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Technical Note	LIGO-T2200130-04	2023/11/04
<b>Configuration of Pcal O4 Transfer Standards (TSA and TSB)</b>		
Pcal Team		

*Distribution of this document:*

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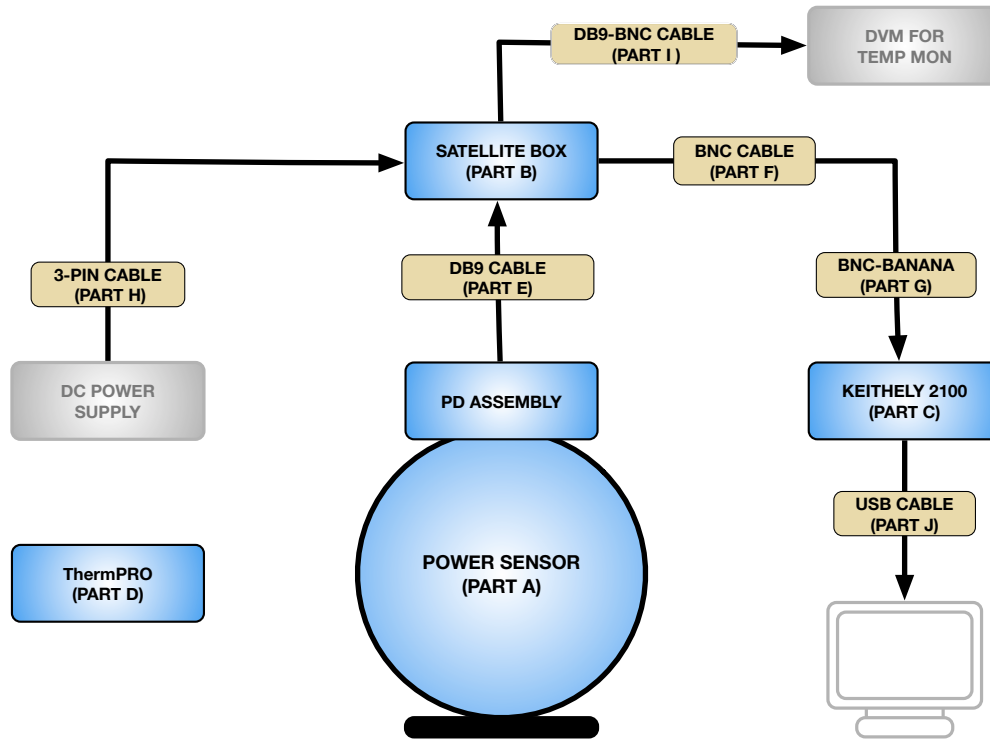


Figure 1: Schematic of LIGO Transfer Standard configuration.

## 1 Hardware configuration and component designations

This document describes the components of the LIGO Photon Calibrator transfer standards, including how to connect and energize them. Figure 1 is a schematic diagram of the transfer standard configuration during a responsivity measurement. Figure 2 is an image with the components that comprise a transfer standard. The designations for the transfer standard components are listed in Table 1. The serial numbers for the main components are listed in Table 2.

## 2 Electrical connections and energizing

***CAUTION: Line voltage for Keithley voltmeter MUST be set for local voltage (Europe, Japan, United States, etc.).***

Refer to [https://download.tek.com/manual/2100-900-01F\\_Aug\\_2018\\_user.pdf](https://download.tek.com/manual/2100-900-01F_Aug_2018_user.pdf) pages 2-4 to 2-7 for instructions.

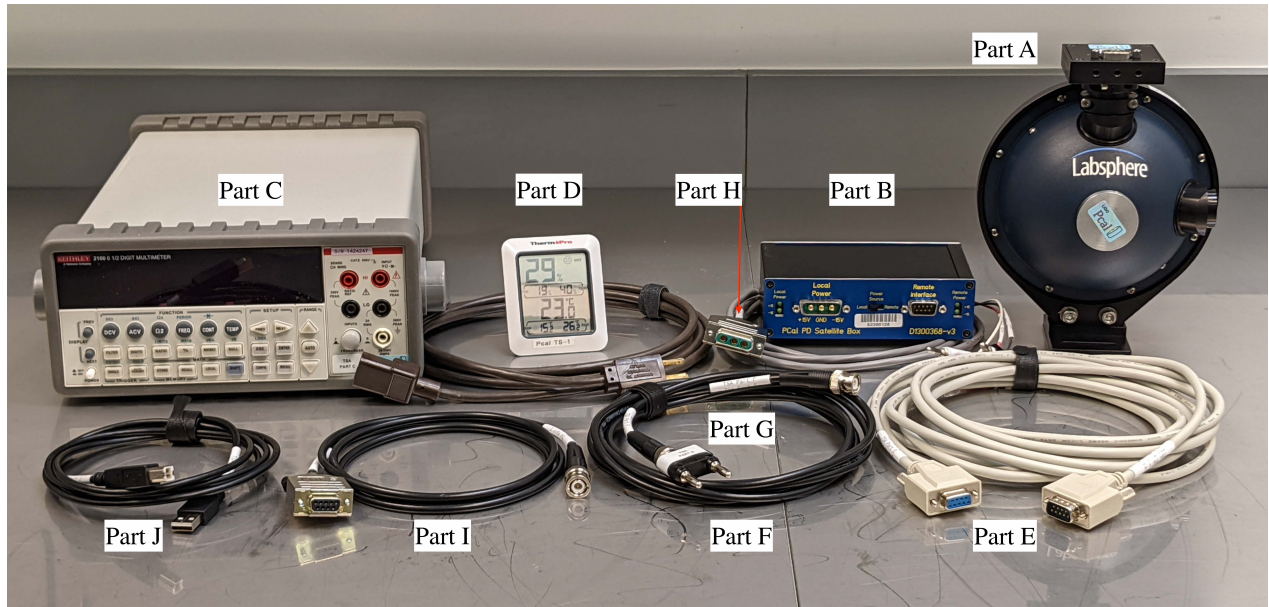


Figure 2: Transfer Standard components

Designation	Component
Part A	Power sensor (int. sphere and PD assembly)
Part B	Pcal PD Satellite Box
Part C	Keithley model 2100 voltmeter
Part D	ThermPro digital thermometer
Part E	Cable: DB-9 female to DB-9 male (15 ft)
Part F	Cable: BNC male to BNC male (10 ft)
Part G	Adapter: BNC female to banana male
Part H	Cable: Banana male to 3-Pin D-sub female (6 ft)
Part I	Cable: DB-9 female to BNC male (5 ft)
Part J	Cable: USB-B to USB-A (6 ft)

Table 1: Transfer standard component designations.

Component		TSA		TSB	
Part A	Integrating sphere	S2101646	LHO 000378	S2101647	LHO 000387
	PD assembly	S2101611		S2101613	
Part B	Satellite box	S2200128	LHO 000381	S2200129	LHO 000390
Part C	Keithley voltmeter	1424247	LHO 000384	1148750	LHO 000393
Part D	Digital thermometer	TS-1		TS-2	

Table 2: Transfer standard key component serial and LHO property numbers.

## 2.1 Electrical connections

Steps for connecting components:

1. Connect the cable (Part E) between the Power Sensor (Part A) and the "To/From PD" connector on the Pcal PD Satellite Box (PartB).
2. Connect the BNC cable (Part F) and the Adapter (Part G) between the "PD Mon" connector on the Pcal PD Satellite Box and the "Input  $V\Omega$ " connector on the front panel of the Keithley model 2100 voltmeter (Part C). Note the polarity of the Adapter. The ground tab indicates the side that should be connected to the "LO" (black) terminal.
3. Connect the Banana to 3-pin D-sub cable (Part H) to the "Local Power" connector on the Pcal PD Satellite box and to a power supply providing  $\pm 15$  V DC voltage.
4. Connect the DB-9 to BNC cable (Part I) to the "Remote Interface" connector on the Pcal PD Satellite Box. Connect the BNC end to a voltmeter that will monitor the temperature of the AD590 temperature sensor mounted to the PD circuit board as described below.
5. Connect the USB cable between the USB-A connector on the back of the Keithley model 2100 voltmeter and the device that will read the Keithley voltmeter output via the USB interface.

## 2.2 Configuring components and energizing

1. Move the "Power Source" switch on the Pcal PD Satellite Box to the "Local" position.
2. Energize the  $\pm 15$  V DC power supply source.
3. Move the "PD Power On/Off" switch to the "On" position.
4. Energize the Keithley model 2100 voltmeter and make or confirm the following settings:
  - (a) Set the Front/Rear switch to the "Front" (F) position.

- (b) Set NPLC: 1
  - (c) Set Auto Range: Auto
  - (d) Set Digital Filter: Off
5. Place the ThermPro digital thermometer near where the Transfer Standard will be located for responsivity measurements.

### **3 Temperature monitoring**

The temperature displayed on the ThermPro digital thermometer should be close to (within one or two degrees) of the ambient laboratory temperature. The temperature of the reported by the AD590 sensor mounted on the PD circuit board is estimated by multiplying the output voltage (using the DB9 to BNC cable, connected to a voltmeter) by 100. This gives the PD board temperature in K, i.e. the AD590 gives 10 mV/K. Note that the temperature reported by the AD590 temperature sensor is typically about 7 °C above the ambient temperature due to the heat generated by the components on the PD circuit board.