Application Note

High Isolation, Fast Frequency Switching With LMX2820 in Ping-Pong Architecture

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ABSTRACT

The LMX2820 RF synthesizer has a hardware MUTE pin to mute or unmute the RF outputs instantaneously. The attenuation after mute is as high as 50 dB. If the application system requires to switch or to sweep frequency very quick, the user can use two LMX2820 and a RF switch to ping-pong the two LMX2820's output. The additional isolation from the RF switch can probably add up the total attenuation on the mute side to more than 80 dB. This ping-pong architecture approach is therefore an excellent choice for high-power output system.

LMX2820 has Instant Calibration feature that allows VCO frequency change in a very short period of time. During the mute period, the user can change the VCO frequency so that a new frequency can pop up in the next unmute period. As a result, the user can sweep the output frequency of this ping-pong system very fast.

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Trademarks

1 Introduction

LMX2820 RF output can be muted or unmuted through the MUTE pin. Direction of mute control is configurable with the PINMUTE_POL register bit (R77[8]). With one of the LMX2820 configured to active-high mute while the other LMX2820 is set to active-low mute, the user can use one mute control signal to ping-pong two LMX2820.

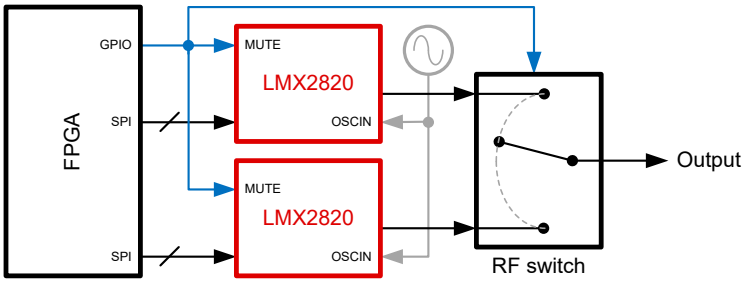

Figure 1-1. Ping-pong with Two LMX2820

The RF switch takes the same mute control signal to pass the selected input channel RF signal to the output.

Table 1-1. Truth Table

GPIO Control Pin	PINMUTE_POL	LMX2820 Output	RF Switch Output
0	0 (Active HIGH)	Unmute (Upper channel)	Upper channel
0	1 (Active LOW)	Mute (Lower channel)	
1	0	Mute (Upper channel)	Lower channel
1	1	Unmute (Lower channel)	

Program the LMX2820 to different frequencies, the user can switch between two frequencies very fast.

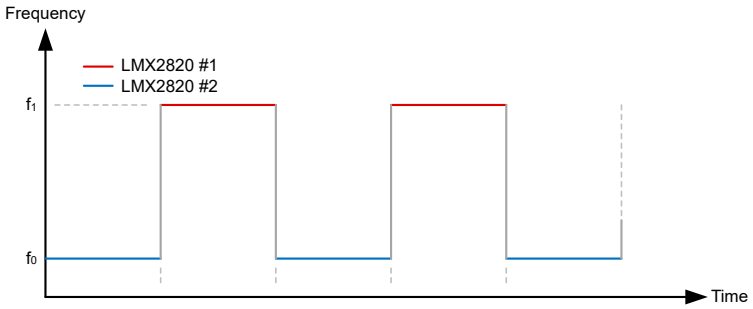

Figure 1-2. Ping-pong Output

With Instant Calibration, LMX2820 can change VCO frequency within a few micro-second. For details, see the *Dramatically Improve Your Lock Time with VCO Instant Calibration* application note. If the mute control signal has a period greater than 10 µs, the user has sufficient time to change the deselected LMX2820 output frequency during the mute period. Repeat programming LMX2820 in this way, the user can end up with a fast frequency sweep sub-system.

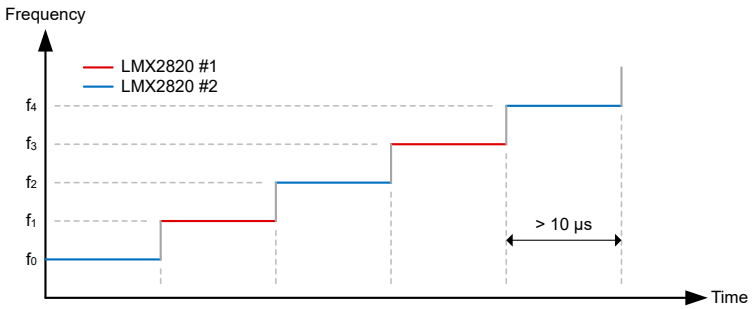

Figure 1-3. Fast Frequency Sweep with Ping-pong Architecture

2 Test Results

The following figures show the mute and unmute time of the LMX2820 RF output in response to the status of the MUTE pin (green trace). The RF switch is not included in following measurement plots.

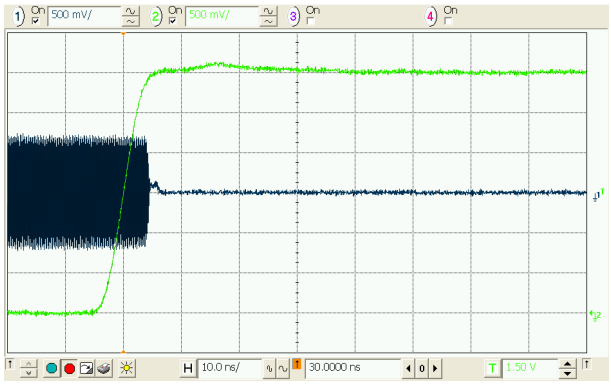

Figure 2-1. LMX2820 RFOUT Mute Time (Active High)

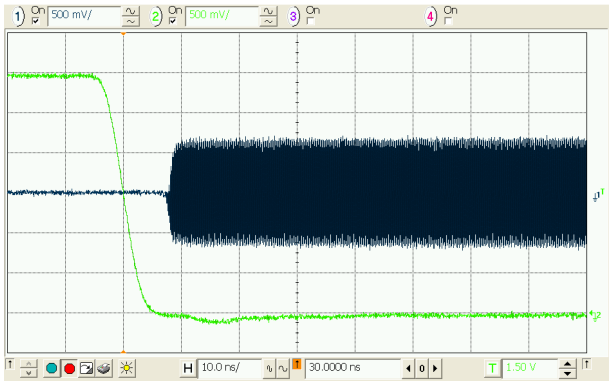

Figure 2-2. LMX2820 RFOUT Unmute Time (Active High)

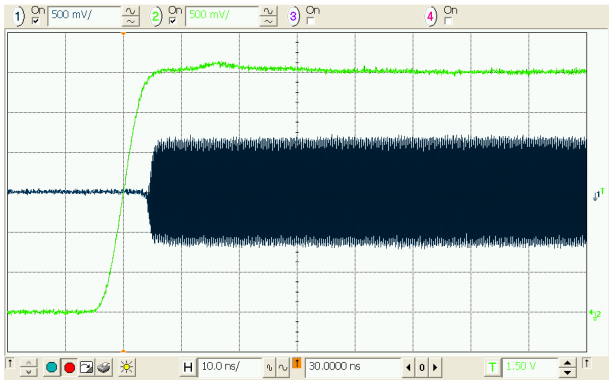

Figure 2-3. LMX2820 RFOUT Unmute Time (Active Low)

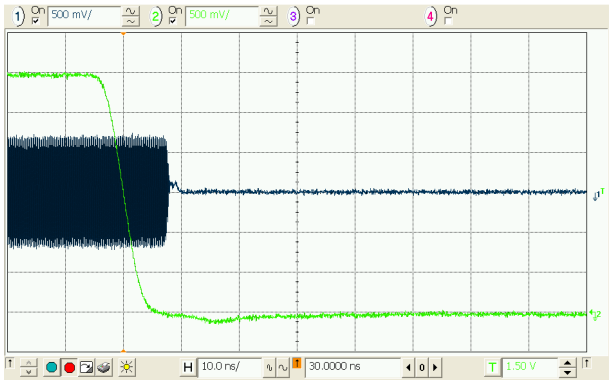

Figure 2-4. LMX2820 RFOUT Mute Time (Active Low)

MUTE pin response time is very short. In less than 10 ns, LMX2820 output can be muted or unmuted completely.

Combining MUTE with the RF switch, the output signal of the RF switch is shown in the following figures. Whenever the mute control signal flips over, RF switch selected the alternate input channel with some delay. Turn-on time of the switch is kind of slow, however.

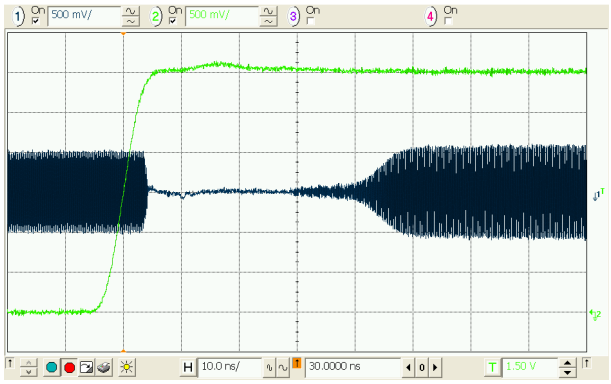

Figure 2-5. RF Switch Output - MUTE Rising

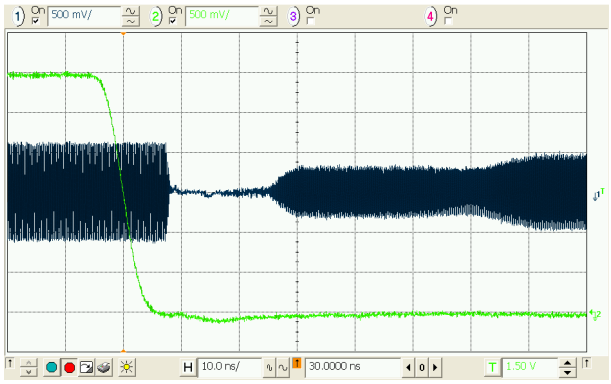

Figure 2-6. RF Switch Output - MUTE Falling

Disregarding the on-time characteristic of the chosen RF switch being used in this report, the overall switching time is around 30 ns to 40 ns.

Figure 2-7 shows the ping-pong switching characteristic in frequency-time domain. One of the LMX2820 is programmed to 5.7 GHz and the other one is programmed to 6 GHz. Mute control is a 2 kHz signal, the output of the RF switch is therefore toggling between 5.7 GHz and 6 GHz every 250 µs.

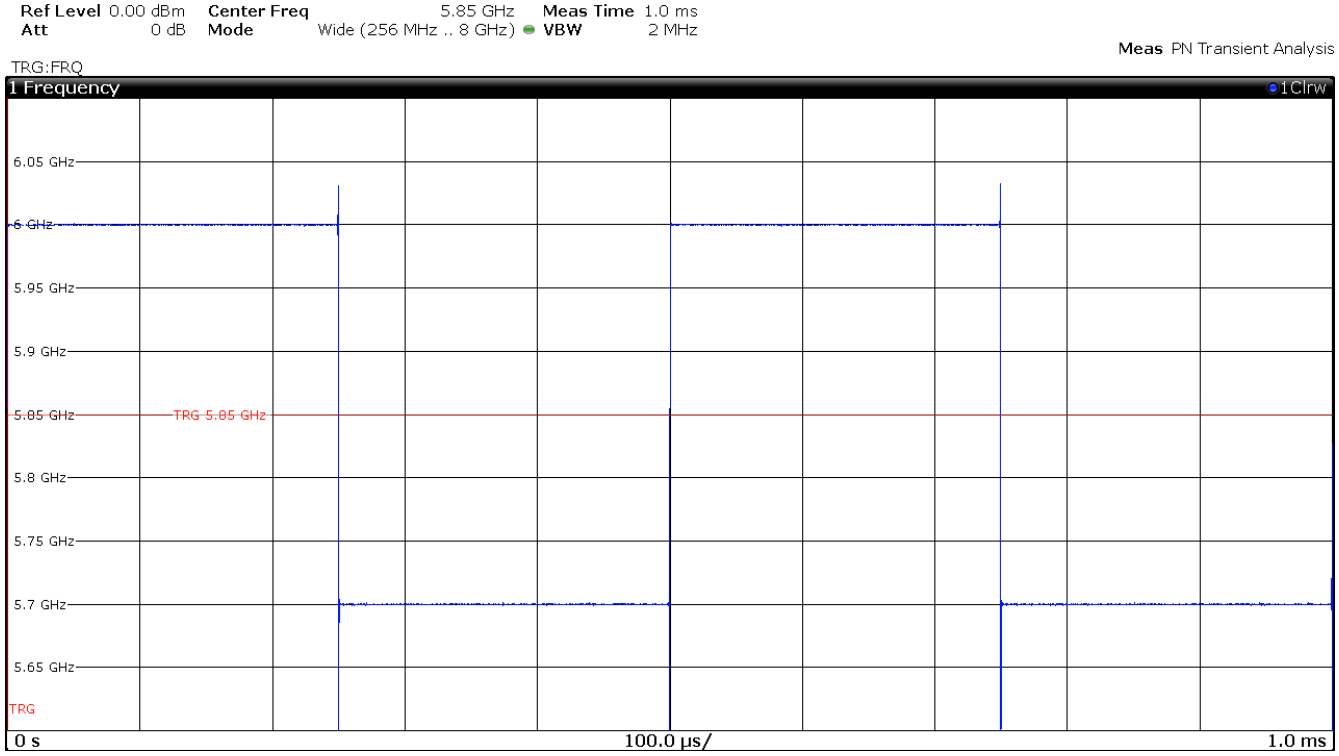

Figure 2-7. RF Switch Output

The following figures show the attenuation from the MUTE function, isolation from the RF switch and the combination of both MUTE and RF switch. Blue trace and black trace represents the output signal when the selected channel is activated and deactivated respectively.

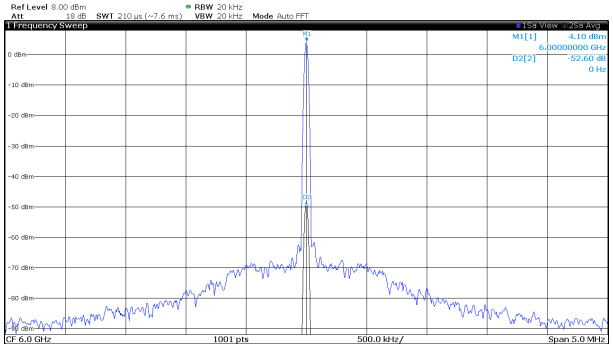

Figure 2-8. MUTE Pin Attenuation - 6 GHz

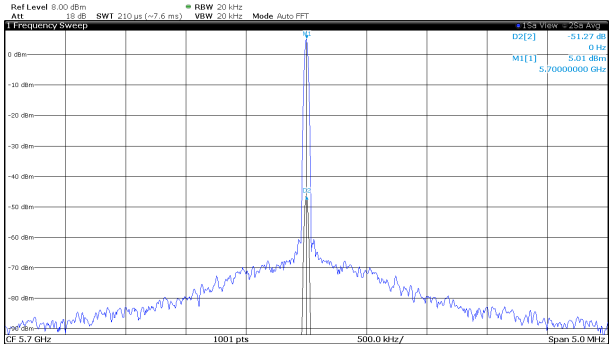

Figure 2-9. MUTE Pin Attenuation - 5.7 GHz

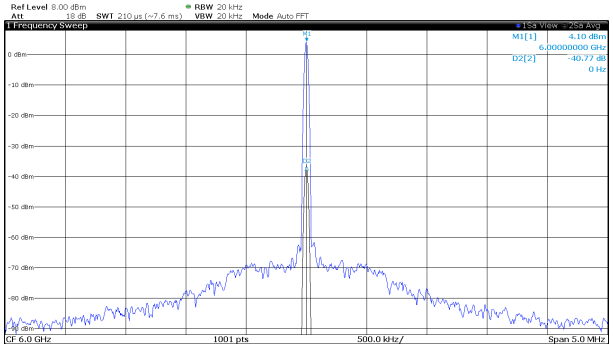

Figure 2-10. RF Switch Isolation - 6 GHz

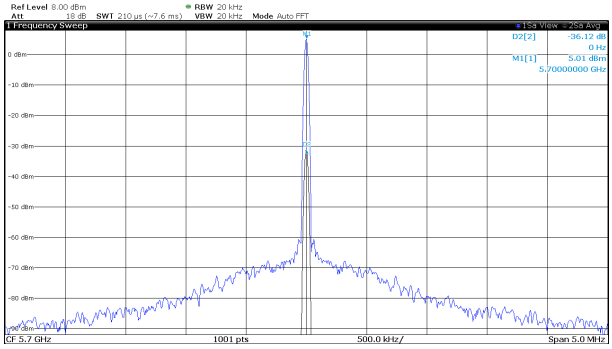

Figure 2-11. RF Switch Isolation - 5.7 GHz

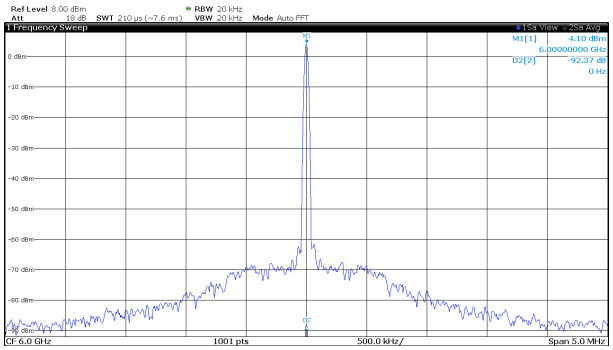

Figure 2-12. Total Isolation - 6 GHz

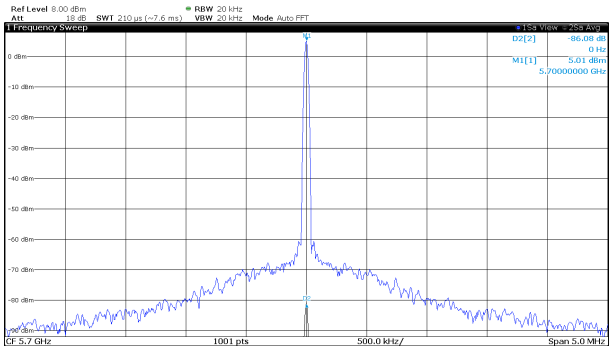

Figure 2-13. Total Isolation - 5.7 GHz

Attenuation from the MUTE pin is approximately 50 dB. RF switch provides another 36 to 40 dB isolation. The total attenuation when the channel is unmuted and switched out is 86 to 90 dB. In other words, when one of the LMX2820 is routed to the output of the RF switch, the user can continue to measure the signal from the other LMX2820 with an isolation of 86 to 90 dB.

3 Summary

This application note presented the test results of how fast the user can switch the RF signal output from two LMX2820s with a RF switch in a ping-pong architecture. LMX2820 only takes 10 ns to mute or unmute, the overall switching time is basically determined by the RF switch. With the chosen RF switch for use in this application note, the switching time is around 40 ns, which is still much shorter than a typical VCO frequency switching time of a synthesizer.

When muted, LMX2820 leakage is about 50 dBc. The RF switch provides another 40 dB isolation, making the overall system isolation to around 90 dB.

Table 3-1. Summary

Performance Metric	LMX2820	LMX2820 + RF Switch
Isolation	50 dB	90 dB
Mute or unmute time	10 ns	40 ns

4 References

- Texas Instruments, *LMX2820 22.6-GHz Wideband PLLatinum™ RF Synthesizer With Phase Synchronization and JESD204B Support* data sheet.
- Texas Instruments, *Dramatically Improve Your Lock Time with VCO Instant Calibration*, application note.

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