

NLC RF Phase and Timing Distribution Status 3/22/2000

System configuration: Running with 15Km main fiber, 2.2Km temperature control fiber, PC DAQ system.

Performance:

Temperature sensitivity: 3° X-band / $^\circ\text{C}$. Exceeds requirement of 4° X-band/ $^\circ\text{C}$. (measured for 15Km fiber).

Phase Noise: 3° X-band in a 100Hz bandwidth. Feedforward calculated to reduce this to 1.8° X-band. Requirement is 0.3° X-band. (X6 below requirement).

Noise Sources:

Detectors: Spec is $3\text{pW}/\text{Hz}^{1/2}$. Measured is $\sim 8\text{pW}/\text{Hz}^{1/2}$.

Optical power on receiver detector is $45\mu\text{W}$. This should give us a phase noise of $.003^\circ$ X-band in a 100Hz bandwidth. For the reflected detector the power is about 10dB lower, should still give 0.03° X-band. Detector noise is not a limit at this time.

Laser Noise: The laser noise was measured at $\sim -134\text{dBc}/\text{Hz}$. This compares with a spec of $-135\text{dBc}/\text{Hz}$ for a standard telecom laser. High performance lasers with $-160\text{dB}/\text{Hz}$ are available. This noise level corresponds to $.004^\circ$ X-band in a 100Hz bandwidth. Laser noise is not believed to be a limit at this time.

Synthesizer Phase Noise: The specified synthesizer phase noise corresponds to $\sim 1.2^\circ$ X-band in a 100Hz bandwidth. This is similar to our measured noise of 3° in a 100Hz bandwidth. The synthesizer phase noise is believed to be the primary contribution.

VCXO: We have ordered a low phase noise VCXO. Its phase noise should result in an output phase noise of $\sim 0.1^\circ$ X-band in a 100Hz bandwidth: meets requirements.

Recent Work

Checked system noise - found that readings were consistent with synthesizer phase noise.

Installed Rubidium source.

Checked signal levels - found that the detector amplifiers were near saturation. Found that the laser diode RF drive was too high.

Found 3GHz oscillation in one of the receivers. Fixed.

Constructed and tested TEC Oven. range was 70° C. (2-3X existing oven).

Found feedback oscillates slightly at 1Hz. Fix parameters soon.

Ordered low noise VCXOs.

Ordered Agilent synthesizer.

Plans

Replace Rhode and Schwarz synthesizer (357.025MHz) with VCXO. Will free up synthesizer for use with the wavelength tunable laser. May reduce phase noise.

Install phase shifter feedforward: First attempt failed because phase shifter had too much range (~3000° X-band). Need phase shifter with 10° X-band (0.3° 357MHz) range.

Future

Short haul coax system?

120Hz DAQ?

Integrated system?

Fiducial transmission?

X-band generation?