

LIGO Laboratory / LIGO Scientific Collaboration

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Advanced LIGO

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Ring Heater Test Procedure

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1 Overview

This test procedure applies to Ring Heater Driver Chassis LIGO-D1003254. Contained within the chassis assembly are two constant current driver boards. One driver heats the upper segment of the Ring Heater and the other driver heats the lower segment of the Ring Heater. A Block diagram of the Ring Heater system is shown in

2 Electronics

Each ring heater driver Chassis (D1003254-v1) shall be tested to verify the following performance requirements. The tests shall be performed with the driver connected to a 30Ω load capable of dissipating at least 20W. The following tests will be performed on both the upper segment (with the load connected between pins 18 and 5 of the 25 pin connector) and the lower segment (with the load connected between pins 24 and 11 of the 25 pin connector).

2.1 DC Power Output

The ring heater driver shall output from 0 to 10W of power to the load, with the power level set by a DC voltage across pins 1 and 6 of the DAC. The traveler shall record the DC set voltages required to produce 0W and 10W output power.

2.2 AC Power output

The ring heater driver shall output at least 50mA rms amplitude AC current to the load in the frequency range of 10-1000Hz. Using a function generator, an AC voltage is applied across pin 2 and pin 7 of the DAC. The traveler shall record the rms AC voltage amplitude of the function generator at 150Hz required to produce 50 mA AC current to the load. The DC current is set at 100mA by applying voltage across pins DAC P1 and DAC P6.

2.3 Voltage Sensor

The ring heater driver shall sense the voltage across the load over the whole 0 to 10W power range and provide a voltage from pin ADC P1 to ground. The traveler shall record the voltage at ADC P1 for both 0W and 10W output power.

2.4 Current Sensor

The ring heater driver shall sense the current to the load over the whole 0 to 10W power range and provide a voltage from pin ADC P4 to ground. The traveler shall record the voltage at ADC P4 for both 0W and 10W output power.

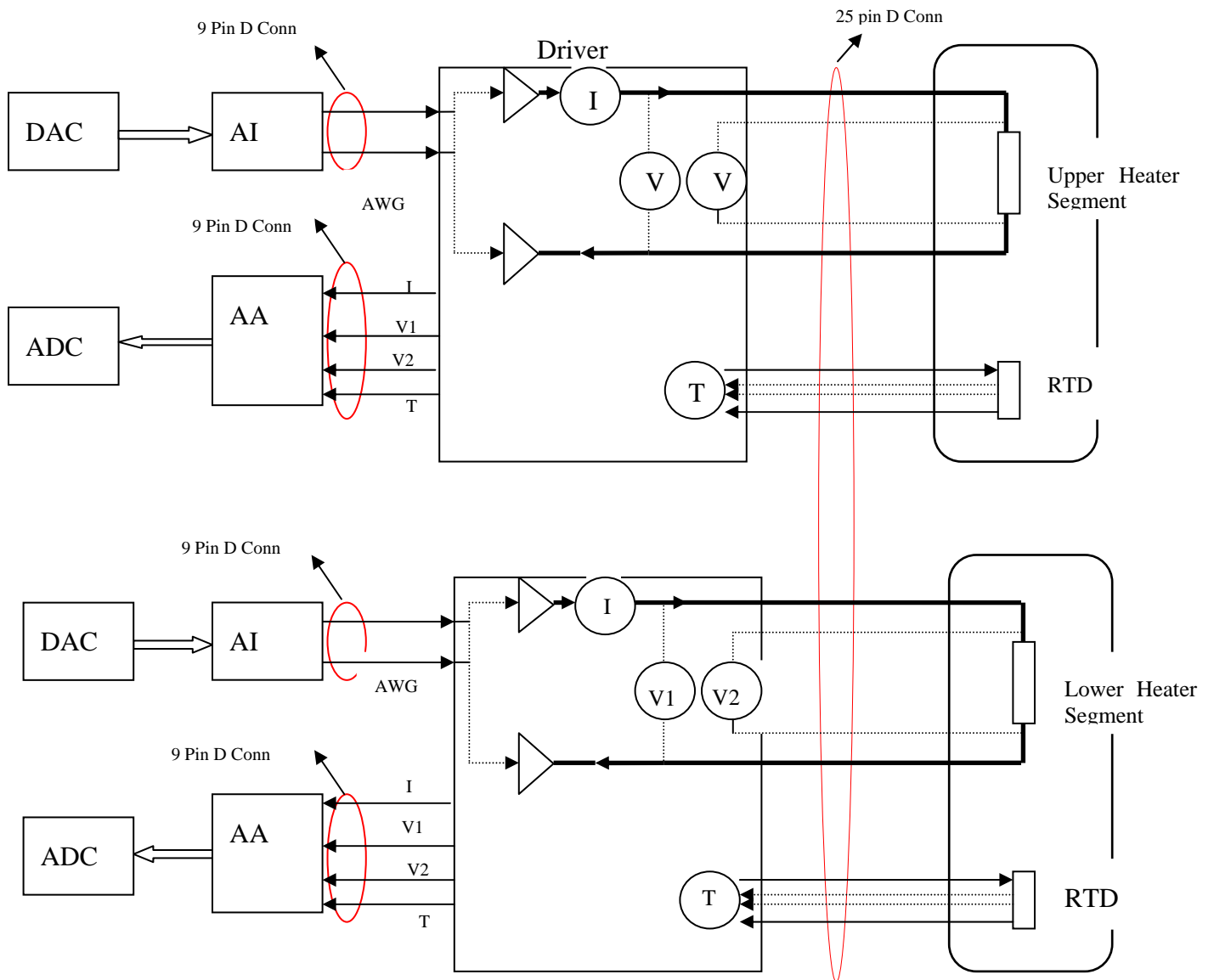
2.5 RTD sensor

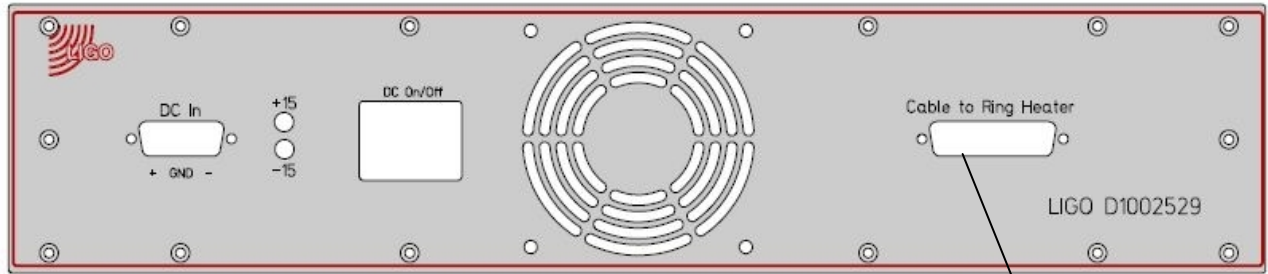
The RTD electronics of the lower segment of the Ring Heater is tested by having a RTD's red wire connected to pin 7 of the 25 pin connector and its black wire connected to pin 20 of the 25 pin connector. The voltage from pin ADC P2 lower segment to ground for both room temperature and with the RTD submerged in an ice bath are measured and recorded. The test is repeated for the

upper segment with the red wire connected to pin 1 of the 25 pin connector and the black wire connected to pin 14 of the 25 pin connector. The voltage at pin ADC P2 upper segment to ground for both room temperature and with the RTD submerged in an ice bath are measured and recorded.

2.6 Noise Performance

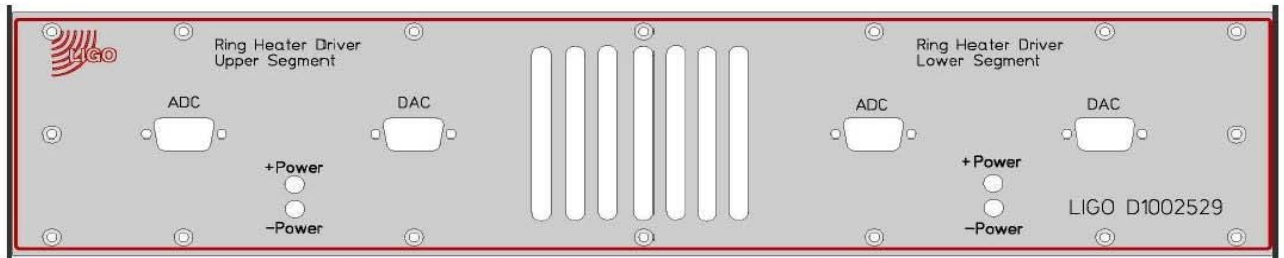
The current noise of the ring heater shall not exceed $10 \mu\text{A}/\sqrt{\text{Hz}}$ over the 10-1000Hz range. This test shall be done at 1W and 10W delivered power to the load. Using a SR785 dynamic signal analyzer, the voltage noise spectrum across the 30 ohm load is measured. The current noise is 30 ohms / voltage noise. The traveler shall record the highest noise and frequency.. Two drivers are packaged in one chassis. There are two inputs controlling the current - a wide BW input and a narrow BW input. There are four output voltages – Current, Voltage, and Temperature at RH as well as Voltage at PCB.





Rear Panel of Ring Heater

25 Pin Conn



Front Panel of Ring Heater

3 Electronics

Each ring heater driver Chassis (D1003254-v1) shall be tested to verify the following performance requirements. The tests shall be performed with the driver connected to a 30Ω load capable of dissipating at least 20W. The following tests will be performed on both the upper segment (with the load connected between pins 18 and 5 of the 25 pin connector) and the lower segment (with the load connected between pins 24 and 11 of the 25 pin connector).

3.1 DC Power Output

The ring heater driver shall output from 0 to 10W of power to the load, with the power level set by a DC voltage across pins 1 and 6 of the DAC. The traveler shall record the DC set voltages required to produce 0W and 10W output power.

3.2 AC Power output

The ring heater driver shall output at least 50mA rms amplitude AC current to the load in the frequency range of 10-1000Hz. Using a function generator, an AC voltage is applied across pin 2 and pin 7 of the DAC. The traveler shall record the rms AC voltage amplitude of the function generator at 150Hz required to produce 50 mA AC current to the load. The DC current is set at 100mA by applying voltage across pins DAC P1 and DAC P6.

3.3 Voltage Sensor

The ring heater driver shall sense the voltage across the load over the whole 0 to 10W power range and provide a voltage from pin ADC P1 to ground. The traveler shall record the voltage at ADC P1 for both 0W and 10W output power.

3.4 Current Sensor

The ring heater driver shall sense the current to the load over the whole 0 to 10W power range and provide a voltage from pin ADC P4 to ground. The traveler shall record the voltage at ADC P4 for both 0W and 10W output power.

3.5 RTD sensor

The RTD electronics of the lower segment of the Ring Heater is tested by having a RTD's red wire connected to pin 7 of the 25 pin connector and its black wire connected to pin 20 of the 25 pin connector. The voltage from pin ADC P2 lower segment to ground for both room temperature and with the RTD submerged in an ice bath are measured and recorded. The test is repeated for the

upper segment with the red wire connected to pin 1 of the 25 pin connector and the black wire connected to pin 14 of the 25 pin connector. The voltage at pin ADC P2 upper segment to ground for both room temperature and with the RTD submerged in an ice bath are measured and recorded.

3.6 Noise Performance

The current noise of the ring heater shall not exceed $10 \mu\text{A}/\sqrt{\text{Hz}}$ over the 10-1000Hz range. This test shall be done at 1W and 10W delivered power to the load. Using a SR785 dynamic signal analyzer, the voltage noise spectrum across the 30 ohm load is measured. The current noise is 30 ohms / voltage noise. The traveler shall record the highest noise and frequency.

Example of test data sheet

Chassis 1103185				Property									
Description	DCC No.	Version	S/N	Noise <10mA/rHz, from 10-1000Hz (section 2.6)	AC voltage for 50mA @ 150Hz (section 2.2)	DC power, voltage for 0W & 10W (section 2.4)	Voltage Sensing >50% ADC voltage (section 2.3)	RTD Sensing @ room temp & cold bath (section 2.5)	Current Sensing: sense resistor voltage for 0W and 10W (section 2.4)				
			1103186	800nA @ 10W & 10 Hz	0.62 V	0.0 V_0W 14.57 V_10W	0.001 V_adcP1@ 4.3 V_adcP1	5.14 COLD BATH 5.54 ROOM TEMP	0.002 V_adcP4 @ 0W 7.27 V_adcP4 @ 10W				
Ring Heater Driver	D1002529	-V2	1103187	900nA @ 10W & 10 Hz	0.62 V	0 V_0W 14.56 V_10W	0.002 V_adcP1 4.29 V_adcP1	5.07 COLD BATH 5.52 ROOM TEMP	0.001 V_adcP4 @ 0W 7.19 V_adcP4 @ 10W				
SN 1103187 -- Upper Segment													
SN 1103186 -- Lower Segment													