PEREGRINE SEMICONDUCTOR

AN14: Application Note

Using the PE3501 Prescaler with the PE3236 PLL to Synthesize Frequencies up to 3.5 GHz

Features

- Extends F_{MAX} of available PLL devices
- Negligible additive phase noise
- Low power prescaler operation (12 mA @ 3V typical)

Introduction

There are many applications that require the synthesis of frequencies above 3 GHz. However, this range is generally beyond the maximum frequency that PLL devices can directly accept. By using an external prescaler, the range of a PLL can be extended. This Application Note explains how the PE3501 Divide-by-2 Prescaler can be used in combination with a PE3236 PLL to synthesize frequencies as high as 3.5 GHz.

Setup

Figure 1 shows the block diagram of the PE3501 and PE3236 used together in a high-frequency synthesizer. The PE3236 phase detector outputs are fed through a loop filter into a differential operational amplifier (see Figure 2). The voltage output of the op-amp is used to control the tuning pin of the voltage-controlled oscillator (VCO). The VCO used is capable of generating 3.0 to 3.5 GHz. A small portion of this VCO signal is fed back to the PE3501 prescaler input, where its frequency is divided in half. The resulting 1.50 to 1.75 GHz signal is then applied to the PE3236 frequency input. This is well below the upper frequency limit of 2.2 GHz for the PE3236.

Figure 1. Block Diagram of PE3236 / PE3501 Loop

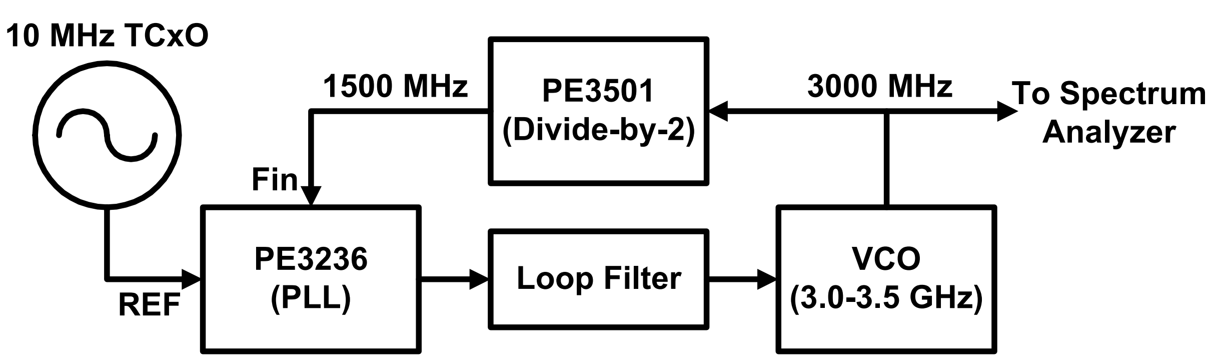
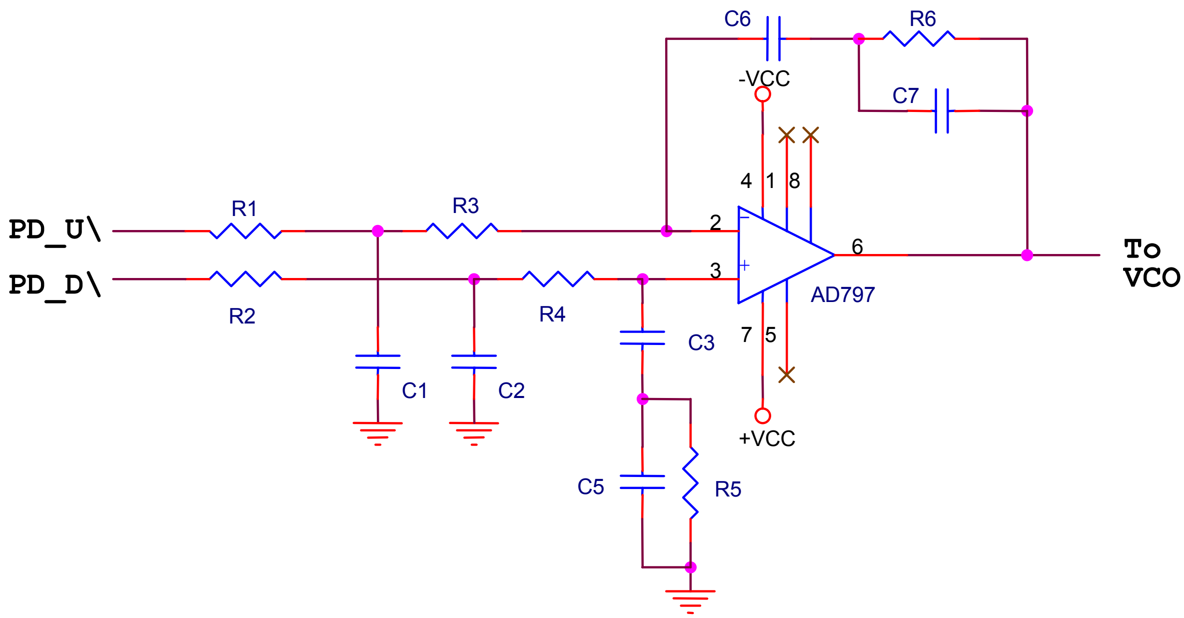


Figure 2. Loop Filter Used for This Design



Loop Filter Setup:

In order to calculate the loop filter component values, several constants are needed. The following list represents those constants. Table 1 shows the calculated values for the loop filter components.

LPF Constants:

VCO = Micronetics M3500C-2032S
Kvco = 100 MHz / V at 3.0 GHz
REF = Vectron TCXO OSC-3A0-10 MHz
Fc = 1 MHz
Phase Detector Gain = 430 mV / RAD
R1 = R2 = 120 ohms
R3 = R4 = 390 ohms
C5 = C7 = 22 pF

Table 1. Loop Filter Parameters

LPF Characteristics		LPF Components		
BW (kHz)	Phase Margin (Degrees)	C1, C2	C3, C6	R5, R6
68.00	66.00	5.6 nF	4.7 nF	2.7 kohms

Results

Figure 3 shows the phase noise as measured at both the output of the VCO and the output of the PE3501 prescaler. In addition to these two plots, a third plot is shown which is exactly 6 dB below the VCO's phase noise plot. This third plot represents the theoretical phase noise improvement that results from dividing the VCO output frequency by 2. (6 dB = 20 log(N), where N is the prescaler division ratio of 2).

We see from Figure 3 that this theoretical phase noise plot is almost identical to the actual phase noise measured at the output of the PE3501. This indicates the PE3501 has a negligible affect on the phase noise of the system.

Figure 3. Phase Noise Plot

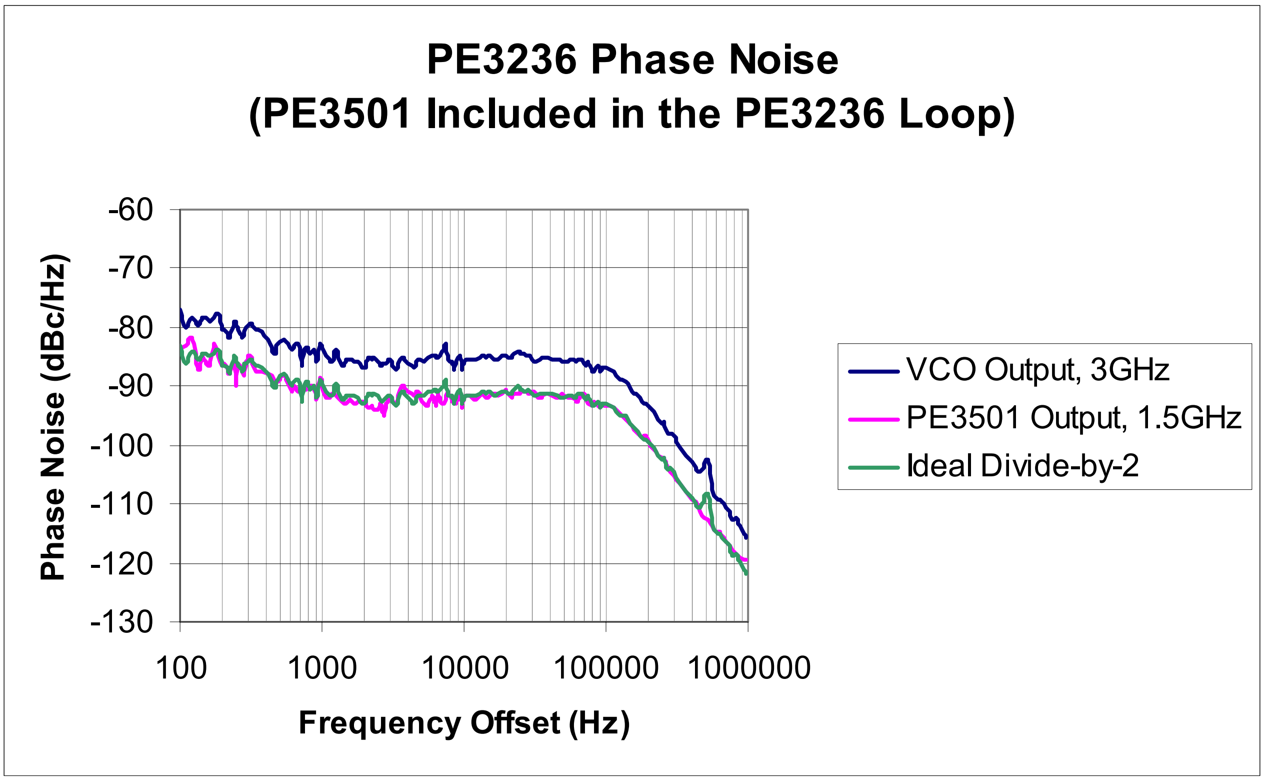
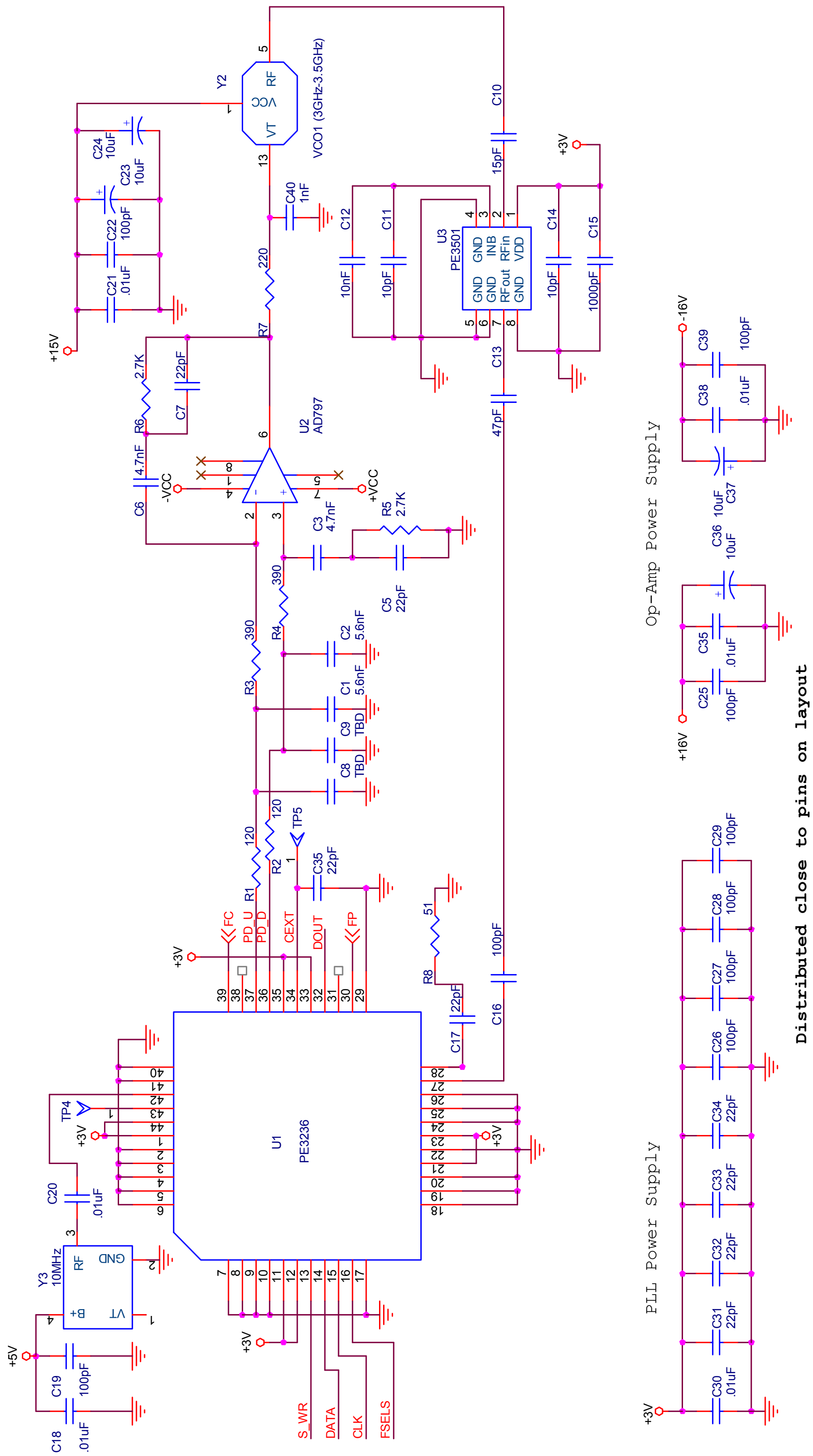


Figure 4. PE3236 / PE3501 Schematic



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