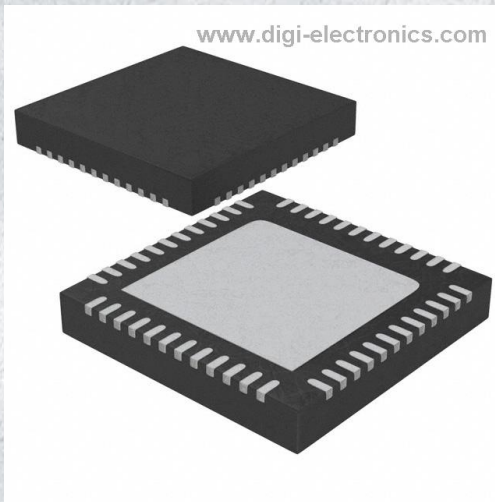


# PI6LC4820ZDEX Datasheet



<https://www.DiGi-Electronics.com>

DiGi Electronics Part Number	PI6LC4820ZDEX-DG
Manufacturer	<a href="#">Diodes Incorporated</a>
Manufacturer Product Number	PI6LC4820ZDEX
Description	IC CLOCK GENERATOR TQFN
Detailed Description	Ethernet IC 312.5MHz 1 Output 48-TQFN (7x7)



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## Purchase and inquiry

Manufacturer Product Number:

PI6LC4820ZDEX

Series:

HiFlex™

DiGi-Electronics Programmable:

Not Verified

Main Purpose:

Ethernet

Output:

LVDS, LVPECL

Ratio - Input:Output:

2:9

Frequency - Max:

312.5MHz

Operating Temperature:

-40°C ~ 85°C

Package / Case:

48-VFQFN Exposed Pad

Base Product Number:

PI6LC4820

Manufacturer:

Diodes Incorporated

Product Status:

Obsolete

PLL:

Yes

Input:

HCSL, LVDS, LVPECL, Crystal

Number of Circuits:

1

Differential - Input:Output:

Yes/Yes

Voltage - Supply:

3V ~ 3.6V

Mounting Type:

Surface Mount

Supplier Device Package:

48-TQFN (7x7)

## Environmental & Export classification

RoHS Status:

ROHS3 Compliant

REACH Status:

REACH Unaffected

HTSUS:

8542.39.0001

Moisture Sensitivity Level (MSL):

1 (Unlimited)

ECCN:

EAR99



# PI6LC4820

## HiFlex™ Ethernet Network Clock Generator

### Features

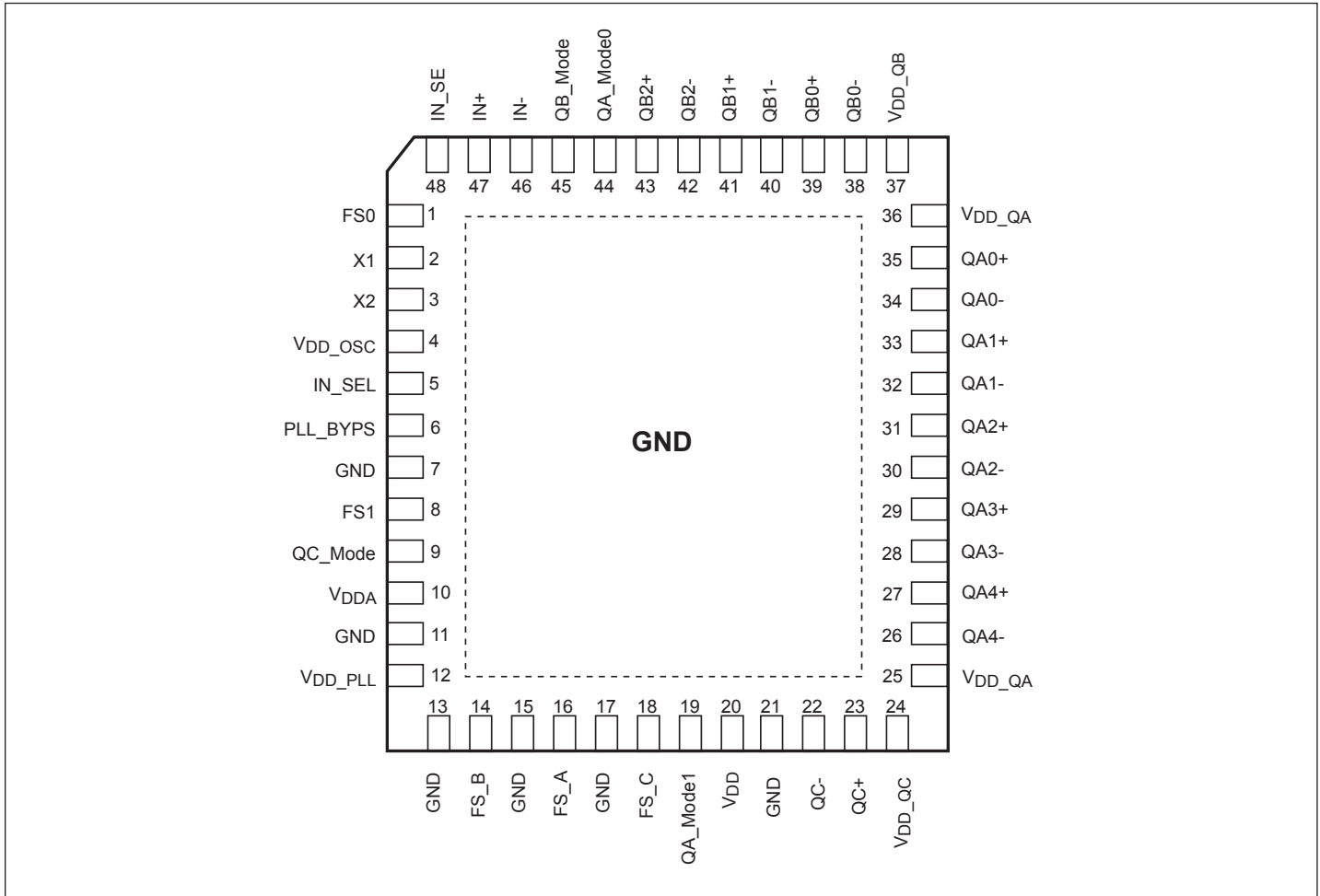
- 3.3V supply voltage
- Crystal input: 25 MHz
- Differential input: 25MHz, 156.25 MHz
- Output frequencies of 312.5, 156.25, 125MHz supported
- 9 LVPECL or LVDS bank selectable outputs
- Low Ips max integrated phase noise design (12kHz to 20MHz)
- Optional xtal or clock input selection
- PLL Bypass mode for test
- Power supply noise rejection: -50 dBc typical @ 156.25 MHz
- Packaging (Pb-free & Green): 48-lead 7x7mm TQFN

### Description

The PI6LC4820 is an LC VCO based low phase noise design intended for 10GbE applications. Typical 10GbE usage assumes a 25Mhz crystal input, while the PLL loop is used to generate the 156.25MHz outputs. An additional buffered crystal oscillator output is provided to serve as a low noise reference for other circuitry.

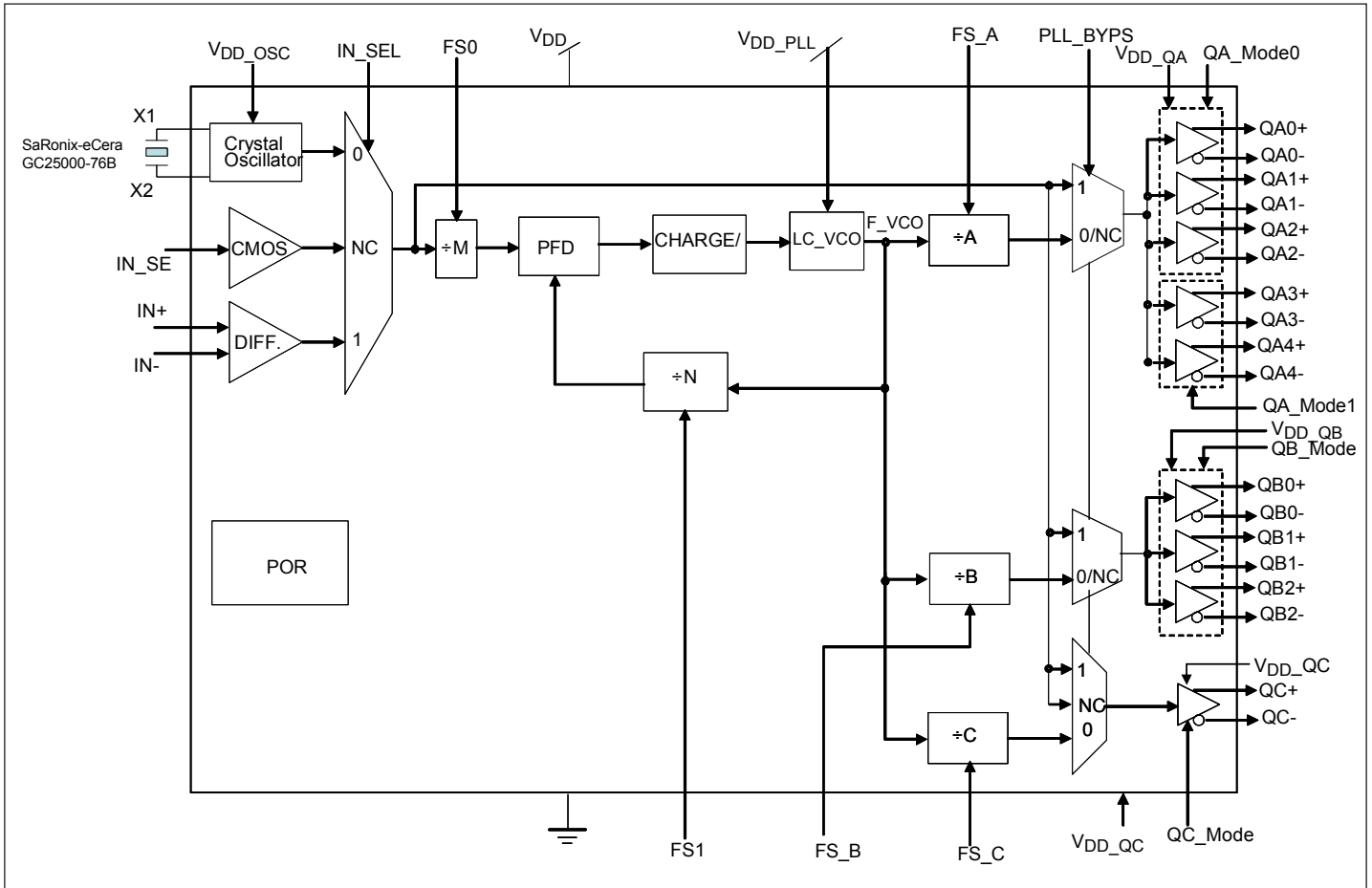
For Ethernet applications other than 10GbE, programmable dividers allow for simultaneous output of 312.5, 156.25, and 125MHz.

### Pin Configuration





**Block Diagram**





## Pin Description

Pin Number	Pin Name	Type	Description
1	FS0	Input (LVCMOS)	Frequency Select Pin. Use FS0=FS1=0 for all 25MHz input sources. Internal pull-down is 100K-Ohm
2	X1	Input	Crystal input pin. No internal xtal load capacitance
3	X2	Output	Crystal output pin. No internal xtal load capacitance
4	V <sub>DD</sub> _OSC	Power	V <sub>DD</sub> for reference oscillator
5	IN_SEL	Input (LVCMOS)	Input mux selection pin
6	PLL_BYPS	Input (LVCMOS)	Optional mode to bypass PLL and have input reference source connect directly to outputs
7	GND	Power	Ground pin
8	FS1	Input (LVCMOS)	Frequency Select Pin. Use FS0=FS1=0 for all 25MHz input sources. Internal pull-down is 100K-Ohm
9	QC_Mode	Input (LVCMOS)	Out mode control pin selects LVPECL or LVDS mode. If left floating, outputs are tri-stated
10	V <sub>DDA</sub>	Power	V <sub>DD</sub> for analog circuitry
11	GND	Power	Ground pin
12	V <sub>DD</sub> _PLL	Power	V <sub>DD</sub> for PLL.
13	GND	Power	Ground pin
14	FS_B	Input (LVCMOS)	Frequency Select Pin for Bank B, Output Divider
15	GND	Power	Ground pin
16	FS_A	Input (LVCMOS)	Frequency Select Pin for Bank A, Output Divider
17	GND	Power	Ground pin
18	FS_C	Input (LVCMOS)	Frequency Select Pin for Bank C, Output Divider
19	QA_Mode1	Input (LVCMOS)	Out mode control pin selects LVPECL or LVDS mode. If left floating, outputs are tri-stated
20	V <sub>DD</sub>	Power	V <sub>DD</sub>
21	GND	Power	Ground pin
22, 23	QC-, QC+	Output (Differential)	Bank C LVDS/LVPECL selectable output. Controlled by QC_Mode pin
24	V <sub>DD</sub> _QC	Power	V <sub>DD</sub> for bank C outputs
25	V <sub>DD</sub> _QA	Power	V <sub>DD</sub> for bank A outputs
26, 27	QA4-, QA4+	Output (Differential)	Bank A LVDS/LVPECL selectable output. Controlled by QA_Mode1 pin
28, 29	QA3-, QA3+	Output (Differential)	Bank A LVDS/LVPECL selectable output. Controlled by QA_Mode1 pin
30, 31	QA2-, QA2+	Output (Differential)	Bank A LVDS/LVPECL selectable output. Controlled by QA_Mode0 pin



### Pin Description (Continued..)

Pin Number	Pin Name	Type	Description
32, 33	QA1-, QA1+	Output (Differential)	Bank A LVDS/LVPECL selectable output. Controlled by QA_Mode0 pin
34, 35	QA0-, QA0+	Output (Differential)	Bank A LVDS/LVPECL selectable output. Controlled by QA_Mode0 pin
36	V <sub>DD-QA</sub>	Power	V <sub>DD</sub> for bank A outputs
37	V <sub>DD-QB</sub>	Power	V <sub>DD</sub> for bank B outputs
38, 39	QB0-, QB0+	Output (Differential)	Bank B LVDS/LVPECL selectable output. Controlled by QB_Mode pin
40, 41	QB1-, QB1+	Output (Differential)	Bank B LVDS/LVPECL selectable output. Controlled by QB_Mode pin
42, 43	QB2-, QB2+	Output (Differential)	Bank B LVDS/LVPECL selectable output. Controlled by QB_Mode pin
44, 45	QA_Mode0, QB_Mode	Input (LVCMOS)	Out mode control pins select LVPECL, LVDS mode. If left floating, outputs are tri-stated
46	IN-	Input (Differential)	Frequency input pin, differential (accepts: LVDS, LVPECL, HCSL)
47	IN+	Input (Differential)	Frequency input pin, differential (accepts: LVDS, LVPECL, HCSL)
48	IN_SE	Input	Frequency input pin, Single Ended

### Input Mux Selection

IN_SEL	Input
0	Select Crystal Input (Pins 2, 3)
1	Select IN+, IN- Differential Input (Pins 46, 47)
NC	Select IN_SE LVCMOS Input (pin 48)

### PLL Bypass Control Function

PLL_BYPS	PLL operation
0	PLL enabled
1	PLL bypassed
NC	PLL enabled for Banks A, B; Bank C is driven directly by the output of the input mux.

### Input Divider Control Table

FS0	Divider Ratio
0	1
1	5



### PLL Feedback Divider Control Table

FS1	Feedback Divider Ratio
0	25
1	20

### Output Frequency Control Table

FS_A	FS_B	FS_C	Output Frequency
0	0	0	156.25
1	1	1	125
NC	NC	NC	312.5

### Bank A Output Control

QA_Mode0	QA[2:0]	QA_Mode1	QA[4:3]
0	LVDS	0	LVDS
1	LVPECL	1	LVPECL
NC	Hi-Z	NC	Hi-Z

### Bank B Output Control

QB_Mode	QB[2:0]
0	LVDS
1	LVPECL
NC	Hi-Z

### C-bank Output Interface Control Configuration

QC_Mode	QC+/-
0	LVDS
1	LVPECL
NC	Hi-Z



## 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, VDD .....	-0.5V to +4.6V
ESD Protection (HBM) .....	2000 V

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.

## Operating Conditions

Symbol	Parameters	Min.	Max.	Units
V <sub>DD</sub>	General Power Supply Voltage	3.0	3.6	V
T <sub>A</sub>	Ambient Temperature	-40	85	°C
I <sub>DD</sub>	Power Supply Current	All outputs loaded	425	mA
I <sub>DD_A</sub>	Power Supply Current for pin10		13	
I <sub>DD_PLL</sub>	Power Supply Current for pin12		30	
V <sub>DDA</sub>	Analog Power Supply Voltage	2.7	3.6	V
V <sub>DD_PLL</sub>	PLL Power Supply Voltage	2.7	3.6	

## LVC MOS Input Electrical Characteristics

Symbol	Parameters	Conditions	Min.	Typ.	Max.	Units
V <sub>IH</sub>	Input High Voltage	FS0, FS1	2			V
V <sub>IL</sub>	Input Low Voltage				0.8	V
V <sub>IH</sub>	Input High Current	IN_SEL, PLL_BYPS, FS_A, FS_B, FS_C, QA_Mode, QB_Mode, QC_Mode	2.6			V
V <sub>IL</sub>	Input Low Current				0.8	V
I <sub>IH</sub>	Input High Current	V <sub>IN</sub> = V <sub>DD</sub>			45	μA
I <sub>IL</sub>	Input Low Current	V <sub>IN</sub> = 0V	-45			μA
R <sub>pu</sub>	Internal pull up resistance			100		KΩ
R <sub>dn</sub>	Internal pull down resistance			100		KΩ
T <sub>DC</sub>	Input Duty Cycle		35		65	%
C <sub>IN</sub>	Input Capacitance <sup>1</sup>			1.5		pF
F <sub>IN</sub>	Input Frequency		15		160	MHz

**Note:**

1. There is no internal load capacitance built in to the X1 and X2 pins




**Differential Input Characteristics**

Symbol	Parameters	Conditions	Min.	Typ.	Max.	Units
V <sub>IH</sub>	Input High Voltage				V <sub>DD</sub> - 0.7	V
V <sub>IL</sub>	Input Low Voltage		V <sub>DD</sub> - 2.0			V
V <sub>CM</sub>	Input Bias Voltage		V <sub>DD</sub> - 1.8	V <sub>DD</sub> / 2		V
R <sub>IN</sub>	Input Differential Impedance <sup>2</sup>		80	100	120	Ω
V <sub>IN-PP</sub>	Input Differential Swing		0.3		1.8	V <sub>PP</sub>
C <sub>IN</sub>	Differential Input Capacitance			1.5		pF

**Note:**

1. 2. Differential input can be AC or DC coupled.

**LVPECL Output Characteristics** (Over Operating Conditions. See Fig. 1 and 2 for load conditions.)

Symbol	Parameters	Condition	Min.	Typ.	Max.	Units
F <sub>OUT</sub>	Output Frequency		25		312.5	MHz
T <sub>rise</sub> / T <sub>fall</sub>	Rise and Fall Time	20% to 80%, single-ended			400	ps
T <sub>DC</sub>	Duty Cycle	Differential	47		53	%
J <sub>phase</sub>	Integrated phase jitter	12KHz-20MHz @ 156.25MHz, 25MHz Xtal input		0.54	1	ps rms
T <sub>DIS</sub>	Output Disable Time				80	ns
T <sub>EN</sub>	Output Enable Time				80	ns
T <sub>LOCK</sub>	PLL Lock Time				2	ms
V <sub>PP</sub>	Output peak-peak Voltage	Single-ended	0.6		1	V
V <sub>OH</sub>	Output High Voltage	V <sub>DD</sub> = 3.3V	V <sub>DD</sub> -1.4		V <sub>DD</sub> -0.9	V
V <sub>OL</sub>	Output Low Voltage	V <sub>DD</sub> = 3.3V	V <sub>DD</sub> -2.0		V <sub>DD</sub> -1.7	V

**LVDS Output Characteristics** (Over Operating Conditions See Fig. 1 and 2 for load conditions.)

Symbol	Parameters	Condition	Min.	Typ.	Max.	Units
F <sub>OUT</sub>	Output Frequency		25		312.5	MHz
T <sub>rise</sub> / T <sub>fall</sub>	Rise and Fall Time	20% to 80%, single-ended			270	ps
T <sub>DC</sub>	Duty Cycle	Differential	47		53	%
J <sub>phase</sub>	Integrated phase jitter	12KHz-20MHz @ 156.25MHz, 25MHz Xtal input		0.54	1	ps rms


**LVDS Output Characteristics (Continued..)**

Symbol	Parameters	Condition	Min.	Typ.	Max.	Units
T <sub>DIS</sub>	Output Disable Time				80	ns
T <sub>EN</sub>	Output Enable Time				80	
T <sub>LOCK</sub>	PLL Lock Time				2	ms
V <sub>AMP</sub>   <sup>1</sup>	Differential Output Voltage Amplitude	V <sub>OH</sub> - V <sub>OL</sub>   with 100Ω external termination	250		520	mV
		V <sub>OH</sub> - V <sub>OL</sub>   with 120Ω external termination	250		600	
V <sub>OH</sub>	Output High Voltage				1.8	V
V <sub>OL</sub>	Output Low Voltage		0.925			
V <sub>OS</sub>	Output offset voltage		1.125		1.375	
R <sub>OL</sub>	Differential output impedance		85		140	Ω

**Note:**

- Valid for part numbers with date code after Y1338.

**Power Supply Noise Rejection Specification**

Parameter	Conditions	Min.	typ	Max.	Units
Supply Noise induced phase spur @ 156.25 MHz output (see note)	F <sub>m</sub> = 100kHz to 400KHz		-50		dBc

**Note:**

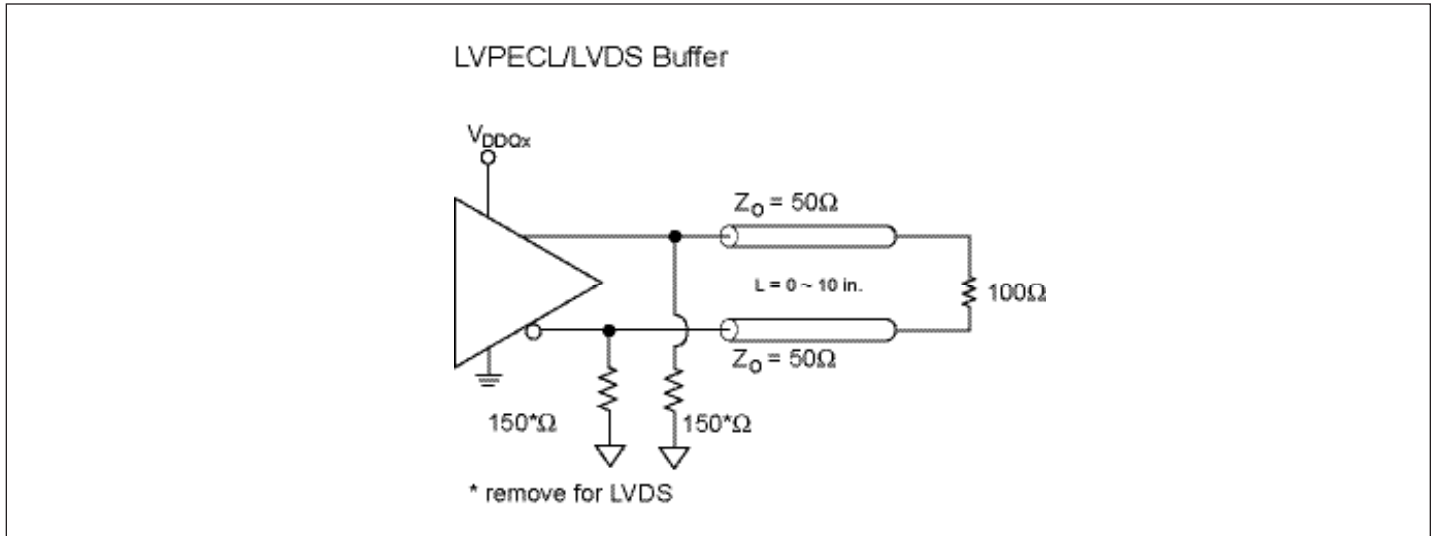
- Measured with 50mVp-p Sinusoidal Interference on the supply VDDQx, measured with the supply filter as shown in Figure 2.

**Crystal Characteristic** (link to "<http://www.pericom.com/saronix>" for more detailed crystal specifications)

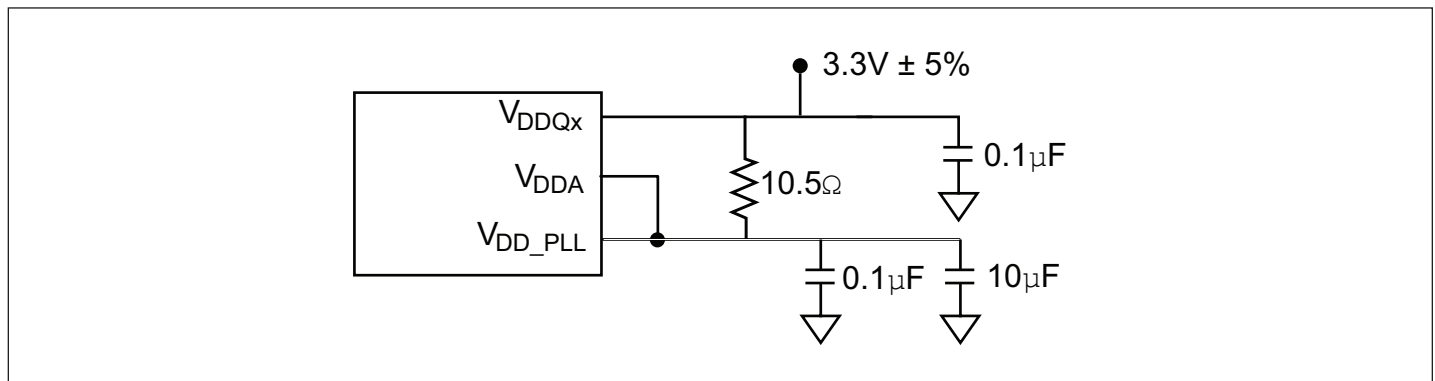
Parameters	Description	Min	Typ	Max.	Units
OSCmode	Mode of Oscillation	Fundamental			
FREQ	Frequency		25		MHz
ESR <sup>(1)</sup>	Equivalent Series Resistance			50	Ohm
Cload	Load Capacitance		18		pF
Cshunt	Shunt Capacitance			7	pF
	Drive Level			0.1	mW

**Note:**

- ESR value is dependent upon frequency of oscillation



**Figure 1. Test Circuit**



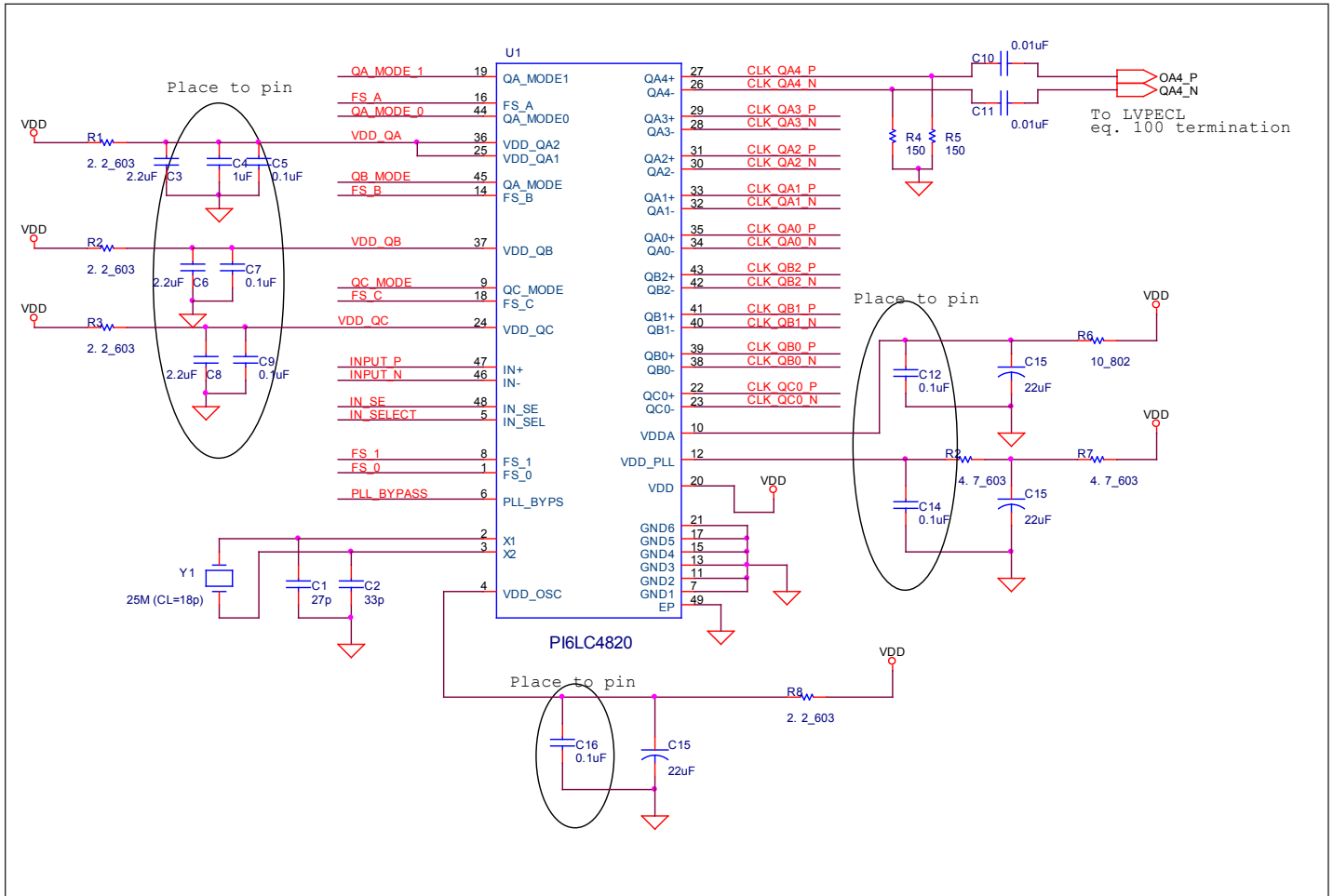
**Figure 2. Power Supply Filter**

## Application Notes

PI6LC4820 is a high performance and low jitter clock generator for advanced Gigabit Ethernet systems. It has three independent banks whose outputs can be set to LVPECL or LVDS and in 3 outputs frequencies : 125MHz, 156.25MHz, and 312.5MHz. It is critical to ensure the power supply is properly decoupled and the layout around the crystal is properly routed to achieve this low jitter performance. The following guide is highly recommended to be adopted into the system PCB designs.



**Power Decoupling Schematic**

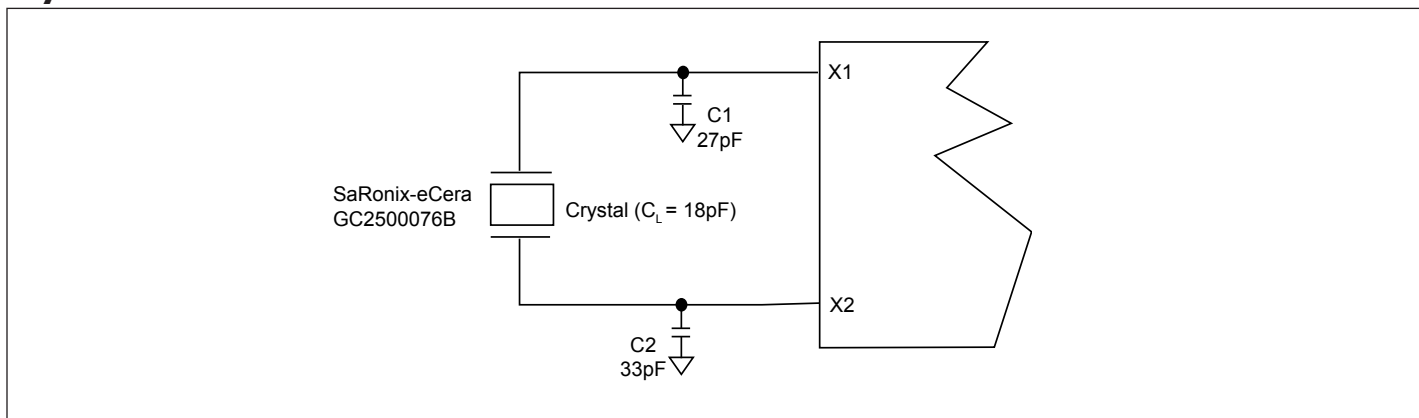


- 1) It is suggested to use the schematic's decoupling RC value to get best board noise filtering
- 2) Typical LVPECL is using 150Ω pull down in AC or DC coupling drive according to ASIC ref\_clk I/O spec
- 3) The crystal circuit C1/C2 load values are for CL=18pF crystal, they can be adjusted for other CL crystals
- 4) Please refer to the datasheet for other static I/O logic set for the request work modes and output frequencies

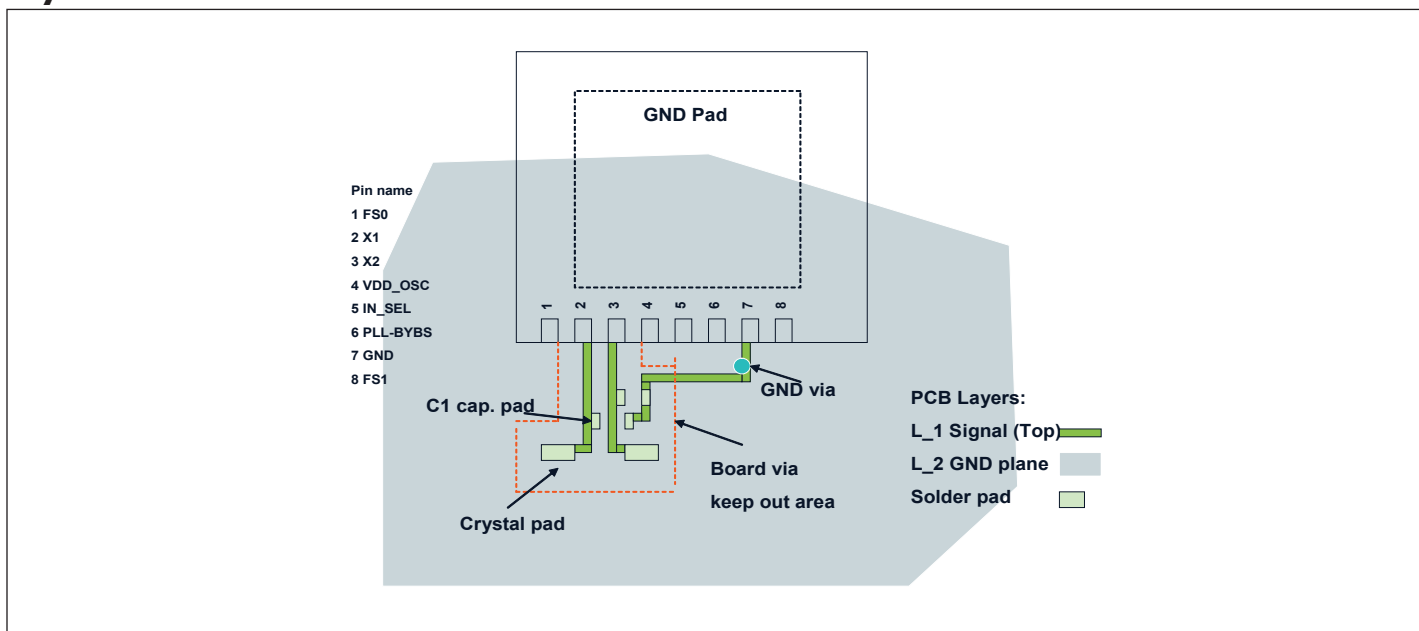
## Crystal circuit connection

The following diagram shows PI6LC4820 crystal circuit connection with a parallel crystal. For the  $CL=18\text{pF}$  crystal, it is suggested to use  $C1=27\text{pF}$ ,  $C2=33\text{pF}$ .  $C1$  and  $C2$  can be adjusted to fine tune to the target ppm of crystal oscillator according to different board layouts.

## Crystal Oscillator Circuit



## Crystal Circuit Oscillator

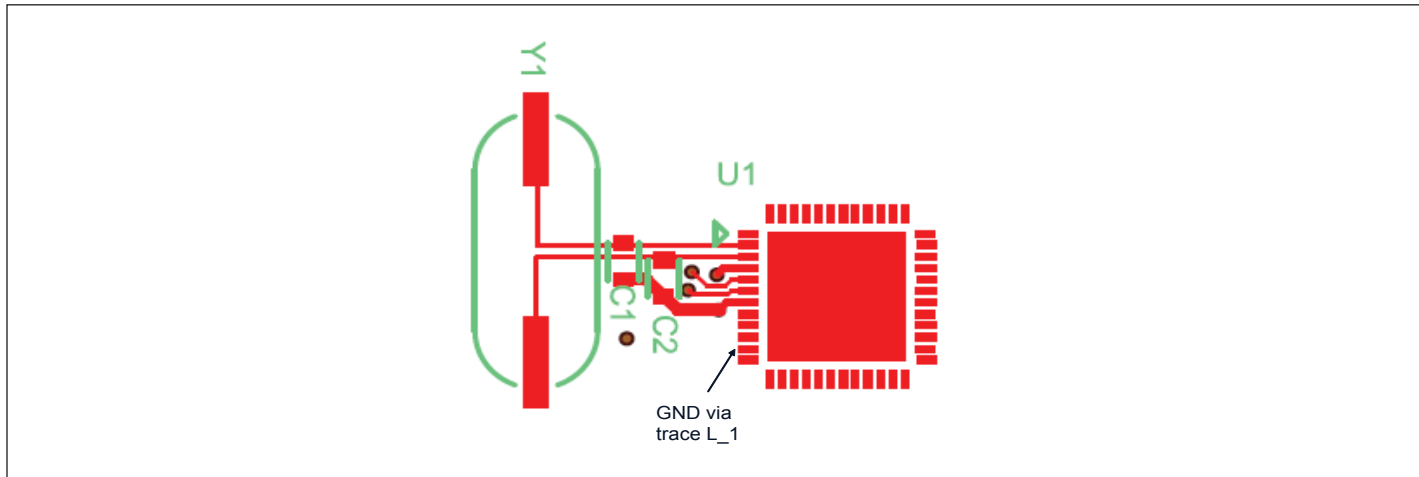


## Recommended Crystal Specification

Pericom recommends:

- GC2500003 XTAL 49S/SMD(4.0 mm), 25M,  $CL=18\text{pF}$ ,  $\pm 30\text{ppm}$ , [http://www.pericom.com/pdf/datasheets/se/GC\\_GF.pdf](http://www.pericom.com/pdf/datasheets/se/GC_GF.pdf)
- FY2500081, SMD 5x3.2(4P), 25M,  $CL=18\text{pF}$ ,  $\pm 30\text{ppm}$ , [http://www.pericom.com/pdf/datasheets/se/FY\\_F9.pdf](http://www.pericom.com/pdf/datasheets/se/FY_F9.pdf)
- FL2500047, SMD 3.2x2.5(4P), 25M,  $CL=18\text{pF}$ ,  $\pm 20\text{ppm}$ , <http://www.pericom.com/pdf/datasheets/se/FL.pdf>

## Crystal Layout Example



- 1) X1 pin is the most sensitive as crystal amplifier input
- 2) X1 and X2 pins connected to crystal trace loop should be very narrow without any board via in the loop and keep the via out of the area
- 3) Place crystal as close to the IC as possible along with C1/C2 load caps. There should be no via at the top layer to the crystal
- 4) Keep crystal load cap. C1/C2 to GND sides as close as possible so that the minimum board noise could be coupled into the caps

## 4. VDD and GND Pins Layout

- 1) Small value decoupling caps. (0.1uF, 1uF, and 2.2uF) should be placed close to each VDD pin or via
- 2) Each GND pin should have its own via to the common GND plane
- 3) Thermal pad must be connected to the GND plane for better thermal distribution and signal conducting with reasonable via counts (>6)

## 5. LVPECL Differential Output Layout

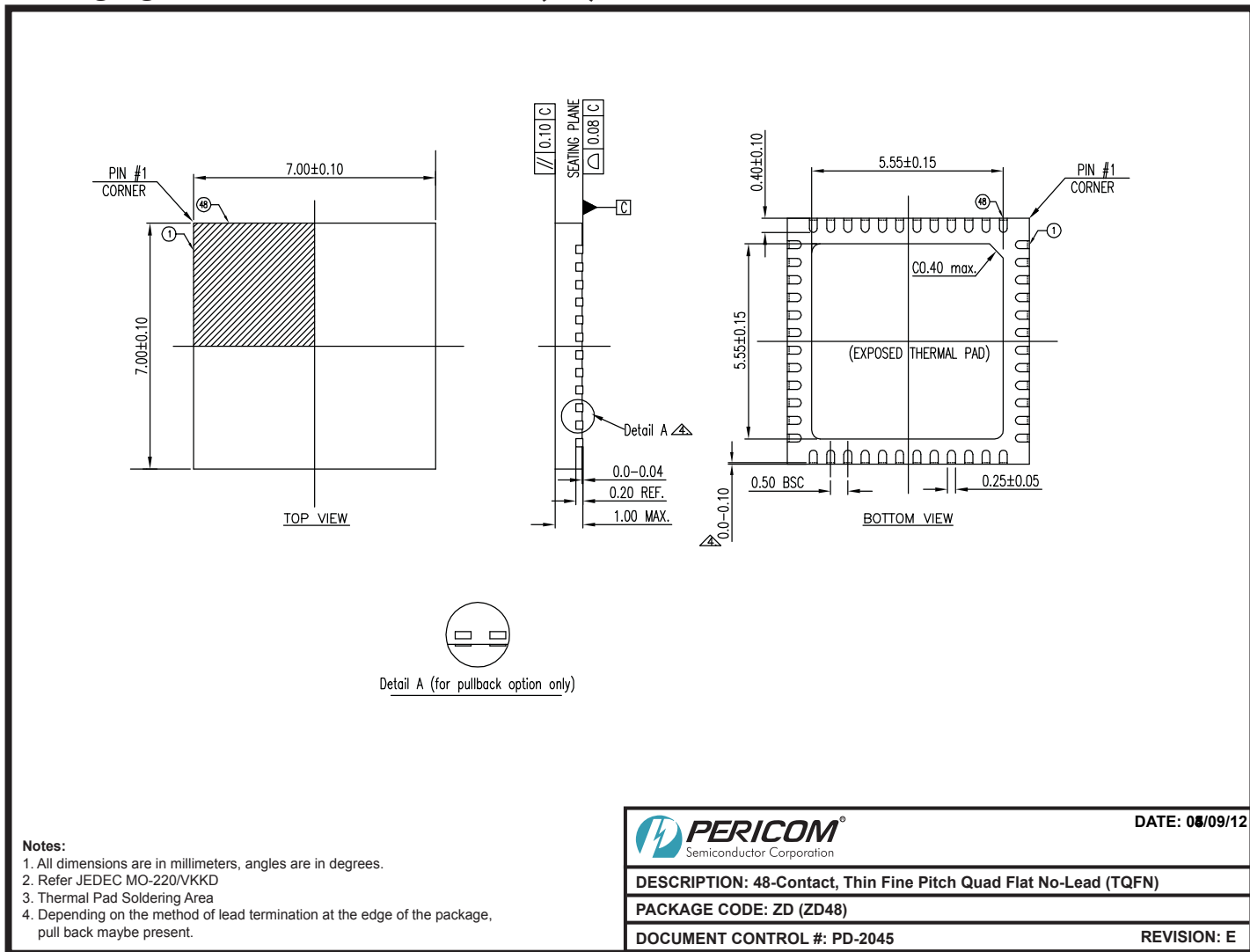
- 1) 150Ω pull-down should be put close to clock output side with symmetrical position in one pair
- 2) Do not share 150Ω pull-down GND via between each pairs

## 6. Differential Input

- 1) This device differential input (pin 47, 48) can accept 25MHz, 125MHz, and 156.25MHz frequencies in most common differential signals (LVPECL, LVDS, HCSL etc.) in either AC or DC coupling, with proper IN\_SEL, FS0, and FS1 setting
- 2) The device differential input has equivalent 100Ω differential termination on chip, so PCB 100Ω external termination is normally not necessary.



**Packaging Mechanical: 48-Pin TQFN (ZD)**



12-0458

**Note:**

- 1. • For latest package info, please check: <http://www.pericom.com/products/packaging/mechanicals.php>

**Ordering Information(1-3)**

Ordering Code	Package Code	Package Description
PI6LC4820ZDE	ZD	48-Pin, Pb-free & Green (TQFN)

**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. 3. Adding an X suffix = Tape/Reel

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