LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

LIGO Laboratory / LIGO Scientific Collaboration

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Test Procedure for RF Distribution Amplifier

Paul Schwinberg and Daniel Sigg

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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 descrbes the test of proper operation of the RF Distribution Amplifier. The unused outputs should always be properly terminated.

2 Test Equipment

- Voltmeter
- Oscilloscope
- Stanford Research SR785 analyzer
- Tektronix AFG3101 function generator
- RF Power Meter HP E4418A
- Board Schematics--http://ilog.ligo-wa.caltech.edu:7285/advligo/RfDistributionAmplifier1U

3 Tests

The RF Distribution Amplifier 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).

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 ____________0.1 A Nom. -24 Volt current __________0.0 A Nom.

+17 Volt current _______________ less than 1.1 A

-17 Volt current _______________ less than 0.01 A

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, (OK) should be Logic high ~3Volts. 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 200 nVrms/sqrt Hz at 140 Hz

TP13 noise _____________________less than 900 nVrms/sqrt Hz at 140 Hz

TP11 noise _____________________ less than 1 uVrms/sqrt Hz at 140 Hz

TP6 noise ______________________ less than 1 uVrms/sqrt Hz at 140 Hz.

5) **Test the power monitors by applying a 30 MHz, 10 dBm rf signal through an attenuator to J1.** Measure the output voltages mon1, mon2 and mon3 and with a RF power meter measure the RF power at the 13 dBm nominal outputs.

Mon1

Nom output pwr	**Input pwr dBm**	**Mon volt (M)**	**Measured volt.**	**Measured Pwr**
13 dBm		**2.9V (0.725)**		
10 dBm		**3.2V (0.800)**		
7 dBm		**3.5V (0.875)**		
0 dBm		**4.2V (1.05)**		
-10 dBm		**5.2V (1.30)**		
-20 dBm		**6.2V (1.55)**		

Mon 2

Nom output pwr	**Input pwr dBm**	**Mon volt (M)**	**Measured volt**	**Measured Pwr**
13 dBm		**2.9V (0.725)**		
10 dBm		**3.2V (0.800)**		
7 dBm		**3.5V (0.875)**		
0 dBm		**4.2V (1.05)**		
-10 dBm		**5.2V (1.30)**		
-20 dBm		**6.2V (1.55)**		

Mon3

Nom output pwr	**Input pwr dBm**	**Mon volt (M)**	**Measured volt**	**Measured Pwr**
13 dBm		**2.9V (0.725)**		
10 dBm		**3.2V (0.800)**		
7 dBm		**3.5V (0.875)**		
0 dBm		**4.2V (1.05)**		
-10 dBm		**5.2V (1.30)**		
-20 dBm		**6.2V (1.55)**		

6) **Test the noise on the RF power monitors by applying a 30 MHz, 10 dBm rf signal to J1 and measure the noise on mon1, mon2, and mon3 with a SR785 using an rms power spectrum. Power monitor sensitivity is -100 mV/dBm. Compare with power monitor driven directly by 30 MHz, RF signal, remember to adjust the power to give the same dc output, the noise should be within 3dB.**

Mon 1

Offset in Hz	AM spec.	DD RF pwr	DC out	DD measured	Measured
10 Hz	-140 dBc/Hz				
100 Hz	-150 dBc/Hz				
1 kHz	-150 dBc/Hz				

Mon 2

Offset	AM spec.	DD RF pwr	DC out	DD measured	Measured
10 Hz	-140 dBc/Hz				
100 Hz	-150 dBc/Hz				
1 kHz	-150 dBc/Hz				

Mon 3

Offset	AM spec.	DD RF pwr	DC out	DD measured	Measured
10 Hz	-140 dBc/Hz				
100 Hz	-150 dBc/Hz				
1 kHz	-150 dBc/Hz				

7) Measure the Phase noise of the RF Oscillator Source driving the RF Distribution Amplifier , with 1PPS locking 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 Distribution Amplifier will need to be attenuated to the amplitude needed by the wenzel phase noise measurement system (about 10 dBm). Test all the outputs that have different amplifiers. Compare to the Phase noise of the RF Oscillator Source alone, it should be within 3dB.

J2-J7

Offset freq. Hz	Phase noise spec.	RF osc. phase noise	RF osc mit amp noise
10 Hz	-110 dBc/Hz		
100 Hz	-140 dBc/Hz		
1 kHz	-160 dBc/Hz		

J8

Offset freq. Hz	Phase noise spec.	RF osc. phase noise	RF osc mit amp noise
10 Hz	-110 dBc/Hz		
100 Hz	-140 dBc/Hz		
1 kHz	-160 dBc/Hz		

J9

Offset freq. Hz	Phase noise spec.	RF osc. phase noise	RF osc mit amp noise
10 Hz	-110 dBc/Hz		
100 Hz	-140 dBc/Hz		
1 kHz	-160 dBc/Hz		