LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY
- LIGO -
CALIFORNIA INSTITUTE OF TECHNOLOGY
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Technical Note	LIGO-T1500062-v7	2019/01/29

Pcal End Station Power Sensors Responsivity Ratio Measurements Log

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END STATION: LHO Y end DATE: 1/29/19

PEOPLE DOING THE WORK: Niko, Dimitri E, Rick

* • Need to install repaired shutter.
• Found PM100 PM100D/A PM200 5V DC Power Supply at Pcal pylon

Calibration Log

Before (or after) going to the End Station

- Check the calibration of the Keithley Model 2100 voltmeter using the Martel Calibrated Voltage source (the same one that will be taken to the end station.
  - −4 V with Martel = −4.0000 V on Keithley 2100 DVM
  - −2 V with Martel = −2.0006 V on Keithley 2100 DVM
  - 0 V with Martel = 0.00001 V on Keithley 2100 DVM

Items to take to the end station for the measurements:

- Working Standard
- PD Satellite Box (blue box), D1300368
- Long (25') and short (6'-10') 9-pin D-sub cables
- BNC cable
- Martel calibrated voltage source and charger
- IR-only laser glasses

Before recording time series:

- Check that ETM is pointed properly. Check Pcal beam locations at the Rx sensor (photograph spot locations on white card). long step stools for Rx modules
- Open **gpsclock**
- Open **StripTool** and display the following sensor outputs. Always verify that signals are stable before recording time series.
  - **(IFO):CAL-PCAL(END)_TX_PD_VOLTS_OUTMON**
  - **(IFO):CAL-PCAL(END)_RX_PD_VOLTS_OUTMON**
  - **(IFO):CAL-PCAL(END)_WS_PD_INMON** (OUTMON in Volts)
  - **(IFO):CAL-PCAL(END)_OFS_PD_OUTPUT** ~~PUT~~ MON
- Calibrate the Working standard channel using a **Martel Calibrated Voltage** source. Connect Martel to INPUT 1 on the ***BNC to DB9*** module. Record 15 seconds of data for each input voltage.

† turn off excitations on Pcal Medm screen

- - 4 V = -3.998 V ~~cts~~ and GPS Start Time 1232 815 080
- - 2 V = -2.000 cts and GPS Start Time 110
- 0 V = -0.000 cts and GPS Start Time 135

- Record OFS settings:
  - Offset: 3.75 volt
  - Gain: 46 dB
  - OFS PD: -3.733 volt
- Record Working Standard temperature sensor voltage at Interface Module **WS PD MON** BNC output
  - WS PD MON: 2.599V volts

Convert to °K
2.599 x100 → 285.89° K
.90909 12.9°C → 55.2°F

Time Series Measurements

- Connect Pcal Blue Box PD MON output to INPUT 1 on the ***BNC to DB9*** module.

Measurement 1:

- Block the OUTER beam with a razor blade dump in the Tx module.
- Place the WS in the INNER beam in the Tx module.

WS in the INNER beam in the Tx module.				
GPS Times		Readings from MEDM screen		
Start Time #1	1232 815 890	TxPD	3.078	volt
Duration	240 seconds	WSPD	-3.157	volt
End Time #1	816 130	OFSPD	-3.733	volt

Measurement 2:

- Move the block to the INNER beam in the Tx module.
- Move the WS to the OUTER beam in the Tx module.

WS in the OUTER beam in the Tx module.			
GPS Times		Readings from MEDM screen	
Start Time #2	1232 816 210	TxPD	3.079
Duration	240 seconds	WSPD	-3.221
End Time #2	816 450	OFSPD	-3.733

Measurement 3: OK. INNER

- Leave the WS in the ~~OUTER~~ beam in the Tx module with the INNER beam blocked.
- Close the shutter in the Tx module.

WS in the OUTER beam in the Tx module. Shutter CLOSED.			
GPS Times		Readings from MEDM screen	
Start Time #3	1232 816 530	TxPD	0.011
Duration	60 seconds	WSPD	0.000
End Time #3	590	OFSPD	-0.011

Measurement 4:

- Leave the block in the INNER beam in the Tx module.
- Open the shutter in the Tx module.
- Replace the Rx sensor with the WS in the Rx module.

WS in the Rx module. INNER beam blocked in the Tx module.			
GPS Times		Readings from MEDM screen	
Start Time #4	1232 817 270	TxPD	3.078
Duration	240 seconds	WSPD	-3.183
End Time #4	1232 817 510	OFSPD	-3.733

Measurement 5:

- Move the block to the OUTER beam in the Tx module.

WS in the Rx module. OUTER beam blocked in the Tx module.			
GPS Times		Readings from MEDM screen	
Start Time #5	1232 817 600	TxPD	3.078
Duration	240 seconds	WSPD	-3.129
End Time #5	840	OFSPD	-3.733

Measurement 6:

- CLOSE the shutter in the Tx module.

WS in the Rx module. Shutter CLOSED in the Tx module.			
GPS Times 7 880		Readings from MEDM screen	
Start Time #6	1232 816 ~~530~~	TxPD	0.011
Duration	60 seconds	WSPD	0.000
End Time #6	817 ~~540~~ 940	OFSPD	-0.011

Measurement 7:

- OPEN the shutter in the Tx module.
- Leave the beam block in the OUTER beam in the Tx module.
- Replace the WS with the Rx sensor in the Rx module.

OUTER beam blocked in the Tx module. Rx sensor in the Rx module.			
GPS Times 160		Readings from MEDM screen	
Start Time #7	1232 818 ~~250~~	TxPD	3.078
Duration	240 seconds RxPD	~~WSPD~~	2.241
End Time #7	~~470~~ 400	OFSPD	-3.733

← changed start + end times due to dropouts in data

Measurement 8:

- Move the beam block to the INNER beam in the Tx module.

INNER beam blocked in the Tx module. Rx sensor in the Rx module.			
GPS Times		Readings from MEDM screen	
Start Time #8	1232 818 500	TxPD	3.078
Duration	240 seconds RxPD	~~WSPD~~	2.279
End Time #8	740	OFSPD	-3.733

Measurement 9:

- CLOSE the shutter in the Tx module.

Inner Beam Blocked

Shutter CLOSED in the Tx module. ~~Beam block removed~~ in the Tx module.			
GPS Times		Readings from MEDM screen	
Start Time #9	1232 818 805	TxPD	0.011
Duration	60 seconds	RxPD ~~WSPD~~	0.000
End Time #9	818 865	OFSPD	-0.011

When measurements are finished.

- Remove the beam block from the INNER beam in the Tx module.
- OPEN shutter in the Tx module.
- Check that ETM is pointed properly. Check Pcal beam locations at the Rx sensor (photograph spot locations on white card).
- Analyze the data and upload results to the SVN.
- Make aLog entry, append image of beam spots at the Rx module, add pointer to measurements results in the SVN.

restart excitations, if applicable

1/15/19
$\alpha_T = -0.4808$ → -0.480488
$\alpha_R = -0.7158$ → -0.715410
epics records file

1/29/19
$\alpha_T = -0.480937$ (Rat 1.00093)
$\alpha_R = -0.716157$ (Rat 1.00104)

$$M_T = \frac{2L_{05\theta}}{c}\left(\frac{1}{\rho_{GS}\alpha_{WG}\varepsilon_T\alpha_{TW}}\right)$$

$$M_R = \frac{2L_{05\theta}}{c}\left(\frac{1}{\rho_{GS}\alpha_{WG}\varepsilon_R\alpha_{RW}}\right)$$