

3.3V, 16-Bit to 8-Bit, Mux/DeMux Gigabit Ethernet LAN Switch with Single Enable

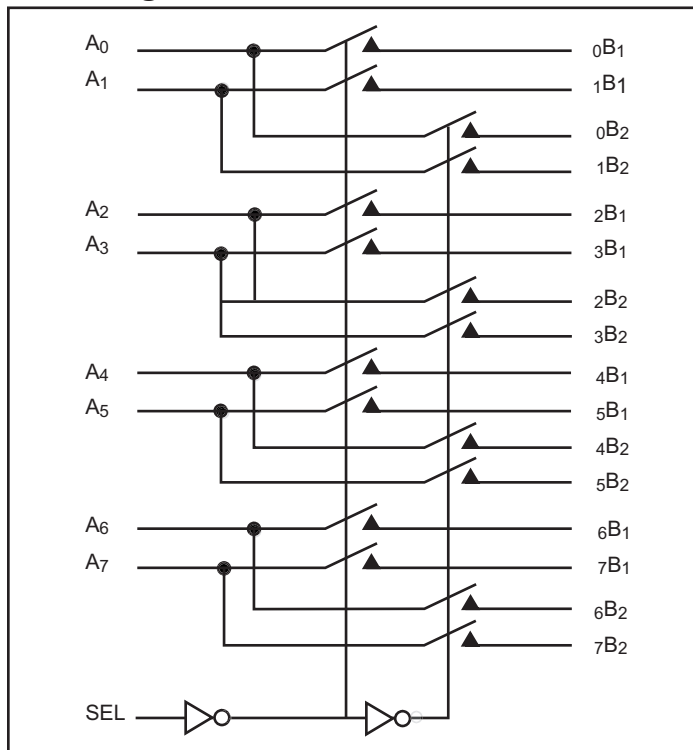
Features

- R_{ON} is 4Ω typical
- Low bit-to-bit skew: 200ps
- Low crosstalk: -27dB @ 250MHz
- Low Current Consumption: $20\mu\text{A}$
- Near-Zero propagation delay: 250ps
- Switching speed: 9ns
- Channel On-Capacitance: 9.5pF (typical)
- V_{CC} Operating Range: +3.0V to +3.6V
- ESD $>3000\text{V}$. . . Human Body Model
- $>350\text{ MHz}$ bandwidth (or data frequency)
- Packaging (Pb-free & Green available):
48-pin 240 mil wide plastic TSSOP (A)

Applications

- Dual Physical Layer Device sharing to one interface connector
- SONET OC-12(622Mbps) signal routing
- Routes physical layer signals for 10/100/1000 Mbit Ethernet

Block Diagram



Description

The PI3L series of logic circuits are produced using the Company's advanced sub-micron CMOS technology, achieving industry leading performance.

The DIODES PI3L301D is a 16- to 8-bit multiplexer/demultiplexer LAN Switch. Industry leading advantages include a propagation delay of less than 250ps, resulting from its low channel resistance and I/O capacitance. The device multiplexes differential outputs from a Gigabit Ethernet transceiver (PHY) device to one of two corresponding B1 or B2 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, high channel-to-channel noise isolation and is compatible with various standards, such as 10/100/1000 Base-T (Ethernet).

Generally, this part can be used to replace mechanical relays in low-voltage LAN applications that interface a physical layer over CAT 5 or CAT 6 unshielded twisted pair cable through an isolation transformer.

Pin Description

| | | | |
|----------|----|----|----------|
| V_{DD} | 1 | 48 | 0B1 |
| A_0 | 2 | 47 | 1B1 |
| GND | 3 | 46 | GND |
| A_1 | 4 | 45 | 0B2 |
| GND | 5 | 44 | 1B2 |
| V_{DD} | 6 | 43 | GND |
| GND | 7 | 42 | 2B1 |
| A_2 | 8 | 41 | 3B1 |
| GND | 9 | 40 | GND |
| A_3 | 10 | 39 | 2B2 |
| GND | 11 | 38 | 3B2 |
| V_{DD} | 12 | 37 | GND |
| GND | 13 | 36 | V_{DD} |
| NC | 14 | 35 | 4B1 |
| A_4 | 15 | 34 | 5B1 |
| GND | 16 | 33 | GND |
| A_5 | 17 | 32 | 4B2 |
| GND | 18 | 31 | 5B2 |
| V_{DD} | 19 | 30 | GND |
| GND | 20 | 29 | 6B1 |
| A_6 | 21 | 28 | 7B1 |
| GND | 22 | 27 | GND |
| A_7 | 23 | 26 | 6B2 |
| SEL | 24 | 25 | 7B2 |

Truth Table

| Function | SEL |
|-----------------------------------|-----|
| A _N to NB ₁ | L |
| A _N to NB ₂ | H |

Maximum Ratings

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

| | |
|---|-----------------|
| Storage Temperature..... | –65°C to +150°C |
| Supply Voltage to Ground Potential..... | –0.5V to +4.0V |
| DC Input Voltage..... | –0.5V to +5.5V |
| 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 for 1000 Base-T Ethernet Switching over Operating Range

(T_A = –40°C to +85°C, V_{CC} = 3.3V ±10%)

| Parameter | Description | Test Conditions ⁽¹⁾ | Min. | Typ. ⁽²⁾ | Max. | Units |
|-----------------------|--|--|------|---------------------|------|-------|
| V _{IH} | Input HIGH Voltage | Guaranteed HIGH level | 2 | - | - | V |
| V _{IL} | Input LOW Voltage | Guaranteed LOW level | –0.5 | - | 0.8 | |
| V _{IK} | Clamp Diode Voltage | V _{CC} = Max., I _{IN} = –18mA | - | –0.7 | –1.2 | |
| I _{IH} | Input HIGH Current | V _{CC} = Max., V _{IN} = V _{CC} | - | - | ±5 | μA |
| I _{IL} | Input LOW Current | V _{CC} = Max., V _{IN} = GND | - | - | ±5 | |
| I _{OFF} | Power Down Leakage Current | V _{CC} = 0V, V _A = 0V, V _B ≤ 3.6 | - | - | ±5 | |
| R _{ON} | Switch On-Resistance ⁽³⁾ | V _{CC} = Min., 1.5V ≤ V _{IN} ≤ V _{CC} , I _{IN} = –40mA | - | 4 | 8 | Ω |
| R _{FLAT(ON)} | On-Resistance Flatness ⁽⁴⁾ | V _{CC} = Min., V _{IN} @ 1.5V and V _{CC} , I _{IN} = –40mA | - | 1 | - | |
| ΔR _{ON} | On-Resistance match from center ports to any other port ⁽⁴⁾ | V _{CC} = Min., 1.5V ≤ V _{IN} ≤ V _{CC} , I _{IN} = –40mA | - | 0.9 | 2 | |

DC Electrical Characteristics for 10/100 Base-T Ethernet Switching over Operating Range
 $(T_A = -40^{\circ}\text{C to } +85^{\circ}\text{C}, V_{CC} = 3.3\text{V} \pm 10\%)$

| Parameter | Description | Test Conditions ⁽¹⁾ | Min. | Typ. ⁽²⁾ | Max. | Units |
|-----------------------|--|--|------|---------------------|------|-------|
| V _{IH} | Input HIGH Voltage | Guaranteed HIGH level | 2.0 | - | - | V |
| V _{IL} | Input LOW Voltage | Guaranteed LOW level | -0.5 | - | 0.8 | |
| V _{IK} | Clamp Diode Voltage | V _{CC} = Max., I _{IN} = -18mA | - | -0.7 | -1.2 | |
| I _{IH} | Input HIGH Current | V _{CC} = Max., V _{IN} = V _{CC} | - | - | ±5 | μA |
| I _{IL} | Input LOW Current | V _{CC} = Max., V _{IN} = GND | - | - | ±5 | |
| I _{OFF} | Power Down Leakage Current | V _{CC} = 0V, V _A = 0V, V _B ≤ 3.6 | - | - | ±5 | |
| R _{ON} | Switch On-Resistance ⁽³⁾ | V _{CC} = Min., 1.25V ≤ V _{IN} ≤ V _{CC} , I _{IN} = -10mA to -30mA | - | - | 8 | Ω |
| R _{FLAT(ON)} | On-Resistance Flatness ⁽⁴⁾ | V _{CC} = Min., V _{IN} @ 1.25V and V _{CC} , I _{IN} = -10mA to -30mA | - | 1.0 | - | |
| ΔR _{ON} | On-Resistance match from center ports to any other port ⁽⁴⁾ | V _{CC} = Min., 1.25V ≤ V _{IN} ≤ V _{CC} , I _{IN} = -10mA to -30mA | - | 0.9 | 2.0 | |

Capacitance (T_A = 25°C, f = 1MHz)

| Parameters ⁽⁴⁾ | Description | Test Conditions | Typ. | Max. | Units |
|---------------------------|--------------------------------|----------------------|--------------------|------|-------|
| C _{IN} | Input Capacitance | V _{IN} = 0V | 3.1 | 3.6 | pF |
| C _{OFF(B1, B2)} | Port B Capacitance, Switch OFF | | 2.8 | 6.0 | |
| C _{ON(A/B)} | A/B Capacitance, Switch ON | | 9.5 ⁽⁵⁾ | 10.9 | |

Notes:

- For max. or min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at V_{CC} = 3.3V, T_A = 25°C ambient and maximum loading.
- Measured by the voltage drop between A and B pins at indicated current through the switch. On-Resistance is determined by the lower of the voltages on the two (A & B) pins.
- This parameter is determined by device characterization but is not production tested.
- Measured on worst case corner pin.

Power Supply Characteristics

| Parameters | Description | Test Conditions ⁽¹⁾ | Min. | Typ. ⁽²⁾ | Max. | Units |
|-----------------|--------------------------------|--|------|---------------------|------|-------|
| I _{CC} | Quiescent Power Supply Current | V _{CC} = Max., V _{IN} = GND or V _{CC} | - | - | 800 | μA |

Notes:

- For max. or min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at V_{CC} = 3.3V, T_A = 25°C ambient and maximum loading.

Dynamic Electrical Characteristics Over the Operating Range (T_A = -40° to +85°C, V_{CC} = 3.3V ± 10%, GND = 0V)

| Parameter | Description | Test Conditions ⁽¹⁾ | Min. | Typ. ⁽²⁾ | Max. | Units |
|-------------------|----------------|-----------------------------------|------|---------------------|------|-------|
| X _{TALK} | Crosstalk | f = 250MHz, See Fig. 2 | - | -27 | - | dB |
| O _{IRR} | OFF Isolation | f = 250MHz, See Fig. 3 | - | -32 | - | |
| BW | Bandwidth -3dB | C _L = 10pf, See Fig. 1 | - | 350 | - | MHz |

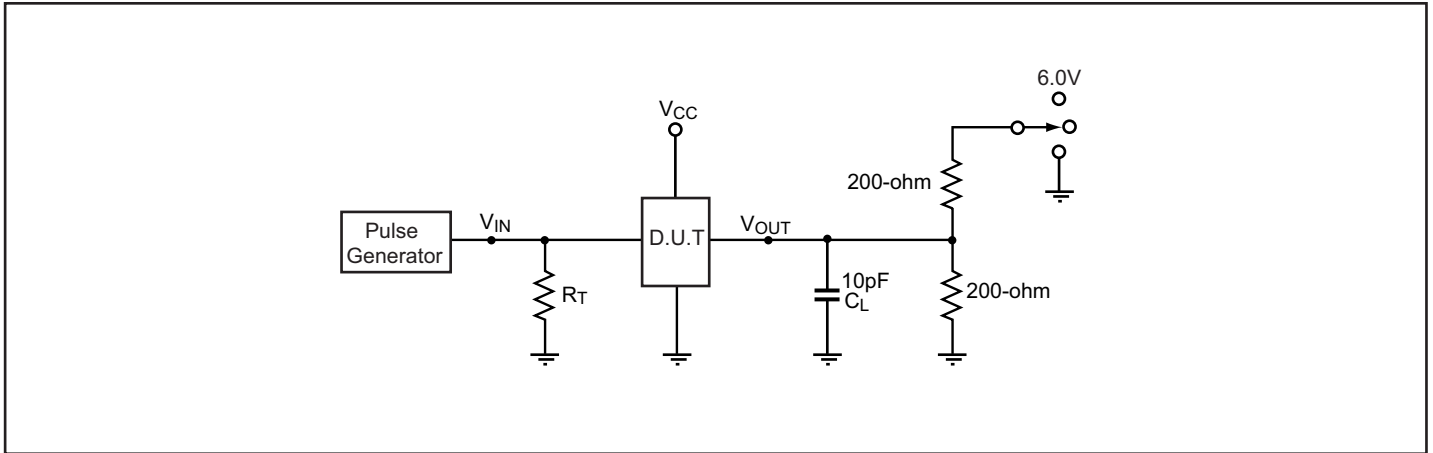
Switching Characteristics

| Parameter | Description | Test Conditions | Min. | Typ. ⁽²⁾ | Max. | Units |
|-------------------------------------|--|-----------------|------|---------------------|------|-------|
| t _{PD} | Propagation Delay ^(3,4) | | - | 0.25 | | ns |
| t _{PZH} , t _{PZL} | Line Enable Time - SEL to A _N , B _N | | 0.5 | - | 15 | |
| t _{PHZ} , t _{PLZ} | Line Disable Time - SEL to A _N , B _N | | 0.5 | - | 9 | |
| t _{SK(o)} | Output Skew between center port (A4 to A5) to any other port ⁽⁴⁾ | | - | 0.1 | 0.2 | |
| t _{SK(p)} | Skew between opposite transitions of the same output (t _{PHL} - t _{PLH}) ⁽⁴⁾ | | - | 0.1 | 0.2 | |

Notes:

- For max. or min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at V_{CC} = 3.3V, T_a = 25°C ambient and maximum loading.
- The bus 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 0.25ns 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 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.
- Guaranteed by design.

Test Circuit for Electrical Characteristics



Notes:

C_L = Load capacitance: includes jig and probe capacitance.

R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator

All input impulses are supplied by generators having the following characteristics: $f = 10\text{MHz}$, $Z_O = 50\Omega$, $t_R \leq 2.5\text{ns}$, $t_F \leq 2.5\text{ns}$.

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) | 6.0V |
| t_{PHZ} , t_{PZH} (output on B-side) | GND |
| Prop Delay | Open |

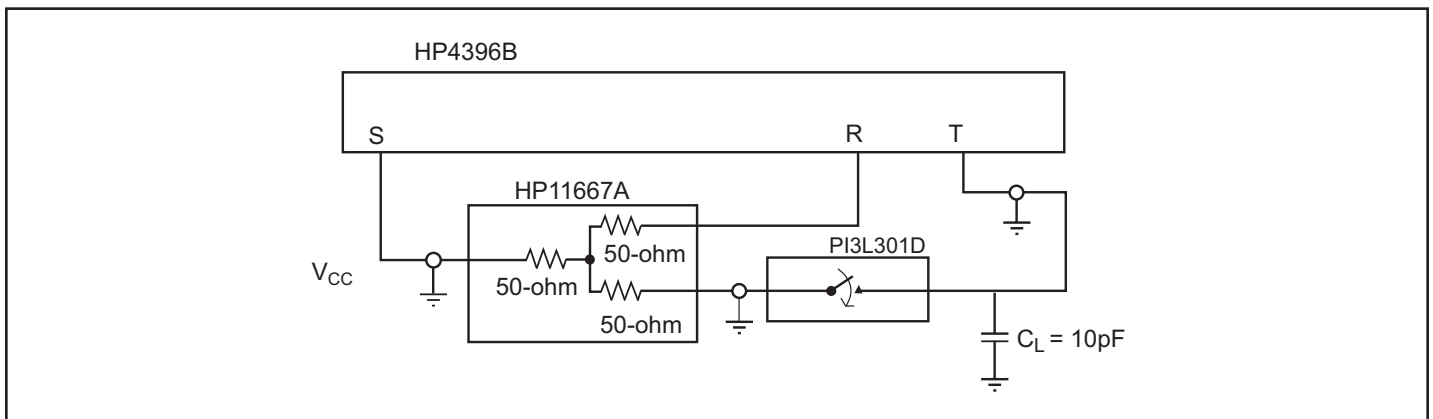


Figure 1. Bandwidth -3db Testing

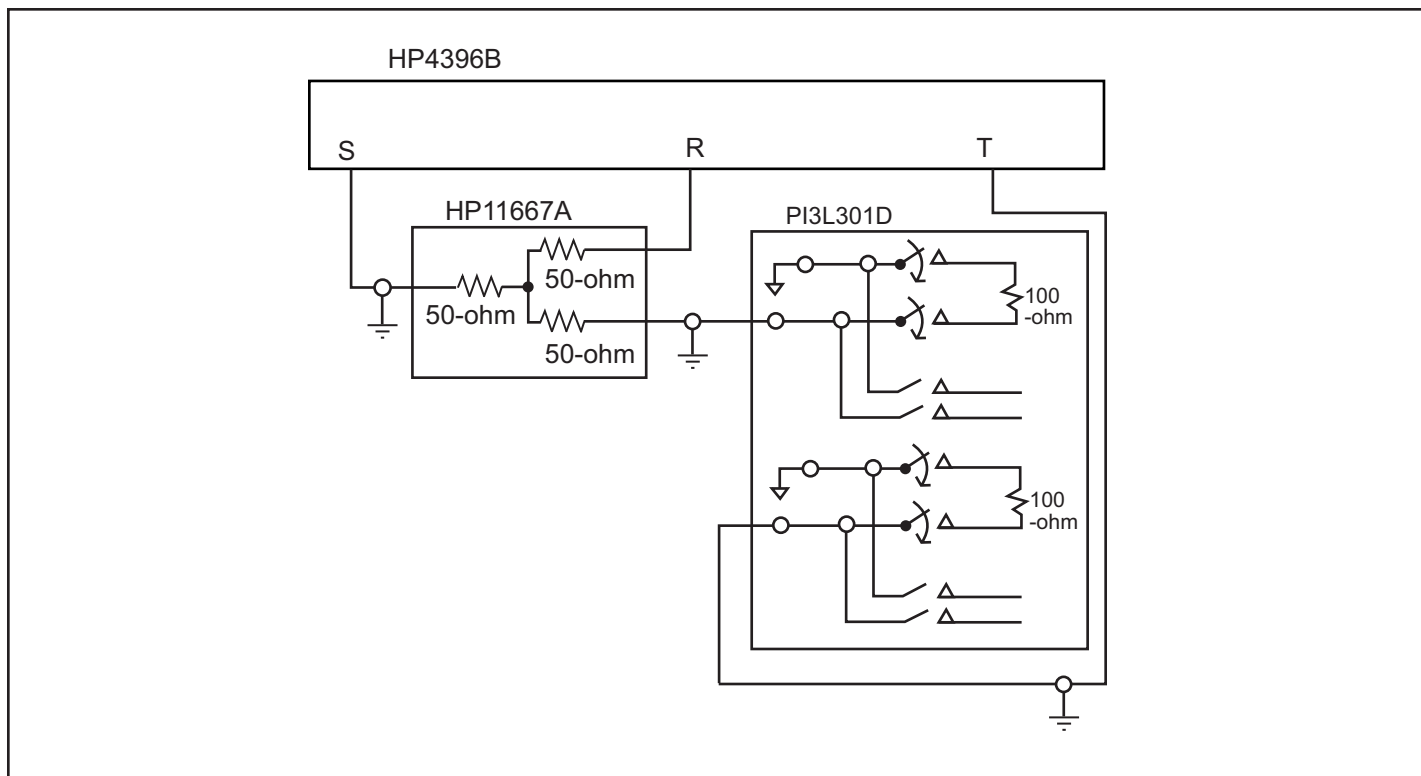


Figure 2. Crosstalk Test Setup

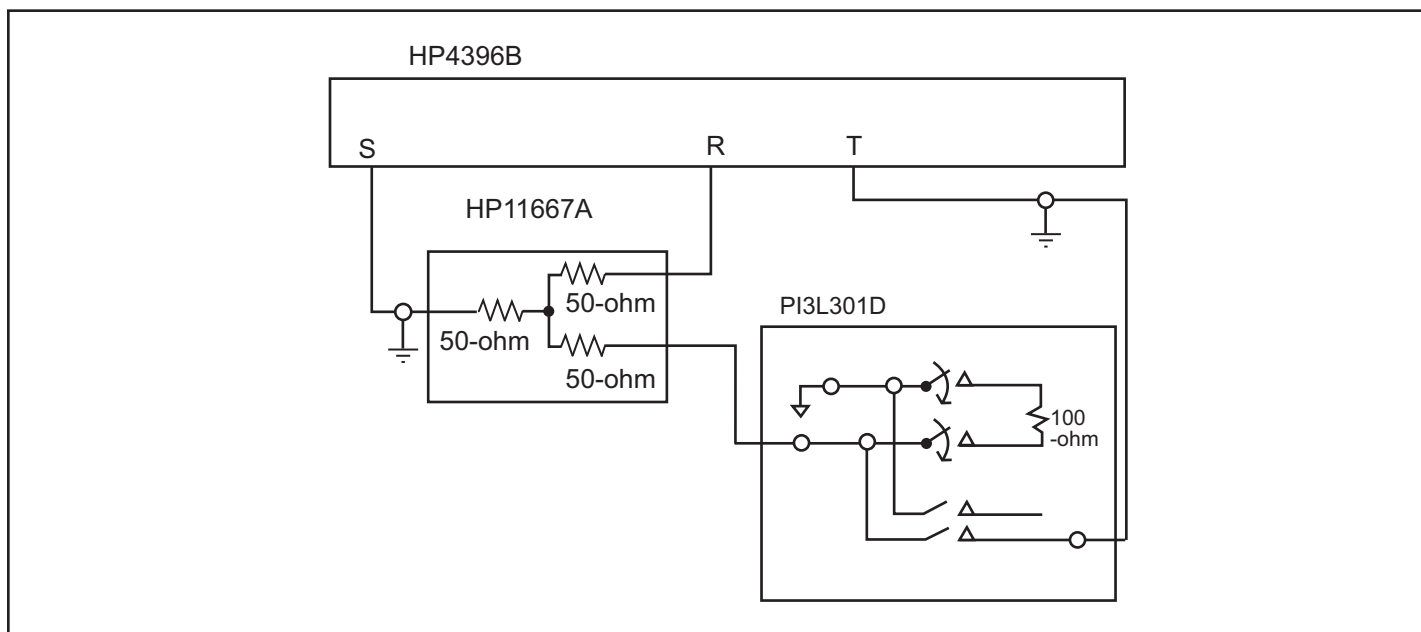
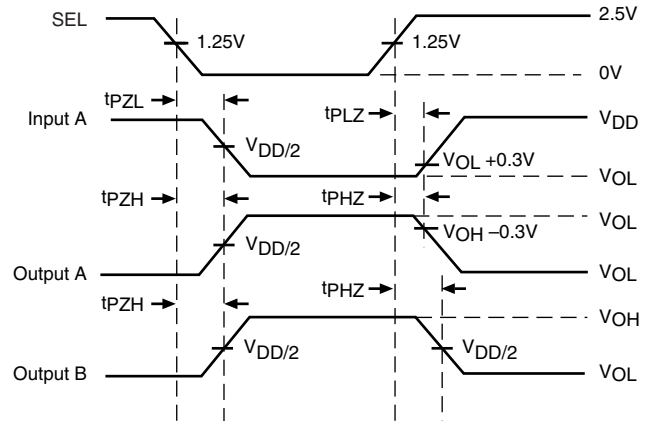
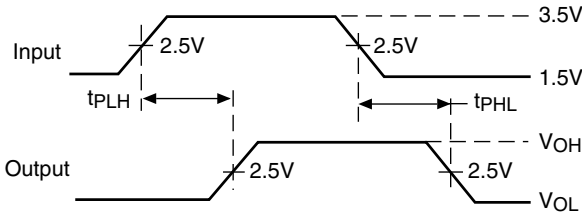
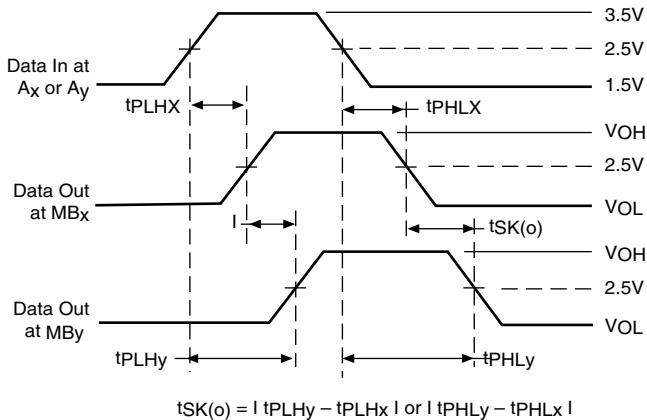


Figure 3 . Off Isolation Tets Setup

Switching Waveforms

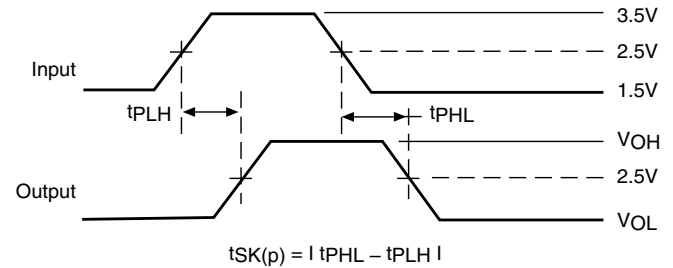


Voltage Waveforms Propagation Delay Times



Output Skew - $t_{SK(o)}$

Voltage Waveforms Enable and Disable Times



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

Applications Information

Logic Inputs

The logic control inputs can be driven up to +3.6V regardless of the supply voltage. For example, given a +3.3V supply, the output enables or select pins may be driven low to 0V and high to 3.6V. Driving IN Rail-to-Rail® minimizes power consumption.

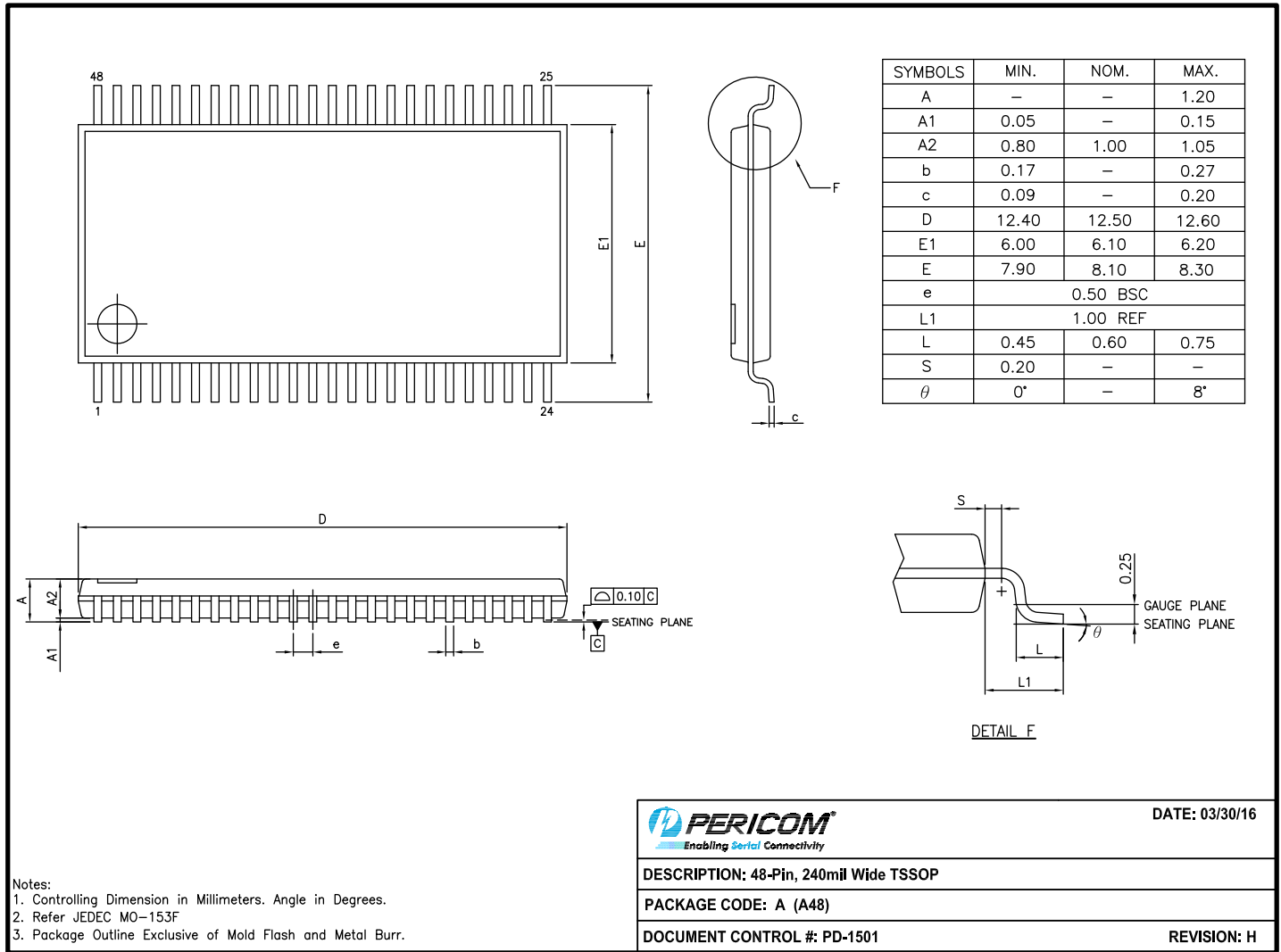
Power-Supply Sequencing

Proper power-supply sequencing is advised for all CMOS devices. It is recommended to always apply V_{CC} before applying signals to the input/output or control pins.

Rail-to-Rail is a registered trademark of Nippon Motorola, Ltd

PI3L301D

Packaging Mechanical: 48-Pin TSSOP (A)



16-0065

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 |
|---------------|--------------|--|
| PI3L301DAE | A | 48-Pin, 240mil Wide (TSSOP) |
| PI3L301DAEX | A | 48-Pin, 240mil Wide (TSSOP), Tape & Reel |

Notes:

- Thermal characteristics can be found on the company web site at www.diodes.com/design/support/packaging/
- E = Pb-free and Green
- Adding an X suffix = Tape/Reel

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