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LSC I & Q Demodulator Board  
Functional Test

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Distribution of this document:  
LIGO Science Collaboration

This is an internal working note  
of the LIGO Project.

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FUNCTIONAL TEST OF THE I & Q DEMODULATOR BOARD  
PART NUMBER D990511

SETUP

The functional test of the I & Q demodulator boards is normally done in conjunction with tuning the boards. See document LIGO-T000112-00-C for the tuning procedure.

Connect power supplies to provide  $\pm 24$  V and +15V either to P1, or to the test points. Typical currents are 180 mA on the +15 V line, and 30 mA on each 24 V line.

Two signal generators are used for this test, and will be designated as follows: Signal generator #1 will be used as the LO (Local Oscillator) input to the board. It is to be set at the operational frequency of the board, at a power level of 0 dBm. Signal generator #2 will be the PD (Photo diode) input. It is to be set 100 Hz. higher than the operational frequency, at a power level of +9.0 dBm.

1. POWER SUPPLY CURRENTS

Connect the power supplies to the board and apply power. Record the currents for each of the three voltages.

2. DETECTOR VOLTAGE VS LO INPUT POWER

For this portion of the test, only the LO input is required. Supply power to the board and apply the LO input signal. Vary the LO input power level, while monitoring the DC detector voltage at Test Point 8.

Begin at  $-20$  dBm, increasing in 2 dBm increments up to  $-10$  dBm. Continue to increase power level in 1 dBm increments, up to +3 dBm. At each power level, record the power level and detector voltage.

### 3. DYNAMIC TESTS

For the dynamic tests, connect both signal generators, as described in the SETUP section. Use an oscilloscope to monitor the I OUT and Q OUT signals. The tuning of the board affects the measured phase difference between the two signals. If the board has not been tuned, it should be done at this time.

#### a. Signal check

Monitor the two outputs on the oscilloscope. Record the voltage magnitude of each signal, and the phase difference between the two. Imperfect tuning of the board can lead to errors in the phase measurement. It may be necessary to measure the phase difference at two points, and average the two readings. For example, the phase difference can be measured as both waveforms pass through zero while increasing. The same measurement can be repeated at the point where the waveforms pass zero while decreasing. Averaging the two will give a more accurate reading.

#### b. Linearity Check

This portion of the test checks to see that the output waveform voltage is linear with respect to input power.

Decrease the PD Input power level from +9 dBm to +3 dBm. The two output voltages should decrease by 50%. Record the magnitude of the two output voltages and the phase difference between them.

Return the PD input signal generator to +9 dBm.

#### c. Frequency check.

This portion of the test checks to make sure that changing frequency by a relatively small amount does not have an effect on the output.

On both of the input signal generators, increase the frequency by 100 KHz. Record the magnitude of the two output voltages and the phase difference between them.

Return the signal generators to their original frequencies.

#### 4. DC OFFSET

Terminate the PD Input with a 50 ohm device, and supply only the LO input to the board. Using a multimeter, measure and record the DC voltage at the I OUT and Q OUT jacks.