A. Specifications

The CALI box is intended to digitize up to 4 sensors, and transmit continuously their digitized signals via an Ethernet network (more precisely under UDP).

It contains 2 cards:
1. One ADC card, by Bernard PAUL[*].
2. One FPGA card including a microprocessor communicating via Ethernet : initial realization Sébastien L'HENORET, then Philippe VENAULT[*] and Michel GROS[*].

1. The ADC card: 4 channels

- For each channel:
    - 16 bits ADC polarized at ±1,25V;
    - Programmable gain:
        - x1, for an input at ±1,25V (corresponding to 38,15 mV/ADU),
        - x1,5, for an input at ±0,833V (corresponding to 25,43 mV/ADU);
    - Sampling at 10 MHz;
    - Anti-aliasing filter, resulting in 5MHz as the best signal sampling frequency;
    - Single or differential inputs;
    - AC/DC input (by means of a jumper selection);
    - Gain before digitization: x1, x4/3, x2, x4 (by means of a jumper selection);
- External clock outputs and input for the time synchronization between several boxes (not yet operational).

2. The FPGA card: a commercial Xilinx mezzanine

- Large FPGA including a PPC emulation;
- Programming language: VHDL (pure FPGA) and C (PPC emulation);
- Communication:
    - 1 serial port RS232;
    - 1 Ethernet port RJ45;
    - 1 USB port (not programmed);
    - Control writes: under TCP, Data readout: under UDP;
- Power supply: 5V DC;
- 4 front LEDs.

B. Performances

- Throughput: 320Mbits/s (@ 5MS/s) ;
- IP address: 192.168.2.x (suited to a private acquisition network); 169.254.123.x is also available;
- Selection of the ADC data to be transmitted (1 to 4 of the 4 ADCs);
- Selection of the data rate:
    - Fundamental clock: 100 MHz;

---

[*] permanent position at CEA/IRFU, centre de Saclay, 91191 GIF/Yvette CEDEX, FRANCE

- Sampling rate: nearest from 10 MHz as possible (to keep the benefit of the anti-aliasing filter);
- Completed by a smoothing by a power of 2;
- Example: goal = 1 MHz:
  - The sampling divider is set to 12 and the smoothing factor is set to 8;
  - This gives a data rate of 100/96 MHz;
  - The combination is to be computed by the readout software.

- Noise:
  - Less than 1 ADU at 1 MHz;
  - Varies as the square root of the data rate.

C. <u>Connectors</u>

Input #4+	
Input #4-	Power input, 5V DC
Input #3+	
Input #3-	LEDs
Synchro	
Synchro	USB Connector
Synchro	
Synchro	Ethernet Connector
Synchro	
Input #2+	
Input #2-	
Input #1+	RS232 Connector
Input #1-	

D. Software

A full acquisition software is currently available from Michel GROS, CEA/IRFU, FRANCE. This software comes with a quick offline analysis software, which is also interfaced to other event-level offline applications.

E. Signal Input Jumpers definition

For each input connector, there are 3 removable jumpers. With the differential mode, up to 6 jumpers per signal may be necessary.

A first jumper allows choosing among a DC and an AC input.

The 2 other ones allow modifying the input amplifier gain. The actual gain is the ratio between the feedback resistor and the amplifier input resistor. The available gain values are therefore 1, 4/3, 2 and 4, depending upon the involved resistors.

The rules concerning these jumpers are recalled in the following diagram, also glued on one of the box sides.

Position des cavaliers en entrée de la carte CALI