A Product Line of
Diodes Incorporated

PI6C10806B

1.5V/1.8V/2.5V/3.3V, 160MHz, Low Skew 1:6 Crystal to LVCMOS Clock Buffer

Features

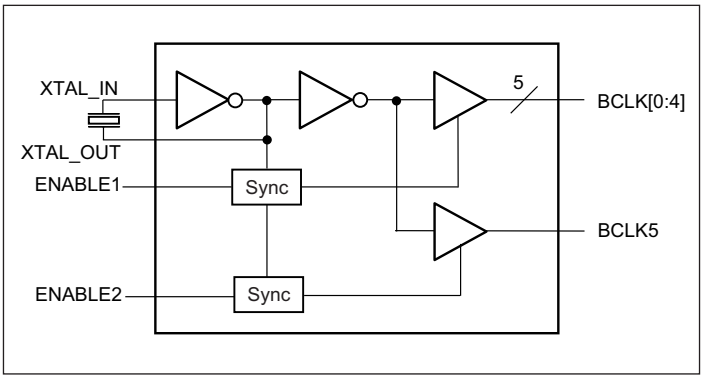
- Six low skew outputs: < 80ps
- Crystal oscillator input: 10MHz to 50MHz
- Switching frequency up to 160 MHz
- Fast output rise/fall time (down to 1.8V): < 800ps
- Synchronous output enables
- 1.5V, 1.8V, 2.5V, and 3.3V operation
- Industrial Temperature range: –40°C to +85°C
- Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)
- Halogen and Antimony Free. "Green" Device (Note 3)
- For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please contact us or your local Diodes representative.
  https://www.diodes.com/quality/product-definitions/
- Packaging (Pb-free & Green available):
  - 16-pin, 173-mil wide TSSOP (L)

Description

Diodes' PI6C10806B is a low skew, six output, crystal oscillator driver. The device's input range is from 10MHz to 50MHz. If the XTAL_IN is driven with a signal source, then the input frequency can be as high as 160MHz. The outputs are configured into two groups: a five output and a single output, each with an independent output enable.

The PI6C10806B has a wide range of operating voltages: 1.5V, 1.8V, 2.5V, and 3.3V. This feature, paired with the low output-to-output and part-to-part skew, makes the device ideal for low voltage, low power, high frequency, single ended applications; such as in networking.

Block Diagram



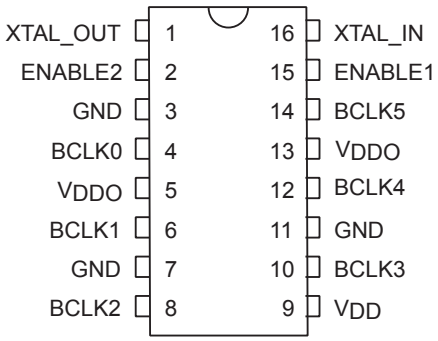
Truth Table(1)

Inputs		Outputs	
ENABLE1	ENABLE2	BCLK[0:4]	BCLK5
L	L	L	L
L	H	L	Switching
H	L	Switching	L
H	H	Switching	Switching

Note:
1. H = High Voltage Level, L = Low Voltage Level

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

Pin Configuration



Pin Description

Pin#	Pin Name	Description
15, 2	ENABLE1, ENABLE2	Active High Output Enable Inputs
16	XTAL_IN	Crystal interface
1	XTAL_OUT	Crystal interface
4, 6, 8, 10, 12, 14	BCLK[0:5]	Clock Outputs
3, 7, 11	GND	Ground
9	V_{DD}	Core Power
5, 13	V_{DDO}	Output Power

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

Storage Temperature.....–65°C to +150°C
V_{DD}, V_{DDO} Voltage.....–0.5V to +3.6V
Output Voltage (max. 4.6V).....–0.5V to V_{DD}+0.5V
Input Voltage (max 4.6V).....–0.5V to V_{DD}+0.5V
Junction Temperature.....Max. 125°C

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.

Power Supply DC Characteristics (V_{DD}/V_{DDO} = 3.3V ± 5%, T_A = -40°C to 85°C)

Symbols	Parameters	Test Conditions	Min.	Typ	Max.	Units
V_{DD}	Core Supply Voltage		3.135	3.3	3.465	V
V_{DDO}	Output Supply Voltage		3.135	3.3	3.465	V
I_{DD}	Power Supply Current	ENABLE1:2 = '00'			10	mA
I_{DDO}	Output Supply Current	ENABLE1:2 = '00'			5	mA

Power Supply DC Characteristics (V_{DD}/V_{DDO} = 2.5V ± 5%, T_A = -40°C to 85°C)

Symbols	Parameters	Test Conditions	Min.	Typ	Max.	Units
V_{DD}	Core Supply Voltage		2.375	2.5	2.625	V
V_{DDO}	Output Supply Voltage		2.375	2.5	2.625	V
I_{DD}	Power Supply Current	ENABLE1:2 = '00'			8	mA
I_{DDO}	Output Supply Current	ENABLE1:2 = '00'			4	mA

Power Supply DC Characteristics (V_{DD}/V_{DDO} = 1.8V ± 0.2V, T_A = -40°C to 85°C)

Symbols	Parameters	Test Conditions	Min.	Typ	Max.	Units
V_{DD}	Core Supply Voltage		1.6	1.8	2.0	V
V_{DDO}	Output Supply Voltage		1.6	1.8	2.0	V
I_{DD}	Power Supply Current	ENABLE1:2 = '00'			5	mA
I_{DDO}	Output Supply Current	ENABLE1:2 = '00'			3	mA

Power Supply DC Characteristics (V_{DD}/V_{DDO} = 1.5V ± 5%, T_A = -40°C to 85°C)

Symbols	Parameters	Test Conditions	Min.	Typ	Max.	Units
V_{DD}	Core Supply Voltage		1.425	1.5	1.575	V
V_{DDO}	Output Supply Voltage		1.425	1.5	1.575	V
I_{DD}	Power Supply Current	ENABLE1:2 = '00'			5	mA
I_{DDO}	Output Supply Current	ENABLE1:2 = '00'			3	mA

Power Supply DC Characteristics (V_{DD} = 3.3V ± 5%, T_A = -40°C to 85°C)

Symbols	Parameters		Test Conditions	Min.	Typ	Max.	Units
I_{DD}	Power Supply Current	ENABLE1:2 = '00'	V_{DDO} = 2.5V ± 5%			10	mA
			V_{DDO} = 1.8V ± 0.2V				
			V_{DDO} = 1.5V ± 5%				

Power Supply DC Characteristics Cont.

Symbols	Parameters		Test Conditions	Min.	Typ	Max.	Units
I_{DDO}	Output Supply Current	ENABLE1:2 = '00'	V_{DDO} = 2.5V ± 5%			4	mA
			V_{DDO} = 1.8V ± 0.2V			3	
			V_{DDO} = 1.5V ± 5%			3	

Power Supply DC Characteristics (V_{DD} = 2.5V ± 5%, T_A = -40°C to 85°C)

Symbols	Parameters		Test Conditions	Min.	Typ	Max.	Units
I_{DD}	Power Supply Current	ENABLE1:2 = '00'	V_{DDO} = 1.8V ± 0.2V			8	mA
			V_{DDO} = 1.5V ± 5%				
I_{DDO}	Output Supply Current	ENABLE1:2 = '00'	V_{DDO} = 1.8V ± 0.2V			3	
			V_{DDO} = 1.5V ± 5%				

Power Supply DC Characteristics (V_{DD} = 1.8V ± 0.2V, T_A = -40°C to 85°C)

Symbols	Parameters		Test Conditions	Min.	Typ	Max.	Units
I_{DD}	Power Supply Current	ENABLE1:2 = '00'	V_{DDO} = 1.5V ± 5%			5	mA
I_{DDO}	Output Supply Current	ENABLE1:2 = '00'	V_{DDO} = 1.5V ± 5%			3	

I/O DC Characteristics (T_A = -40°C to 85°C)

Symbols	Parameters		Test Conditions	Min.	Typ	Max.	Units
V_{IH}	Input High Voltage	ENABLE 1, ENABLE 2	V_{DD} = 3.3V ± 5%	2		V_{DDO} + 0.3	V
			V_{DD} = 2.5V ± 5%	1.7		V_{DDO} + 0.3	V
			V_{DD} = 1.8V ± 0.2V	0.65* V_{DDO}		V_{DDO} + 0.3	V
			V_{DD} = 1.5V ± 5%	0.65* V_{DDO}		V_{DDO} + 0.3	V
V_{IL}	Input Low Voltage	ENABLE 1, ENABLE 2	V_{DD} = 3.3V ± 5%	-0.3		0.8	V
			V_{DD} = 2.5V ± 5%	-0.3		0.7	V
			V_{DD} = 1.8V ± 0.2V	-0.3		0.35* V_{DDO}	V
			V_{DD} = 1.5V ± 5%	-0.3		0.35* V_{DDO}	V
V_{OH}	Output High Voltage		V_{DDO} = 3.3V ± 5% (1)	2.6			V
			V_{DDO} = 2.5V ± 5%; I_{OH} = -1mA	2			V
			V_{DDO} = 2.5V ± 5% (1)	1.8			V
			V_{DDO} = 1.8V ± 0.2V(1)	V_{DDO} - 0.3			V
			V_{DDO} = 1.5V ± 5% (1)	V_{DDO} - 0.3			V

I/O DC Characteristics Cont.

Symbols	Parameters	Test Conditions	Min.	Typ	Max.	Units
V_{OL}	Output Low Voltage	V_{DD} = 3.3V ± 5% (1)			0.5	V
		V_{DDO} = 2.5V ± 5%; I_{OL} = 1mA			0.4	V
		V_{DDO} = 2.5V ± 5% (1)			0.45	V
		V_{DDO} = 1.8V ± 0.2V (1)			0.35	V
		V_{DDO} = 1.5V ± 5% (1)			0.3	V
R_{OUT}	Output Impedance	V_{DDO} = 3.3 V		7		Ω
		V_{DDO} = 2.5 V		8		Ω
		V_{DDO} = 1.8 V		13		Ω
		V_{DDO} = 1.5 V		20		Ω

Notes: 1. I_{OH} = -8mA, I_{OL} = 8mA.

AC Characteristics (Over Operating Range: V_{DD} = 3.3V ± 5%, T_A = -40° to 85°C)

Parameters	Description	Test Conditions(1)		Min.	Typ	Max.	Units
f_{OUT}	Output Frequency	Using Crystal		10		50	MHz
		External Clock(2)	V_{DDO} = 3.3V±5%	0		160	
			V_{DDO} = 2.5V±5%				
			V_{DDO} = 1.8V±0.2V				
			V_{DDO} = 1.5V±5%	0		100	
t_{DC}	Output Duty Cycle	@ V_{DDO}/2	V_{DDO} = 3.3V±5%	47		53	%
			V_{DDO} = 2.5V±5%				
			V_{DDO} = 1.8V±0.2V				
			V_{DDO} = 1.5V±5%	45		55	
t_R/t_F	CLKn Rise/Fall Time	20% to 80%	V_{DDO} = 3.3V±5%	150		800	ps
			V_{DDO} = 2.5V±5%	200		800	
			V_{DDO} = 1.8V±0.2V	200		800	
			V_{DDO} = 1.5V±5%	600		1300	
RMS	Random RMS Phase Jitter	25MHz @ Integration Range 100Hz - 1MHz	V_{DDO} = 3.3V±5%		0.098		ps
			V_{DDO} = 2.5V±5%		0.112		
			V_{DDO} = 1.8V±0.2V		0.233		
			V_{DDO} = 1.5V±5%		0.277		
$t_{SK(O)}$(3)	Output to Output Skew between any two outputs of the same device @ same transition	@V_{DDO}/2				80	ps
t_{DIS},t_{EN}(4)	Output Enable/Disable	@V_{DDO}/2				4	cycles

Notes:

1. Unless noted otherwise, all parameters are tested with xtal @ f <= Fxtal_max,; outputs are terminated @ 50Ω to V_{DDO}/2, see waveforms.
2. External clock source is driving XTAL_IN input
3. Identical conditions: loading, transitions, supply voltage, temperature, package type and speed grade.
4. These parameters are guaranteed, but not tested. Max delay is 4 cycles. Min. setup time = 3ns.

AC Characteristics (V_{DD} = 2.5V±5%, T_A = -40°C to 85°C)

Parameters	Description	Test Conditions(1)		Min.	Typ	Max.	Units
f_{OUT}	Output Frequency	Using Crystal		10		50	MHz
		External Clock(2)	V_{DDO} = 2.5V±5%	0		160	
			V_{DDO} = 1.8V±0.2V	0		160	
			V_{DDO} = 1.5V±5%	0		100	
t_{DC}	Output Duty Cycle	@ V_{DDO}/2	V_{DDO} = 2.5V±5%	47		53	%
			V_{DDO} = 1.8V±0.2V				
			V_{DDO} = 1.5V±5%	45		55	
t_R/t_F	CLKn Rise/Fall Time	20% to 80%	V_{DDO} = 2.5V±5%	150		800	ps
			V_{DDO} = 1.8V±0.2V	200		900	
			V_{DDO} = 1.5V±5%	700		1400	
RMS	Random RMS Phase Jitter	25MHz @ Integration Range 100Hz - 1MHz	V_{DDO} = 2.5V±5%		0.112		ps
			V_{DDO} = 1.8V±0.2V		0.233		
			V_{DDO} = 1.5V±5%		0.277		
$t_{SK(O)}$(3)	Output to Output Skew between any two outputs of the same device @ same transition	@V_{DDO}/2				80	ps
t_{DIS},t_{EN}(4)	Output Enable/Disable	@V_{DDO}/2				4	cycles

Notes:

1. Unless noted otherwise, all parameters are tested with xtal @ f <= Fxtal_max,; outputs are terminated @ 50Ω to V_{DDO}/2, see waveforms.
2. External clock source is driving XTAL_IN input
3. Identical conditions: loading, transitions, supply voltage, temperature, package type and speed grade.
4. These parameters are guaranteed, but not tested. Max delay is 4 cycles. Min. setup time = 3ns.

AC Characteristics (V_{DD} = 1.8V±0.2V, T_A = -40°C to 85°C)

Parameters	Description	Test Conditions(1)		Min.	Typ	Max.	Units
f_{OUT}	Output Frequency	Using Crystal		10		50	MHz
		External Clock(2)	V_{DDO} = 1.8V±0.2V	0		160	
			V_{DDO} = 1.5V±5%	0		100	
t_{DC}	Output Duty Cycle	@ V_{DDO}/2	V_{DDO} = 1.8V±0.2V	47		53	%
			V_{DDO} = 1.5V±5%	45		55	
t_R/t_F	CLKn Rise/Fall Time	20% to 80%	V_{DDO} = 1.8V±0.2V	150		800	ps
			V_{DDO} = 1.5V±5%	800		1500	
RMS	Random RMS Phase Jitter	25MHz @ Integration Range 100Hz - 1MHz	V_{DDO} = 1.8V±0.2V		0.233		ps
			V_{DDO} = 1.5V±5%		0.277		
$t_{SK(O)}$(3)	Output to Output Skew between any two outputs of the same device @ same transition	@V_{DDO}/2				80	ps
t_{DIS},t_{EN}(4)	Output Enable/Disable	@V_{DDO}/2				4	cycles

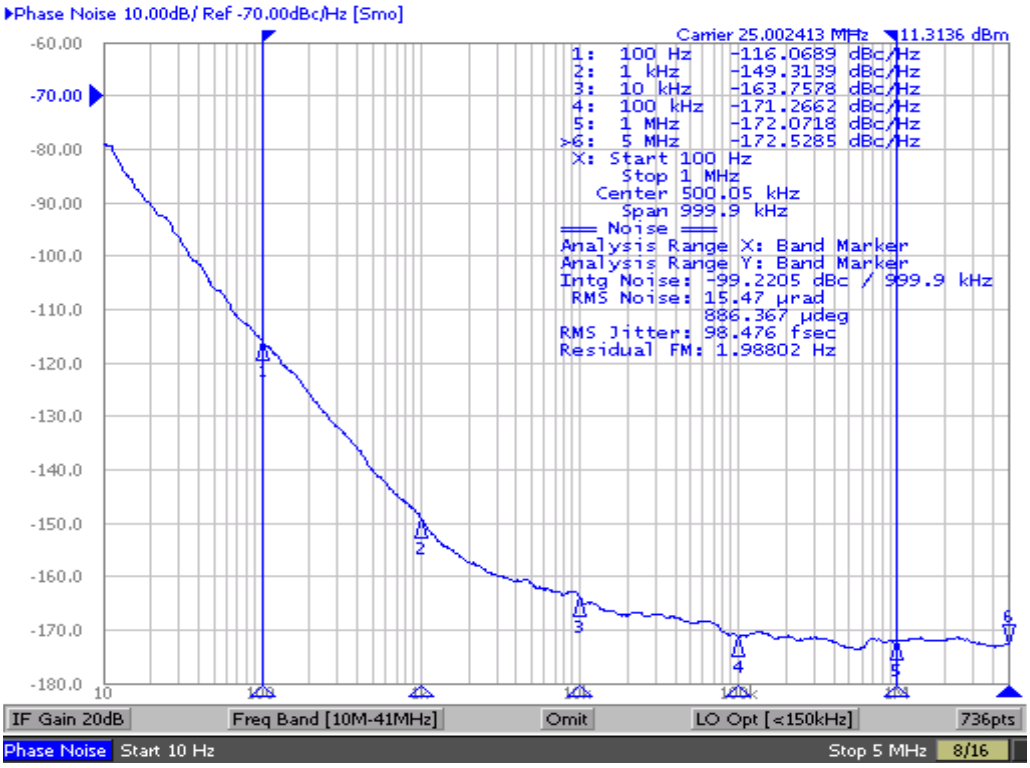
Notes:
All parameters measured at f=f_{MAX} using a crystal input unless noted otherwise.
Outputs are terminated at 50Ω to V_{DDO} /2.
1. XTAL_IN can be overdriven relatively to a signal a crystal provides.
2. Defined as skew between outputs at the same supply voltage and with equal load conditions. Measured at V_{DDO} /2.
3. These parameters are guaranteed, but not tested.
4. This parameter is defined in accordance with JEDEC Standard 65.

AC Characteristics (V_{DD} = 1.5V±5%, T_A = -40°C to 85°C)

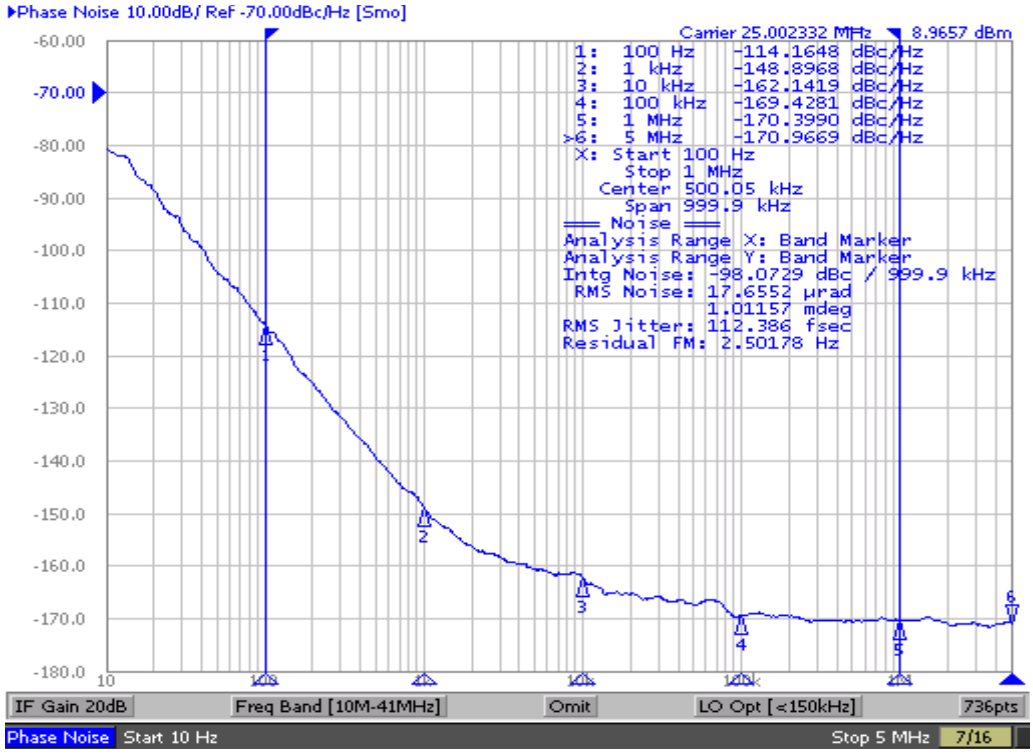
Parameters	Description	Test Conditions(1)		Min.	Typ	Max.	Units
f_{OUT}	Output Frequency	Using Crystal		10		50	MHz
		External Clock(2)		0		100	
t_{DC}	Output Duty Cycle	@ V_{DDO}/2		45		55	%
t_R/t_F	CLKn Rise/Fall Time	20% to 80%	V_{DDO} = 1.5V±5%	800		1500	ps
RMS	Random RMS Phase Jitter	25MHz @ Integration Range 100Hz - 1MHz	V_{DDO} = 1.5V±5%		0.277		ps
$t_{SK(O)}$(3)	Output to Output Skew between any two outputs of the same device @ same transition	@V_{DDO}/2				80	ps
t_{DIS},t_{EN}(4)	Output Enable/Disable	@V_{DDO}/2				4	cycles

Notes:
All parameters measured at f=f_{MAX} using a crystal input unless noted otherwise.
Outputs are terminated at 50Ω to V_{DDO} /2.
1. XTAL_IN can be overdriven relatively to a signal a crystal provides.
2. Defined as skew between outputs at the same supply voltage and with equal load conditions. Measured at V_{DDO} /2.
3. These parameters are guaranteed, but not tested.
4. This parameter is defined in accordance with JEDEC Standard 65.

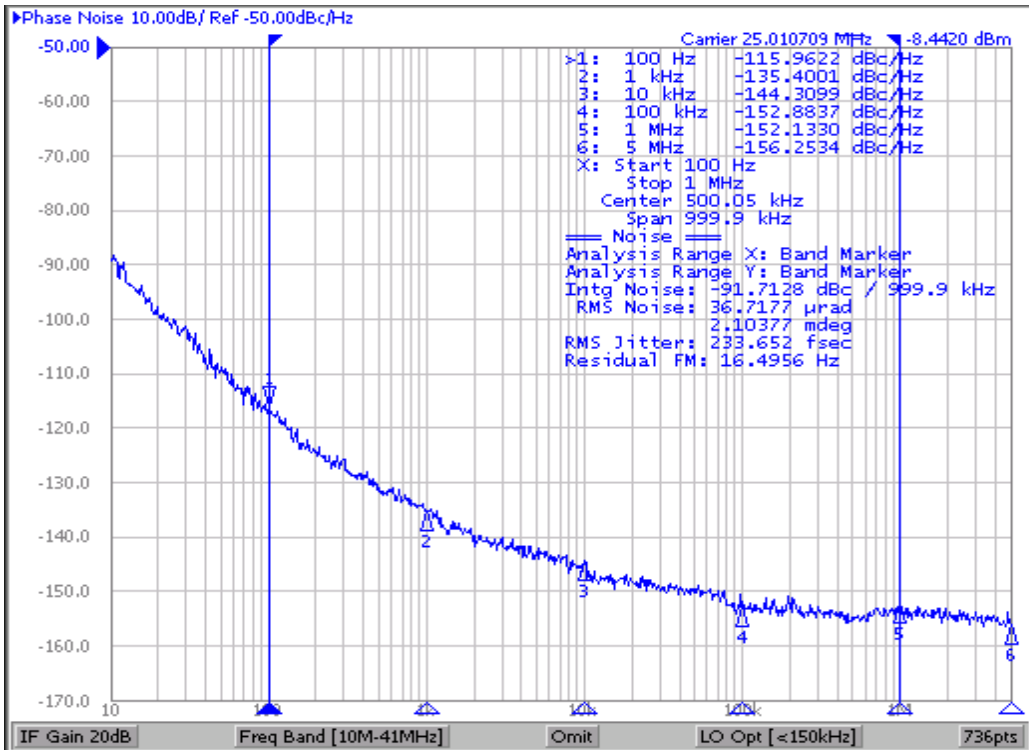
Jitter (typical phase noise at 25MHz)



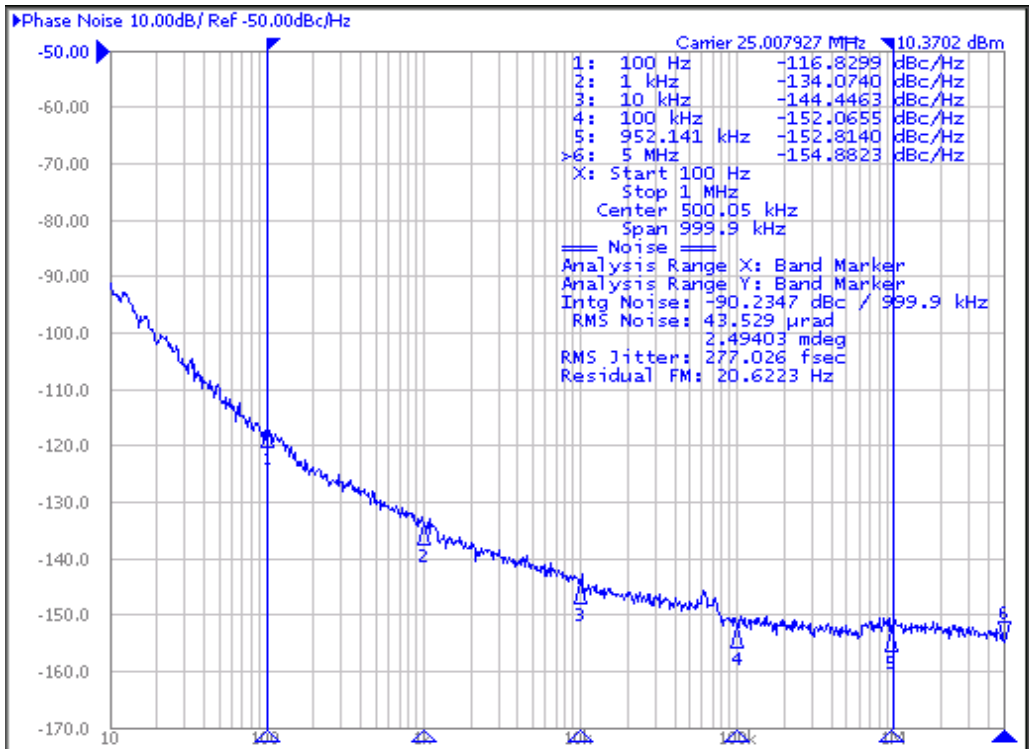
3.3V Core/3.3V Output
RMS phase jitter (Random)
100Hz to 1MHz =0.098ps (typical)



2.5V Core/2.5V Output
RMS phase jitter (Random)
100Hz to 1MHz =0.112ps (typical)



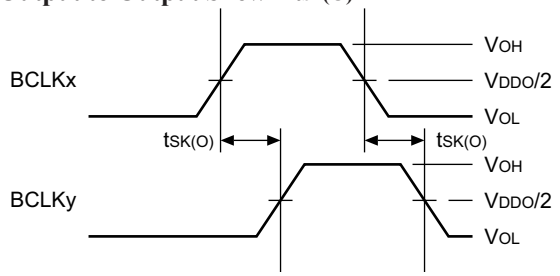
1.8V Core/1.8V Output
RS phase jitter (Random)
100Hz to 1MHz =0.233ps (typical)



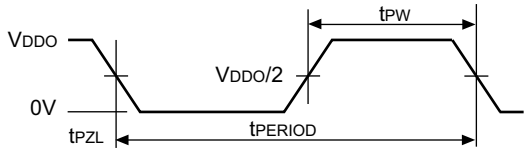
1.5V Core/1.5V Output
RMS phase jitter (Random)
100Hz to 1MHz =0.277ps (typical)

Waveforms

Output to Output Skew – $t_{SK(O)}$

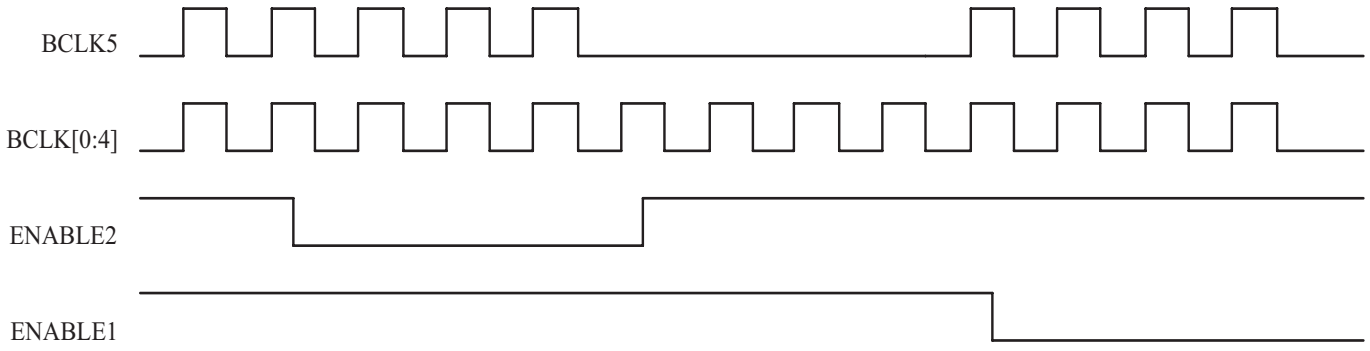


Duty Cycle – t_{DC}

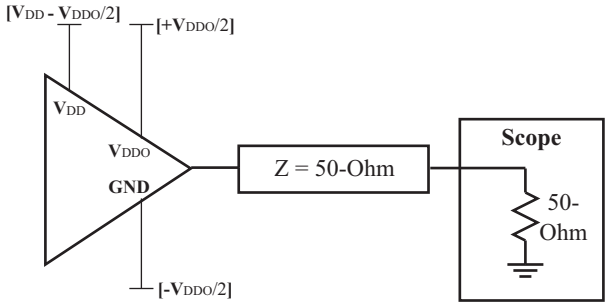


$t_{DC} = (t_{PW} / t_{PERIOD}) \times 100\%$

ENABLE1, ENABLE2 Timing Diagram



AC Test Circuit Load



Note:
V_{DD}/V_{DDO} = 1.5V ± 5%,
1.8V ± 0.2V,
2.5V ± 5%,
3.3V ± 5%

Crystal Characteristic

Parameters	Description	Min	Typ	Max.	Units
OSCMODE	Mode of Oscillation		Fundamental		
FREQ	Frequency	10	25	50	MHz
ESR(1)	Equivalent Series Resistance	30		50	Ohm
CLOAD	Load Capacitance		18		pF
CSHUNT	Shunt Capacitance			7	pF
DRIVE level				1	mW

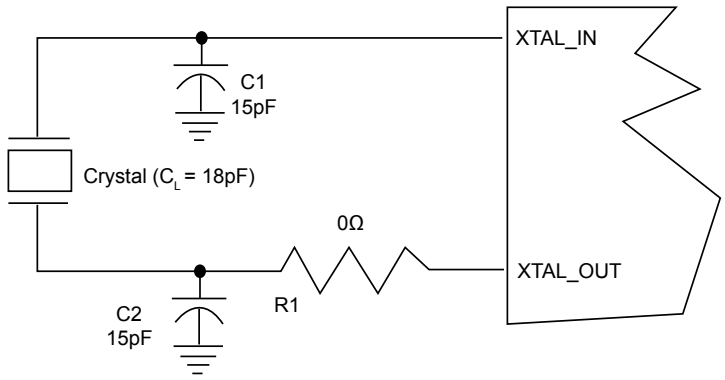
Note: 1. ESR value is dependent upon frequency of oscillation

Application Notes

Crystal Circuit Connection

The following diagram shows PI6C10806B crystal circuit connection with a parallel crystal. For the C_L=18pF crystal, it is suggested to use C1=15pF, C2=15pF. C1 and C2 can be adjusted to fine tune to the target ppm of crystal oscillator according to different board layouts. R1 is not recommended.

Crystal Oscillator Circuit

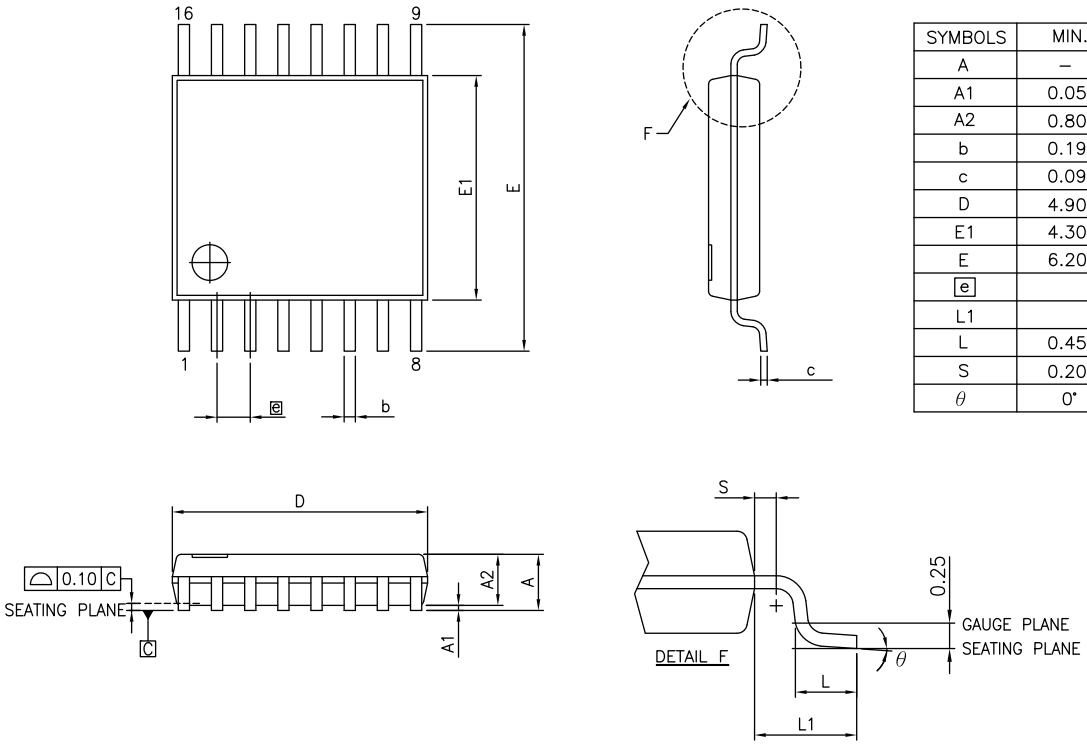


Part Marking

PI6C
10806BLE
ZYWXX̄

Z: Die Rev
Y: Year
W: Workweek
1st X: Assembly Code
2nd X: Fab Code

Packaging Mechanical: 16-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.

PERICOM Enabling Serial Connectivity — DATE: 03/24/16

DESCRIPTION: 16-Pin, 173mil Wide TSSOP

PACKAGE CODE: L (L16)

DOCUMENT CONTROL #: PD-1310 — REVISION: G

16-0061

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
PI6C10806BLEX	L	16-Pin, 173mil Wide (TSSOP)

Notes:

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
4. E = Pb-free and Green
5. X suffix = Tape/Reel

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