LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

LIGO Laboratory / LIGO Scientific Collaboration

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COMMENTS RELATING TO THE CONTROLS PROTOTYPE ELECTROSTATIC DRIVE DESIGN

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1 Scope

The purpose of this document is to gather information related to the electrostatic design used in the Advanced LIGO controls prototype quadruple pendulum suspension.

2 Design

Two prototype electrostatic plates made. Each plate, LIGO-D040052, was made from Corning Pyrex 7740. A gold coating of 1 micron was requested from the vendor. This was deposited using a mask, LIGO-D040146, designed by Russell Jones. Vendor information can be obtained from Helena Armandula, ahelena@ligo.caltech.edu. All of the drawings can be found on the LIGO DCC and the PDMWorks vault.

Figure (1): - Photograph of the gold coating on the face plate, LIGO-D040052.

3 Gold Tabs

The gold tabs, shown in figure (2), were soldered on to the gold deposited circuit grid with Indium solder using a Nitrogen flow across the surface of the soldering area. The gold tabs are .001 inch thick by .250 wide by 1.0 long

4 Wiring

The micro coax is attached using Indium solder with a nitrogen flow. This is done by firstly striping the outside shield back to expose1.5 inches of the center insulated conductor. Then the gold tab is rolled around the outer shielding insulation. Lastly the center conductor is soldered to the tab (at the tab) solder joint. It is important to make sure that the gold rapping also gets soldered.

Our experience is that this technique secures the wire both mechanically and electrically, see figure (3). However, they are fairly delicate and require careful handling.

Prior to installation onto the test mass assembly we used Kapton tape to secure the wires, see figure (4).

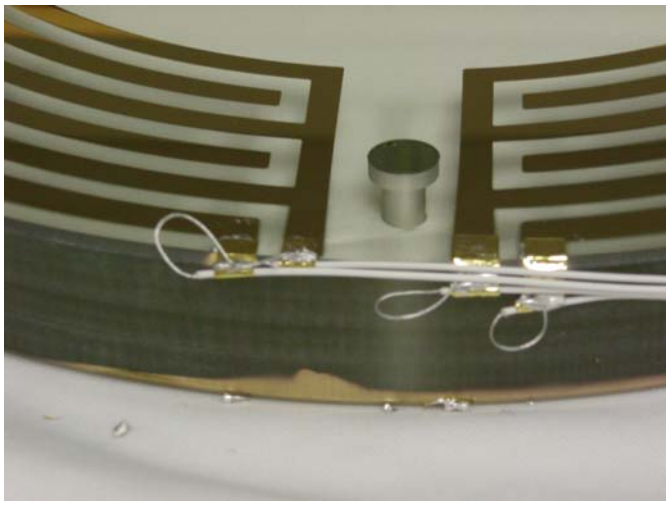

Figure (2): - Photograph of the gold tabs and the wiring on the face plate, LIGO-D040052.

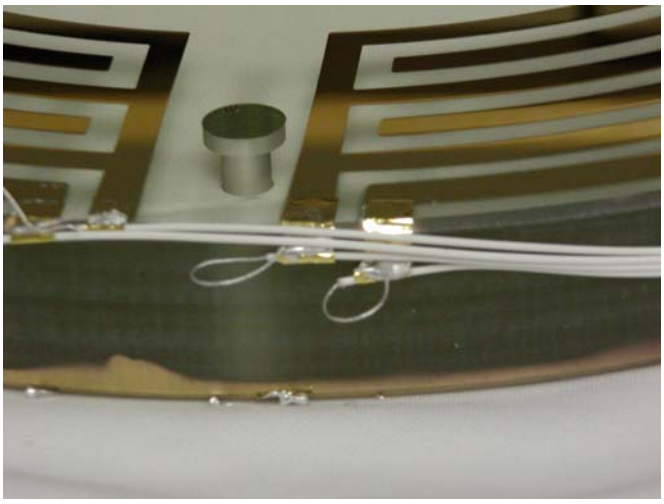

Figure (3): - Close up of the gold tabs and wiring on the face plate, LIGO-D040052.

Figure (4): - Photograph of the wiring on the face plate, LIGO-D040052.

5 Resistance

The resistance measurements were done with an AEMC digital/analog meter model 1026. It has a range from 0.1 Ohms to 4K Ohms dc and 0 to 1000M Ohms ac/dc. The lead resistance of the meter was measured to be 0.4 Ohms.

We believe that the measured resistances on the ESD circuit paths, as indicated in figure (5), vary because of meter lead contact resistance.

For information the following measurements were also made. The insulation resistance of the micro coax was above 1000M Ohms @ 1000Vac/dc. The resistance of the circuit from the coax connector to the tab on the ESD is 4.3 Ohms. The resistance from the coax connector to the end of the circuit path on the ESD is 5.7 Ohms.

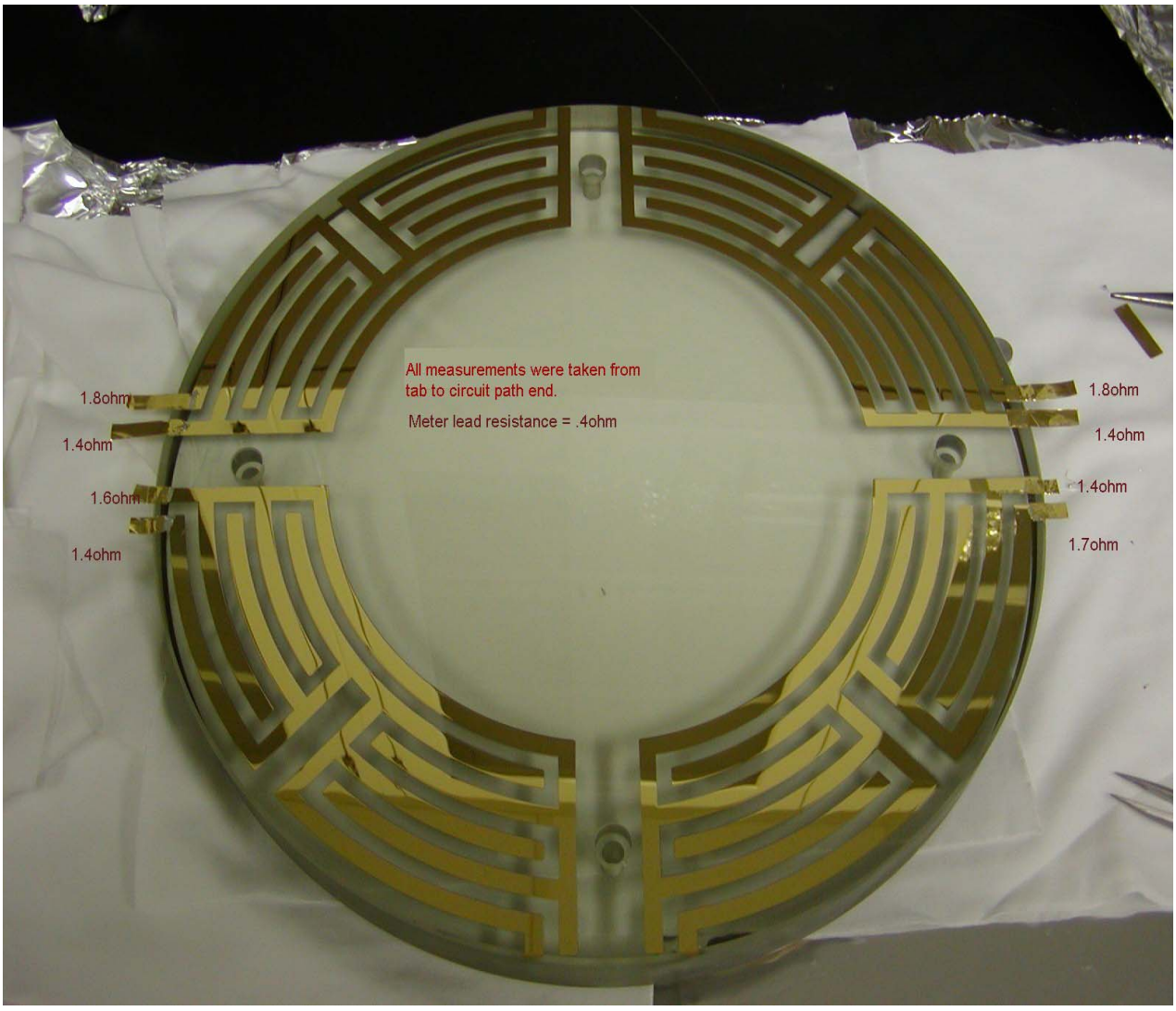

Figure (5): - Photograph of the gold coating on the face plate, LIGO-D040052.

6 Strain Relief and wiring in the reaction chain

Once assembled onto the reaction test mass assembly, LIGO D040XXX, the cabling shown in figure (4) are constrained on the flat of the reaction test mass and again on the barrel. They are again constrained on the penultimate reaction mass, LIGO D040XXX.

The wires were constrained using a modified design, LIGO-D020XXX, previously used on the LIGO 40 m experiment. These can be found on the LIGO DCC.

The strain relief used on the reaction test mass is of course unique to the controls prototype due to the fact that in the noise prototype the reaction test mass is made from glass. However, a similar method could be used on the penultimate reaction mass in the noise prototype.

At present in the controls prototype the wires are again constrained at the reaction upper intermediate mass, in 2 locations, and then again on the upper structure. There is an option to again constrain these and the global controls wires on the reaction top mass but at this point this is not utilized.

In order to allow the “3 and 1” assembly technique, LIGO-D040XXX, to be carried out all the cabling in the reaction chain has a connector close to the interface with the upper structure.

NOTE:- TBD - PHOTOS FOR THIS SECTION TO FOLLOW IN FUTURE RELEASE OF THE DOCUMENT!

Further photographs can be found at the following address: -

http://www.ligo.caltech.edu/~ctorrie/QUAD_ETM/quad_etm.html

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