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Using the RFFC5072 as a 5.8GHz Signal Source

Introduction

The RFFC5072 is a reconfigurable frequency conversion device with integrated fractional-N phased locked loop (PLL), voltage controlled oscillator (VCO) and a high linearity mixer. The PLL/VCO combined with an external loop filter allows the user to generate local oscillator (LO) signals from 85MHz to 4200MHz. The RFFC5072 can be configured to work as a signal source by bypassing the integrated mixer. Although the mixer operates up to 6GHz, the synthesizer is normally limited to a maximum LO frequency of 4.2GHz.

This application note describes how the RFFC5072 may be configured as a 5.8GHz signal source by using the second harmonic of the LO signal generated in the mixer. This involves setting the LO frequency to 2.9GHz, and using a 4.9GHz to 5.9GHz ISM band ceramic balun and buffer amplifier on the mixer output.

The proposed solution exploits the relatively high second harmonic output of the RFFC5072 mixer to implement a low cost 5.8GHz signal source.

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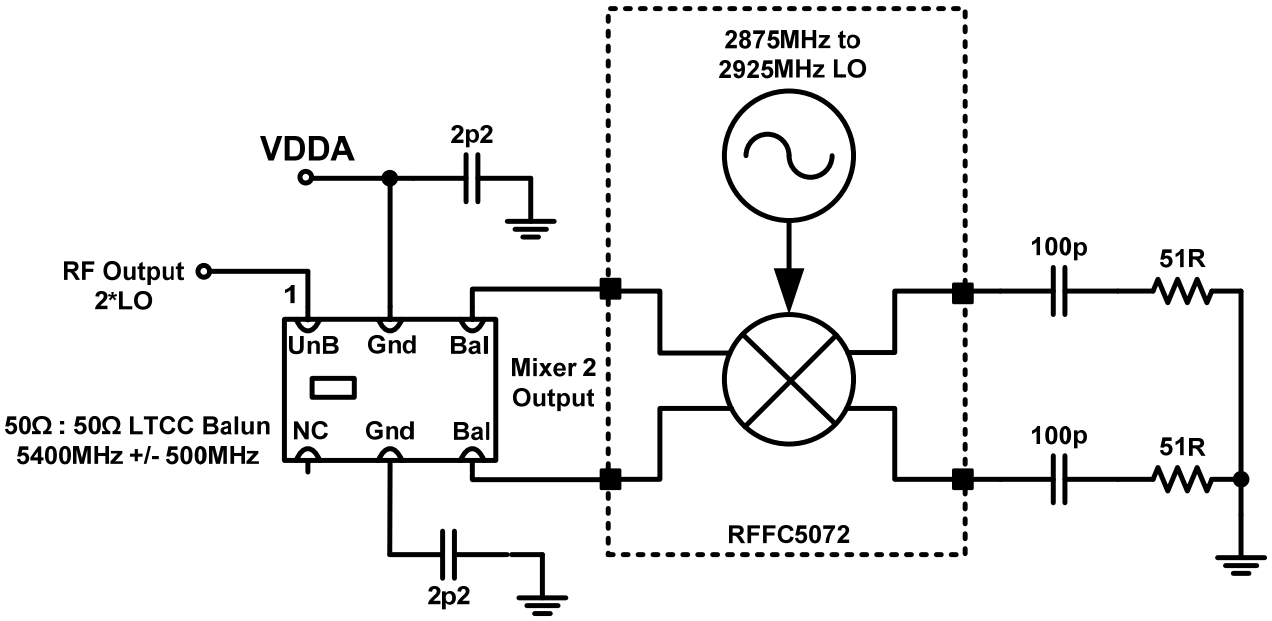
RFFC5072 Set Up

The RFFC5072 is configured as shown, the mixer inputs are terminated and a 50Ω to 50Ω balun is used on the output. This balun covers the frequency range 4.9GHz to 5.9GHz. Note that the mixer is supplied via the output pins through the balun, and ac coupling capacitors are used on the balun ground pins.



At the balun output the level of the LO second harmonic at 5.8GHz is about -14dBm. The leakage of the LO fundamental at 2.9GHz is about -28dBm, or -14dBc compared to the wanted 2*LO signal.

To raise the level of the 2*LO signal the output was buffered with an RF5515, a 4.9GHz to 5.9GHz LNA. This increased the output level to -4dBm. This LNA also gives some attenuation at lower frequencies, improving the fundamental suppression to about 22dBc. The RF5515 evaluation board was unmodified in this set-up. Extra high pass filtering could be added as required to attenuate the LO fundamental further.

A 52MHz reference TCXO was used to minimize phase noise. The reference spurs were measured at around -50dBc. Changing pllcpl (LF bits 0:2) from 2 to 3 lowers the 52MHz reference spurs by 2-3dB. The reference clock spurs are frequency-dependent; using a 20MHz clock improves the spurs by about 5dB, at the expense of phase noise. The default mixer linearity setting MIX2_IDD = 4 was used. The output level will vary somewhat with the mixer linearity setting, as will the RFFC5072 current consumption.

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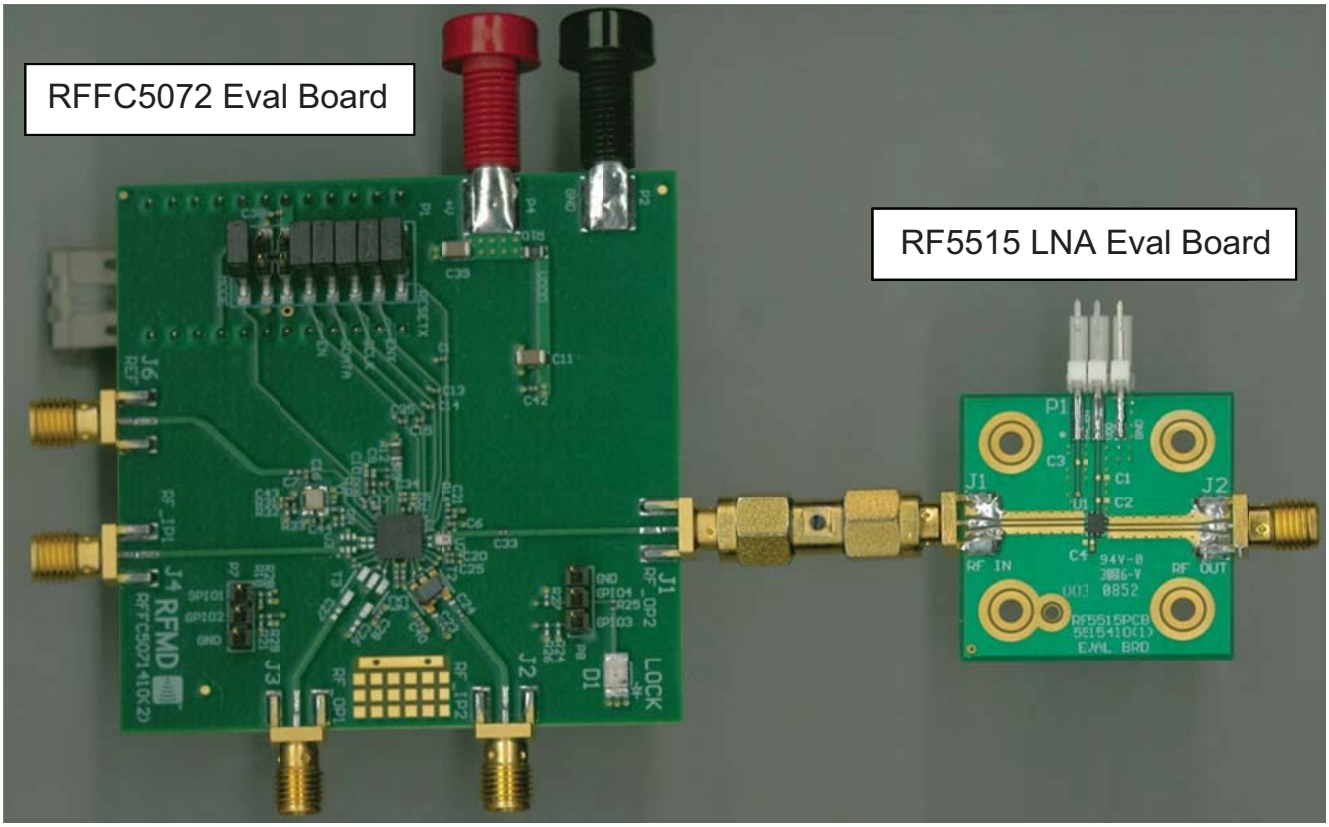
RFFC5072 Evaluation Board and RF5515 LNA Evaluation Board



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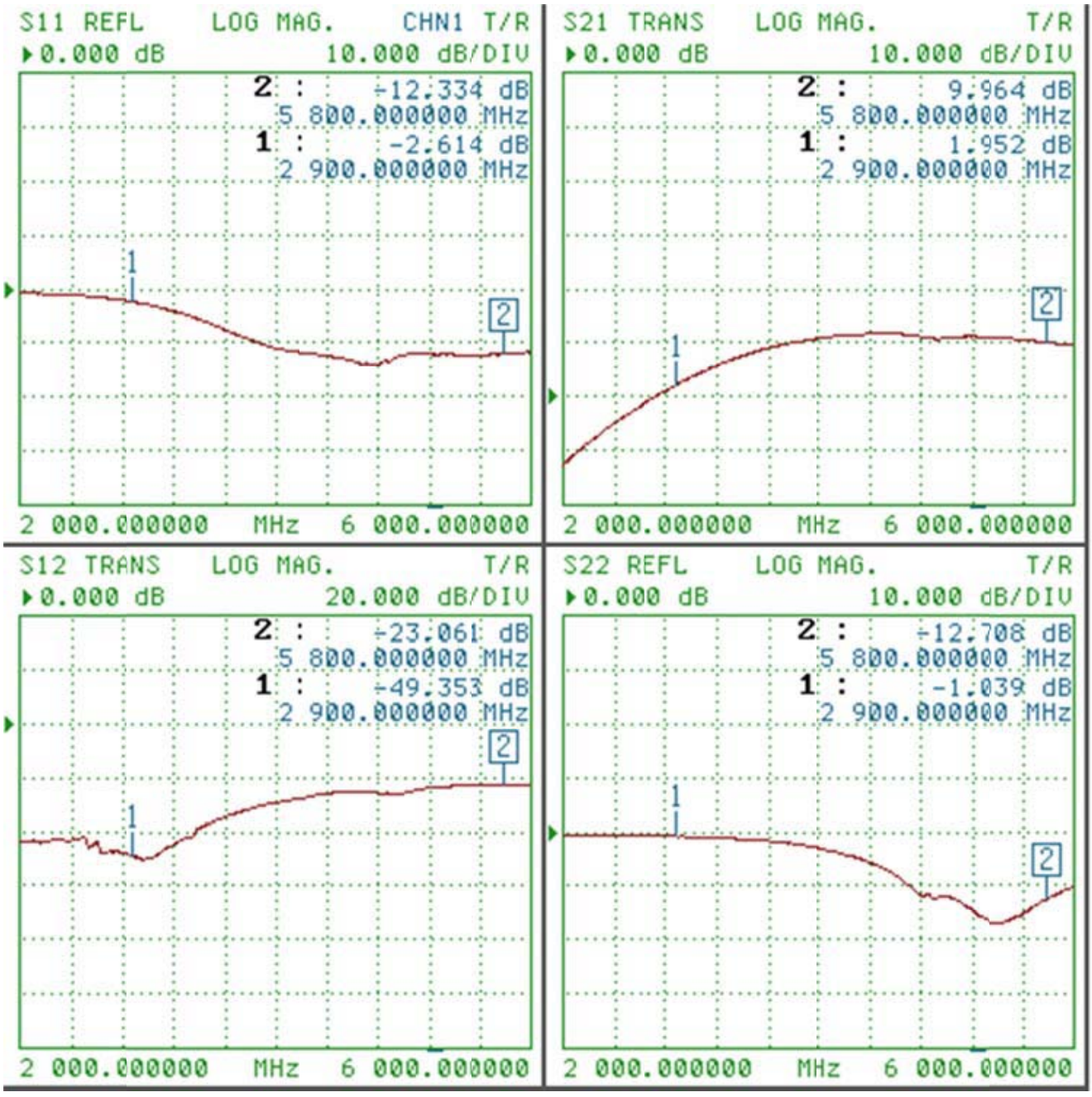
RF5515 LNA Response



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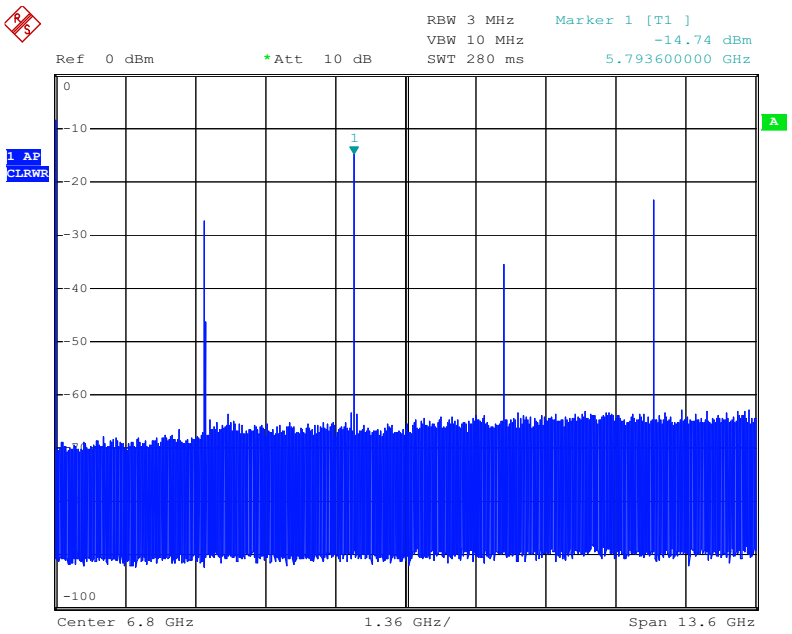
Output Spectrum: RFFC5072 Only



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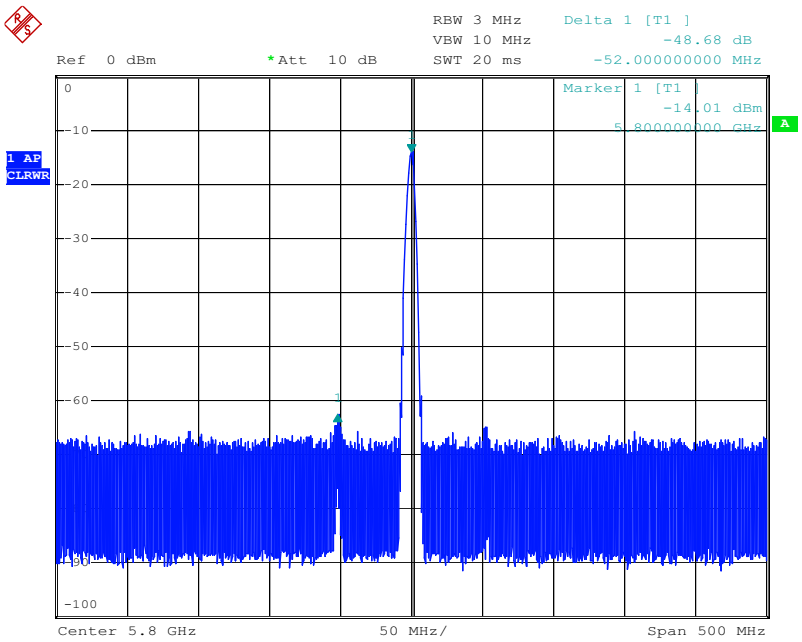

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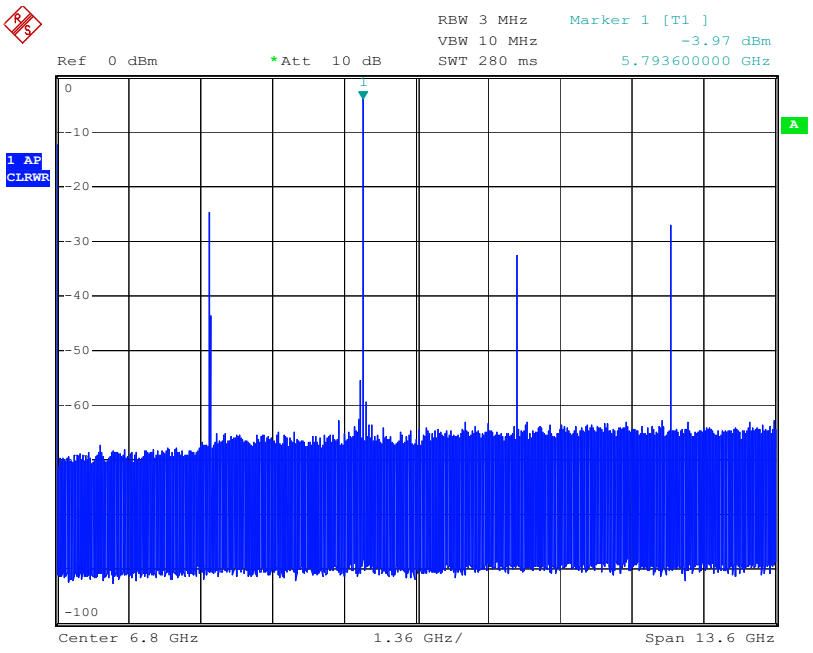
Output Spectrum: RFFC5072 and RF5515



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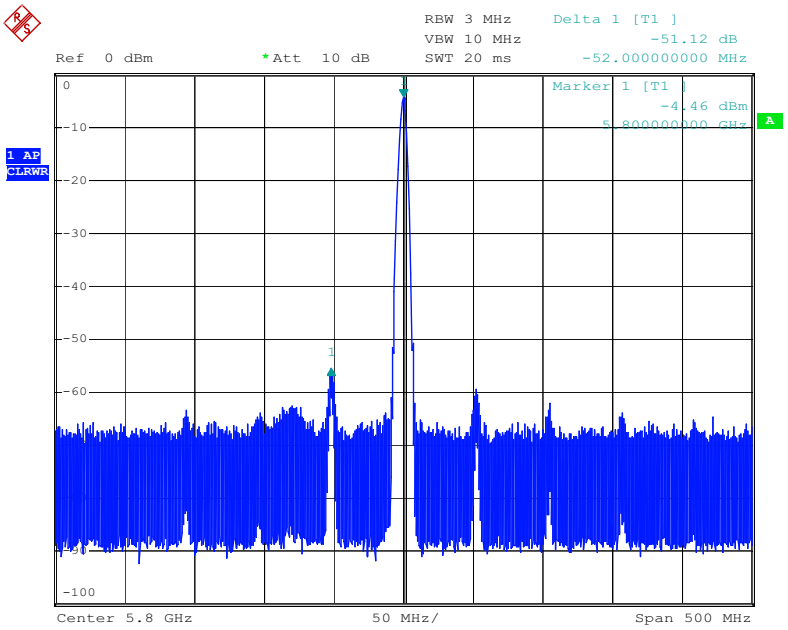

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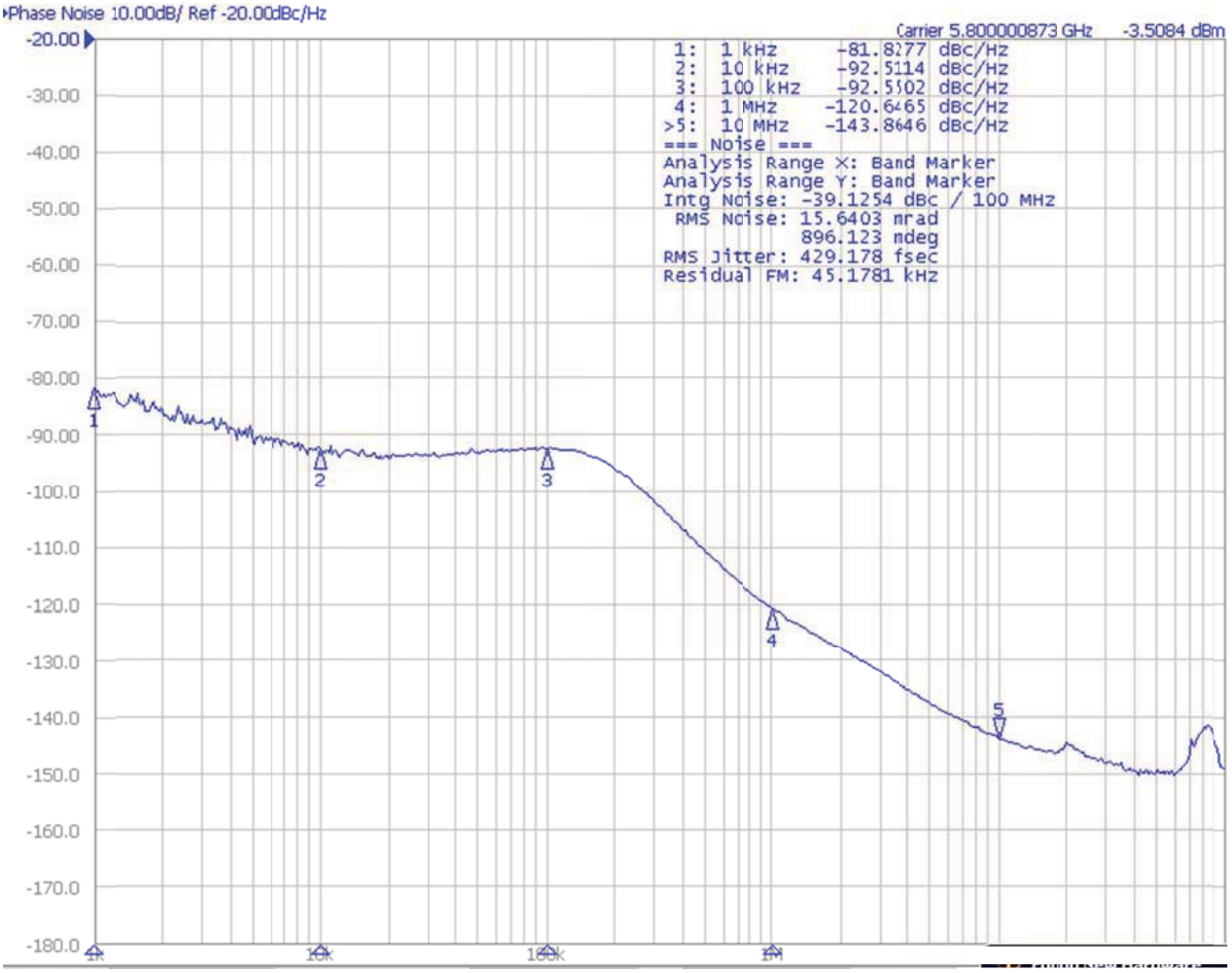
Phase Noise



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Conclusions

The performance achieved by the setup was as follows:

- Current consumption at 3V = 137mA for RFFC5072 only
- Current consumption at 3V = 150mA with RF5515
- Output frequency = 5.75GHz to 5.85GHz
- Output power = -3.5dBm
- Integrated rms phase noise (1K to 100MHz) = 0.9° rms
- Phase noise =
    - -82dBc/Hz at 1kHz
    - -92dBc/Hz at 10kHz
    - -93dBc/Hz at 100kHz
    - -120dBc/Hz at 1MHz
    - -144dBc/Hz at 10MHz
- Fundamental (2.9GHz) suppression = 22dB

As the RFFC5072 can produce wideband LO signals from 85MHz to 4200MHz, this 2*LO implementation could be used to generate output signals covering a wider frequency range.

References

RFFC5072 on RFMD website: https://estore.rfmd.com/RFMD_Onlinestore/Products/RFMD+Parts/PID-P_RFFC5072.aspx

RFFC5072 data sheet: http://www.rfmd.com/CS/Documents/RFFC5071_2DS.pdf

RF5515 data sheet: http://www.rfmd.com/CS/Documents/RF5515DS.pdf

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