

PI6LC48H02

PCIe® 4.0/3.0/2.0/1.0 Clock Generator with 2 HCSL Outputs

Features

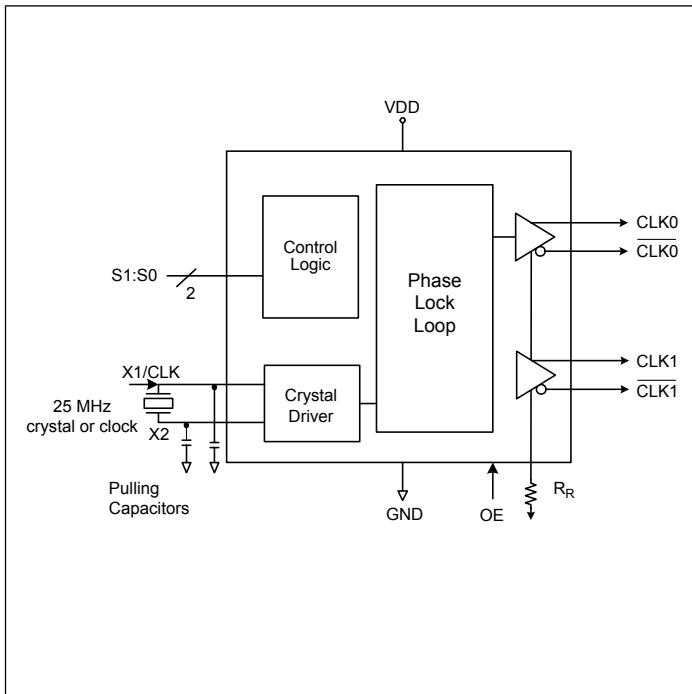
- PCIe® 4.0/3.0/2.0/1.0 compliant
- LVDS compatible outputs
- Supply voltage of 3.3V ±10%
- 25MHz crystal or clock input frequency
- HCSL outputs, 0.8V Current mode differential pair
- Jitter 35ps cycle-to-cycle (typ)
- RMS phase jitter 12kHz ~ 20MHz @ 100MHz - 0.32ps (typ)
- RMS phase jitter 12kHz ~ 20MHz @ 125MHz - 0.3ps (typ)
- Industrial temperature range
- Packaging: (Pb-free and Green)
 - 16-pin TSSOP (L16)

Description

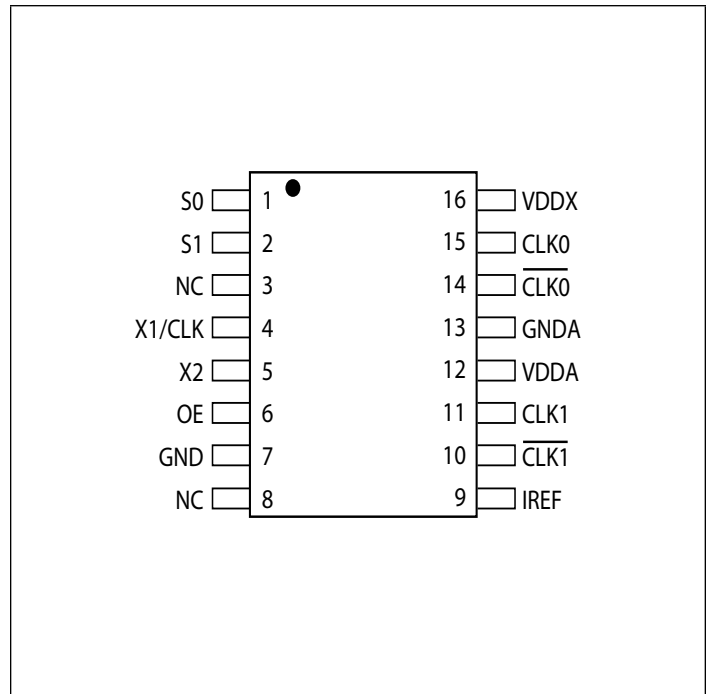
The PI6LC48H02 is a clock generator compliant to PCI Express® 4.0/3.0/2.0/1.0 and Ethernet requirements. The device is used for PC or embedded systems.

The PI6LC48H02 provides two differential (HCSL) or LVDS outputs. Using Diodes' patented Phase Locked Loop (PLL) techniques, the device takes a 25MHz crystal input and produces two pairs of differential outputs (HCSL) at 25MHz, 100MHz, 125MHz, 200MHz clock frequencies.

Block Diagram



Pin Configuration (16-Pin TSSOP)



Pin Description

Pin #	Pin Name	I/O Type	Description
1	S0	Input	Select pin 0 (Internal pull-up resistor). See Table 1.
2	S1	Input	Select pin 1 (Internal pull-up resistor). See Table 1.
3	NC	-	Do not connect
4	X1/CLK	Input	Crystal or clock input. Connect to a 25MHz crystal or single ended clock.
5	X2	Output	Crystal connection. Leave unconnected for clock input.
6	OE	Input	Output enable. Internal pull-up resistor.
7	GND	Power	Ground
8	NC	-	Do not connect
9	IREF	Output	Precision resistor attached to this pin is connected to the internal current reference.
10	$\overline{\text{CLK1}}$	Output	HCSL compliment clock output
11	CLK1	Output	HCSL clock output
12	VDDA	Power	Connect to a +3.3V source.
13	GND A	Power	Output and analog circuit ground.
14	$\overline{\text{CLK0}}$	Output	HCSL compliment clock output
15	CLK0	Output	HCSL clock output
16	VDDX	Power	Connect to a +3.3V source.

Table 1: Output Select Table

S1	S0	CLK(MHz)
0	0	25
0	1	100
1	0	125
1	1	200

Application Information

Decoupling Capacitors

Decoupling capacitors of 0.01 μ F should be connected between each V_{DD} pin and the ground plane and placed as close to the V_{DD} pin as possible.

Crystal

Use a 25MHz fundamental mode parallel resonant crystal with less than 300PPM of error across temperature.

Crystal Capacitors

C_L = Crystals's load capacitance in pF

Crystal Capacitors (pF) = $(C_L - 8) * 2$

For example, for a crystal with 16pF load caps, the external effective crystal cap would be 16 pF. $(16-8)*2=16$.

Current Source (IREF) Reference Resistor - R_R

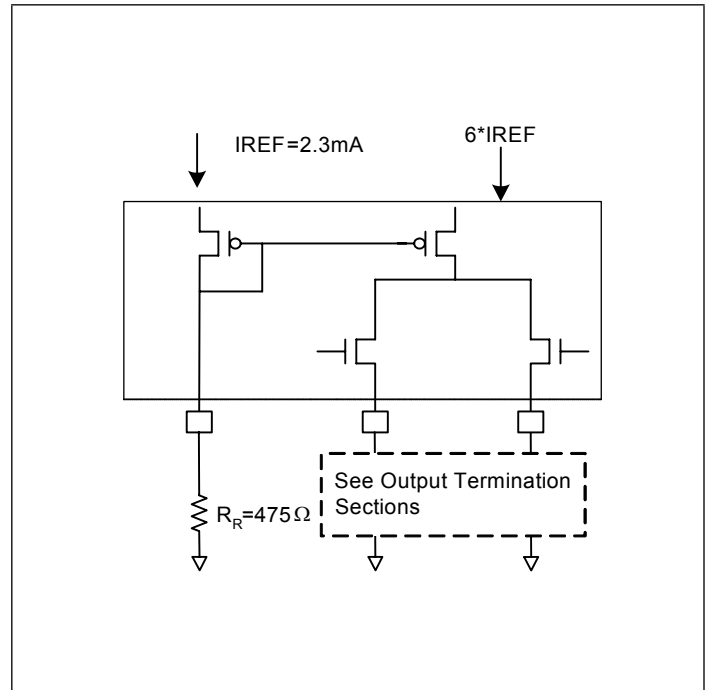
If board target trace impedance is 50 Ω , then R_R = 475 Ω providing an IREF of 2.32 mA. The output current (I_{OH}) is 6*IREF.

Output Termination

The PCI Express differential clock outputs of the PI6LC48H02 are open source drivers and require an external series resistor and a resistor to ground. These resistor values and their allowable locations are shown in detail in the PCI Express Layout Guidelines section.

The PI6LC48H02 can be configured for LVDS compatible voltage levels. See the LVDS Compatible Layout Guidelines section.

Output Structures



PI6LC48H02

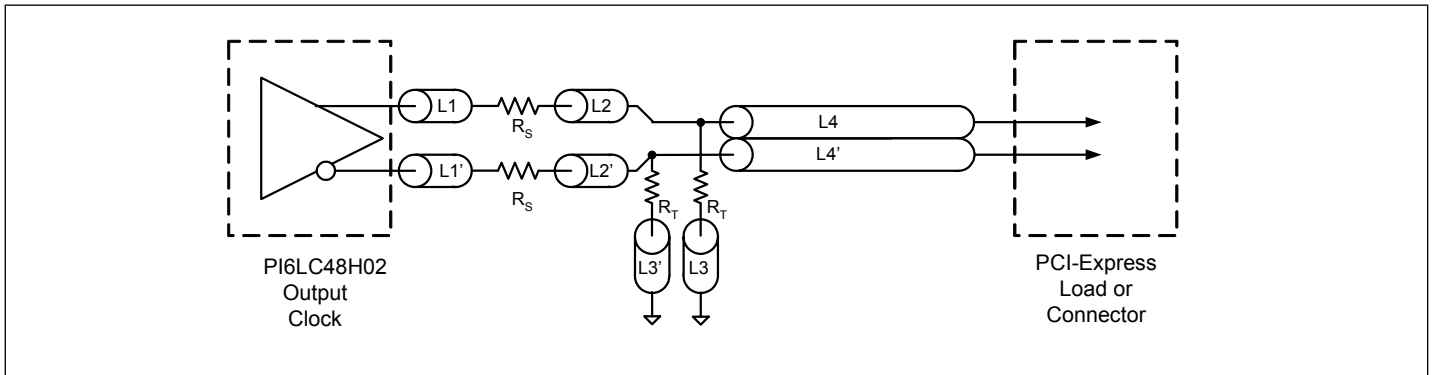
PCI Express Layout Guidelines

Common Recommendations for Differential Routing	Dimension or Value	Unit
L1 length, route as non-coupled 50Ω trace.	0.5 max	inch
L2 length, route as non-coupled 50Ω trace.	0.2 max	inch
L3 length, route as non-coupled 50Ω trace.	0.2 max	inch
R _S	33	Ω
R _T	49.9	Ω

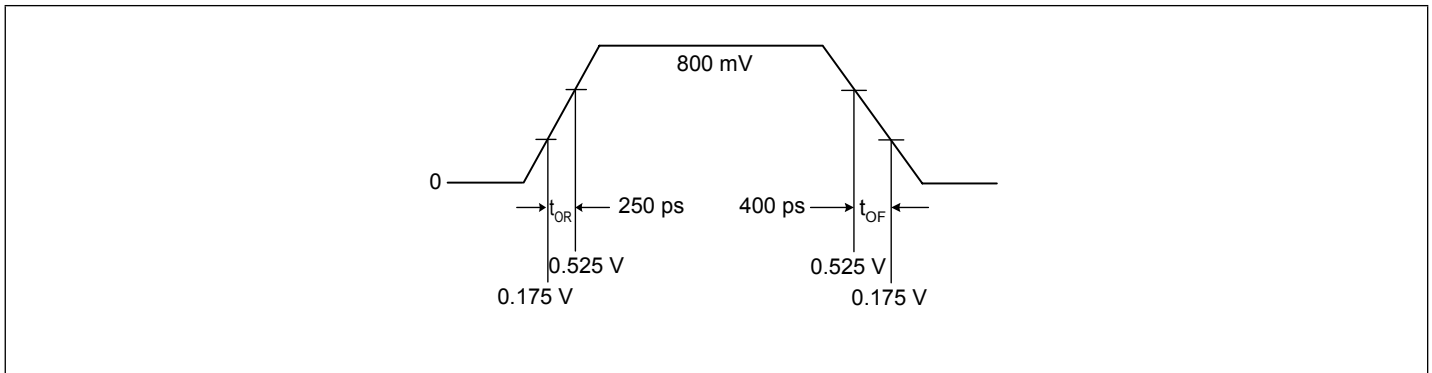
Differential Routing on a Single PCB	Dimension or Value	Unit
L4 length, route as coupled microstrip 100Ω differential trace.	2 min to 16 max	inch
L4 length, route as coupled stripline 100Ω differential trace.	1.8 min to 14.4 max	inch

Differential Routing to a PCI Express connector	Dimension or Value	Unit
L4 length, route as coupled microstrip 100Ω differential trace.	0.25 min to 14 max	inch
L4 length, route as coupled stripline 100Ω differential trace.	0.225 min to 12.6 max	inch

PCI Express Device Routing



Typical PCI Express (HCSL) Waveform

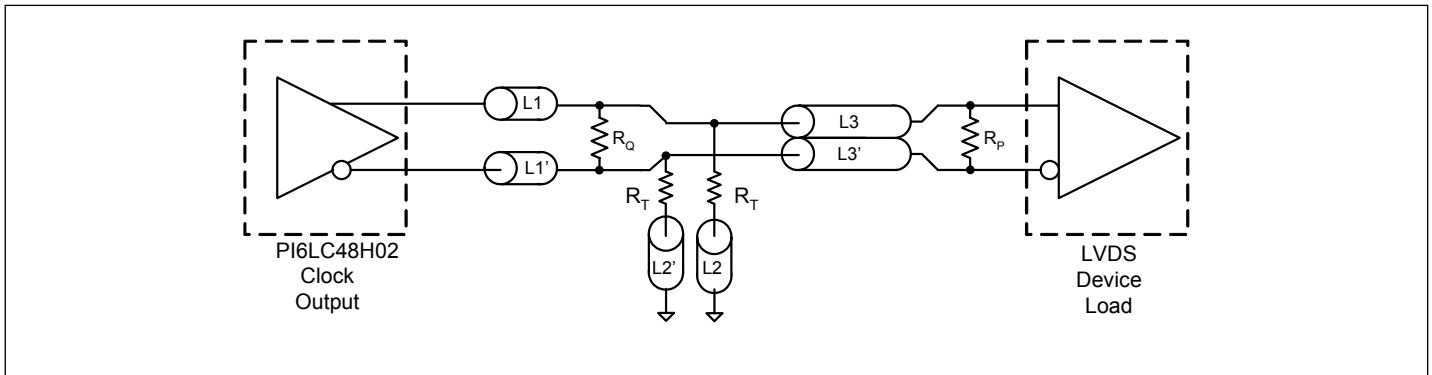


PI6LC48H02

Application Information

LVDS Recommendations for Differential Routing	Dimension or Value	Unit
L1 length, route as non-coupled 50Ω trace.	0.5 max	inch
L2 length, route as non-coupled 50Ω trace.	0.2 max	inch
RP	100	Ω
RQ	100	Ω
RT	150	Ω
L3 length, route as 100Ω differential trace.		
L3 length, route as 100Ω differential trace.		

LVDS Device Routing



Maximum Ratings

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

Supply Voltage to Ground Potential	4.6V
All Inputs and Outputs	-0.5V to $V_{DD}+0.5V$
Ambient Operating Temperature	-40 to +85°C
Storage Temperature	-65 to +150°C
Junction Temperature	125°C
Soldering Temperature	260°C
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.

Electrical Specifications

Recommended Operation Conditions

Parameter	Min.	Typ.	Max.	Unit
Ambient Operating Temperature	-40		+85	°C
Power Supply Voltage (measured in respect to GND)	+3.0		+3.6	V

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{DD}	Supply Voltage		3.0	3.3	3.6	V
V_{IH}	Input High Voltage ⁽¹⁾	OE, S0, S1	2.0		$V_{DD} + 0.3$	V
V_{IL}	Input Low Voltage ⁽¹⁾	OE, S0, S1	GND - 0.3		0.8	V
I_{IH}	Input High Current	$V_{in} = V_{DD}$	-5		5	μA
I_{IL}	Input Low Current	$V_{in} = 0$	-20		20	
I_{DD}	Operating Supply Current	$R_L = 50\Omega$, $C_L = 2pF$			115	mA
I_{DDOE}		OE = LOW			65	mA
C_{IN}	Input Capacitance	@ 55MHz			7	pF
C_{OUT}	Output Capacitance	@ 55MHz			6	pF
L_{PIN}	Pin Inductance				5	nH
R_{OUT}	Output Resistance	CLK Outputs	3.0			kΩ

Notes:

1. Single edge is monotonic when transitioning through region.

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Industry Max.	Unit
F_{IN}	Input Frequency			25			MHz
F_{OUT}	Output Frequency		25		200		MHz
V_{OH}	Output High Voltage ^(1,2)	100 MHz HCSL output @ $V_{DD} = 3.3V$	660	800	900		mV
V_{OL}	Output Low Voltage ^(1,2)		-150	0			mV
V_{CPA}	Crossing Point Voltage ^(1,2)	Absolute	250	350	550		mV
V_{CN}	Crossing Point Voltage ^(1,2,4)	Variation over all edges			140		mV
J_{CC}	Jitter, Cycle-to-Cycle ^(1,3)			35	60		ps
J_{Phase}	RMS Phase Jitter, (Random)	100MHz 25MHz Xtal input, 12kHz - 20MHz		0.32	0.5		ps
		125MHz 25MHz Xtal input, 12kHz - 20MHz		0.3	0.5		ps
$J_{RMS2.0}$	PCIe 2.0 RMS Jitter	PCIe 2.0 Test Method @ 100MHz Output - Low BW		0.4	1.0	3.0	ps
		PCIe 2.0 Test Method @ 100MHz Output - High BW		1.9	2.5	3.1	ps
$J_{RMS3.0}$	PCIe 3.0 RMS Jitter	PLL L-BW @ 2M & 5M 1st H3		1.42	1.9	3	ps
		PLL L-BW @ 2M & 4M 1st H3		2.05	2.5	3	ps
		PLL H-BW @ 2M & 5M 1st H3		0.45	0.7	1	ps
		PLL H-BW @ 2M & 4M 1st H3		0.45	0.7	1	ps
$J_{RMS4.0}$	PCIe 4.0 RMS Jitter	PCIe Gen 4 (PLL BW of 2-4 or 2-5MHz, CDR =10MHz)		0.37	0.45	0.5	ps
t_{OR}	Rise Time ^(1,2)	From 0.175V to 0.525V	175		700		ps
t_{OF}	Fall Time ^(1,2)	From 0.525V to 0.175V	175		700		ps
T_{SKEW}	Skew between outputs	At Crossing Point Voltage			50		ps
$T_{DUTY-CYCLE}$	Duty Cycle ^(1,3)		45		55		%
T_{OE}	Output Enable Time ⁽⁵⁾	All outputs			10		μs
T_{OT}	Output Disable Time ⁽⁵⁾	All outputs			10		μs
t_{STABLE}	Stabilization Time	From Power-up $V_{DD}=3.3V$		3.0			ms

Notes:

- $R_L = 50\text{-}\Omega$ with $C_L = 2\text{ pF}$
- Single-ended waveform
- Differential waveform
- Measured at the crossing point
- CLK pins are tri-stated when OE is LOW

PI6LC48H02

Thermal Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
θ_{JA}	Thermal Resistance Junction to Ambient	Still air			90	$^{\circ}\text{C}/\text{W}$
θ_{JC}	Thermal Resistance Junction to Case				24	$^{\circ}\text{C}/\text{W}$

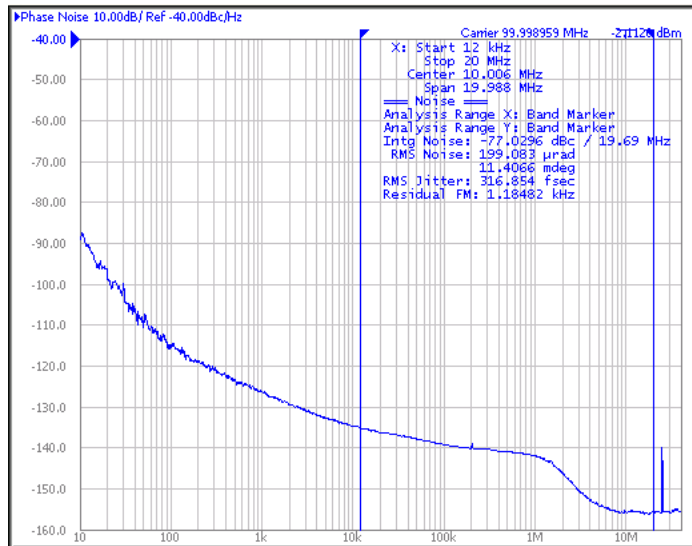
Recommended Crystal Specification

Diodes recommends:

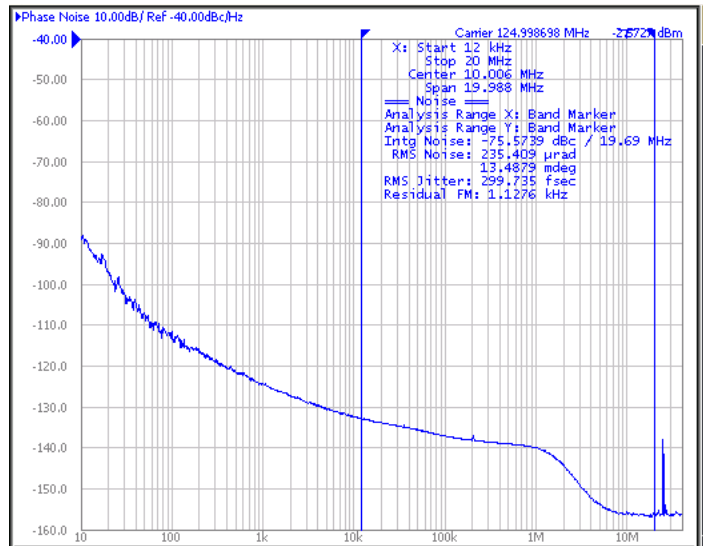
- a) GC2500003 XTAL 49S/SMD(4.0 mm), 25M, CL=18pF, +/-30ppm
- b) FY2500107, SMD 5x3.2(4P), 25M, CL=18pF, +/-30ppm
- c) FL2500038, SMD 3.2x2.5(4P), 25M, CL=18pF, +/-20ppm

Phase Noise Plot

100MHz



125MHz



PI6LC48H02

Packaging Mechanical: 16-Pin TSSOP (L)

SYMBOLS	MIN.	NOM.	MAX.
A	–	–	1.20
A1	0.05	–	0.15
A2	0.80	1.00	1.05
b	0.19	–	0.30
c	0.09	–	0.20
D	4.90	5.00	5.10
E1	4.30	4.40	4.50
E	6.20	6.40	6.60
e	0.65 BSC		
L1	1.00 REF		
L	0.45	0.60	0.75
S	0.20	–	–
θ	0°	–	8°

NOTES:
 1. ALL DIMENSIONS IN MILLIMETERS. ANGLES IN DEGREES.
 2. JEDEC MO-153F
 3. DIMENSIONS DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.

		DATE: 03/24/16
DESCRIPTION: 16-Pin, 173mil Wide TSSOP		
PACKAGE CODE: L (L16)		
DOCUMENT CONTROL #: PD-1310	REVISION: G	

16-0061

Ordering Information

Ordering Code	Package Code	Package Type	Operating Temperature
PI6LC48H02LIE	L	16-pin, 173mil Wide (TSSOP)	Industrial
PI6LC48H02LIEX	L	16-pin, 173mil Wide (TSSOP), Tape & Reel	Industrial

Notes:

- Thermal characteristics can be found on the company web site at www.Diodes.com/packaging/
- "E" denotes Pb-free and Green
- Adding an "X" at the end of the ordering code denotes tape and reel packaging

IMPORTANT NOTICE

DIODES INCORPORATED MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).

Diodes Incorporated and its subsidiaries reserve the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. Diodes Incorporated does not assume any liability arising out of the application or use of this document or any product described herein; neither does Diodes Incorporated convey any license under its patent or trademark rights, nor the rights of others. Any Customer or user of this document or products described herein in such applications shall assume all risks of such use and will agree to hold Diodes Incorporated and all the companies whose products are represented on Diodes Incorporated website, harmless against all damages.

Diodes Incorporated does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.

Should Customers purchase or use Diodes Incorporated products for any unintended or unauthorized application, Customers shall indemnify and hold Diodes Incorporated and its representatives harmless against all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized application.

Products described herein may be covered by one or more United States, international or foreign patents pending. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks.

This document is written in English but may be translated into multiple languages for reference. Only the English version of this document is the final and determinative format released by Diodes Incorporated.

LIFE SUPPORT

Diodes Incorporated products are specifically not authorized for use as critical components in life support devices or systems without the express written approval of the Chief Executive Officer of Diodes Incorporated. As used herein:

A. Life support devices or systems are devices or systems which:

1. are intended to implant into the body, or
 2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.
- B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

Customers represent that they have all necessary expertise in the safety and regulatory ramifications of their life support devices or systems, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of Diodes Incorporated products in such safety-critical, life support devices or systems, notwithstanding any devices- or systems-related information or support that may be provided by Diodes Incorporated. Further, Customers must fully indemnify Diodes Incorporated and its representatives against any damages arising out of the use of Diodes Incorporated products in such safety-critical, life support devices or systems.

Copyright © 2016, Diodes Incorporated
www.diodes.com



Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)

Факс: 8 (812) 320-02-42

Электронная почта: org@eplast1.ru

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.