

LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY
- LIGO -
CALIFORNIA INSTITUTE OF TECHNOLOGY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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aLIGO, SQZ, Electronics, Analog, In-vacuum wiring		
J. Miller for the squeezers		

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1 Suspensions

1.1 HAM5 Tip-Tilt suspension

- Used to steer squeezed beam into the OFI
- Four BOSEMs
- A single 25-pin D-sub cable routes down from the vacuum feedthrough and terminates on a cable bracket integral to the Tip-Tilt assembly. A short fanout cable that is part of the Tip-Tilt assembly splits the signals to each of the 4 OSEMS.
- **One D-25 cable, one fanout cable**

1.2 HAM6 Tip-Tilt suspension

- Used to steer the squeezed beam into the OFI (along with the HAM5 Tip-Tilt)
- Four BOSEMs
- Wiring: As described for the HAM5 Tip-Tilt above
- **One D-25 cable, one fanout cable**

1.3 VOPO suspension

- Used to isolate the squeezed vacuum source
- Six aOSEMs (for damping)
- The 6 OSEMS used for the VOPO suspension are served by two 25-pin D-sub cables. Each cable routes from the vacuum feedthrough to a cable bracket that holds each 25-pin terminating connector. A 25-pin connector mates to this bracket/connector and fans out into 4, 9-pin micro-D legs (known colloquially as the quadrapus). As only 6 connections are ultimately used, two of the unused micro-D legs are tied back to keep them out of the way.
- **Two D-25 cables, two D-25 cable brackets, two quadrapuses**

2 Items on suspended platform

2.1 Strategy

We shall run two D-25 cables (see Table 1) from the vacuum feedthrough to a bracket placed on the ISI table or stage 0 of the VOPO suspension¹ (TBD). From the bracket the cables will run as unshielded twisted pairs. One D-25 cable shall be reserved for high-voltage (PZT) signals to minimise crosstalk observed in experiments at MIT. Standard LIGO D-25 cables

¹Possibly on the blade guards

are used where a D-9 or D-15 might suffice to provide for design changes and future capacity (e.g. adaptive/remote mode matching to the filter cavity or OMC or additional thermistors).

Table 1: Distribution of electrical signals emanating from the suspended VOPO platform onto two 25-pin subminiature-D cables.

D-25 cable 1 (high-voltage)		D-25 cable 2 (low-voltage)	
Component	Conductors	Component	Conductors
OPO PZT 1	2	Peltier	2
OPO PZT 2	2	Thermistor 1	2
Oven stage	2	Thermistor 2	2
Lens stage	2	Thermistor 3	2
Shield	1	DCPD 1	3
		DCPD 2	3
		Shield	1
Total	9	Total	15

2.2 OPO PZTs

- Used to control the length of the OPO cavity
- Two NAC2124 PZTs [1]
- Max. voltage 200 V
- Two conductors per PZT
- **Four conductors total**

2.3 Oven/crystal translation stage

- Used to translate the crystal in the plane of the OPO cavity, perpendicular to the beam path, in order to compensate for refractive index changes on moving to vacuum. We require that 532 and 1064 nm beams resonate simultaneously
- Plan to use PI Q-521 series stage (pending approval for in-vac use) [2]
- High-voltage (100 V, stage is driven by a PZT)
- **Two conductors total²**

2.4 Lens translation stage

- Used to translate a lens along the direction of the beam to provide a remote actuator for mode matching to IFO

²Closed loop version uses many more wires.

- As above, plan to use PI Q-521 series stage (pending approval for in-vac use)
- High-voltage (100 V, stage is driven by a PZT)
- **Two conductors total**

2.5 Oven peltier heater/TEC

- Used to control the temperature of the OPO's PPKTP crystal
- One Marlow Industries NL1013T [3]
- Potentially high current (~ 2.5 A) [4]
- **Two conductors total**

2.6 Oven thermistors

- Used to sense the temperature of the PPKTP crystal³ (two thermistors) and its thermal reservoir, i.e. the 'cold' side of the TEC, (one thermistor)
- Three⁴ TDK B57541G1103F [5]
- Two conductors per thermistor
- **Six conductors total**

2.7 DCPD

- Used to measure the light power rejected by the thin-film polarisers at the output of the pump/532 and CLF/seed/1064 fibres
- Two DC photodiodes of Rich Abbott's new design [6]
- Three conductors per diode
- **Six conductors total**

3 Other

3.1 In-vacuum beam diverter

- Used to send the squeezed light out of vacuum for diagnostic tests [7]
- This beam diverter is already present in HAM6 but is currently used for another purpose. We will relocate it to the opposite side of the chamber.
- In-vacuum wiring for the beam diverter already exists but cable length must be checked

³Really the crystal holder.

⁴Possibly more, depending on test at LASTI.

References

- [1] J. Miller et al., “Quotes aLIGO Squeezer PZTs,” Tech. Rep. [LIGO-C1700001](#), LIGO Laboratory, Jan. 2017.
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- [4] D. Sigg, “EtherCAT TEC Driver,” Tech. Rep. [LIGO-D1201359](#), LIGO Laboratory, Oct. 2012.
- [5] J. Miller et al., “aLIGO VOPO Oven Thermistor,” Tech. Rep. [LIGO-E1700023](#), LIGO Laboratory, Jan. 2017.
- [6] E. Sanchez, “InGaAs-Q3000/YAG-444-AH QPD Enclosure,” Tech. Rep. [LIGO-D1600083](#), LIGO Laboratory, Feb. 2016.
- [7] P. Fritschel et al., “aLIGO, ISC, In-Vacuum Beam Diverter,” Tech. Rep. [LIGO-E1200835](#), LIGO Laboratory, Jan. 2017.