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Evaluation Kit
User's Manual

Integer-N PLL Frequency Synthesizer
PE97240

Table of Contents

Introduction

The PE97240 is a high-performance integer-N PLL capable of frequency synthesis up to 5 GHz. The device is designed for superior phase noise performance for use in commercial space applications. The PE97240 includes a dual modulus prescaler capable of dividing the VCO frequency by either 5/6 or 10/11, depending on the value of the modulus selected.

The PE97240 PLL Evaluation Kit includes the application software and hardware required to control and evaluate the functionality of the PLL using a PC running the Windows™ operating system to control the USB interface board.

Applications Support

For any technical inquiries regarding the evaluation kit or software, please visit applications support at www.psemi.com (fastest response) or call **(858) 731-9400**.

Evaluation Kit Contents and Requirements

Kit Contents

The PE97240 Evaluation Kit (EVK) includes all of the specific software and hardware required to evaluate the PLL frequency synthesizer. Included in the EVK are:

Quantity	Description
1	PE97240 Integer-N Evaluation Board Assembly (DOC-50870)
1	Peregrine PLL USB Interface Board Assembly (DOC-02635)
1	USB-A to USB-B mini cable
1	Power cable for PE97240
1	Power cable for the VCO
1	Power cable for the Op Amp loop filter

Software Requirements

The application software will need to be installed on a computer with the following minimum requirements:

- PC compatible with Windows™ XP Vista 7 or 8 (32-bit or 64-bit)
- Mouse
- USB port
- HTML browser with internet access
- Administrative privileges

Hardware Requirements

In order to evaluate the phase noise performance of the evaluation board, the following equipment is required:

- DC power supplies and DC cables
- External TCXO or other low-noise source

CAUTION: The PE97240 PLL EVK contains components that might be damaged by exposure to voltages in excess of the specified voltage, including voltages produced by electrostatic discharges. Handle the board in accordance with procedures for handling static-sensitive components. Avoid applying excessive voltages to the power supply terminals or signal inputs or outputs.

PE97240 PLL Evaluation Board Assembly

Overview

The evaluation board is assembled with a PE97240 integer-N frequency synthesizer, an on-board VCO and a second order active loop filter. The loop filter is followed by two low pass filters to filter out high frequency noise. The VCO tuning range is from 2915–3155 MHz. The active loop filter is designed for a 50 MHz comparison frequency, a 3000 MHz output frequency with unity gain crossover at 200 kHz and a phase margin of 70 degrees. The 3 dB bandwidth is approximately 250 kHz. The data provided was measured with an external 100 MHz TCXO for best phase noise performance.

Figure 1. PE97240 Evaluation Board Showing Front-side Assembly

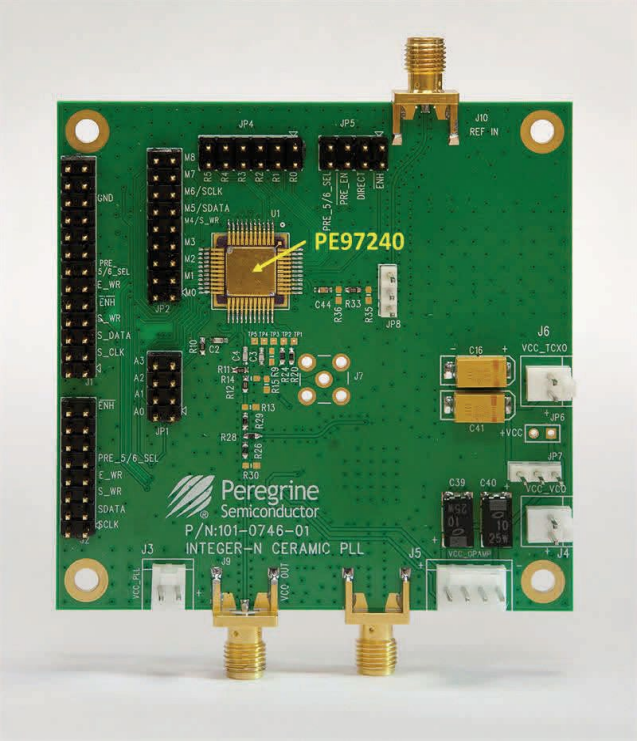
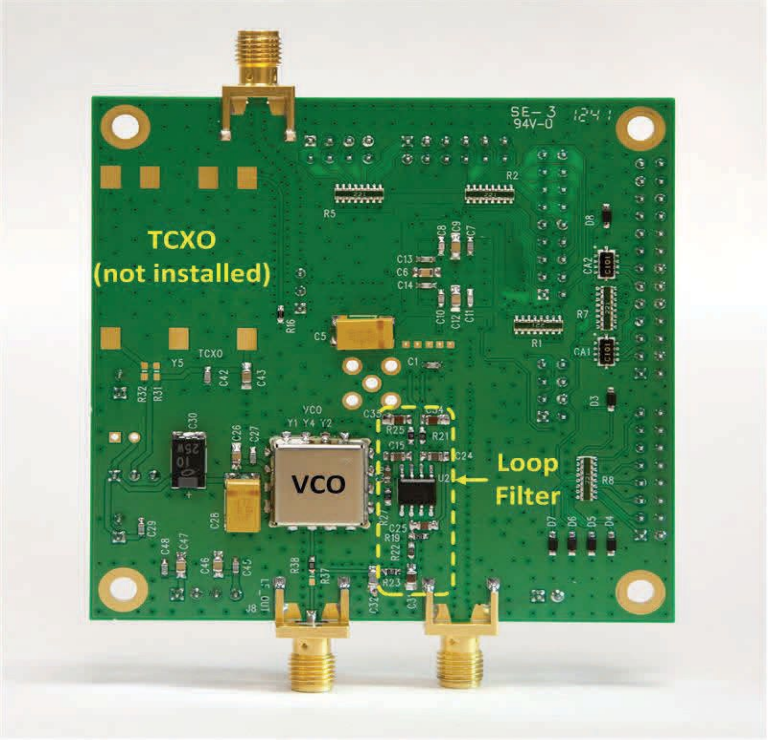


Figure 2. PE97240 Evaluation Board Showing Back-side Assembly

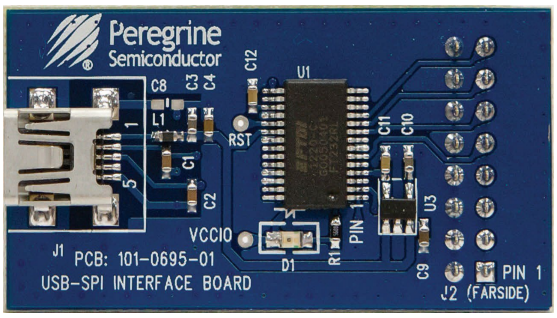


USB Interface Board

USB Interface Board Overview

A USB interface board (*Figure 3)* is included in the EVK. The board allows the user to send SPI commands to the device under test by using a PC running the Windows™ operating system. To install the software, simply extract the zip file to a temporary directory and follow the installation procedure included.

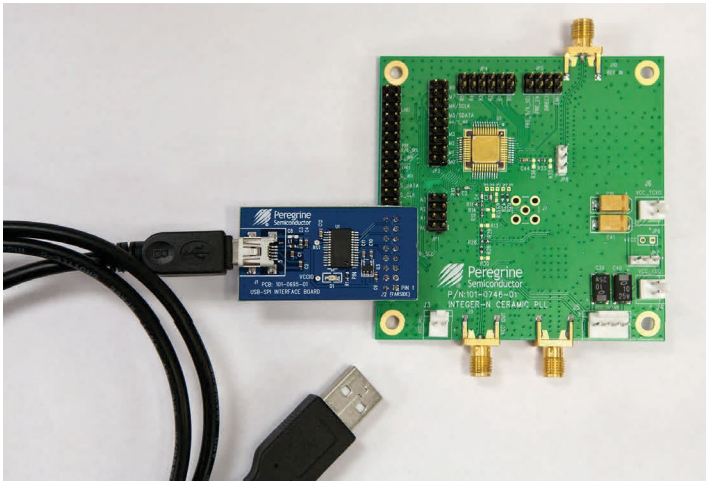
Figure 3. PLL USB Interface Board



Connection of the USB Interface Board to the Evaluation Board

The evaluation board and the USB interface board contain a keyed 16-pin header. This feature allows the USB interface board (socket) to connect directly to the evaluation board (pin) on the front side, as shown in *Figure 4.*

Figure 4. PLL USB Interface Board Connected to the PE97240 Evaluation Board for Serial Programming

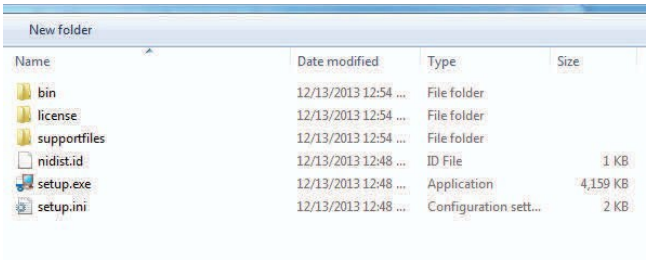


EVK Software Installation

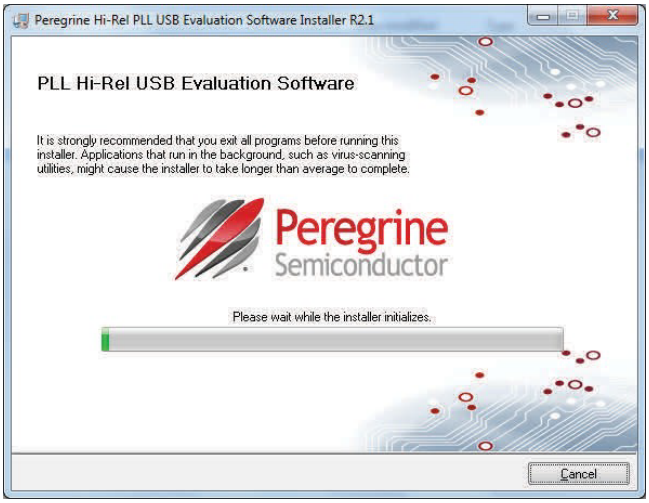
In order to evaluate the PE97240 performance using serial programming mode, the application software has to be installed on your computer. The USB interface and PLL application software is compatible with computers running Windows™ XP Vista 7 or 8 (32-bit or 64-bit configurations). This software is available directly from Peregrine's website at www.psemi.com.

To install the PLL evaluation software, unzip the archive and execute the "setup.exe."

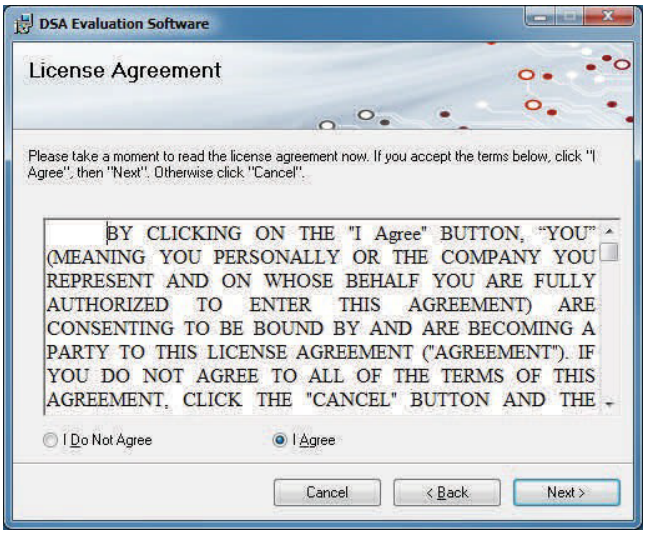
Figures 5(a-c). Application Software Installation Procedure



After the setup.exe file has been executed, a welcome screen will appear. It is strongly recommended that all programs be closed prior to running the install program. Click the "Next>" button to proceed.

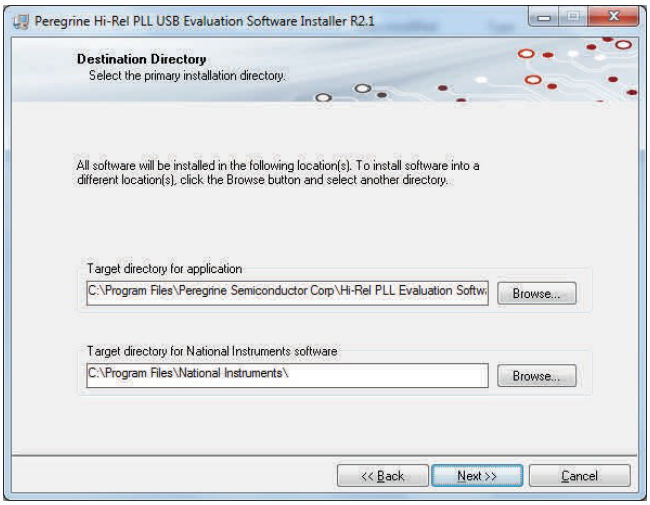


Take a moment to read the license agreement, then click "I Agree" and "Next>."

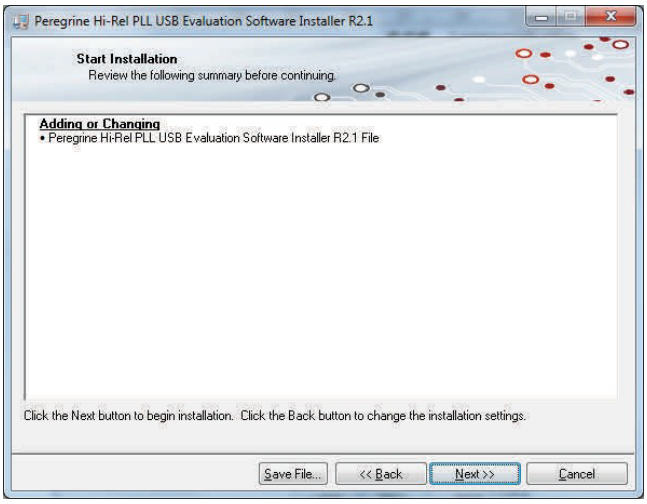


For most users the default install location for the program files is sufficient. If a different location is desired, the install program can be directed to place the program files in an alternate location. The software is installed for “Everyone” by default. Once the desired location is selected, click “Next >.”

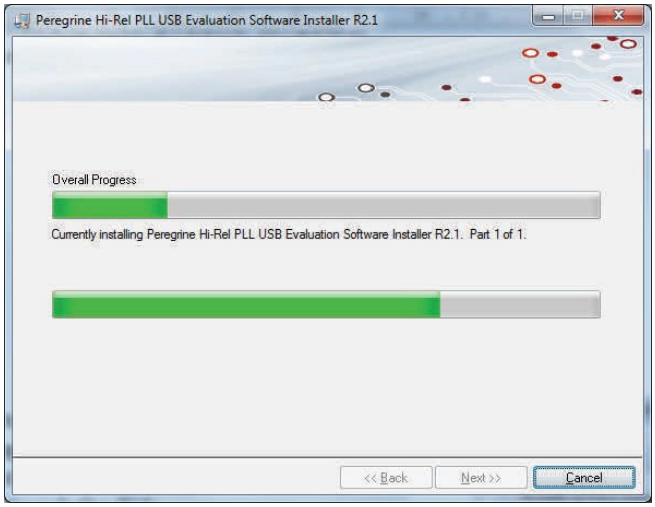
Figures 5(d-f). Application Software Installation Procedure



The next installation screen starts the installation process. If the PLL application software is already installed, the installer will update the files to the newest version.



As the software files are installed, a progress indicator will be displayed. On slower computers, installation of the software may proceed for a few moments.



Once the evaluation software is installed, click “Finish” to exit.

A new Start Menu item under Peregrine Semiconductor will appear in the start menu of your computer. Select “PLL Hi-Rel Evaluation Software” to launch the GUI.

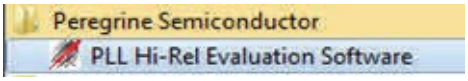
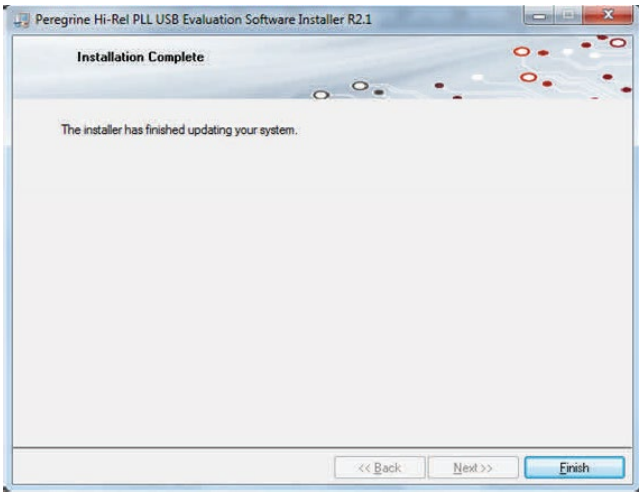


Figure 5(g). Application Software Installation Procedure



Using the Application Software Graphical User Interface

Figure 6 displays the PLL application software graphical user interface (GUI), which has the USB interface board plugged into the computer. See “Hardware Operation” for the EVK hardware configuration to use with the GUI control software. If the USB interface board is not connected when the application software is launched, the message “**The USB interface board is not connected. Please connect it and restart the program.**” will appear at the bottom of the screen.

In the upper left corner, under the Peregrine logo, there is a drop-down menu item to select the part for evaluation and the part description is right below the part number box. This is an important drop-down item, as it determines which serial peripheral interface and telegram structure the program will send to the parts under test. It is important to select the part being evaluated. Selecting the wrong part number may result in sending improper commands to the PLL under test, yielding unpredictable test results.

Once the part number to test has been selected, the part number will appear in place of the Select Part location on the GUI. The software is now ready to use.

Figure 6. PLL Application Software Graphical User Interface (GUI)

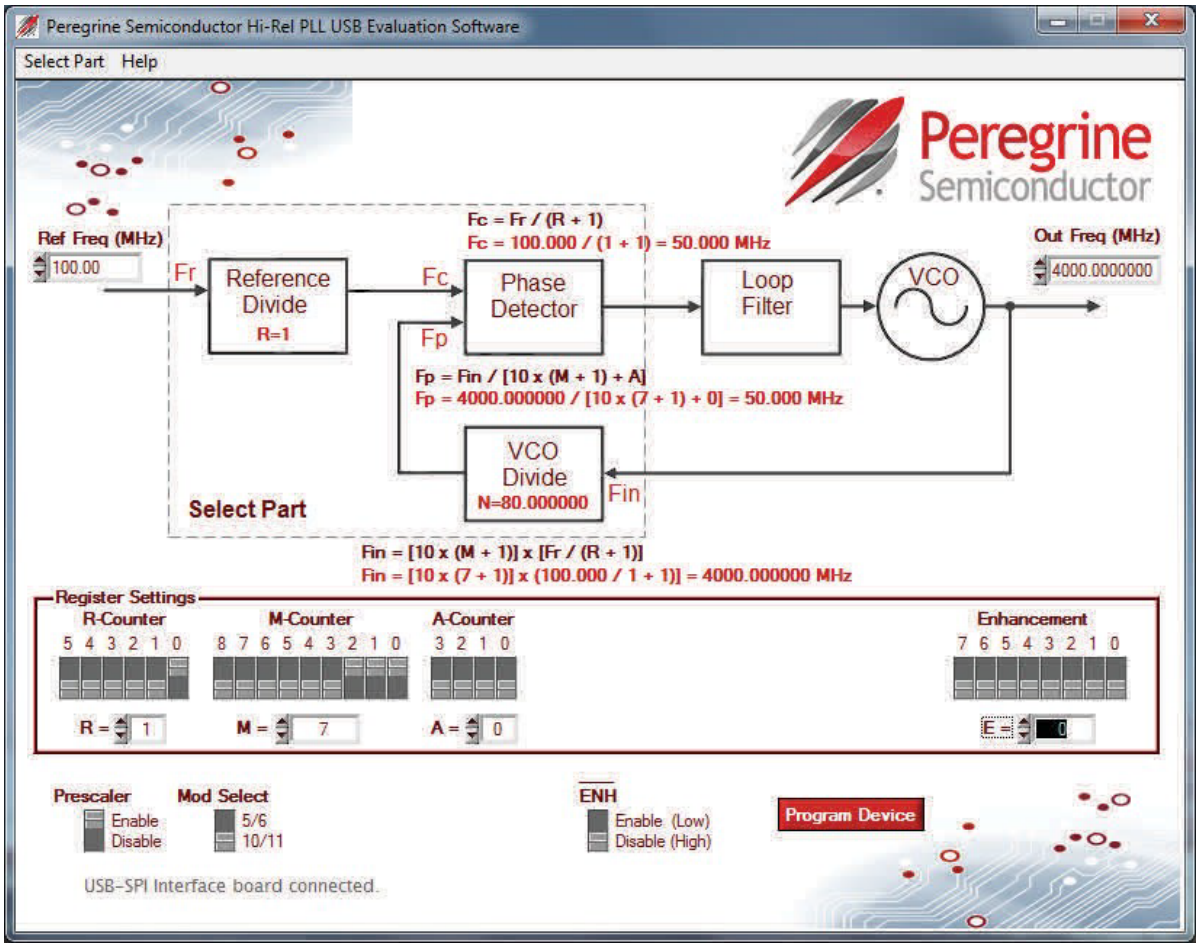


Figure 7. PLL GUI Control Bits

Prescaler

Enabling the prescaler control bit activates the 5/6 or 10/11 prescaler. The prescaler can be set to either a 5/6 or 10/11 modulus based on the Mod Select pin. Disabling the prescaler control bit allows F_{IN} to bypass the 5/6 or 10/11 modulus. In this mode, the prescaler and A counter are powered down and the input VCO frequency is divided by the M counter directly.

Mod Select

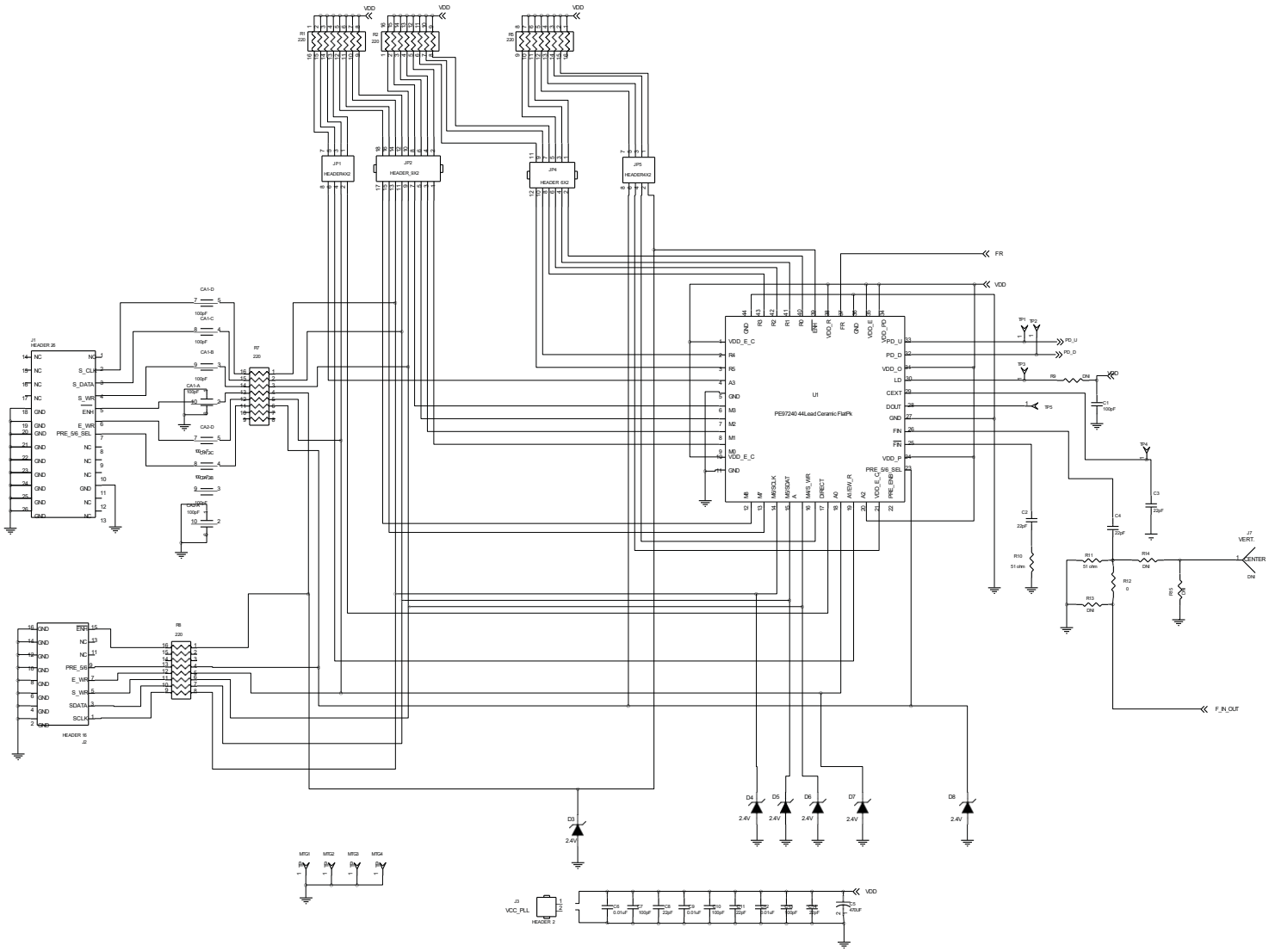
Selects prescaler modulus of 5/6 or 10/11.

ENH

Enhancement mode. When enabled “Low” the enhancement register bits become functional. The enhancement mode control bit needs to be held “High” (disabled) during normal operation under all programming modes. Setting the control bit “Low” will either put the part into a shutdown state and the phase detector output will have no output pulse, or it will go into a reset state and the phase detector will have no output pulse, similar to the shutdown state. Refer to *Table 9* in the PE97240 datasheet for the enhancement register bit functionality.

Evaluation Board Overview

Figure 8. PE97240 Evaluation Board Schematic*

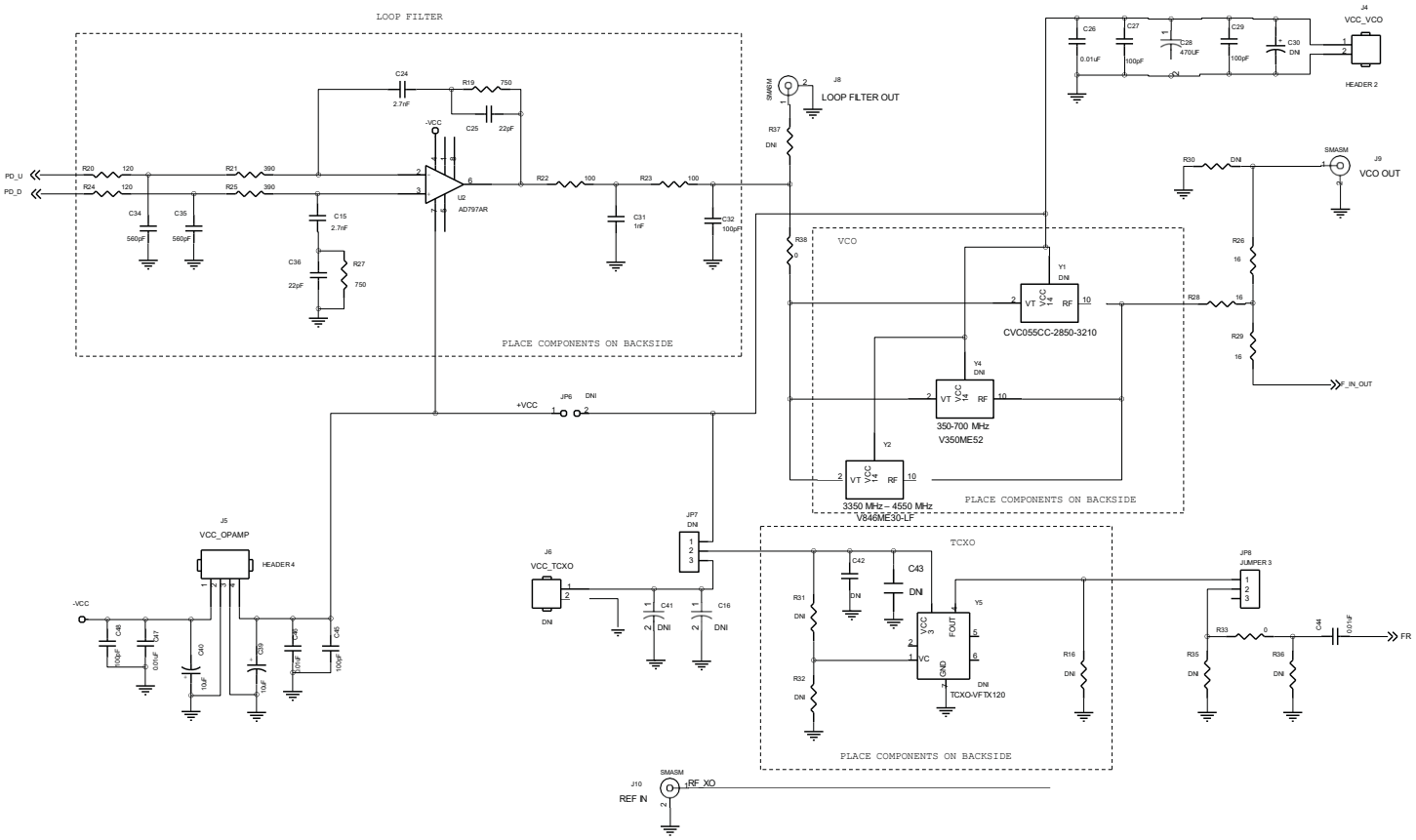


Note: * Use 101-0746-01

DOC-50870

Evaluation Board Overview

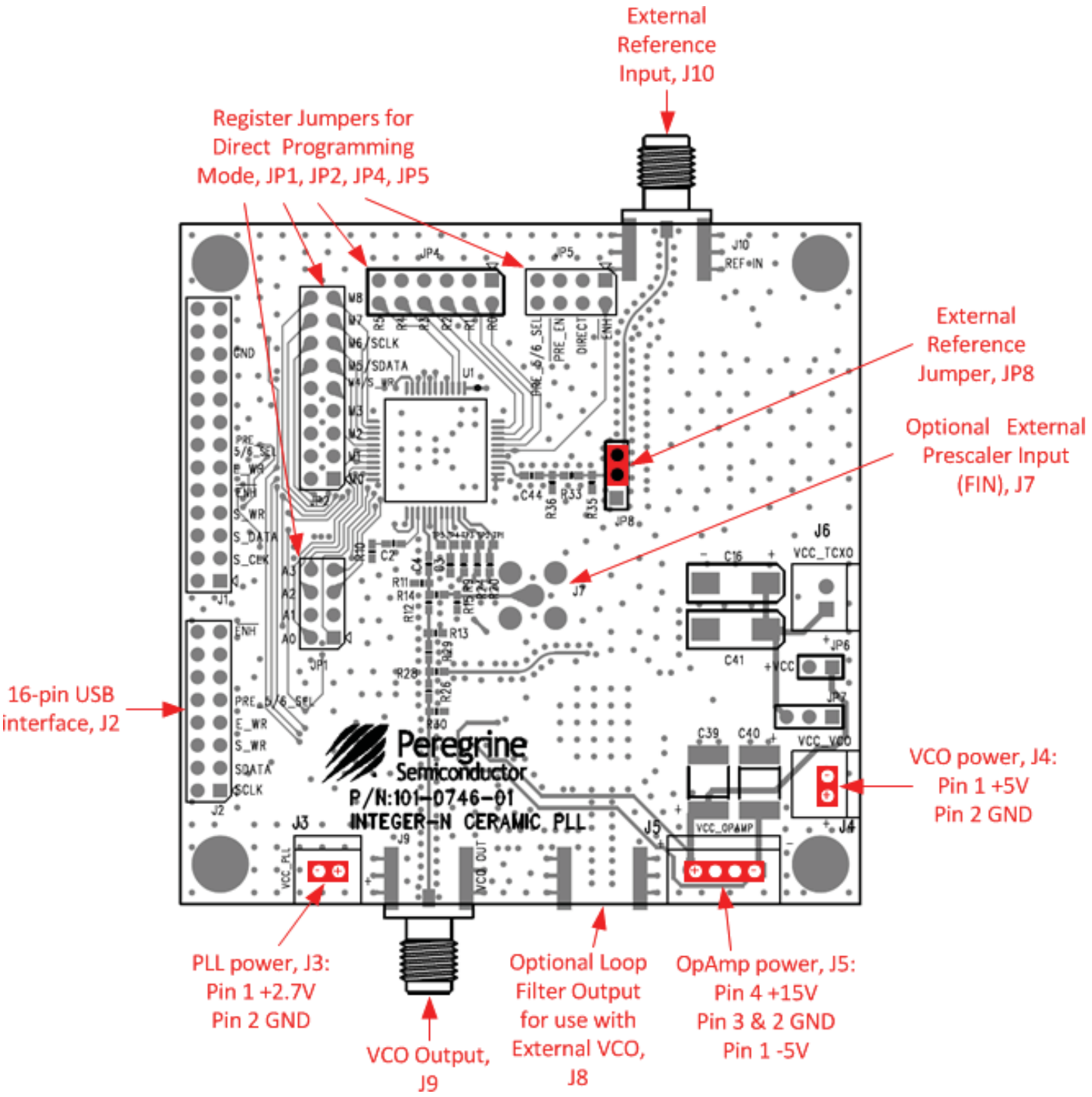
Figure 8. PE97240 Evaluation Board Schematic (cont.)



DOC-50870

Evaluation Board Overview

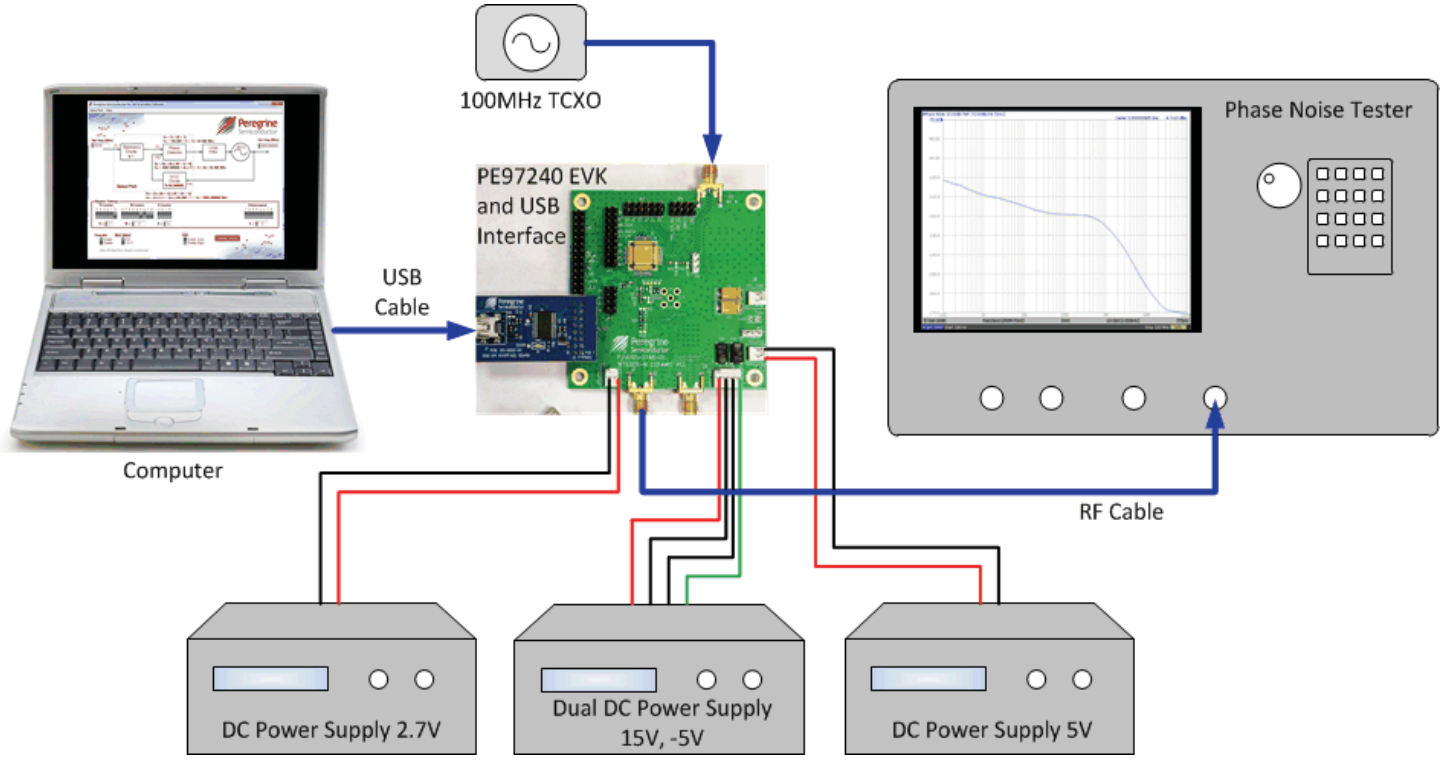
Figure 9. PE97240 Evaluation Board Outline Showing Functional Overview



Hardware Operation

1. Refer to the test setup shown in *Figure 9*.
2. Verify that all DC power supplies are turned off before proceeding.
3. Connect +2.7V DC and GND to J3 on the evaluation board to power the PE97240.
4. Connect +5V DC and GND to J4 on the evaluation board to power the VCO.
5. Connect +15V and -5V DC and GND to J5 on the evaluation board to power the Op Amp.
6. Connect the reference source (TCXO) to the external reference port (J10).
7. Connect the phase noise tester to the evaluation board using an RF cable.
8. Turn on the DC power supplies in the following order:
    a. PLL (2.7V)
    b. VCO (5V)
    c. Op Amp (15V and –5V)
9. Connect from the USB interface board to the computer using the USB cable. The red LED on the USB interface board should blink a few times indicating that the hardware is recognized.
10. Connect the USB interface board to J2 on the evaluation board.
11. Launch the application software. Once the GUI is open, the red LED on the USB interface board should remain on. The evaluation software is now ready to use.
12. Select the part to be tested from the menu bar on the GUI.
13. Set the registers values and control bits on the GUI to obtain the required frequency and operation modes.
14. Click the Program Device button on the GUI to program the PLL.

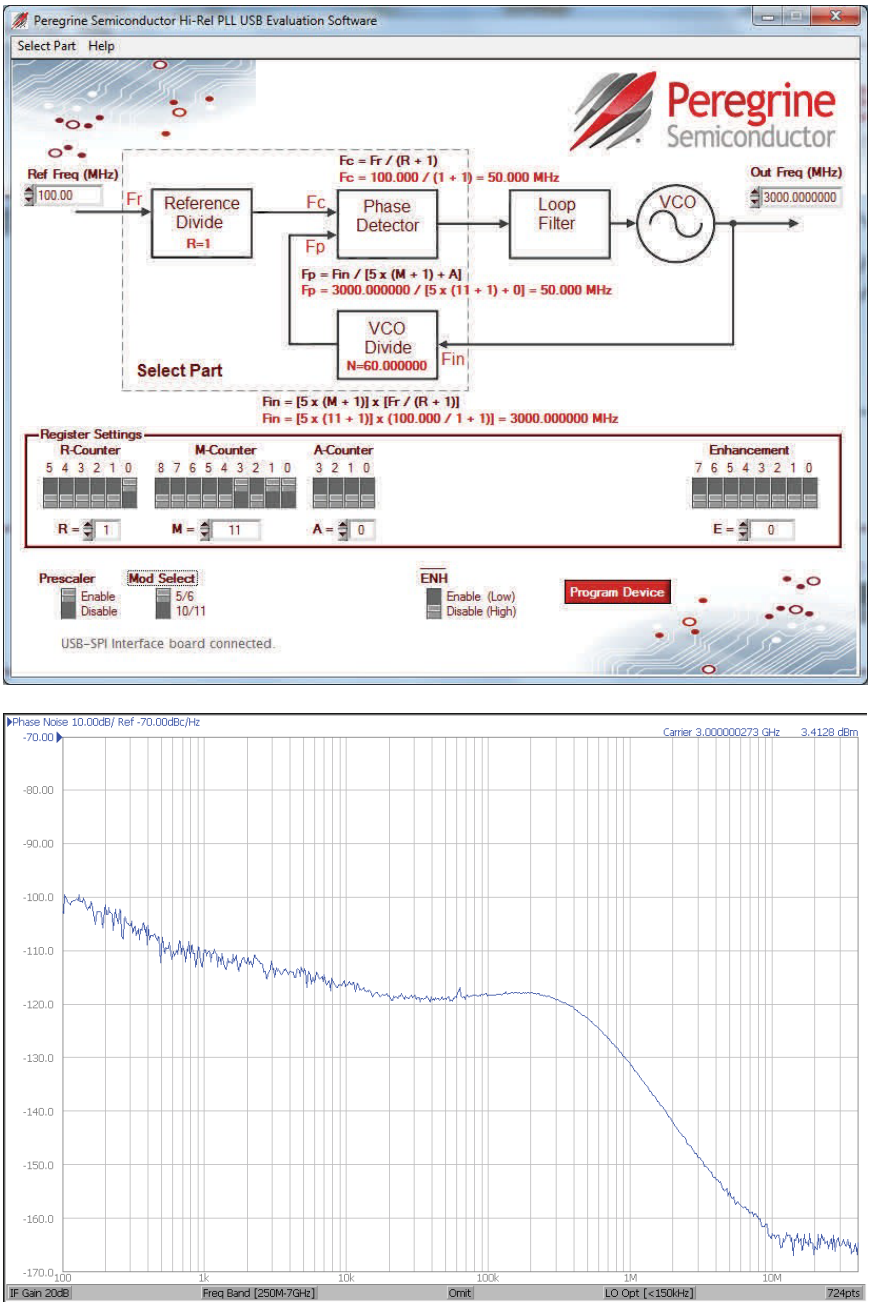
Figure 10. Suggested Test Setup for Evaluating Phase Noise



EVK Testing Using the Graphical Interface (Example 1)

Figure 11 shows the resulting phase noise measurement with the PE97240 evaluation board operating at a 50 MHz comparison frequency with a 3 GHz VCO and the 5/6 prescaler mode selected.

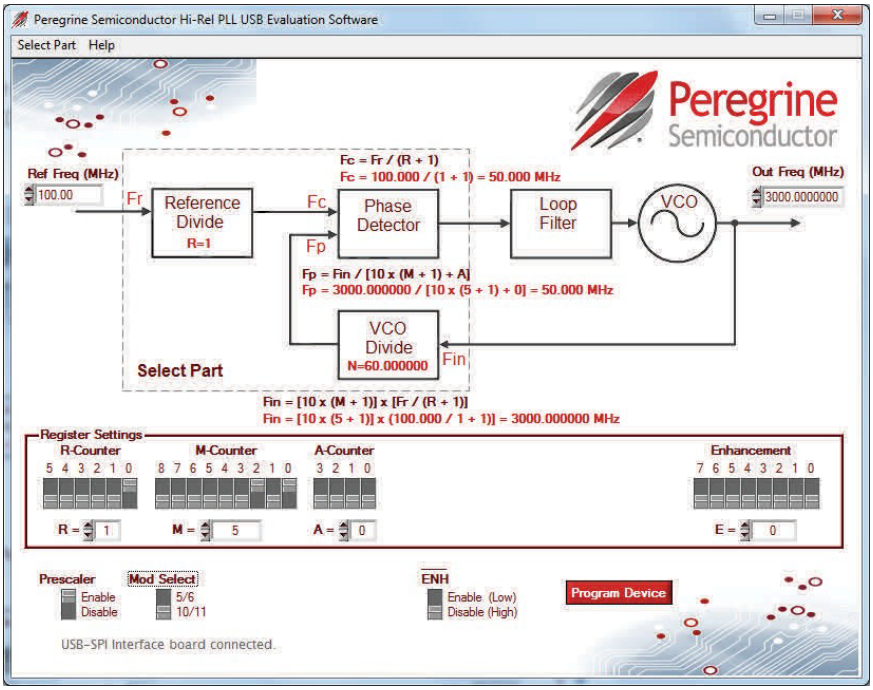
Figure 11. PE97240 Evaluation Board Test Example 1

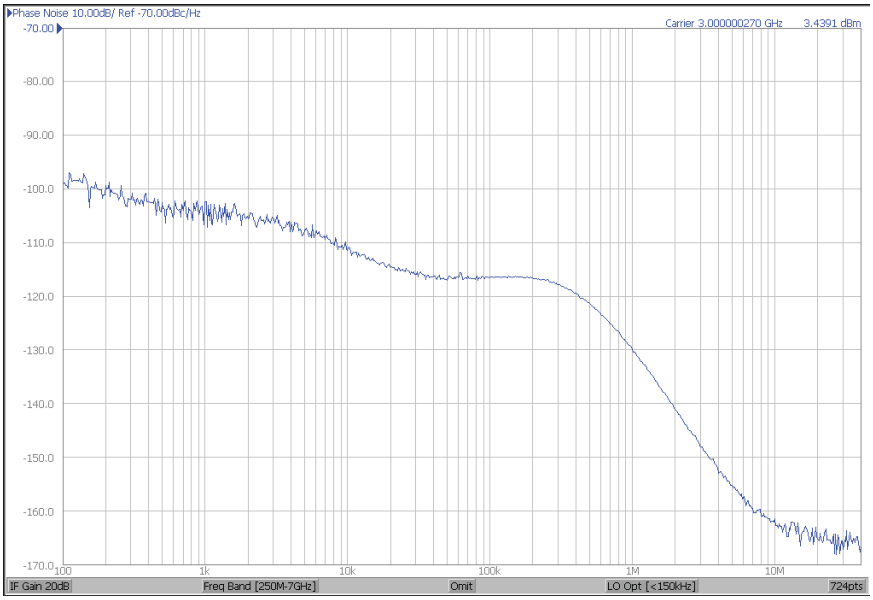


EVK Testing Using the Graphical Interface (Example 2)

Figure 12 shows the resulting phase noise measurement with the PE97240 evaluation board operating at a 50 MHz comparison frequency with a 3 GHz VCO and the 10/11 prescaler mode selected.

Figure 12. PE97240 Evaluation Board Test Example 2

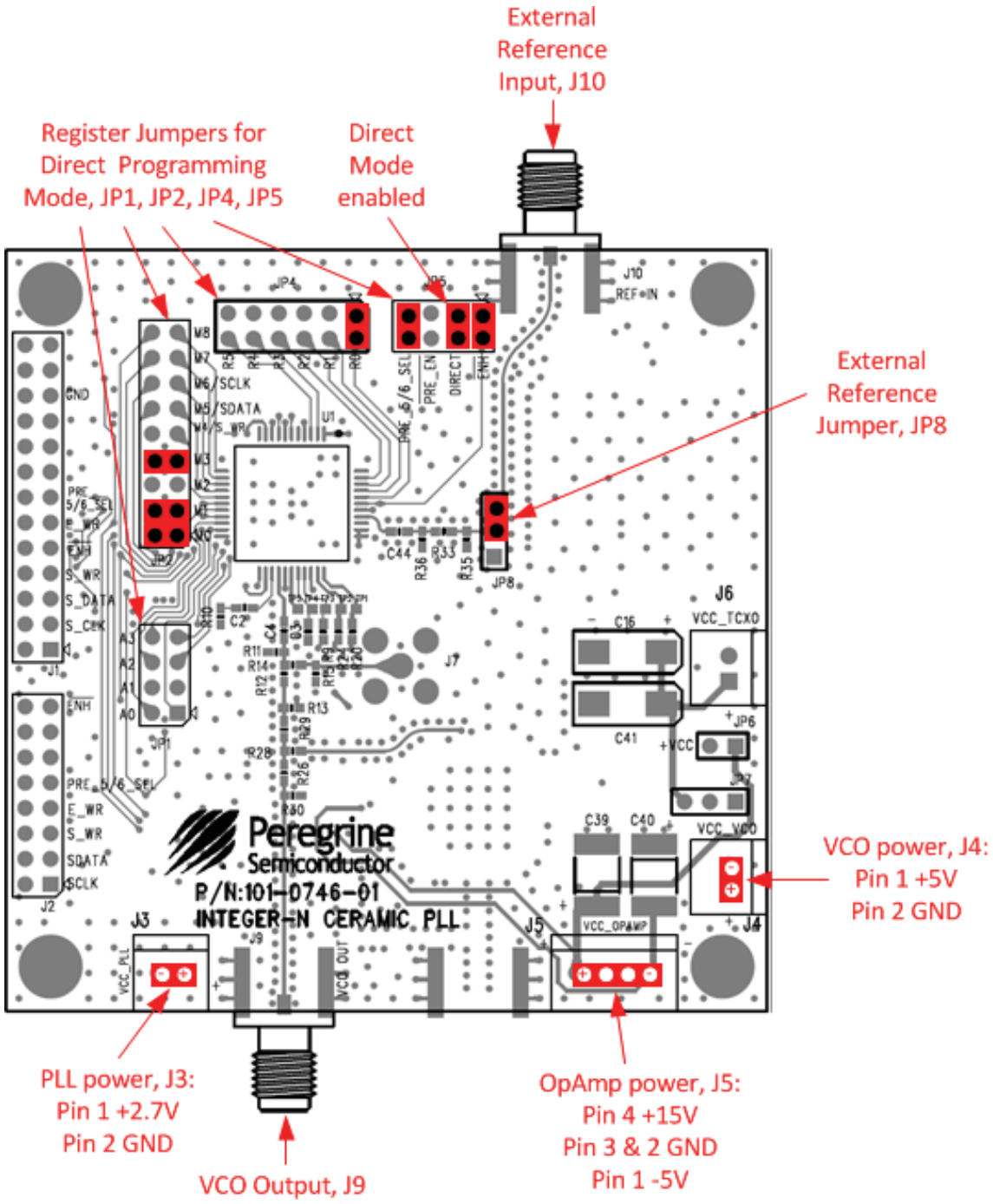




Direct Programming Mode

Direct programming mode allows for manual evaluation of the EVK without the application software. However, it is handy to have the GUI open to determine the values of the R, M and A register settings needed. The counters can then be set directly with on-board jumpers (JP1, JP2, JP4 and JP5), as shown in *Figure 12.* To enable direct mode programming, both the ENH and the direct programming jumpers (JP5) should be installed.

Figure 13. Direct Programming Mode Settings Using 5/6 Prescaler from Test Example 1



Troubleshooting Tips

The message **"The USB interface board is not connected. Please connect it and restart the program"** reappears after closing and restarting the application software. Follow these steps:

1. Close the program. Make sure the USB interface board is connected. Restart the application software.
2. Verify that the USB interface board is well connected. Remove the USB cable from the computer and reinsert it. Restart the application software.
3. Go to http://www.ftdichip.com/Drivers/D2XX.htm and follow the instructions for downloading the latest version of the D2XX driver software for your computer's operating system.
4. Repeat Step 1.

If any of the following occur, go to http://www.ftdichip.com/Drivers/D2XX.htm and follow the instructions for downloading the latest version of the D2XX driver software for your computer's operating system.

- An error message states the driver software not found for FT232R USB UART.
- The application software does not close or causes the computer to lock up.
- The application software does not work with Windows 8 or on a 64-bit operating system.

Technical Resources

Additional technical resources are available for download in the Products section at www.tdehirel.com. These include the Product Specification datasheet, Evaluation Kit schematic and Bill of Materials, PC-compatible software file, Evaluation Kit instruction manual, phase noise loop filter calculation spreadsheet and application notes.

Trademarks are subject to trademark claims.

Appendix A

The PE97240 is characterized using a 100 MHz, ultra low noise OCXO frequency reference. An exceptionally clean reference oscillator will ensure that the reference noise does not limit the phase noise measurement results. The following table shows the typical phase noise of the OCXO operating at 100 MHz.

Typical Specifications:						
Frequency *(Specify)*		30 to 130 MHz				
Frequency		50		100		MHz
Output Level		+13				dBm
Aging		±1 x 10^{-6} / year				
Phase Noise						
	100 Hz	-130	-136	-125	-130	dBc/Hz
	1 kHz	-160	-164	-150	-158	dBc/Hz
	10 kHz	-174	-176	-174	-176	dBc/Hz
	20 kHz	-174	-176	-174	-176	dBc/Hz
Temperature Stability *(Specify)*						
Range A	0 to +50C	±5 x 10^{-7} to ±2 x 10^{-7}				
Range B	0 to +65C					
Range C	0 to +70C					
Range D	-20 to +70C					
Range E	-40 to +70C					
Range F	-55 to +85C					
Electrical Tuning Range *(Specify)*						
Tuning A	0 to +10 VDC	±2 x 10^{-7} to ±4 x 10^{-6}				
Tuning B	±5 VDC					
Supply Voltage *(Specify)*		+12 or +15				VDC
Warm-up Power		5 for 5 minutes				Watts
Total Power *typical*		2.5 at 25°C				Watts
Crystal Type		SC				
Dimensions		44.4 x 74.7 x 25.4 1.75 x 2.94 x 1				mm inches
Connectors		SMA on side and solder pins on base				

Sales Contact and Information

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