

### DESCRIPTION

PhaseLink's Analog Frequency Multipliers™ (AFMs) are the industry's first "Balanced Oscillator" utilizing analog multiplication of the fundamental frequency (at double or quadruple frequency), combined with an attenuation of the fundamental of the reference crystal, without using a phase-locked loop (PLL), in CMOS technology.

PhaseLink's patent pending PL66x family of AFM products can achieve up to 800 MHz differential PECL, LVDS, or single-ended CMOS output with little jitter or phase noise deterioration.

PL66x-xx family of products utilize a low-power CMOS technology and are housed in **GREEN**/RoHS compliant 16-pin TSSOP and 3x3 QFN packages.

### FEATURES

- Non-PLL frequency multiplication
- Input frequency from 30-200 MHz
- Output frequency from 60-800 MHz
- Low phase noise and jitter (equivalent to fundamental at the output frequency)
- Ultra-low jitter
  - RMS phase jitter < 0.25 ps (12 kHz to 20 MHz)
  - RMS period jitter < 2.5 ps typ.
- Low phase noise
  - -145 dBc/Hz @ 100 kHz offset from 155.52 MHz
  - -150 dBc/Hz @ 10 MHz offset from 155.52 MHz
- Low input frequency eliminates the need for expensive crystals
- Differential PECL/LVDS, or single-ended CMOS output
- Single 2.5V or 3.3V +/- 10% power supply
- Optional industrial temperature range (-40°C to +85°C)
- Available in 16-pin **GREEN**/RoHS compliant TSSOP, and 16-pin 3x3 QFN packages.

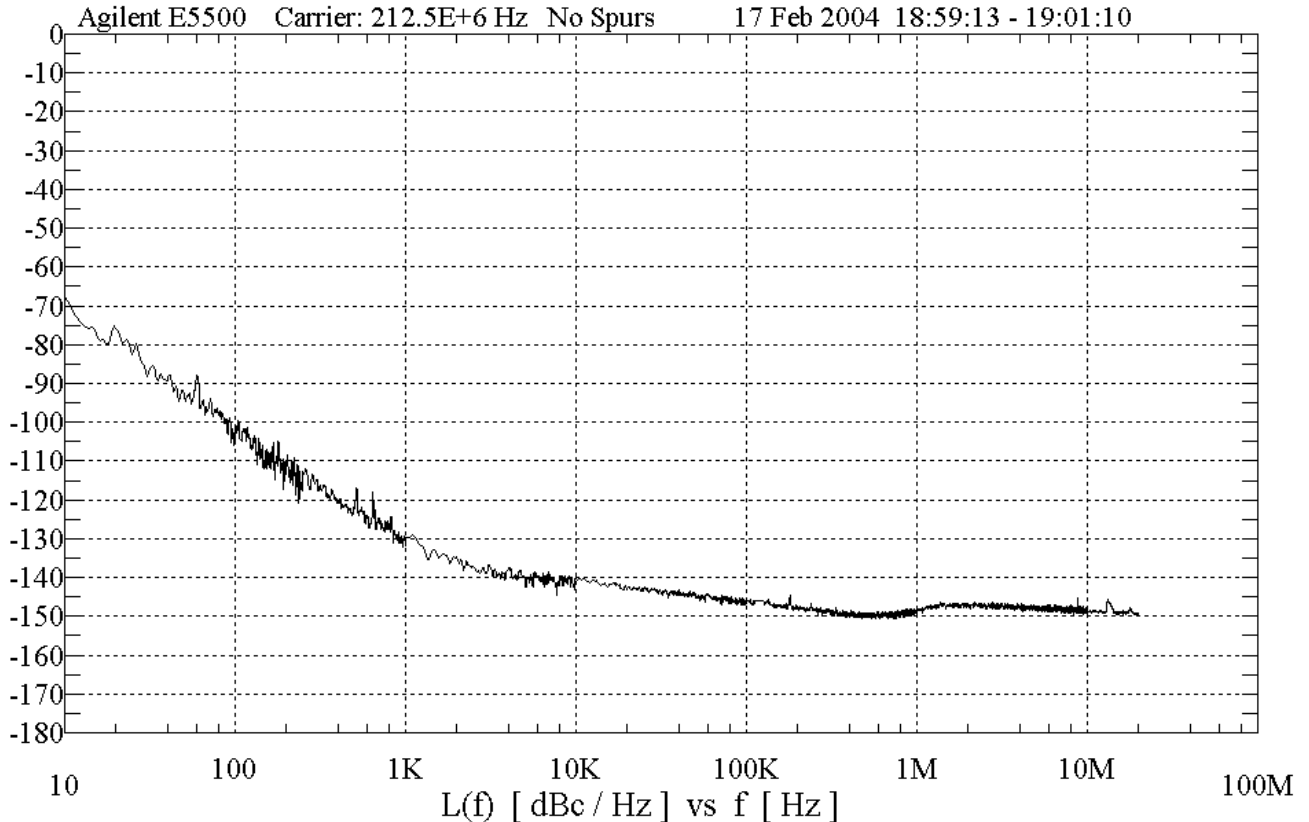
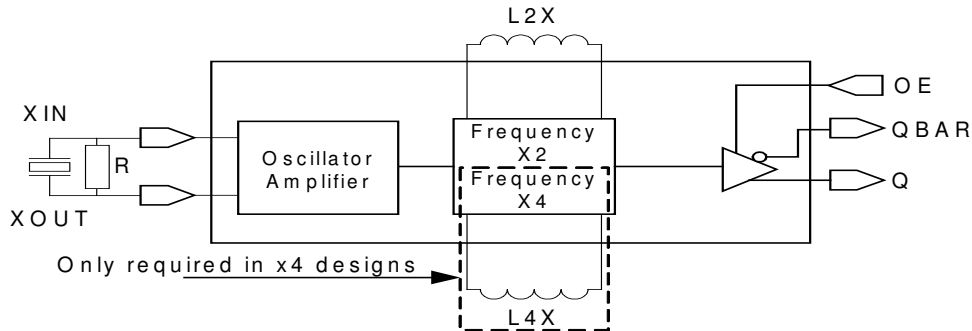


Figure 1: 2X AFM Phase Noise at 212.5 MHz (106.25 MHz 3<sup>rd</sup> overtone crystal)

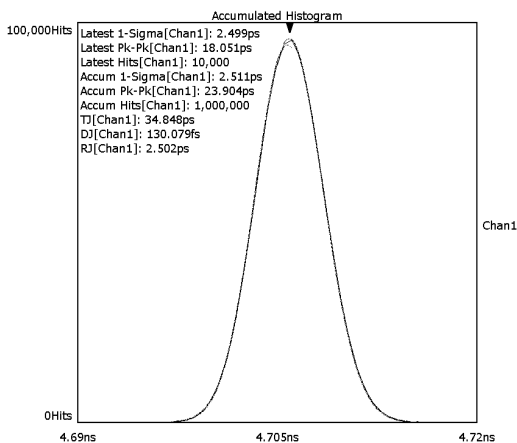
# Analog Frequency Multiplier

PL660 and PL663 XO Families

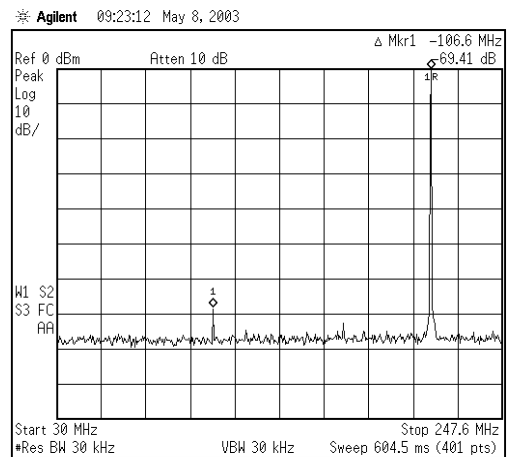


**Figure 2: Block Diagram of AFM XO**

Figure 3 shows the period jitter histogram of the 2x Analog Frequency Multiplier at 212.5 MHz, while Figure 4 shows the very low levels of sub-harmonics that correspond to the exceptional performance (i.e. low jitter).



**Figure 3: Period Jitter Histogram at 212.5MHz Analog Frequency Multiplier (2x), with 106.25 MHz crystal**



**Figure 4: Spectrum Analysis at 212.5MHz Analog Frequency Multiplier (2x), with sub-harmonics below -69 dBc**

## OE LOGIC SELECTION

OUTPUT	OESEL	OE	Output State
PECL	0 (Default)	0 (Default)	Enabled
		1	Tri-state
	1	0	Tri-state
		1 (Default)	Enabled
LVDS or CMOS	0 (Default)	0	Tri-state
		1 (Default)	Enabled
	1	0 (Default)	Enabled
		1	Tri-state

OESEL and OE: Connect to VDD to set to "1", connect to GND to set to "0". [The 'Default' state is set by internal pull up/down resistor.]

### PRODUCT SELECTOR GUIDE

### FREQUENCY VERSUS PHASE NOISE PERFORMANCE

Part Number	Input Frequency Range (MHz)	Analog Frequency Multiplication Factor	Output Frequency Range (MHz)	Output Type	Phase Noise at Frequency Offset From Carrier (dBc/Hz)							
					Carrier Freq. (MHz)	10 Hz	100 Hz	1 KHz	10 KHz	100 KHz	1 MHz	10 MHz
PL660-08	30 - 80	4	120 - 320	PECL	155.52	-72	-100	-125	-132	-142	-147	-149
PL660-09	30 - 80	4	120 - 320	LVDS	155.52	-72	-100	-125	-132	-142	-147	-149
PL663-07	30 - 80	2	60 - 160	CMOS	156.25	-75	-105	-130	-140	-145	-150	-150
PL663-08	30 - 80	2	60 - 160	PECL	156.25	-75	-105	-130	-140	-145	-150	-150
PL663-09	30 - 80	2	60 - 160	LVDS	156.25	-75	-105	-130	-140	-145	-150	-150
PL663-17	75 - 140	2	150 - 280	CMOS	212.5	-70	-100	-130	-140	-145	-148	-148
PL663-18	75 - 140	2	150 - 280	PECL	212.5	-70	-100	-130	-140	-145	-148	-148
PL663-19	75 - 140	2	150 - 280	LVDS	212.5	-70	-100	-130	-140	-145	-148	-148
PL663-28	140 - 160	2	280 - 320	PECL	311.04	-60	-92	-122	-140	-142	-146	-146
PL663-29	140 - 160	2	280 - 320	LVDS	311.04	-60	-92	-122	-140	-142	-146	-148

### FREQUENCY VERSUS JITTER, AND SUB-HARMONIC PERFORMANCE

Part Number	Output Freq. (MHz)	RMS Period Jitter (ps)			Peak to Peak Period Jitter (ps)			RMS Accumulated (L.T.) Jitter (ps)			Phase Jitter (12 KHz-20MHz) (ps)			Spectral Specifications / Sub-harmonic Content (dBc) Frequency (MHz)							
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Carrier Freq. MHz (Fc)	@ -75% (Fc)	@ -50% (Fc)	@ -25% (Fc)	@ +25% (Fc)	@ +50% (Fc)	@ +75% (Fc)	
PL660-08	155.52		3	5		21	30			5		0.25		155.52	-66	-61				-67	-70
PL660-09	155.52		3	5		21	30			5		0.25		155.52	-66	-61				-67	-70
PL663-07	156.25		2	3		18	20			3		0.24		156.25		-70				-75	
PL663-08	156.25		2	3		18	20			3		0.24		156.25		-70				-75	
PL663-09	156.25		2	3		18	20			3		0.24		156.25		-70				-75	
PL663-17	212.50		2.5	4		18	20			4		0.19		212.50		-70				-75	
PL663-18	212.50		2.5	4		18	20			4		0.19		212.50		-70				-75	
PL663-19	212.50		2.5	4		18	20			4		0.19		212.50		-70				-75	
PL663-28	311.04		2.5	4		18	20			4		0.16		311.04		-65				-70	
PL663-29	311.04		2.5	4		18	20			4		0.16		311.04		-65				-70	

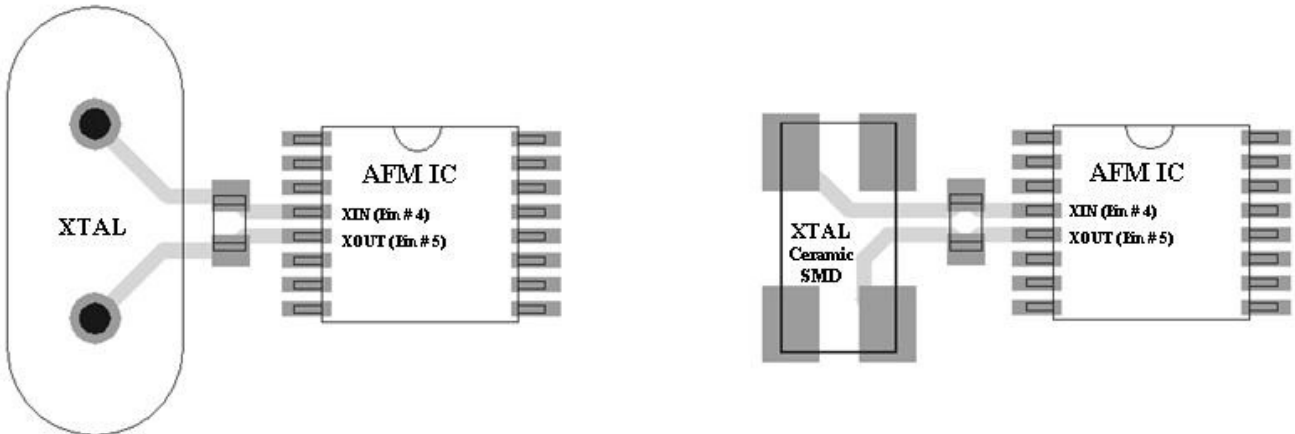
**Note:** Wavecrest data 10,000 hits. No Filtering was used in Jitter Calculations.

Agilent E5500 was used for phase jitter measurements.

Spectral specifications were obtained using Agilent E7401A.

### BOARD LAYOUT CONSIDERATIONS AND CRYSTAL SPECIFICATIONS

#### BOARD LAYOUT CONSIDERATIONS



To minimize parasitic effects and improve performance, do the following:

- Place the crystal as close as possible to the IC.
- Make the board traces that are connected to the crystal pins symmetrical. The board trace symmetry is very important, as it reduces the negative parasitic effects to produce clean frequency multiplication with low jitter.

#### CRYSTAL SPECIFICATIONS

Part Number	Crystal Resonator Frequency ( $F_{XIN}$ )	Mode	CL (xtal)	ESR( $R_E$ )	C0	C0/C1
			Typical	Max.	Max.	Max.
PL660-08 PL660-09	25~75MHz	Fundamental or 3rd overtone	5 pF	30 $\Omega$	4.5 pF	N.A.
PL663-07 PL663-08 PL663-09	30~80MHz	Fundamental or 3rd overtone	5 pF	30 $\Omega$	4.5 pF	N.A.
PL663-17 PL663-18 PL663-19	75~140MHz	Fundamental or 3rd overtone	5 pF	60 $\Omega$	4.0 pF	N.A.
PL663-28 PL663-29	140~200MHz	Fundamental or 3rd overtone	5 pF	60 $\Omega$	4.0 pF	N.A.

**Note:** Non-specified parameters can be chosen as standard values from crystal suppliers.

CL ratings larger than 5pF require a crystal frequency adjustment.

Request detailed crystal specifications from PhaseLink.

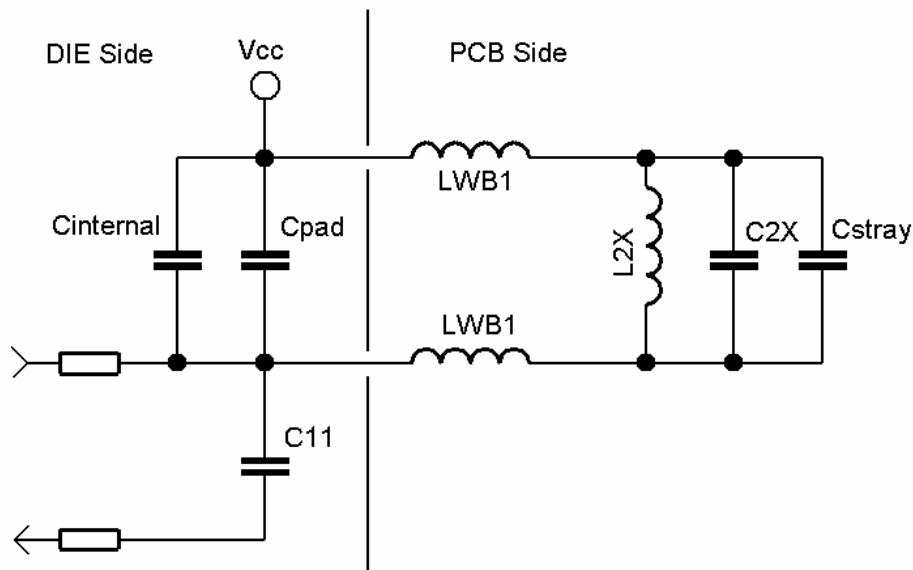
### EXTERNAL COMPONENT VALUES

#### INDUCTOR VALUE OPTIMIZATION

The required inductor value(s) for the best performance depends on the operating frequency, and the board layout specifications. The listed values in this datasheet are based on the calculated parasitic values from PhaseLink's evaluation board design. These inductor values provide the user with a starting point to determine the optimum inductor values. Additional fine-tuning may be required to determine the optimal solution.

To assist with the inductor value optimization, PhaseLink has developed the "AFM Tuning Assistant" software. You can download this software from PhaseLink's web site ([www.phaselink.com](http://www.phaselink.com)). The software consists of two worksheets. The first worksheet (named L2) is used to fine-tune the 'L2' inductor value, and the second worksheet (named L4) is used for fine tuning of the 'L4' (used in 4x AFMs only) inductor value.

For those designs using PhaseLink's recommended board layout, you can use the "AFM Tuning Assistant" to determine the optimum values for the required inductors. This software is developed based on the parasitic information from PhaseLink's board layout and can be used to determine the required inductor and parallel capacitor (see LWB1 and Cstray parameters) values. For those employing a different board layout in their design, we recommend to use the parasitic information of their board layout to calculate the optimized inductor values. Please use the following fine tuning procedure:



**Figure 5: Diagram Representation of the Related System Inductance and Capacitance**

#### DIE SIDE

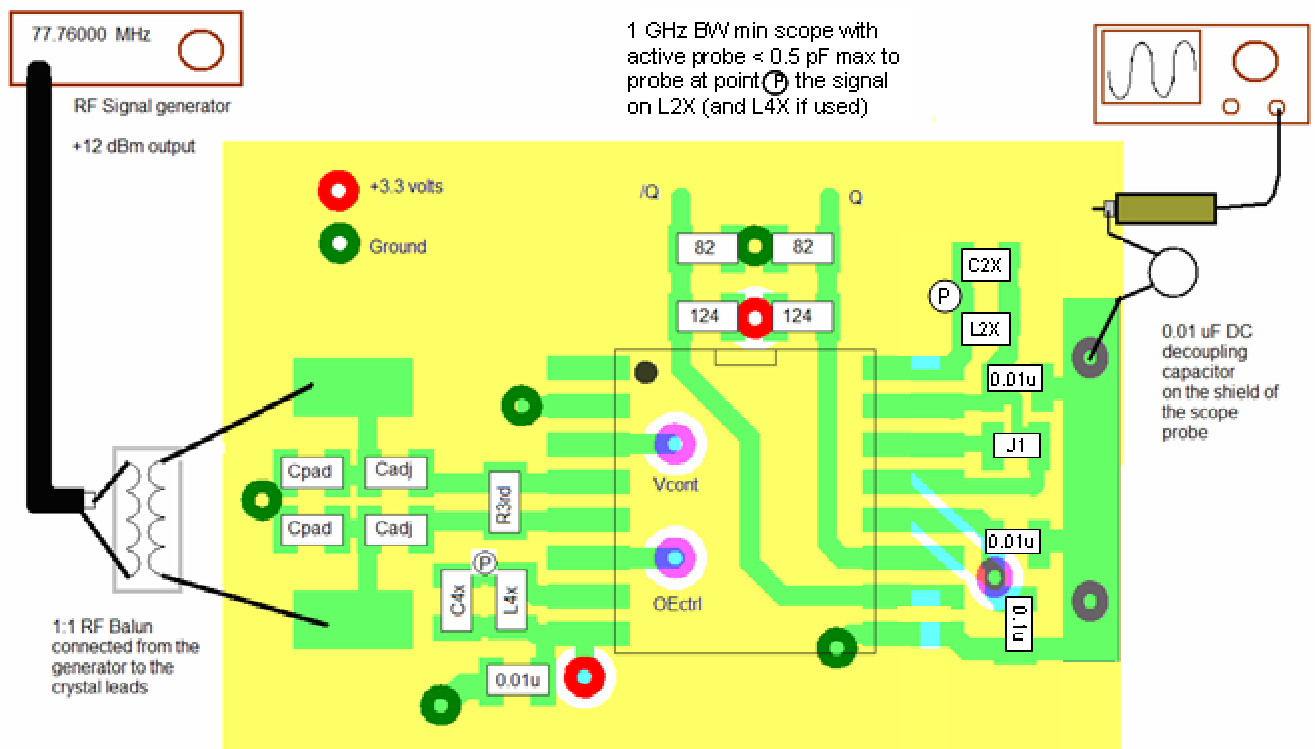
- Cinternal = Based on AFM Device
- Cpad = 2.0 pF, Bond pad and its ESD circuitry
- C11 = 0.4 pF, The following amplifier stage

#### PCB side

- LWB1 = 2 nH, (2 places), Stray inductance
- Cstray = 1.0 pF, Stray capacitance
- L2X (L4X) = 2x or 4x inductor
- C2X (C4X) = range (0.1 to 2.7), Fine tune inductor if used

- There are two default variables that normally will not need to be modified. These are Cpad, and C11 and are found in cells B22 and B27 of 'AFM Tuning Assistant', respectively.
- LWB1 is the combined stray inductance in the layout. The DIE wire bond is ~ 0.6 nH and in the case of a leaded part an additional 1.0 nH is added. Your layout inductance must be added to these. There are 2 of these and they are assumed to be approximately symmetrical so you only need to enter this inductance once in cell B23.
- Enter the stray parasitic capacitance into cell B26. An additional 0.5 pF must be added to this value if a leaded part is used.
- Enter the appropriate value for Cinternal into B21 based on the device used (see column D). Use the 'AFM Tuning Assistant' software to calculate L2X (and C2X if used) for your resonance frequency.
- For 4X AFMs, repeat the same procedure in the L4X worksheet.
- See the examples below.

### DETERMINING STRAY L's AND C's IN A LAYOUT



**Figure 6: Diagram Representation of PL660-08 Board Layout**

Let's take the PL660-08 (4x XO) for example, as shown in Figure 6. This takes a crystal input range of 30 to 80 MHz and multiplies this to an output of 120 to 320 MHz. To determine the stray L's and C's of the layout we will assemble two test units. One AFM will be tuned to the lower range of the device (120 MHz), and the other to the upper range of the device (320 MHz).

# Analog Frequency Multiplier

## PL660 and PL663 XO Families

**120 MHz AFM Tuning:** Using the “AFM Tuning Assistant” find the PL660-0x in the L2X worksheet. Enter the Cinternal value found next to it into cell B21. In cell B24 enter the closest standard inductor value (see CoilCraft 0603CS series for example) to achieve the closest peak frequency to 60 MHz. Repeat the same procedure for L4X at 120 MHz.

**Results: L2X = 180 nH, L4X = 82 nH.**

**320 MHz AFM tuning:** Repeat the previous procedure for L2X at 120 MHz and L4X at 320 MHz.

**Results: L2X = 24 nH, L4X = 10 nH.**

Proceed and assemble the test units.

**Measuring 120 MHz L2X:** Connect the RF generator and scope probe as shown in Figure 6. While power is applied to the PCB, set the generator output to +12 dBm and the frequency to 30 MHz. Since this is the 2x port, the scope will show 60 MHz with ~ 3V pk-pk amplitude. Vary the generator above and below 30 MHz until the amplitude on the scope is maximum and record the generator frequency. For example peak recorded at 29.8x2 or 59.6 MHz.

**Measuring 320 MHz L2X:** Connect the RF generator and scope probe as shown in Figure 6. While power is applied to the PCB, set the generator output to +12 dBm and the frequency to 80 MHz. Since this is the 2x port the scope will show 160 MHz with ~ 3V pk-pk amplitude. Vary the generator above and below 80 MHz until the amplitude on the scope is maximum and record the generator frequency. For example peak recorded at 78.0 x 2 = 156 MHz

In the AFM Tuning Assistant, add the scope’s probe capacitance to the Cstray cell. For our example 0.5 pF + 1.0 pF = 1.5 pF. With L2X at 24 nH adjust LWB1 (cell B23) until the peak frequency reads 156 MHz. Next replace the L2X value with 180 nH and see if it peaks at 59.6 MHz. If it does not, adjust the Cstray until 59.4 MHz is achieved. Again enter 24 nH for L2X and fine tune LWB1 for 156 MHz.

**Results: LWB1 = 1.6 nH, Cstray = 2.9 pF-0.5 pF = 2.4 pF (subtract scope probe stray)**

Repeat the same steps for the L4X: Set the generator to 80 MHz. The 82 nH peaks at 118 MHz and the 10 nH peaks at 304 MHz.

**Results: LWB1 = 1.8 nH, Cstray = 2.5 pF-0.5 pF = 2.0 pF (subtract scope probe stray)**

Internal Capacitor Selection by Device		
Device Number	Cinternal (pF)	
	2X	4X
PL660-0X	34.125	16.500
PL663-0X	46.500	
PL663-1X	14.625	
PL663-2X	14.625	

# Analog Frequency Multiplier

## PL660 and PL663 XO Families

### EXTERNAL COMPONENT VALUES – 3<sup>RD</sup> OVERTONE RESISTOR SELECTIONS (R3rd)

This resistor is only required when a third overtone crystal is used. The chart below indicates the calculated and the nearest “E12” resistor values versus frequency.

PL660-08/09			PL663-07/08/09			PL663-017/18/19			PL663-28/29		
Freq. (MHz)	R3rd (Ω)	E12 Pick KΩ	Freq. (MHz)	R3rd (Ω)	E12 Pick KΩ	Freq. (MHz)	R3rd (Ω)	E12 Pick KΩ	Freq. (MHz)	R3rd (Ω)	E24 Pick KΩ
24	12,396	12	30	9,917	10	75	2,125	2.2	140.0	915	0.91
26	11,442	12	32	9,297	10	77.5	2,056	2.2	142.0	902	0.91
28	10,625	10	34	8,750	8.2	80	1,992	2.2	144.0	890	0.91
30	9,917	10	36	8,264	8.2	82.5	1,932	1.8	146.0	878	0.91
32	9,297	10	38	7,829	8.2	85	1,875	1.8	148.0	866	0.91
34	8,750	8.2	40	7,438	6.8	87.5	1,821	1.8	150.0	854	0.82
36	8,264	8.2	42	7,083	6.8	90	1,771	1.8	152.0	843	0.82
38	7,829	8.2	44	6,761	6.8	92.5	1,723	1.8	154.0	832	0.82
40	7,438	6.8	46	6,467	6.8	95	1,678	1.8	156.0	821	0.82
42	7,083	6.8	48	6,198	6.8	97.5	1,635	1.5	158.0	811	0.82
44	6,761	6.8	50	5,950	5.6	100	1,594	1.5	160.0	801	0.82
46	6,467	6.8	52	5,721	5.6	102.5	1,555	1.5	162.0	790	0.82
48	6,198	6.8	54	5,509	5.6	105	1,518	1.5	164.0	780	0.75
50	5,950	5.6	56	5,313	5.6	107.5	1,483	1.5	166.0	770	0.75
52	5,721	5.6	58	5,129	4.7	110	1,449	1.5	168.0	759	0.75
54	5,509	5.6	60	4,958	4.7	112.5	1,417	1.5	170.0	749	0.75
56	5,313	5.6	62	4,798	4.7	115	1,386	1.5	172.0	740	0.75
58	5,129	4.7	64	4,648	4.7	117.5	1,356	1.5	174.0	730	0.75
60	4,958	4.7	66	4,508	4.7	120	1,328	1.2	176.0	720	0.75
62	4,798	4.7	68	4,375	4.7	122.5	1,301	1.2	178.0	711	0.68
64	4,648	4.7	70	4,250	3.9	125	1,275	1.2	180.0	701	0.68
66	4,508	4.7	72	4,132	3.9	127.5	1,250	1.2	182.0	692	0.68
68	4,375	4.7	74	4,020	3.9	130	1,226	1.2	184.0	683	0.68
70	4,250	3.9	76	3,914	3.9	132.5	1,203	1.2	186.0	674	0.68
72	4,132	3.9	78	3,814	3.9	135	1,181	1.2	188.0	665	0.68
74	4,020	3.9	80	3,719	3.9	137.5	1,159	1.2	190.0	656	0.68
76	3,914	3.9				140	1,138	1.2	192.0	647	0.62
									194.0	639	0.62
									196.0	630	0.62
									198.0	622	0.62
									200.0	614	0.62



### ELECTRICAL SPECIFICATIONS

#### ABSOLUTE MAXIMUM RATINGS

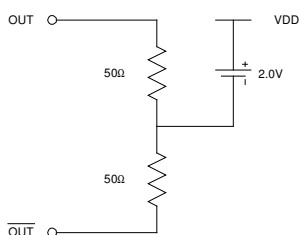
PARAMETERS	SYMBOL	MIN.	MAX.	UNITS
Supply Voltage	$V_{DD}$		4.6	V
Input Voltage, DC	$V_I$	GND-0.5	$V_{DD}+0.5$	V
Output Voltage, DC	$V_O$	GND-0.5	$V_{DD}+0.5$	V
Storage Temperature	$T_S$	-55	+150	°C
Industrial Ambient Operating Temperature	$T_{A_I}$	-40	+85	°C
Commercial Ambient Operating Temperature	$T_{A_C}$	0	+70	°C
Junction Temperature	$T_J$		125	°C
Lead Temperature (soldering, 10s)			260	°C

Exposure of the device under conditions beyond the limits specified by Maximum Ratings for extended periods may cause permanent damage to the device and affect product reliability. These conditions represent a stress rating only, and functional operations of the device at these or any other conditions above the operational limits noted in this specification is not implied.

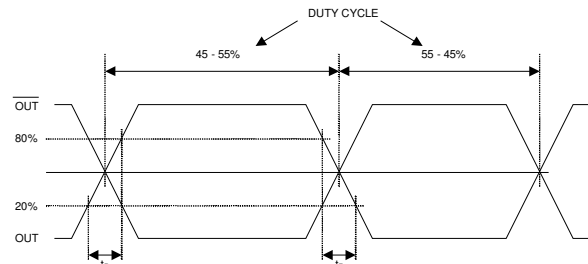
#### PECL ELECTRICAL CHARACTERISTICS

PARAMETERS	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Supply Current (with loaded outputs)	$I_{DD}$	$F_{out} = 212.5 \text{ MHz}$	58	65	75	mA
Operating Supply Voltage	$V_{DD}$		2.25		3.63	V
Output Clock Duty Cycle		@ $V_{DD} - 1.3V$	45	50	55	%
Short Circuit Current				$\pm 50$		mA
Output High Voltage	$V_{OH}$	$R_L = 50 \Omega$ to $V_{DD} - 2V$	$V_{DD} - 1.025$			V
Output Low Voltage	$V_{OL}$	$R_L = 50 \Omega$ to $V_{DD} - 2V$			$V_{DD} - 1.620$	V
Clock Rise Time	$t_r$	@20/80%		0.25	0.45	ns
Clock Fall Time	$t_f$	@80/20%		0.25	0.45	ns

PECL Levels Test Circuit



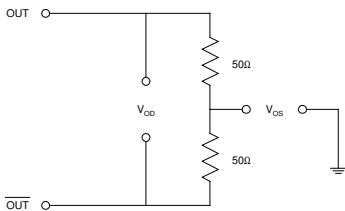
PECL Transition Time Waveform



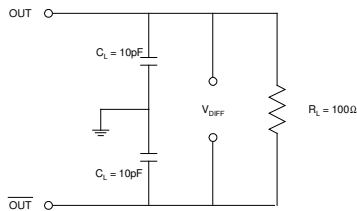
### LVDS ELECTRICAL CHARACTERISTICS

PARAMETERS	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Supply Current (with loaded outputs)	$I_{DD}$	$F_{out} = 212.5 \text{ MHz}$		55	60	mA
Operating Supply Voltage	$V_{DD}$		2.25		3.63	V
Output Clock Duty Cycle		@ 1.25V	45	50	55	%
Output Differential Voltage	$V_{OD}$	$R_L = 100 \Omega$ (see figure)	247	355	454	mV
$V_{DD}$ Magnitude Change	$\Delta V_{OD}$		-50		50	mV
Output High Voltage	$V_{OH}$			1.4	1.6	V
Output Low Voltage	$V_{OL}$		0.9	1.1		V
Offset Voltage	$V_{OS}$		1.125	1.2	1.375	V
Offset Magnitude Change	$\Delta V_{OS}$		0	3	25	mV
Power-off Leakage	$I_{OXD}$	$V_{out} = V_{DD} \text{ or GND}$ $V_{DD} = 0V$		$\pm 1$	$\pm 10$	$\mu A$
Output Short Circuit Current	$I_{OSD}$			-5.7	-8	mA
Differential Clock Rise Time	$t_r$	$R_L = 100 \Omega$ $C_L = 10 \text{ pF}$ (see figure)	0.2	0.5	0.7	ns
Differential Clock Fall Time	$t_f$		0.2	0.5	0.7	ns

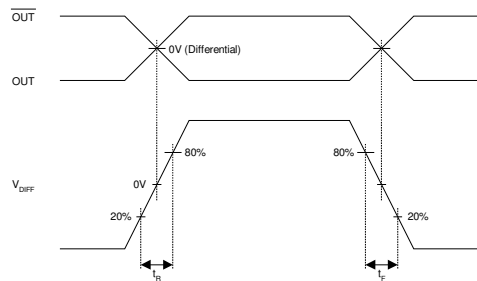
LVDS Levels Test Circuit



LVDS Switching Test Circuit



LVDS Transition Time Waveform



### CMOS ELECTRICAL CHARACTERISTICS

PARAMETERS	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Supply Current, Dynamic, with Loaded Outputs	$I_{DD}$	At 100MHz, load=15pF		32	40	mA
Operating Supply Voltage	$V_{DD}$		2.25		3.63	V
Output High Voltage (LVTTL)	$V_{OH3.3}$	$I_{OH} = -8.5\text{mA}$ , 3.3V Supplies	2.4			V
Output Low Voltage (LVTTL)	$V_{OL3.3}$	$I_{OL} = 8.5\text{mA}$ , 3.3V Supplies			0.4	V
Output High Voltage (LVCMOS)	$V_{OHC3.3}$	$I_{OH} = -4\text{mA}$ , 3.3V Supplies	$V_{DD} - 0.4$			V
Output High Voltage	$V_{OH2.5}$	$I_{OH} = 1\text{mA}$ , 2.5V Supplies	$V_{DD} - 0.2$			V
Output Low Voltage	$V_{OL2.5}$	$I_{OL} = 1\text{mA}$ , 2.5V Supplies			0.2	V
Output drive current	$I_{OSD}$	$V_{OL} = 0.4\text{V}$ , $V_{OH} = 2.4\text{V}$ (per output)		8.5		mA
Output Clock Rise/Fall Time	$T_r/T_f$	10% ~ 90% VDD with 10 pF load		1.2	1.6	ns
Output Clock Duty Cycle		Measured @ 50% VDD	45	50	55	%
Short Circuit Current	$I_s$			$\pm 50$		mA

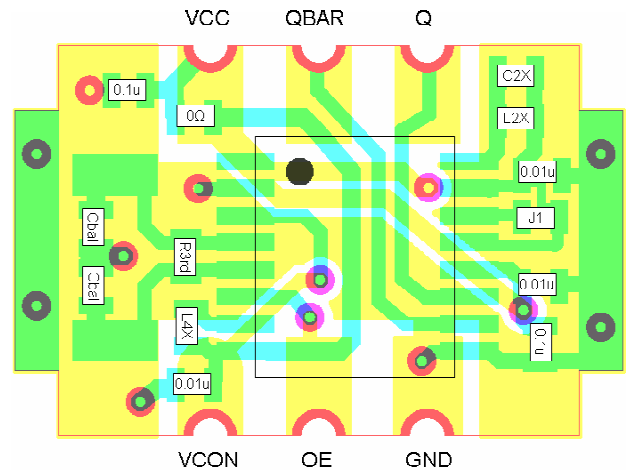
### BOARD DESIGN AND LAYOUT CONSIDERATIONS

**L2X and L4X:** Reduce the PCB trace inductance to a minimum by placing L2X and L4X as physically close to their respective pins as possible. Also be sure to bypass each  $V_{DD}$  connection especially taking care to place a 0.01  $\mu\text{F}$  bypass at the  $V_{DD}$  side of L2X and L4X (see recommended layout).

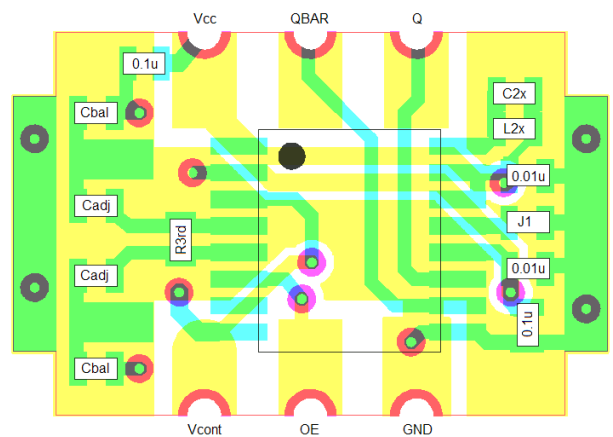
**Crystal Connections:** Be sure to keep the ground plane under the crystal connections continuous so that the stray capacitance is consistent on both crystal connections. Also be sure to keep the crystal connections symmetrical with respect to one another and the crystal connection pins of the IC. If you chose to use a series capacitance and/or inductor to fine tune the crystal frequency, be sure to put symmetrical pads for this cap on both crystal pins (see Cadj in recommended layout), even if one of the capacitors will be a 0.01  $\mu\text{F}$  and the other is used to tune the frequency. To further maintain a symmetrical balance on a crystal that may have more internal  $C_{\text{stray}}$  on one pin or the other, place capacitor pads (Cbal) on each crystal lead to ground (see recommended layout). R3rd is only required if a 3<sup>rd</sup> overtone crystal is used.

**$V_{DD}$  and GND:** Bypass VDDANA and VDDBUF with separate bypass capacitors and if a  $V_{DD}$  plane is used, feed each bypass cap with its own via. Be sure to connect any ground pin including the bypass caps with short via connection to the ground plane.

**OESEL:** J1 is recommended so the same PCB layout can be used for both OESEL settings.

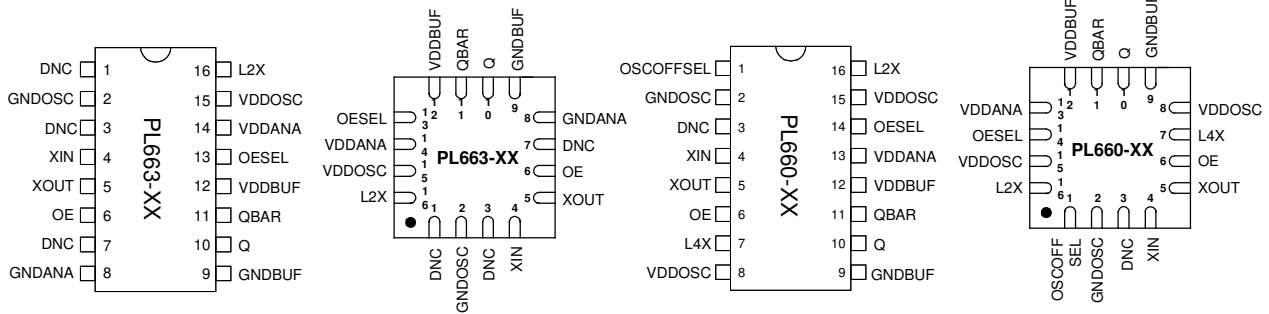


PL660 (4x AFM) TSSOP Layout



PL663 (2x AFM) TSSOP Layout

### PACKAGE PIN DESCRIPTION AND ASSIGNMENT



2x AFM Package Pin Out

4x AFM Package Pin Out

### PIN ASSIGNMENTS

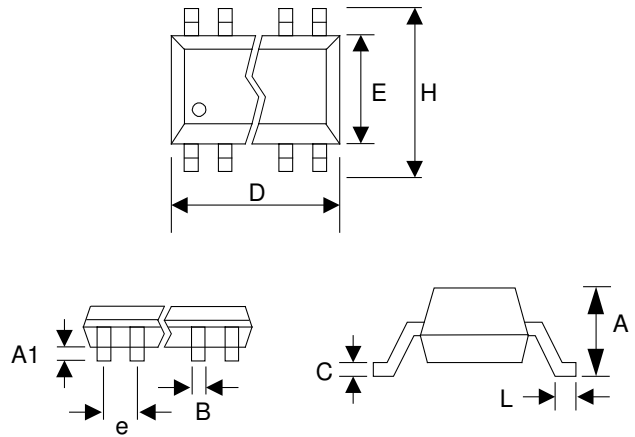
Name	Pin #	Type	Product	Description
DNC	1	I	2X	Do Not Connect.
OSCOFFSEL			4X	Set to "0" (GND) to turn off the oscillator when outputs are disabled (OE). Default (no connect) is OSC always on.
GNDOSC	2	P	2X & 4X	GND connection for oscillator.
DNC	3	I	2X & 4X	Do Not Connect.
XIN	4	I	2X & 4X	Input from crystal oscillator circuitry.
XOUT	5	O	2X & 4X	Output from crystal oscillator circuitry.
OE	6	I	2X & 4X	Output Enable input. See "OE LOGIC SELECTION TABLE".
DNC	7	I	2X	Do Not Connect.
L4X			4X	External inductor connection. The inductor is recommended to be a high Q small size 0402 or 0603 SMD component, and must be placed between L4X and adjacent VDDOSC. Place inductor as close to the IC as possible to minimize parasitic effects and to maintain inductor Q. This inductor is used with 4x AFMs.
GNDANA	8	P	2X	GND connection.
VDDOSC			4X	VDD connection for oscillator circuitry. VDDOSC should be separately decoupled from other VDDs whenever possible.
GNDBUF	9	P	2X & 4X	GND connection.
Q	10	O	2X & 4X	PECL/LVDS/CMOS output.
QBAR	11	O	2X & 4X	Complementary PECL/LVDS output or in-phase CMOS.
VDDBUF	12	P	2X & 4X	VDD connection for output buffer circuitry. VDDBUF should be separately decoupled from other VDDs whenever possible.
OESEL	13	I	2X	Selector input to choose the OE control logic (see "OE SELECTION TABLE"). If no connection is applied, value will be set to default through internal pull-down resistor.
	14		4X	
VDDANA	14	P	2X	VDD connection for analog circuitry. VDDANA should be separately decoupled from other VDDs whenever possible.
	13		4X	
VDDOSC	15	P	2X & 4X	VDD connection for oscillator. VDD should be separately decoupled from other VDDs whenever possible.
L2X	16	I	2X & 4X	External inductor connection. The inductor is recommended to be a high Q small size 0402 or 0603 SMD component, and must be placed between L2X and adjacent VDDOSC. Place inductor as close to the IC as possible to minimize parasitic effects and to maintain inductor Q.

Note: 663-xx devices are 2x multipliers, and 660-xx devices are 4x multipliers.

### PACKAGE INFORMATION

#### 16 PIN TSSOP

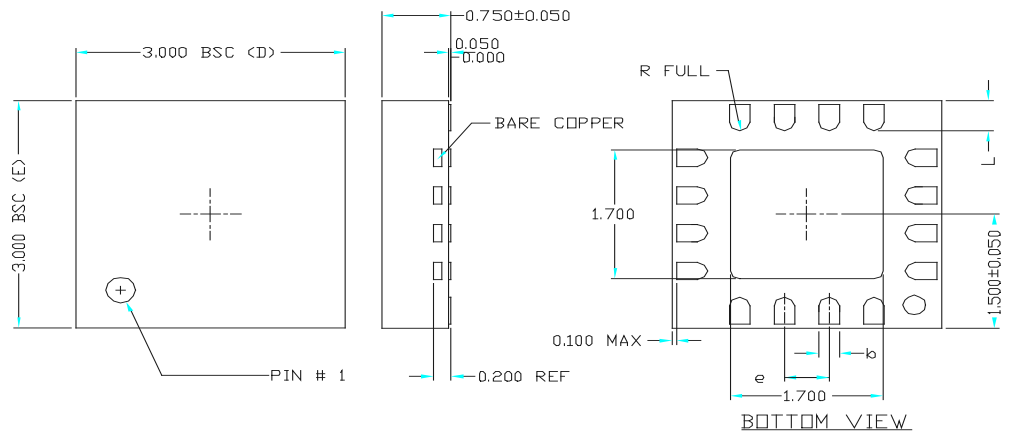
16 PIN TSSOP ( mm )		
Symbol	Min.	Max.
A	-	1.20
A1	0.05	0.15
B	0.19	0.30
C	0.09	0.20
D	4.90	5.10
E	4.30	4.50
H	6.40 BSC	
L	0.45	0.75
e	0.65 BSC	



#### 16 PIN 3x3 QFN

VARIATIONS:

SYMBOL	16 LD		
	MIN	NDM	MAX
e	0.50 BSC		
b	0.18	0.23	0.30
L	0.30	0.40	0.50
ND	4		
NE	4		



### ORDERING INFORMATION

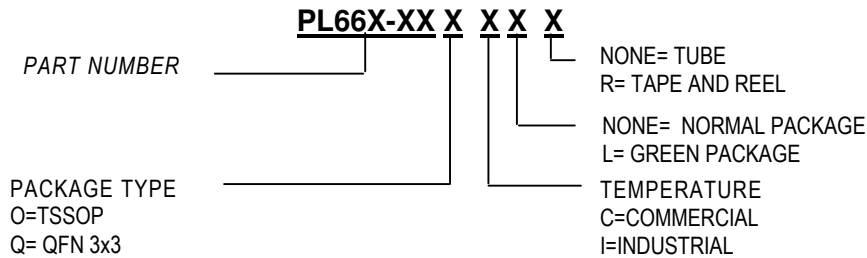
**To order parts, please contact our Sales Department:**

47745 Fremont Blvd., Fremont, CA 94538, USA

Tel: (510) 492-0990 Fax: (510) 492-0991

#### PART NUMBER

The order number for this device is a combination of the following:  
Device number, Package type and Operating temperature range



Order Number	Marking	Package Option
PL66X-XXOC	P66X-XX OC	TSSOP – Tube
PL66X-XXOC-R	P66X-XX OC	TSSOP – Tape and Reel
PL66X-XXOCL	P66X-XX OC	TSSOP (GREEN)– Tube
PL66X-XXOCL-R	P66X-XX OC	TSSOP (GREEN)– Tape and Reel
PL66X-XXQC	P66X-XX QC	QFN – Tube
PL66X-XXQC-R	P66X-XX QC	QFN – Tape and Reel
PL66X-XXQCL	P66X-XX QC	QFN (GREEN)– Tube
PL66X-XXQCL-R	P66X-XX QC	QFN (GREEN)– Tape and Reel

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