MICE front-end electronics

RC pulse shaper status

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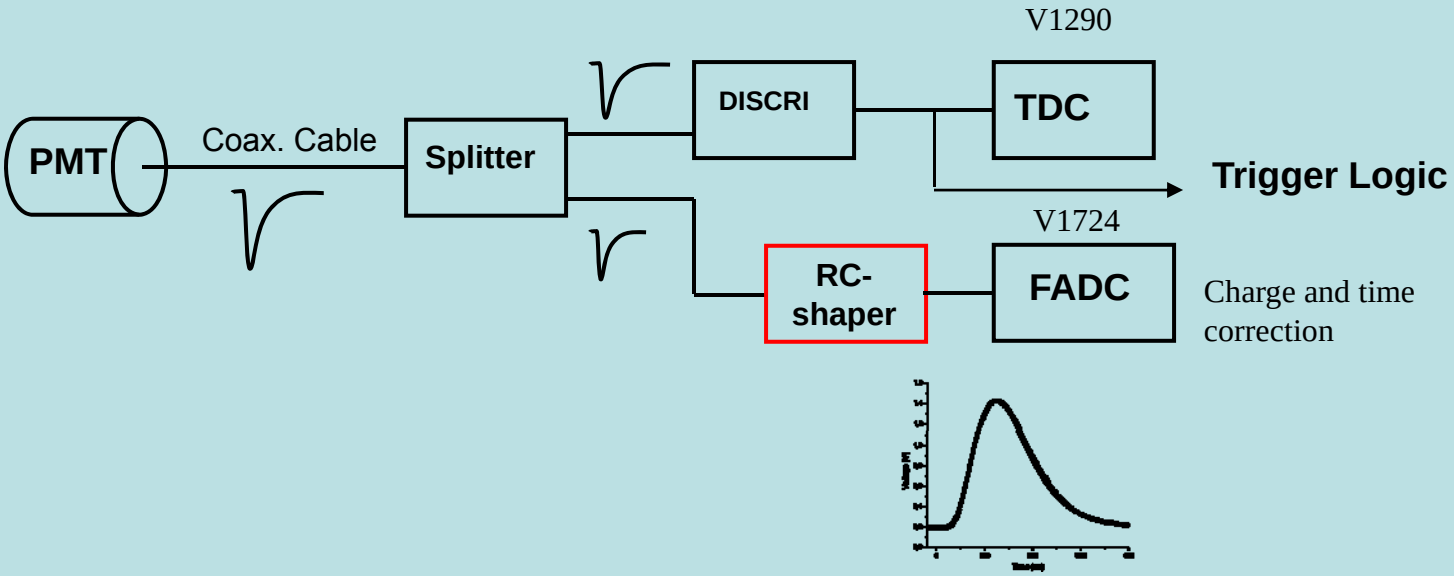
•**Purpose:** To be used in the charge measurement scheme for shaping/ stretching the PMT pulses prior to discretization by a FLASH ADC.

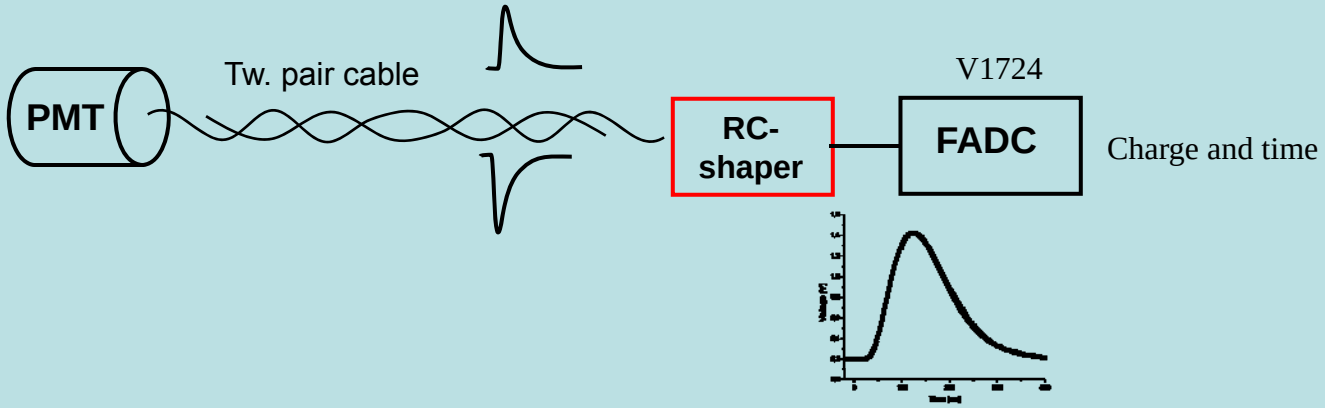
•**Principle:** Several stages of active RC low-pass filtering of the input signal preserving proportionality between shaped voltage pulse area and input charge.

•**Groups involved in the design and test work:** DPNC-University of Geneva, INFN - Roma III, INFN - Milan, Sofia University.

TOF


V1290
PMT
Coax. Cable
Splitter
DISCRI
TDC
Trigger Logic
V1724
RC-
shaper
FADC
Charge and time
correction

EMCAL


PMT
Tw. pair cable
V1724
RC-
shaper
FADC
Charge and time

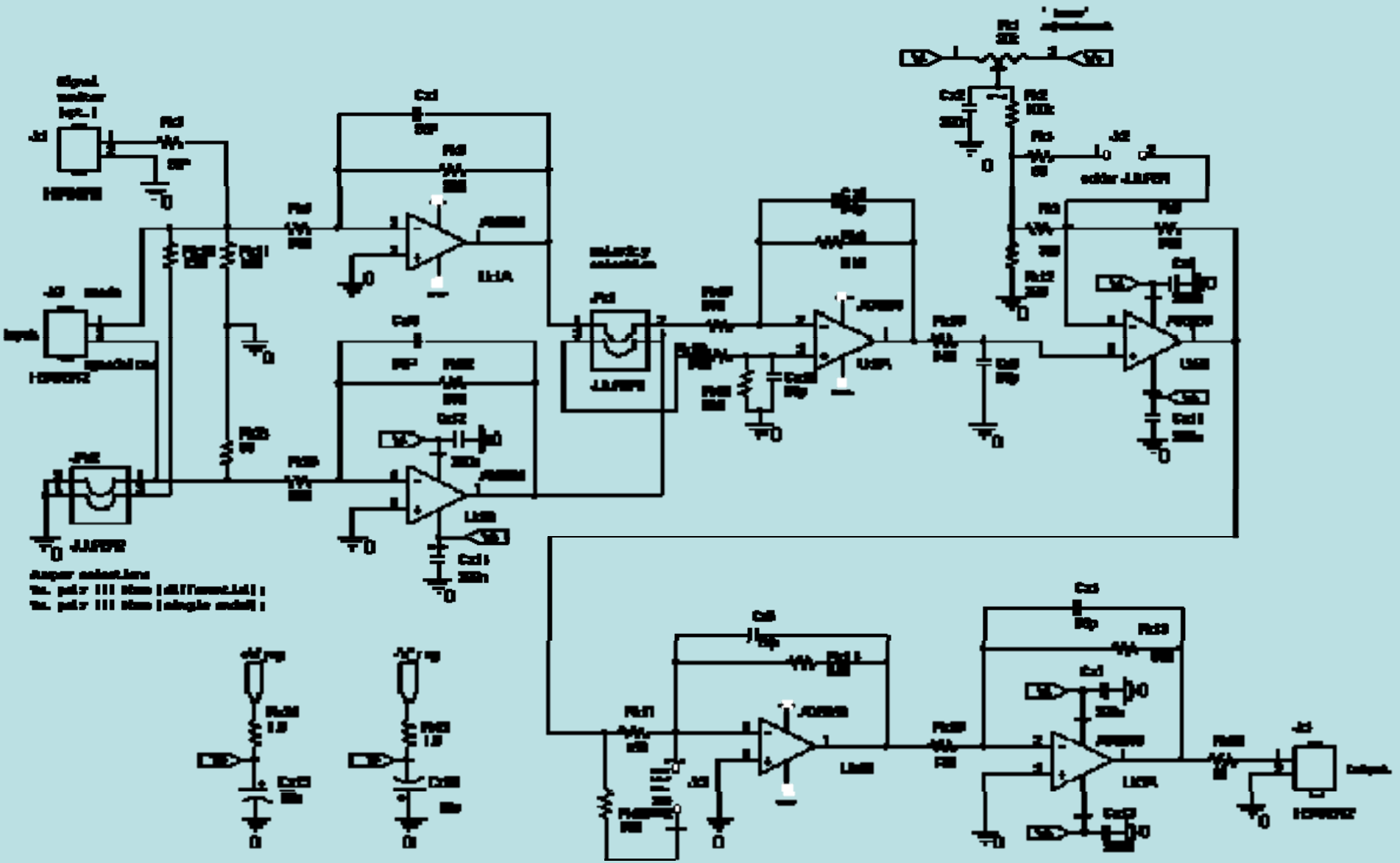
Characteristics

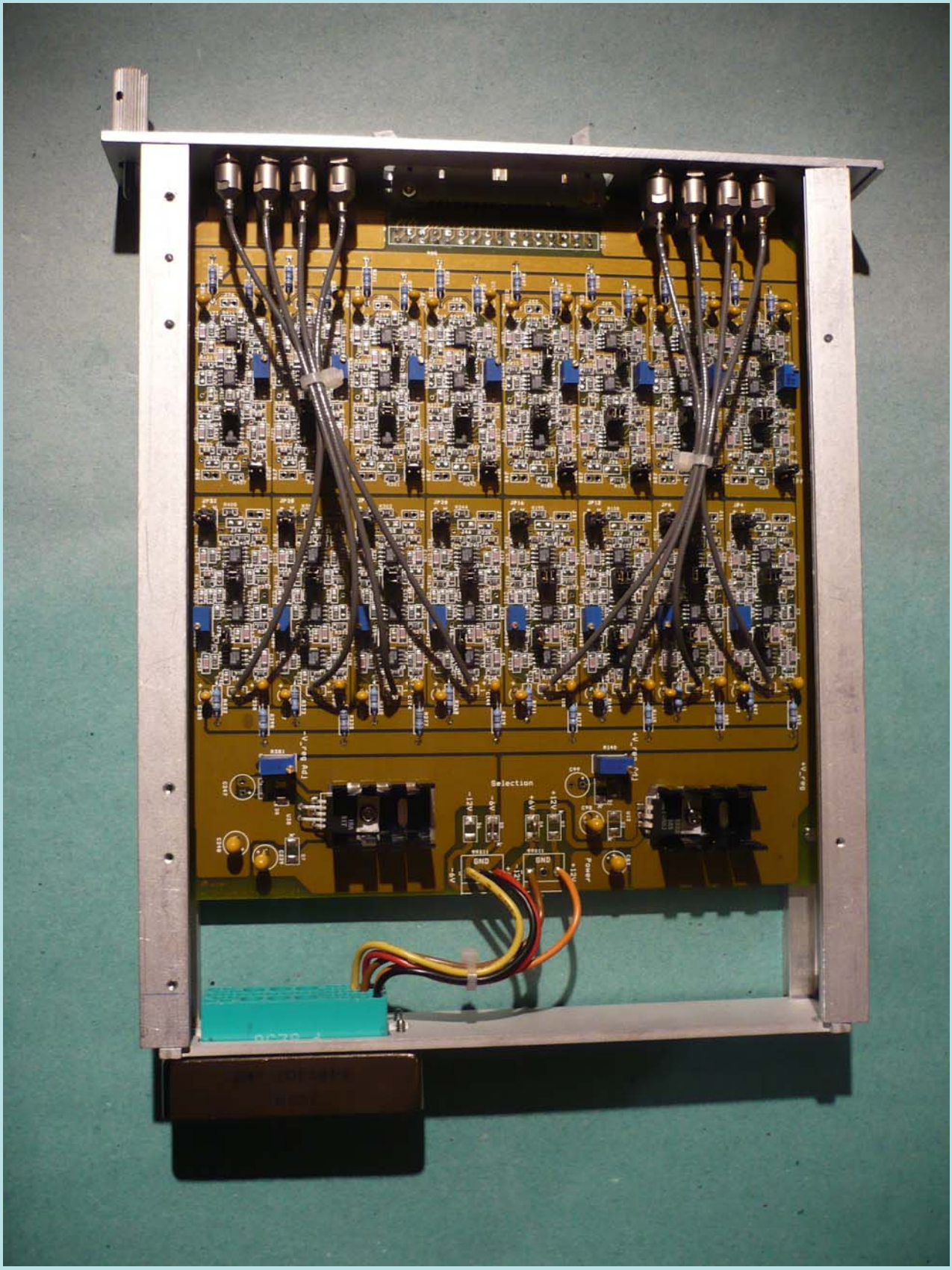
- **Jumper selectable differential or single-ended input (to be used with EMCAL,Cherenkov or TOF photomultipliers respectively).**
- **On-board termination of the signal cable /splitter output.**
- **4-stage RC low-pass filtering (2-stage option).**
- **Fixed shaping time constant (20-30 ns giving 400-500 ns effective pulse duration). Changeable by re-soldering a few resistors/capacitors .**
- **Jumper selectable gain (out of four values in the range 2.9 -14.4), changeable by re-soldering 1..3 resistors.**

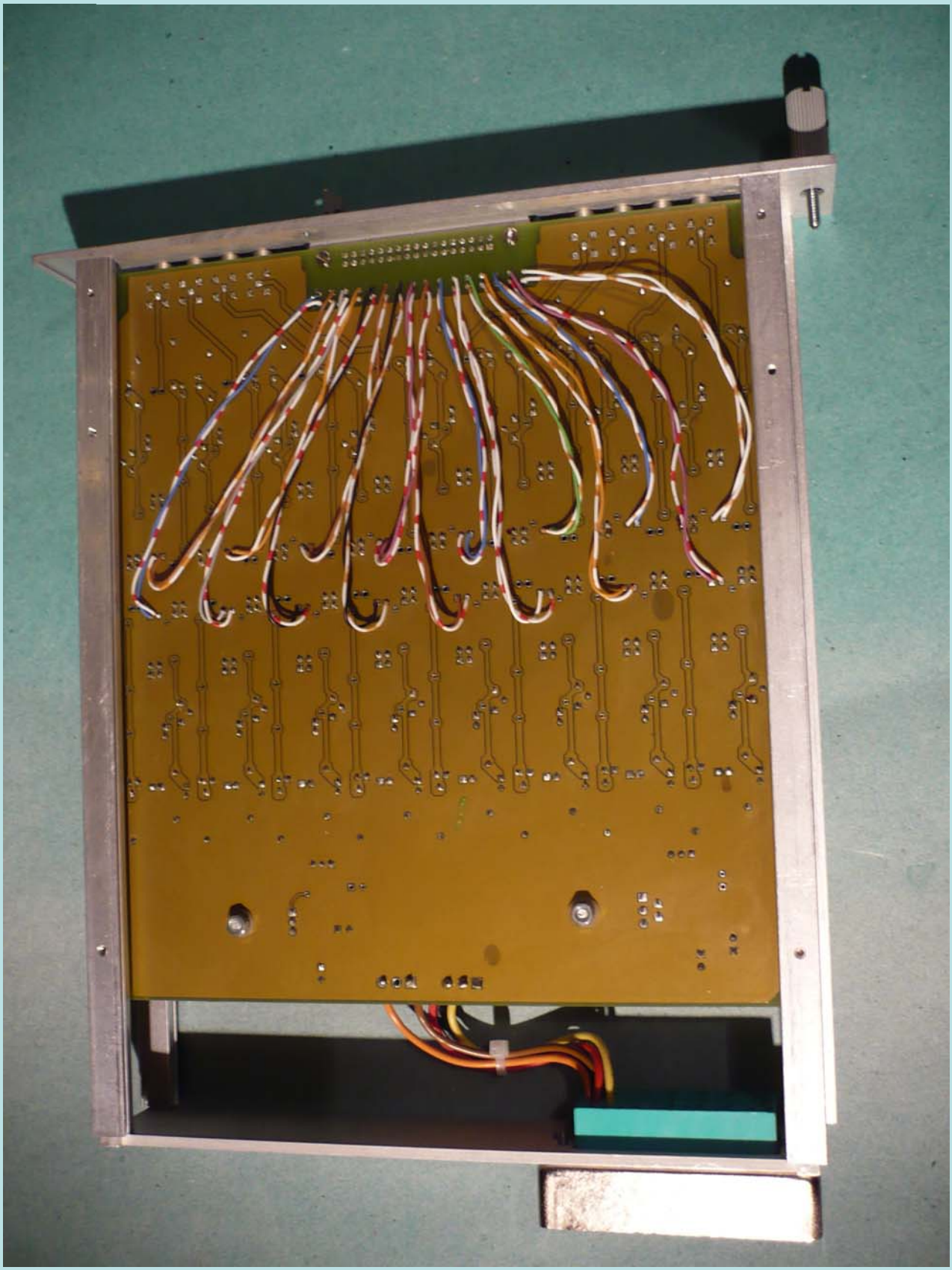
- Single-ended output (50 Ohms).

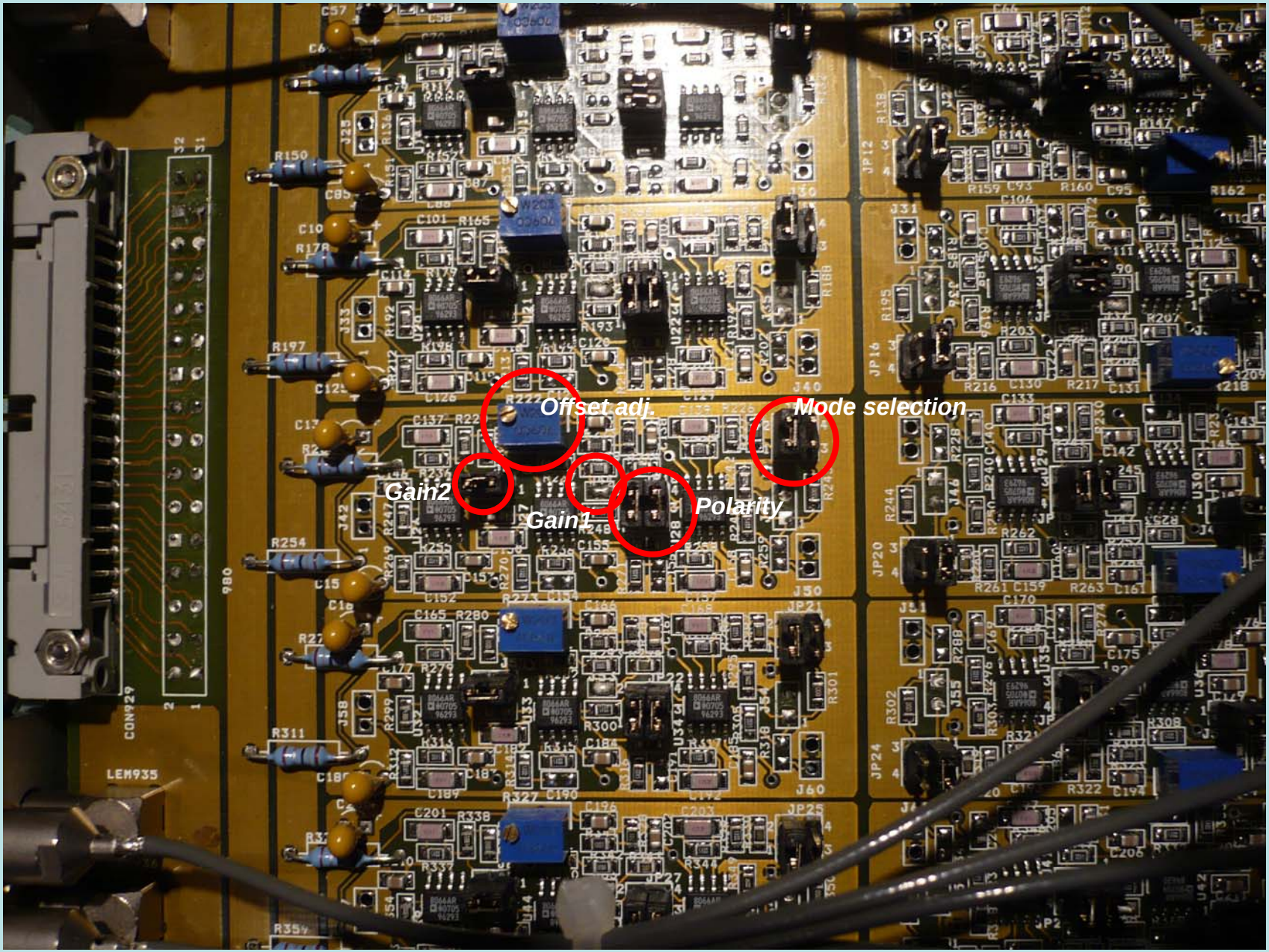
- Baseline offset zeroing (by a multi-turn trimming potentiometer) of each channel.
- Jumper selectable output polarity.
- Possibility for input signal monitoring.
- 16 channels in a single-width NIM module (surface-mounted design on a 2-layer printed circuit board).
- On board power supply with low dropout voltage regulators (from +/- 6V or +/- 12V NIM crate power supply).

Electrical schematic

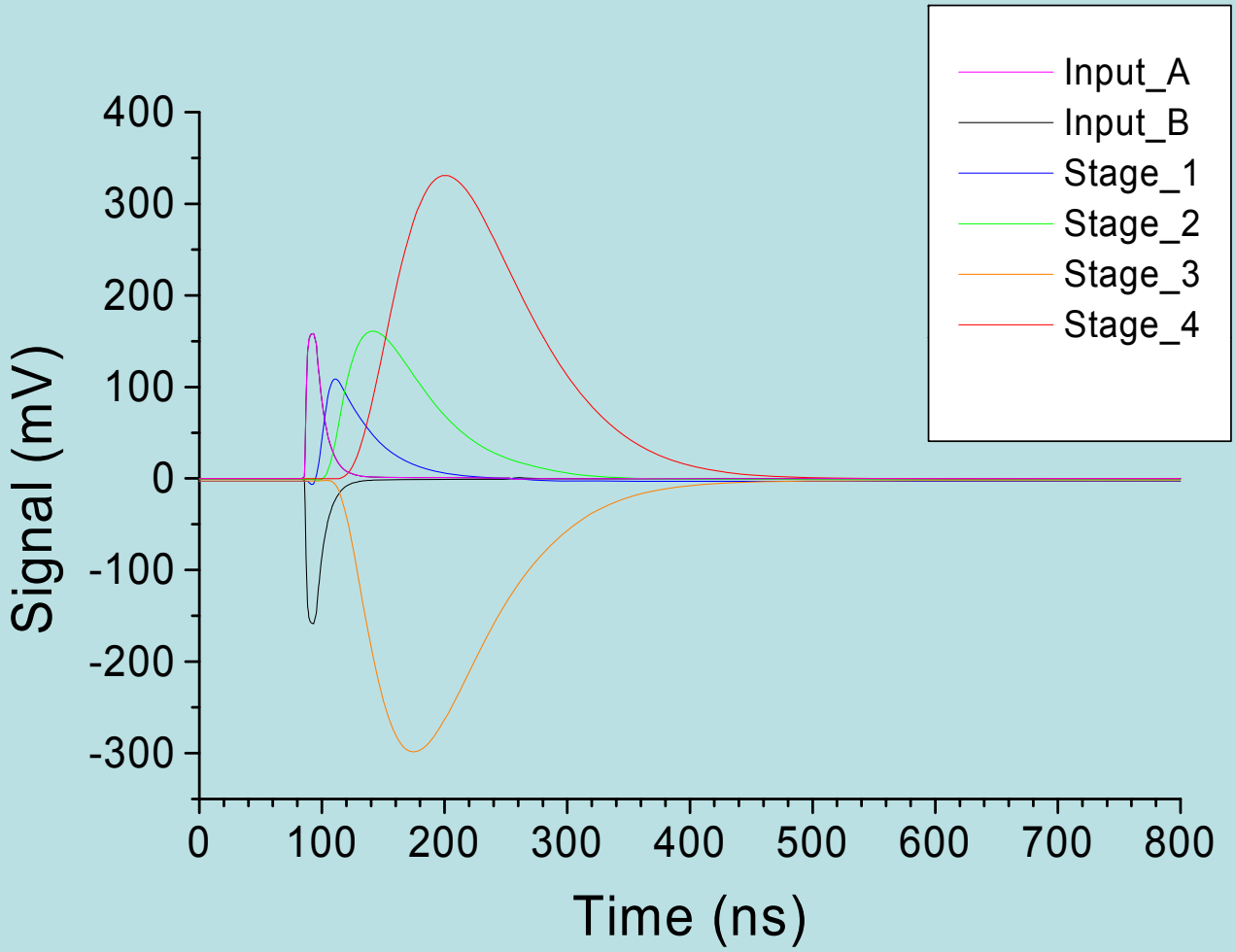



Selection
GND
GND
Power

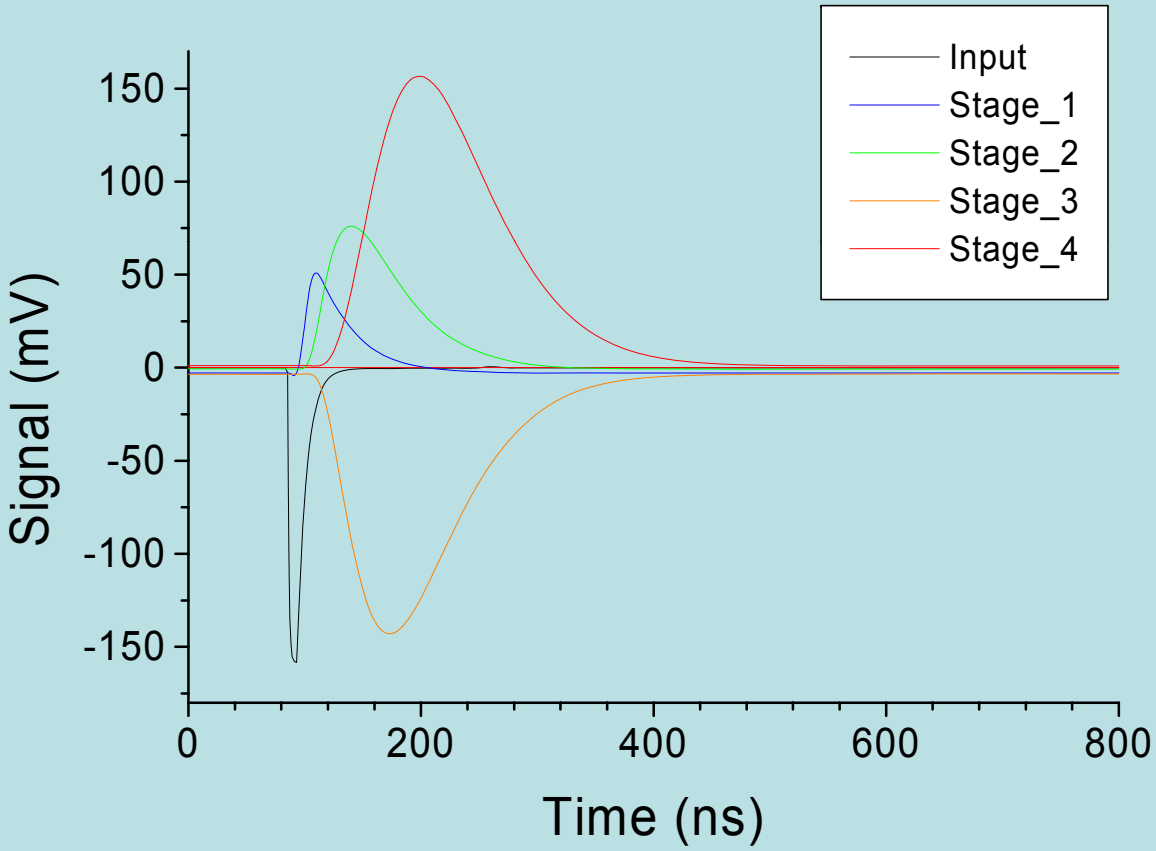



Offset adj.
Mode selection
Gain2
Gain1
Polarity
LEM935
CON929

Simulated RC shaping with differential input signal

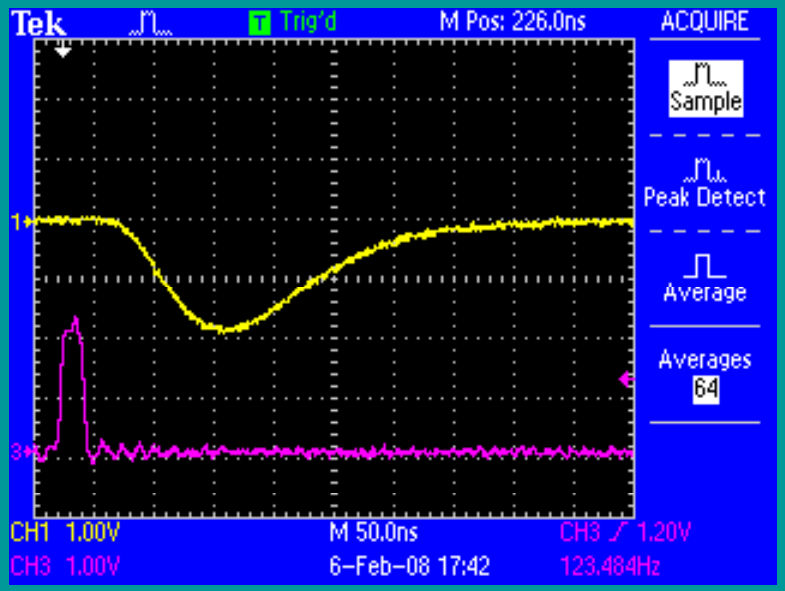


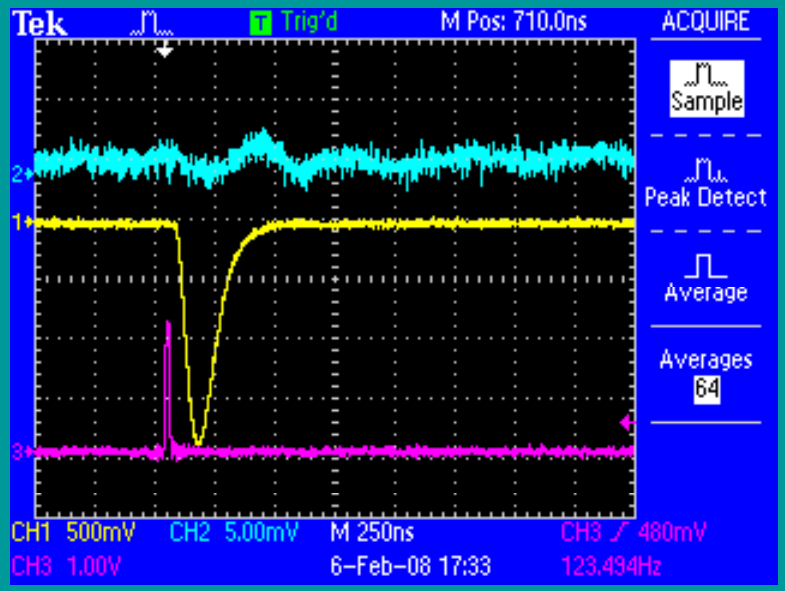
Simulated RC shaping with single-ended input signal



Tests with a pulser

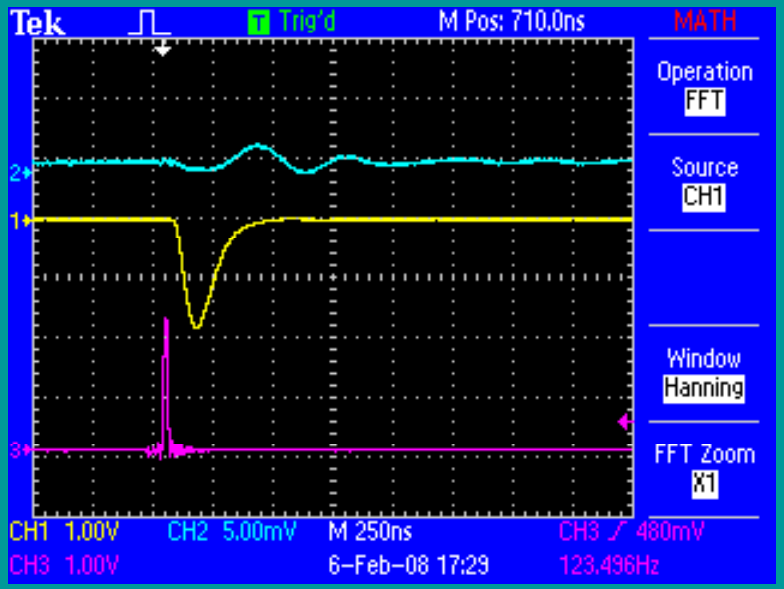
Acquisition in one sweep



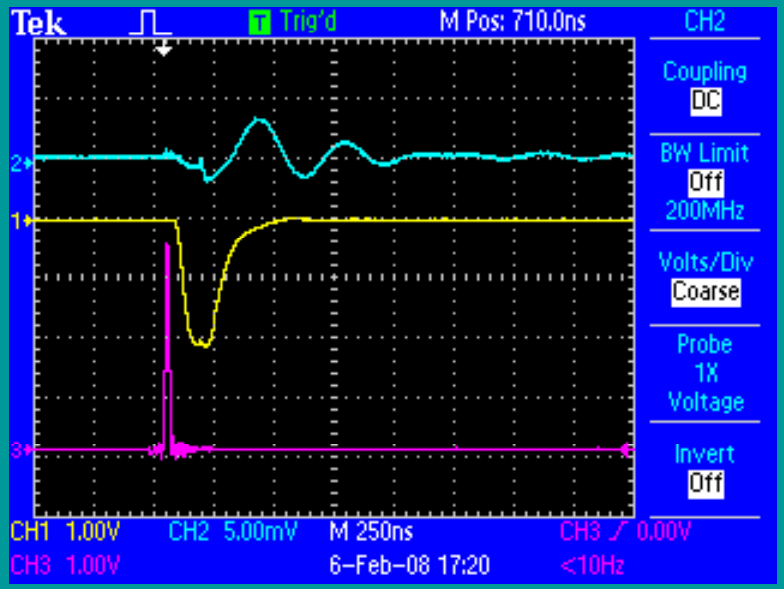


Cross-talk in an adjacent channel at:

driven channel close to maximum voltage output swing



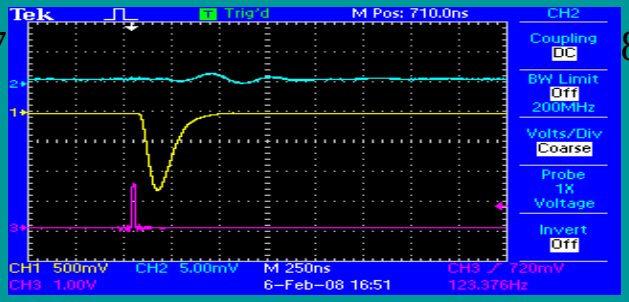
saturation of the driven channel's output



Inter-channel cross-talk

-inverting shaper set up
-DC gain :14.4
-signal input to ch. N 5
-50 Ω load of ch. N5 and measured channels' outputs
-signal averaged over 16 sweeps

7



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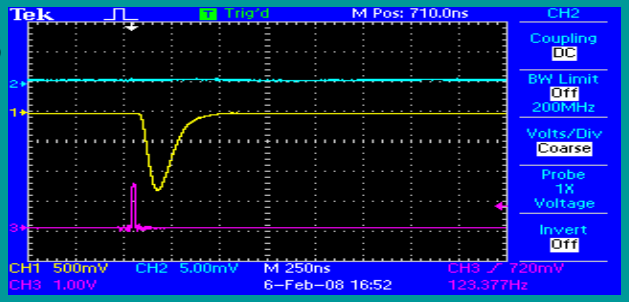

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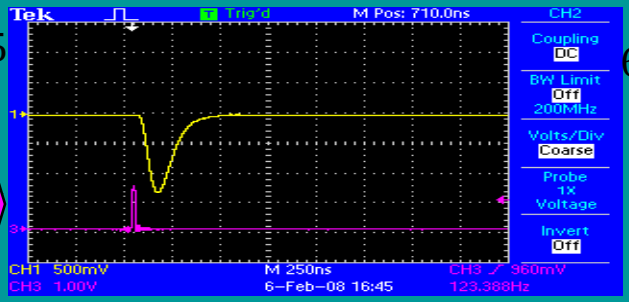

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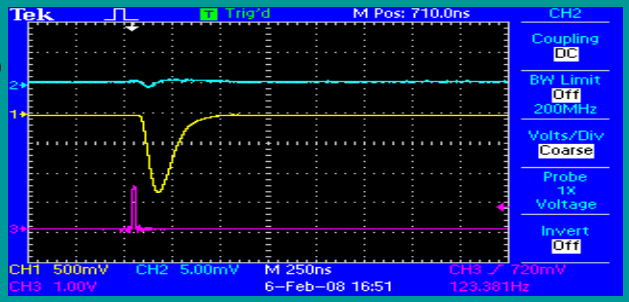

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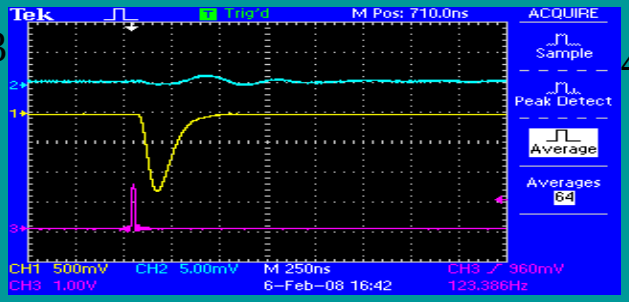

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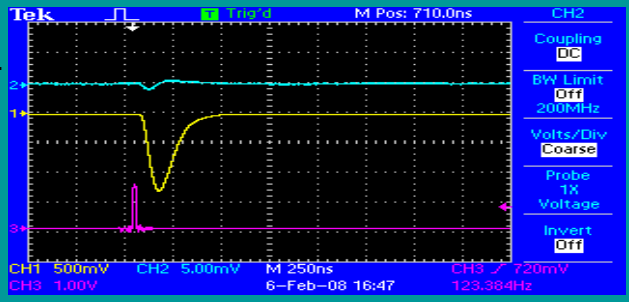
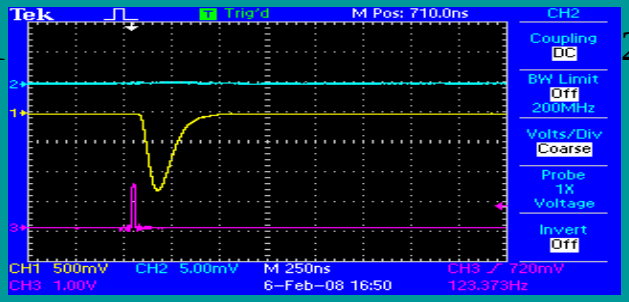


1



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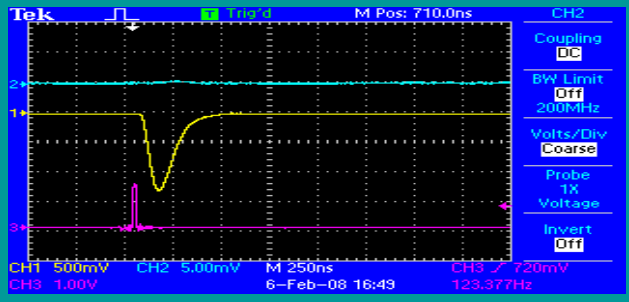
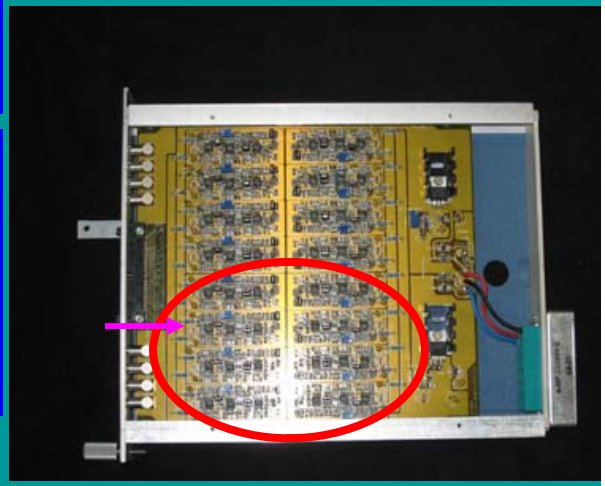
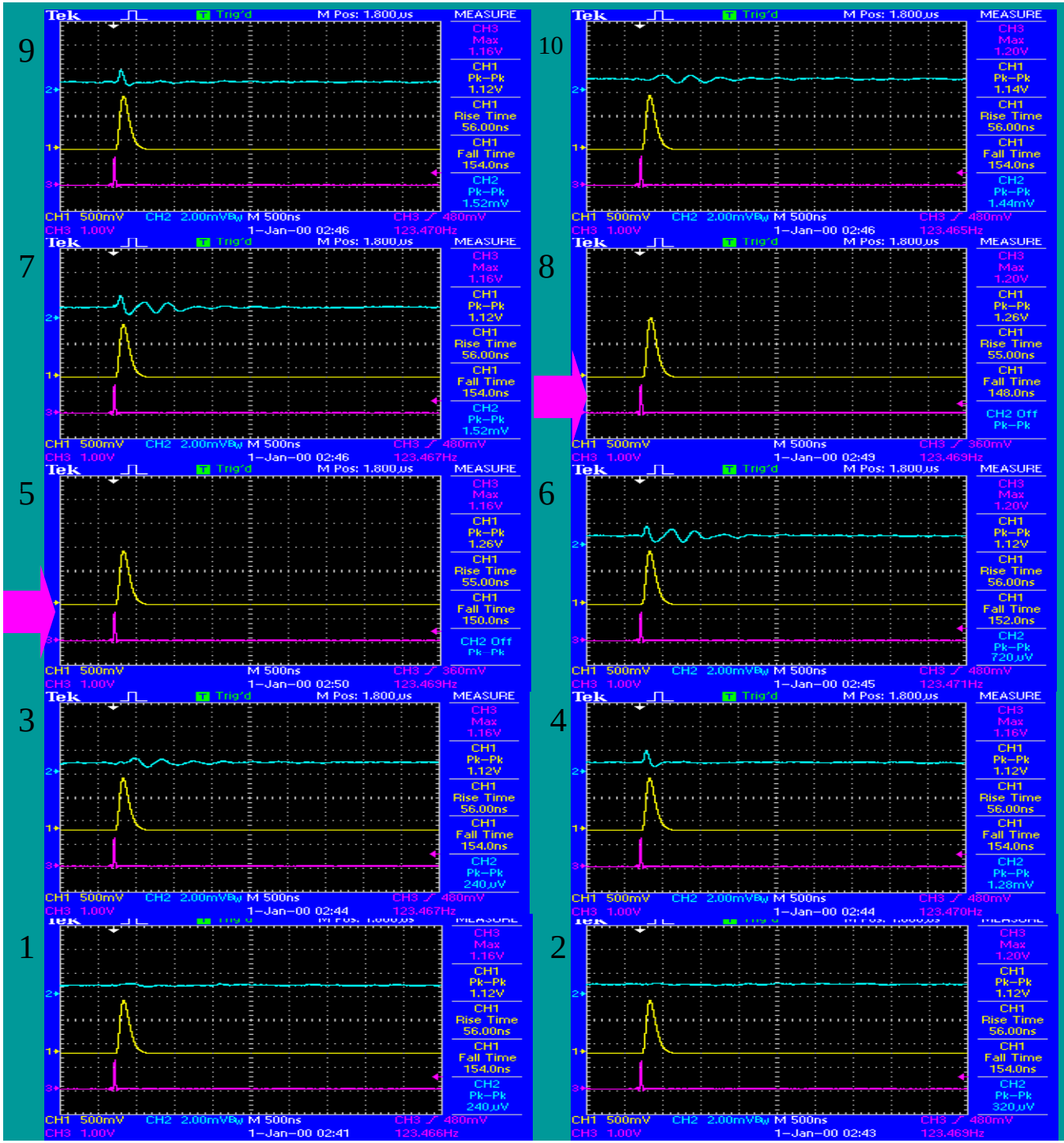


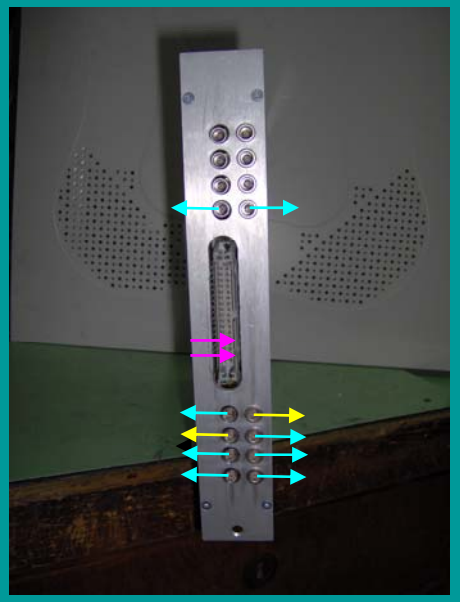




Inter-channel cross-talk

-non-inverting shaper set up
-DC gain :14.4
-signal pulses input simulta-neously to ch. N 5,8
-50 Ω load of channels
-signal averaged over 16 sweeps

-Most of the channels are affected mainly by the closest driven channel
-Typical crosstalk level: 50—55 dB

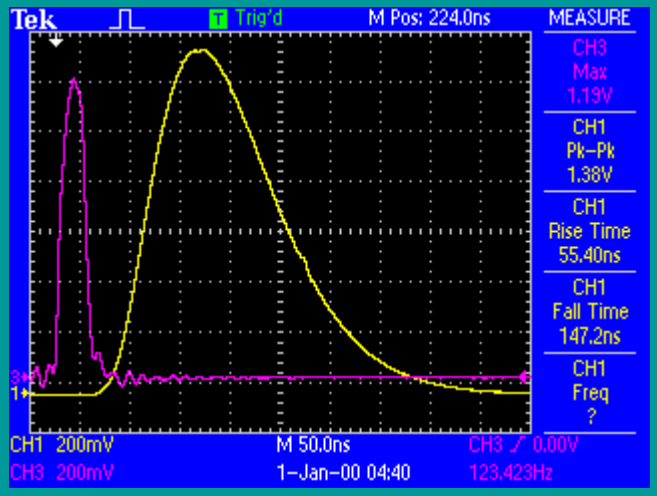


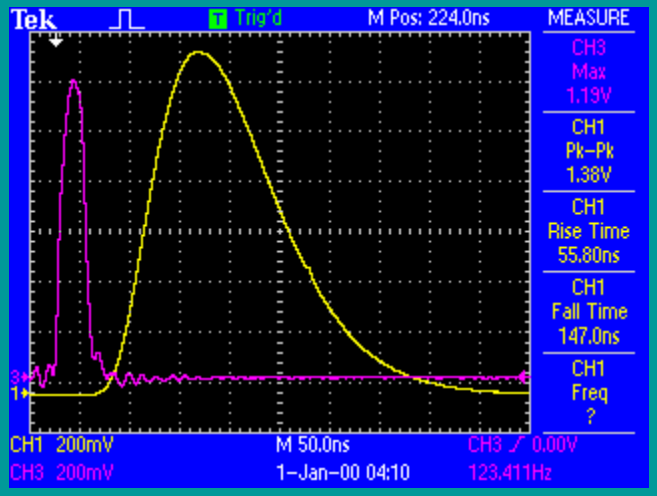
Gain, temperature dependence

- **DC gain distribution over the 5 amplifier stages:**
  input → 1 → 2(3) → 1.2(4) → 1.2→ output

- **two jumpers in combination select DC gain from 4 values: 2.9, 4.3, 9.6, 14.4**

- **small drift of gain with temperature : <0.2%/ ^{0}C**





Temperature drift of DC voltage offset at channel output

• varies from channel to channel in the range 0 - 3 mV for 10 ^{0}C change in temperature in the range 20-40 ^{0}C , typically around 1mV

Ch. number	Offset (mV) at temperature:			
	23 ^{o}C	27 ^{o}C	30 ^{o}C	33 ^{o}C
1	-2.0	-1.3	-0.8	-0.6
2	-1.2	-0.7	-0.4	-0.2
3	0.3	0.4	0.4	0.5
4	-2.1	-1.4	-0.8	-0.5
5	0.3	0.4	0.5	0.6
6	-1.5	-0.9	-0.6	-0.4
7	0.6	0.9	1.1	1.2
8	0.1	0.0	0.0	-0.0

Current status

- 10 boards produced with SMD components machine-soldered
- 7 modules have been assembled in Geneva
- 3 in Sofia
- Currently 5 modules are tested and tuned (+ 2 modules of earlier versions available)
- Preparation of doccumentation in progress