National Semiconductor™

LMX2326 Evaluation Board Operating Instructions

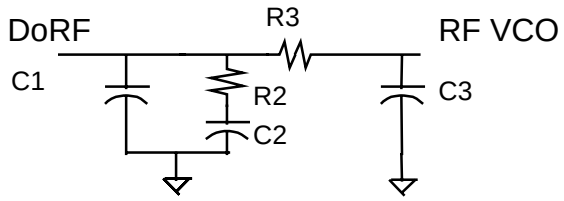
General Description

The LMX2326 Evaluation Board simplifies the evaluation of the LMX2326 3.0GHz PLLatinum frequency synthesizer. It enables all performance measurements, with no additional support circuitry.

The board consists of a LMX2326 device, a VCO module and a loop filter built by discrete components. The SMA flange mount connectors are provided for external reference input, RF output and the power & grounding connection. A cable assembly is bundled with the evaluation board for connecting to PC through the parallel printer port. By means of uWire serial port emulation, the Code Loader software included can be run on PC to facilitate the LMX2326 internal register programming for the evaluation and measurement.

Loop Filter Illustration

Type 2 third order passive loop filter configuration is employed on the LMX2326 evaluation board. The loop filter was designed based on the assumption of 12KHz loop bandwidth, 45 degree phase margin, charge pump in "High " gain mode, and 200KHz reference frequency. The actual implementations are shown as below:



LOOP FILTER

C1 = 390pF

C2 = 2200pF

R2= 15kohm

R3 = 27kohm

C3 = 6.8pF

Quick Start

The LMX2326 Evaluation Board is fully assembled and factory tested. Follow the instructions below to set up the hardware platform for the measurement of interest.

Recommended Test Equipment

- Spectrum analyzer with 10MHz reference output (operating frequency range >= 2 GHz)
- Modulation Domain Analyzer
- DC power supply with adjustable voltage outputs
- 10MHz Signal Source/Generator (optional, in case no reference output from spectrum analyzer)

Connection and Setup

1. Connect the RF_OUT output port to the input of a spectrum analyzer for Phase Noise and Reference Spur measurement or the input of a modulation analyzer for Lock Time measurement.

2. Connect a oscillator reference to the OSCIN input port. It is advised to use a high quality reference source for an accurate and low noise measurement. A 10MHz reference is generally available from most of the spectrum analyzer at the reference output port.

3. Plug the DB25 connector end of the cable assembly to the parallel port of the PC. Connect the other end of the cable to the on-board 5x2 pin header. Beware of pin #1 position.

4. Put jumper blocks to shunt pins 1&2 and 3 & 4 to connect VCO_Vcc

5. Turn on the DC power supply and adjust the voltage output to 3 Volt. Turn off supply.

6. Connect the DC power supply output to Vcc port of evaluation board. Turn on supply.

7. Turn on the signal generator and set the reference output frequency to 10MHz.

8. Run the Code Loader software on the PC for LMX2326 register programming.

Phase Noise Measurement Using A Spectrum Analyzer

1. Use the Code Loader software to set the desired frequency and to program the LMX2326 device. (Please reference Code Loader User Manual for details.) The VCO operating frequency range can be obtained in Appendix D.

2. The spectrum analyzer is set to the desired center frequency and the span is adjusted so the appropriate offset frequency can be viewed.

3. The video averaging feature of the analyzer is turned ON for better determination of the noise level.

4. The difference between the level of the carrier and the noise level minus 10[log(resolution bandwidth)] is equal to the phase noise in dBc/Hz. The resolution bandwidth can be read directly from the spectrum analyzer.

Reference Spur Measurement Using A Spectrum Analyzer

1. Use the Code Loader software to set the desired frequency and to program the LMX2326 device. (Please reference the Code Loader User Manual for details.) The VCO operating frequency range can be obtained in Appendix D.

2. The spectrum analyzer is set to the desired center frequency and the span is set to allow the reference sidebands to be viewed. For example, the span can be set to 500KHz during the measurement as its loop filter design is based on 200kHz reference frequency.

3. The spurious output is the difference between the level of the PLL tone (at the center frequency) and the level of the reference spur (at the center frequency +/- the reference frequency).

Lock Time Measurement Using A Modulation Domain Analyzer

1. Decide the maximum and minimum frequency to be switched to and from. The VCO operating frequency range can be obtained in Appendix D. Enter Burst Mode menu of Code Loader software to create a macro to program the LMX2326 to the maximum and minimum frequency alternatively over time. Beware of putting long enough delay between the PLL programming. (Please reference Code Loader User Manual for details.)

2. Set the center frequency of the modulation domain analyzer to be half the way from the maximum and minimum frequency. Set the frequency span to cover the entire frequency range from maximum to minimum. Then a switching signal should be seen on the screen.

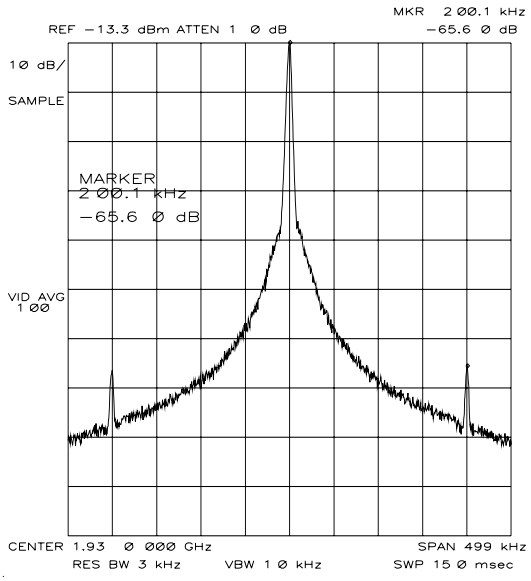
3. Set the center frequency to be the trigger condition for One-Shot mode. Press [Start/Stop] button to capture the switching curve. Adjust the frequency and time scale accordingly to get a close-up plot for detailed information.

4. The lock time is the time difference between the point the frequency starts to change and the point that the PLL frequency settles within +/- 1KHz range.

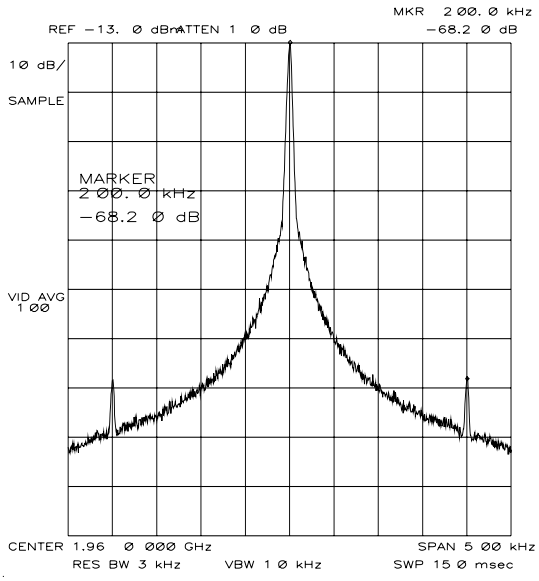
LMX2326 Performance Measurement Result – A Typical Example

Reference spurs

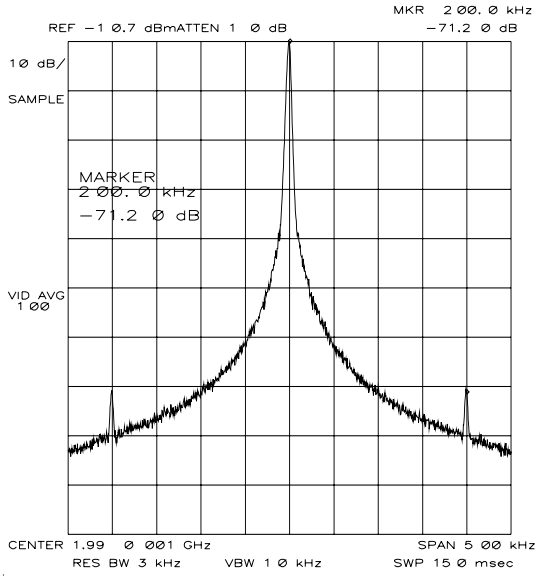
Fvco = 1930 MHz



Fvco = 1960MHz

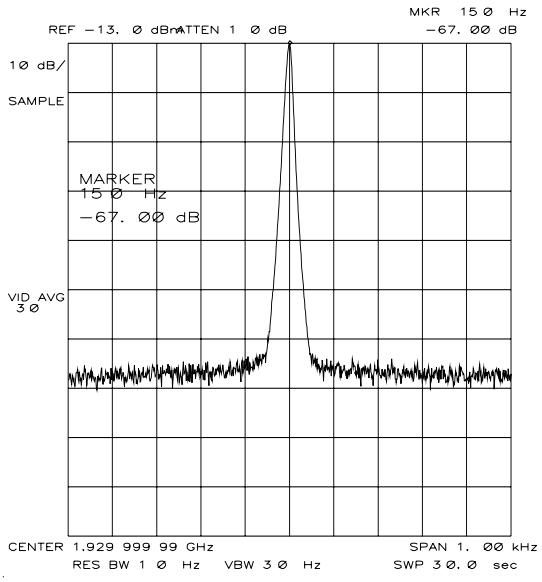


Fvco = 1990MHz

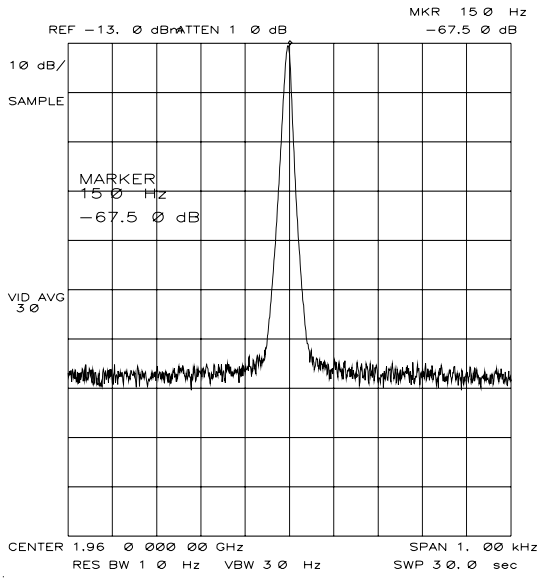


Phase Noise

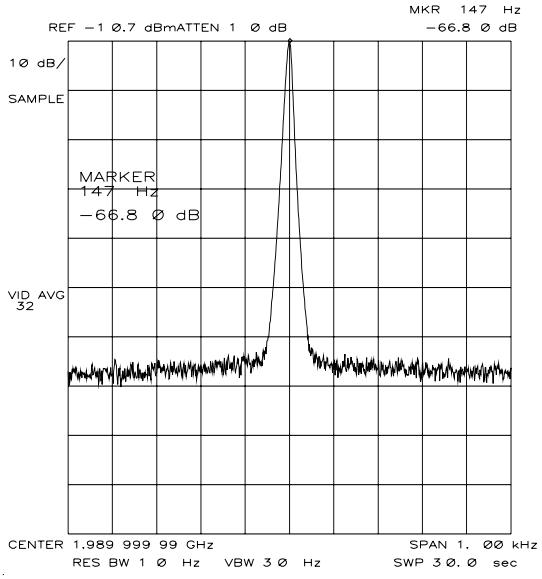
Fvco = 1930 MHz



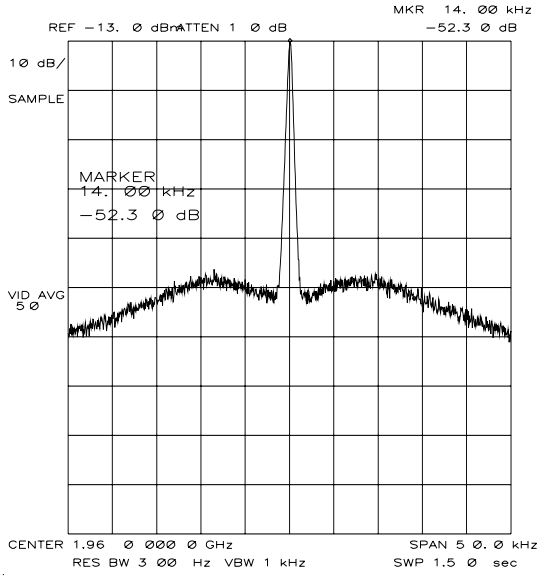
Fvco=1960MHz



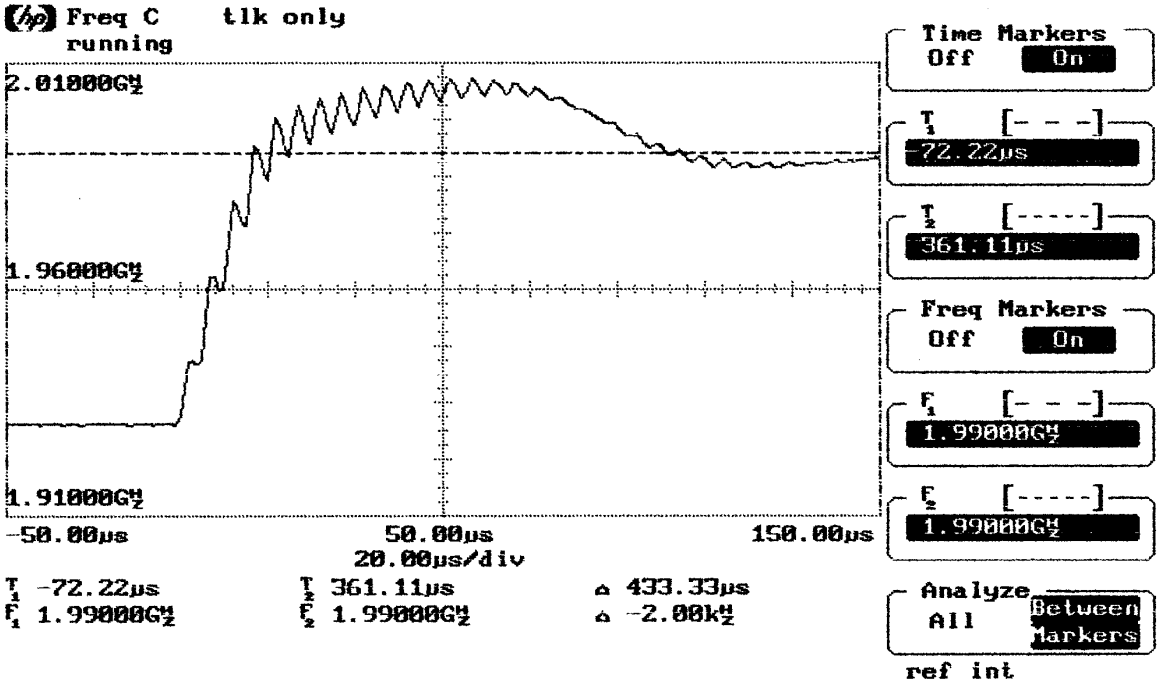
Fvco=1990MHz



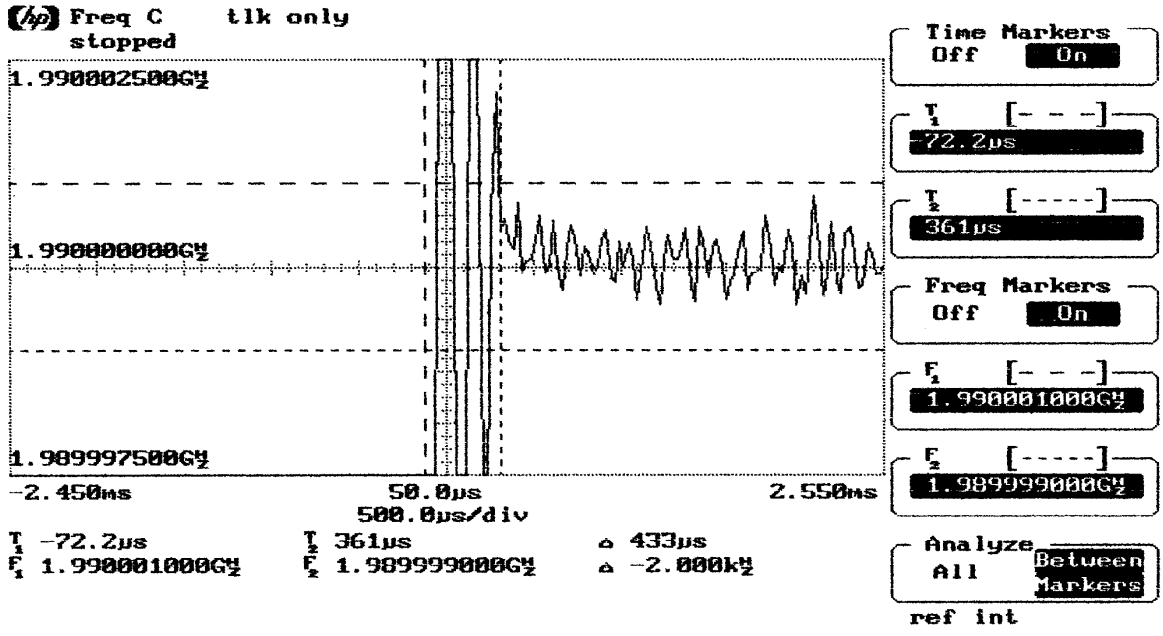
Loop bandwidth Fvco=1960MHz



Lock Time Measurement Result

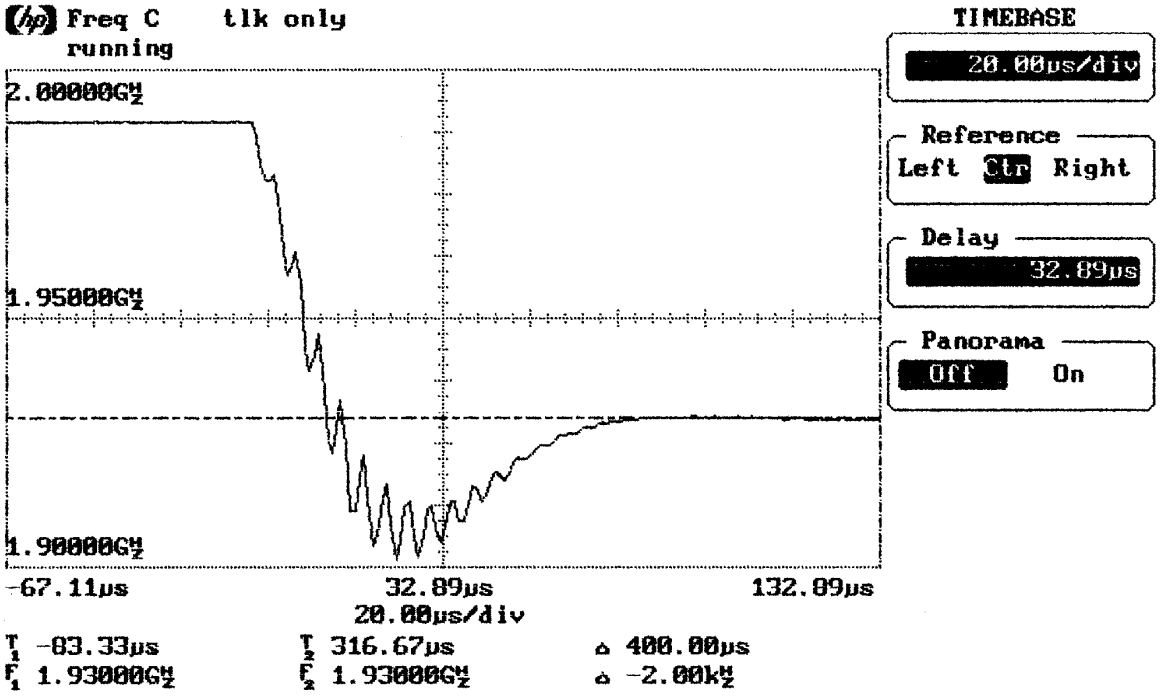


Positive Frequency Switching Waveform

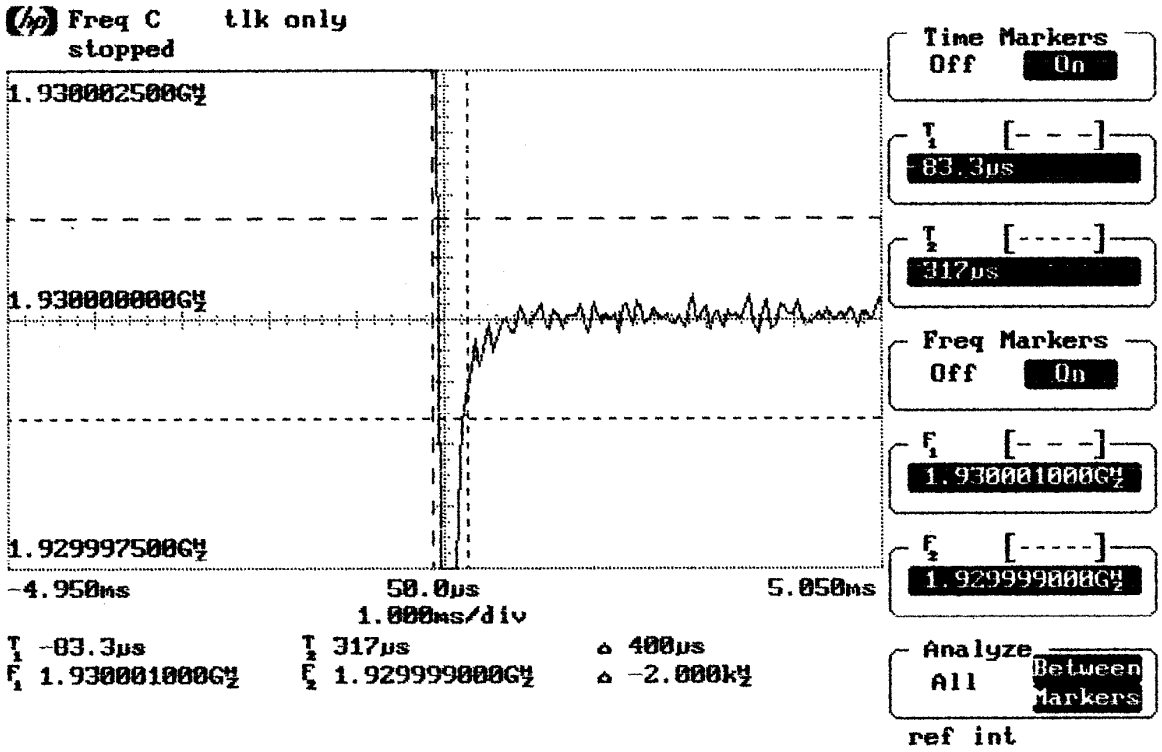


Positive Lock Time to within 1 kHz Range

Lock Time Measurement Result (Cont.)



Negative Frequency Switching Waveform



Negative Lock Time to within 1kHz Range

MEASUREMENT CONDITIONS

The LMX2326 Evaluation Board has been tested to meet the typical performance criteria as shown below:

Testing Condition

VCC Operating Voltage	:	3.0 Volt
VCO Tuning Range	:	1930 - 1990 MHz
RF Comparison Frequency	:	200 KHz
Icp	:	High

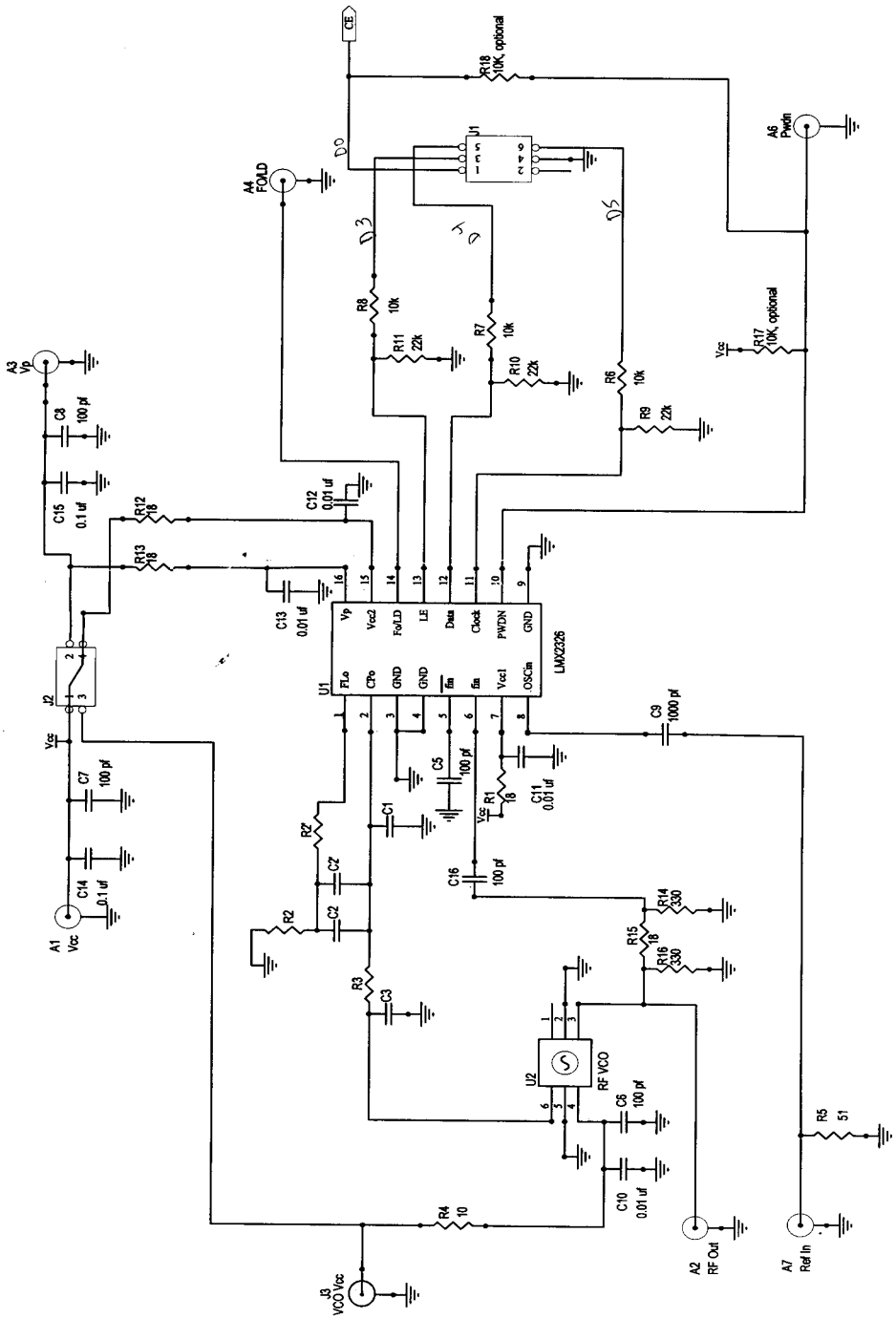
Typical Performance Criteria

VCO Phase Noise	:	Less than -65 dBc/Hz @ 150Hz
VCO Reference Spur	:	Less than -55 dBc @ 200kHz
VCO Lock Time	:	Less than 500 us (within +/- 1KHz settling frequency)

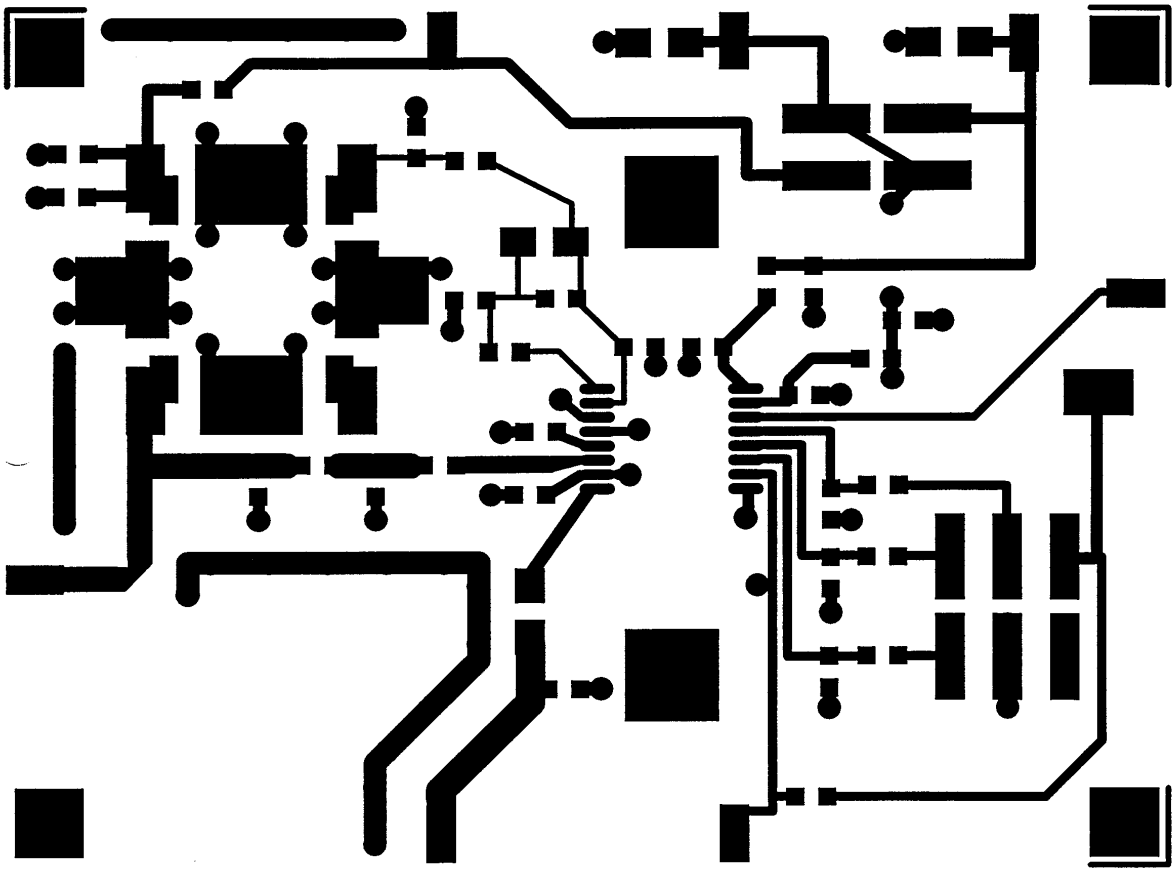
Remark

Computer monitors and other lab equipment has 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 Evaluation Board Schematic Diagram



Appendix B - LMX2326 Evaluation Board Layout



Appendix C - How To Do Port Setup of Code Loader Software

The LMX2326 Evaluation board is designed so that port setup is required to be configured as follows except for the **Port Address**. The **Port Address** should be selected according to the user PC parallel port.

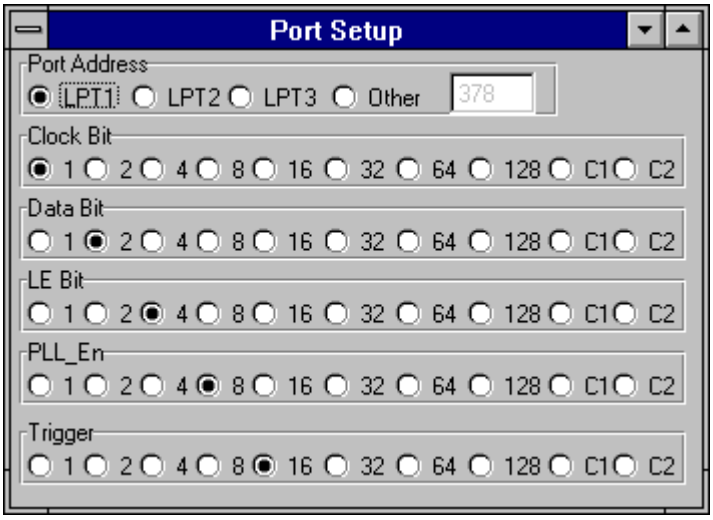


FIGURE C-1: PORT SETUP FOR LMX2326 EVALUATION BOARD

Appendix D - LMX2326 Code Loader Main Menu Description

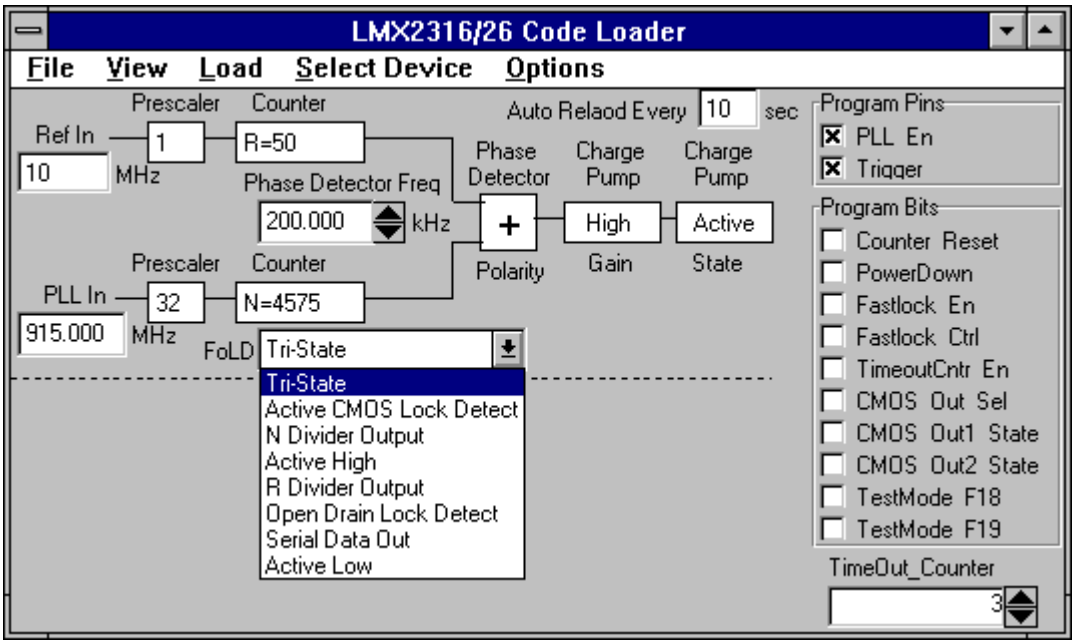


FIGURE D-1: "CODE LOADER" MAIN MENU FOR LMX2326

All parameter values or states can be changed except for the R counter prescalers. The parameter boxes can be changed by just clicking on or by clicking on and entering new values. The user must press **Enter** on the keyboard after the parameters are changed. Only registers for which the new changes are relevant are loaded when the **Enter** is pressed. To load all registers in both RF and IF PLLs, select the **Load - PLL** pull down menu or enter Ctrl + L.

Ref In - TCXO or reference crystal oscillator input. NSC's normal LMX2326 evaluation board is designed for a 10 MHz TCXO. The user is advised to use a high quality crystal reference for an accurate and low noise measurement. A high quality 10 MHz reference signal is generally available from the most of spectrum analyzer reference output port or signal generator reference output port.

Phase Detector - Phase detector (comparator) frequency. NSC's normal LMX2326 evaluation boards are designed for a 200 kHz PLL phase detector frequency. The component values of the loop filter require redesign if the user wishes to use other phase detector frequency.

PLL In - VCO output frequency (PLL fin input frequency). Operating frequencies for the VCO's used on NSC's normal LMX2326 evaluation boards are as follows:

	VCO used	Operating frequency range [MHz]
LMX2326	Varil 1960	1930 - 1990

The user is allowed to enter a frequency within the VCO operating frequency range. The component values of the loop filter should be redesigned if the user wishes to use other VCOs.

Prescale - Prescaler value of the counters. There is no prescaler used in the R counter indicated by 1. Availability of the prescaler values depends on the user's device type. Refer to the data book for the available prescaler values. The prescaler value can be changed by clicking on the **Prescale** box.

Phase Detector Polarity - The polarity can be changed by clicking on the "+" or "-". Refer to the data sheet for the description of this function.

Charge Pump Gain - Charge pump output current. The LMX2326 has only one charge pump mode.

Auto Reload Every [XX] sec - Time interval the program reloads all the counters. The user enables the reload function by selecting **Options - Auto Reload** from the pull down menu.

Program Pins - Trigger - External Trigger for the programming port. The programming port assigned for **Trigger** becomes high when selected and port goes low when not selected.

Program Bits - Refer to the datasheet for function of the each programming mode.

FoLD - Multiplexed output of the RF programmable or reference dividers and lock detect. See datasheet for more detail. For normal evaluation, FoLD is on TRI-STATE.

TimeOut-Counter - duration of how long Fastlock™ is in effect. It ranges from 3bits to 63bits with 3bit increment.