



# **PE9704 EVALUATION KIT USER'S MANUAL**

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# Table of Contents

<b>Introduction.....</b>	<b>4</b>
Introduction.....	5
Applications Support.....	5
FCC Labeling Requirement.....	5
<b>Hardware Section.....</b>	<b>6</b>
Evaluation Kit Contents & Requirements.....	7
Evaluation Kit Configuration.....	8
Evaluation Kit Setup.....	9
<b>Software Section.....</b>	<b>13</b>
Software Installation Instructions.....	14
Printer Port Programming.....	14
4-Wire Interface Cable with Ground Configuration .....	15
Software Operation Instructions .....	15
Programming Tip.....	16

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This device is intended for use only in a research and development environment. It has not been tested for compliance with FCC regulations regarding interference with radio frequency energy. It might cause harmful interference with radio communications. The user assumes responsibility for any interference caused by this device.



# Introduction

## Introduction

This Evaluation Kit is specifically designed for evaluating the PE9704 3 GHz Integer-N PLL. The Evaluation Kit allows maximum flexibility for optimizing phase noise, spur, lock time and power performance for specific applications. Using the hardware and software provided in the Evaluation Kit, both serial and direct modes of programming can be demonstrated.

## Applications Support

If you have a problem with your evaluation kit, software, or if you have applications questions call **(858) 455-0660** and ask for applications support.

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## FCC Labeling Requirement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may cause harmful interference, and (2) this device must accept any interference received including interference that may cause undesired operation.



## Hardware Section

## Evaluation Kit Contents & Requirements

The Evaluation Kit includes all of the specific software and hardware required to evaluate the PE9704. Included in the Evaluation Kit are:

- 1 PE9704 Evaluation Board
- 1 PE9704 3 GHz Integer-N PLL
- 1 Peregrine CD-ROM with application software included
- 2 Jumper shunts
- 1 4-Wire Interface Cable with GND
- 2 2-Wire Power Supply Cables
- 1 4-Wire Power Supply Cable
- 1 Set of Evaluation Kit Data Plots

In order to program the part using serial programming mode the evaluation kit software will need to be installed on a computer with the following minimum requirements:

PC Compatible with Windows™ '95/98/2000

Mouse

Parallel Port

HTML Browser to access CD contents

**CAUTION:** *The PE9704-EK circuit 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.*

## Evaluation Kit Configuration

The PE9704 Evaluation Board is configured with an on-board VCO, TCXO reference and a second order active loop filter. The loop filter is followed by an optional low pass filter after the Op Amp. The VCO tuning range is 3000 MHz to 3500 MHz and the reference oscillator runs at 20 MHz. The active loop filter is designed for a 1 MHz comparison frequency and a 3000 MHz output frequency with unity gain crossover at 66 kHz, phase margin of 73 degrees and 1.2 dB of peaking. The data provided was measured in this configuration with the default jumper settings shown in Figure 1.

Two jumper shunts (J3 & J32) configure the Evaluation Board to operate with either the on-board reference oscillator (TCXO) or an external reference applied to J10. Figure 1 shows the proper configuration for utilizing the on-board TCXO reference. J32 in the middle-to-right connection as shown connects the output of the TCXO to the PLL  $f_r$  input, while J3 installed provides power to the TCXO. Do not connect any external reference to J10 if the on-board reference is selected. To use an external reference, place J32 in the middle-to-left connection which connects the PLL  $f_r$  input to the J10 SMA connector and remove the jumper on J3 to power-down the TCXO. Figure 2 shows the configuration of using an external reference. The red texts show the necessary modification from Fig. 1.

The PE3336 Evaluation Kit also allows for manual programming using the 19 on-board switches (R0-R5, M0-M8 and A0-A3). Setting the Dmode Control switch ON (Dmode switch S3-4) enables direct mode programming. Setting the Dmode Control switch to the OFF position (S3-4) the serial programming mode is enabled allowing for software control.

The default jumper and switch settings are shown in Figure 1, which will place the part into serial programming mode utilizing the on-board reference. Peregrine Semiconductor recommends that the default settings be used initially to bring up the evaluation board and duplicate the enclosed measured data.



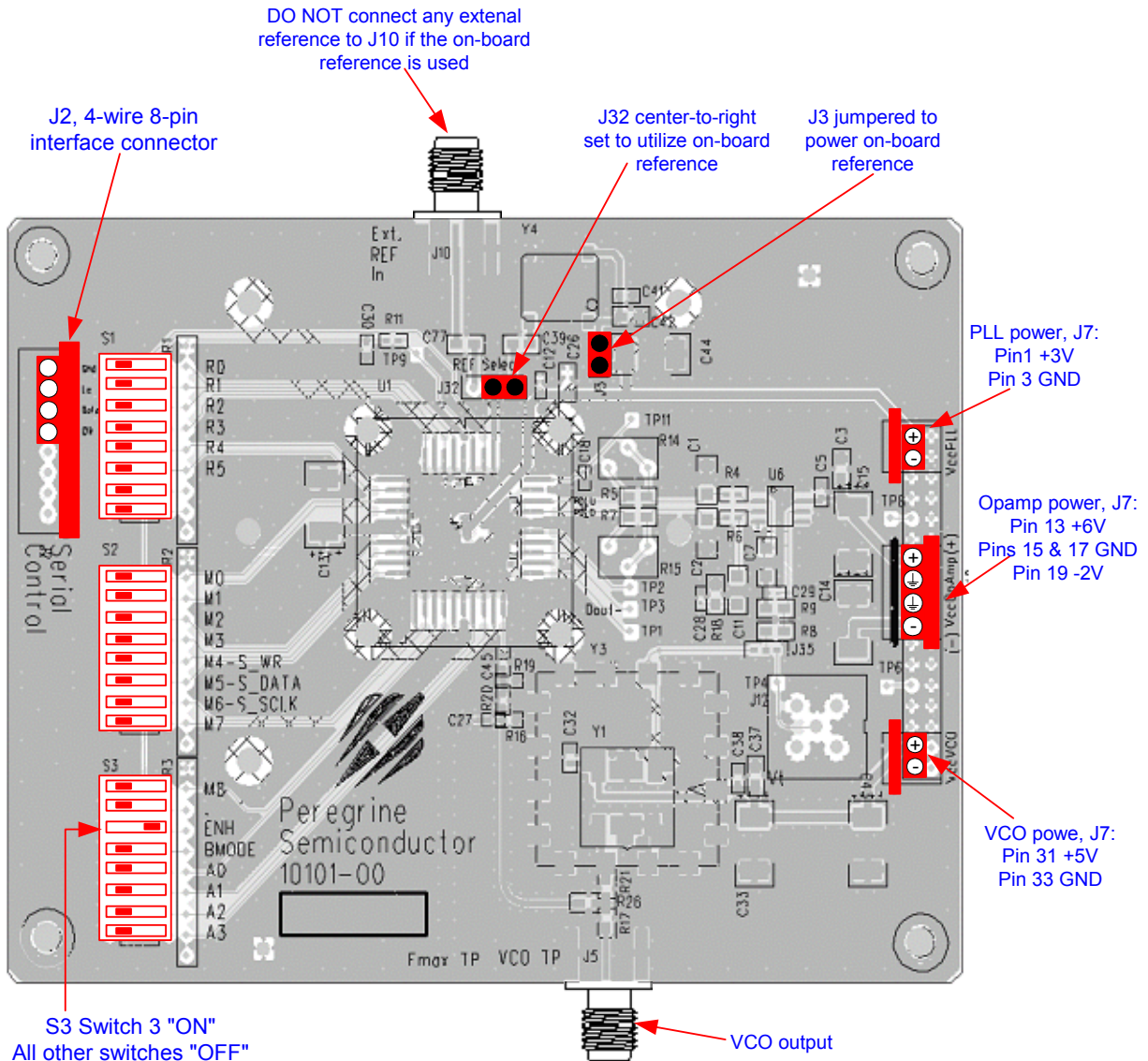


Figure 1. Evaluation Kit Default Jumper & Switch Settings Using On-board Reference.

## Evaluation Kit Setup

1. Verify a jumper is placed on the connector J3 and REF Selector (J32) is positioned in the middle-to-right connection to select the on-board reference as shown in Figure 1.
2. Verify that Switch 3 (ENH) of S3 is at "ON" position to inhibit enhancement mode. This applies to both the serial and direct interface mode. The rest of the switches should be at "OFF" position.

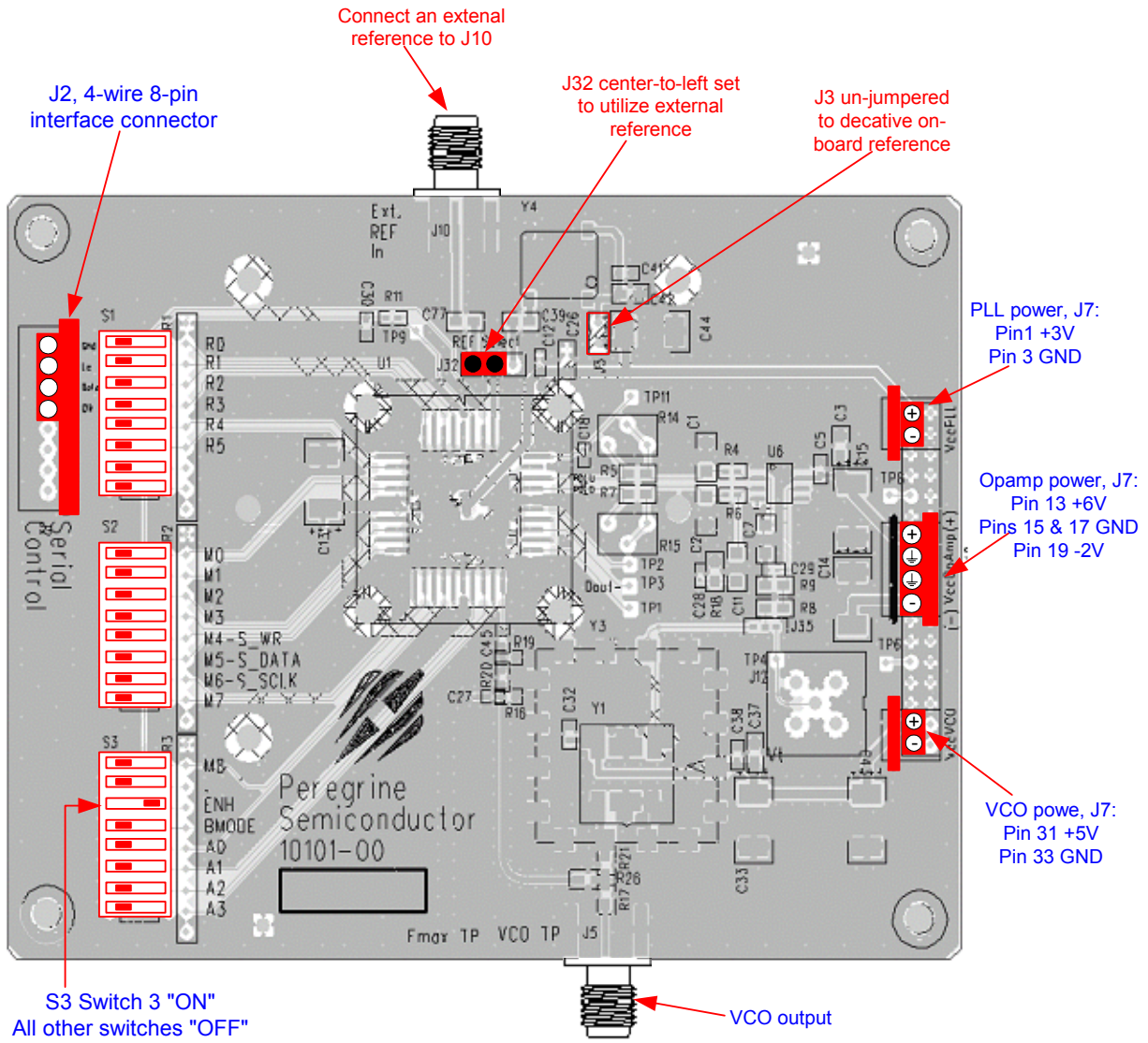


Figure 2. Jumper Setting to Use an External Reference. The red texts show the necessary modification from Fig. 1.

3. Connect power supply cable to the Evaluation Kit board as shown in Figure 1. Note that the red connector of the power cable is always the positive and the black connector is ground in a 2-wire cable or the negative in a 4-wire cable.

Verify all supplies are turned off prior to connecting to evaluation board.

- ➔ Connect the +3 V supply to J7, Pin 1 (+) and Pin 3 (GND)
- ➔ Connect the +6/-2 V supply to J7, Pin13 (+6V), Pins 15 and 17 (GND), and Pin19 (-2V)

➔ Connect the +5 V supply to J7, Pin 31 (+) and Pin 33 (GND)

4. Turn on the powers to the board.
5. Using the application software provided and described in detail in the next section, serial programming can be evaluated. To enable software control of the evaluation board, ensure all DIP switches are turned OFF except for ENH (Switch 3 of S3) as shown in Figure 1. The 4-wire interface cable (3-wire serial interface and GND) should be connected from your computer's printer port to J2 on the evaluation board to enable software control.
6. Direct mode programming can be evaluated manually without the Application Software enabled. To enable direct mode programming, both the ENH (Switch 3 of S3) and the Dmode (Switch 4 of S3) DIP switches should be turned on as shown in Figure 3. The on-board DIP switches can then be used to manually program the PLL. Instructions for programming PLL registers are available in the datasheet. One easy way is to use the Application Software to display the R, M and A counter register settings as shown in Figure 4 and at bottom of Fig. 3. The example shown is for an output frequency 3 GHz, reference frequency 20 MHz and comparison frequency 1 MHz. The on-board DIP switches are marked clearly for the R, M or A counter registers controlled and can be set to "ON" or "OFF" accordingly. Other unmarked switches (Switches 7 & 8 of S1, Switch 2 of S3) should be left in "OFF" position.
7. The output of the on-board VCO can be measured by connecting a spectrum analyzer to port J5. Before making modifications to the board, verify and duplicate the performance found in the included plots. Additional GND posts and test points are available on the Evaluation Board for measurement flexibility.
8. Refer to the next section for further information on configuring and running the application software.

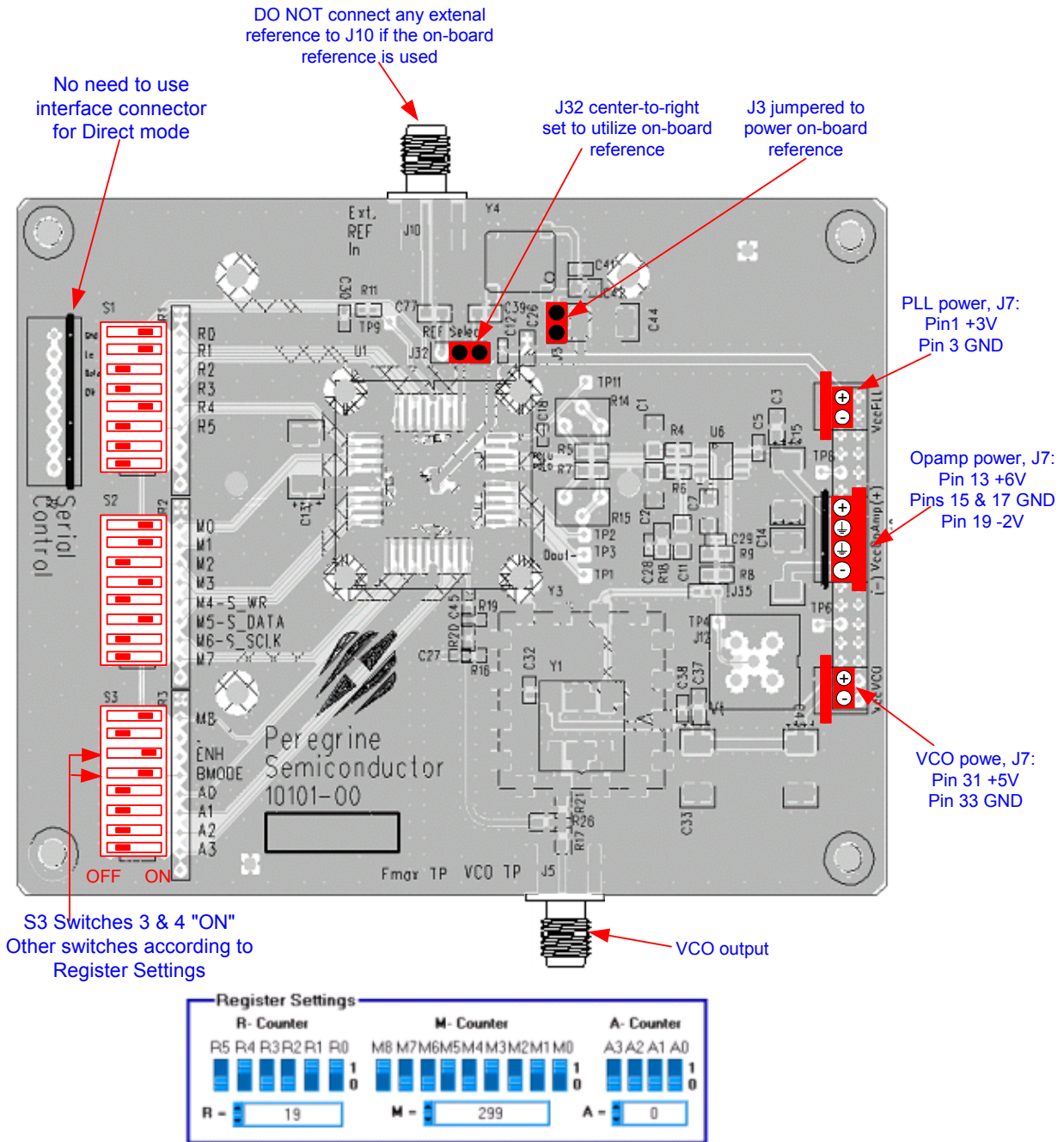


Figure 3. Jumper & Switch Settings in Direct Mode Interface Using On-board Reference. The R, M and A counter register settings shown in S1, S2 and S3 is for an output frequency 3 GHz, reference frequency 20 MHz and comparison frequency 1 MHz.



## **Software Section**

## Software Installation Instructions

In order to evaluate the PE9704 performance, the Evaluation Software has to be installed in your computer. Follow the steps below to install the software.

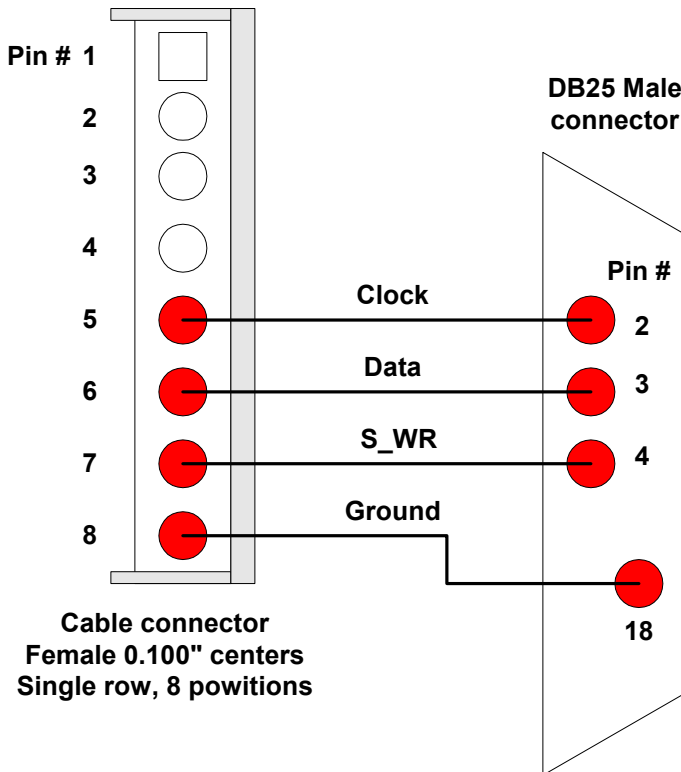
1. Start Microsoft Windows™ '95/98/2000.
2. Insert the Peregrine CD into CDROM drive. If your computer has AutoPlay enabled and the splash screen automatically appears, select the Products link at the bottom of the splash screen. If the Peregrine splash screen does not automatically appear, utilize Windows Explorer to browse the CD directory and open the file \cd\startup.htm.
3. Select the PE3236 link on the Products page to obtain product information and evaluation kit documentation. The Peregrine Evaluation Software is generic software applicable to all Peregrine Integer-N PLLs including PE9704. The PE9704 wasn't available when the CD was made. We'll use the software for the PE3236 which is applicable to PE9704.
4. Select the Evaluation Board Software link and choose the option of "Run this program from its current location." Identify the desired directory for installation and select the Unzip option when the WinZip Self-Extractor window appears.
5. Utilize Explorer to run "Setup.exe" from your hard disk directory and follow the instructions on the screen. This will install the Evaluation Kit Application Software in the selected directory and add a shortcut to the Windows Start menu.

## Printer Port Programming

When programming the PE9704 in serial mode using the computer printer port option, the Enhancement mode and Ping-pong mode software programming features are not available nor applicable to the PE9704.

## 4-Wire Interface Cable with Ground Configuration

The following graph shows the configuration of a 4-Wire Interface Cable with ground.



## Software Operation Instructions

To run the PEPE9704 using your computer's printer port follow steps 1 through 7 below and reference Figure 4.

- Step 1: Start the Peregrine Integer-N PLL EK Control program. This is a generic program for all Interger-N PLL's at Peregrine Semiconductor, like PE3236, PE3336, PE9601, PE3335, etc..
- Step 2: Select the PE3236 from the pull-down menu button in the upper left corner of the program screen. This selection will enable certain product specific modes of operation. Figure 4 shows one example of PE3236 Software Control Panel which is applicable to the PE9704 also.
- Step 3: Enter reference frequency (crystal frequency) value in MHz into the Ref Freq box (marked by red dot at left). It shows Ref Freq = 20 MHz in Fig. 4.
- Step 4: Set reference counter (R counter) to the desired value by entering it into the R Register box in the middle left side (marked by yellow dot at left). Note that

the numbers in the orange boxes are computed values and cannot be directly typed in. It shows  $R = 19$  in Fig. 4.

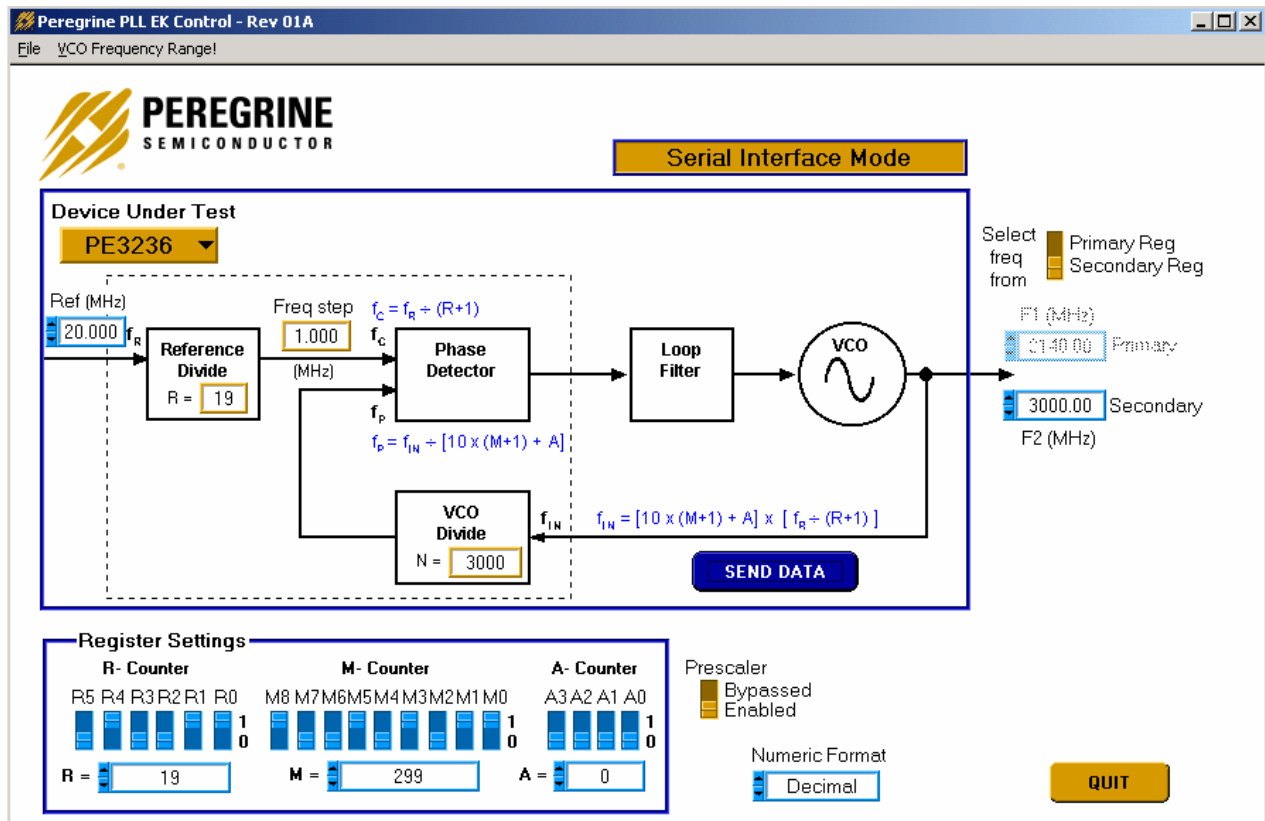
- Step 5: Verify “frequency step” (which is also called phase detector frequency) is at the desired value. It shows frequency step = 1 MHz in Fig. 4.
- Step 6: Verify that the Prescaler switch is in the default position “Enabled” for a normal operation. Switch it to “Bypassed” position if the prescaler is to be bypassed (disabled). It shows “Enabled” in Fig. 4.
- Step 7: Verify that the Register selection switch is in the default position “Secondary Reg.” There is only one 20-bit frequency register. The Register selection is not applicable in the PE9704.
- Step 8: Set the VCO frequency to the appropriate value by typing it into the secondary register frequency box. Once the frequency value is entered into the box, the corresponded M and A register values are displayed in the “M Register” and “A Register” Boxes, respectively. Instead of entering the frequency value into the secondary register frequency box, the frequency can also be changed by entering M register and A register values into the “M Register” and “A Register” boxes directly. Once the frequency values are entered by "Enter" key in the keyboard, the software will automatically send out data to program PLL. You can also click the "Send Data" button to program PLL. Fig. 4 shows the output frequency = 3000 MHz,  $M = 299$  and  $A = 0$ .
- Step 9: Verify on the spectrum analyzer that the part locks to the desired frequency.
- Step 10: To exit the program, click the “QUIT” button.

## Programming Tip

When the PLL is first powered on and before programming, the Op Amp output could be resting at a negative voltage preventing proper VCO operation. The PLL will not lock in this condition. If this mode occurs, the power supply for Op Amp (+6/-2 V) should be cycled. To prevent this from happening, the following power on sequence is recommended:

1. Turn on power supplies for PLL VDD and VCO VCC.
2. Program PLL.
3. Turn on the power supply for the Op Amp.





- ➔ Light blue number boxes identify user defined program states and can be modified by utilizing the arrows next to the boxes or clicking into the box and typing the appropriate value. Either clicking on the light blue switches or typing the counter variable into the text box can program the registers.
- ➔ Programming of the Secondary or Primary register is selected utilizing the switch identified in the upper right side of the panel. However, this is not applicable to the PE9704. Leave the register at the default selection (Secondary). Do not change it.
- ➔ The prescaler enabled or disabled can be selected by the Prescaler switch. “Enabled” is the default selection.
- ➔ The enhancement mode enable function is currently unavailable.
- ➔ Data is sent to the evaluation board with every change in register value. To force data across the bus, click on the dark blue “Send Data” button below the loop diagram.

Figure 4. PE3236 Software Control Panel Which Is Applicable To PE9704.

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