LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

LIGO Laboratory / LIGO Scientific Collaboration

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Test Procedure for RF Frequency Doubler

Paul Schwinberg, Daniel Sigg, Marc Pirello

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This is an internal working note
of the LIGO Laboratory.

California Institute of Technology
LIGO Project – MS 18-34
1200 E. California Blvd.
Pasadena, CA 91125
Phone (626) 395-2129
Fax (626) 304-9834
E-mail: info@ligo.caltech.edu

Massachusetts Institute of Technology
LIGO Project – NW22-295
185 Albany St
Cambridge, MA 02139
Phone (617) 253-4824
Fax (617) 253-7014
E-mail: info@ligo.mit.edu

LIGO Hanford Observatory
P.O. Box 159
Richland WA 99352
Phone 509-372-8106
Fax 509-372-8137

LIGO Livingston Observatory
P.O. Box 940
Livingston, LA 70754
Phone 225-686-3100
Fax 225-686-7189

http://www.ligo.caltech.edu/

1 Introduction

The following Test Procedure describes the test of proper operation of the RF Frequency Doubler.

2 Test Equipment

- Voltmeter
- Oscilloscope
- Stanford Research SR785 analyzer
- Tektronix AFG3101 function generator (or similar)
- RF Power Meter HP E4418A
- Board Schematics—Frequency Doubler

3 Tests

The RF Frequency Doubler comes with a number of different power supply boards so I will assume that we are using the latest which is the Low Noise Power Module (D0901846) with the RF Distribution Amplifier :Interface (D1000064).

Determine doubler base frequency and record here: ______________________

1) **Verify the proper current draw.** Using a bench DC supply apply ±24Volts to P7 and ±17 Volts to P6 of the low noise power Module (D0901846). Measure the current draw of the board.

+24 Volt current ______________ 30mA Nom.

–24 Volt current ______________ 30mA Nom.

+17 Volt current ______________ less than 500mA

–17 Volt current ______________ less than 50mA

2) On the low noise power module check the voltage on TP 1-13.

TP1 (+17V) _______________ TP2 (–17V) ________________

TP3 , 4 (GND) TP5 (+ 5V)_________________

TP6 (–15V) _________________ TP7 (+24V) _________________

TP8 (GND) TP9 (–24V) _____________________

TP10 (GND) TP11 (+15V) _____________________

TP12 (+VREF) ______________ TP13 (–VREF) _____________________

3) If TP 1 , 2, 7 , 9 and 8 are correct then pin 5 on U1 and U7, TP14 (OK) should be Logic high ~3Volts. The front panel LED should be on.
Confirm.______________________

4) The noise on TP 12, 13, 11 and 6 should be measured with a SR785 using an rms power spectrum.

TP12 noise _____________________less than 20 nVrms/√Hz at 140 Hz

TP13 noise ______________________less than 30 nVrms/√Hz at 140 Hz

TP11 noise ______________________ less than 40 nVrms/√Hz at 140 Hz

TP6 noise _______________________ less than 60 nVrms/√Hz at 140 Hz.

5) **Test the RF monitor by applying the base frequency directly to the power meter at M1.** Monitor the nominal output power at the DB25 and M1 on the back of the unit.

Nom output pwr	Input PWR	M1 Volts	DB25 Volts
10 dBm		(0.55V)	(2.2V)
0 dBm		(0.8V)	(3.2V)
-10 dBm		(1.05V)	(4.2V)
-20 dBm		(1.3V)	(5.2V)
-30 dBm		(1.55V)	(6.2V)
none		(2.15V)	(8.6V)

6) **Test the RF output powers by applying the base frequency to the input port.** With a RF power meter measure the power at the output (13+/-2 dBm nominal). If the output power is consistently too high, an attenuator A1 has to be adjusted accordingly. Nominal output power is 13+/-2 dBm.

Output: ______________________ (13+/-2 dBm nominal)

7) **Measure the phase noise of an OCXO driving the RF Frequency Doubler at close to the base frequency.** Use a second OCXO which is 2x the first OCXO frequency as the second oscillator to compare the output signal of the doubler, using the Wenzel single channel phase noise measurement technique (3.5.3), Figure 3.5.2-1, which can be found at:

http://www.wenzel.com/pdffiles1/BP1000Manual/BP_1000_v101_2_.pdf .

A reasonable FFT analyzer is the SR785, which can be set to measure power units if you start in Display Setup. A Reference Source must be provided which can be just a Wenzel crystal oscillator of frequency close enough to lock, properly powered and connected to the Wenzel phase noise measurement system. The output of the RF Frequency Doubler will need to be attenuated to the amplitude needed by the Wenzel phase noise measurement system (about 10 dBm). Compare to the phase noise of the OCXO datasheet, add 6dB to the noise of the base unit and add it in quadrature to the noise of the 160MHz unit. The noise of the doubler should be within 3dB.

Offset (Hz)	Phase noise spec (dB/Hz)			Measured (dB/Hz)
	Base MHz	2xBase MHz	total	
10	–90	–84	–81	
100	–110	–104	–101	
1000	–140	–134	–131	
10000	–160	–154	–151	