

Libera Current Meter

Robert Feri, Libera Workshop 2018, 17.05.2018

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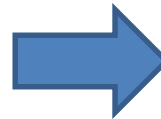
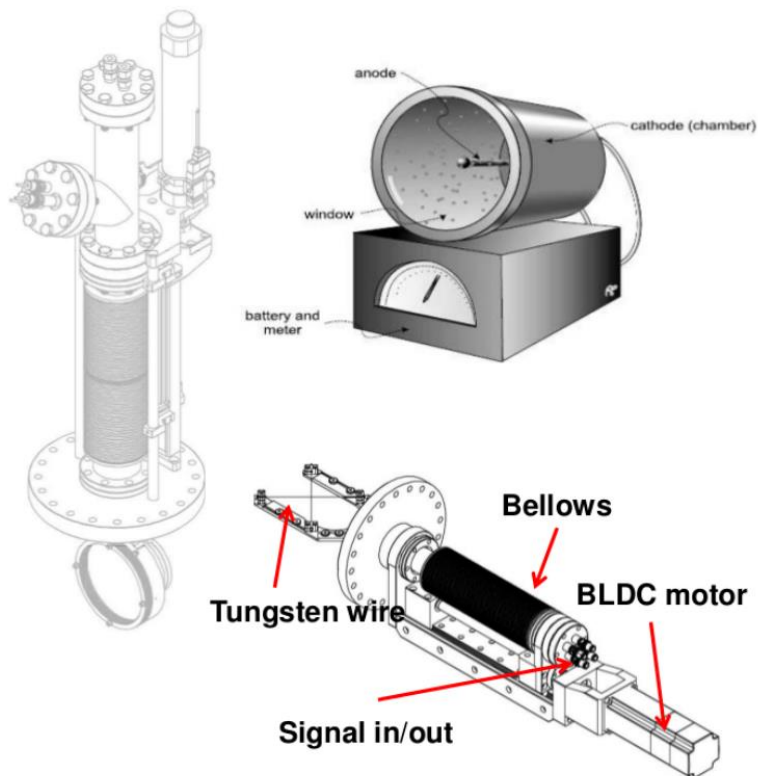


Motivation for a new instrument

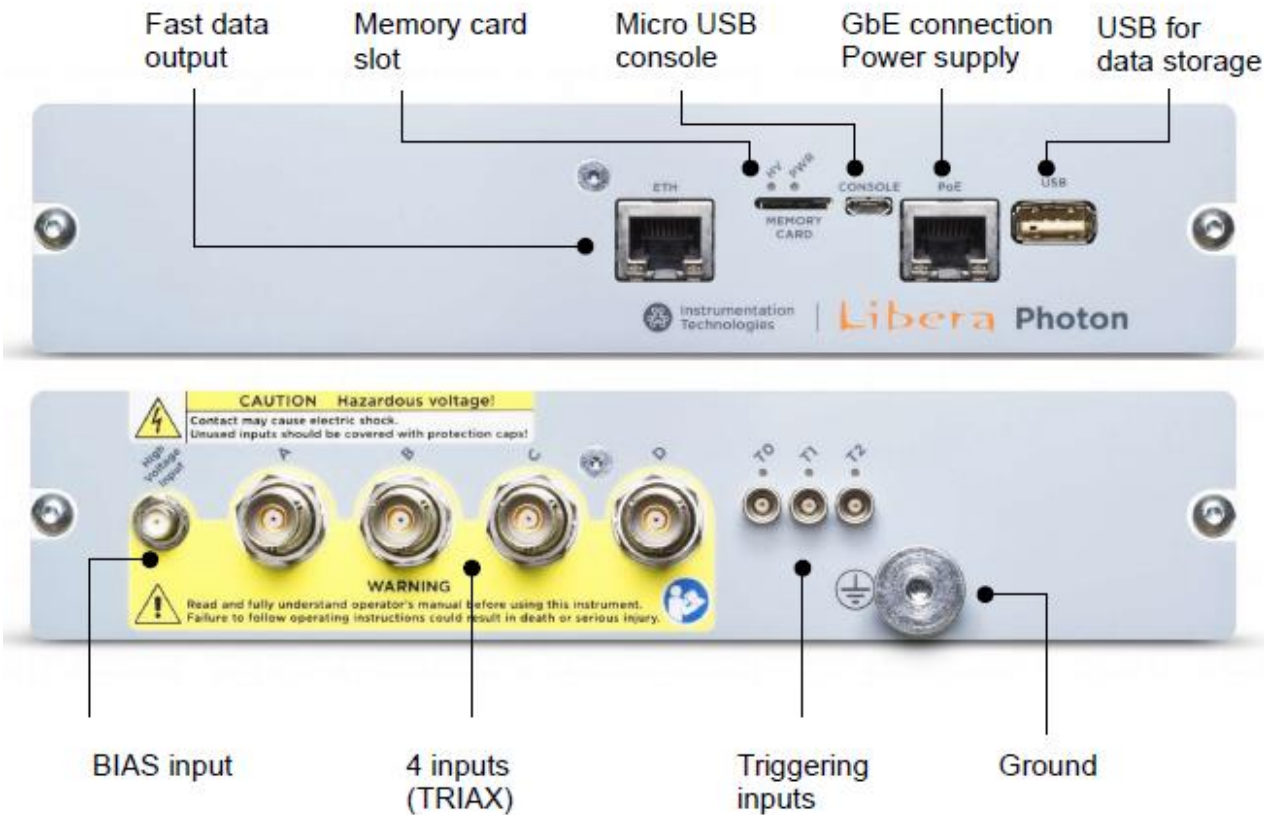
We have an existing instrument Libera Photon used in beamlines which is compatible with

- Blade detectors
- Diamond detectors
- **Wire scanners and faraday cups**

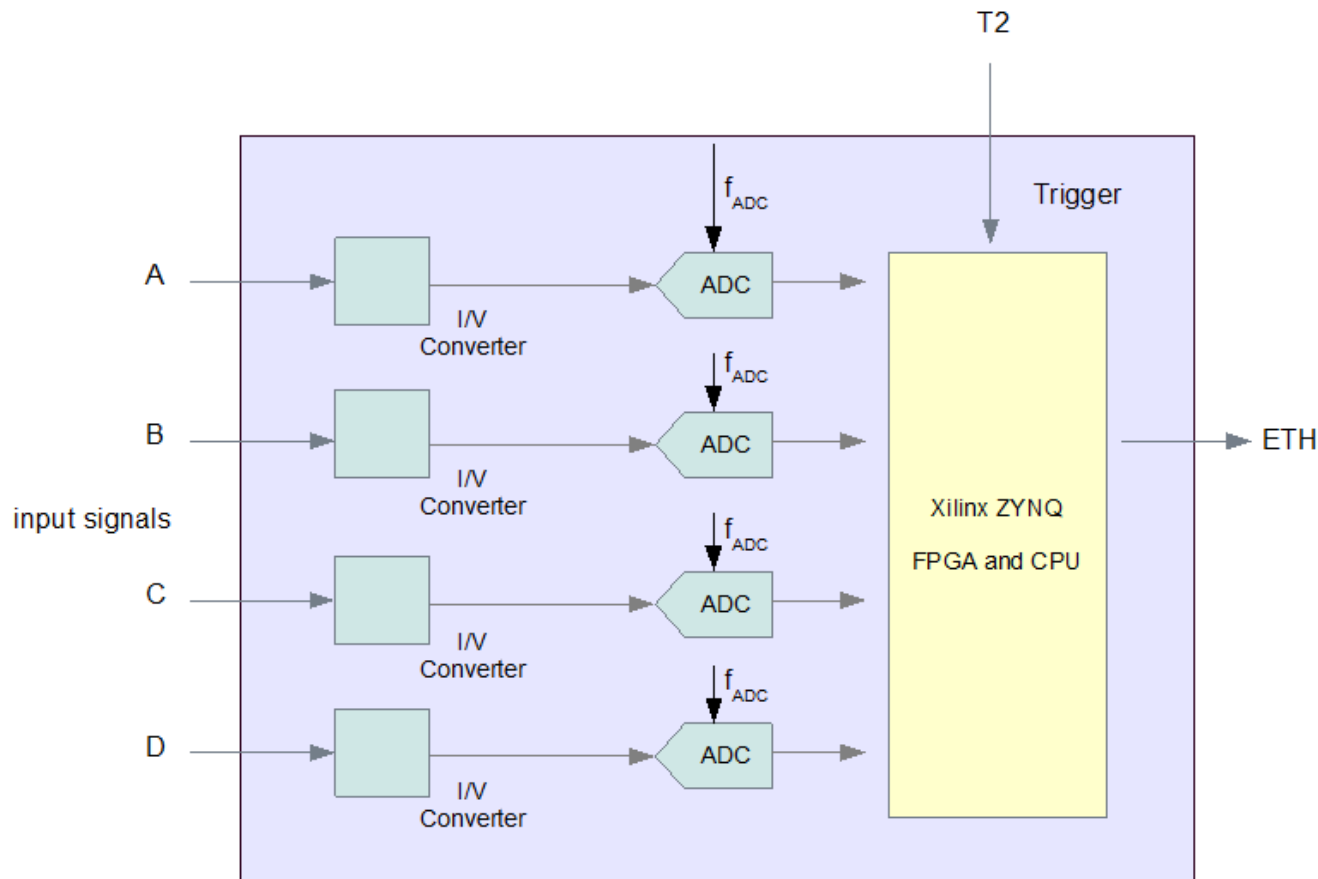
Main specifications – different detectors



Main specifications – front / back panel



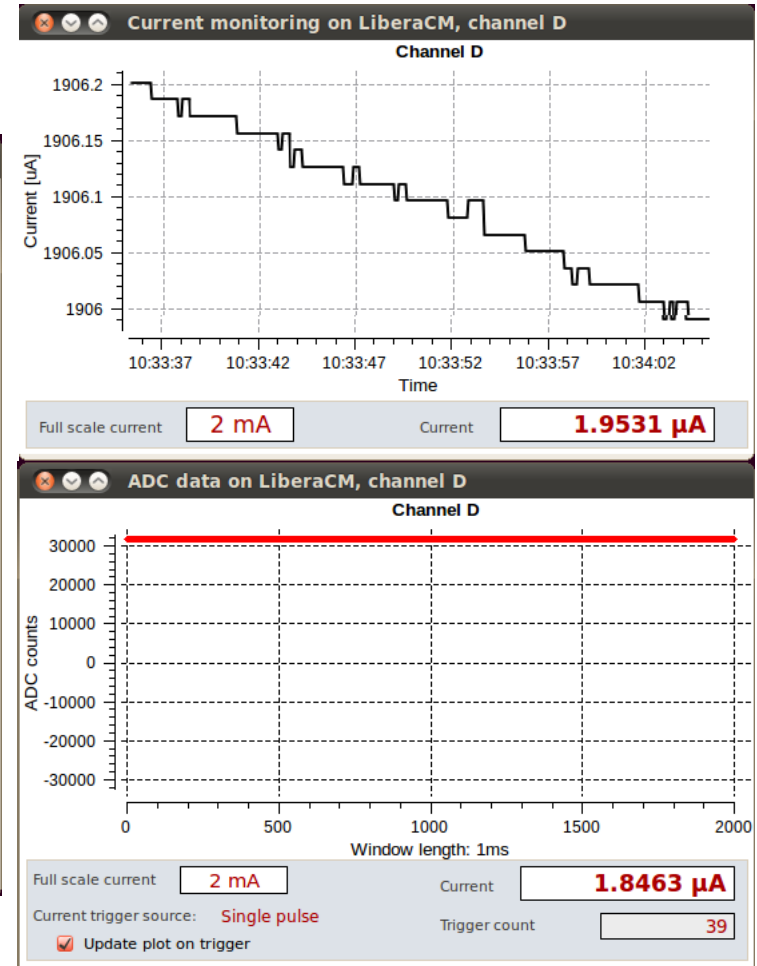
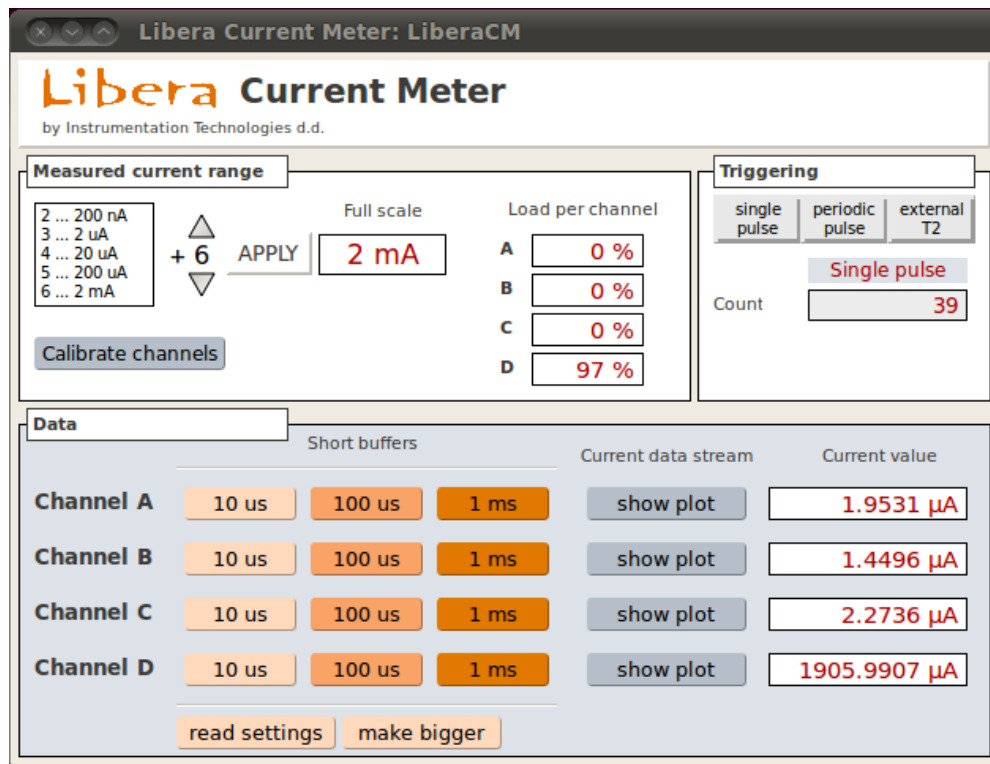
Main specifications – block scheme



Main specifications

	Libera CM
Dimesions (H x W x D) mm	44 x 210 x 210
FPGA / CPU	Zynq-7020 / ARM Cortex-A9
Platform management	Passive cooling, PoE, network boot, SD card boot
Input channels	4
A/D conversion	2.5 MHz / 18-bit
Sampling clock	PLL
Timing signals	3
Maximum input signal	20 mA
Input gain/attenuation	Programmable
Bandwidth	Up to 50 MHz

GUI and basic settings



GUI and basic settings

Libera Current Meter: LiberaCM

by Instrumentation Technologies d.d.

Measured current range

2 ... 200 nA
3 ... 20 μ A
4 ... 200 μ A
5 ... 200 μ A
6 ... 2 mA

+ 6 APPLY **2 mA**

Full scale

Load per channel

A **0 %**
B **0 %**
C **0 %**
D **97 %**

Calibrate channels

Triggering

single pulse periodic pulse external T2

Count **39**

Data

Short buffers

Current data stream

Current value

Channel A 10 us 100 us 1 ms show plot **1.9531 μ A**

Channel B 10 us 100 us 1 ms show plot **1.4496 μ A**

Channel C 10 us 100 us 1 ms show plot **2.2736 μ A**

Channel D 10 us 100 us 1 ms show plot **1905.9907 μ A**

read settings make bigger

LiberaCM: Calibration

Manual calibration

	Offset	Scale	Amplitude (channel A)
Channel A	$\Delta \Delta \Delta \Delta$ + 0 0 0 0 $\nabla \nabla \nabla \nabla$ 0	$\Delta \Delta \Delta \Delta$ + 1.0 0 0 0 $\nabla \nabla \nabla \nabla$ 1.0000	125
Channel B	$\Delta \Delta \Delta \Delta$ + 0 0 0 0 $\nabla \nabla \nabla \nabla$ 0	$\Delta \Delta \Delta \Delta$ + 1.0 0 0 0 $\nabla \nabla \nabla \nabla$ 1.0000	90
Channel C	$\Delta \Delta \Delta \Delta$ + 0 0 0 0 $\nabla \nabla \nabla \nabla$ 0	$\Delta \Delta \Delta \Delta$ + 1.0 0 0 0 $\nabla \nabla \nabla \nabla$ 1.0000	146
Channel D	$\Delta \Delta \Delta \Delta$ + 0 0 0 0 $\nabla \nabla \nabla \nabla$ 0	$\Delta \Delta \Delta \Delta$ + 1.0 0 0 0 $\nabla \nabla \nabla \nabla$ 1.0000	126491

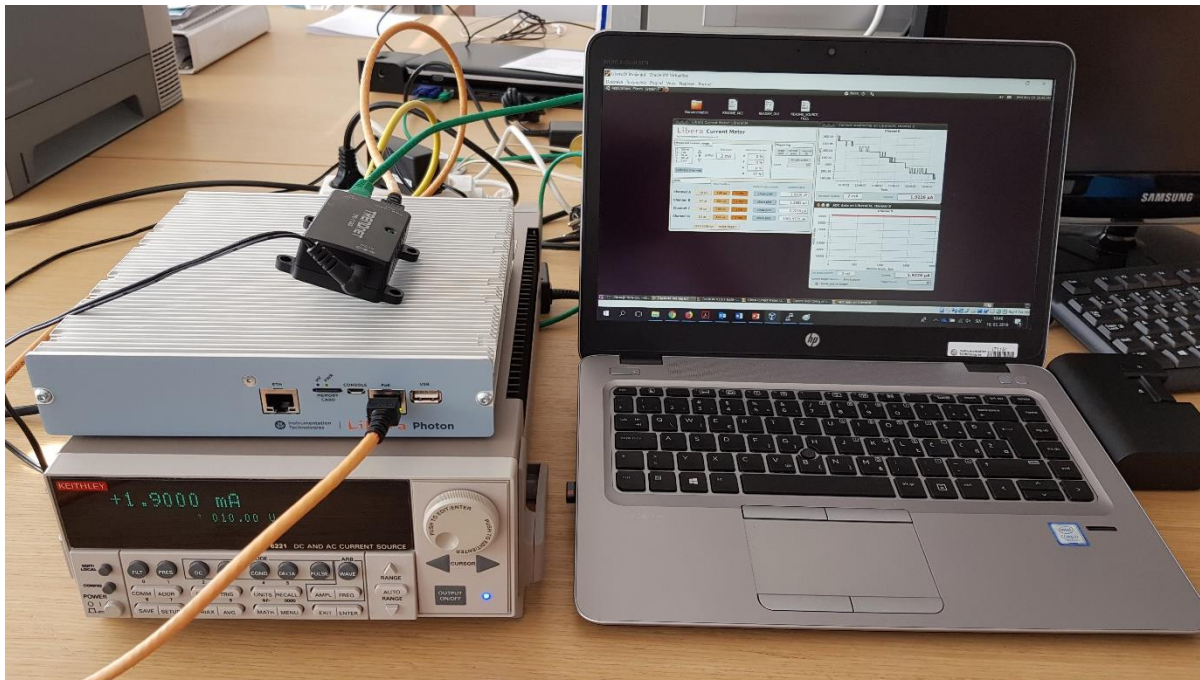
Offset ... set in amplitude counts [-8192, 8191]
Scale ... A = k*Ar_{aw} [0, 1.9999]
Amplitude ... current corrected raw amplitude

Procedure:
1. No input current
2. Set Offset to get ~0 Amplitude

Measurements

Setup environment consisted of:

- Keithley 6221 DC source
- Libera Current Meter instrument, temperature stabilized (after 2 hours of operation)
- PoE injector and PC connected to the network



Measurements

- On each current range we wanted to see where the saturation occurs
- Just below the saturation we've measured ADC counts and checked the current output on Keithley source
- This data can be then used to ADC/current conversion
- Measurements were performed on each channel on two instruments

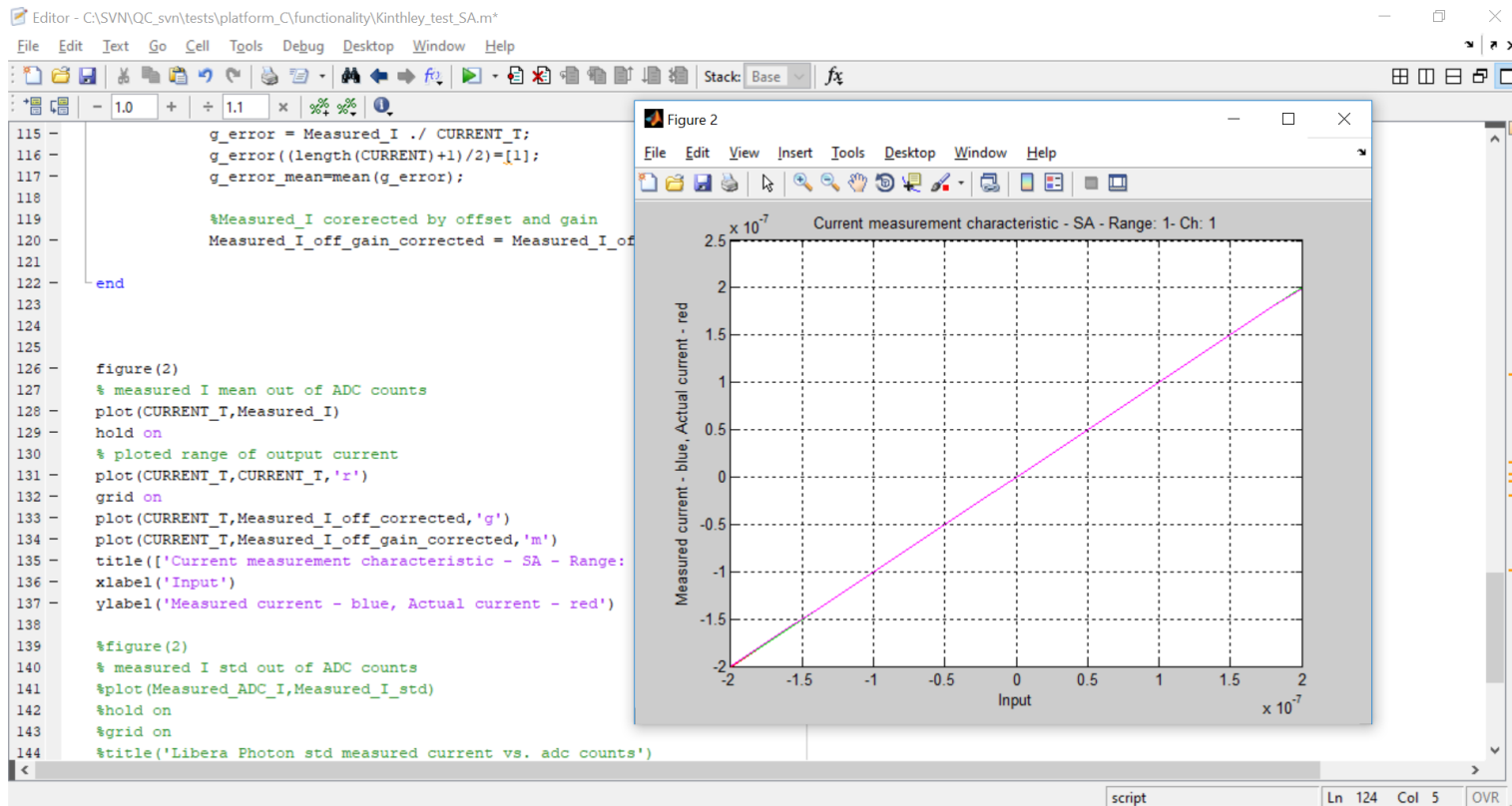
Current Meter IT1130						
RANGE			ch A	ch B	ch C	ch D
6			1.9939 mA	1.984 mA	2 mA	1.9888 mA
5			196.3 uA	195.26 uA	195.82 uA	195.72 uA
4			19.64 uA	19.599 uA	19.63 uA	19.65 uA
3			2.103 uA	2.014 uA	2.024 uA	2.015 uA
2			239.3 nA	238 nA	239.5 nA	239.5 nA
1			60.35 nA	59.9 nA	60.8 nA	60.4 nA
Current Meter IT01-002						
RANGE			ch A	ch B	ch C	ch D
6			1.9923 mA	1.9893 mA	2.0648 mA	1.9905 mA
5			196.02 uA	200 uA	196.35 uA	196.34 uA
4			19.639 uA	19.7 uA	19.453 uA	19.648 uA
3			2.019 uA	2.0154 uA	2.016 uA	2.0146 uA
2			239.2 nA	238.7 nA	238.7 nA	238.7 nA
1			60 nA	60.19 nA	59.99 nA	59.98 nA

*temperature stabilized, after to 2h of operation, Zynq temp. 44-46C

Nominal measurement ranges and RMS

Software value (registry node setting)	Nominal range	Analog 3 dB bandwidth	RMS
1	± 60 nA	>25 kHz	3.4 pA
2	± 200 nA	>10 kHz	9.1 pA
3	± 2 μ A	>80 kHz	0.1 nA
4	± 20 μ A	>80 kHz	1.0 nA
5	± 200 μ A	>90 kHz	10.4 nA
6	± 2 mA	>90 kHz	97.6 nA
7	± 20 mA	>90 kHz	N/A

Measurements with Matlab



Next steps

Incorporate the auto-range to automatically change through ranges

Define the accuracy of the instrument and incorporate offset / gain correction

Make a final version of GUI

We are thinking to change triax connectors to BNC

The goal is to have the final version of the instrument by end of this year