

Another Satellite Amplifier

J. Heefner

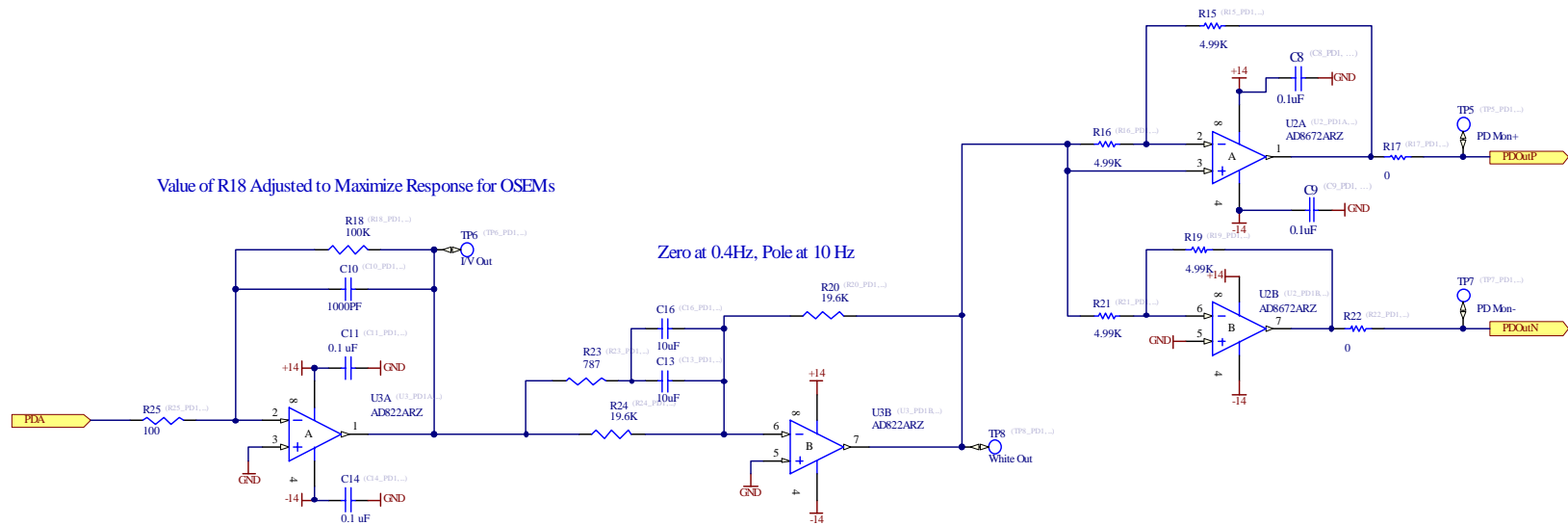
- **Why?**

- » **The “original” LIGO satellite amplifiers were designed in 1996 and many of the parts are now obsolete.**
- » **The “replacement” satellite amplifier was designed by Mohana in 2005 to be forward and backward compatible. It then needed to be updated in 2008 because some of the parts used could not be purchased.**
- » **Neither of these designs incorporate whitening in the PD signal path.**
- » **The older designs use field boxes and in many instances such as test stands and the OMC it may be more advantageous to use rack mount designs.**
- » **The older designs were 5 channels and in many AdL applications the OSEMs come in groups of 4, so adapters had to be designed for many applications.**

- **PD Signal**

- » The noise floor of the B-OSEM is $5 \times 10^{-11} \text{ m}/\sqrt{\text{Hz}}$ @ 10Hz. This corresponds to $1.3 \text{ pA}/\sqrt{\text{Hz}}$, so the input-referred noise of the I/V circuit should be small in comparison to this number.
- » The OMC and many other SUS systems need a small amount of whitening. In the case of the OMC a single zero at 0.4Hz and a pole at 10Hz is desirable.
- » The open-light current for the B-OSEM is nominally 60uA. This needs to be matched into the 20V_{peak} input of the ADC, so the gain of the I/V should be on the order of:

$$20\text{V}/60\mu\text{A} = 333\text{Kohms}$$



- Gain at DC = 300Kohms if R18 is 150K
- Zero at 0.4Hz, Pole at 10Hz
- Input-Referred Noise = $\sim 0.4 \text{ pA}/\sqrt{\text{Hz}}$ @10Hz (dominated mostly by 150K)

- **LED Driver**

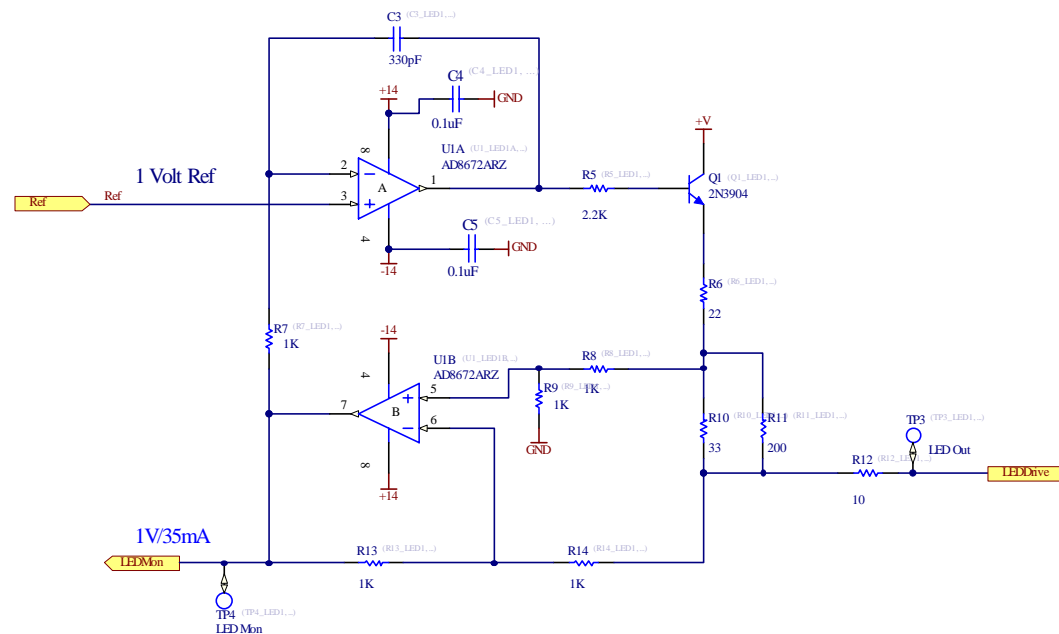
- » Supply “stable” low-noise 35 mA bias to LEDs
- » Amplitude noise in LED converts to PD noise. The conversion “coupling” can be approximated by:

$$60\mu\text{A}/35\text{mA} = 1/583 = 0.0017 \text{ A/A}$$

So LED amplitude noise must be:

$$\text{LED}_{\text{noise}} \ll (1.3\text{pA}/\sqrt{\text{Hz}}) * 583 = 758 \text{ pA}/\sqrt{\text{Hz}}$$

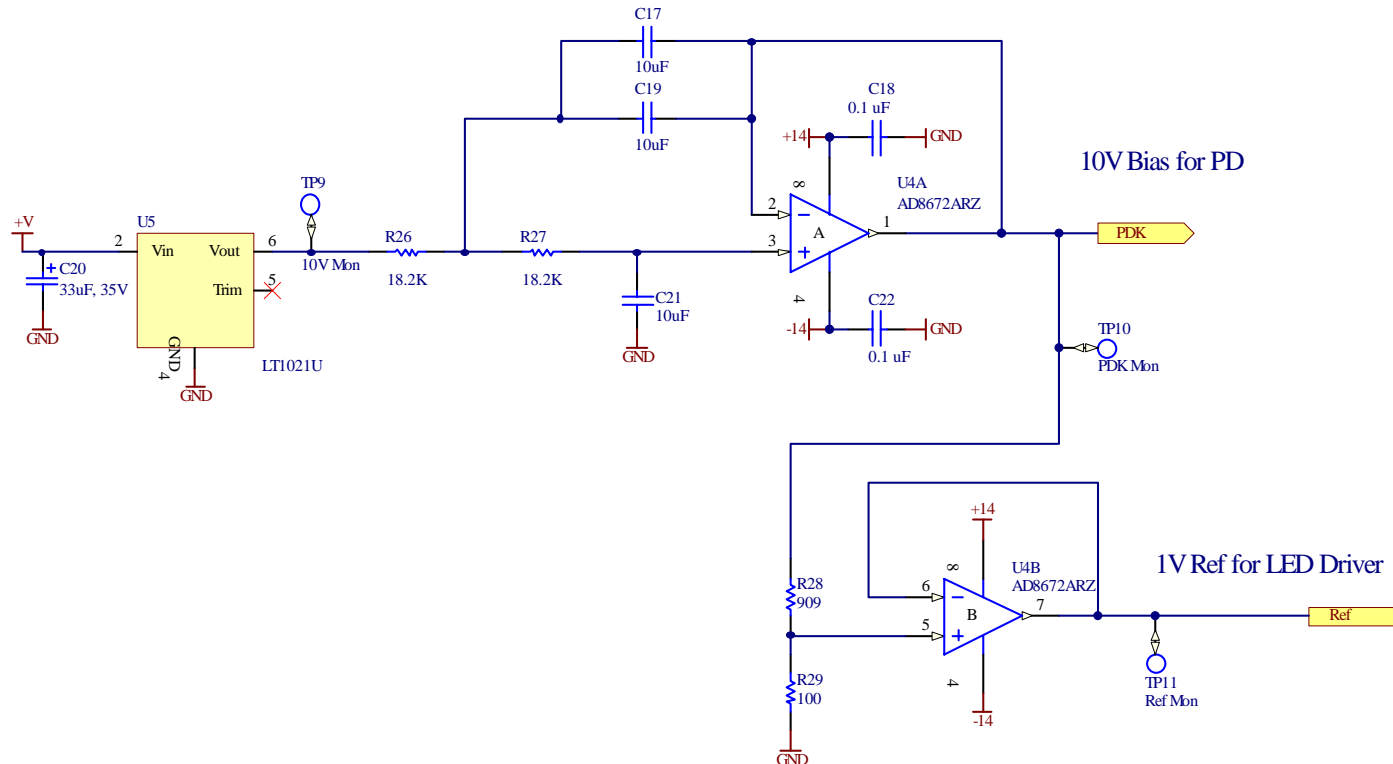
- Driver Design “Stolen” From UK Satellite Amp
 - » Drive is 35mA
 - » Amplitude Noise is $\sim 200\text{pA}/\sqrt{\text{Hz}}$ @ 10 Hz (simulated for design as shown)
 - » If the gain of the circuit is adjusted to give $35\text{mA}/5\text{V}$, the noise can be decreased to $<100\text{pA}/\sqrt{\text{Hz}}$ @ 10 Hz.



June 4, 2008

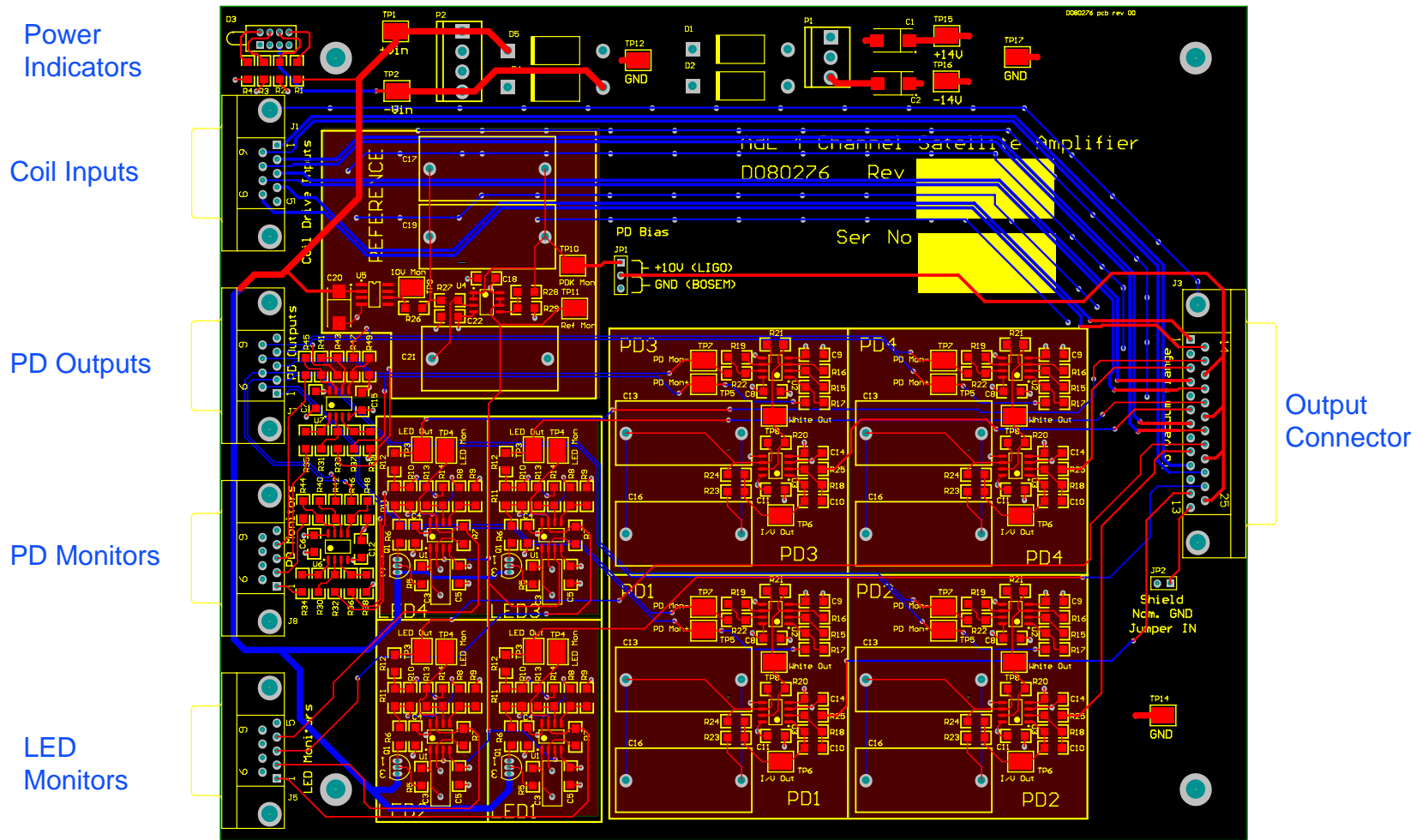
LIGO-G080321-00-C

- Needs to have an output noise $\ll 21\text{nV}/\sqrt{\text{Hz}}$ @ 10Hz
- Simulated output noise is $\sim 4\text{nV}/\sqrt{\text{Hz}}$ @ 10Hz
- The design would need to be adjusted if the reference voltage was changed to 5V



- **The coil signals pass straight through to the output connector.**
- **The pin out of the output connector must match the vacuum flange connectors**
- **The unit should be made in multiples of 4 channels**
- **The unit should have rack or field box capabilities**
- **The unit should have local monitors for PD outputs and LED currents.**
- **The unit should be compatible with B-OSEMs and LIGO OSEMs**

What Does it Look Like ? (Preliminary Layout)

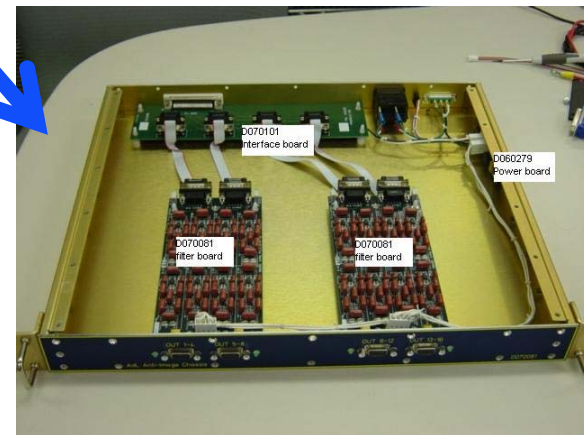


June 4, 2008

LIGO-G080321-00-C

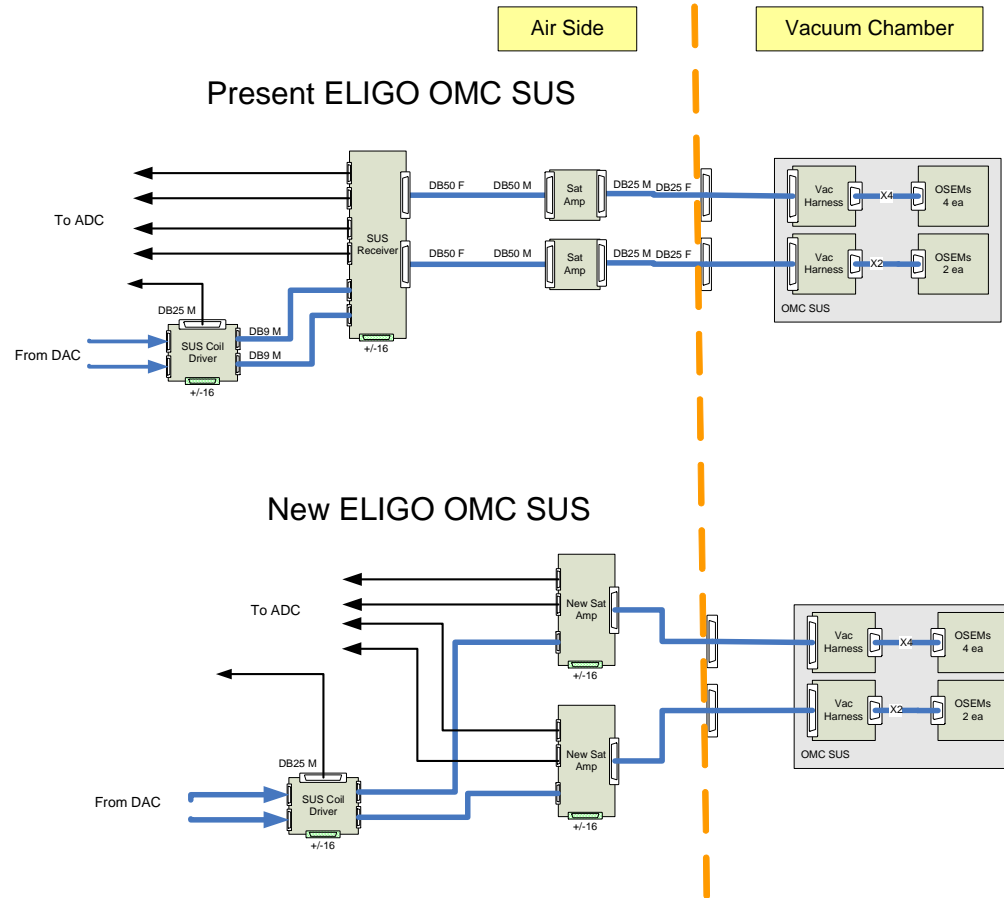
What Does It Look Like?

- Each Board is 4 channels
- Single boards can be mounted in field boxes similar to those presently used
- Two boards can be mounted in 1U rack mount chassis to form an 8 channel unit (similar to AI)
- Power comes from the same Chassis Power Board used in other AdL chassis.



- **ELIGO OMC**
 - » The new satellite amplifier would replace the existing amplifier and eliminate the need for the SUS Receiver.
 - » Some rewiring would be required, but it is minimal
 - » Presently there are two 4 channel units on the OMC SUS and two 4 channel units on the Tip-Tilt. These could be replaced with 4 field boxes or two 1U rack mount chassis either mounted in the control racks on in a mini-rack near the chamber.
 - » The OMC design calls for whitening to be added to the PD signals, so we either need to go with the “new” satellite amplifier or design a new SUS Receiver that incorporates whitening.
- **AdL SUS**
 - » Test stands at CIT, LHO and LLO.
 - » Triple SUS at LASTI
 - » HAM Aux suspensions in AdL

New Configuration Vs Old Configuration for ELIGO OMC SUS



- **The Test Stand for the RM is needed sometime towards the end of the fiscal year.**
- **It could be used on the OMC at anytime, but sometime in the near (?) future the whitening would be advantageous.**
- **If the requirements and design are seen as sufficient we could have the first prototype by July. Production units could available by the end of summer.**