

LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

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AdL OMC Suspension Electronics Requirements		
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1 Introduction

1.1 Purpose

The purpose of this document is to outline the design requirements for the AdL OMC (Output Mode Cleaner) suspension electronics. This includes all electronics, both analog and digital, necessary to:

- Provide a constant 35mA current source to the BOSEM (Birmingham OSEM) LEDs
- Monitor the photodiode current from the BOSEMs
- Power the coil integral to the design of the BOSEMs

1.2 Precedence

The design requirements outlined in this document are specific to the design of the AdL OMC Suspensions. In addition to the requirements outlined below, the requirements outlined in LIGO document number T000053, “Universal Suspension Subsystem Design Requirements” must be met. In the event of a conflict between the requirements outlined in this document and the Universal DRD, the requirements in this document take precedence.

1.3 Assumptions

1.3.1 Control Electronics

This document does not attempt to break the design requirements for the OMC Suspension controls into analog and digital portions. The requirements outlined in this document are for the entire system. Allocation of the requirements between the analog and digital portions of the system is left to the designer.

For the purposes of design, it can be assumed that the AdL suspensions controls will provide input signals (DAC outputs) to the coil drivers with the following specifications:

- Voltage Range: +/-10V, (20V_{p-p}), differential.
- Noise Voltage: 700nV/ $\sqrt{\text{Hz}}$ over the frequency range of interest for the coil driver.

The AdL suspension controls will also provide for monitoring of signals with a voltage range of +/-20V (40V_{p-p}). The AdL-provided ADCs have the following specifications:

- Voltage Range: +/-20V (40V_{p-p}), differential
- Noise Voltage: 5uV/ $\sqrt{\text{Hz}}$ over the frequency range of interest for the coil driver.

1.3.2 BOSEM Naming Conventions and Locations

There are 6 BOSEMs used in the design of the OMC Suspension. The figure below shows the name and relative position of each BOSEM as viewed from the top of the assembly.

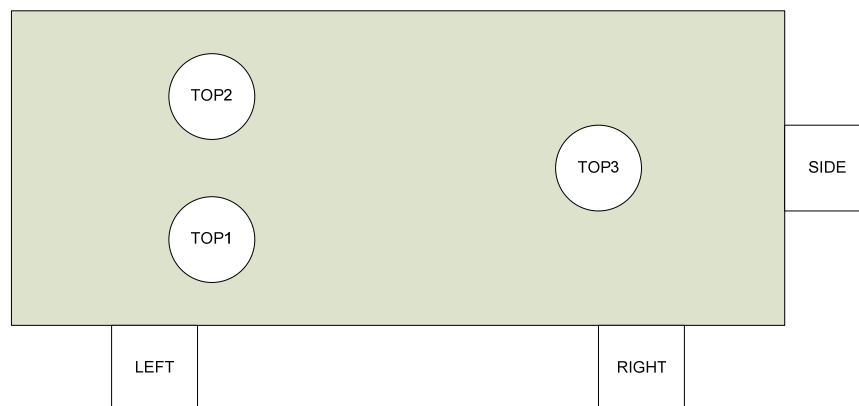


Figure 1: BOSEM Locations and Names (Not to scale)

1.3.3 Coil Actuator Strengths

The following assumptions were made as to the magnet sizes and actuator strengths.

Table 1: Magnet Sizes and Actuator Strengths

BOSEM Name	OSEM Type	Magnet Size	Actuation Strength
TOP 1	BOSEM	10mm x 10mm	2 N/A
TOP 2	BOSEM	10mm x 10mm	2 N/A
TOP 3	BOSEM	10mm x 10mm	2 N/A
LEFT	BOSEM	10mm x 10mm	2 N/A
RIGHT	BOSEM	10mm x 10mm	2 N/A
SIDE	BOSEM	10mm x 10mm	2 N/A

2 Requirements

2.1 BOSEM PD Signal Circuitry

The noise floor of the BOSEM is 5×10^{-11} m/ $\sqrt{\text{Hz}}$ at 10Hz. This corresponds to 1.3 pA/ $\sqrt{\text{Hz}}$. The open light current for the BOSEM is 60uA. The circuitry used to monitor PD signals shall be capable of “seeing” the BOSEM noise floor at 10Hz while simultaneously being able to “see” the full open light current at frequencies much less than 10Hz.

2.2 BOSEM LED Driver

The requirements for the LED Driver are:

- Provide 35mA DC current for the BOSEM LED
- Amplitude Noise $\ll 758$ pA/ $\sqrt{\text{Hz}}$

2.3 BOSEM Coil Driver

2.3.1 Current Noise

The current noise of the driver circuitry, including the DAC shall be better than 50pA/ $\sqrt{\text{Hz}}$ at 10Hz.

2.3.2 Output Current

The output current for the driver shall meet the requirements shown in the table below.

Table 2: Coil Driver Output Current Requirements

Frequency	Output Current
freq < 0.5Hz	10 mA peak
1 Hz	5 mA peak
10Hz < freq < 100Hz	0.5 mA peak

3 Monitors and Controls

The following monitors and controls shall be provided as part of the design.

- Coil Driver output voltage monitor- the bandwidth of this monitor shall be at least 1KHz and does not need to be capable of seeing the noise floor of the driver.
- Coil Driver Enable/Disable- The design of the coil driver shall provide for an Enable/Disable feature for each channel. When the coil driver is disabled, the input signal from the AdL Controls DACs shall be disconnected from the input of the coil driver

circuitry. The nominal position of this switch shall be such that the coil driver is disabled. In the disabled mode of operation, the nominal output current from the driver shall be 0mA.

- LED Driver Output Current- this is a very low bandwidth monitor of the LED drive current used to monitor and track possible drifts or changes in the LED current over time. The precision of this monitor should be better than 1% (relative).
- PD output voltage- a monitor of the PD output shall be provided. This monitor is separate from the signal used for the OMC suspension damping loops.