APPLICATION NOTE

OPTIMUM PHASE COHERENCE BETWEEN MULTIPLE RF OUTPUTS

This application note describes the achievable phase coherence of two APSINXXG signal generator or APSYN420 synthesizer units phase locked to an external 10 MHz reference.

INTRODUCTION

Anapico's synthesized signal generator products are now available up to 26 GHz while enabling tight stability, phase coherency and extremely fast tuning speeds. Anapico's RF synthesizers are stand alone units with an integrated precision 100 MHz OCXO, but external programmable 1 to 250 MHz references can be used for phase lock. Some application require phase coherence to an external reference and particularly between multiple RF channels.

REQUIREMENTS

Early frequency synthesizers were not necessarily controlled by a single crystal standard. Adequate frequency stability was obtained using several internal crystal oscillators that contributed to the overall frequency stability of the output. These devices were considered non-coherent. As applied to frequency synthesizers, phase coherence describes the relation of the frequency standard to the output frequency. If the output frequency accurately reproduces the relative frequency stability of the standard, the device is considered coherent.

Despite this definition, the assumption that all contemporary systems that use a single standard (external or internal) are coherent is incorrect. Many systems that utilize fractional-N or binary DDS fine-resolution synthesizers are not truly phase coherent; rather they have specified small but finite reference-to-output errors.

What is of particular interest is the phase stability observed over a long period of time between two independent signal sources that are phase locked to the same external (10 MHz) reference.

TEST SETUP

Figure 1 shows the test setup to determine the level of phase stability (coherence) between two APSYN420C frequency synthesizers programmed to 16 GHz output. An APPH Signal source analyzer is used to monitor the phase stability between two RF channels over a long time interval, in this case approx. 9 hours.

Figure 1: Test setup

In the first measurement, the right source is phase locked to the 10 MHz external reference (REF IN port) and outputs the 10 MHz (REF OUT) that is fed into the REF IN of the left source and is phase locked to the 10 MHz as well.

Figure 2 shows the phase error between the two RF outputs over time. As can be seem from the plot (phase error is plotted versus time), the phase error remains within approx 10 degrees over the 9 hours measurement period.

In the second measurement, the right source is again phase locked to the external 10 MHz. The REF OUT is programmed to output 100 MHz that is fed into the left source. The left source is configured to use the 100 MHz input as reference clock.

Figure 3 shows the phase error considerably improved to less than two degrees over the entire measurement time of 9 hours.

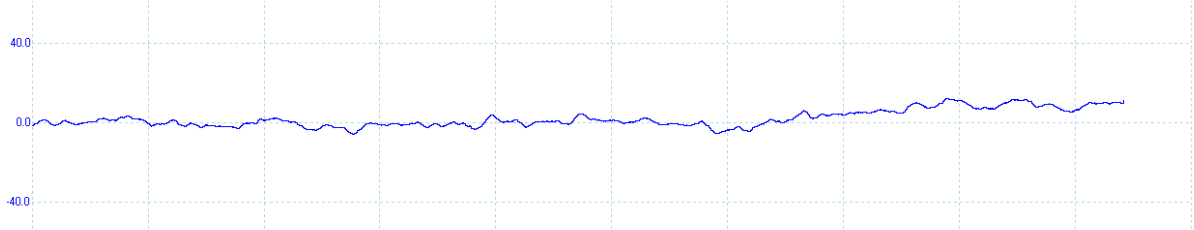

Figure 2: Phase stability between two 16 GHz RF signals locked to 10 MHz external reference

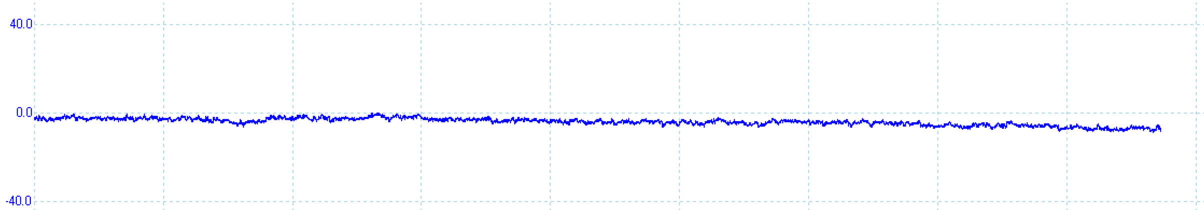

Figure 3: Phase stability between two 16 GHz RF signals, one source locked to 10 MHz and output 100 MHz internal reference which is used as clock of the second source.

CONCLUSION

Good phase stability can be achieved using two Anapico APSYN420 synthesizers phase locked to an external 10 MHz reference. Further improving phase stability can be achieved by using the cascaded reference mode of the Anapico signal sources.