RFPD Calibration Head Notes
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T1200396-v2

1. Overview

A small laser diode based calibration head has been built that allows easy RF signal injection into aLIGO LSC and WFS RFPD heads in order to characterize these signal chains in situ. The laser diode produces several milliwatts of light at 980nm. The light source is fully enclosed by its packaging, and self-aligns to the RFPD diode element under test. This note records some normal operating parameters such that the calibration head can be diagnosed in case of a malfunction.

The current source that drives the laser diode is a Thorlabs part number **VLDC002**, with markings "**M0094-160-1/B**" on the circuit board. The light source is a Thorlabs **L980P010**, 980nm Laser Diode. The circuit board used at the point of attachment of the head to the detector under test is D1200690

2. Normal Operating Parameters

An arbitrary laser diode current in the vicinity of 20mA was established by adjustment of the SET LASER (P2) potentiometer. The LIMIT potentiometer (P1) is normally adjusted fully clockwise such that no current limit is established. All baseline data that follows was taken at this fixed operating laser diode current.

3. D-Sub Readings on Interface Cable to Head

A breakout board was put in-line with the laser diode head and the following readings were taken. All readings are taken such that the positive lead of a Fluke multimeter comes first, and the negative last. So, for a reading between pin 1 and 2 of 5 VDC, the red (positive) lead was on pin 1 and the black (negative) lead would be on pin 2.

Table 1, D-Sub Connector Usage

D-Sub Pin	*Function*	*Voltage*
3+ *7-*	Drive to diode cathode	1.402 VDC
4+ *2-*	Current Monitor	0.000 VDC

Figure 1, Thorlab's Current Driver CON-5 Monitor Connector

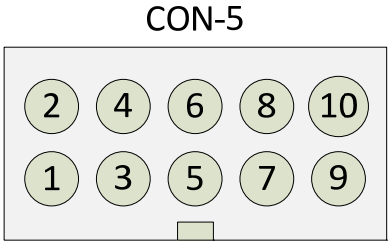


Table 2, CON-5 Connector on Thorlab's PCB. Readings WRT ground

Pin	*Function*	*Voltage*	*Gain*	*Actual*
1	GND	0	-	-
2	LD ON	4.98 VDC	Hi=ON	ON
3	Error	0	HI=Error	NO Error
4	I_{LD} Set	2.128 VDC	100mV/mA	21.28 mA
5	I_{LD} Actual	2.129 VDC	100mV/mA	21.29 mA
6	I_{PD}	-0.0375	1V/mA	-37.5 µA

Table 3 shows the mapping between the gold Microtech connector on the head and the D-Sub connector that plugs onto the control board.

Table 3, Pin Map from Head to Current Driver Board

M8 Pin	*D-Sub Pin*	*Function*
1	7	LD Drive
2	3	GND
3	4	PD Readback
4	2	GND

Operation of this PD calibrator head with an aLIGO single channel WFS head, S1203014 produced the following distribution of photocurrents in each quadrant of the detector. The responsivity of the Q3000 InGaAs photodiode at 980 nm is not given on the datasheet making it somewhat less useful as an absolute estimate of power. The elliptical nature of the laser diode light emission is observable in each quadrant's photocurrent.

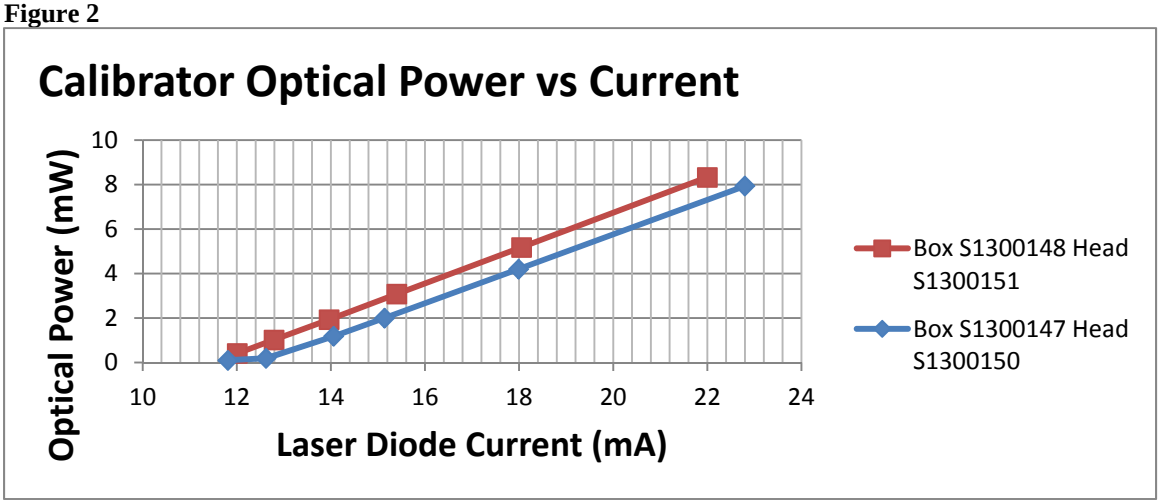
Quadrant	*Differential Voltage*	*DC Transimpedance*	*Photocurrent*
1	-1.111 VDC	996 Ω	1.115 mA
2	-0.716 VDC	996 Ω	0.719 mA
3	-1.151 VDC	997 Ω	1.154 mA
4	-0.573 VDC	996 Ω	0.575 mA

A RED fluted potentiometer labeled "MOD. FREQ. (P3)" is visible on the internal circuit board of the calibrator box. With the "MOD FREQ (S3)" switch in the LOW position, the internal modulation switch set to internal on the rear panel of the box, and a laser head attached to the unit, use an oscilloscope to view the triangle wave seen on the BNC modulation connector. Set the modulation frequency to 100Hz by turning P3.

4. Measured Data

The following data were taken in the 40 meter lab for two of the production laser calibrators built at Caltech. Figure 2 shows a plot of the data listed in the following two tables.

Figure 2



Box S1300148
Head S1300151

Measured Laser Diode Current Monitor (VDC)	Measured Internal diode PD voltage (-mV)	Calculated Laser Diode Current (mA)	Measured Model 840, Newport Power Meter (mW)
2.2	39.7	22	8.33
1.805	25.3	18.05	5.18
1.54	15.5	15.4	3.08
1.396	10.2	13.96	1.93
1.279	6	12.79	1.02
1.201	3.1	12.01	0.41

Box S1300147
Head S1300150

Measured Laser Diode Current Monitor (VDC)	Measured Internal diode PD voltage (-mV)	Calculated Laser Diode Current (mA)	Measured Model 840, Newport Power Meter (mW)
2.28	37.5	22.8	7.94
1.799	21.1	17.99	4.2
1.514	11	15.14	2
1.406	7.3	14.06	1.18
1.262	2.5	12.62	0.19
1.181	2.1	11.81	0.1