LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

-LIGO-

CALIFORNIA INSTITUTE OF TECHNOLOGY

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Document Type	DCC Number	August 7, 2014
Test Procedure	**T1400484**-v2	
PCal Interface Chassis Test Procedure		
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Performed by:_____
Date:_____
Board Serial Number: _____

1. **Overview**
   The PCal Interface Chassis (D1400153-v1) houses a PCal Interface Board (D1400152-V2), and a PCal Interface Back Board (D1400149-v1). The function of this chassis is Interface the EtherCAT and fast controls and readbacks with the laser AOM and Power Supply chassis, Optical Follower servo, Access control, and several temperature sensors and photodiodes.

2. **Test Equipment**

   2.1 Power Supply capable of +/- 18V
   2.2 Voltage Calibrator, or adjustable power supply
   2.3 SR785 Network Analyzer, or equivalent
   2.4 Dsub Breakout boards (9-pin, 15-pin, 37-pin)
   2.5 Digital Multimeter (DMM)

3. **Preliminaries**

   3.1 Perform visual inspection of the Chassis to make sure nothing looks overtly broken.
   3.2 Before connecting the power to the box, set a power supply to +/- 18 Volts and then turn it off. Connect the power supply to the chassis under test at the connector labeled "Power".
   3.3 Open the chassis lid, and set (or insert) jumpers such that P1 and P2 are set to the "switched" position on the back board, and WSPDA, and WSPDB, are both set to the "WSPD" position on the main board.
   3.4 Connect a 37-pin Dsub Breakout board to the "To/From EtherCAT" connector on the back panel.

4. **Electrical Tests**

   4.1 Turn on the power supplies, and record the current in the table below.

Voltage	Current	Observed Current	Front and Back panel +/-15V LEDs On?
+18V	130mA +/- 15mA		
-18V	130mA +/- 15mA		

4.2 Continuity Checks

    4.2.1 Optical follower Continuity: Attach a 15-pin DSub Breakout board to the connector labled "To/From Optical Follower", and a 9-pin Dsub Breakout to the connector labled "To Anti-Alias Chassis" and Check for continuity (any "No" answer is a fail):

EtherCAT Pin	Optical Follower Pin	Continuous (Yes/No)?
J2-Pin 1	J4-Pin 1	
J2-Pin 20	J4-Pin 9	
J2-Pin 2	J4-Pin 2	
J2-Pin 21	J4-Pin 10	
J2-Pin 7	J4-Pin 3	
J2-Pin 26	J4-Pin 11	
J2-Pin 10	J4-Pin 4	
J2-Pin 29	J4-Pin 12	

Anti-Alias Pin	Optical follower Pin	Continuous (Yes/No)?
J1-Pin 1	J4-Pin 6	
J1-Pin 6	J4-Pin 14	
J1-Pin 4	J4-Pin 7	
J1-Pin 9	J4-Pin 15	

    4.2.2 Laser Power and AOM Chassis Continuity: Attach a 15-pin DSub Breakout board to the connector labled "To/From Laser Power and AOM Chassis", and a 37-pin Dsub Breakout board to the "To/From EtherCAT" connector on the back panel. Check continuity as below (any "No" answer is a fail):

EtherCAT Pin	Laser Power and AOM Pin	Continuous (Yes/No)?
J2-Pin 3	J5-Pin 1	
J2-Pin 22	J5-Pin 9	
J2-Pin 31	J5-Pin 2	
J2-Pin 29	J5-Pin 10	
J2-Pin 29	J5-Pin 11	
J2-Pin 29	J5-Pin 12	

    4.2.3 Access Control Continuity: Using two 9-pin DSub Breakout boards, or other effective method, short together Pins 2&7 of both the Rx and Tx Temp and Interlock connectors on the front panel. Once this is done, Pins 1&6 on the back panel "To Access Control" connector should be shorted together. Disconnecting either front panel connector should break the short. Operation as stated above? (Yes/No)_____

4.2.4 WSPD Continuity: With the WSPDA and WSPDB Jumpers still in the "WSPD" position, Check continuity from the front panel WS PD connector to the EtherCAT connector:

EtherCAT Pin	WS PD Pin	Continuous (Yes/No)?
J2-Pin 4	J7-Pin 1	
J2-Pin 23	J7-Pin 6	

4.3 Relay Functions: Verify that Pins 11 and 12 on the EtherCAT connector read +15V with respect to Pin 29 (GND).
Pin 11 +15V?_____
Pin 12 +15V?_____

Using a clip lead, tie EtherCAT Pin 11 (+15V) to Pin 13 (Beckhoff remote GND). Next clip a long clip lead to pin 12 (+15V), and use this to actuate the relays in the table below. In cells that call out Local/Remote switch position, verify that the switch is in that position. Look for the appropriate signal (and LED lighting, where appropriate), and record the results in the table below:

Pin to connect with Pin 12	Switch positions	Readout pin	Expected signal	Signal present (Yes/No)?
"To Shutter" Pin 6	Remote	"EtherCAT" Pin 32	+15V +/- .5V, "Open" LED lit	
"To Shutter" Pin 5	Remote	"EtherCAT" Pin 14	+15V +/- .5V "Closed" LED lit	
"Optical Follower" Pin 5	Remote	"EtherCAT" Pin 33	+15V +/- .5V	
"EtherCAT" Pin 30	Remote	"To Shutter" Pin 1	+15V +/- .5V	
"EtherCAT" Pin 30	Remote	"To Shutter" Pin 3	+15V +/- .5V	
"EtherCAT" Pin 30	Local	"To Shutter" Pin 1	+15V +/- .5V	
"EtherCAT" Pin 30	Local	"To Shutter" Pin 3	0V	
"EtherCAT" Pin 30	Local, pushing "Open" button	"To Shutter" Pin 3	+15V +/- .5V	
"EtherCAT" Pin 30	Local, pushing "Close" button	"To Shutter" Pin 1	0V	

Disconnect both clip leads.

4.4 Photodiode input tests:

4.4.1 Signal Tests: Using a network analyzer, apply a 5Vp-p, signal and sweep from 100Hz to 100KHz to the appropriate pins in the table below. Read out the signal differentially (A-B) for the Anti-Alias pins, and single-ended for the BNC monitors, and verify that the signal is correct across the entire frequency range:

Input	Output Pins (Expected 0dB +/- 0.5dB)	Observed Output
"Rx PD" Pins 1(+) and 6(-)	"To Anti-Alias" Pins 2(+) and 7(-)	
"Rx PD" Pins 1(+) and 6(-)	Rx PD Mon BNC	
"Tx PD" Pins 1(+) and 6(-)	"To Anti-Alias" Pins 3(+) and 8(-)	
"Tx PD" Pins 1(+) and 6(-)	Tx PD Mon BNC	
"WS PD" Pins 1(+) and 6(-)	"EtherCAT" Pins 4(+) and 23(-)	
"WS PD" Pins 1(+) and 6(-)	WS PD Mon BNC	

4.4.2 Alternate WSPD Input Test: Now move the jumpers WSPDA and WSPDB from the "WSPD" position, to the Alt. WSPD position. Apply the above signal to the front panel "Alt. WSPD" BNC, and read out the signal in the appropriate places in the table below:

Input	Output Pins (Expected +6dB +/- 0.5dB)	Observed Output
"Alt. WSPD" BNC	"EtherCAT" Pins 4(+) and 23(-)	
"Alt. WSPD" BNC	WS PD Mon BNC	

4.4.3 Power to PD tests: The front panel connectors supply power to the remote photodiode boxes. These tests check to make sure the voltages are present.

Pins	Expected Voltage	Observed Voltage
"Rx PD" Pins 2(+) and 7(GND)	+15V +/- 0.5V	
"Rx PD" Pins 3(-) and 7(GND)	-15V +/- 0.5V	
"Tx PD" Pins 2(+) and 7(GND)	+15V +/- 0.5V	
"Tx PD" Pins 3(-) and 7(GND)	-15V +/- 0.5V	
"WS PD" Pins 2(+) and 7(GND)	+15V +/- 0.5V	
"WS PD" Pins 3(-) and 7(GND)	-15V +/- 0.5V	

4.5 Laser Diode Current and Temperature Tests: Using a network analyzer, apply a 1Vp-p, signal and sweep from 100Hz to 100KHz to the appropriate pins in the table below. Read out the signal differentially (A-B) for the Anti-Alias pins, and verify that the signal is correct across the entire frequency range:

Input	Output Pins (Expected 6dB +/- 0.5dB)	Observed Output
"Laser Power and AOM" Pin 3(+) and 11(-)	"EtherCAT" Pins 8(+) and 27(-)	
"Laser Power and AOM" Pin 4(+) and 12(-)	"EtherCAT" Pins 9(+) and 28(-)	

4.6 Temperature Sensor tests: Set up the Voltage Calibrator to output current, and connect the ground lead to Pin 2 of the "To Shutter" connector (Board GND). Apply 1mA onto the appropriate pins, and read out the signal using a DMM as per the table below:

Input Pins	Output Pins	Expected Output	Observed Output
"Tx Temp. and Interlock" Pin 6	"EtherCAT" Pins 5(+) and 24(-)	20V +/- 0.1V	
"Rx Temp. and Interlock" Pin 6	"EtherCAT" Pins 6(+) and 25(-)	20V +/- 0.1V	

Move the jumpers WSPDA and WSPDB back to the "WSPD" position.