BFP410

Investigation of Phase Noise in Ku-Band DROs using BFP410

Phase noise performance vs. collector current

Application Note AN235

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Page	Subjects (major changes since last revision)

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1 Overview

This application note shows how different DC supply currents affect the phase noise of a DRO.

One parameter strongly affecting the phase noise performance is the flicker noise (1/f - noise) of the transistor used as the active element in the oscillator circuit. Other parameters are loaded Q of the resonator or the Noise Factor F, for example.

Figure 1 shows the 1/f-noise of Infineon's BFP410 bipolar transistor for different collector currents over frequency. It can clearly be seen that reducing the collector current results in lower 1/f-noise.

The question that led to this application note was how much will the phase noise performance of a DRO improve when the current consumption of the transistor is reduced.

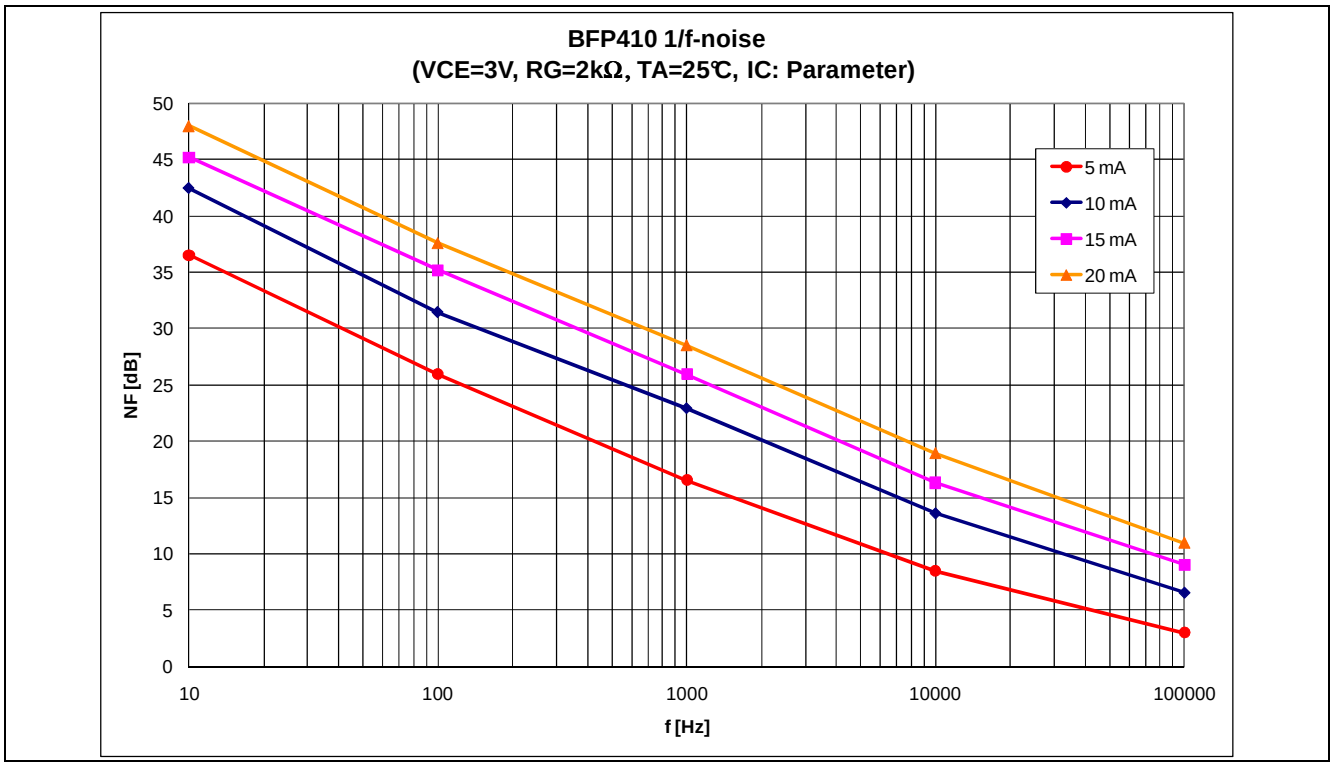

Figure 1 Flicker Noise Performance of BFP410

1.1 Test Setup

The current consumption of BFP410 in the LNB that was used for testing was changed by modifiying the values of the biasing resistors. Current consumption was calculated by checking the voltage drop over a resistor connecting from Vcc to the transistor's collector.

A block diagram of the test setup that was used for measuring phase noise is displayed in the next picture.

The LNB was powered with a standard lab DC source. All components on the LNB were running as they would do in normal operation when receiving satellite signals.

The signal of the 9.75 GHz DRO was monitored using a horn antenna. The signal couples through the closed cover of the LNB. Having the cover open would have extremely affected the behavior of the LNB. But even with closed lid the DRO's signal was strong enough to be easily detected.

A RF amplifier was used to boost signal strength so there was enough dynamic range to perform the actual phase noise measurement with a spectrum analyzer.

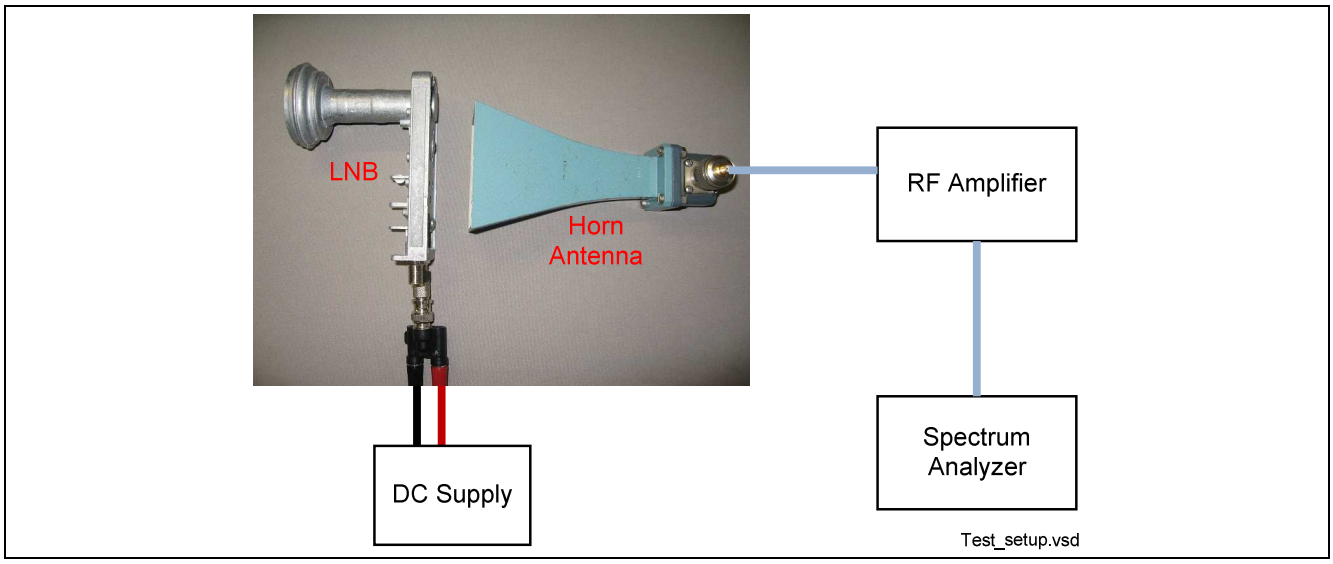

Figure 2 Setup for Measuring Phase Noise.

2 Test Results

The following pages show the results of the phase noise measurements at different currents.

It can be seen that there is a phase noise minimum when adjusting the collector current to about 11 mA.

Furtherly reducing the current results again in increasing phase noise figures.

Table 1 Phase Noise vs. DC current and offset frequency

DC current / mA	Phase Noise / (dBc/Hz) at offset frequency of:		
	1 kHz	10 kHz	100 kHz
7.5	-72.8	-98.6	-107.9
9	-75.3	-99.1	-109.5
11	-78.4	-100.3	-109.7
14	-74.8	-98.8	-110.3
20	-66.7	-94.1	-110.0

Figure 3

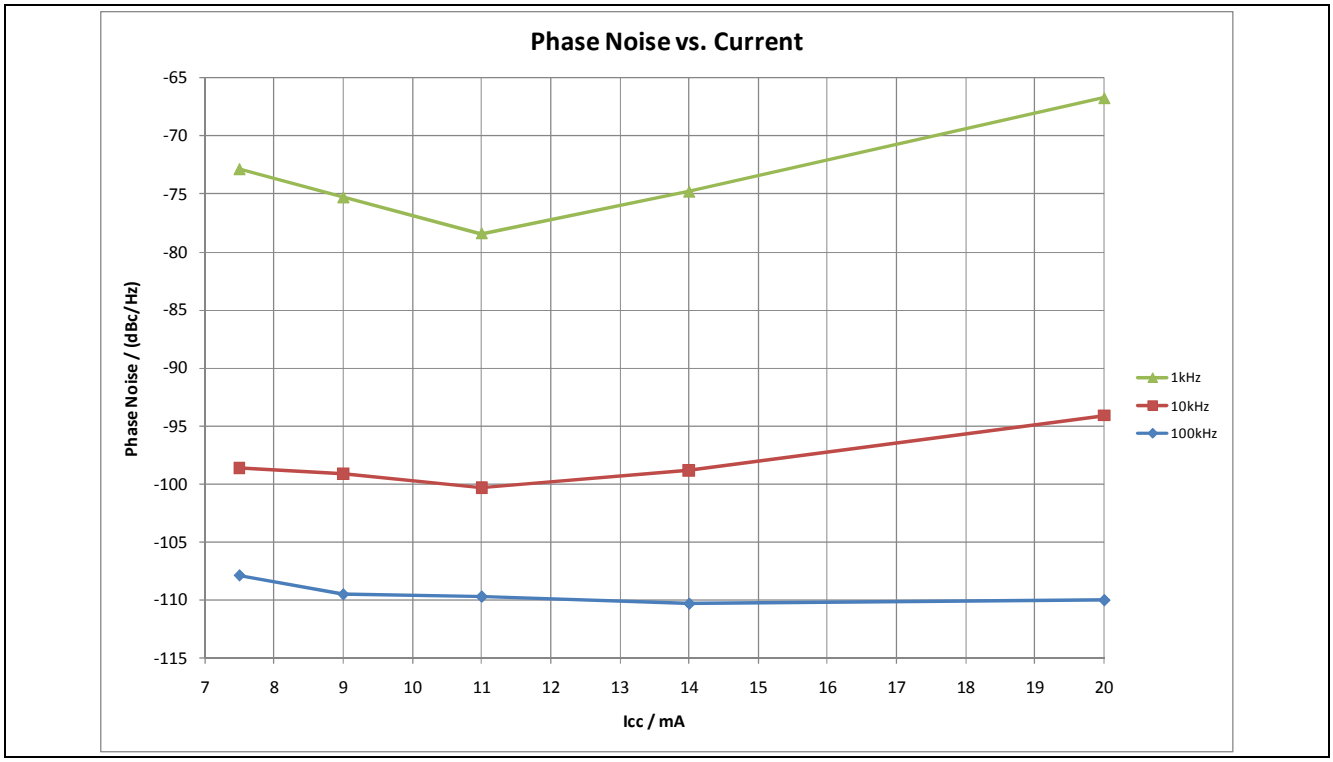

Figure 4

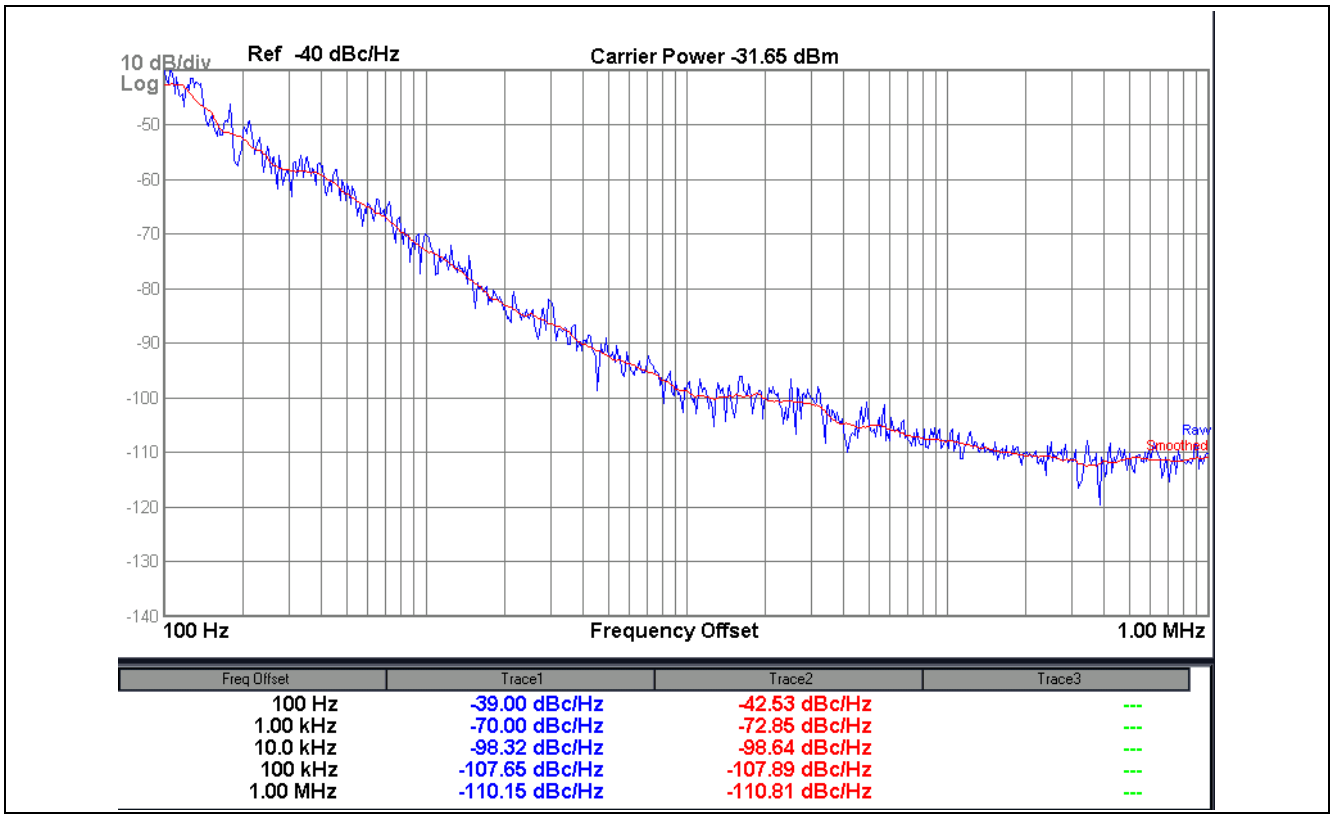

Figure 5 Phase Noise at 7.5 mA – logarithmic plot

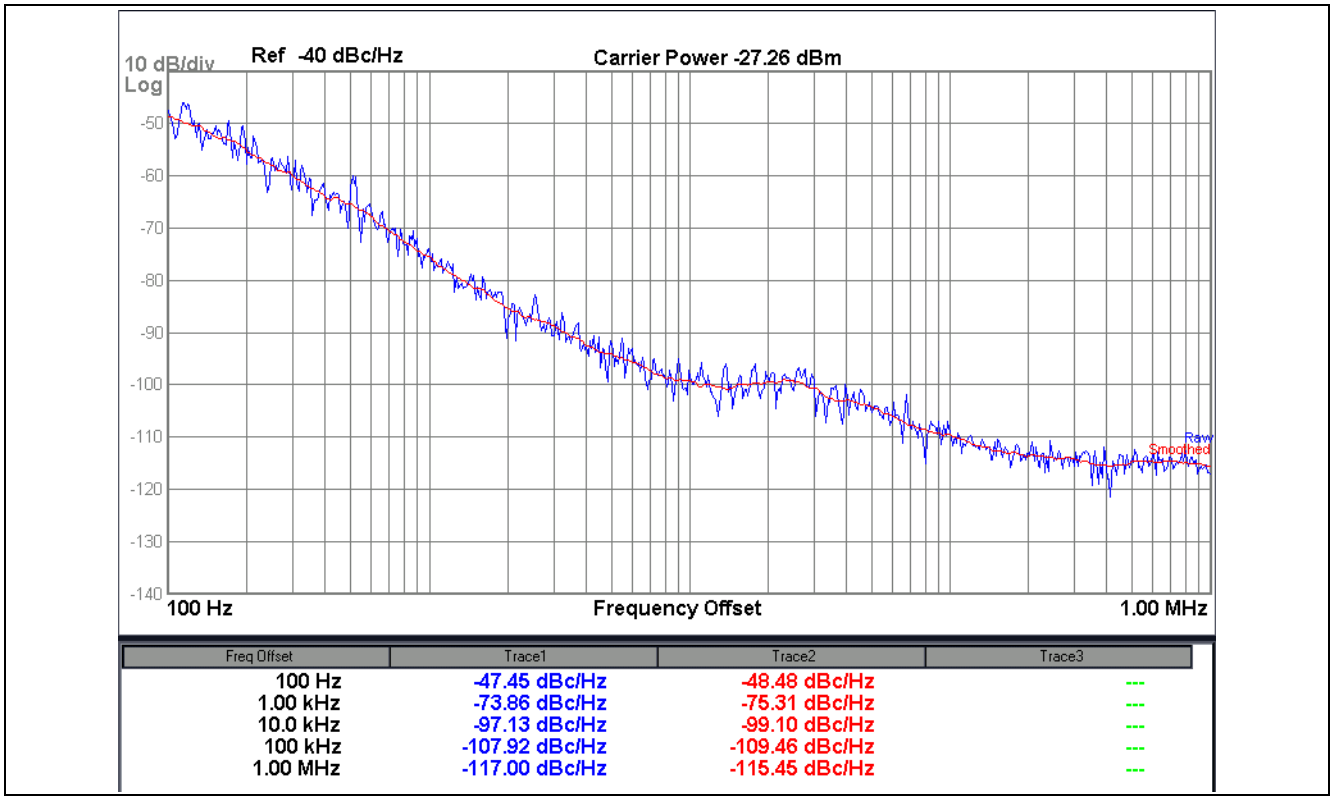

Figure 6 Phase Noise at 9 mA – logarithmic plot

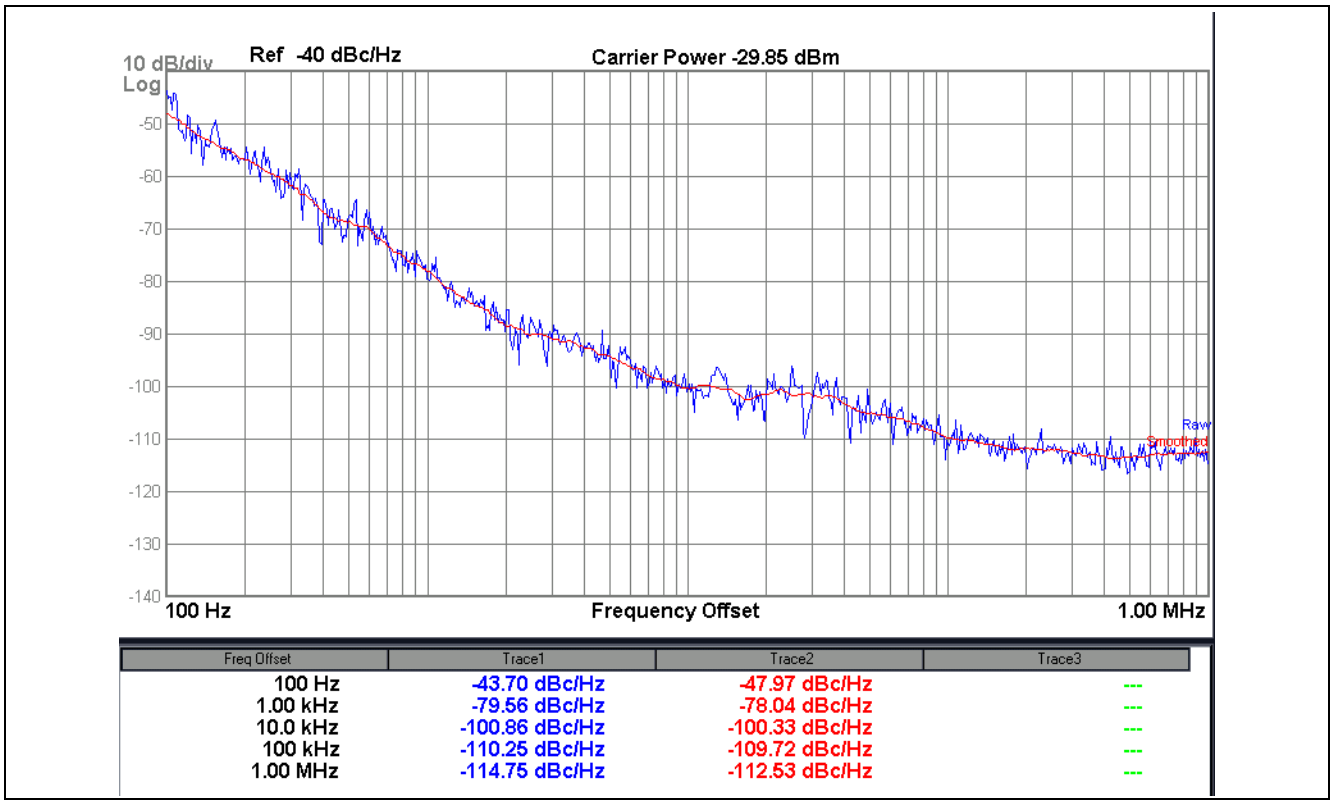

Figure 7 Phase Noise at 11 mA – logarithmic plot

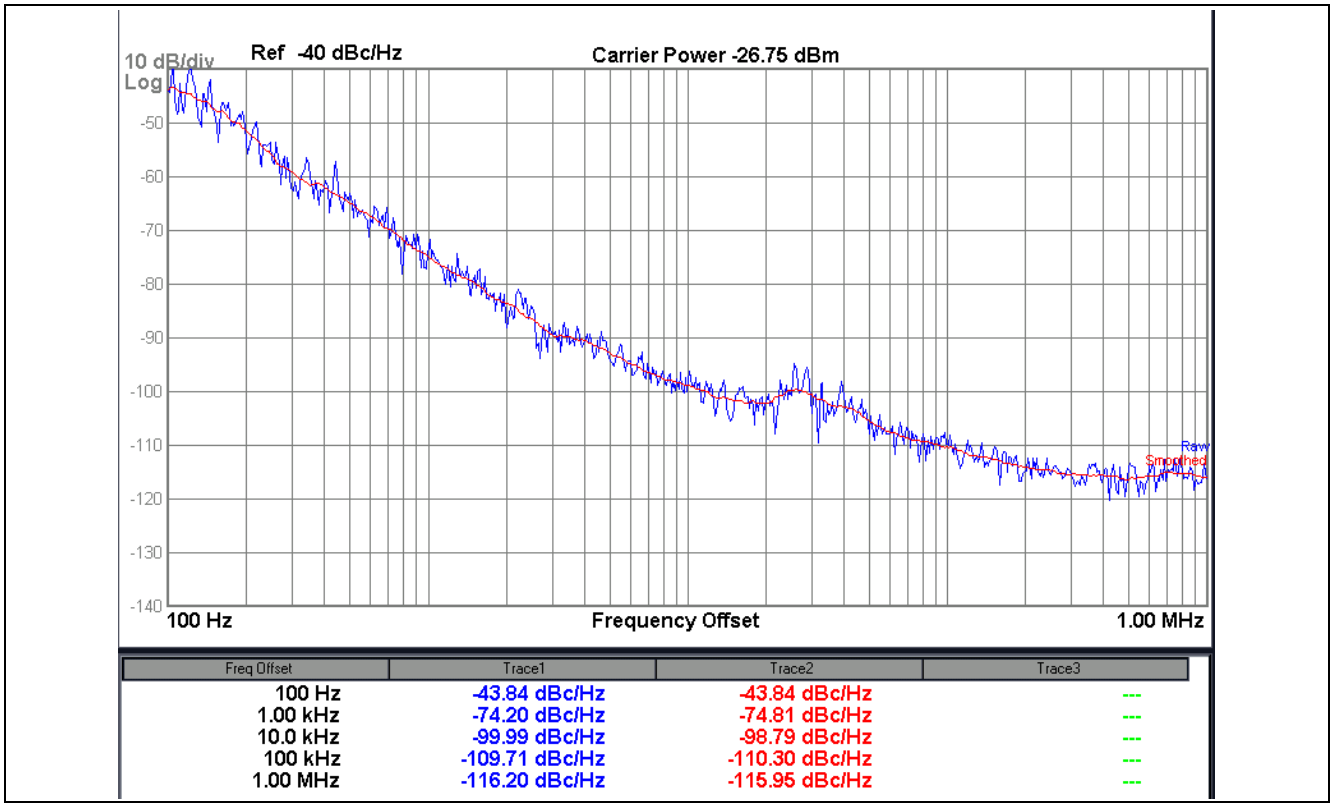

Figure 8 Phase Noise at 14 mA – logarithmic plot

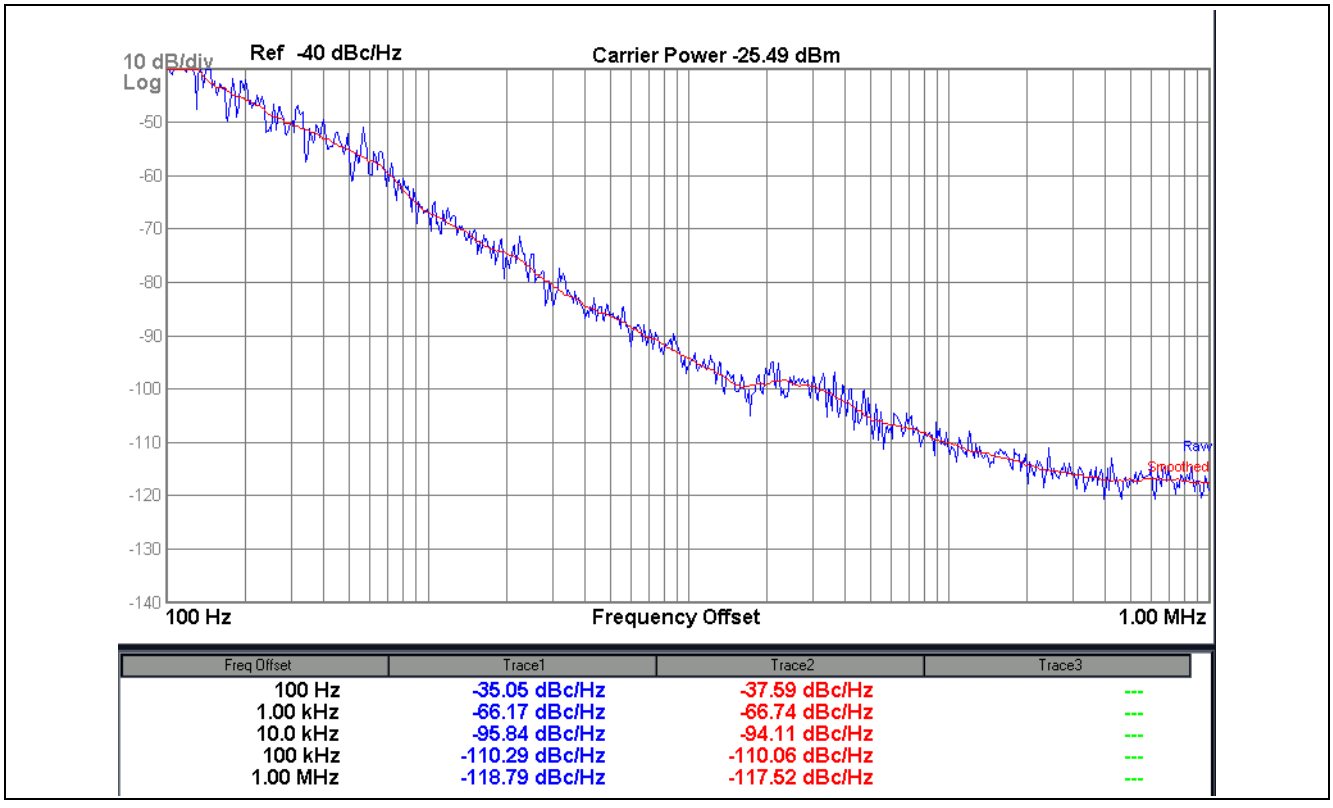

Figure 9 Phase Noise at 20 mA – logarithmic plot

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