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

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aLIGO, SQZ, Electronics, Analog, HV supply requirements

J. Miller for the squeezers

Distribution of this document:

LIGO Lab

California Institute of Technology
LIGO Project, MS 18-34
Pasadena, CA 91125
Phone (626) 395-2129
Fax (626) 304-9834
E-mail: info@ligo.caltech.edu

Massachusetts Institute of Technology
LIGO Project, Room NW17-161
Cambridge, MA 02139
Phone (617) 253-4824
Fax (617) 253-7014
E-mail: info@ligo.mit.edu

LIGO Hanford Observatory
Route 10, Mile Marker 2
Richland, WA 99352
Phone (509) 372-8106
Fax (509) 372-8137
E-mail: info@ligo.caltech.edu

LIGO Livingston Observatory
19100 LIGO Lane
Livingston, LA 70754
Phone (225) 686-3100
Fax (225) 686-7189
E-mail: info@ligo.caltech.edu

http://www.ligo.caltech.edu/

Executive summary

The H1 squeezing test employed several different rails in its various high-voltage drivers. For simplicity, we have minimised the number of required supplies for the aLIGO squeezer by using the same PZT (Noliac NAC2124) throughout. 180 V was chosen as the default rail to match the supply used for the broadband EOM in the H1 test and to stay below the maximum operating voltage of the PZTs (200 V). We list the high-voltage supplies required to run the squeezer in Table 1.

Table 1: High voltage supplies required to run a single aLIGO squeezer.

Location	Component	Voltage	Note	See section
OPO	Cavity length PZTs	0-180 V	Two channels (2 PZTs)	1
SHG	Cavity length PZT	0-180 V		2
TTFSS	Broadband EOM	±180 V	Squeezer–PSL PLL	3
LO path	PZT mirror	0-180 V		4
Seed path	PZT mirror	0-180 V		4

1 OPO

The in-vacuum OPO cavity [1] is equipped with two Noliac NAC2124 PZTs [2] to allow the cavity length to be controlled.[1] In the prototype OPO, the actuation coefficient of a single PZT has been measured to be ∼91 V/µm (Hang Yu, Dec 2016), yielding a range of approximately 2 µm for a 180 V input.

2 SHG

The SHG used during the H1 test employed a 1000 V PI PZT (P-016.00H). By changing to a Noliac NAC2124, the required voltage has been reduced. The new actuation coefficient, measured at LASTI (Lee McCuller, Jan 2017), is ∼105 V/µm, yielding a range of approximately 1.7 µm for a 180 V input.

3 TTFSS

A broadband EOM is used as one of the feedback actuators in the offset PLL locking the squeezer laser to the PSL. No change has been made to the drive voltage relative to the H1 test (±180 V), where reasonable performance was experienced.

[1] Only one is required in normal operation.

4 LO/ Seed path

PZT mirrors are required to lock the LO phase of the diagnostic homodyne[2] and to drive the phase of the seed during (diagnostic) measurements of the parametric gain. Neither measurement will run during observations. Again, for simplicity, we plan to use the Noliac NAC2124 PZTs for this application. A similar PZT (Noliac NAC2123) achieved a first resonance of 89 kHz in tests at MIT [3]. Should greater range be required, for example in long-term tests, we can switch to e.g. Noliac NAC2023-HXX.[3]

References

[1] L. Barsotti et al., "VOPO node of aLIGO SQZ tree," Tech. Rep. LIGO-E1500361, LIGO Laboratory, Aug. 2015.

[2] J. Miller et al., "Quotes aLIGO Squeezer PZTs," Tech. Rep. LIGO-C1700001, LIGO Laboratory, Jan. 2017.

[3] E. Oelker, "Better LO Actuator. 89 kHz resonance," Dec. 2015. MIT iLog.

[2] Which lives on the in-air squeezer table.

[3] PI P-820 (specified for the H1 test) or Thorlabs AE0505D16F (currently used at MIT) are also viable options but can be damaged by 180 V inputs.