



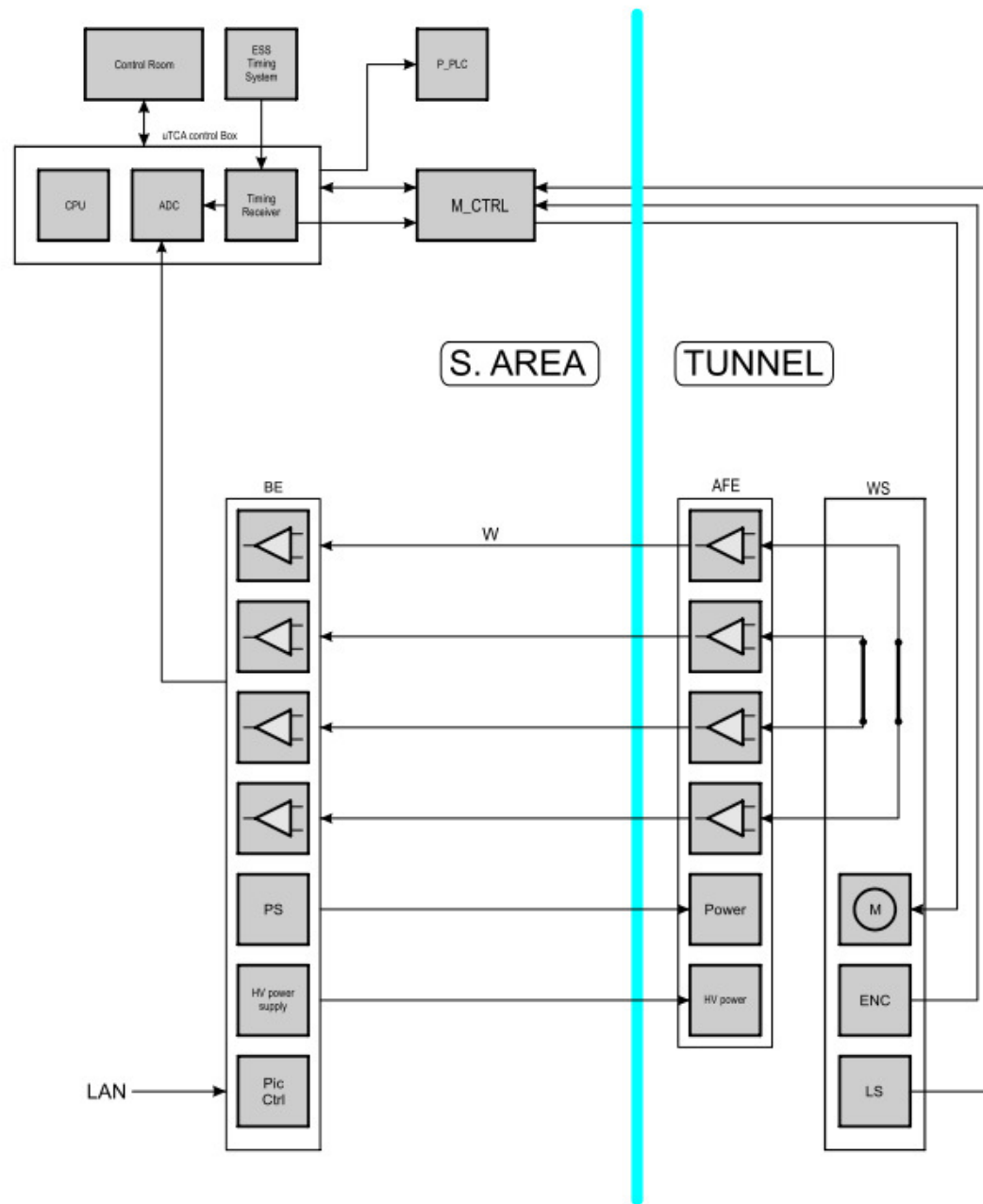
Elettra Sincrotrone Trieste

AFE and BE development upgrade



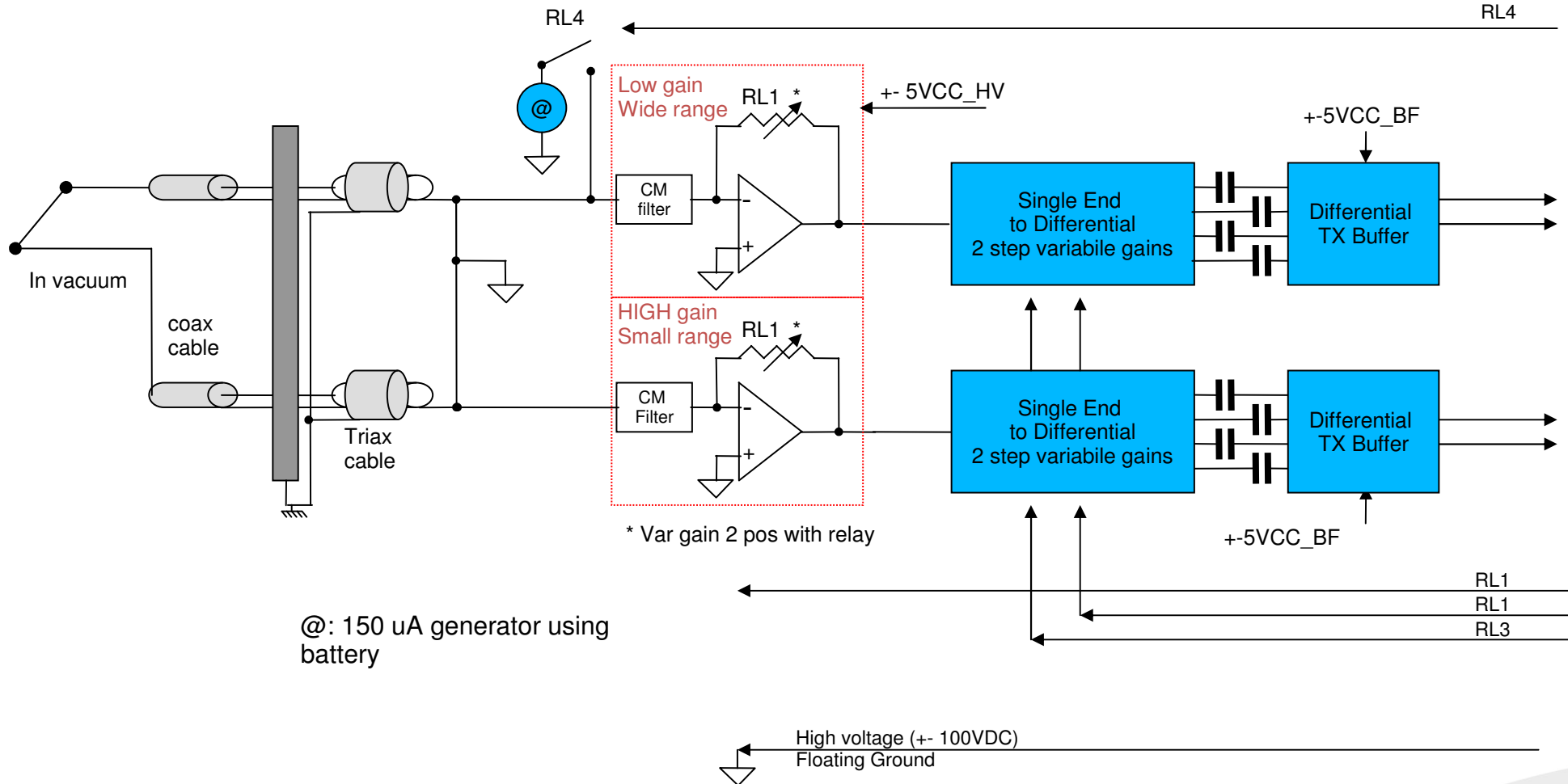
WSAS simplified system block diagram

Diagram by S.Gulja



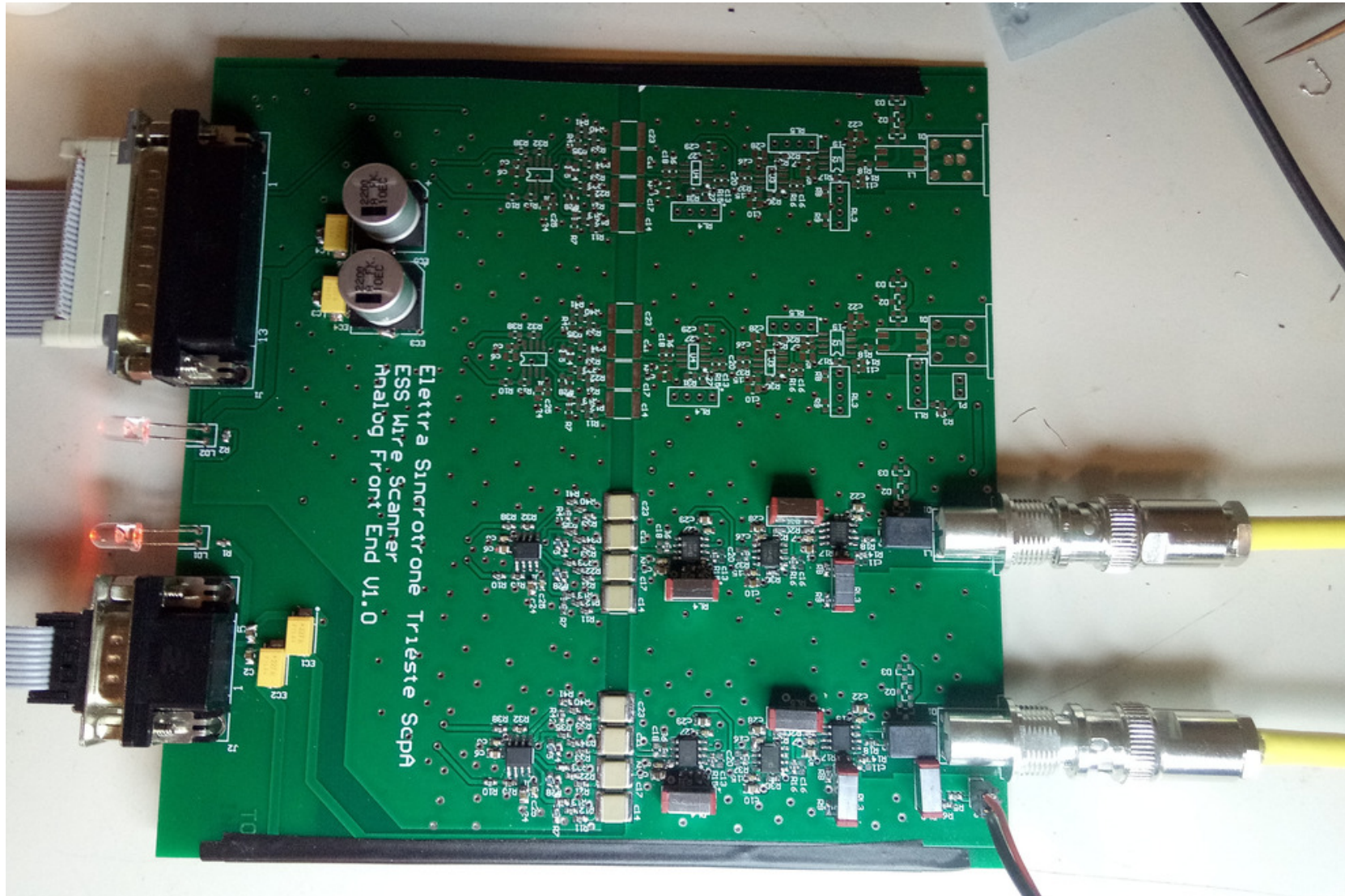
Simplified Block Diagram for AFE V1.0

Analog Front End TWO IDENTICAL STAGES: Horizontal and Vertical





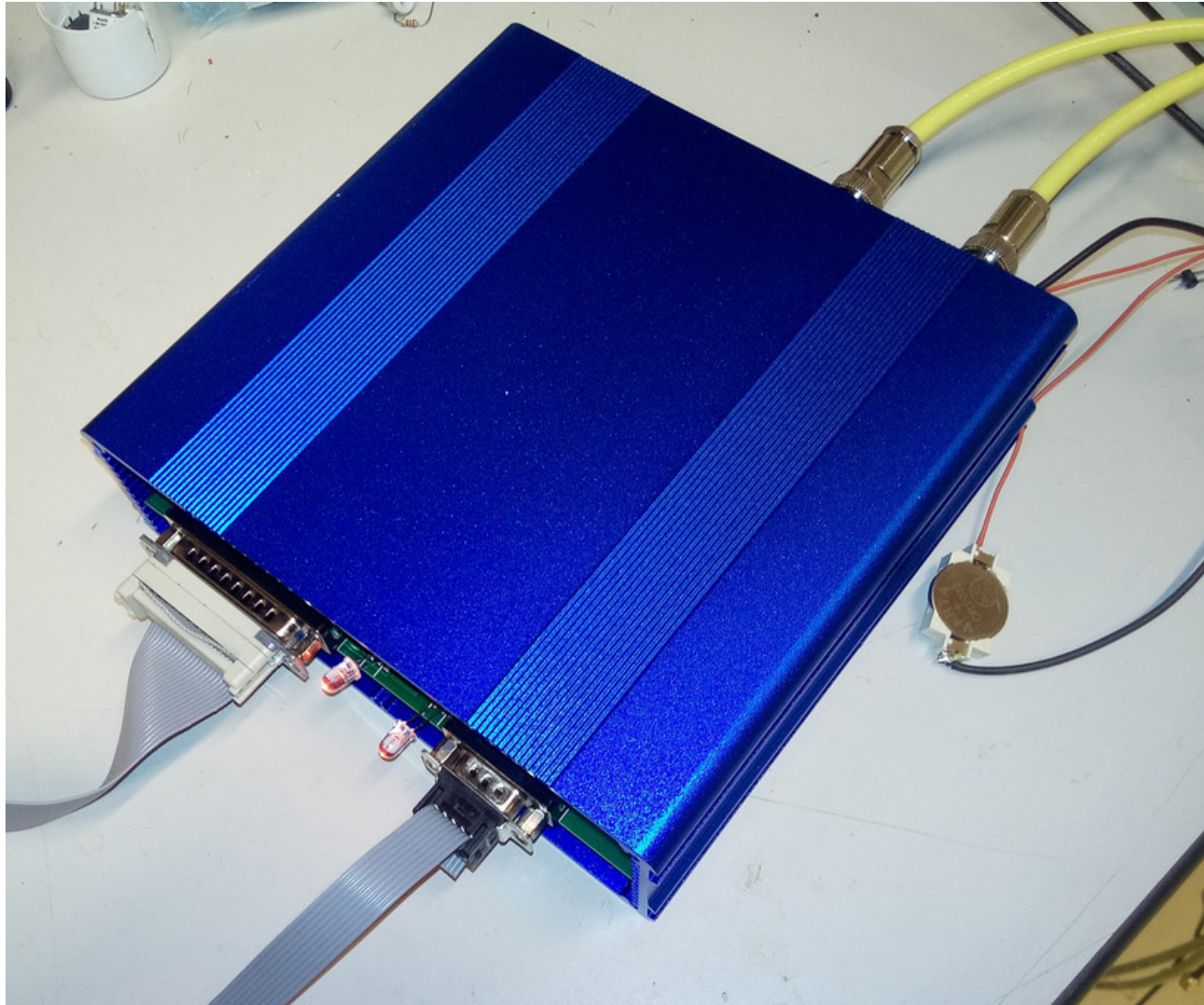
AFE prototype





Elettra
Sincrotrone
Trieste

WS Analog Front-End BOX



ESS 3rd BI Forum

Raffaele De Monte, Apr 27, 2017

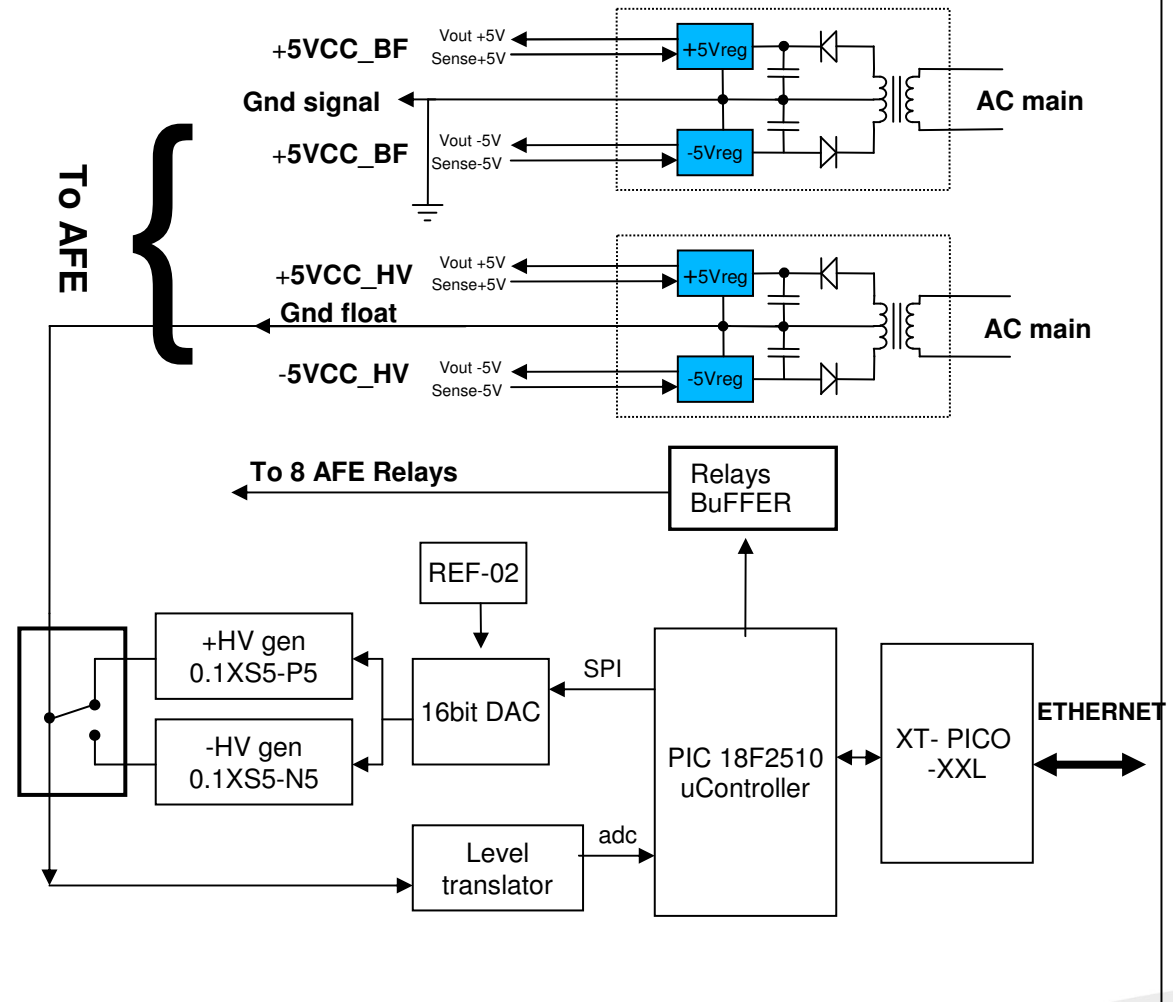
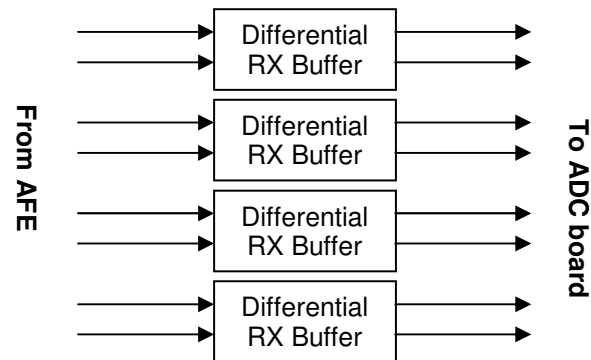


AFE specifications

| Parameter | Value | Symbol | Notes |
|-------------------|------------------------------|---------------------|-----------------------|
| Input channel | 4 | $I_{Wi}; i=1\dots4$ | Tri-axial |
| Max Input Voltage | 3VAC | $I_{W_{MAX}}$ | Input diode protected |
| Max Input Current | N/A | $I_{W_{MIN}}$ | |
| Input Impedance | 50 ohm | Z_{IN} | Not well matched |
| Bandwidth | 2MHz | BW_{AFE} | |
| Output channel | 4 | OUT_{AFE}^i | Balanced twisted pair |
| Minimum Gain | 1V/400 μ A | G_{MIN} | V / A |
| Maximum Gain | 1V/1 μ A | G_{MAX} | V / A |
| Power supply | +/- 5 V @ 50mA MAX | I_{supply} | via BE cable |
| Dimension | 170 x 160 x 54 | | mm |
| Weight | 400 g | | |

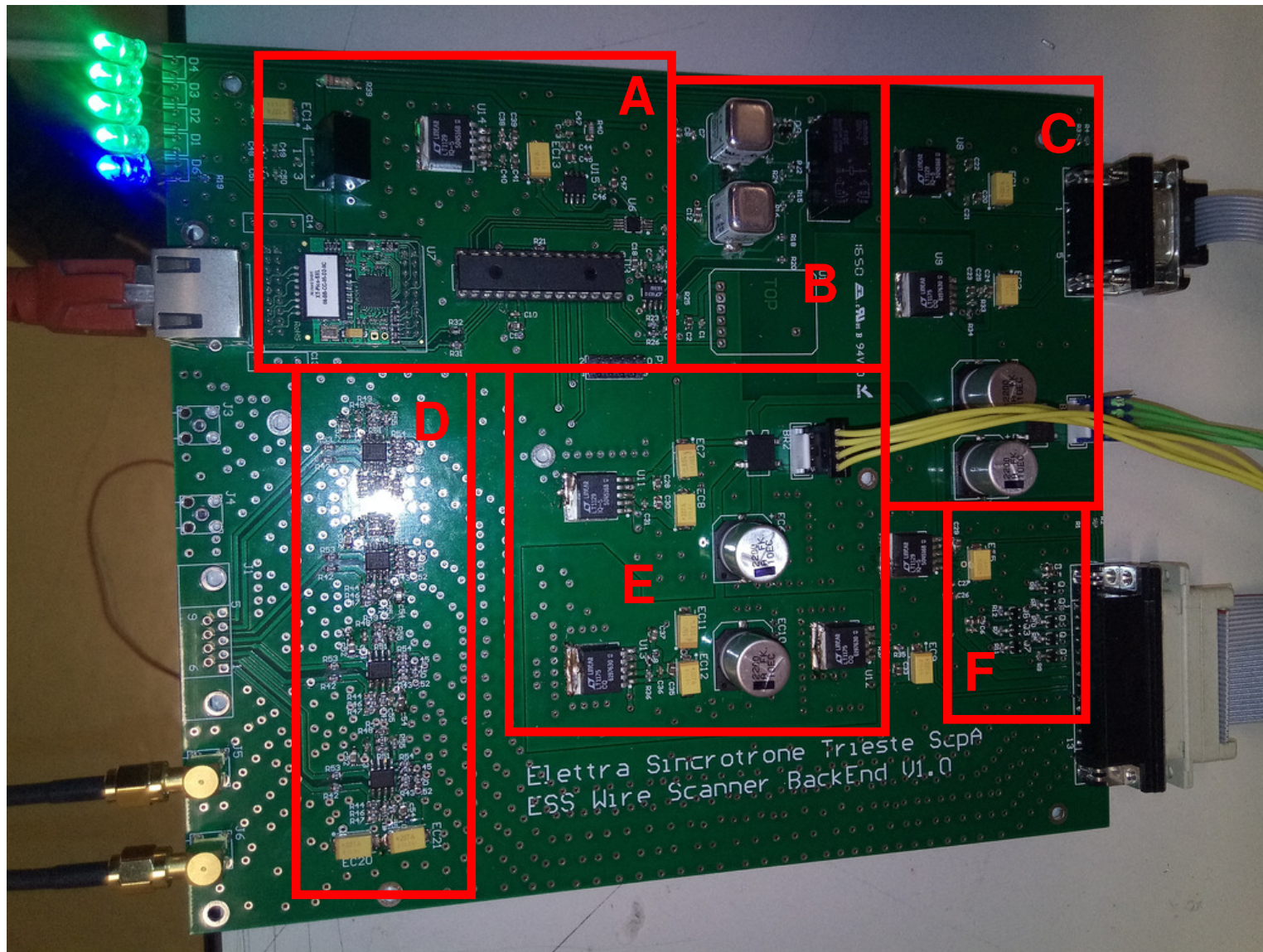
- The input signal range has been extended by adding two relays in the signal chain. It also increase the gain of the entire system.
- Added a Common Mode Choke to filter better the input signal. It prevent also some parasitic charges to interfere with the signals.
- Added a strong capacitor (2200uF) on the Buffer power supply to increase the output buffer performances.

To control various functions like HV control and check, gain and self test controls using an Ethernet port to the CPU, a PIC 18F2510 μ controller connected to a XT- PICO -XXL has been chosen.





BackEnd in practice



| | |
|----------|---|
| A | Pic controller, eth intf, DAC, I/O translators |
| B | High Voltage (Ultravolt) positive and negative generators and relay |
| C | Floating +5 and -5VDC remote power supply |
| D | Differential/SE buffers/receivers |
| E | NON Floating +5 and -5VDC remote power supply |
| F | Relay buffers |

Input /outputs:

- 1 x DB9 : +-5VDC Floating power supply
- 1 x DB25: +-5VDC NON floating P.S., 8 relays outputs, 4 differential signal inputs
- 2 x 4pin header: 2x6.3VAC inputs (transformers)
- 4 x SMA: Low impedance S.E. signal analog outputs
- 1 x DB9: Low impedance differential signal analog outputs
- 1 x RJ45: Ethernet communication port
- 1 x 5+5 header: PIC programming connector
- 1 x Blue LED: uController activity
- 4 x Green Led: +5V/-5Vfloat, +5V/-5Vnonfloat power return from AFE (off if AFE not connected)

Simple command protocol:

All commands are in ASCII format with Carriage Return (cr) character termination
ALL unrecognized commands return 'KOcr'

SET FUNCTIONS: all of the 'SET' commands return 'OK' string or 'KO' if wrong parameter

SetVoltage: (integer) Sets the bias voltage: the command starts a *procedure* that sets the DAC *until* the desired value is reached: the DAC has to be set in +- 10% of the theoretical set value. If > of 10% a error flag is set.

SV:voltage (from -100 to +200)

SetBit (8BIT 0-255) : sets the 8 bits that controls gain and test input current

SB:number

Set Pulse for wire test (time): Sets all of the relays in a condition to read the reference current for a limited time expressed in microseconds, then revert all back

SP:number

READ FUNCTIONS: all of the 'Read' commands returns ascii value terminated by a CR

Read Voltage (returns from -100 to +200)

RV?

Read Bits (returns 0-255)

RB?

READ TEMPERATURE (returns da 0 a 100) Only for SCINT version

RT?

READ STATUS: it returns a string:

SETVOLTAGE:READVOLTAGE:BITS:SWVERSION:SWTYPE:RMF:COUNTER

where:

SWVERSION : number 1 - 0xFFFF

SWTYPE : 1 = WS 5=SCINT

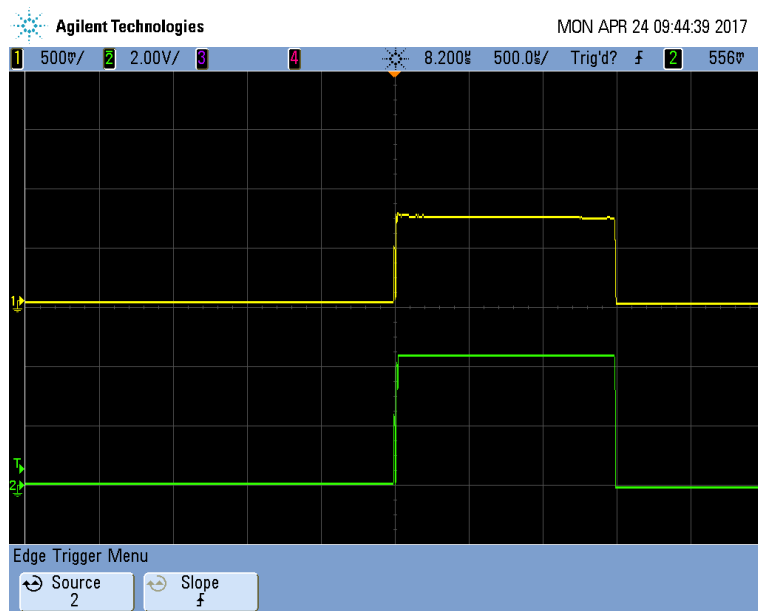
RMF : 'R' if Running, 'M' if Moving, 'F' if Fault

COUNTER : loop counter (WATCHDOG purpose)

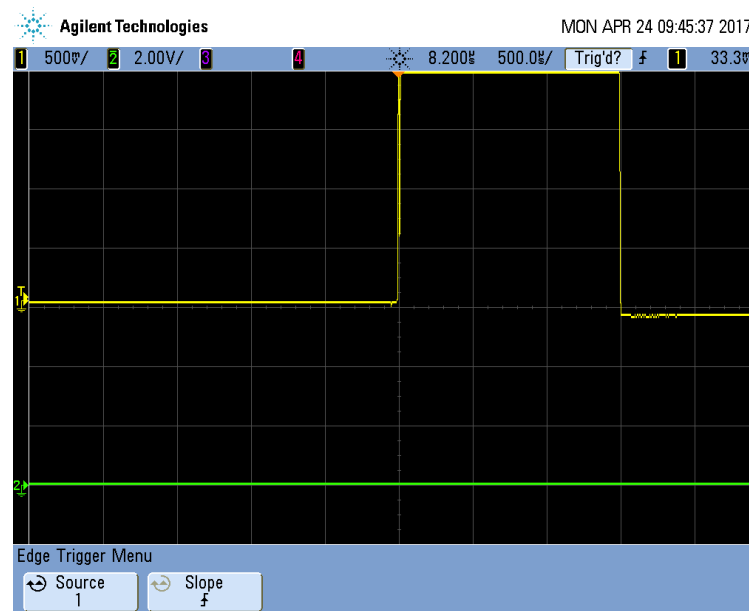
RS?

- 0.5A 3.3V DC-DC converter (powering Ethernet interface) vulnerability : solved changing with a 1A version
- Ripple noise in HV ($\sim 200\text{mV}$ pkpk $\sim 10\text{KHz}$): solved adding HV capacitor (4.7uF 250VDC)
- Buffer Power supply (on +5VDC) fail on power up due to shifting on negative at power off because of high capacitors: solved adding resistors to discharge fast and equally the capacitors.
- Poor precision in high voltage generator: a readback/set function has been implemented in the PIC software to reach the desired value with a single command. An asynchronous system has been implemented.
- The output signal is monopolar 0-5V. The ADC from Struck board accept $\pm 1\text{VDC}$. Solved putting a 50ohm attenuator (losing 1 of the 16 bits..)

Command SENT via ethernet: SP:1500



Result with intact wire

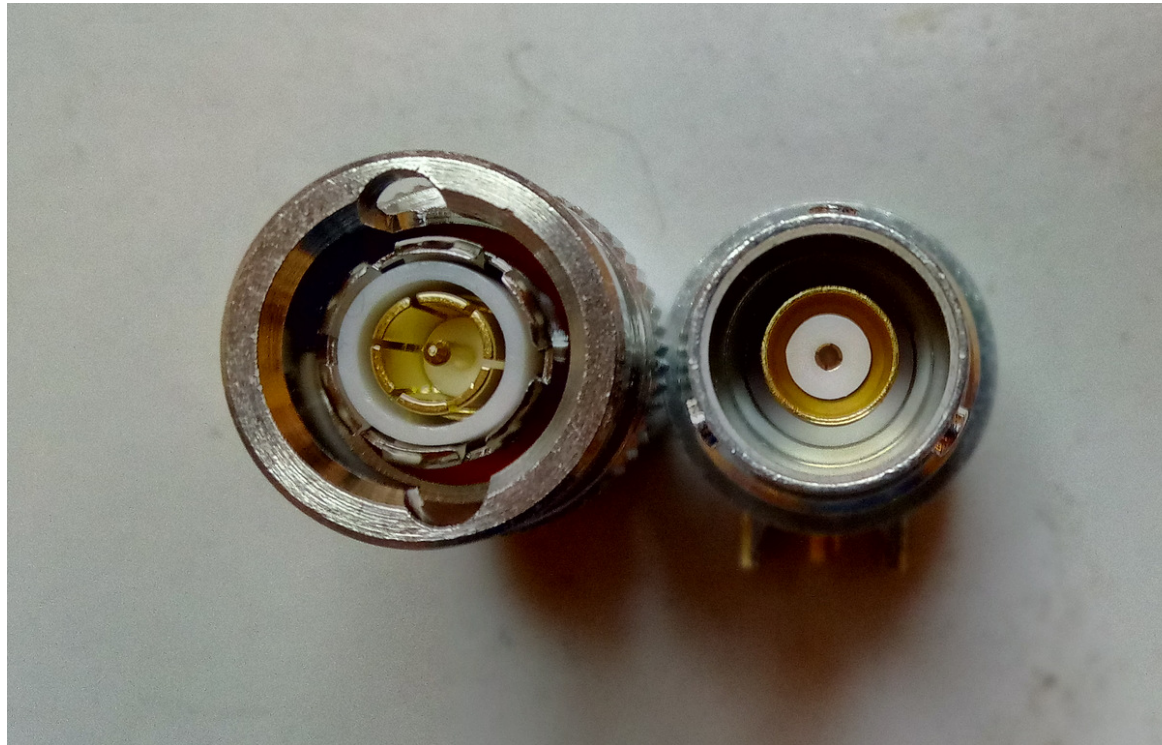


Result with broken wire

Set Pulse for wire test (time): Sets all of the relays in a condition to read the reference current for a limited time expressed in microseconds, then revert all back

- The Back End prototype PCB has been implemented
- The full functionality of the Back End has been tested
- The full functionality of the Back End connected to the Front End has been tested
- The firmware for the PIC uController is running in 'beta' version
- The system is ready to be connected to the uTCA acquisition crate

“Funny” Triaxial connectors



Specify if 2 or 3 lug !



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SPARE SLIDES

WSAS simplified system laboratory test bench