LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

-LIGO-

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Test Procedure	**T1400330**-v1	
TCS HWS SLED Chassis, D1200614, Test Procedure		
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Performed by:_____
Date:_____
Board Serial Number: _____

1. **Overview**
   The Thermal Compensation System (TCS) HWS superluminescent diode driver chassis provides current for the HWS SLEDs, reads out the photocurrent from a photodiode inside the SLED, and reads back and controls the temperature of the SLED using a thermistor and TEC, respectively (both also inside the SLED). This document will describe how to test each box, to ensure proper functionality.

2. **Test Equipment**

   2.1 3x Power Supply capable of +/- 18V
   2.2 Current source capable of 2mA.
   2.3 Digital Multimeter (DMM)
   2.4 Voltage Calibrator, or adjustable power supply
   2.5 20 Ohm resistor rated for 2W.

3. **Preliminaries**

   3.1 Perform visual inspection on board to check for missing components or solder deficiencies
   3.2 Before connecting the power to the chassis, set power supply to +/- 18 Volts and then turn them off. Connect the power supply to the chassis under test at the back panel 3-pin power connector labeled “Power Input” paying attention to the values and polarities on the panel.

4. **DC Tests**

   4.1 Turn on the +/- 18V power supplies to the system under test and then turn on the Chassis Power switch. Record the total current.

Measure	**Expected Current**	**Observed Current**	**FP Leds On?**
+18V Supply	270mA +/- 20mA		
-18V Supply	270mA +/- 20mA		

5. I/O Tests

Applies to SLED 1 and SLED 2 channels. All test procedures are the same for the two channels, except where called out.

- Power up the chassis by:
  - Applying +/- 18V to the power connector on the rear of the chassis.
  - Turn on switch
  - Current draw expected = ??
  - Check voltages on output test points:
    - TP1: +5V ± $0.05\mathrm{V}$
    - TP3: +15V ± $0.15\mathrm{V}$
    - TP6: -15V ± $0.15\mathrm{V}$

To Be Tested:

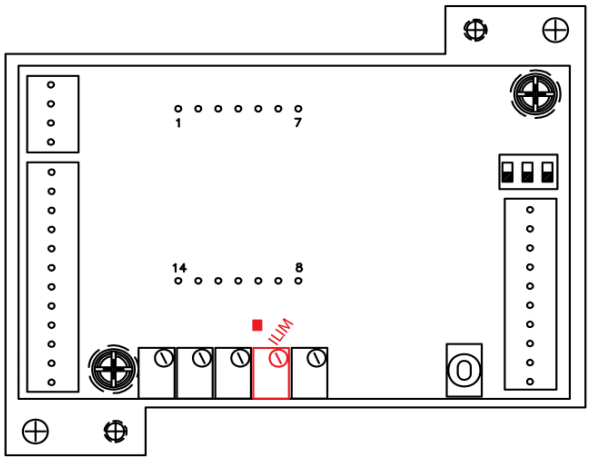
Beckhoff inputs/outputs (back panel)

- ☐ LD SHD 1
- ☐ Ext LD SET 1
- ☐ Ext T SET 1
- ☐ LD SHD 2
- ☐ Ext LD SET 2
- ☐ Ext T SET 2
- ☐ LD P MON 1
- ☐ LD I MON 1
- ☐ TEMP MON 1
- ☐ SET T MON 1
- ☐ LD P MON 2
- ☐ LD I MON 2
- ☐ TEMP MON 2
- ☐ SET T MON 2

SLED interface signals (front panel)

- ☐ PD Current 1
- ☐ LD Current 1
- ☐ TEC Cooler 1
- ☐ Thermistor 1
- ☐ PD Current 2
- ☐ LD Current 2
- ☐ TEC Cooler 2
- ☐ Thermistor 2

Limit Current Trimpot and Testpoint



1. Remove cover from LDTC driver module
2. Set dip switches modes to the following. The labels for the switches are only visible when the driver cover is in place.
    a. LDREF: EXT (external laser diode reference)
    b. CC|CP: INT (constant current setting)
    c. TREF: EXT (external temperature reference)

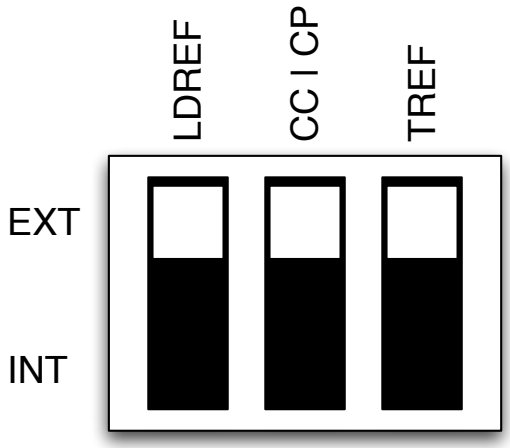


Figure 1: DIP switches on LDTC0520. Note: these labels are only visible when the driver cover in on.

3. Adjust ILIM (current limit) trimpot to set the maximum allowable current. Measure using the adjacent test point, shown in Figure 1, (transfer function = 250mA/V). Set ILIM according to the desired SLED indicated in the table below.

a. Once the ILIM voltage has been set, attach a label to the front of the SLED driver chassis, next to the appropriate SLED 1 or SLED 2 channel, that indicates the Type and Part # that driver has been matched to.

Table 1: A list of the available super-luminescent diodes in aLIGO that the diode drivers must be matched to.

Location	Type	Part #	Op. current	Max current	ILIM voltage
HWS Y – SLED 2	QSDM-840-5	12.02.32	134 mA	147 mA	**588 mV**
HWS Y – SLED 2	QSDM-840-5	12.02.43	142 mA	156 mA	**624 mV**
HWS Y – SLED 2	QSDM-840-5	12.02.44	131 mA	144 mA	**576 mV**
HWS Y – SLED 2	QSDM-840-5	12.02.45	129 mA	142 mA	**568 mV**
HWS Y – SLED 2	QSDM-840-5	12.02.46	116 mA	128 mA	**512 mV**
HWS Y – SLED 2	QSDM-840-5	12.02.47	127 mA	140 mA	**560 mV**
HWS X – SLED 1	QSDM-790-5	12.05.21	165 mA	182 mA	**728 mV**
HWS X – SLED 1	QSDM-790-5	11.10.39	153 mA	168 mA	**672 mV**
HWS X – SLED 1	QSDM-790-5	11.10.40	145 mA	160 mA	**640 mV**
HWS X – SLED 1	QSDM-790-5	11.10.45	149 mA	164 mA	**656 mV**
HWS X – SLED 1	QSDM-790-5	11.10.51	160 mA	176 mA	**704 mV**
HWS X – SLED 1	QSDM-790-5	11.10.52	155 mA	170 mA	**680 mV**

4. Plug a 9-pin breakout board into the 9-pin output on the front panel
    a. Connect one side of a 20 Ohm resistor, rated for 2W or less, to pins 4 and 5
    b. Connect the other side of the resistor to pins 8 and 9
    c. Connect a 1mA current source, to simulate the Photodiode (P), across pins 6 (PD Cathode) & 7 (PD Anode).
    d. Short Laser Anode (Pin 8) to Photodiode cathode (PIN 6) on Breakout board
5. Connect a 15-pin breakout board to the 15-pin connector
    a. Connect a 10kOhm RTD (or a 10kOhm trimpot) across pins 7 & 8
    b. Connect one side of 10 Ohm resistor to pins 1 & 2
    c. Connect the other side of the resistor to pins 3 & 4
6. Connect a 25-pin breakout board to the back of the chassis
    a. Check Temperature set and readback, T SET, TEMP MON, SET T MON
        i. SLED 1: Connect a voltage monitor across pins 7 (+) and 20 (-)
            ☐ Confirm output voltage is 2V ± 0.5V and varies as the “temperature RTD/trimpot” is varied.
        ii. SLED 2: Connect a volt monitor across pins 11 (+) and 24 (-)
            ☐ Confirm output voltage is 2V ± 0.5V and varies as the “temperature RTD/trimpot” is varied.
        iii. SLED1: Connect a voltage source, Vset, across pins 2 (+) & 4 (GND) – TEMPERATURE SET. This will attempt to drive temperature of the diode to one such that the resistance of the RTD, R(Temp) = Vset/100uA.
            ☐ Set Vset to be 3.33V. Measure the SET TEMPERATURE VOLTAGE across pins 8 (+) and 21 (-). Confirm it is 2V ± 0.05V.
            ☐ Set Vset to [2.5, 2.75, 3.0, 3.25, 3.5]V. Record the corresponding values of SET TEMPERATURE VOLTAGE
        iv. SLED2: Connect a voltage source across pins 16 (+) & 4 (GND) – TEMPERATURE SET

- ☐ Set Vset to be 3.33V. Measure the SET TEMPERATURE VOLTAGE across pins 12 (+) and 25 (-). Confirm it is 2V ± 0.05V.
- ☐ Set Vset to [2.5, 2.75, 3.0, 3.25, 3.5]V. Record the corresponding values of SET TEMPERATURE VOLTAGE

b. *Check photodiode readback, LD P MON*
   - *i.* SLED1: Connect a voltage sensor to the 25-pin connector pins 5 (+) and 18(-) to sense LD P MON 1.
   - *ii.* Apply a current of 1mA to the 9-pin connector pins in Step 4c.
     - ☐ Confirm output voltage, LD P MON 1, is 2V ± 0.05V
   - *iii.* SLED2: Connect a voltage sensor to the 25-pin connector pins 9 (+) and 2(-) to sense LD P MON 2
   - *iv.* Apply a current of 1mA to the 9-pin connector pins in Step 4c.
     - ☐ Confirm output voltage, LD P MON 2, is 2V ± 0.05V

c. *Check the laser shutdown and setpoint, LD SHD, LD SET, LD I MON.*
   - *i.* Turn on the LDCT0520 laser diode module by moving the ON/OFF switch to the ON position.
   - ii. SLED 1: Connect a 0-5V signal (LD SHD) across pins 1 (+) & 4 (GND). Set it to 0V.
     - ☐ Measure the voltage across the 20 Ohm resistor attached in Step 4a. Confirm there is a voltage of 3V ± 1.5V across this resistor.
     - ☐ Increase LD SHD from 0V to 5V. Confirm that > 3V on LD SHD shuts down the current to the 20 Ohm resistor by observing the voltage across that resistor and confirming it drops to zero.
   - iii. SLED 1: Connect a voltage source, LD SET 1, across pins 14 (+) & 4 (GND)
   - iv. SLED 1: Connect a voltage sensor, LD I MON 1, across pins 6 (+) and 19 (-)
     - ☐ Set voltage LD SET 1 to 5V. Set LD SHD to 0V. Confirm that LD I MON 1 reads 1V ± $0.05\mathrm{V}$.
     - ☐ Turn LD SHD to 5V. Confirm that LD I MON 1 drops to 0V ± $0.05\mathrm{V}$.
     - ☐ Set LD SET 1 to [5, 8]V in 0.25V increments. Record that LD I MON 1 for these settings. Confirm that LD I MON 1 saturates at the predefined current limit, ILIM.
   - v. SLED 2: Connect a 5V signal (LD SHD 2) across pins 15 (+) & 4 (GND)
     - ☐ > 3V shuts down the laser
   - vi. SLED 2: Connect a voltage source, LD SET 2, across pins 3 (+) & 4 (GND)
   - vii. SLED 2: Connect a voltage sensor, LD I MON 2, across pins 10 (+) and 23 (-)
     - ☐ Set voltage LD SET 2 to 5V. Set LD SHD to 0V. Confirm that LD I MON 2 reads approximately 1V ± $0.05\mathrm{V}$.
     - ☐ Turn LD SHD to 5V. Confirm that LD I MON 2 drops to 0V ± $0.05\mathrm{V}$.
     - ☐ Set LD SET 2 to [5, 8]V in 0.25V increments. Record that LD I MON 2 for these settings. Confirm that LD I MON 2 saturates at the predefined current limit, ILIM.

7. Connect a Newport 740 module with a test SLED to D1200614. Leave the 25-pin connector connected to D1200614
   a. SLED1: Measure the TEMP MON +1 temperature monitor voltage for SLED driver 1 across pins 7 (+) and 20(-) on the 25-pin connector

b. SLED 1: Connect a voltage source, Vset, across pins 2 (+) & 4 (GND) – TEMPERATURE SET.
    i. Set Vset to [2.5, 2.75, 3.0, 3.25, 3.5]V. Record the corresponding values of TEMP MON +1 (the actual temperature). Confirm it is within 10% of the values recorded in step 6.a.iii.
c. SLED2: Measure the TEMP MON +2 temperature monitor voltage for SLED driver 1 across pins 11(+) and 24(-) on the 25-pin connector
d. SLED 2: Connect a voltage source across pins 16 (+) & 4 (GND) – TEMPERATURE SET
    i. Set Vset to [2.5, 2.75, 3.0, 3.25, 3.5]V. Record the corresponding values of TEMP MON +1 (the actual temperature). Confirm it is within 10% of the values recorded in step 6.a.iv
    ii.