Quartzlock

Precise time and frequency instrumentation
GENERATION ~ MEASUREMENT ~ DISTRIBUTION

Dear C Wonnacott

QUARTZLOCK NEWSLETTER ~ November 2012

In this issue

1. Reducing Instrument and Test System Noise

What is phase noise and its effect.

Phase noise is the frequency domain representation of rapid, short-term, random fluctuations in the phase of a waveform, caused by time domain instabilities ("jitter"). Generally speaking, radio frequency engineers speak of the phase noise of an oscillator, whereas digital system engineers work with the jitter of a clock.

Phase noise is one of the causes of poor quality radio transmissions; it limits the operating range of radar and causes bit errors in Phase Shift Keyed digital modulation

Noise can have numerous adverse effects on system performance. Some of these effects are:

1. It limits the ability to determine the current state and the predictability of precision oscillators
2. It limits synchronization and synchronization accuracies;
3. it can limit a receiver's useful dynamic range, channel spacing, and selectivity;
4. it can cause bit errors in digital communications systems;
5. It can cause loss of lock, and limit acquisition and reacquisition capability in phase locked loop systems;
6. It can limit radar performance, especially Doppler radar.

For example in surveillance, Doppler radars especially require low-noise oscillators. The velocity of the target and the radar frequency are primary determinants of the phase noise requirements. Slow-moving targets produce small Doppler shifts; therefore, low phase noise close to the carrier is required. To detect fast-moving targets, low noise far from the carrier is required. For example, when using an X-band radar to detect a 4kmjhour target (e.g., a slow moving vehicle), the noise 70 Hz from the carrier is the important parameter, whereas to detect supersonic aircraft, the noise beyond 10 kHz is important.

The combination of low flicker and low noise floor improves the bit error rate of a digital communication system for a given modulation scheme since the BER increases with the area under the phase noise curve. This small integrated noise or phase jitter similarly improves the resolution and probability of detection of radars and enhances the accuracy of distance measuring devices. Modern spectrum analyzers using low noise synthesized local oscillators have improved sufficiently to allow for the direct observation of sideband noise of fairly good sources. A higher performance reference would lower than local oscillator noise even further, making smaller measurement bandwidths feasible for direct measurement of all but the best sources.

The most commonly used reference frequency is 10MHz, however, work on 5MHz core oscillator with doubler are increasingly being considered. -123dBc/Hz @ 1Hz phase noise at 5MHz is a low cost option if the reference input allows, or doubled to 10MHz, even when doubler noise and loss are considered. -175dBc/Hz noise floor seems de-rigor for 2012.

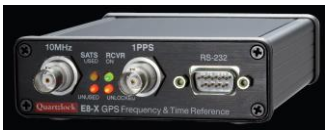
The OCXO, however stable needs an external phenomenon to lock, for at least a 100x improvement in accuracy / drift. GPS and Rubidium are the obvious choices. Here the tune / lock line needs very careful design consideration. GPS effectively removes drift / year, 2E-12/day. Rubidium will achieve 4E-10 / year and improving Rubidium is antenna free, an advantage for many users as the GPS service cannot be guaranteed. Antennas come down in storms; wires get accidentally cut and connections become loose. Recent developments show that GPS signals can be disrupted due to solar

E10-Y8 Desk Top 8 Output Low Noise Rubidium Reference

E10-P Portable Rubidium Reference

E10-LN Low Noise Rubidium Reference

E5-6 Distribution Amplifier



E8-Y GPS Frequency & Time Reference

E10-MRX Sub Miniature Rubidium Oscillator

events (solar flares) and Earth based signals (intentional and unintentional) operating in or near the GPS band.

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Add to the ideal reference a compatible low noise distribution amplifier, built into the reference with say 8 outputs then the complete RF and microwave system will see significant benefits:

1 All system instruments will now be on the same frequency

2 Most instruments will see a very significant improvement in phase noise (many instruments have noise floor problems of their own….outside reference control)

3 Considerable improvement in Allan Variance short term stability.

Typical instruments/system elements to benefit include:

Spectrum Analyzers, Digital Storage Oscilloscopes, Microwave Analyzers, Frequency Counters, Surveillance Receivers, Panoramic Receivers, Signal Stability Analyzers, Signal Sources, GPS Air Interface Simulators and GPS Simulation Systems. These are referencing applications. Calibration and standards laboratory uses are common.

Quartzlock has a number of low and ultra low noise references that will enable customer systems to take advantage of these benefits in both their applications and in house testing facilities.

Desk Top Modules

2. Quartzlock are exhibiting at Electronica 2012

The electronica 2012 meeting will be held at the Munich Trade Fair Centre Germany November 13th to 16th. This is the 25th International Trade Fair for Electronic Components, Systems and Applications. Come and visit Quartzlock in Hall B5 Booth 509. To find out more about this exhibition please click here.

3. Newsletter sign up

We'd like to send you occasional email newsletters with items of interest to the time and frequency community, press releases and new product information. To request the newsletter please sign up here. We will not send more than 1 newsletter a month on average.

Kind regards

Quartzlock

Quartzlock (UK) Ltd, Gothic, Plymouth Road, Totnes, Devon, TQ9 5LH, England
Phone: +44 (0) 1803 862062 **Email:** sales@quartzlock.com Web: www.quartzlock.com