National Semiconductor™

PLLATINUM™ EVALUATION BOARD
LMX2326/16/06 VERSION

REV A. 2/98

INTRODUCTION

In order to assist in your evaluation of National Semiconductor's Ultra Low Power PLL's, a blank printed circuit board is included with this product sample kit. The PCB is designed to reduce the time required to construct a working evaluation environment for the Ultra Low Power PLL's while still providing the flexibility needed to create a circuit that matches your specific application. This document provides the information necessary to populate the board and build the parallel interface cable that allows PC control of the board. The documentation also includes set-up and operating instructions for the hardware and software. Finally, a troubleshooting section is provided.

PREPARING THE EVALUATION BOARD HARDWARE

The LMX2326/16/06 series single low power PLL Evaluation Board is an implementation of the schematic shown in Appendix A. The board, shown in Appendix B, consists of locations for an Ultra Low Power PLL's, a modular RF VCO and its loop filter. Space for an six pin header is provided for MICROWIRE™ programming of the PLL divider ratios. A ribbon cable connects to the evaluation board pin header and the parallel port of a PC with Window version 3.1 or better.

A bill of materials list for the board can be found in Appendix C. Loop filter components and the RF VCO are not listed in the bill of materials. These components are determined by the user depending upon his/her application. A list of VCO manufacturers can be found in Appendix D of this document. Information on loop filter design can be found in the Application Note (AN-1001) titled, **"An Analysis and Performance Evaluation of a Passive Filter Design Technique for Charge Pump Phase-Locked Loops"** which is also included in the product sample kit, or it can be found in the National Wireless Databook.

The board has two kinds of interconnections. SMA or SMC connectors should be used for the external reference and VCO output, while power supply biasing and ground can be attached to the board either by mounting connectors or by directly soldering to the pads. A four pin header allows VCC, VP, and Vvco to be driven separately or from a single power supply. Resistors denoted as O.C. / S.C. (Open Circuit / Short Circuit) in the schematic are for connecting various outputs to output pads or to ground by using OΩ resistors as shorts.

A simple four wire interface cable can be used to interface a PC (with Window version 3.1 or better) and the evaluation board. The cable, which is described in Appendix E, connects from the PC's parallel port to the six pin header on the evaluation board. The cable provides the MICROWIRE™ signals (i.e. Data, Clock, and Load Enable) needed to program the Ultra Low Power PLL's. Since most PC's parallel ports have an output level of 5V, pads for resistive dividers on the Clock, Data, and Load Enable are also included. This will allow low voltage operation of the PLL without overdriving the MICROWIRE™ inputs.

The RF VCO is assumed AC coupled. Resistor R14, R15 and R16 in the schematic increase impedance so that VCO output power is provided to the load rather than the PLL. Typical values are 10Ω to 200Ω depending on the VCO power level. Fin RF real impedance ranges from 40Ω to 200Ω. A 50Ω termination is often used on test boards to allow use of a signal generator as the external reference oscillator. For actual manufactured products, a TTL or CMOS clock is typically used and no terminating resistor is required. OSCin may be AC or DC coupled. AC coupling is recommended because the input

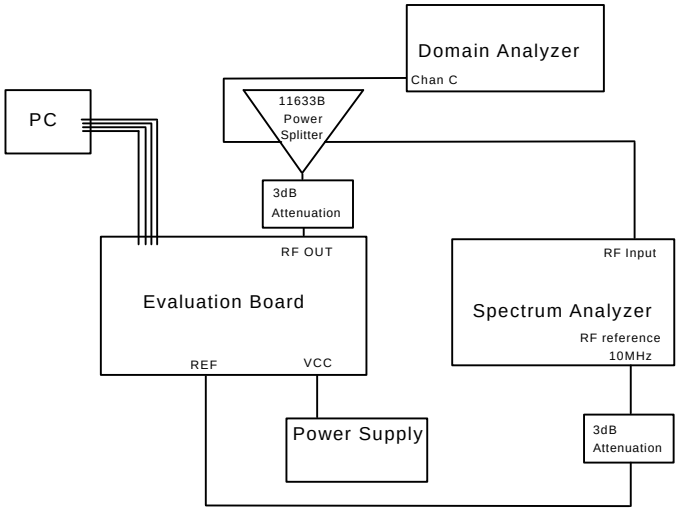
circuit provides its own bias. Proper use of grounds and power supply decoupling is essential to achieve a high level of performance. Pads for power supply decoupling capacitors are provided.
The Ultra Low Power PLL is a static sensitive device. It should be handled only at static free work stations.

USING THE EVALUATION BOARD

Hardware Set-Up Instructions

The user should make the following connections to operate the evaluation board in standard mode: (1) Connect the VCO output **(RF OUT)** to a spectrum analyzer, (2) Connect a reference input within the range 5 MHz to 40 MHz at 0 dBm to the **REF IN** port, (3) Connect the interface cable to the parallel port of the PC and to the pin header on the evaluation board, (4) and connect a power supply to the VCC input (2.3 -5.5 V depending on your application). With both jumpers on the 4 pin voltage header, the VCO and the PLL will run off the same supply. The board is now ready to operate. This configuration is for evaluation purposes only and is not meant to show how the PLL would be used in a system.

The following block diagram shows a typical equipment set-up for evaluating a LMX series PLL. The Spectrum Analyzer can be used to obtain phase noise and reference spur measurements. The Domain Analyzer is used for lock time measurements.



Obtaining the Evaluation Software

The evaluation board software can be obtained through the National Semiconductor web page.

http://www.national.com/models/

The evaluation software is called Code Loader. There are different choices of loading the software depending on which Window's version is used.

Using the Evaluation Software

Please refer to the "Code Loader Operation" document on how to set up and use the software. There are Appendices explaining instructions specific to the LMX2306, LMX2316 and LMX2326.

TROUBLESHOOTING TIPS

- Using magnification, visually inspect the board for cold solder joints, broken, misplaced or partially soldered components, and solder bridges. These items are common causes for partially or non-working boards.

- Verify that the correct voltage levels for Vcc, Vp and Vco are actually getting to the places they need to (i.e. measure the voltage at the PLL and VCO pins, not at the edges of the board). Also verify that the Jumpers are set properly for the number of power supplies being used (i.e. if only one supply is being used, both power supply jumpers should be in place).

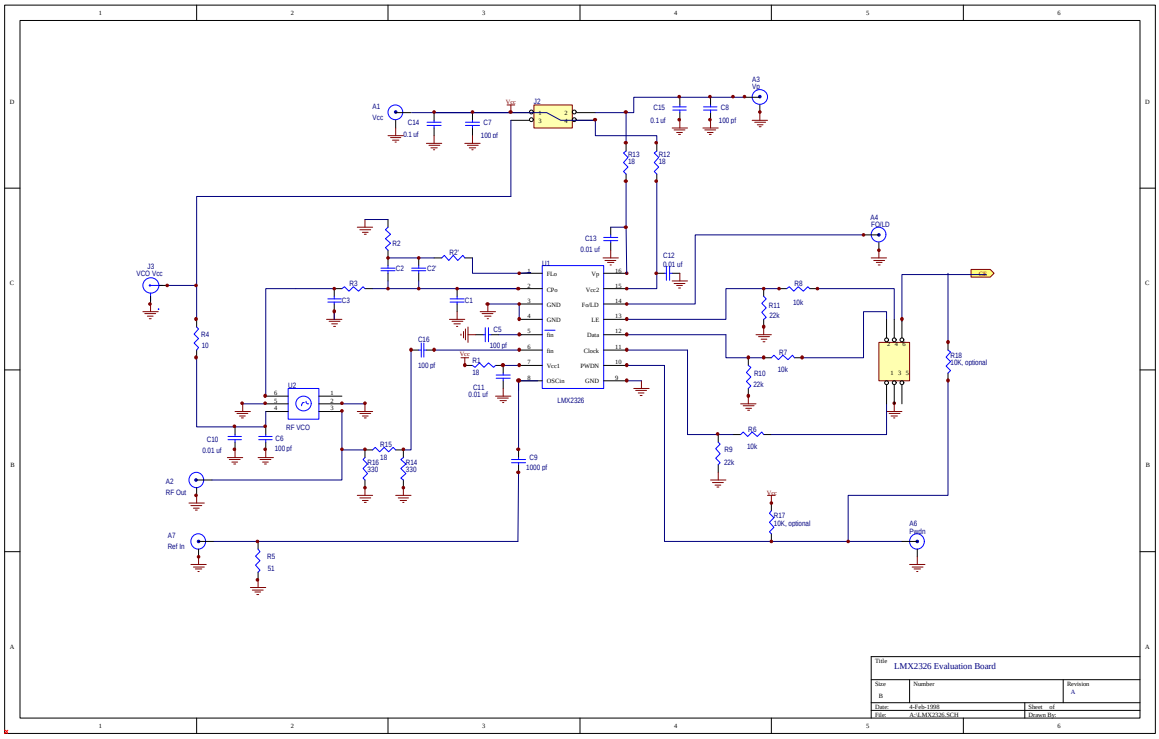
- Verify that OSCin is getting the proper XTAL frequency and that OSCout is an amplified version of it. Both OSCin and OSCout should have a DC offset.

- Verify that the LMX series PLL is getting the proper programming signals by putting the software in "switch" mode and probing the CLOCK, DATA, and LE pins with an oscilloscope. Also verify that the programming signals are at the appropriate level for your application (i.e. if your application is a 3V one, make sure that the 5 volt signals from the PC are being resistivly divided so that they don't overdrive the PLL inputs.)

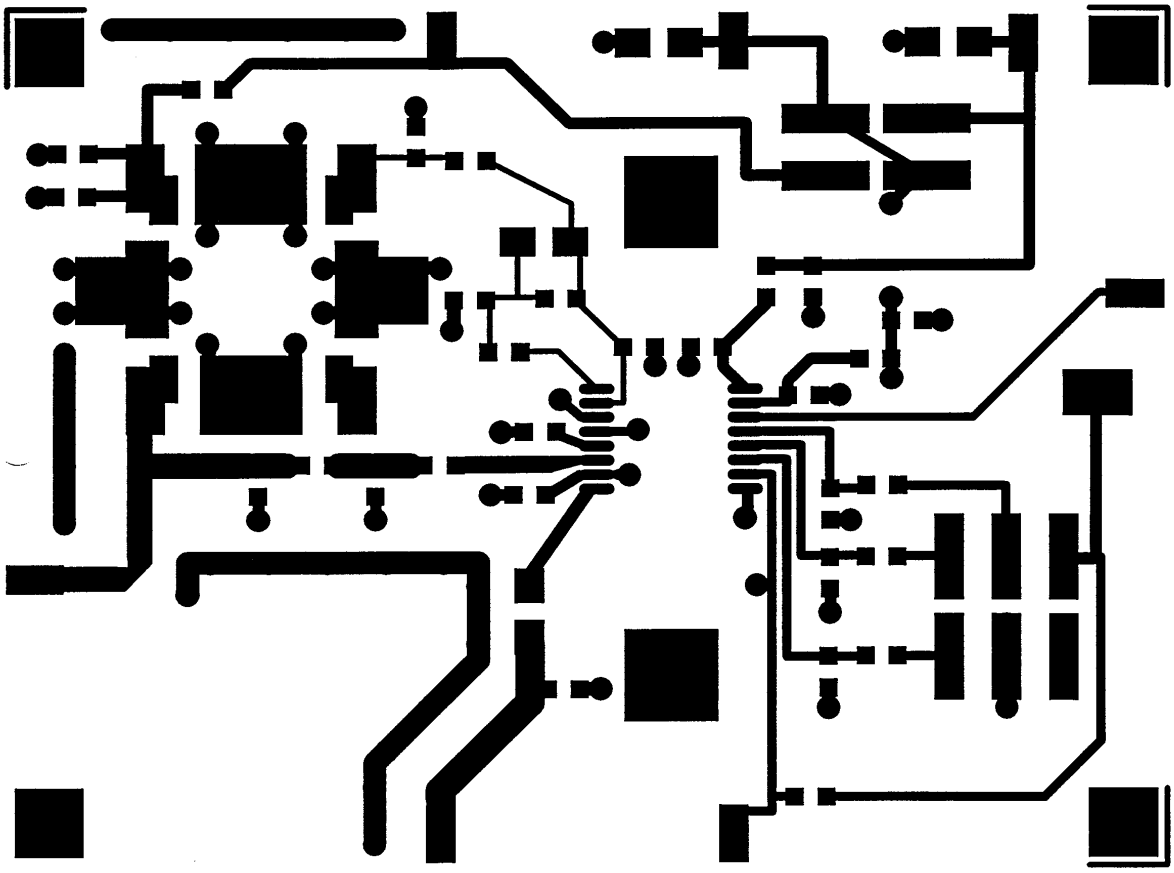
- Verify proper values for VCO frequency, Reference frequency, and crystal frequency in the evaluation software.

- Computer monitors and other lab equipment have been shown to cause noise spikes. If you see noise spikes on the signal try turning off the monitor or other equipment to verify that they are not the cause. Also noise may be getting onto the signal through the cable that connects to the parallel port of the computer.

APPENDIX A: LMX2326/16/06 Evaluation Board Schematic



APPENDIX B: LMX2326/16/06 Evaluation Board Layout



APPENDIX C: LMX2326/16/06 Evaluation Board -

Bill of Materials

For 3 Volt Operation:

QTY	DESCRIPTION	SIZE	LOCATION
5	100 pF	603	C5, C6, C7, C8, C16
4	0.01 uF	603	C10, C11, C12, C13
2	0.1 uF	805	C14, C15
1	1000pf	805	C9
2	10 Ω	603	R4
2	18 Ω	603	R1, R12, R13, R15
1	51 Ω	805	R5
2	330Ω	603	R14, R16
3	10 KΩ	603	R6, R7, R8
3	22 KΩ	603	R9, R10, R11
2	Shunts 0.100” Doublewipe contacts		
1	Surface mount Header 0.100” X 0.100” Double Row, 6 position		
1	Surface mount Header 0.100” X 0.100” Double Row, 4 position		
3	SMA PC Mount End Launch Jack Receptacles for RF out, REF, VCC		

Note: Adjust R4 value to required Vvco level.

For 5 Volt Operation make the following changes:

A. Remove voltage divider resistors, R9, R10 and R11.
B. Use 0 Ω resistors for R6, R7, and R8

Change the following components for specific devices. 3V operation

LMX2306

Murata 243, C1 680pF, C2 4700pF, C3 open, R2 15k, R3 short

LMX2316

Varil 2549, C1 390pF, C2 2200pF, C3 33pF, R2 18k, R3 33k

LMX2326

Varil 1960, C1 390pF, C2 2200pF, C3 6.8pF, R2 15k, R3 27k

APPENDIX D: VCO Suppliers

ALPS Electric CO., LTD.
1-7 Yukigaya Otsuka-Cho
Ota-Ku Tokyo, Japan 143
Phone: (03) 3726-1211
FAX: (03) 3728-1741

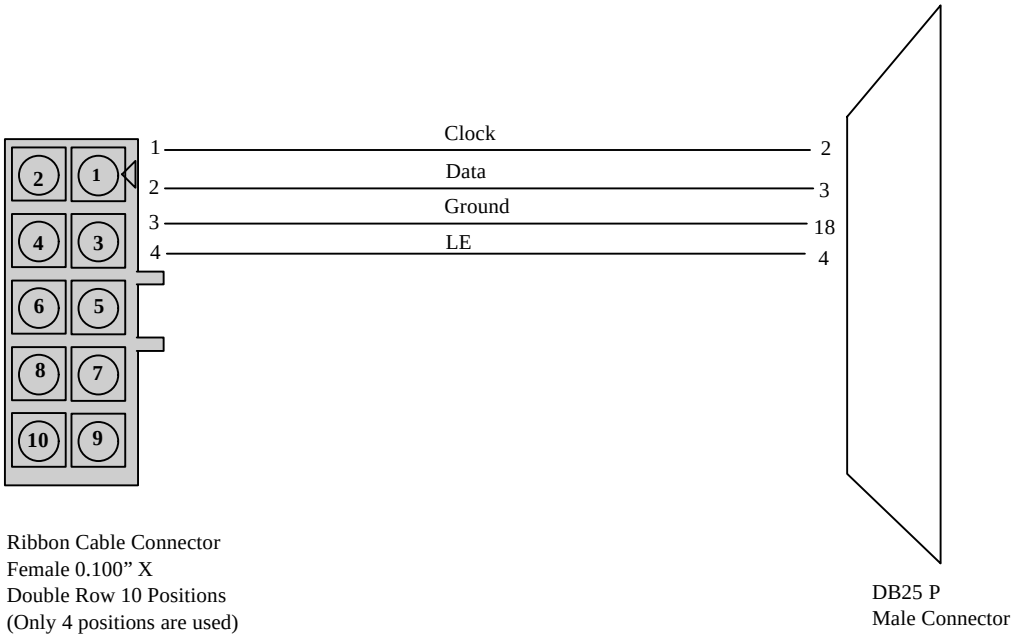
Fuji Electrochemical CO., LTD.
Hama Gomu Building
5-36-11
Shinbashi
Minato-Ku
Tokyo, Japan 105
Phone: (03) 434-1271

M/A-COM
Burlington, MA 01803
Phone: (617) 564-3100
FAX: (617) 564-3050

muRata Manufacturing CO., LTD.
26-10 2-Chome, Tenjin,
Nagaokakyo-shi
Kyoto 617, Japan
Phone: 075-951-9111
FAX: 075-954-7720

muRata Marketing Communications
2200 Lake Park Dr.
Smyrna, GA 30080
Phone: (800) 831-9172
FAX: (404) 436-3030

APPENDIX E: Parallel port to MICROWIRE™ Interface Cable



Ribbon Cable Connector
Female 0.100" X
Double Row 10 Positions
(Only 4 positions are used)

DB25 P
Male Connector