LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

LIGO Laboratory / LIGO Scientific Collaboration

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Test Procedure for AM-AOM Amplifier

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1 Introduction

The following Test Procedure describes the test of proper operation of the AM-AOM Power Stabilization Circuit. Ensure all unused RF inputs are terminate with 50 ohms before testing.

S/N _____ Tester _____ Date _____

2 Test Equipment

- Voltmeter
- Oscilloscope able to measure greater than 200MHz
- Stanford Research SR785 analyzer
- RF Power Meter Agilent E4418A with High Power head attachment
- RF Frequency counter Agilent 53131A
- 200MHz Frequency Source OCXO or IFR
- 2-5MHz Frequency Source OCXO or IFR
- Agilent 4395A Network Analyzer
- AOM Tester D1900355
- 2x Voltage Calibrators
- Board Schematics, LIGO D1900045

3 Tests

The AM-AOM Power Stabilization Circuit uses the Low Noise Power Module (D0901846, rev D) with the RF Distribution Amplifier Interface (D1000064, rev A).

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. (30mA)

   -24 Volt current _____ 0.02 A Nom. (20mA)

   +17 Volt current _____ less than 0.45 A (450mA) AMP OFF

   +17 Volt current _____ less than 0.71 A (710mA) AMP ON

   -17 Volt current _____ less than 0.29 A (290mA)

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, TP14) 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 and at least 4 averages.

TP12 noise _____less than 20 nVrms/sqrt Hz at 140 Hz

TP13 noise _____less than 20 nVrms/sqrt Hz at 140 Hz

TP11 noise _____ less than 20 nVrms/sqrt Hz at 140 Hz

TP6 noise _____ less than 30 nVrms/sqrt Hz at 140 Hz.

5) Test the power monitor by injecting a 30 MHz RF signal to the RF Power Meter on the Interface Board located at M1. Disconnect the SMA cable at the splitter to inject the signal. Monitor the voltage out on the M output on the back panel of the chassis and complete table below.

PMon

Nom input pwr	**Measured Pwr dBm**	**Monitor Voltage (M)**	**Measured Volt**
+10 dBm		2.6 Volts (0.65)	
+5 dBm		3.0 Volts (0.75)	
0 dBm		3.48 Volts (0.87)	
-5 dBm		4.0 Volts (1.0)	
-10 dBm		4.48 Volts (1.12)	

Install AM-AOM Tester

6) **Check Power on the AM-AOM.** Measure voltage at the following test points:
   a. +15V _____VCC _____-15V _____
7) **Check that amplifier power switch activates the amplifier.** The light turns green and the amplifier gets power. Measure across capacitor attached to ISOMET AOM amplifier.
   a. Should be 15V _____
8) **Set dip switches**
   a. SW1 ON, SW2-SW8 OFF
9) **Check Monitor Voltage**
   a. Attach AOM tester to AOM Chassis with DB37 cable. Power with 5V supply.
   b. Attach voltage calibrator to upper and lower limit inputs, +10V upper, -10V lower. This can be done using the same calibrator just connect reversed for negative.
   c. Set AOM tester to the following:
      i. D0-D5 Gain – OFF (up) / D7 EXC – OFF / D8 Bypass – ON
      ii. D13 Output – ON / D9 Boost 2 – OFF / D10 Generic – OFF
      iii. D11 Boost 1 – OFF / D14 AW1 – OFF / D15 AW2 – OFF
   d. Using a second voltage calibrator, inject +5V to the SET POINT INPUT of the AOM tester. Measure the monitor output of the AOM chassis, should be around +7V, verify { },
   e. Switch the voltage calibrator from +5V to -5V and check the voltage at the monitor port, should be -7V, verify { }.
10) **Tune the bias & power**
   a. Attach 200MHz oscillator to the input of the AOM, switch on the amplifier on the front of the chassis.
   b. Measure output power at the output, CAUTION 2 watt output, use oscilloscope or high power, power meter.
   c. Apply -7V to the set point input of the AOM tester, CAREFULLY adjust BIAS screw R4 inside the ISOMET AOM housing in the chassis to zero out the power (0Vpp or 0dBm)
   d. Switch the voltage calibrator to +7V and adjust the POWER screw on the amplifier so that the output power registers 30dBm or 30Vpp.
   e. Repeat step c and step d, iteratively continue until -7V on set point results in 0dBm and +7v results in 30dBm.

11) Test controls and limiter

a. Remove 200MHz signal from input, turn off amplifier on front panel of AOM chassis.

b. Toggle D14 AW1 to the on position.

c. Apply 100Hz 50mV signal to IN1 input of the AOM chassis.

d. Attach oscilloscope to MONITOR output of the AOM chassis

e. Adjust gain settings successively, record output voltage peak to peak.

i. 1dB_____

ii. 2dB + i _____

iii. 4dB + ii _____

iv. 8dB +iii _____

v. 16dB + iv_____

vi. -32dB + v _____

f. Set gain to 31dB, reduce limiter voltage until limit light illuminates _____

g. Continue to reduce limiter voltage, watch to see trace deform on the oscilloscope as the limiter clips the high and low peaks of the 100Hz signal.

h. Return limiter to +/-10V

12) Measure MON, record the following values while adjusting the set point voltage on the AOM tester. Set drive point to zero.

a. +5V _____

b. +2.5V _____

c. 0V _____

d. -2.5V _____

e. -5V _____

13) Measure MOD, record the following values while adjusting drive point voltage on the AOM tester. Set set point to zero.

a. +5V _____

b. +2.5V _____

c. 0V _____

d. -2.5V _____

e. -5V _____

14) Measure transfer function. Connect 200MHz source to the input of the AM-AOM chassis. Connect the modulator input to "RF" out of a network analyzer, also connect that to channel "R" on the network analyzer. Connect the output of the AM-AOM to a 20dB attenuator then to the mixers' "R" port to demodulate the signal. Apply 200MHz to the local oscillator port "L" of the mixer. The I port will attach to input B on the network analyzer. Attach a 21MHz low pass filter in line between the B port and the "I" port of the mixer.

a. Set network analyzer to measure from the lowest value to 5MHz. Adjust phase on local oscillator until maximum demodulation is achieved. Measure power at the 1MHz point._____

b. Measure bandwidth frequency where phase shift is 45 degrees. _____

Configuration:

ZSC-2-1+ Splitter from 200MHz source out to AOM in and Mixer LO port.

Apply BNC extensions to adjust phase on Mixer LO port.

Adjust power out of AOM to match power in to Mixer LO port (~15dB Attenuator)

RF Out on Network Analyzer to R in on Network Analyzer and IN1 on AOM, turn on AW1 switch (D14)

I-OUT from Mixer to Network Analyzer Input use appropriate LPF to strip off 200MHz.

Measure transfer function. I adjusted drive point on the AOM Tester to normalize signal.

15) Apply voltage offsets. Inject voltage to the manual tuning frequency and measure the power at the 1MHz point. I think we adjust drive point and record the power at 1MHz here.

a. +5V _____

b. +2.5V _____

c. 0V _____

d. -2.5V _____

e. -5V _____