Calibration System (WBS 1.2.1.5)

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on behalf of

LAL-Orsay/LPNHE-Paris

- Motivations/Goals
- from Run I to Run II
- Simulations → new proposed Setup
- Prototyping and First Test Results
- Schedule/Conclusions

Calorimeter Electronics Review

Fermilab, 8th of May 1998

On-Line Calibration Activities in France

- Concentrated on hardware up to now
- Starting on calibration software

LAL-ORSAY:	Pierre IMBERT
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LPNHE-PARIS:	Philippe BAILLY
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	Hervé LEBBOLO
	Bob OLIVIER
	Alain VALLEREAU

Motivations

Physics Goals:

M_W: Run I (CC) $\Rightarrow$ 115 MeV uncertainty

	1992–1993	1994–1995	common
M_W from m_T fit	80.35 GeV	80.44 GeV	
W statistics	140 MeV	70 MeV	
Z statistics	160 MeV	65 MeV	
calorimeter linearity			20 MeV
calorimeter uniformity			10 MeV
electron resolution	70 MeV	20 MeV	
electron angle calibration			30 MeV
recoil resolution	90 MeV	25 MeV	
recoil response	50 MeV	20 MeV	
electron removal	35 MeV	15 MeV	
selection bias	30 MeV	5 MeV	
backgrounds	35 MeV	10 MeV	
W production/decay			30 MeV
total uncertainty	255 MeV	105 MeV	50 MeV

Expected for Run II: $\simeq$ 40 MeV uncertainty

$\Rightarrow$ competitive with final LEP II results

- constant term was not the dominant source of energy smearing in Run I
- $\pm$ 1 % calo uniformity must be preserved

$\Rightarrow$ must become smaller if possible

Difficulties:
- shorter shaping time
- calibration $\leq$ 1 %

$\Rightarrow$ redesign the pulser system

Calibration Setup for Run I

- 12 high Voltage pulsers (135 V)
- 32 position switch box

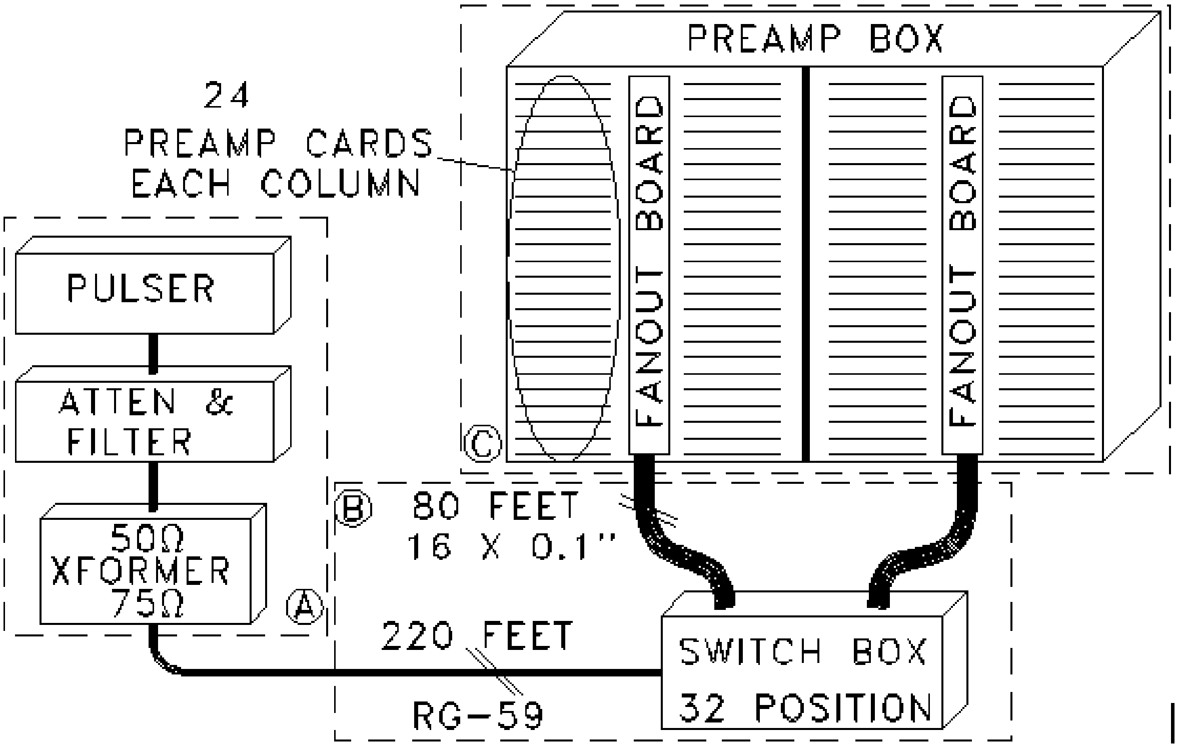
⇒ pulse 144 channels simultaneously

- rectangular pulser signal of 400 ns
- slow shapers (2.2 μs)

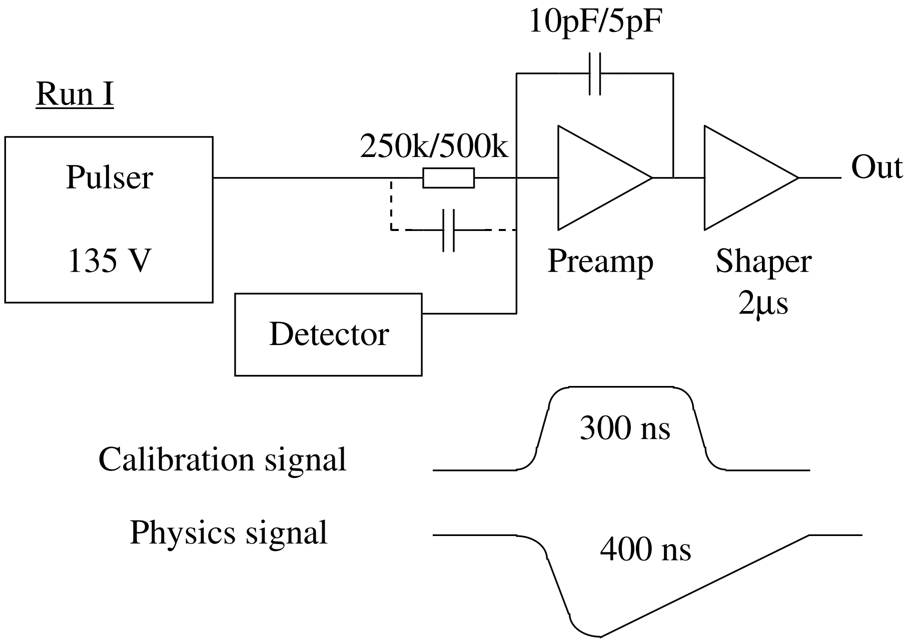
⇒ propagation/reflection in cables were not an issue

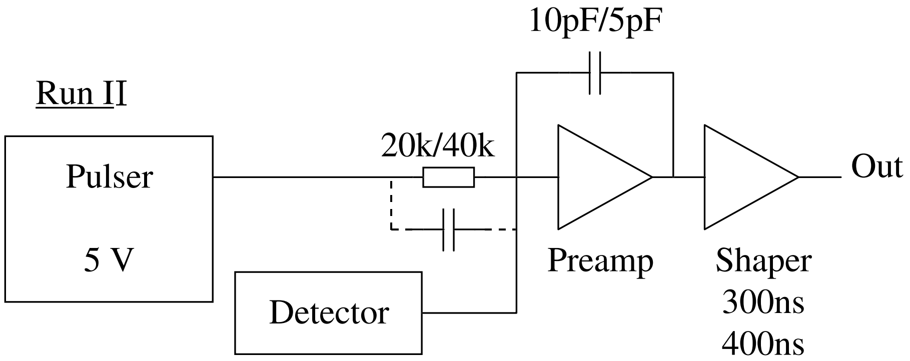
- pulsing at 1 kHz

Calibration Run I:



Simulation Setup for Run I, II
Calibration System

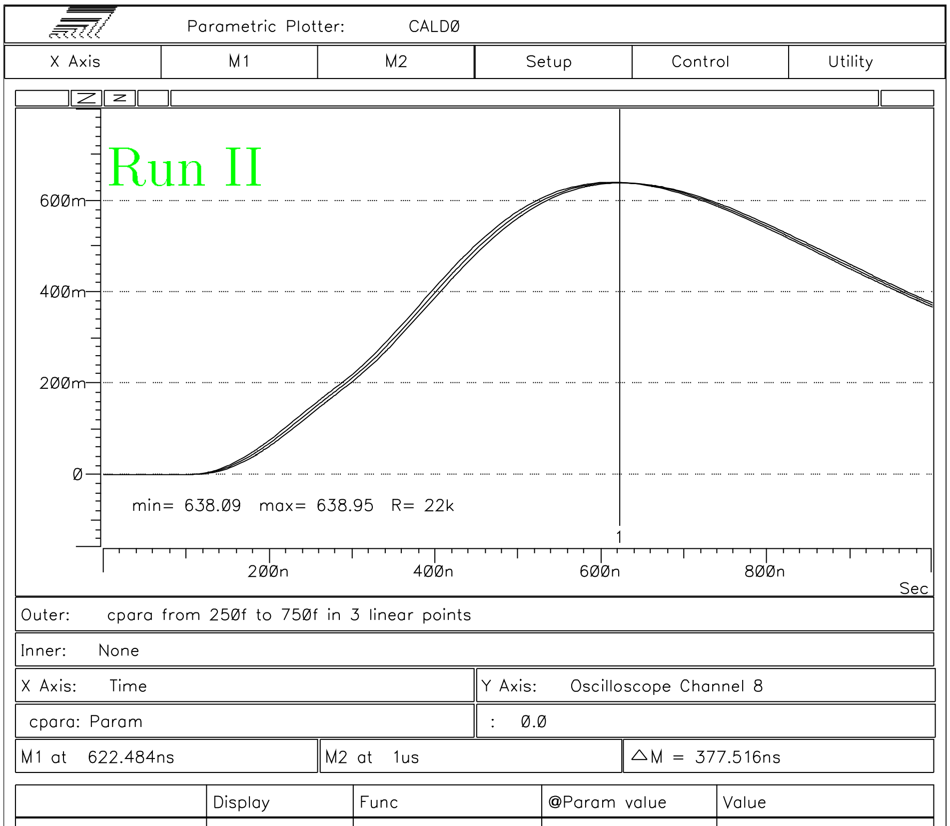




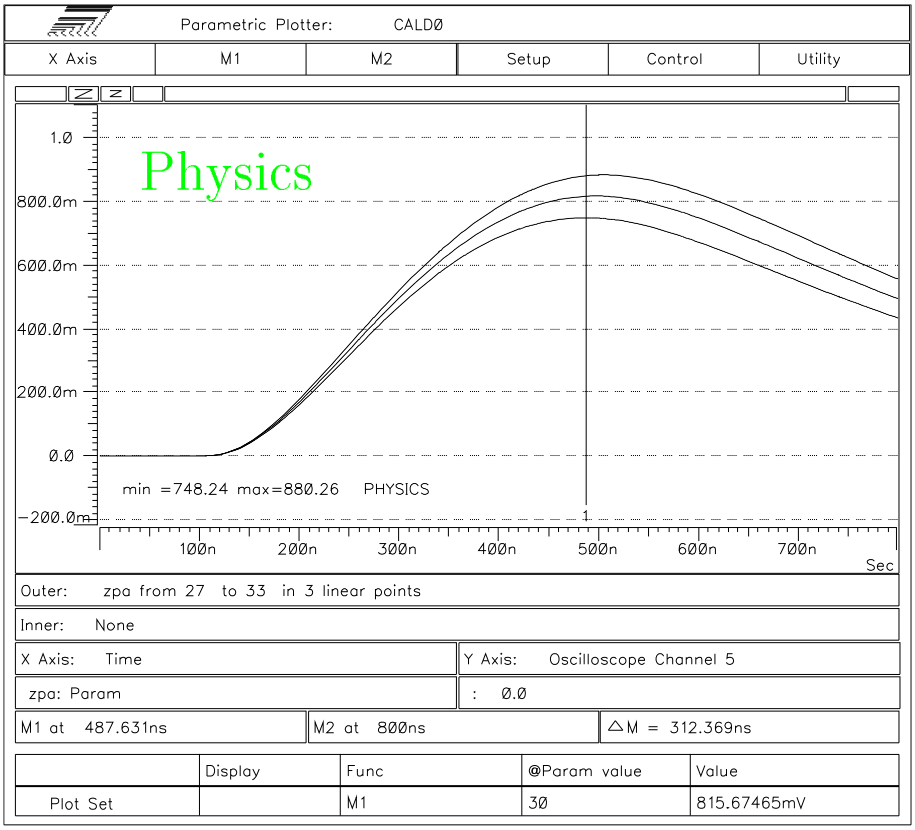
Calibration signal : rising edge : T1 = 40 ns
trailing edge : T2 =200 ns

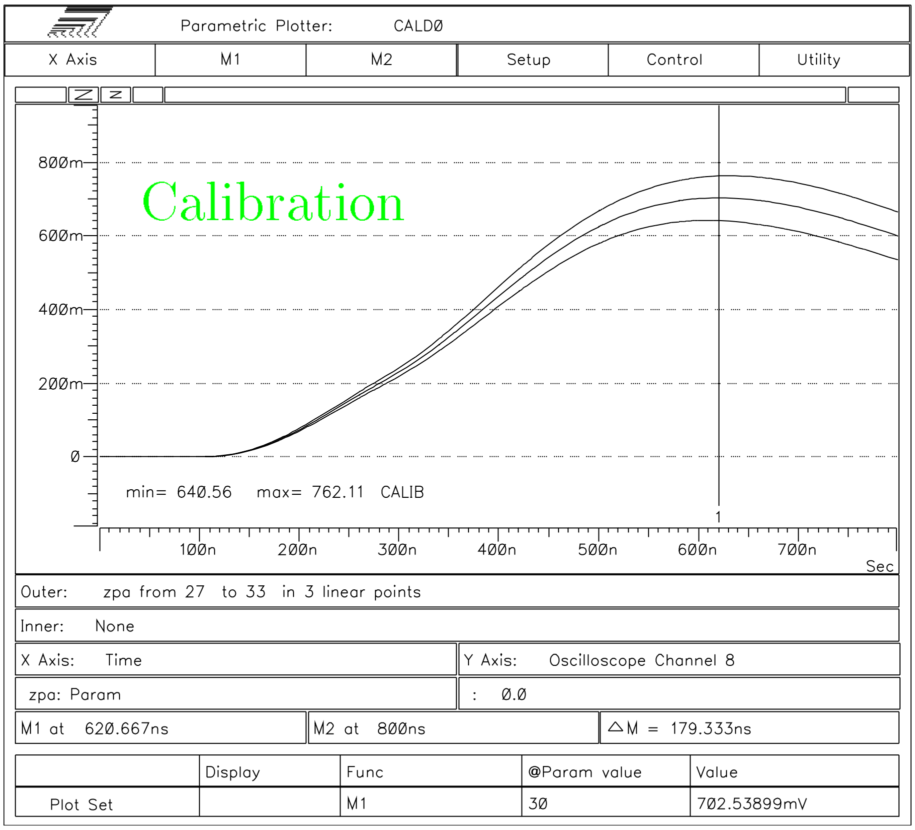
Parasitic Capacitor Effect

effect of a ±50% variation on
the estimated parasitic capacitor of 0.5 pF



Effect of ± 10 % Variation on the Preamp Impedance





Summary of Simulation Results of the Online Calibration System

- Main effect: parasitic capacitor of the injection resistor:

parasitic capacitor	Run II timing with Run I setup	Run II	Run I
± 50 %	23.3 %	0.04 %	1 %

- Effect of +10% variation of some hardware parameters:

parameter	Run II timing	Run II	
	Run I setup	physics	calibration
Z preamplifier	+7.8 %	+8.3 %	+8.7 %
Z signal cable	+2.0 %	+1.7 %	+1.2 %
C detector	−0.3 %	−.03 %	−0.1 %
δt cable	−1.7 %	+.02 %	−0.9 %

- Uncertainty on the electronic calibration :

parameter	Run II/I - physics	Run II - physics
Z preamplifier	0.5 %	0.4 %
Z signal cable	0.3 %	0.5 %
C detector	0.3 %	0.1 %
δt cable	1.7 %	0.9 %
total	2.8 % ($\oplus$ 23.3%)	1.9 %

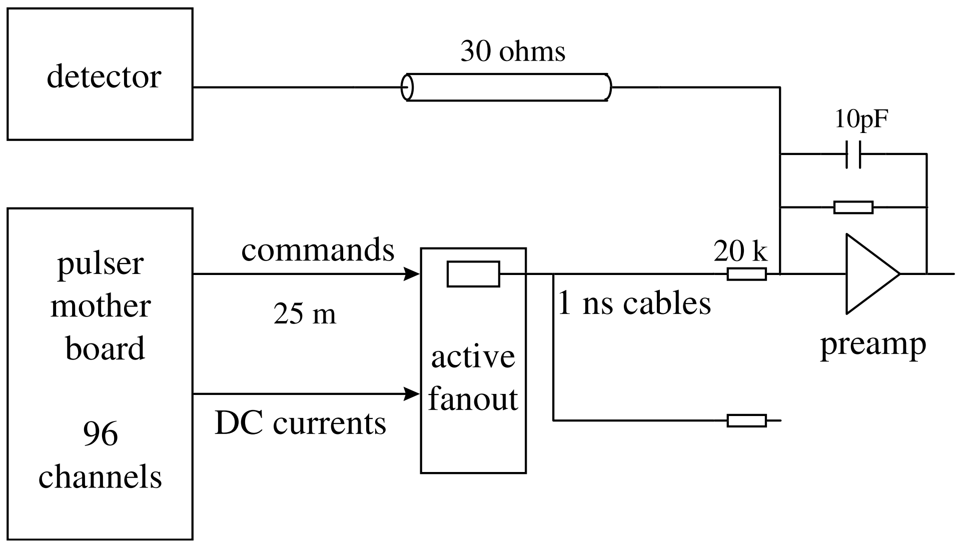
From Run I to Run II

faster shaping time: 2.2 μs $\rightarrow$ 400 ns
lower injection resistor: 250/500 kΩ $\rightarrow$ 20/40 kΩ

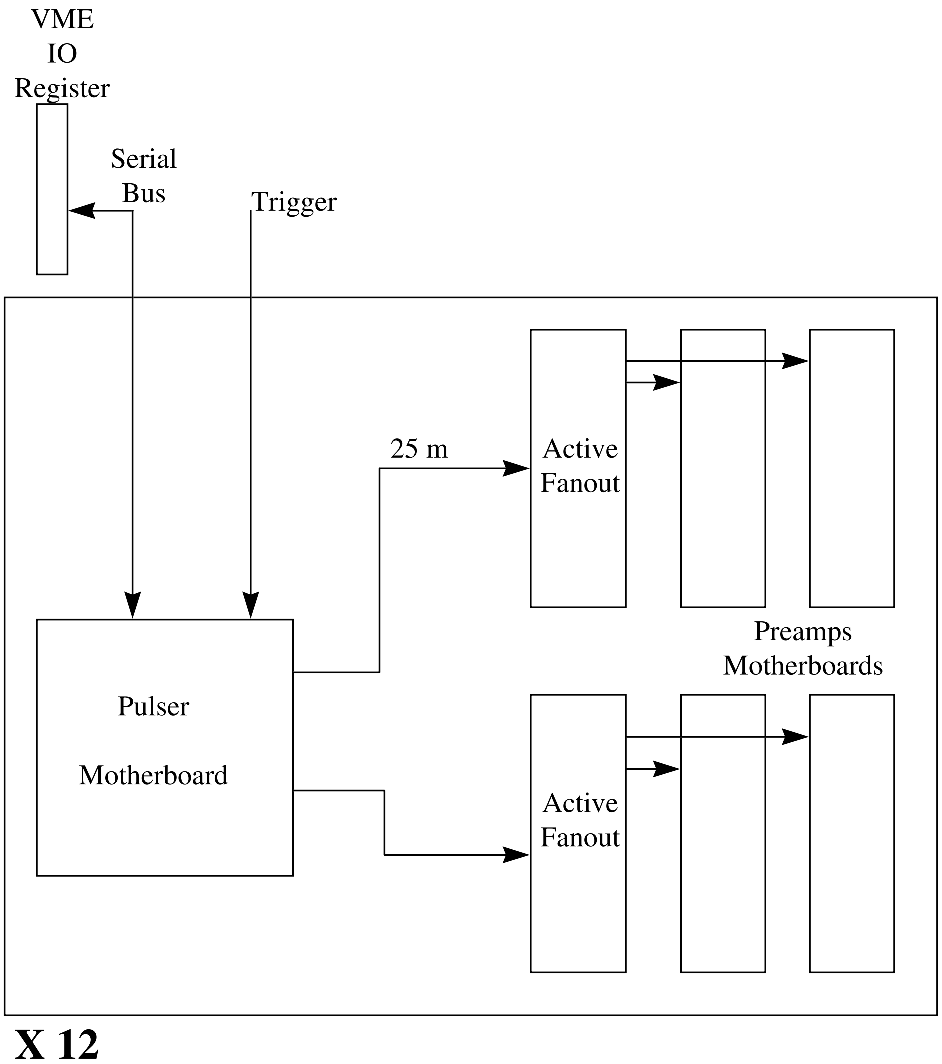
- reduce cable length (90m $\rightarrow$ 25m $\rightarrow$ 0.3m)
- optimize signal distribution
- optimize signal shape $\rightarrow$ sensitivity to: Z_P, Z_C, t_C, C_D

$\Rightarrow$ final shaper needed!

- increase the flexibility on the pulsing patterns, reduce the minimum number of pulsed channels
- increase the pulsing frequency (1kHz $\rightarrow>$ 20 kHz)



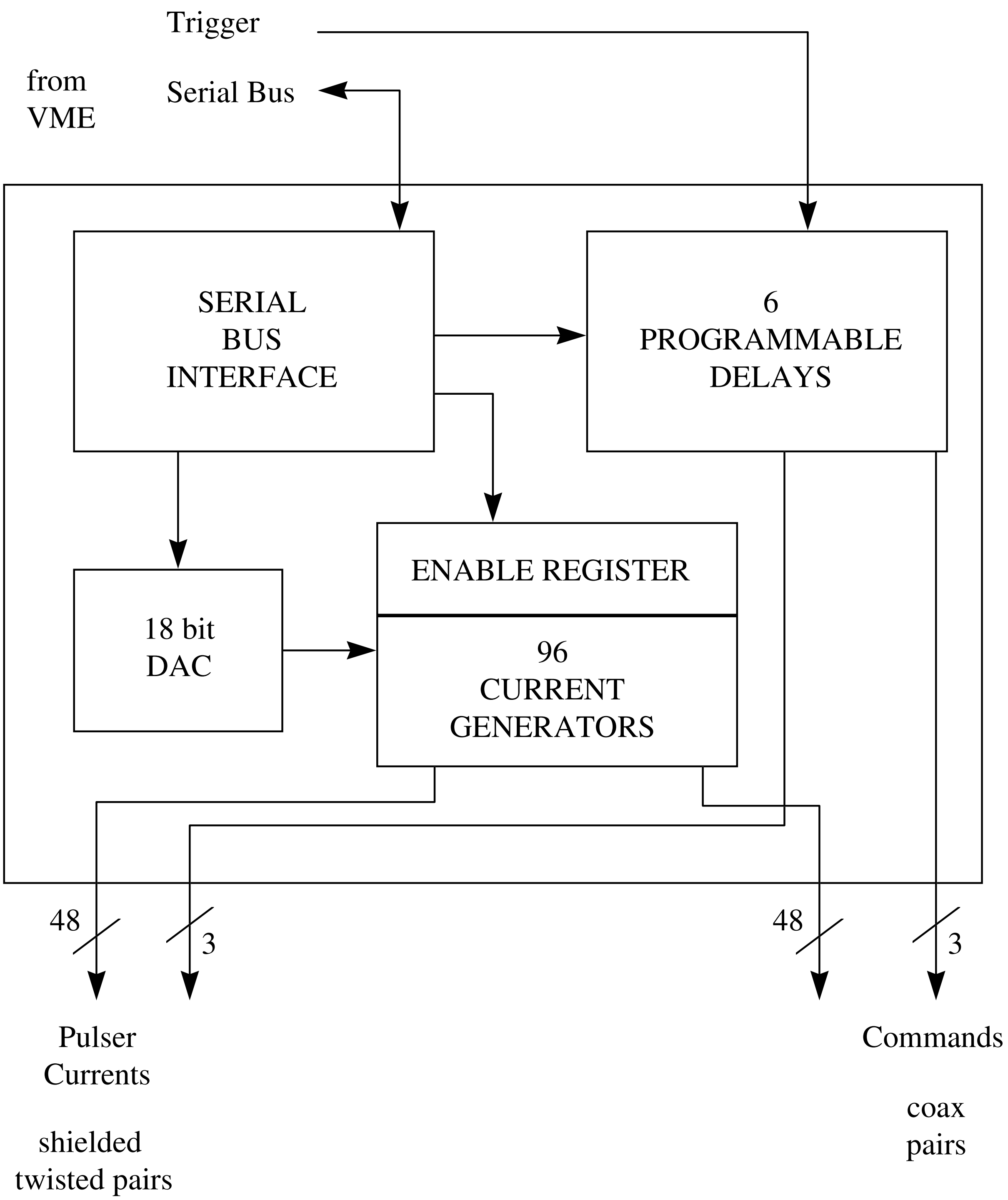
Calorimeter Calibration System for Run II



12 units:

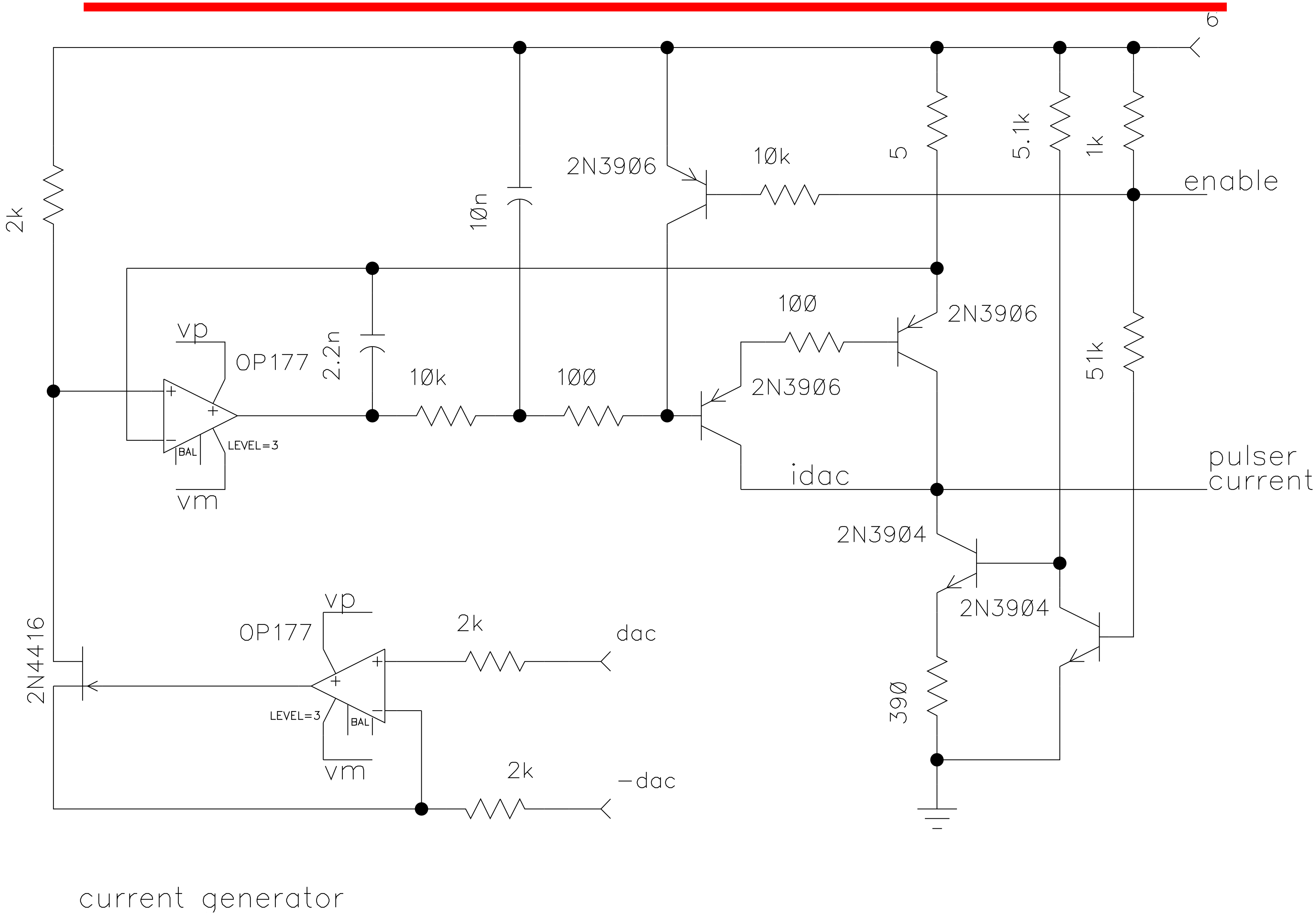
- 1 pulser mother board
- 2 active fanouts
- 96 pulsers
- 4608 preamps

Pulser Mother Board

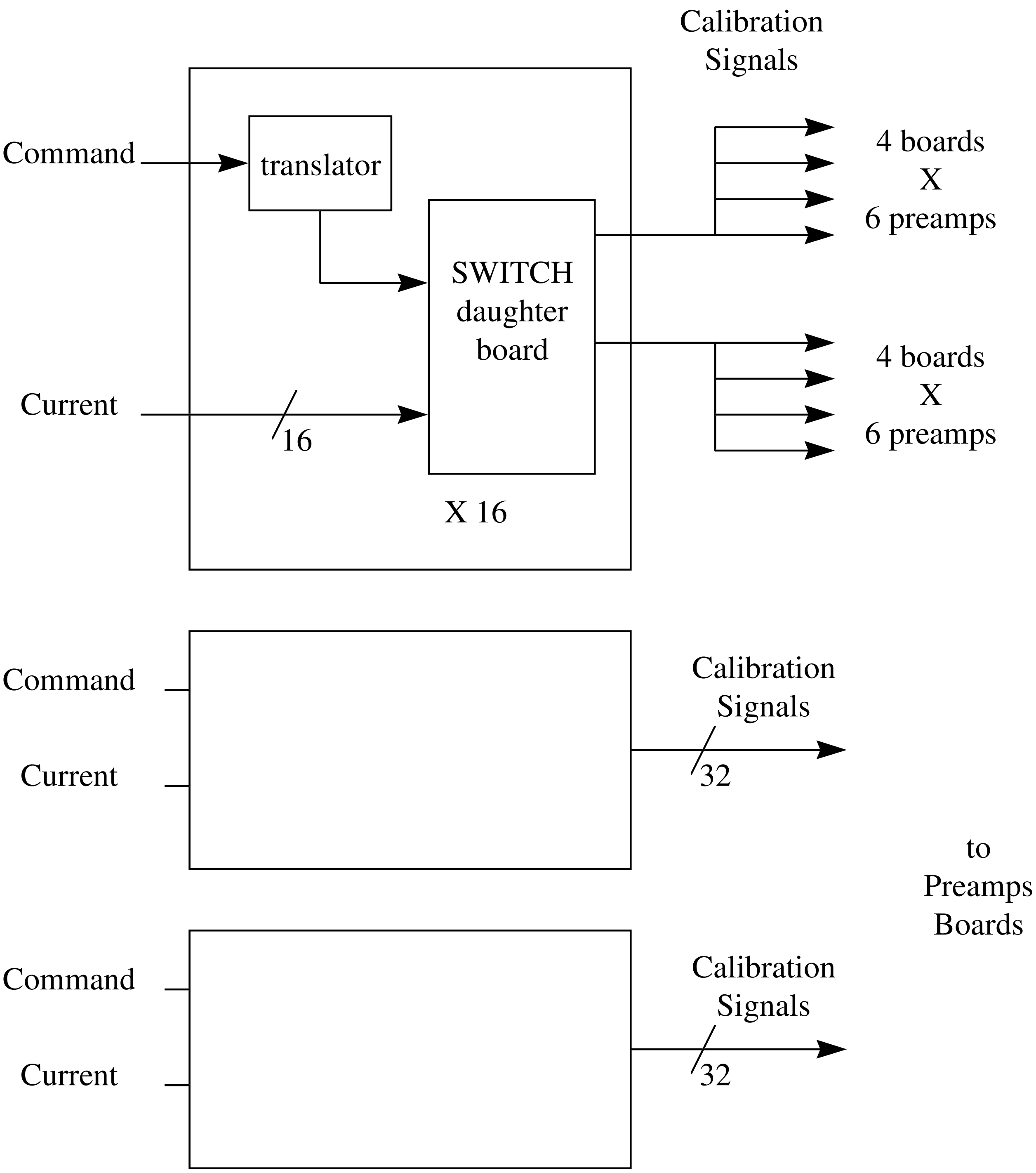


to active fanouts

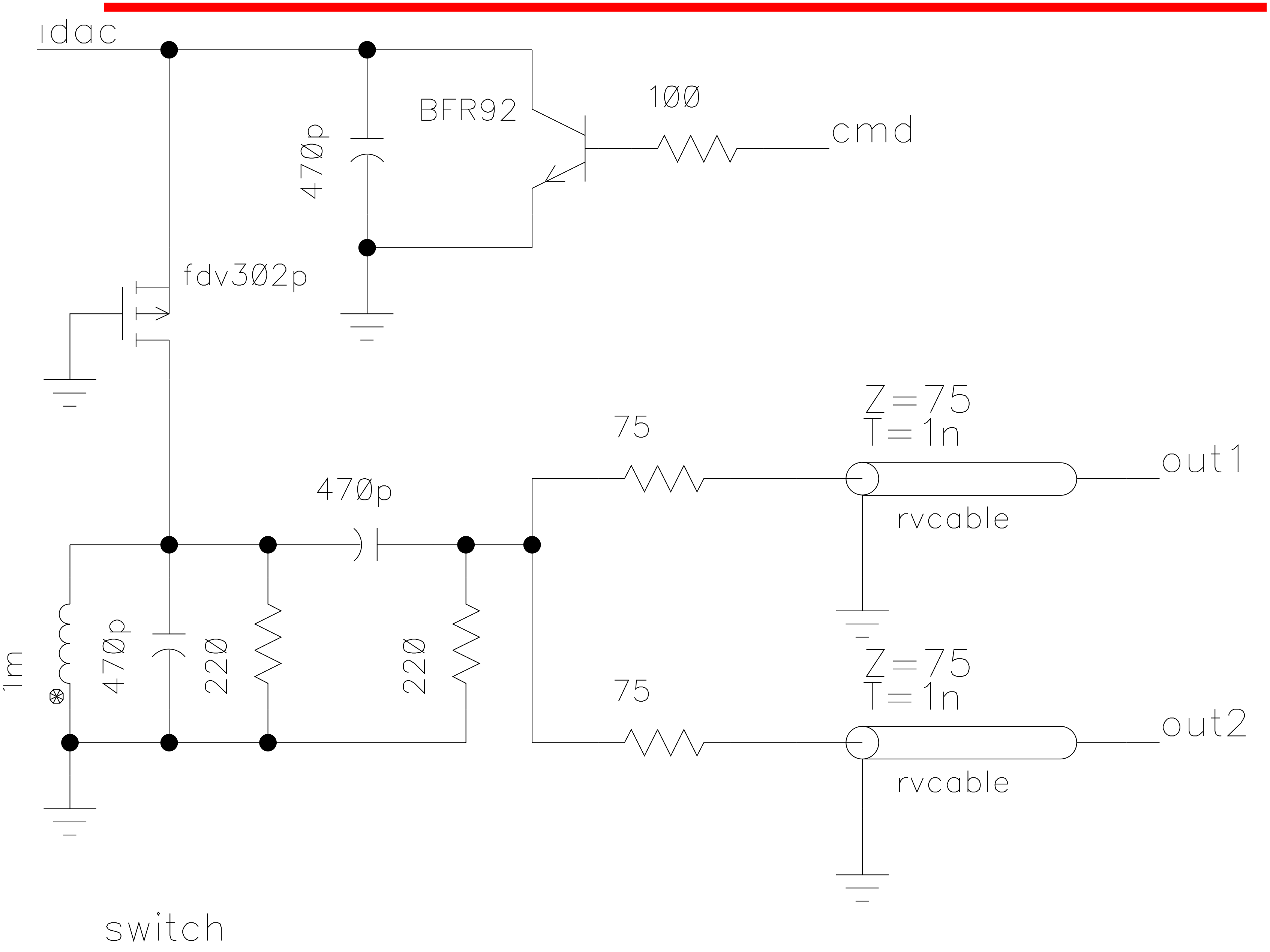
Pulser Mother Board Scheme



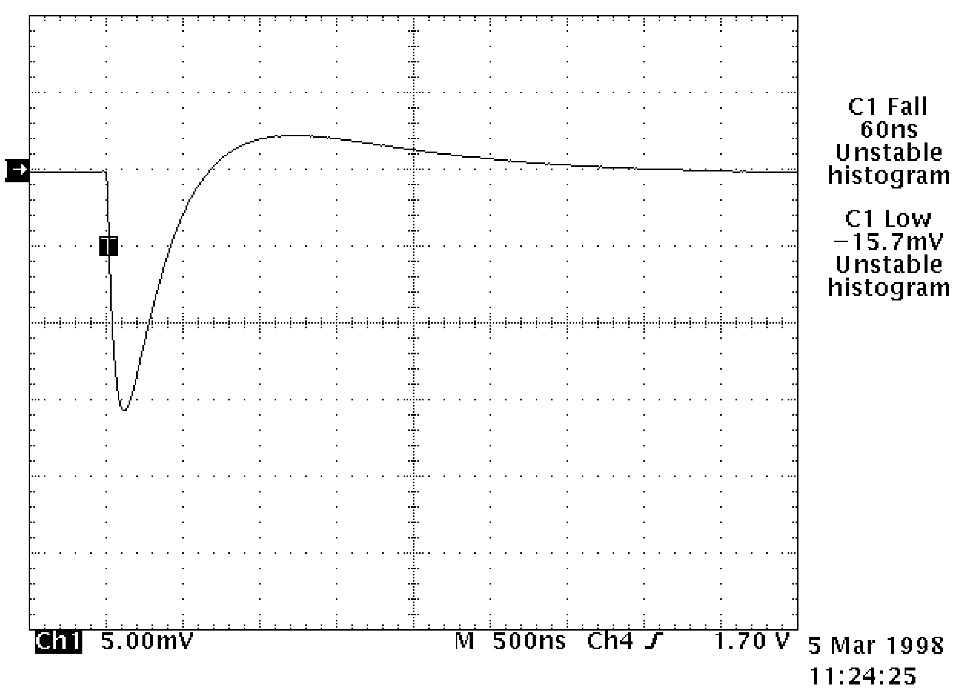
Active Fanout

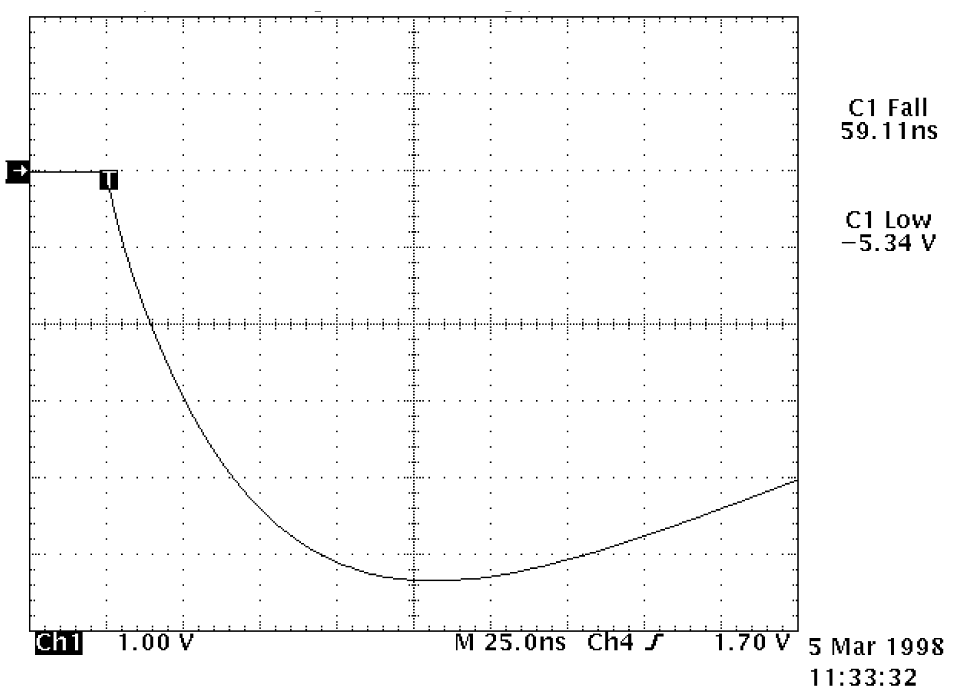


Scheme of the “Switch” Board

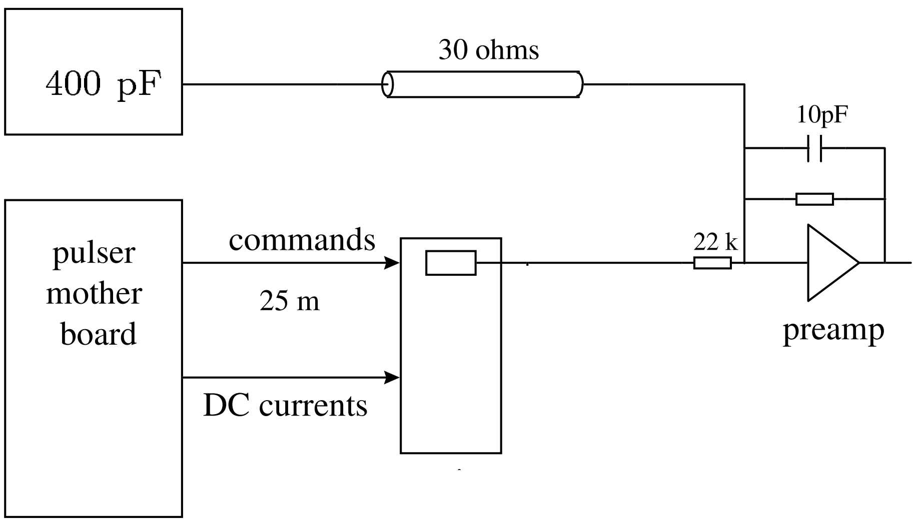


Calibration Pulse

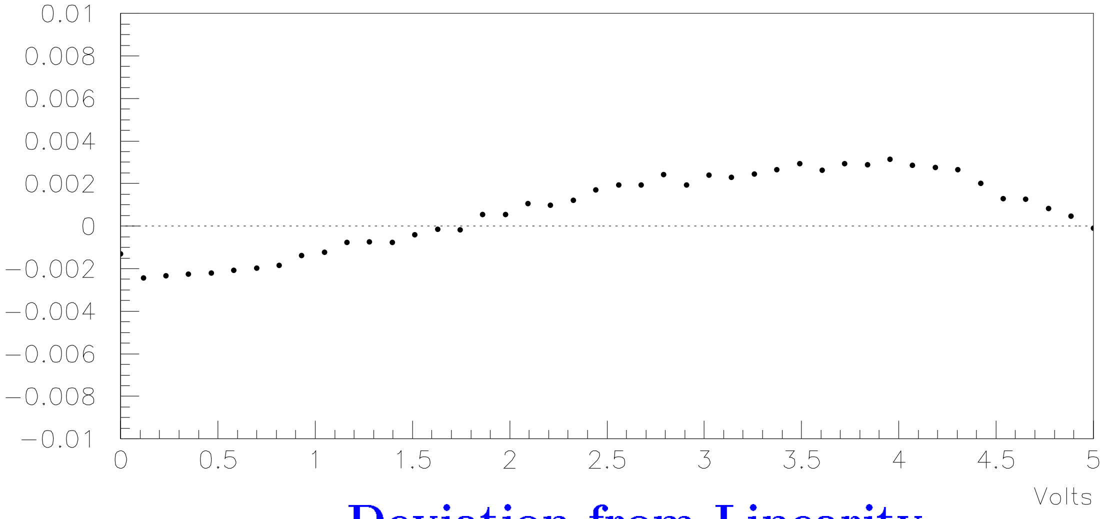




Test of the Pulser Linearity

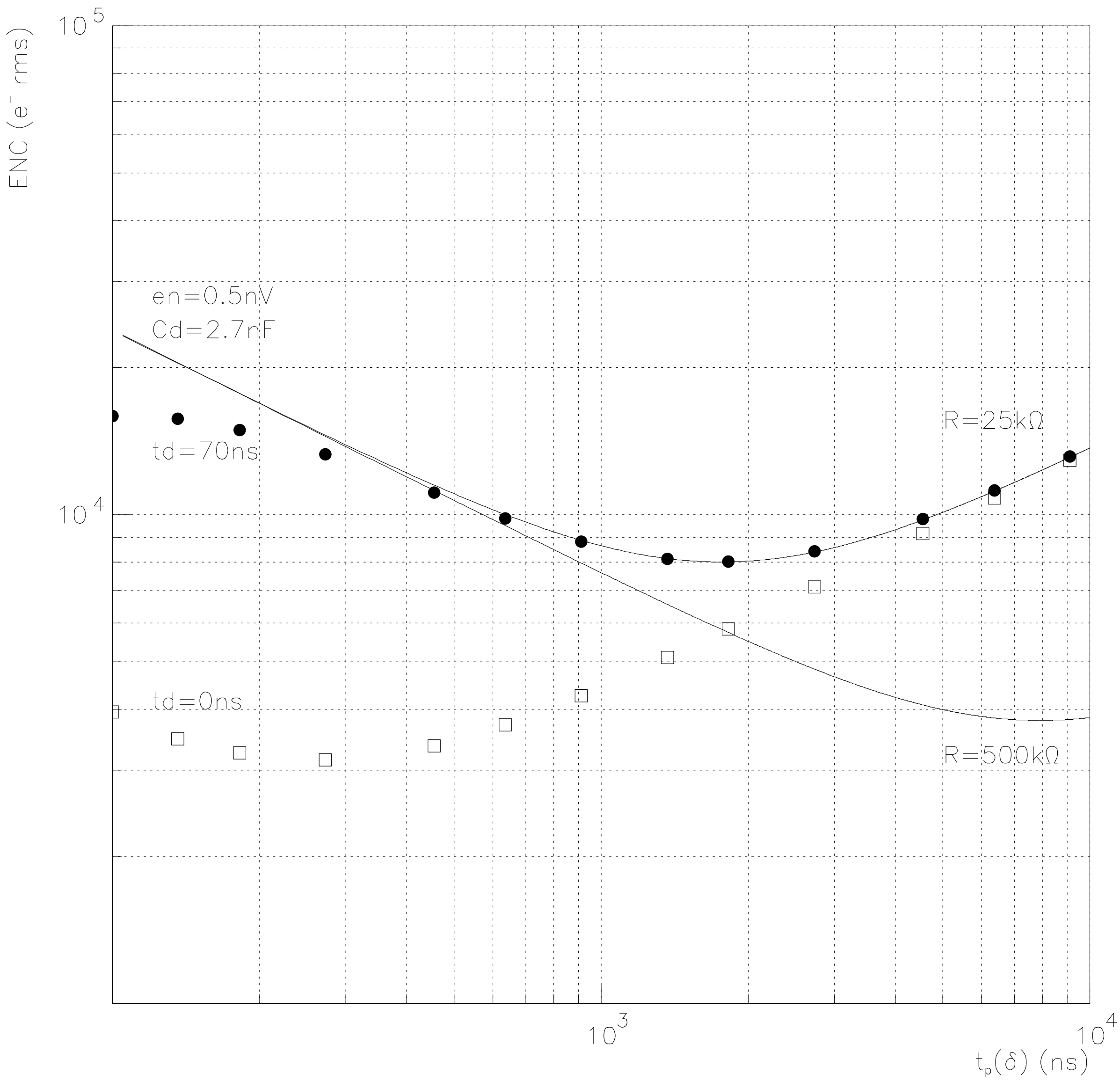


- Test done at Orsay using old pulser motherboard from Atlas and new "switch" for the active fanout for DØ.
- Range $0 \rightarrow 5$ Volts. Linearity ≤ 0.4 % (before shaping)
- 1152 pulsers. But Intercalibration from Atlas experiment : $\rightarrow$ 0.1% dispersion on $\sim$ 100 pulsers.

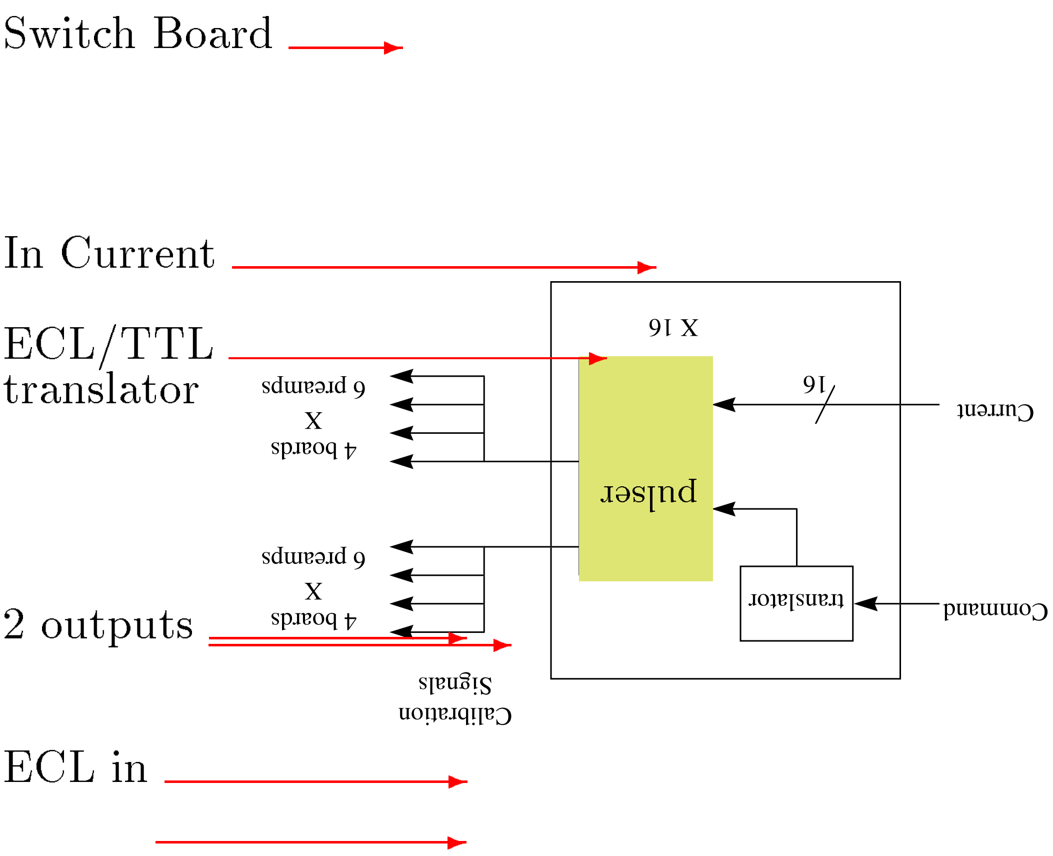


Deviation from Linearity

Noise for RunI/RunII Input Resistor Values

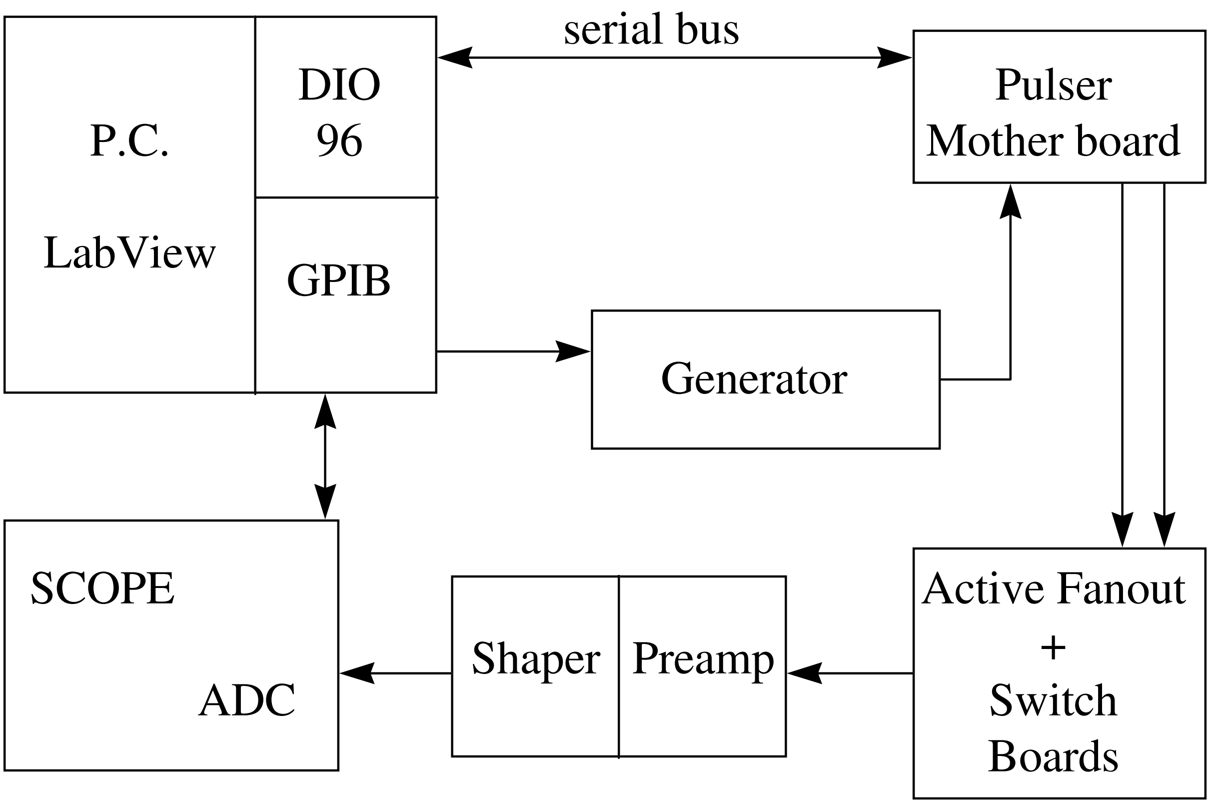


Active Fanout: Mechanical Design



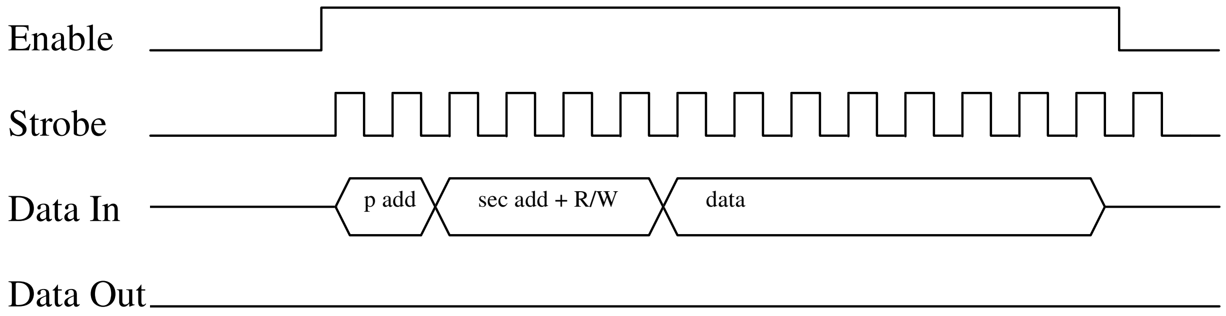
Prototypes

Mother Board :	8 channels one 16 bit DAC two programmable delays one enable register one serial bus interface
Active Fanout :	1/3 16 switch boards

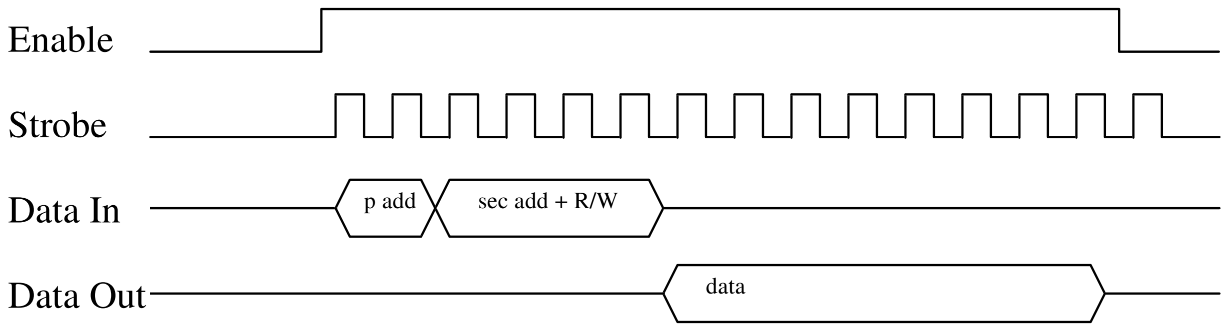


Serial Bus

Write cycle



Read cycle



Schedule

Step of the Project	begin	end
Finalize calibration prototype design		6/98
Prototyping	5/98	10/98
Prototype test at Fermilab (3 weeks)	10/98	12/98
Finalize calibration system design		12/98
Production phase (external manufacturers)	12/98	6/99
Installation/debugging at Fermilab	6/99	9/99

Conclusion

- Hardware Project well underway
- No Timing/Manpower/Financing Problems
- Possibility to integrate the ICD
- Contacts/Projects have to be established for the On-Line Software with SUNY
- Should be ready by Summer 99