Application Note
CMX940 / LMX2571
Performance Comparison

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1 Introduction

This document compares the key performance parameters of two Fractional-N PLLs with integrated VCOs.:-

- The CMX940 Low Power High Performance RF Synthesizer from CML Microcircuits
- The LMX2571 Low Power High-Performance RF Synthesizer from Texas Instruments

For this comparison, the devices were fitted to their respective manufacturer's evaluation boards. The LMX2571 was tested on a Texas Instruments LMX2571EVM Evaluation Board, and the CMX940 was tested on a CML EV9400 Evaluation Board.

All measurement results used in this comparison were obtained at room temperature (approx. 20 C). All measurements were taken with a KDS DSA221SDN 38.4 MHz VCTCXO used to provide the reference frequency; the synthesizer comparison frequency (Fcomp) used in each test case is indicated with the results.

2 History

Version	Changes	Date
1.0	New Issue	08-02-21

3 Spurious Products (Close In), Fractional N Mode

3.1 Fout = 460.825 MHz, LMX2571 vs CMX940

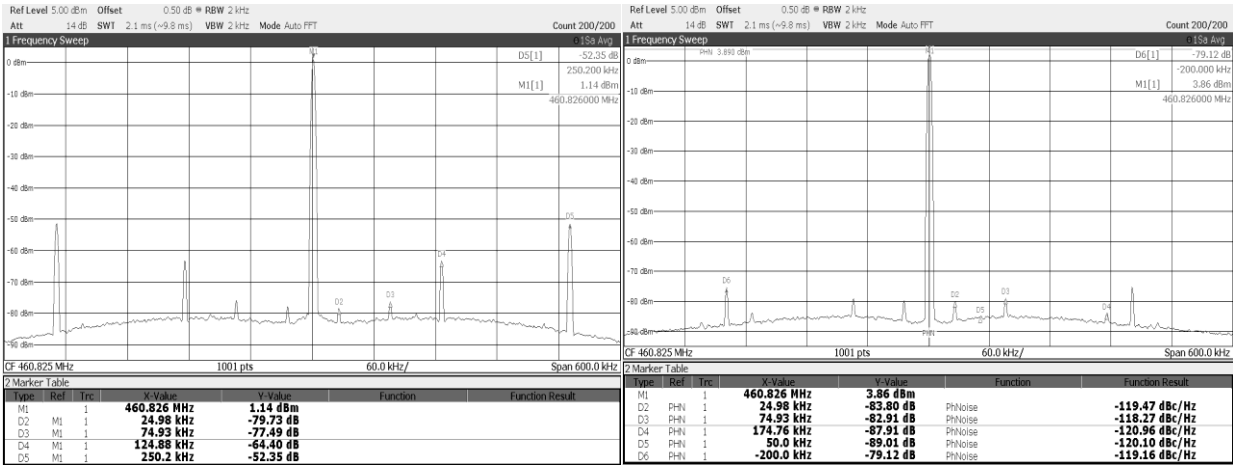

Figure 1 Spurious Products (Close In), Frac-N, 460.825 MHz, LMX2571 left, CMX940 right

Both devices were configured to give an output 25 kHz above the 12th harmonic of the 38.4 MHz master reference (38.4 MHz x 12 = 460.8 MHz) - a test case known to cause high level spurious. In Figure 1, the LMX2571 (left), has an Fcomp of 89.6 MHz and for the CMX940 (right) Fcomp = 88.32 MHz. The LMX2571 Fcomp choice was optimised using the Texas Instruments “Spur B Gone” tool to minimise boundary spur products.

The maximum spurious product exhibited in the CMX940 was approximately 27 dB lower than that in the LMX2571.

3.2 CMX940 with Fcomp Optimised

To further improve the spur performance of the CMX940 shown in Figure 1 (right) the CML Spur Avoidance tool was used to produce a more optimal configuration. The improvement made by doing this is shown in Figure 2 where Fcomp = 110.9333 MHz.

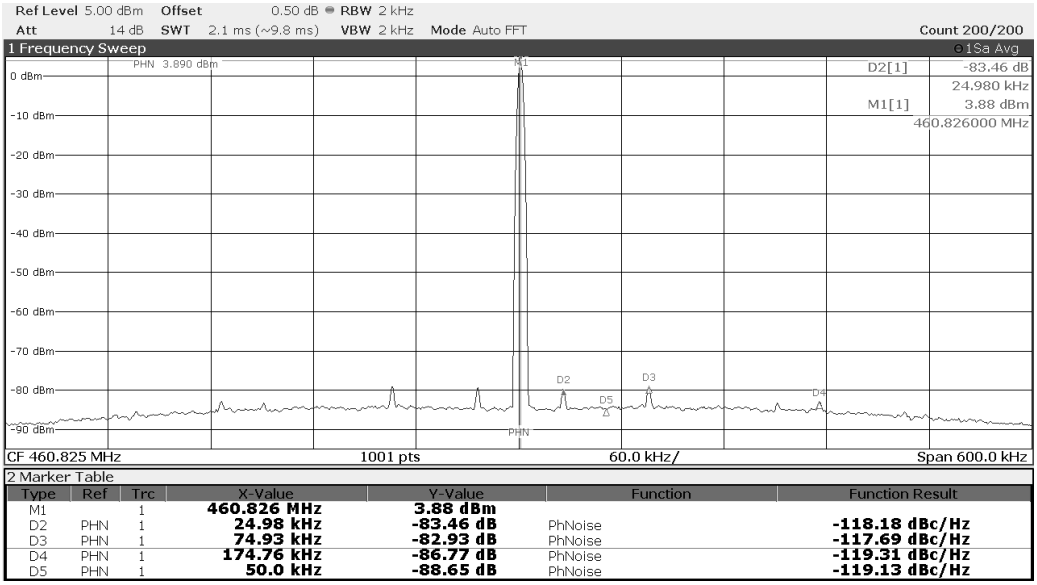

Figure 2 Spurious Products (Close In) Using Spur Avoidance Tool, Frac-N, 460.825 MHz, CMX940, Fcomp = 110.933 MHz

4 Phase Noise, Fractional N Mode

4.1 Fout = 810.525 MHz, LMX2571 vs CMX940

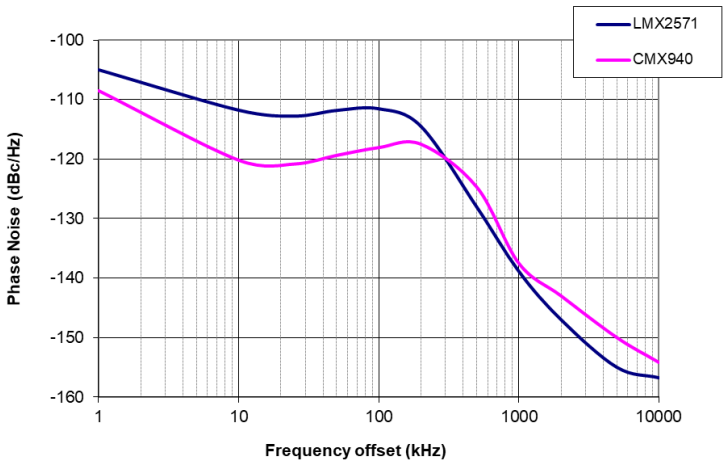

Figure 3 Phase Noise, Frac-N, Fout = 810.527 MHz, LMX2571 and CMX940

In Figure 3, Fcomp = 115.2 MHz for both the LMX2571 and CMX940. For the LMX2571 Icp was set to 625 uA, R3 to 1k1 ohm, R4 bypassed and PFD set to zero to achieve a similar loop bandwidth between both devices.

In the critical adjacent channel and spurious response region between 6.25 and 200 kHz offset, the CMX940 phase noise advantage compared to the LMX2571 is over 5 dB.

4.2 Fout = 435.525 MHz, LMX2571 vs CMX940

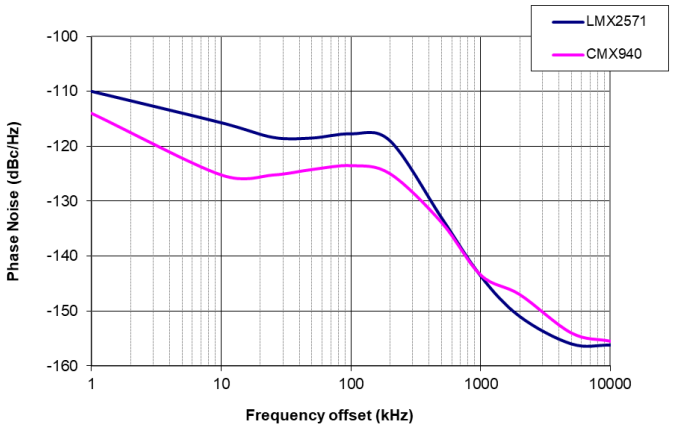

Figure 4 Phase Noise, Frac-N, Fout = 435.525 MHz, LMX2571 and CMX940

In Figure 4, Fcomp = 115.2 MHz for LMX2571 and CMX940. For the LMX2571 Icp was set to 781 uA, R3 to 1k1 ohm, R4 bypassed and PFD set to zero to achieve a similar loop bandwidth between both devices.

Device	Phase Noise at 50 kHz offset (dBc/Hz)
LMX2571	-118.2
CMX940	-124.2

Table 1 Comparison Phase Noise, Frac-N at 435.525 MHz, 50 kHz offset

The typical LO phase noise requirements for a 4FSK, 12.5 kHz system to meet EN 300 113[1] Receiver adjacent channel and spurious responses are as follows:

Parameter	ACS (12.5 kHz offset)	Spurious Response (25 kHz offset and above)	Blocking (1 MHz offset and above)
Rejection	-60 dB	-70 dB	-84 dB
Noise BW of 8.5 kHz	-39.3 dB	-39.3 dB	-39.3 dB
Target S/N ratio[2]	-9 / -10 dB	-9 / -10 dB	-9 / -10 dB
Noise Floor	-108.3 / -109.3 dBc/Hz	-118.3 / -119.3 dB/Hz	-132.3 / -133.3 dBc/Hz
PN at offset + 3dB Margin	-111.3 / -112.3 dBc/Hz	-121.3 / -122.3dBc/Hz	-135.3 /-136.3 dBc/Hz
PN at x2 LO +3dB Margin	-105.3 / -106.3 dBc/Hz	-115.3 / -116.3dBc/Hz	-129.3/ -130.6 dBc/Hz

Table 2 Rx LO Phase Noise Requirement to meet EN 300 113[1]

From Table 2 it can be seen that the spurious response requirement is the most difficult parameter to meet. To give 3 dB margin over the 70 dB requirement it is necessary to have phase noise performance of ~ -122.3 dBc/Hz at 25 kHz offsets and above, with the region around the PLL loop bandwidth, where the noise can peak, being the worst case (circa +/-100 kHz offset). If we look at the measured phase noise performance of the CMX940 in Figure 4/Table 1 it can be seen that the CMX940 has a comfortable 3 dB margin and therefore will easily meet the 70 dB requirement. By contrast, the LMX2571 has no margin and the performance is marginal at some offsets.

5 Spurious (Wideband), Fractional N Mode

5.1 Fout = 435.525 MHz, LMX2571 vs CMX940

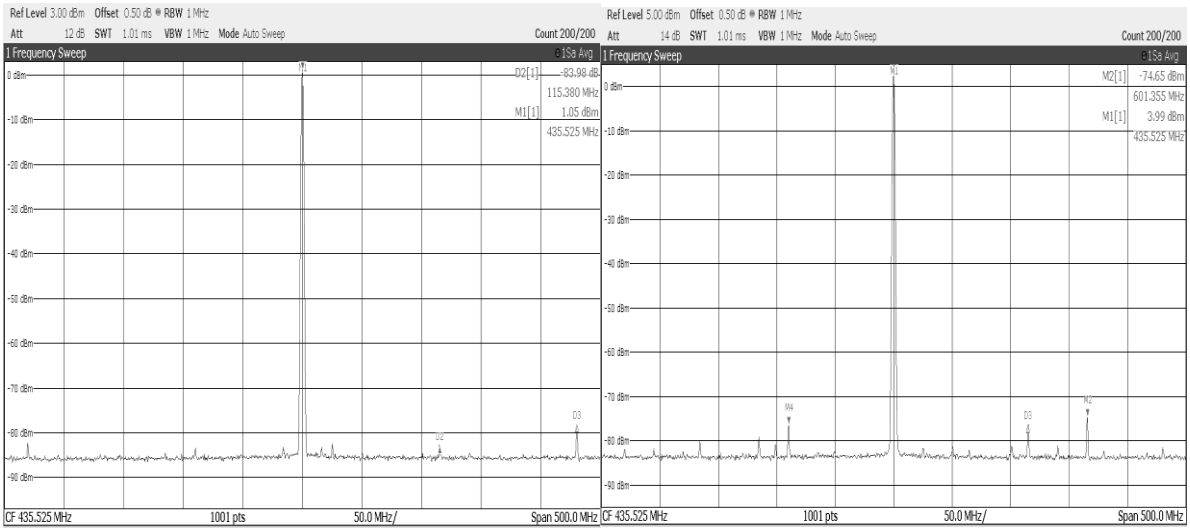

Figure 5 Spurious Products (Wideband), Frac-N, Fout = 435.525 MHz : LMX2571 left, CMX940 right

In Figure 5, Fcomp = 115.2 MHz for both devices.

Device	Highest Spur Level (dBc)	Next Spur Level (dBc)
LMX2571	-79.2	-84
CMX940	-78.6	-80.4

Table 3 Comparison of Spurs (Wideband), Frac-N, Fout = 435.525 MHz

[1] The EN 300 113 specification for Rx co-channel performance is 12 dB, the value used of 9/10 dB represents a practical margin that is achievable for this requirement.

6 Phase Noise, Integer N Mode

6.1 Fout = 460.8 MHz, LMX2571 vs CMX940

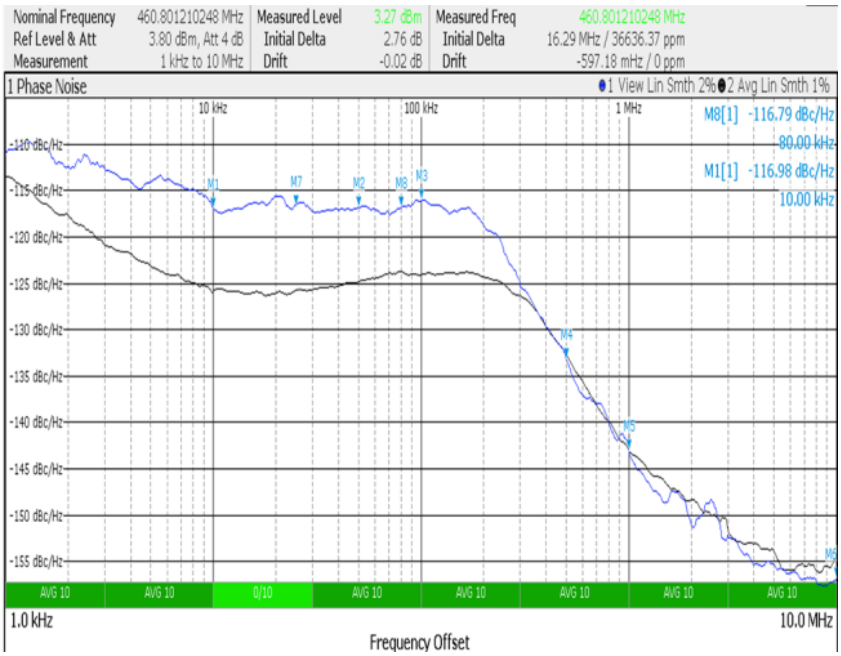

Figure 6 : Phase Noise, Integer-N, Fout = 460 MHz : LMX2571 blue trace, CMX940 black trace

In Figure 6, Fcomp = 115.2 MHz for both devices. In order to achieve best performance on the LMX2571 it was necessary to have the reference buffer turned on (this was not necessary for the CMX940). In addition, the LMX2571 needed a higher clock level..

7 Conclusions

At 435.525 MHz and 810.525 MHz operation, using the same comparison frequency, the CMX940 has typically 6 dB lower phase noise within the loop bandwidth. This confirms that the CMX940 comfortably meets the EN 300 113[1] Receiver adjacent channel and spurious response requirements.

Wideband (500 MHz) spurious rejection is typically 4 dB better at 435.525 MHz using the CMX940 at the identical comparison frequency of 115.2 MHz.

Boundary spur and clock harmonic effects have been demonstrated at 460.825 MHz. By using the CML Spur Avoidance Tool the CMX940 demonstrates typically a 4 dB advantage of close-in boundary spurs and 30 dB for further out spurs.

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