LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

LIGO Laboratory / LIGO Scientific Collaboration

LIGO-T2100299-v2	*LIGO*	8/16/2021

Test Procedure for IO Interface Backplane

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Distribution of this document:
LIGO Scientific Collaboration

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1   Introduction

The following Test Procedure describes the test of proper operation of the PCIe Timing Interface.

S/N _____   Tester _____   Date _____

2   Test Equipment

- Voltmeter
- Oscilloscope
- Fiber from a Timing Master/Fanout (optional),
- Windows PC with open motherboard with at least 1 PCIe slot free. Alternatively, use a PC with a PCIe extender like the Adnaco.
- Extra PC ATX power supply
- Adapter: Dual PSU power supply 24-pin adapter cable for ATX motherboard, and
- 2 test adapter board for backplane, D2100184.
- Breakout Boards – DB25 if needed

3   Preparations

- PC needs to run Windows 10, 64-bit, no secure boot.
- Install the device driver for LIGO Timing.
- Install the LIGOTimingApp program.
- Install a PCIe timing board in the PC and make sure the driver is loaded (it should show up in the Device Manager as "Timing > LIGO Timing Device").

4   Caution

When connecting test adapters, backplanes and daughter cards, it is important that the correct FPGA program is loaded. Otherwise, it is possible to short two outputs together which can potentially damage the board.

- The backplane, D20000297, daughter board, D2000331, and the GPS expansion module, D2000301, require the FPGA timing code, E2000337.

5 Backplane Test

Setup the backplane with the extra ATX power supply and with the dual PSU Power Supply 24-pin adapter cable. Turn on the power.

1) Check the voltages and LEDs on the backplane.

TP7 (+12V) _____   TP3 (+3.3V) _____

TP10 (+5V) _____
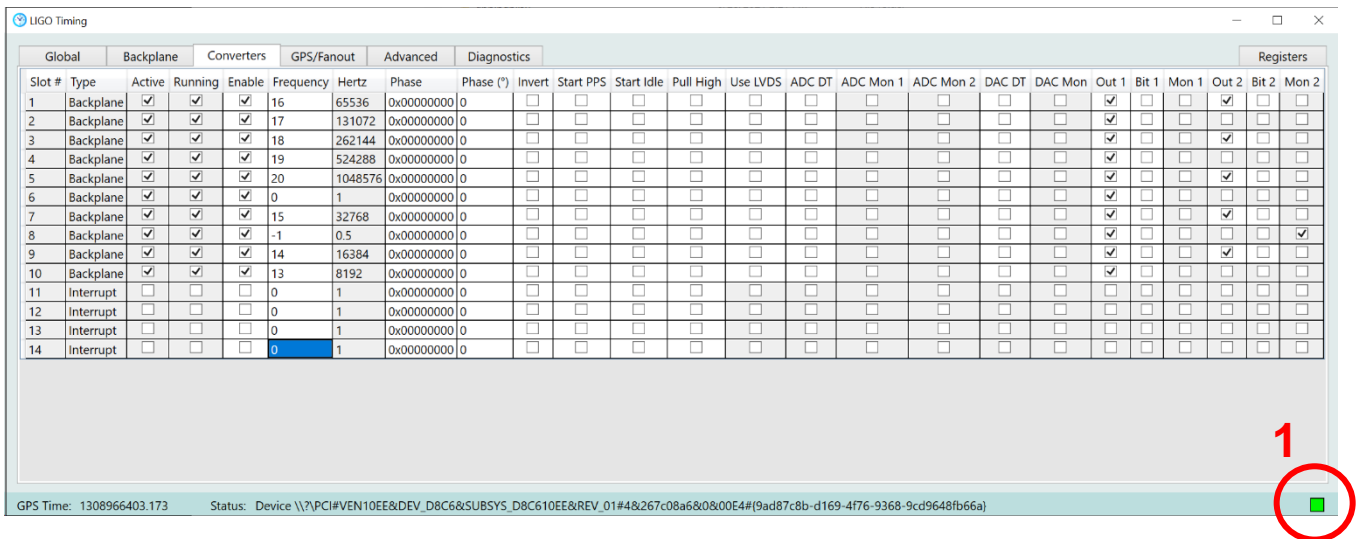
LED DS1 (green) _____   LED DS2 (green) _____

LED DS3 (green) _____

2) Insert PCIe board into PC, connect the DB37 cable.
Run the LIGO Timing App program and make sure it is running.

Set the frequencies of the backplane slots (Converter tab) to 16, 17, 18, 19, 20, 0, 15, -1, 14, and 13. Enable all slots. Set Out1 and Out 2 in the fields with white background.

1: Device driver connected_____   Nominal: green

Make sure the backplane is enabled.
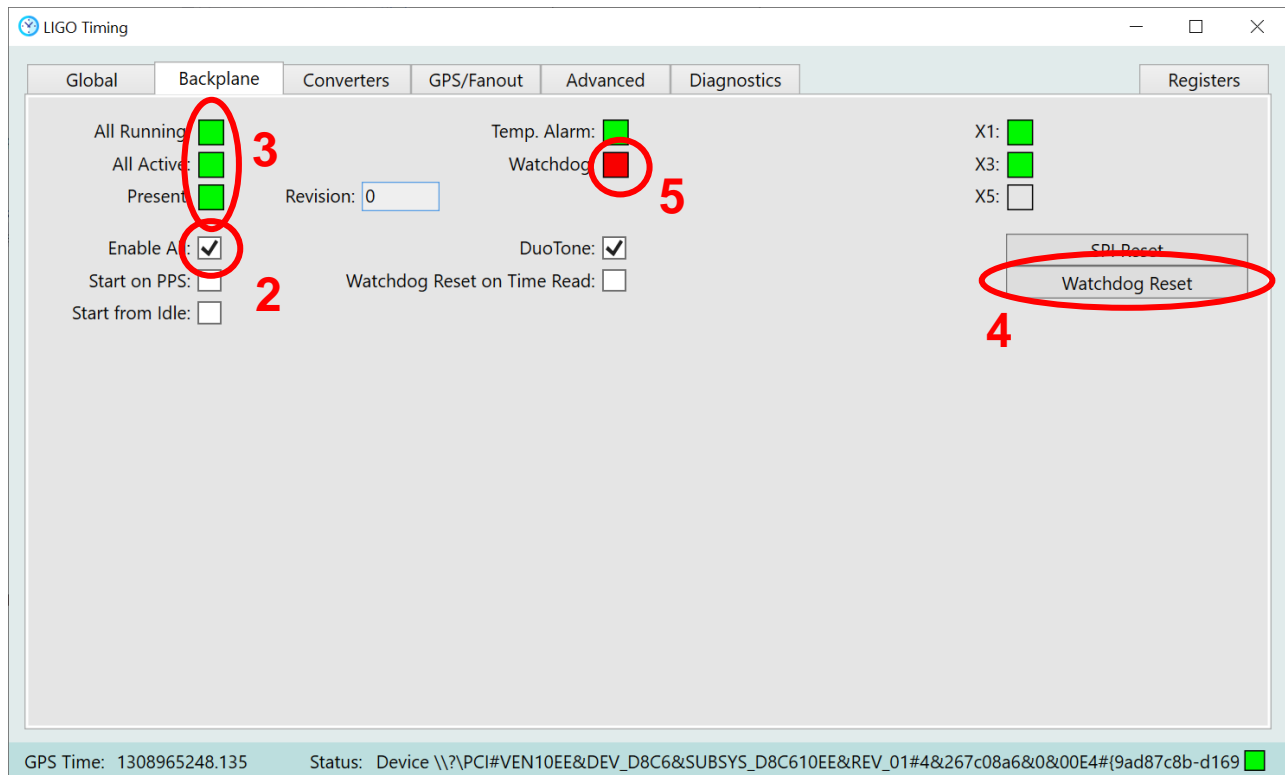
2: All enabled _____   Nominal: check

3: All running _____   Nominal: green

4: Press watchdog button, and check the watchdog go green for ~2 sec.

5: Watchdog indicator _____   Nominal: 2sec-green

6: Short pins 1 & 2 on P3 header _____ Nominal: Temp Alarm goes red

3) **Install two backplane adapter boards into slots 1 and 2, then equip them with DB25 breakout boards.**

Toggle Slot 1/ADC DT: _____ Nominal: Turns off 1st LED in slot 1

Toggle Slot 2/ADC DT: _____ Nominal: Turns off 1st LED in slot 2

Toggle slot 1/DAC DT: _____ Nominal: Turns off 2nd LED in slot 1

Toggle slot 2/DAC DT: _____ Nominal: Turns off 2nd LED in slot 2

Toggle slot 1/Bit 1: _____ Nominal: Turns on 3rd LED in slot 1

Toggle slot 2/Bit 1: _____ Nominal: Turns on 3rd LED in slot 2

Toggle slot 1/Bit 2: _____ Nominal: Turns on 4th LED in slots 1 & 2

Toggle 1st switch in slot 1: _____ Nominal: ADC Mon 1 comes on in slot 1

Toggle 1st switch in slot 2: _____ Nominal: ADC Mon 1 comes on in slot 2

Toggle 2nd switch in slot 1: _____ Nominal: ADC Mon 2 comes on in slot 1

Toggle 2nd switch in slot 2: _____ Nominal: ADC Mon 2 comes on in slot 2

Toggle 3rd switch in slot 1: _____ Nominal: DAC Mon 1 comes on in slot 1

Toggle 3rd switch in slot 2: _____ Nominal: DAC Mon 1 comes on in slot 2

Use a clip to probe the pins on the DB25 breakouts. Repeat after toggling "Use LVDS". Pin 13 can be used as a ground.

Pin 1/slot 1: _____ Nominal: 65536 Hz with LVDS on

Pin 2/slot 1: _____ Nominal: 65536 Hz with LVDS on

Pin 3/slot 1: _____ Nominal: 131072 Hz with LVDS on

Pin 4/slot 1: _____ Nominal: 65536 Hz with LVDS off

Pin 5/slot 1: _____ Nominal: 65536 Hz with LVDS off

Pin 1/slot 2: _____ Nominal: 131072 Hz with LVDS on

Pin 2/slot 2: _____ Nominal: 65536 Hz with LVDS on

Pin 3/slot 2: _____ Nominal: 131072 Hz with LVDS on

Pin 4/slot 2: _____ Nominal: 131072 Hz with LVDS off

Pin 5/slot 2: _____ Nominal: 131072 Hz with LVDS off

With an Ohmmeter check short between pin 8 on slots 1 & 2: _____

With an Ohmmeter check short between pin 21 on slots 1 & 2: _____

With a scope check for DuoTone on pin 7 in slot 1: _____

With a scope check watchdog on pin 25 in slot 1 (press watchdog button!): _____

With a scope check watchdog on pin 25 in slot 2 (press watchdog button!): _____

4) Install two backplane adapter boards into slots 3 and 4, then equip them with DB25 breakout boards.

Toggle Slot 3/ADC DT: _____   Nominal: Turns off 1st LED in slot 3

Toggle Slot 4/ADC DT: _____   Nominal: Turns off 1st LED in slot 4

Toggle slot 3/DAC DT: _____   Nominal: Turns off 2nd LED in slot 3

Toggle slot 4/DAC DT: _____   Nominal: Turns off 2nd LED in slot 4

Toggle slot 3/Bit 1: _____   Nominal: Turns on 3rd LED in slot 3

Toggle slot 4/Bit 1: _____   Nominal: Turns on 3rd LED in slot 4

Toggle slot 3/Bit 2: _____   Nominal: Turns on 4th LED in slots 3 & 4

Toggle 1st switch in slot 3: _____   Nominal: ADC Mon 1 comes on in slot 3

Toggle 1st switch in slot 4: _____   Nominal: ADC Mon 1 comes on in slot 4

Toggle 2nd switch in slot 3: _____   Nominal: ADC Mon 2 comes on in slot 3

Toggle 2nd switch in slot 4: _____   Nominal: ADC Mon 2 comes on in slot 4

Toggle 3rd switch in slot 3: _____   Nominal: DAC Mon 1 comes on in slot 3

Toggle 3rd switch in slot 4: _____   Nominal: DAC Mon 1 comes on in slot 4

Use a clip to probe the pins on the DB25 breakouts. Repeat after toggling "Use LVDS". Pin 13 can be used as a ground.

Pin 1/slot 3: _____   Nominal: 262144 Hz with LVDS on

Pin 2/slot 3: _____   Nominal: 262144 Hz with LVDS on

Pin 3/slot 3: _____   Nominal: 524288 Hz with LVDS on

Pin 4/slot 3: _____   Nominal: 262144 Hz with LVDS off

Pin 5/slot 3: _____   Nominal: 262144 Hz with LVDS off

Pin 1/slot 4: _____   Nominal: 524288 Hz with LVDS on

Pin 2/slot 4: _____   Nominal: 262144 Hz with LVDS on

Pin 3/slot 4: _____ Nominal: 524288 Hz with LVDS on

Pin 4/slot 4: _____ Nominal: 524288 Hz with LVDS off

Pin 5/slot 4: _____ Nominal: 524288 Hz with LVDS off

With an Ohmmeter check short between pin 8 on slots 3 & 4: _____

With an Ohmmeter check short between pin 21 on slots 3 & 4: _____

With a scope check watchdog on pin 25 in slot 1 (press watchdog button!): _____

With a scope check watchdog on pin 25 in slot 2 (press watchdog button!): _____

5) **Install two backplane adapter boards into slots 5 and 6, then equip them with DB25 breakout boards.**

Toggle Slot 5/ADC DT: _____ Nominal: Turns off 1st LED in slot 5

Toggle Slot 6/ADC DT: _____ Nominal: Turns off 1st LED in slot 6

Toggle slot 5/DAC DT: _____ Nominal: Turns off 2nd LED in slot 5

Toggle slot 6/DAC DT: _____ Nominal: Turns off 2nd LED in slot 6

Toggle slot 5/Bit 1: _____ Nominal: Turns on 3rd LED in slot 5

Toggle slot 6/Bit 1: _____ Nominal: Turns on 3rd LED in slot 6

Toggle slot 5/Bit 2: _____ Nominal: Turns on 4th LED in slots 5 & 6

Toggle 1st switch in slot 5: _____ Nominal: ADC Mon 1 comes on in slot 5

Toggle 1st switch in slot 6: _____ Nominal: ADC Mon 1 comes on in slot 6

Toggle 2nd switch in slot 5: _____ Nominal: ADC Mon 2 comes on in slot 5

Toggle 2nd switch in slot 6: _____ Nominal: ADC Mon 2 comes on in slot 6

Toggle 3rd switch in slot 5: _____ Nominal: DAC Mon 1 comes on in slot 5

Toggle 3rd switch in slot 6: _____ Nominal: DAC Mon 1 comes on in slot 6

Toggle 4th switch in slot 6: _____ Nominal: X1 goes off (backplane tab)

Use a clip to probe the pins on the DB25 breakouts. Repeat after toggling "Use LVDS". Pin 13 can be used as a ground.

Pin 1/slot 5: _____ Nominal: 1048576 Hz with LVDS on

Pin 2/slot 5: _____ Nominal: 1048576 Hz with LVDS on

Pin 3/slot 5: _____ Nominal: 1 Hz with LVDS on

Pin 4/slot 5: _____ Nominal: 1048576 Hz with LVDS off

Pin 5/slot 5: _____ Nominal: 1048576 Hz with LVDS off

Pin 1/slot 6: _____ Nominal: 1 Hz with LVDS on

Pin 2/slot 6: _____ Nominal: 1048576 Hz with LVDS on

Pin 3/slot 6: _____ Nominal: 1 Hz with LVDS on

Pin 4/slot 6: _____ Nominal: 1 Hz with LVDS off

Pin 5/slot 6: _____ Nominal: 1 Hz with LVDS off

With an Ohmmeter check short between pin 8 on slots 5 & 6: _____

With an Ohmmeter check short between pin 21 on slots 5 & 6: _____

With a scope check watchdog on pin 25 in slot 1 (press watchdog button!): _____

With a scope check watchdog on pin 25 in slot 2 (press watchdog button!): _____

6) **Install two backplane adapter boards into slots 7 and 8, then equip them with DB25 breakout boards.**

Toggle Slot 7/ADC DT: _____ Nominal: Turns off 1st LED in slot 7

Toggle Slot 8/ADC DT: _____ Nominal: Turns off 1st LED in slot 8

Toggle slot 7/DAC DT: _____ Nominal: Turns off 2nd LED in slot 7

Toggle slot 8/DAC DT: _____ Nominal: Turns off 2nd LED in slot 8

Toggle slot 7/Bit 1: _____ Nominal: Turns on 3rd LED in slot 7

Toggle slot 8/Bit 1: _____ Nominal: Turns on 3rd LED in slot 8

Toggle slot 7/Bit 2: _____ Nominal: Turns on 4th LED in slots 7 & 8

Toggle 1st switch in slot 7: _____ Nominal: ADC Mon 1 comes on in slot 7

Toggle 1st switch in slot 8: _____ Nominal: ADC Mon 1 comes on in slot 8

Toggle 2nd switch in slot 7: _____ Nominal: ADC Mon 2 comes on in slot 7

Toggle 2nd switch in slot 8: _____ Nominal: ADC Mon 2 comes on in slot 8

Toggle 3rd switch in slot 7: _____ Nominal: DAC Mon 1 comes on in slot 7

Toggle 3rd switch in slot 8: _____ Nominal: DAC Mon 1 comes on in slot 8

Toggle 4th switch in slot 8: _____ Nominal: X3 goes off (backplane tab)

Use a clip to probe the pins on the DB25 breakouts. Repeat after toggling "Use LVDS". Pin 13 can be used as a ground.

Pin 1/slot 7: _____ Nominal: 32768 Hz with LVDS on

Pin 2/slot 7: _____ Nominal: 32768 Hz with LVDS on

Pin 3/slot 7: _____ Nominal: 0.5 Hz with LVDS on

Pin 4/slot 7: _____ Nominal: 32768 Hz with LVDS off

Pin 5/slot 7: _____ Nominal: 32768 Hz with LVDS off

Pin 1/slot 8: _____ Nominal: 0.5 Hz with LVDS on

Pin 2/slot 8: _____ Nominal: 32768 Hz with LVDS on

Pin 3/slot 8: _____ Nominal: 0.5 Hz with LVDS on

Pin 4/slot 8: _____ Nominal: 0.5 Hz with LVDS off

Pin 5/slot 8: _____ Nominal: 0.5 Hz with LVDS off

With an Ohmmeter check short between pin 8 on slots 7 & 8: _____

With an Ohmmeter check short between pin 21 on slots 7 & 8: _____

With a scope check watchdog on pin 25 in slot 1 (press watchdog button!): _____

With a scope check watchdog on pin 25 in slot 2 (press watchdog button!): _____

7) Install two backplane adapter boards into slots 9 and 10, then equip them with DB25 breakout boards.

Toggle Slot 9/ADC DT: _____ Nominal: Turns off 1st LED in slot 9

Toggle Slot 10/ADC DT: _____ Nominal: Turns off 1st LED in slot 10

Toggle slot 9/DAC DT: _____ Nominal: Turns off 2nd LED in slot 9

Toggle slot 10/DAC DT: _____ Nominal: Turns off 2nd LED in slot 10

Toggle slot 9/Bit 1: _____ Nominal: Turns on 3rd LED in slot 9

Toggle slot 10/Bit 1: _____ Nominal: Turns on 3rd LED in slot 10

Toggle slot 9/Bit 2: _____ Nominal: Turns on 4th LED in slots 9 & 10

Toggle 1st switch in slot 9: _____ Nominal: ADC Mon 1 comes on in slot 9

Toggle 1st switch in slot 10: _____ Nominal: ADC Mon 1 comes on in slot 10

Toggle 2nd switch in slot 9: _____ Nominal: ADC Mon 2 comes on in slot 9

Toggle 2nd switch in slot 10: _____ Nominal: ADC Mon 2 comes on in slot 10

Toggle 3rd switch in slot 9: _____ Nominal: DAC Mon 1 comes on in slot 9

Toggle 3rd switch in slot 10: _____ Nominal: DAC Mon 1 comes on in slot 10

Use a clip to probe the pins on the DB25 breakouts. Repeat after toggling "Use LVDS". Pin 13 can be used as a ground.

Pin 1/slot 9: _____ Nominal: 16384 Hz with LVDS on

Pin 2/slot 9: _____ Nominal: 16384 Hz with LVDS on

Pin 3/slot 9: _____ Nominal: 8192 Hz with LVDS on

Pin 4/slot 9: _____ Nominal: 16384 Hz with LVDS off

Pin 5/slot 9: _____ Nominal: 16384 Hz with LVDS off

Pin 1/slot 10: _____ Nominal: 8192 Hz with LVDS on

Pin 2/slot 10: _____ Nominal: 16384 Hz with LVDS on

Pin 3/slot 10: _____ Nominal: 8192 Hz with LVDS on

Pin 4/slot 10: _____ Nominal: 8192 Hz with LVDS off

Pin 5/slot 10: _____ Nominal: 8192 Hz with LVDS off

With an Ohmmeter check short between pin 8 on slots 9 & 10: _____

With an Ohmmeter check short between pin 21 on slots 9 & 10: _____

With a scope check watchdog on pin 25 in slot 1 (press watchdog button!): _____

With a scope check watchdog on pin 25 in slot 2 (press watchdog button!): _____

6 Pass/Fail

Pass: _____

Fail: _____

_____

_____

_____

_____

_____

_____

_____