

Low Noise Voltage-Controlled Oscillator

Description

The current baseline is to use the existing VCO (D980401-B) to drive the AOM of the PSL frequency actuator. This AOM runs at a nominal frequency of 80 MHz and has a total range of 10 MHz. The constant noise level corresponds to a frequency noise of approximately 10 mHz/rtHz.

A lower noise VCO can be built by reducing the tuning range. We are looking at a similar design but follow it by a frequency difference divider. A frequency difference divider takes an input signal divides it down and adds it to a fixed frequency low noise reference. If the input signal experiences a high phase noise, the phase noise in the output signal is reduced by the divider ratio---assuming all other noise sources are negligible. A second stage using another frequency difference divider can be added to yield even lower phase noise---albeit by giving up another factor of 10 in range. This is too small for the PSL but might be useful for locking the arm cavities using green light.

Specifications

Frequency:

- 71 MHz (reference input)
- 79-81 MHz nominal (output)
- 2 MHz full range (output)

Input (tuning):

- +/-20V differential
- 1.6 Hz/40 Hz pole/zero pair
- 2-pin LEMO

Oscillator output:

- 13 dBm
- N female
- 131.25 MHz nominal

Frequency divider input:

- 13 dBm
- N female
- 131.25 MHz nominal (first stage)
- 80 MHz nominal (second stage)

Frequency divider output:

- 13 dBm

- N female (2x)
- 80 MHz nominal
- 2 MHz full range (first stage)
- 200 kHz full range (second stage)

Reference input:

- 13 dBm
- N female
- 71 MHz nominal

Phase noise (reference input):

Frequency	Phase noise spec
10 Hz	-90 dBc/Hz
100 Hz	-110 dBc/Hz
1 kHz	-140 dBc/Hz
10 kHz	-160 dBc/Hz
100 kHz	-165 dBc/Hz

Phase noise from model (output):

	Phase noise spec	
Frequency	First stage	Second stage
10 Hz	-60 dBc/Hz	-80 dBc/Hz
100 Hz	-97 dBc/Hz	-112 dBc/Hz
1 kHz	-128 dBc/Hz	-137 dBc/Hz
10 kHz	-152 dBc/Hz	-157 dBc/Hz
100 kHz	-162 dBc/Hz	-162 dBc/Hz

Amplitude noise (input & output):

Frequency	AM noise spec
10 Hz	-140 dBc/Hz
100 Hz	-150 dBc/Hz
1 kHz	-150 dBc/Hz
10 kHz	-150 dBc/Hz

Physical:

- 19" rack mount
- 2U

Power:

- +/-16.5V and +/-24V