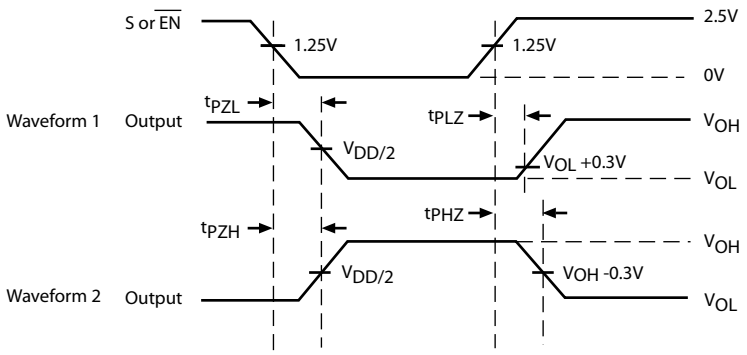

**Notes:**
1. $C_L$ = Load capacitance: includes jig and probe capacitance.
2. $R_T$ = Termination resistance: should be equal to $Z_{OUT}$ of the Pulse Generator
3. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 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 ≤ MHz, $Z_O$ = 50Ω, $t_R \leq 2.5$ns, $t_F \leq 2.5$ns.
5. The outputs are measured one at a time with one transition per measurement.

## Switch Positions

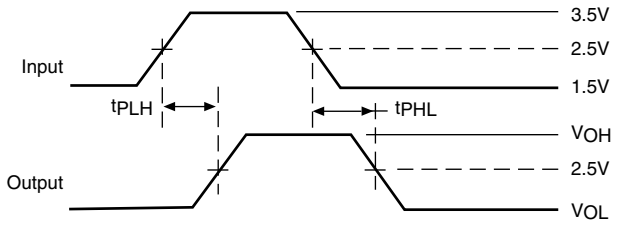
| Test | Switch |
|---|---|
| $t_{PLZ}$, $t_{PZL}$ | 6.0V |
| $t_{PHZ}$, $t_{PZH}$ | GND |
| Prop Delay | Open |

## Switching Waveforms



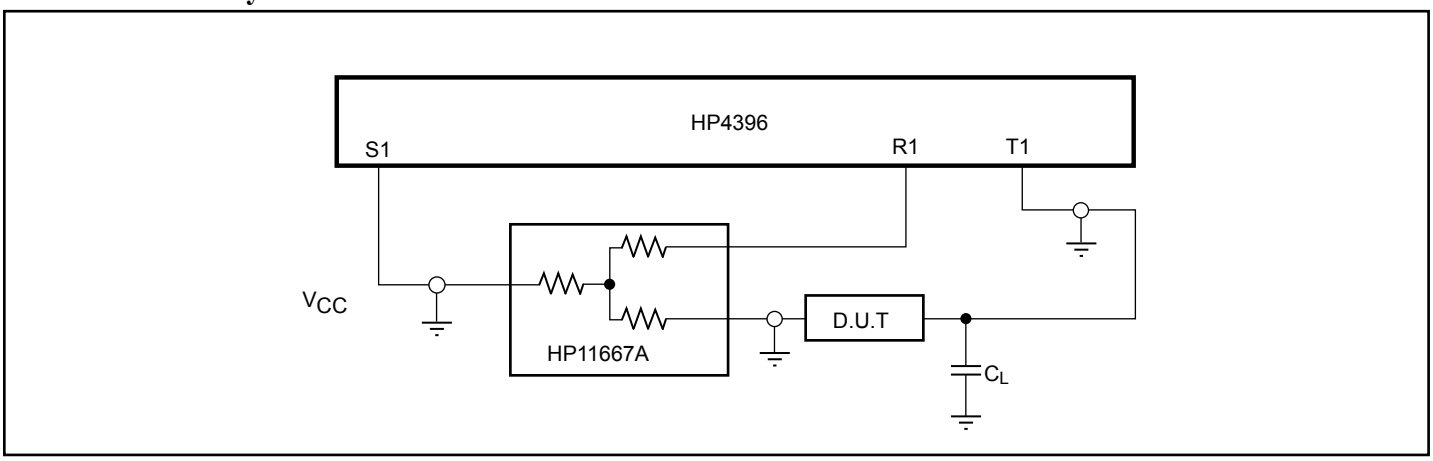

**Voltage Waveforms Enable and Disable Times**



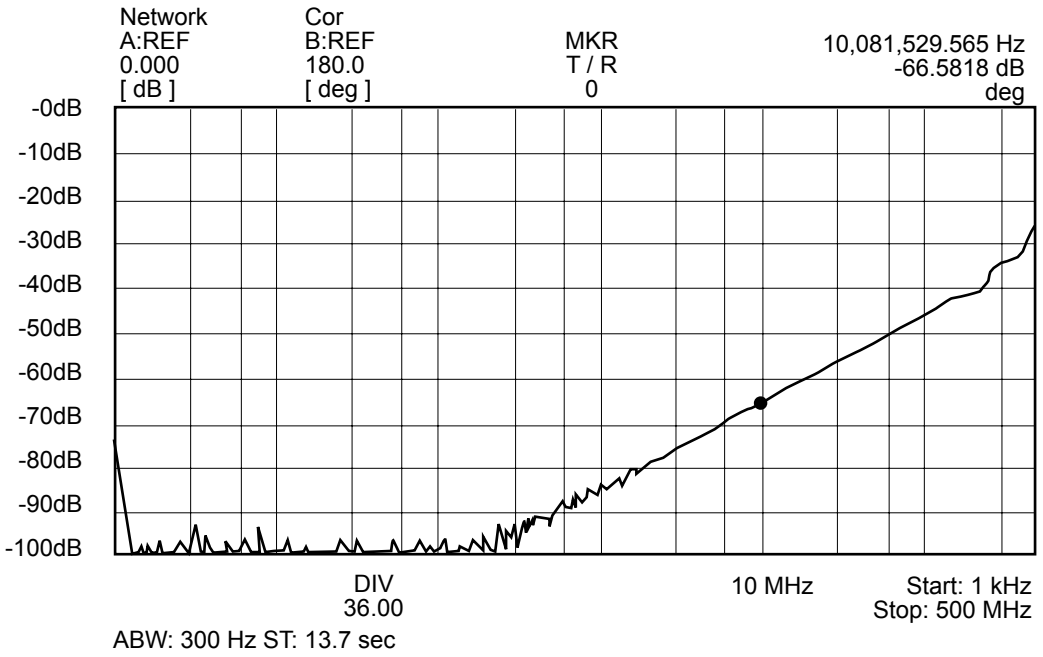

tSK(p) = I tPHL – tPLH I

**Pulse Skew - $t_{SK(p)}$**

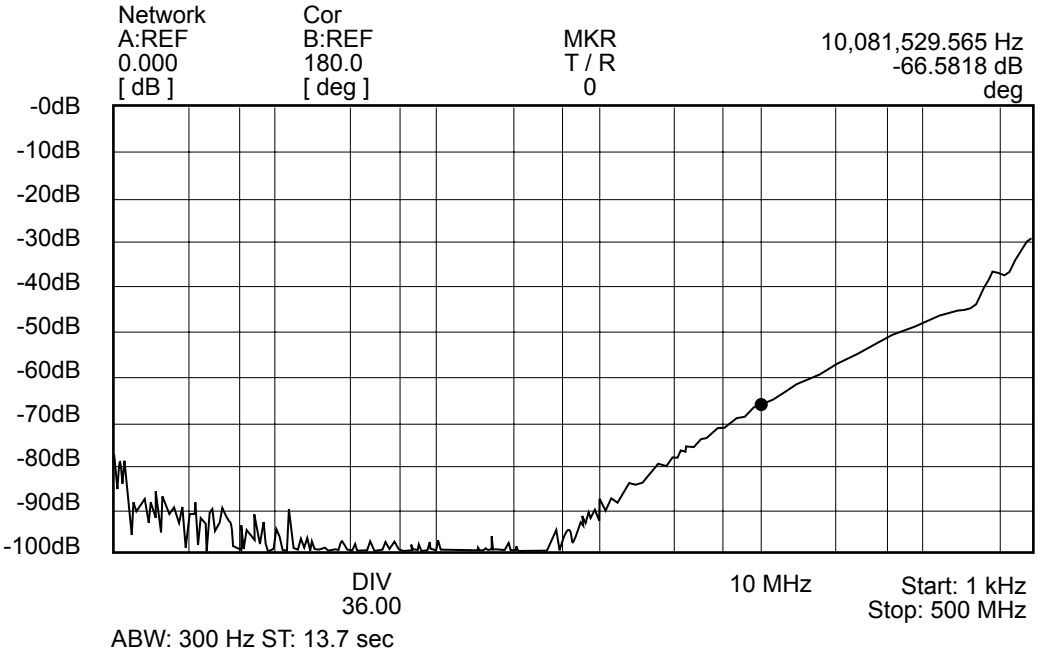
## Test Circuit for Dynamic Electrical Characteristics



**Off Isolation** ($V_{CC}$ = 3.3V, 25°C)




**Crosstalk** ($V_{CC}$ = 3.3V, 25°C)



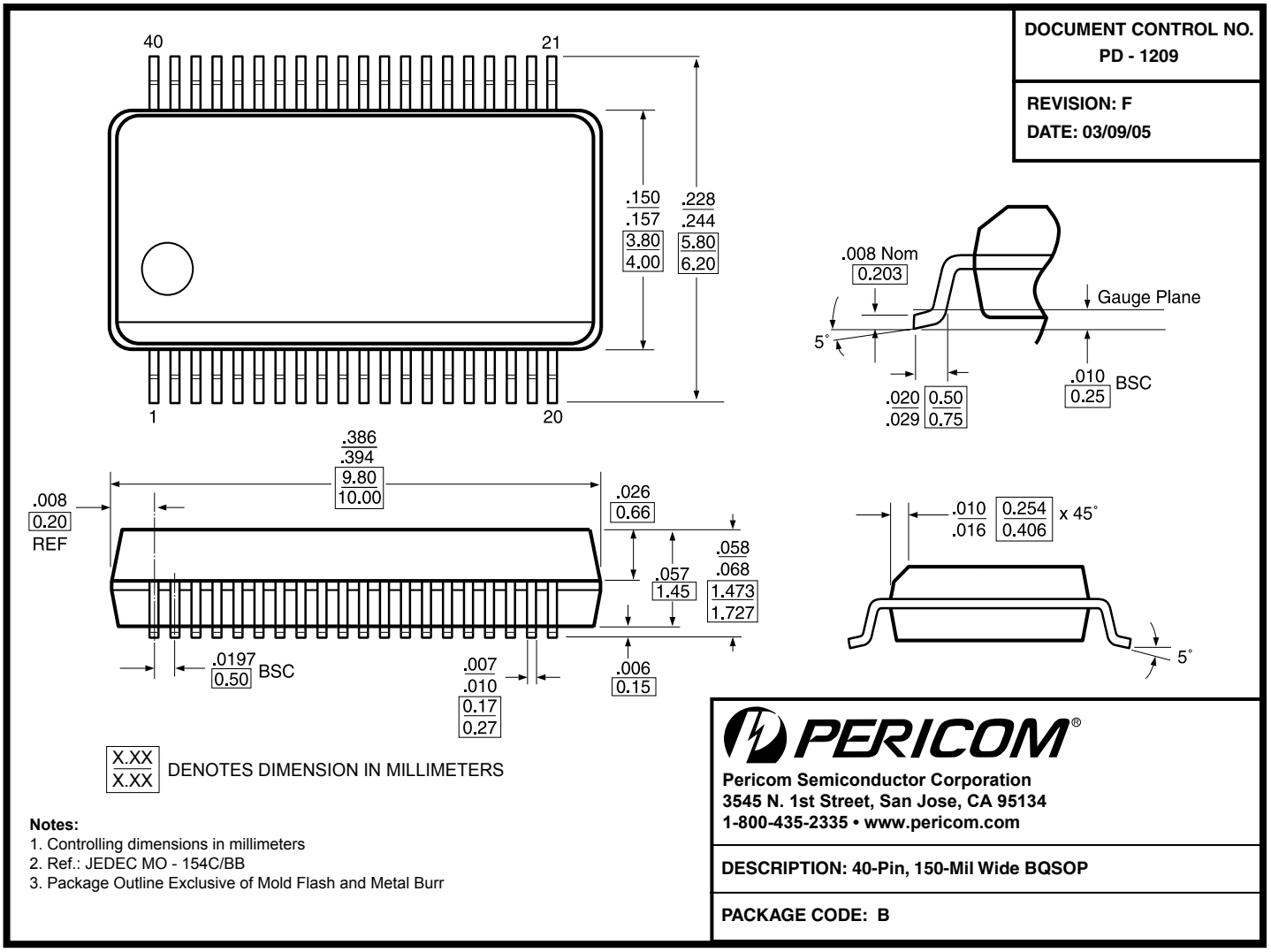
## Applications Information

### Logic Inputs

The logic control inputs can be driven upto 3.6V regardless of the supply voltage. For example, given a +3.3V supply, $\overline{EN}$ maybe driven LOW to 0V and HIGH to 3.6V. Driving $\overline{EN}$ Rail-to-Rail® minimizes power consumption.

### Hot Insertion

For Datacom and Telecom applications that have ten or more volts passing through the backplane, a high voltage from the power supply may be seen at the device input pins during hot insertion. The PI3Vxxx devices have maximum limits of 6V and 120mA for 20ns. If the power is higher or applied for a longer time or repeatedly reaches the maximum limits, the devices can be damaged.




**Notes:**
1. Controlling dimensions in millimeters
2. Ref.: JEDEC MO - 154C/BB
3. Package Outline Exclusive of Mold Flash and Metal Burr

**DOCUMENT CONTROL NO.**
**PD - 1209**

**REVISION: F**
**DATE: 03/09/05**

**Pericom Semiconductor Corporation**
**3545 N. 1st Street, San Jose, CA 95134**
**1-800-435-2335 • www.pericom.com**

**DESCRIPTION: 40-Pin, 150-Mil Wide BQSOP**

**PACKAGE CODE: B**

## Ordering Information[1-3]

| Ordering Code | Packaging Code | Package Description |
|---|---|---|
| PI3V314B | B | 40-pin 150-mil wide plastic BQSOP |
| PI3V314BE | B | Pb-free & Green, 40-pin 150-mil wide plastic BQSOP |

**Notes:**
1. Thermal characteristics can be found on the company web site at www.pericom.com/packaging/
2. E = Lead-free and Green
3. Adding an X suffix = tape/reel