

### 2:1 Mux/DeMux Gigabit Ethernet LAN Switch with Power-down Mode

#### Features

- 1:2 Gigabit LAN Switch
- Power-down support
- Low bit-to-bit skew: 200ps
- Very Low Crosstalk: -75dB @ 250MHz
- Status Indicator LEDs Switched with Ethernet pairs
- V<sub>DD</sub> Operating Range: +3.0V to +3.6V
- Enhanced ESD Protection (on A, B, C, LED pins):
  - 8kV (contact)<sup>(1)</sup>
  - 1.0kV (machine model),
  - 11kV (human body model)
- >650 MHz bandwidth
- Packaging:
  - 56-contact TQFN (5 x 11mm, 0.5 pitch)
  - 42-contact TQFN (3.5 x 9mm, 0.5 pitch)
  - 42-contact TQFN (3.5 x 7mm, 0.4 pitch)

#### Description

The PI3L720 is a 8-Channel 2:1 multiplexer/demultiplexer LAN Switch with Hi-Z outputs. 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 B or C 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).

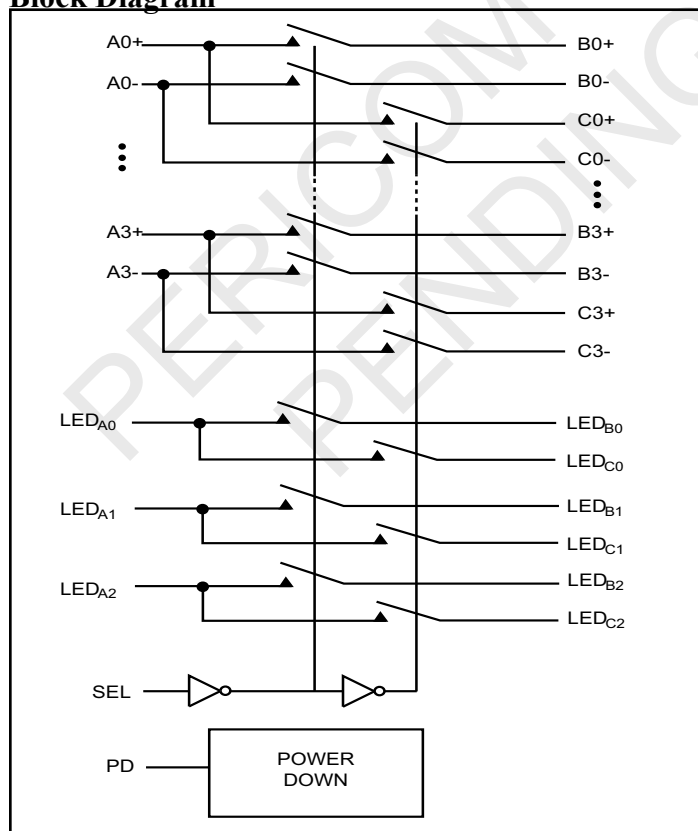
The PI3L720 provides a Power Down input (PD), which can put the device into standby mode (PD=1) while mobile, eliminating an external power switch.

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.

#### Applications

- Dual Physical Layer Device sharing to one interface connector, or one controller to dual connectors for docking
- Routes signals for 10/100/1000 Mbit Ethernet

#### Block Diagram

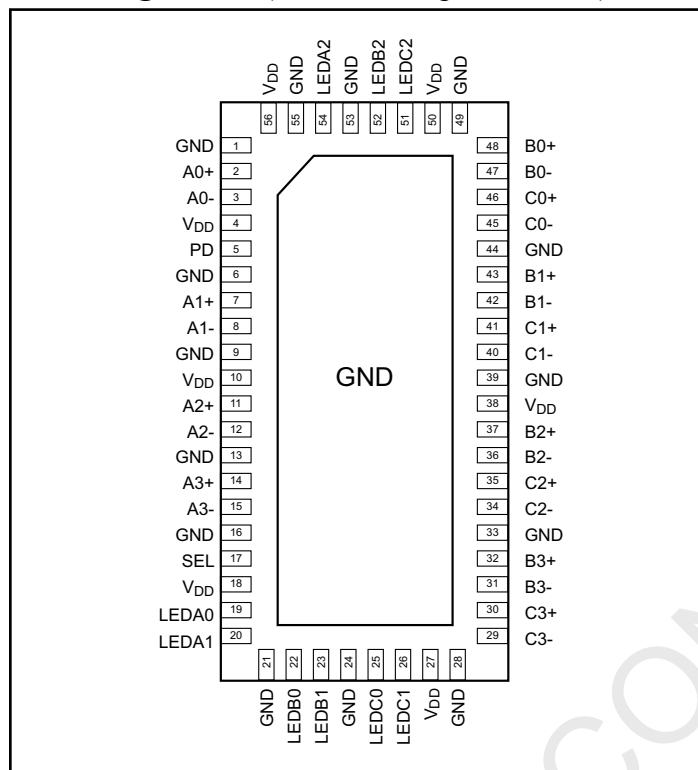


#### Truth Table

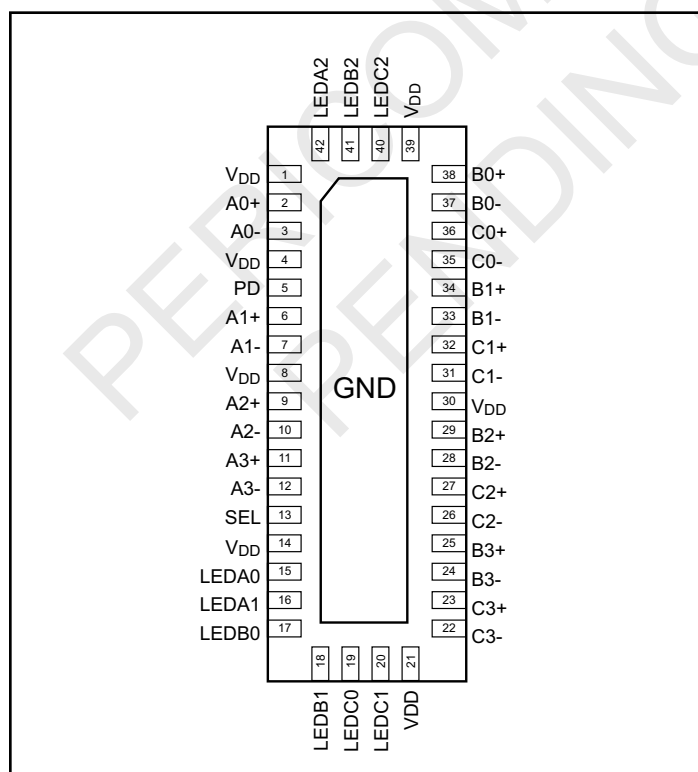
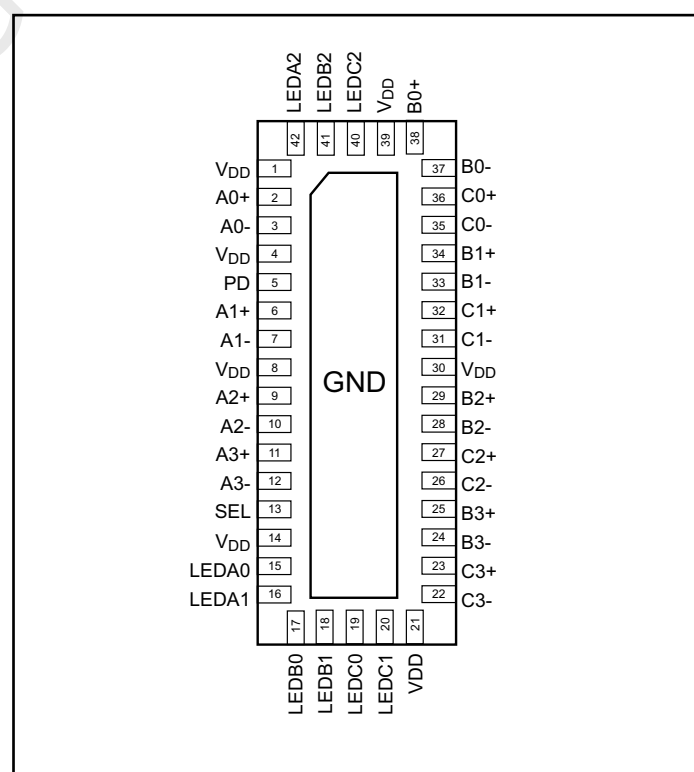
PD	SEL	Function
L	L	A <sub>X</sub> to B <sub>X</sub> ; LEDA <sub>X</sub> to LEDB <sub>X</sub>
L	H	A <sub>X</sub> to C <sub>X</sub> ; LEA <sub>X</sub> to LEDC <sub>X</sub>
H	x	Hi-Z

Note:

1. IEC 6100-4-2

**Pin Configuration (56-TQFN Top-Side View)**

**Pin Description**

Pin Name	Description
A <sub>X</sub> <sup>+</sup> , A <sub>X</sub> <sup>-</sup>	Port A DeMux I/O
B <sub>X</sub> <sup>+</sup> , B <sub>X</sub> <sup>-</sup>	Port B Mux I/O
C <sub>X</sub> <sup>+</sup> , C <sub>X</sub> <sup>-</sup>	Port C LED Mux I/O
GND	Ground
LED <sub>ZX</sub>	LED I/O
PD	Power Down. Active high, with internal pull-down resistor
SEL	Select
V <sub>DD</sub>	Power

**Pin Configuration (42-TQFN ZH, Top-Side View)**

**Pin Configuration (42-TQFN ZL, Top-Side View)**


## 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<sub>A</sub> = –40°C to +85°C, V<sub>DD</sub> = 3.3V ±10%)

Parameter	Description	Test Conditions <sup>(1)</sup>	Min.	Typ. <sup>(2)</sup>	Max.	Units
V <sub>IH</sub>	Input HIGH Voltage	Guaranteed HIGH level (Control Pins)	2.0	–	–	V
V <sub>IL</sub>	Input LOW Voltage	Guaranteed LOW level (Control Pins)	–0.5	–	0.8	
V <sub>IK</sub>	Clamp Diode Voltage	V <sub>DD</sub> = Max., I <sub>IN</sub> = –18mA	–	–0.7	–1.2	
I <sub>IH</sub>	Input HIGH Current	V <sub>DD</sub> = Max., V <sub>IN</sub> = V <sub>DD</sub>	–	–	±2	μA
I <sub>IL</sub>	Input LOW Current	V <sub>DD</sub> = Max., V <sub>IN</sub> = GND	–	–	±2	
R <sub>ON</sub>	Switch On-Resistance <sup>(3)</sup>	V <sub>DD</sub> = Min., 1.5V ≤ V <sub>IN</sub> ≤ V <sub>DD</sub> I <sub>IN</sub> = –40mA	–	4.0	6.5	Ohm
R <sub>FLAT(ON)</sub>	On-Resistance Flatness <sup>(3)</sup>	V <sub>DD</sub> = Min., V <sub>IN</sub> @ 1.5V and V <sub>DD</sub> I <sub>IN</sub> = –40mA	–	0.5	–	
ΔR <sub>ON</sub>	On-Resistance match from center ports to any other port <sup>(3)</sup>	V <sub>DD</sub> = Min., 1.5V ≤ V <sub>IN</sub> ≤ V <sub>DD</sub> I <sub>IN</sub> = –40mA	–	0.4	1.0	

## DC Electrical Characteristics for 10/100 Base-T Ethernet Switching over Operating Range

(T<sub>A</sub> = –40°C to +85°C, V<sub>DD</sub> = 3.3V ±10%)

Parameter	Description	Test Conditions <sup>(1)</sup>	Min.	Typ. <sup>(2)</sup>	Max.	Units
V <sub>IH</sub>	Input HIGH Voltage	Guaranteed HIGH level (Control Pins)	2.0	–	–	V
V <sub>IL</sub>	Input LOW Voltage	Guaranteed LOW level (Control Pins)	–0.5	–	0.8	
V <sub>IK</sub>	Clamp Diode Voltage	V <sub>DD</sub> = Max., I <sub>IN</sub> = –18mA	–	–0.7	–1.2	
I <sub>IH</sub>	Input HIGH Current	V <sub>DD</sub> = Max., V <sub>IN</sub> = V <sub>DD</sub>	–	–	±2	μA
I <sub>IL</sub>	Input LOW Current	V <sub>DD</sub> = Max., V <sub>IN</sub> = GND	–	–	±2	
R <sub>ON</sub>	Switch On-Resistance <sup>(3)</sup>	V <sub>DD</sub> = Min., 1.25V ≤ V <sub>IN</sub> ≤ V <sub>DD</sub> I <sub>IN</sub> = –10mA to –30mA	–	4.0	6.5	Ohm
R <sub>FLAT(ON)</sub>	On-Resistance Flatness <sup>(3)</sup>	V <sub>DD</sub> = Min., V <sub>IN</sub> @ 1.25V and V <sub>DD</sub> I <sub>IN</sub> = –10mA to –30mA	–	0.5	–	
ΔR <sub>ON</sub>	On-Resistance match from center ports to any other port <sup>(3)</sup>	V <sub>DD</sub> = Min., 1.25V ≤ V <sub>IN</sub> ≤ V <sub>DD</sub> I <sub>IN</sub> = –10mA to –30mA	–	0.4	1.0	

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

Parameters <sup>(4)</sup>	Description	Test Conditions <sup>(1)</sup>	Min.	Typ.	Max.	Units
$C_{IN}$	Input Capacitance	$V_{IN} = 0\text{V}$ , $f = 1\text{MHz}$		2.0	3.0	pF
$C_{OFF(B1, B2)}$	Port B Capacitance, Switch OFF			3.0	6.0	
$C_{ON(A/B)}$	A/B Capacitance, Switch ON			8.0	11.0	

**Notes:**

- For max. or min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at  $V_{DD} = 3.3\text{V}$ ,  $T_A = 25^\circ\text{C}$  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.

**Power Supply Characteristics**

Parameters	Description	Test Conditions <sup>(1)</sup>	Min.	Typ. <sup>(2)</sup>	Max.	Units
$I_{DD\text{-Standby}}^{(3)}$	Quiescent Power Supply Current	$V_{DD} = \text{Max.}$ , $V_{IN} = \text{GND}$ or $V_{DD}$	—	0.3	0.5	mA
$I_{DD\text{-Active}}^{(3)}$	Active Power Supply Current	$V_{DD} = \text{Max.}$ , $V_{IN} = V_{DD}$ or $\text{GND}$		1.0	1.5	mA
$I_{DD\text{-PD}}^{(3)}$	Power Down Current	$\text{PD} = 1$ , $V_{DD} = \text{MAX}$ , $V_{IN} = V_{DD}$ or $\text{GND}$		0.15	0.25	mA

**Notes:**

- For max. or min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at  $V_{DD} = 3.3\text{V}$ ,  $T_A = 25^\circ\text{C}$  ambient and maximum loading.
- Active power represents normal data communication. Standby power is when the device is enabled for operation but there is no LAN traffic (cable not connected). Power down current is the minimum power state used when not connected and mobile.
- 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.

**Dynamic Electrical Characteristics Over the Operating Range** ( $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ,  $V_{DD} = 3.3\text{V} \pm 10\%$ )

Parameter	Description	Test Conditions <sup>(1)</sup>	Min.	Typ. <sup>(2)</sup>	Max.	Units
$X_{TALK}$	Crosstalk <sup>(3)</sup>	$R_L = 100\text{-Ohm}$ , $f = 250\text{MHz}$	—	−75	—	dB
$O_{IRR}$	OFF Isolation <sup>(3)</sup>		—	−35	—	
BW	Bandwidth −3dB <sup>(3)</sup>	$R_L = 100\text{-Ohm}$	—	650	—	MHz

**Notes:**

- For max. or min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at  $V_{DD} = 3.3\text{V}$ ,  $T_A = 25^\circ\text{C}$  ambient and maximum loading.
- Guaranteed by design.
- 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.

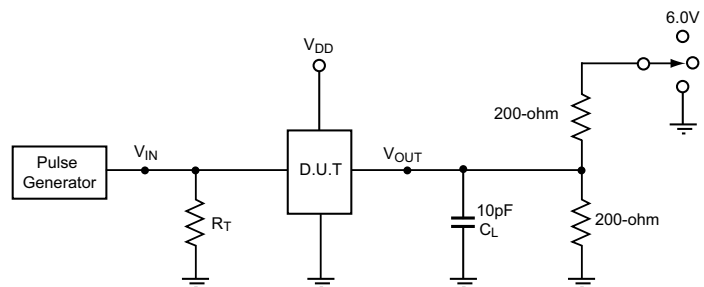
**Switching Characteristics** ( $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{DD} = 3.3\text{V} \pm 10\%$ )

Parameter	Description	Min.	Typ. <sup>(2)</sup>	Max.	Units
$t_{PD}$	Propagation Delay <sup>(3,4)</sup>	–	0.25		ns
$t_{PZH}$ , $t_{PZL}$	Line Enable Time - SEL to $A_N$ , $B_N$	0.5	–	15.0	
$t_{PHZ}$ , $t_{PLZ}$	Line Disable Time - SEL to $A_N$ , $B_N$	0.5	–	5.0	
$t_{SK(o)}$	Output Skew between center port to any other port <sup>(3)</sup>	–	0.1	0.2	
$t_{SK(p)}$	Skew between opposite transitions of the same output ( $t_{PHL} - t_{PLH}$ ) <sup>(3)</sup>	–	0.1	0.2	
$t_{ON/OFF}$	Device enable / disable time from PD		100	200	

**Notes:**

1. For max. or min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at  $V_{DD} = 3.3\text{V}$ ,  $T_A = 25^{\circ}\text{C}$  ambient and maximum loading..
3. Guaranteed by design.
4. 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.

### Test Circuit for Electrical Characteristics



#### Switch Positions

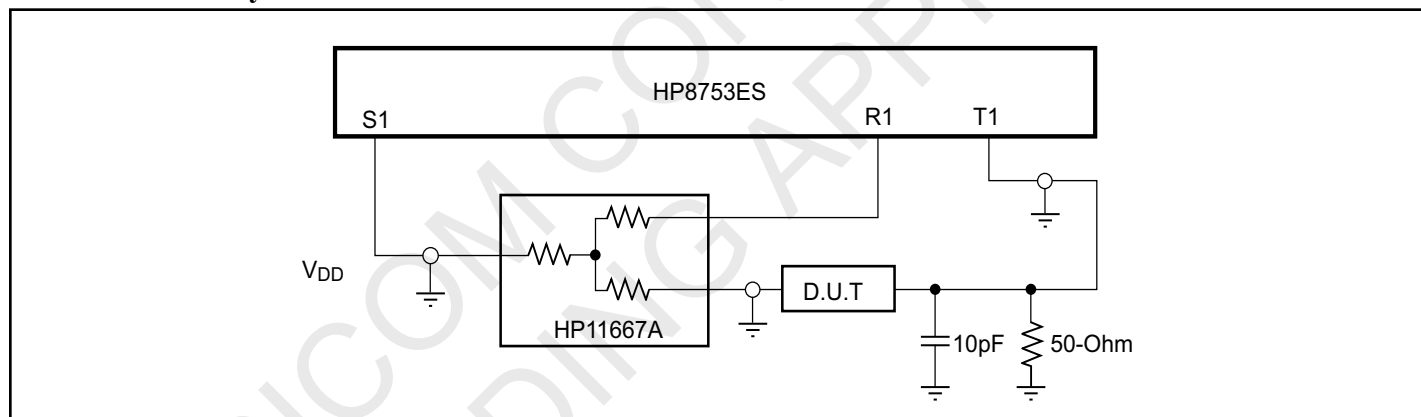
Test	Switch
$t_{PLZ}$ , $t_{PZL}$ (output on B-side)	6.0V
$t_{PHZ}$ , $t_{PZH}$ (output on B-side)	GND
Prop Delay	Open

#### Notes:

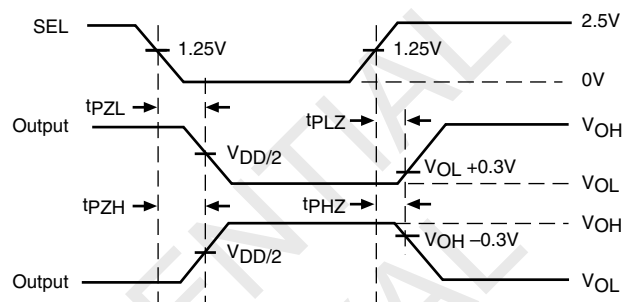
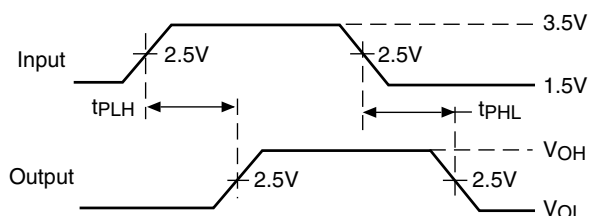
$C_L$  = Load capacitance: includes jig and probe capacitance.

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

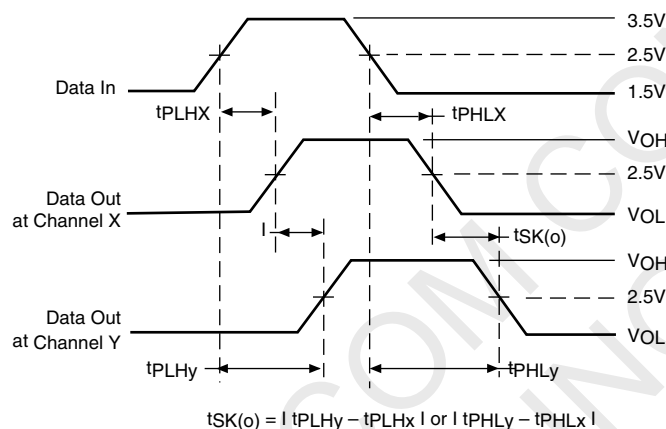
### Test Circuit for Dynamic Electrical Characteristics



## Switching Waveforms

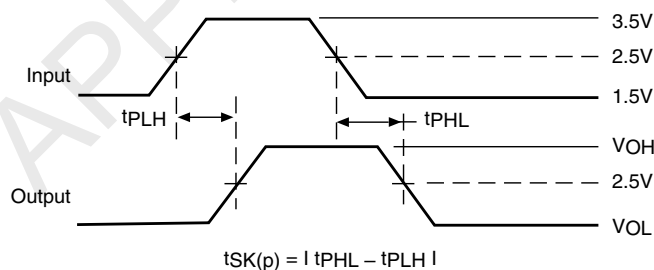


## Voltage Waveforms Propagation Delay Times



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

## Voltage Waveforms Enable and Disable Times



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

### Notes:

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.

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

## Applications Information

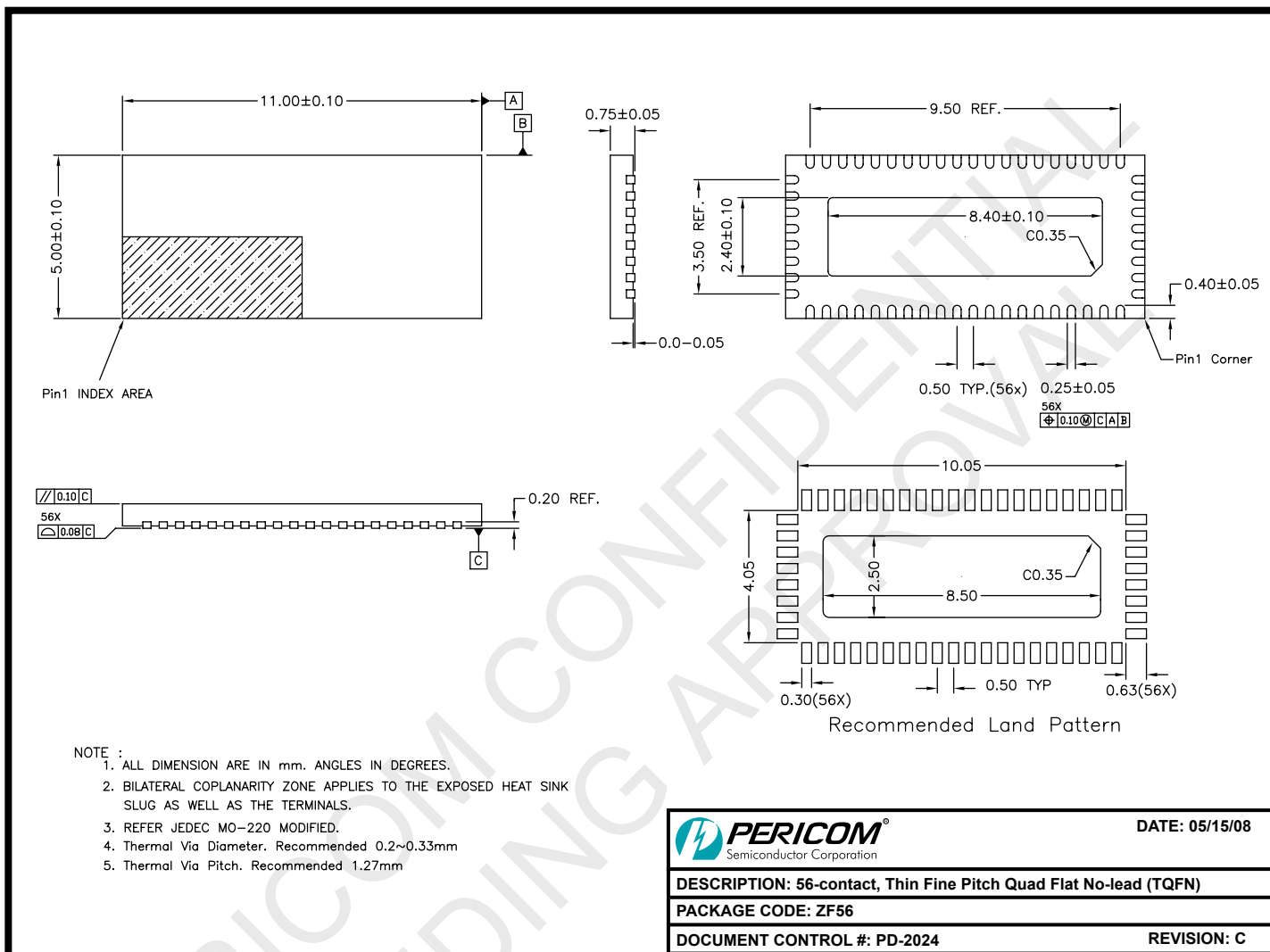
### Logic Inputs

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

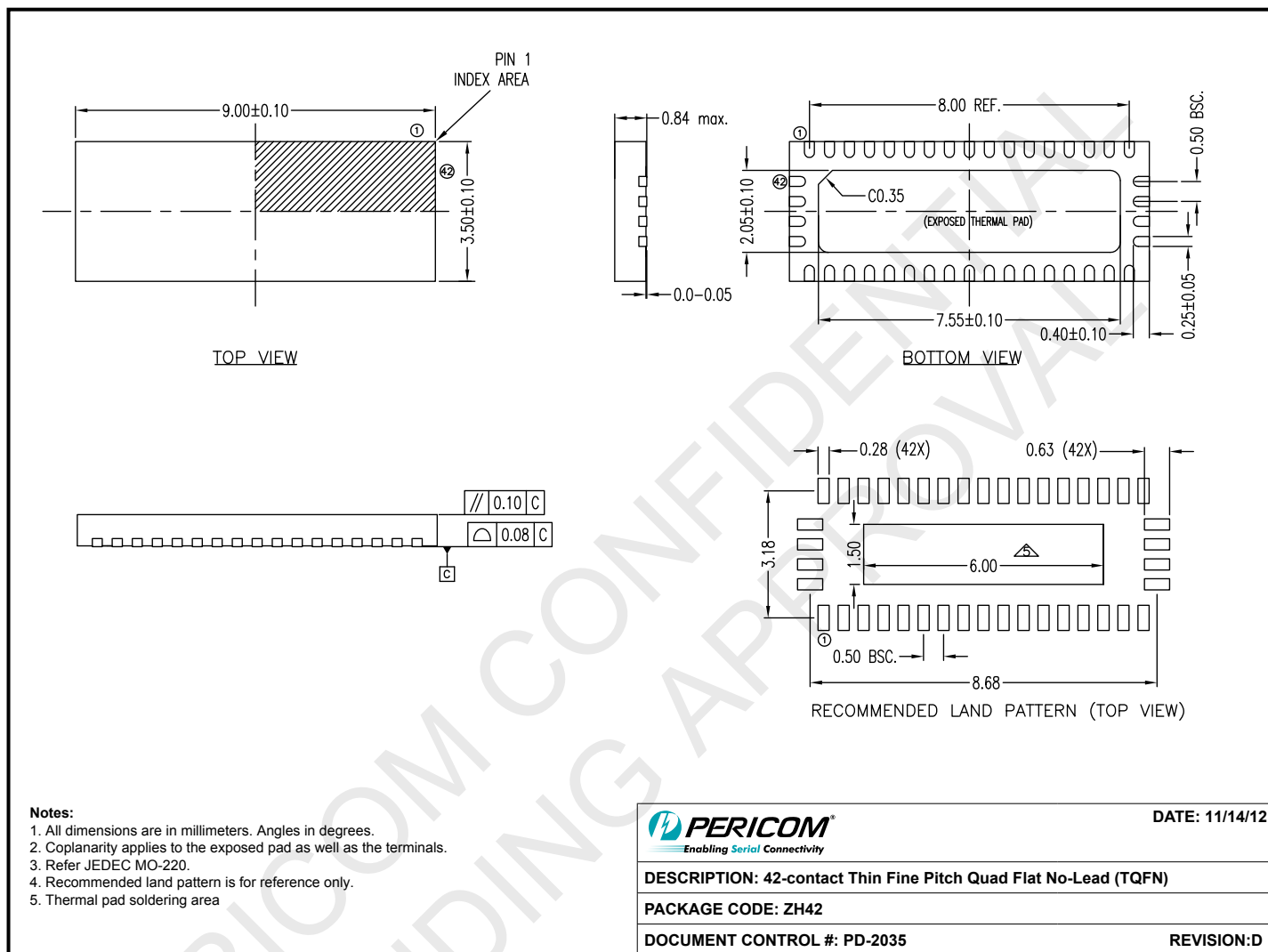
Proper power-supply sequencing is advised for all CMOS devices. It is recommended to always apply V<sub>DD</sub> before applying signals to the input/output or control pins.

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

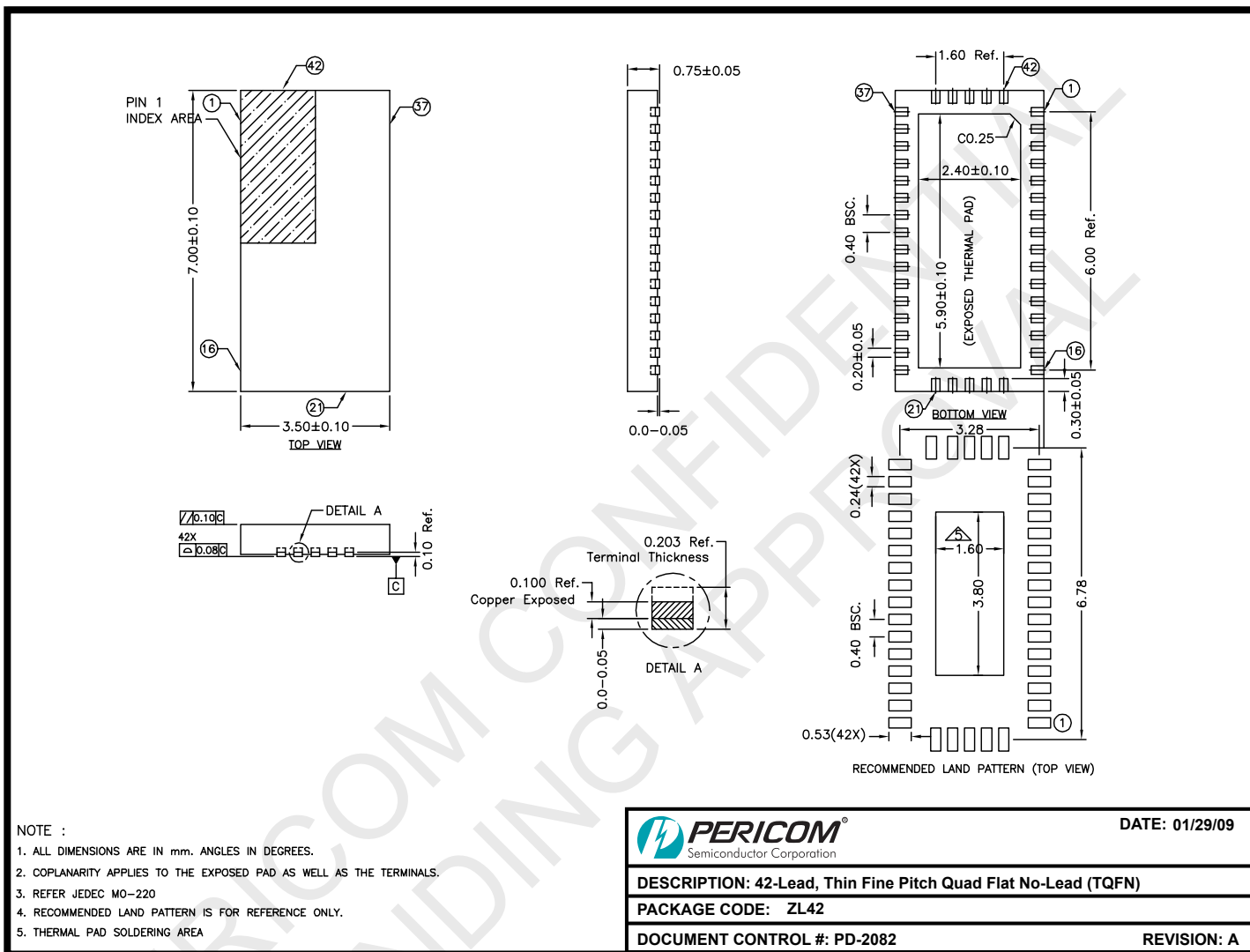
**Packaging Mechanical: 56-Contact TQFN (ZF)**


08-0208



**Packaging Mechanical: 42-Contact TQFN (ZH)**


12-0529

**Packaging Mechanical: 42-Contact TQFN (ZL)**


09-0071

**Ordering Information**

Ordering Number	Package Code	Package Description
PI3L720ZFE	ZF	Pb-free & Green, 56-contact TQFN
PI3L720ZHE	ZH	Pb-free & Green, 42-contact TQFN (0.5mm pitch)
PI3L720ZLE	ZL	Pb-free & Green, 42-contact TQFN (0.4mm pitch)

**Notes:**

1. Thermal characteristics can be found on the company web site at [www.pericom.com/packaging/](http://www.pericom.com/packaging/)
2. Add 'X' for Tape and Reel