

OPERATING INSTRUCTIONS FOR THE NATIONAL SEMICONDUCTOR LMX2320 EVALUATION BOARD

SET-UP INSTRUCTIONS

The LMX2320 Evaluation Board is an implementation of the schematic shown as Figure 1. **(NOTE: The schematic in Figure 1 shows a component value for each component that is actually on the board. Any component shown in the schematic that does not have a component value is not actually on the board, but there is space for this component.)** The board, shown in Figure 2, consists of the LMX2320, a VCO, a loop filter, voltage and data pin headers.

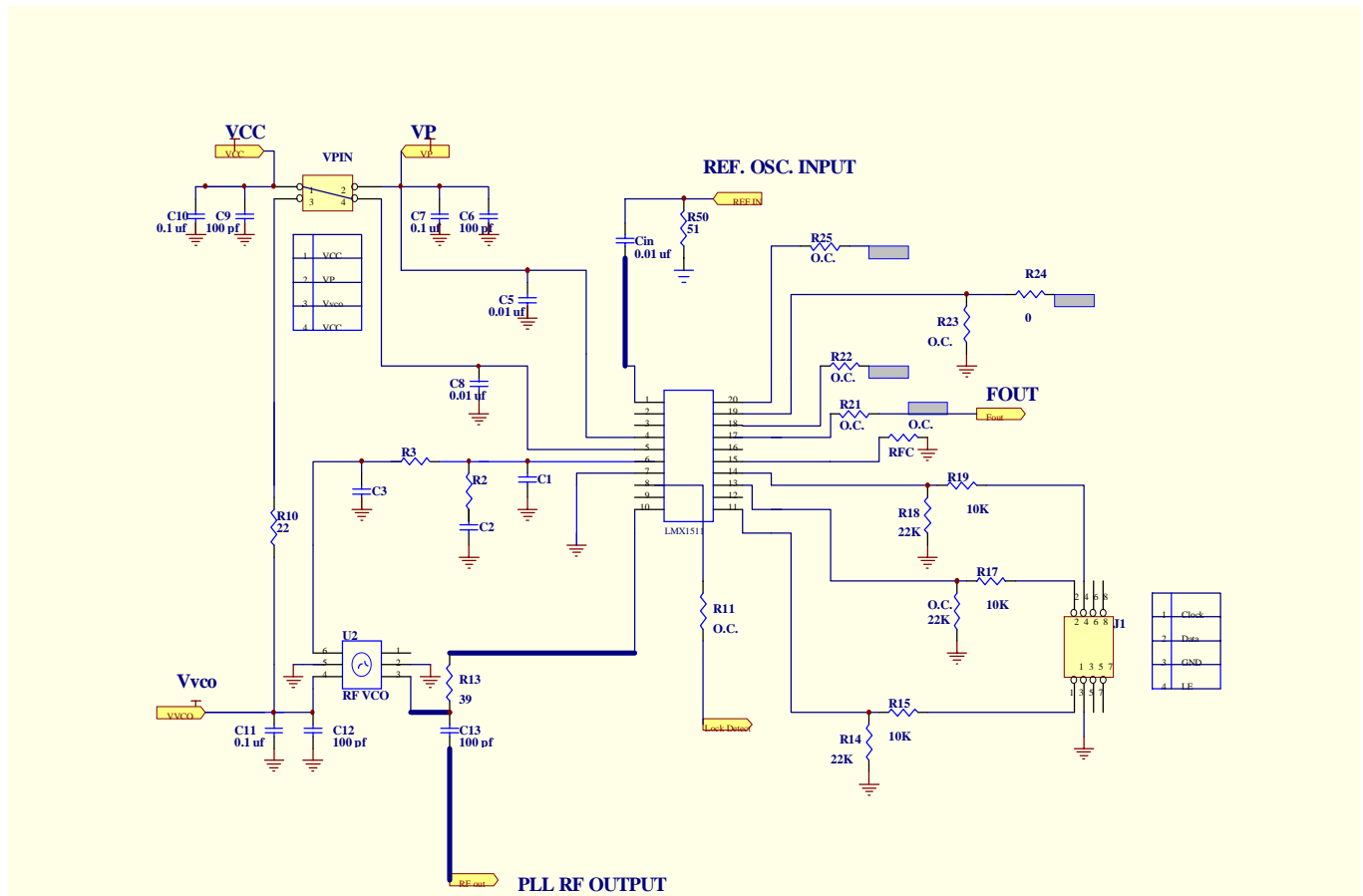


Figure 1 - Schematic for the LMX2320 Evaluation Board

Resistors denoted as O.C. / S.C. are for connecting various outputs to output pads or to ground by using 0Ω resistors as shorts. The board has two kinds of interconnections. SMA flange mount connectors are supplied for the external reference and VCO output, power supply biasing and grounding. A four pin header allows VCC, VP, and VVCO to be driven off either a single voltage supply, or separately. An eight pin header is provided for programming of the PLL prescaler. The cable provided connects to the evaluation board pin header and the parallel port of a PC XT (or better) equivalent. Since most P.C.'s parallel port output level is 5 V, 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.

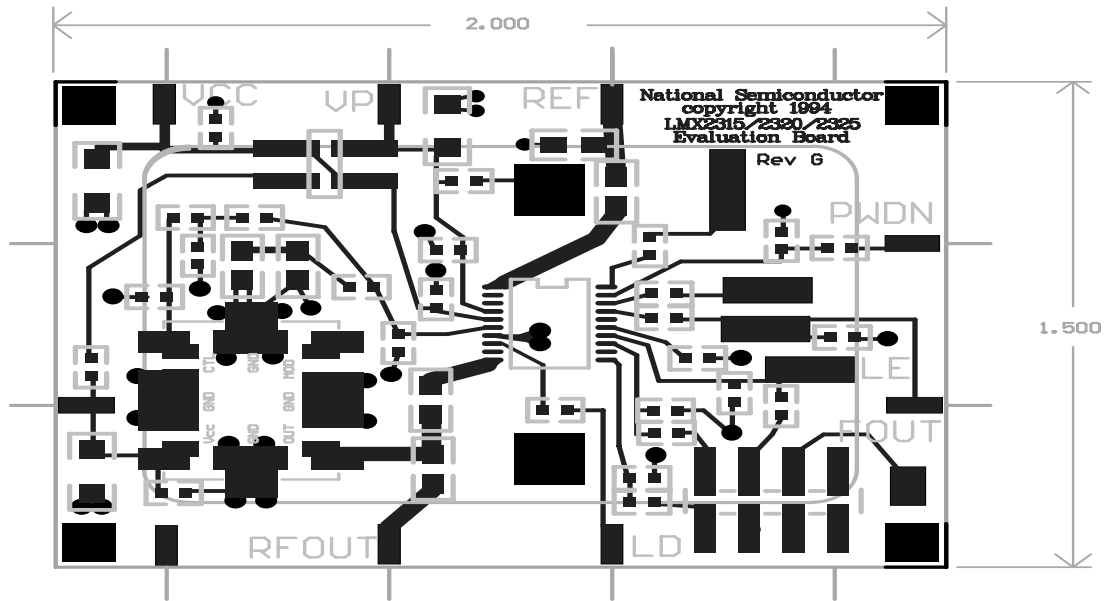
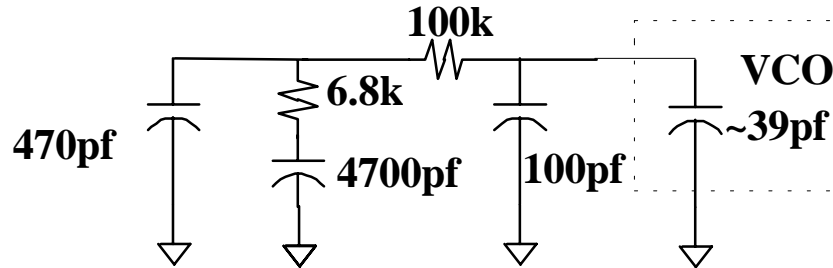


Figure 2 - Drawing of the LMX2320 Evaluation Board

The user should make the following connections to operate the evaluation board in standard mode: (1) Connect the VCO output (**PLL RF OUT**) to a spectrum analyzer, (2) Connect a reference input from 5 MHz to 30 MHz at 0 dBm to the **REF IN** port, (3) Connect the cable assembly to the parallel port of the PC and to the pin header on the evaluation board, (4) and connect a 5.0V power supply to the VCC SMA input. Connect the P.C. cable with the arrow on the connector facing the board. If you were holding the cable in your hand the sockets to the far left should attach to the pins on the board. With both jumpers on the 4 pin voltage pin 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 it will be used in a system.

The loop filter was designed for a 900 MHz GSM application, with a crystal reference frequency of 10.000 MHz, and a comparison frequency of 200 KHz. Loop values for the integrator have been selected and placed in the loop in the configuration shown below. However, the evaluation board has been designed to accept more complex configurations.



USING LMX2320 SOFTWARE

Insert the diskette into drive a: or b:. The program may be operated from the floppy or may be copied onto a hard disk. Because the program uses extended precision real numbers in its calculations the program may not operate on some older DOS computers. A PC-AT or equivalent is recommended. The program may be started by typing LMX2320.

LMX2320 controls the LMX2320 Evaluation Board via a standard parallel port. A cable is provided to make the connection from the computer to the board. The program is intended to be easy to install and use, exercise the PLL, and demonstrate typical performance. It is not intended to be representative of the control code which the customer will implement within their application.

Upon power-up the program will detect the number and location of parallel ports available to the system. The user will be prompted to select one port. The evaluation program is menu driven. All menu selections may be made by pressing "Enter" when a menu is highlighted. Up, down, left and right arrows are used to change which menu is highlighted. Speed keys are also included for each active menu item. Use Speed keys by typing the letter displayed in red corresponding to the mode desired. The top menu pane consists of pull down menus titled "Set (F)requency", "Set (R)egister", "(T)uning", and "(Q)uit" where the speed keys are listed in parentheses. To exit from a menu at anytime press "Escape". A status pane is included at the bottom of the pane to give on-line help descriptions of highlighted menu items.

The program displays a block showing the present tuning parameters for VCO, Crystal Reference, and Phase detector reference frequency. Activate the "Set Frequency" pulldown menu to control these values. To the right of this block is the "Scratchpad", showing the values as you enter them. The program will issue a warning and a suggestion if a value is selected which does not maintain an integer relationship between the VCO or crystal frequency and the reference frequency. The suggestion will be the nearest value of the parameter just changed which will produce an integer relationship. The user may select this value, or any other, so long as the integer relationship is established. Upon successful selection of tuning parameters, the download values are calculated and loaded. The board must be powered up in order for the values to be loaded. If power is applied after the software is on or power is turned off for some reason all that is required is entering "Load Frequencies" to download the values.

The program displays, and allows modification of, the binary values for the VCO divider (P), Reference Divider(R), and control codes. The value of P (either 128 or 64) shows the present status of the first control bit which enables either the 128/129 prescaler or the 64/65 prescaler. When an N value is entered which is invalid for P=128, the program will display an error message and automatically switch to P=64. To modify N, R or P directly, activate the "Set Register" menu, select the desired mode and use the arrow keys to move horizontally or to change values ("up" changes "0" to "1", "down" changes "1" to "0"). You may also type in "1" or "0".

Users will find items in the "Tuning" menu useful. In "Hand Tune" mode the user may step up or down in single increments by using the up or down arrows, or in increments of 10 by using the left and right arrows. Other steps, 2 up to 9, are taken by pressing any number from 2 to 9. Steps downward are taken

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by pressing the down or left arrow keys or by holding down the shift key when pressing any number from 2 to 9.

The "Switch" mode in the "Tuning" menu allows measurement of PLL switching time by initiating switching between the presently tuned frequency and a frequency an arbitrary number of steps away. In "Switch" mode, the user will be prompted for an integer (+ or -) number of steps and a delay (msec). The delay will allow the user to specify the time delay between switching. The "Enable" input forms a fairly good trigger (it is written twice, once for N and once for R). Load time will vary depending upon the processing speed of the computer being used.

The "Auto Tune" mode in the "Tuning" menu allows the user to switch to a set frequency and specify the interval to step in. Entering this mode, the user will be prompted for an integer to step up to, an integer to step by and a delay (msec). The delay allows the user to specify the time delay between steps. This would allow a user to verify operation at all channels of interest.

The program is exited by choosing "Yes,Quit" in the "Quit" menu, which saves the current parameters in a log file. Any mode may be exited by pressing "Enter".

TYPICAL MEASURED PERFORMANCE OF THE LMX2320 EVALUATION BOARD

Normal operating parameters for the 1760-1820 MHz frequency range include spurious at less than -65dBc, switching speed (for a 200 kHz reference frequency and a step of 50 MHz) < 400 microseconds. Phase noise is measured at -80 dBc/Hz at 1 kHz offset. Noise at 100 kHz is under -110 dBc/Hz. Typical current draw at 3 volts is 6 mA (not including the 6 mA VCO). These parameters were measured on a very small sample size. All parameters are subject to change.

NOTE: 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.

LMX2320 Bill of Materials

Part	Used	PartType	Designators

1	5		J1 R14 R17 VPIN
2	1	0	R24
3	3	0.01 uf	C5 C8 Cin
4	3	1uf	C7 C10 C11
5	1	6.8K	R2
6	2	10K	R15 R19
7	1	22	R10
8	1	22K	R18
9	1	39	R13
10	1	39pf	C3
11	1	51	R50
12	1	100K	R3
13	4	100 pf	C6 C9 C12 C13
14	1	470pf	C1
15	1	4700pf	C2
16	1	LMX2320	U1
17	1	Murata 1780	U2
18	2	O.C.	R11 R21
19	1	O.C.	R22
20	3	O.C.	R23 R25 RFC

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