LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

LIGO Laboratory / LIGO Scientific Collaboration

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RF AM Stabilizer
Functional Test

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LIGO Science Collaboration

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TEST PROCEDURE FOR RF AM STABILIZER ASSEMBLIES

This procedure tests the RF AM Stabilizer, Part number D00003, of the LSC frequency distribution system.

INITIAL POWER-UP AND SIGNAL CHECK

Performed at the board level prior to installation in the chassis. This test looks for gross problems on the board. Do not leave the power supply on any longer than necessary because the power amplifiers do not have their heat sinks in place.

Supply power to the board

Set up a power supply to provide +/- 12 vdc, with the current limit set higher than 2 Amps. Connect the power supply outputs to test points 2, 3, and 4. Turn on the power supply.

Check the current indicated on the power supply. Typical current draw is 40-50 mA on the –12V side and up to 2 A on the +12V side.

Check the +/- 5 V supply voltages

Using a multimeter, check the +/- 5 v supplies at JP3 (the daughter card connection header). Pin1 is the one closest to the front edge of the board. Pin 5 is –5 V, and Pin 6 is +5 V.

Signal Test

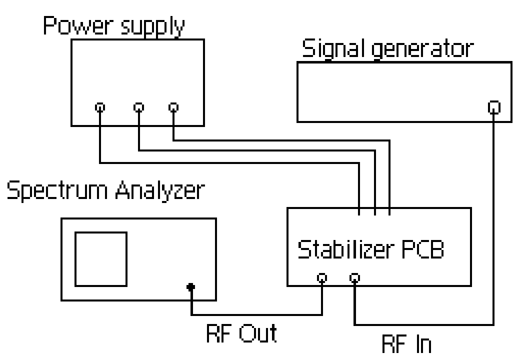
Set up signal generator (usually the Marconi) for +10 dBm at any of the operational frequencies. Connect the output of the signal generator to the RF Input jack J3.

Check the outputs

Use a spectrum analyzer to observe that a signal is present, and can be adjusted, at each of the outputs. Connect the spectrum analyzer to the output jack listed below, and make sure the signal is present. Use a 20 dB attenuator on the spectrum analyzer input. Change the position of the corresponding adjustment switch and observe that the magnitude of the signal changes.

SIGNAL	JACK	SWITCH
ASC Out	J1	SW1
Spare 1	J3	SW3
Spare 2	J4	SW3
RF out to EOM	J10	SW2

Setup



INSTALL DAUGHTER CARD AND CHECK OPERATION OF THE EXTERNAL SETPOINT

Connect the daughter card to header JP3.

Make sure that jumpers JP1 and JP2 are postioned to select U13.

Connect a power supply or precision voltage source to the 'MOD CONT IN' jack, J13, using a test plug. Monitor the output power at J10 with a spectrum analyzer.

Supply power to the board using a power supply connected to TP2, 3, and 4, as described in the previous section.

With the board turned on, and an output signal observed at J10, vary the set point from 1 to 10 Volts. Observe that the output power level changes proportionally. If it does not change properly, change the polarity of the setpoint voltage input and try again.

INSTALL THE BOARD IN THE CHASSIS

Remove the excess solder from the underside of the board beneath U1, U2, U17, and U19. Install the board in the chassis, using the blue thermal pad between the board and the heat sink, and heat sink compound between the chassis and heat sink.

Place a small length of shrink sleeve on the SMA connectors to prevent electrical contact with the front panel. The sleeve should be about one third to one half the length of the connector threads.

The front panel of the chassis may have to be modified. The inside face of the front panel should have a counter sink type cutout on the holes for the SMA connectors. Those holes may also have to be made slightly larger to allow the connector and shrink sleeve to pass through.

When installing the power supply in the chassis, place an insulator underneath to prevent contact with the metal case.

When installing and wiring up the power connections, run the 'Line', or 'hot' wire through the power switch. Use RTV to insulate the power connections on the rear of the power switch and power cord socket.

Connect the internal power supply to the circuit board. Make the connections as follows:

Power supply end	Pins 1-4	+12 V supply
	Pins 5-9	+12V return
	Pins 10-11	no connection
	Pin 12	-12V supply
	Pin 13	-12V return

PCB end is the mirror image

Pins 10-13	+12V supply
Pins 5-9	+12V return
Pins 3-4	no connection
Pin 2	-12V supply
Pin 1	-12V return

Connect the power cord and turn the unit on. Make sure the +/- 12 volt green LED's on the front panel come on.

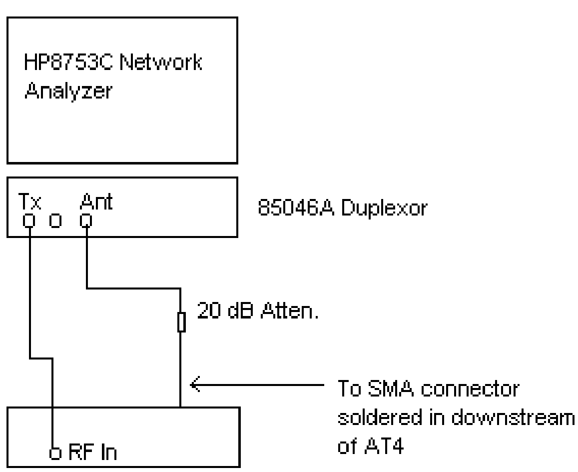
Check the +/- 12 volt supplies at TP2 and TP3.

FUNCTIONAL TEST OF THE COMPLETED ASSEMBLY

Tune the band pass filter

The filter is only installed in the units intended to operate at 29.5 MHz (or 24.495 MHz). This step is skipped for other units.

Setup:



This test is performed with the HP8753C or HP4195A Network analyzer. A signal generated by the network analyzer is input to the AM stabilizer at the RF Input jack, J3. The return signal is taken from an SMA connector (with a short section of semi rigid coax) soldered into the circuit downstream of AT4.

Set the network analyzer to sweep from 15 to 60 MHz with a source power level of 7dBm. Adjust the variable capacitors in the band pass filter to get the best filter response.

Adjust the U-13 control voltage

The typical voltage range for the U13 control voltage is 0 to –1.5 Vdc, measured at TP1 on the daughter card. Adjust SW2 as necessary to get the control voltage in this range.

Diode voltage

The typical voltage range for the diode voltage is -.005 Vdc to –0.3 Vdc, measured at TP2 on the daughter card. Check the diode voltage as the setpoint is varied from 0 to 10 volts.

Collect data

Collect data on the performance of the stabilizer. The first three data sets can be collected at the same time (recommended). The use of the digital precision voltage source for the setpoint voltage will make data collection easier, although a power supply can also be used. Take data at 0.1 volt increments from 0 to 0.5 volts, and at 0.5 volt increments up to 10 volts.

a. Setpoint (Mod cont In) vs. Power out

Monitor output power with the HP8560E spectrum analyzer.

b. Setpoint (Mod cont In) vs AT-255 (U13) control voltage (spot check)

Monitor the control voltage with a DMM, at TP1 on the daughter card.

c. Setpoint (Mod cont In) vs. DET AM (DC)

Monitor the DET AM voltage with a DMM, using a test jack plugged into J8.

d. ASC OUT and SPARE OUT range data

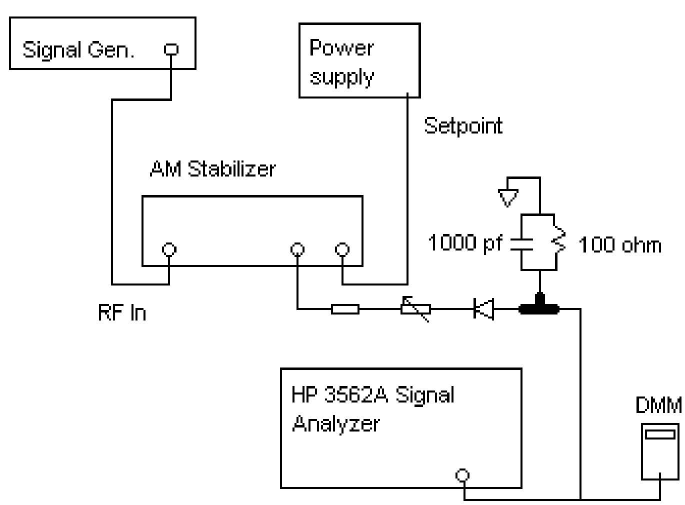
For each output, record the minimum and maximum power output level. Also record the position of the associated adjustment switch, and the corresponding power level. Typical max/min values are 30/17 dBm for the ASC out, and 16/3 dBm for the Spare outputs.

e. Plot of DET AM (AC)

This data plot is made using the HP3562A Dynamic signal analyzer. The signal is taken directly from the DET AM (AC) jack to the signal analyzer. A setpoint input of –5 volts is usually used.

f. Regulated vs. unregulated noise measurement

Noise measurements are made using the following setup:



The output signal is taken from the RF OUT TO EOM jack, run through a fixed attenuator (if required), a variable attenuator, and an ACSP diode detector. The filter after the diode is placed in the circuit using a BNC “T” connector. The diode voltage is read on the DMM.

Notes on setting up and using the HP 3562A Signal Analyzer:

Y axis scale is usually chosen to be –80 to –150 dB (to make comparisons easier)

Units for the vertical scale should be V/sqrt(Hz) (volts per square root of Hz)

MEAS MODE = Log Res

SELECT MEAS = Power spec

AVG = Stable (mean)

FREQ = 100 – 100K Hz

Input coupling = AC

After the measurement is complete, use the built in math function to correct for the diode voltage. Do this by dividing by the voltage. For example, if the diode voltage was 1.5V, the waveform would be divided by 1.5.

Take measurements at the regulated output (RF OUT TO EOM), and one of the unregulated outputs (ASC out or one of the SPARE outputs). Plot the two measurements on the same paper, for comparison purposes. Make sure that the regulated output has a lower noise level than the unregulated output.

Cycle power at low and high power

With the unit operating, cycle the power at each end of the power range. When power is restored, make sure that the power level comes back up and controls at the proper level.

Plot the data

a. Setpoint vs. Power out (in dBm)

b. Setpoint vs. Power out (in mW)

Convert the power level measurements to mW using the formula $mW = 10^{dBm/10}$.