TIB System Test

An overview of measurements with Analog Optical Links

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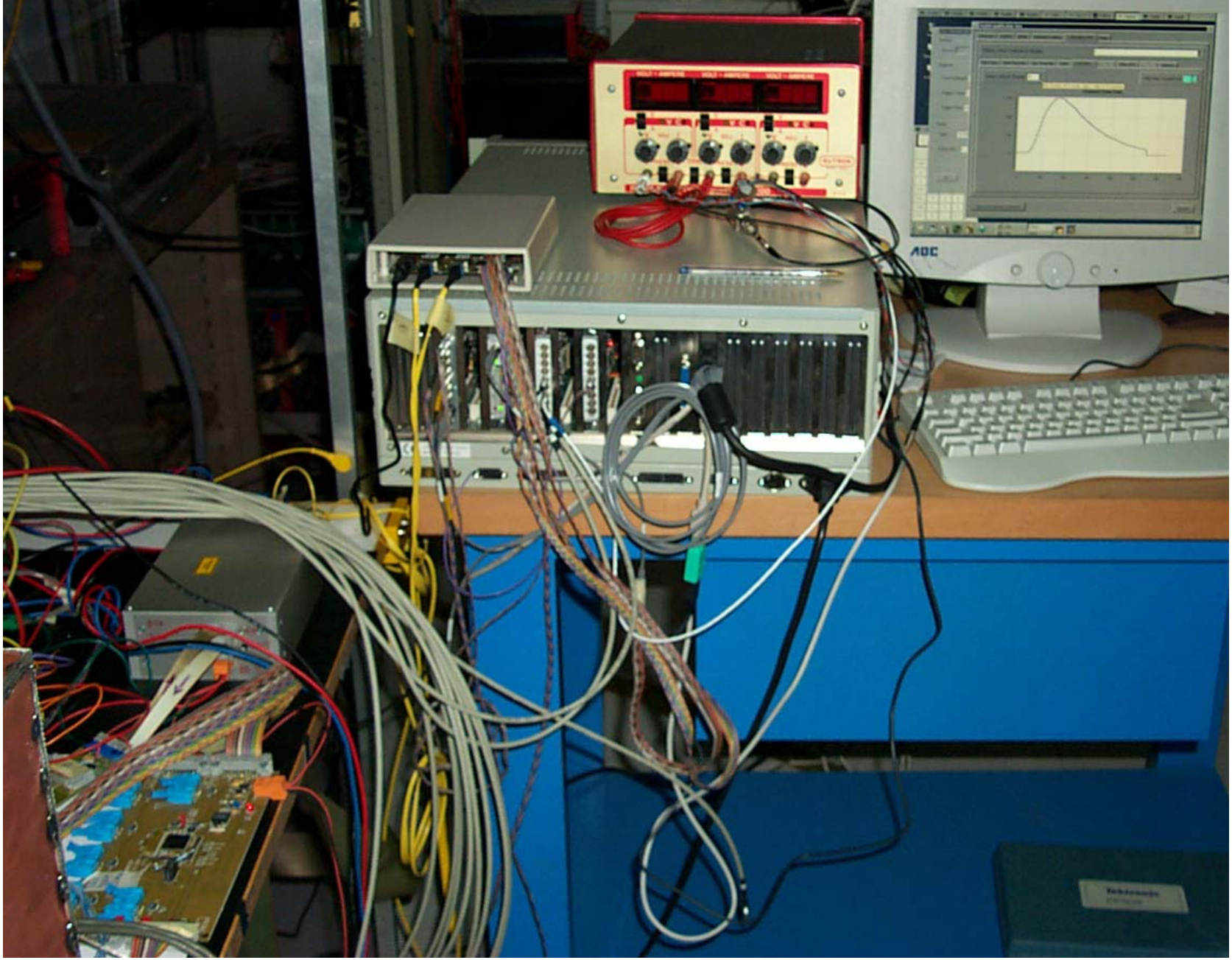
Introduction

- As a milestone of TIB System Test we have installed in Firenze a full DAQ chain with (quasi-final) digital and analog components, reading out a TIB module
- We focused mainly on system aspects, and in particular:
- Noise performance
- Study of optimal signal termination on analog opto-hybrid and APVMUX

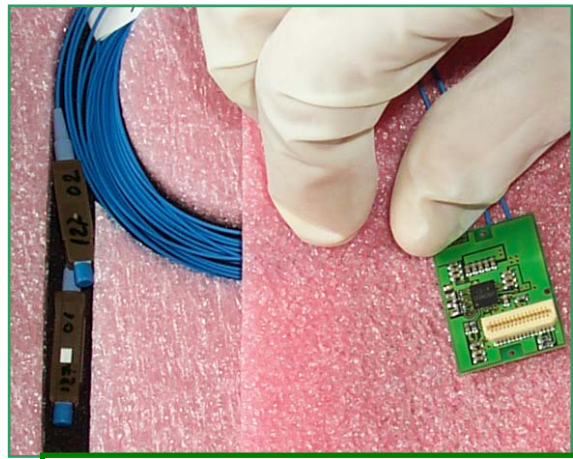
Setup (1)

- HW in PC (Linux RH 7.0) :
  - FEC (modified at CERN to be used with digital optolink)
  - TSC (Lyon)
  - FED (RAL)
- OPTO HW:
  - D-Link Tx-Rx (Vienna)
  - D-Link Rx-Tx and CCU25 interface (CERN)
  - Analog Opto Hybrid (Perugia) equipped with LDD2
  - Analog Opto Receiver (CERN)
- Control ring: 1 CCU25 (CERN)


AOC

Setup (2)

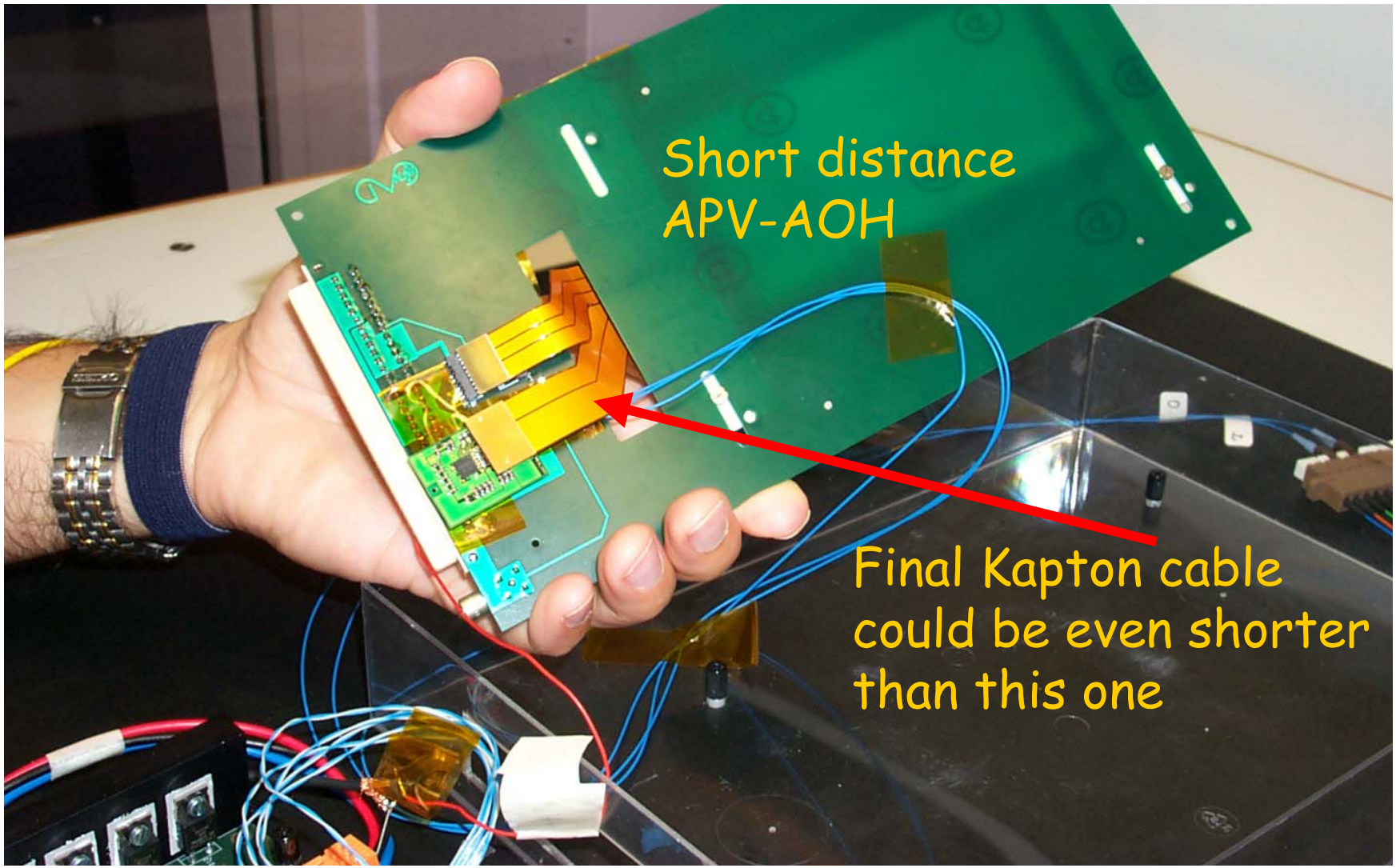
- Front end APV25-s1 on FR4 hybrid, TIB module, 300 um thick



3 Lasers A.O. Hybrid

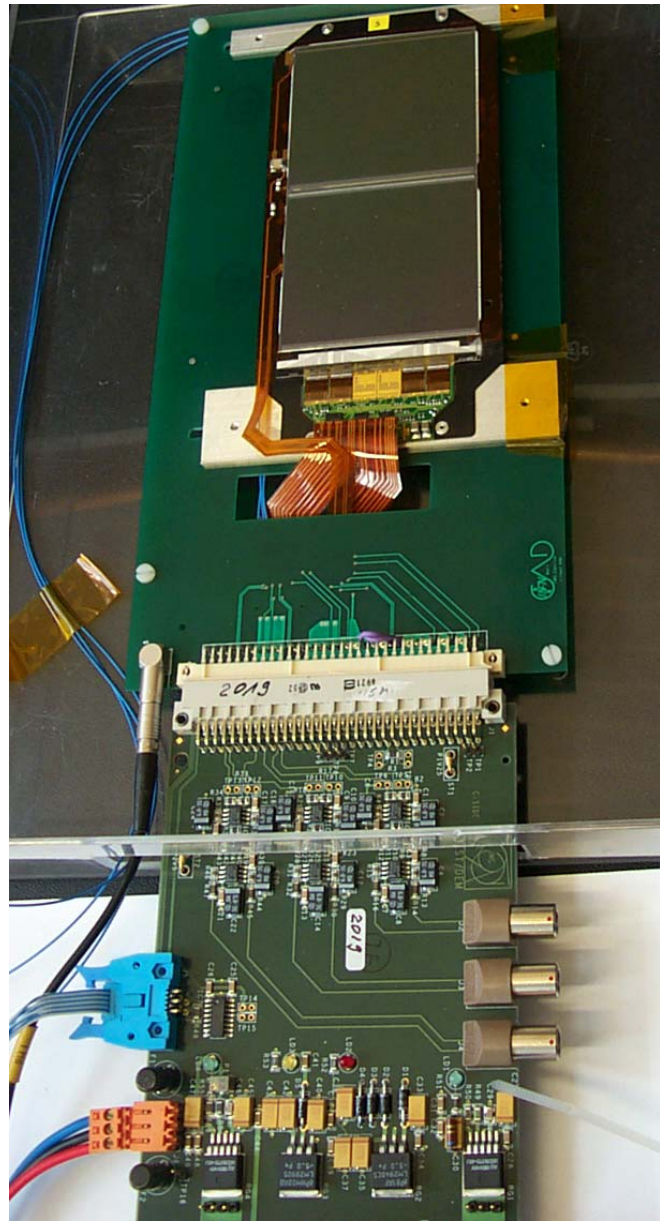
12 way optoreceiver

Input/Output temporary connections on the back of module carrier



Lab Environment & Equipment

- Laminar flow hood
- ESD safe station
- Standard laboratory LV power supplies
- Detector depleted at 200 V during measurements (Keithley p.s.)
- VUTRI CARD (CERN) gives 2.5 and 1.25 V for hybrids, input digital lines
- Adapter VME-Samtec (Bari)
- We built a 12 ch. buffer for optoreceiver output to FED (Firenze)

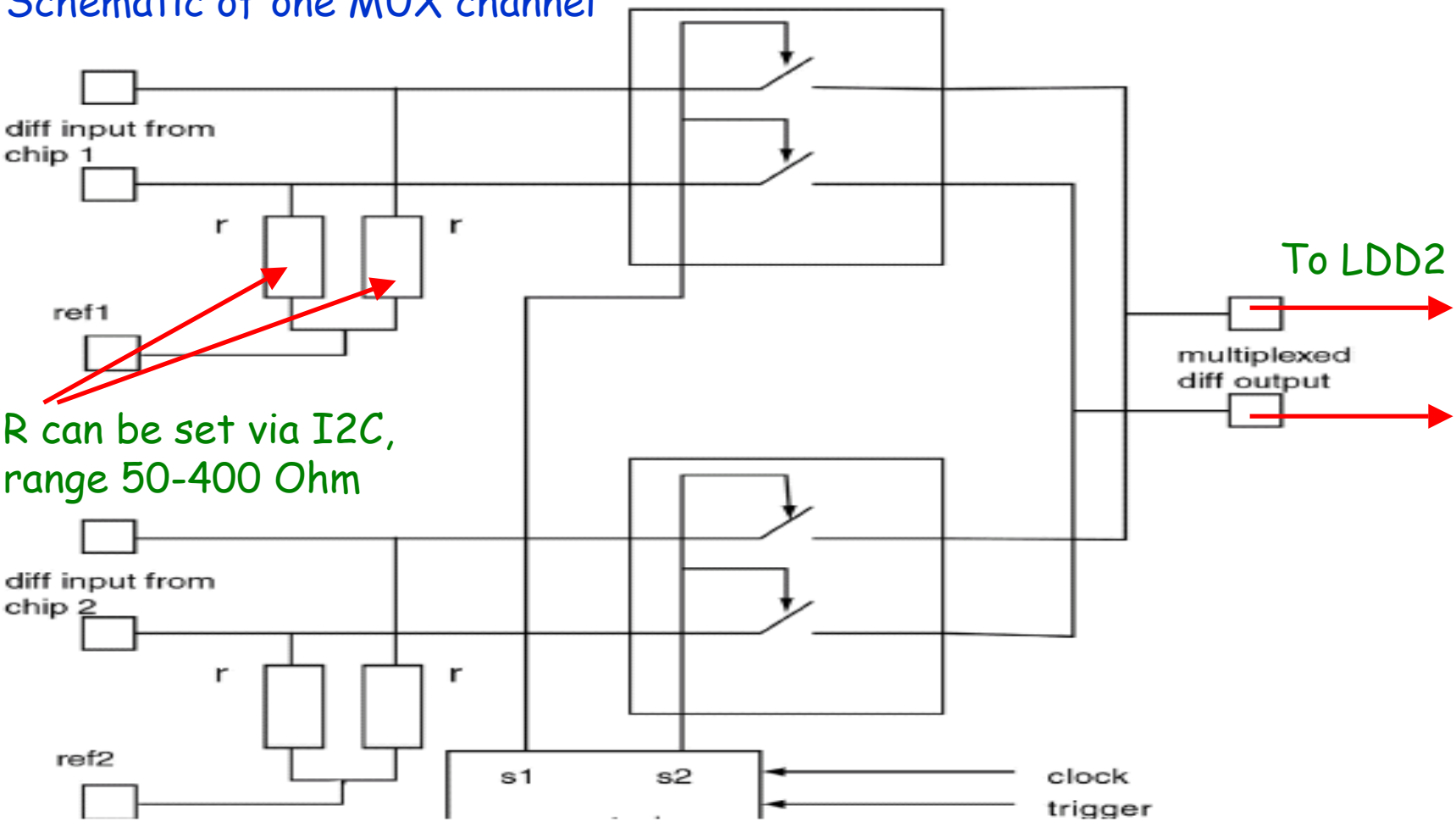


SW and Settings

- We have used the CMS setup SW (L. Mirabito) to control the system, only minor modifications to talk to Laser Driver v2 and for modified FEC handling
- We adopt the same SW for calibration and noise measurements, using the standard module test macros (by L. Demaria)
- M. Raymond's APV settings (as in user guide 2.2)

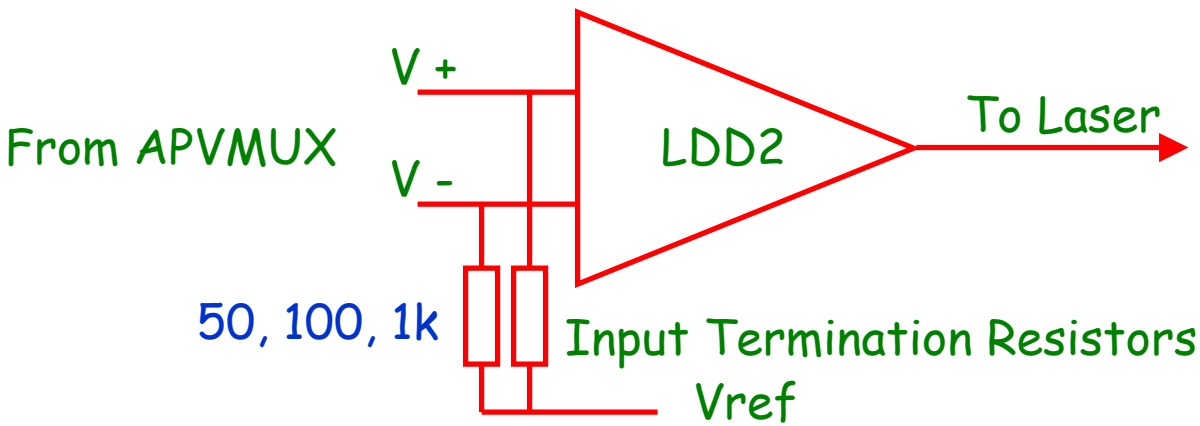
Analog Signal Termination on APVMUX

Schematic of one MUX channel



Termination on AOH

- We have been working with 2 analog OH with LDD2
- 1 was left unchanged with all channels terminated on 50 Ohm
- We modified the other OH and put resistors to have the first input channel on 100 Ohm and the third input on 1K Ohm termination

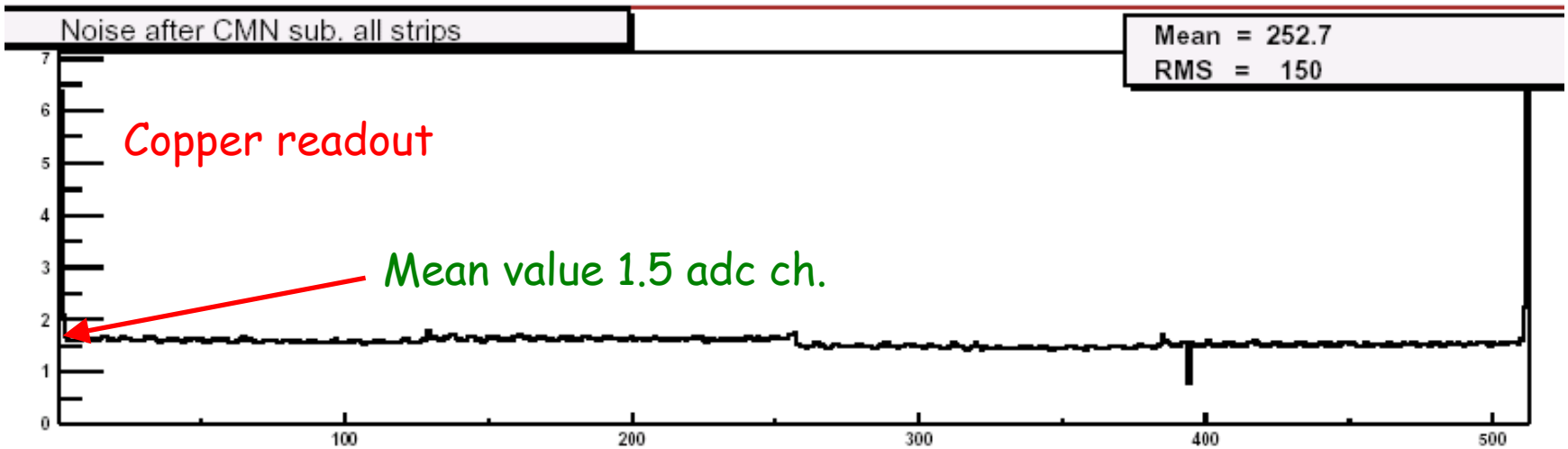


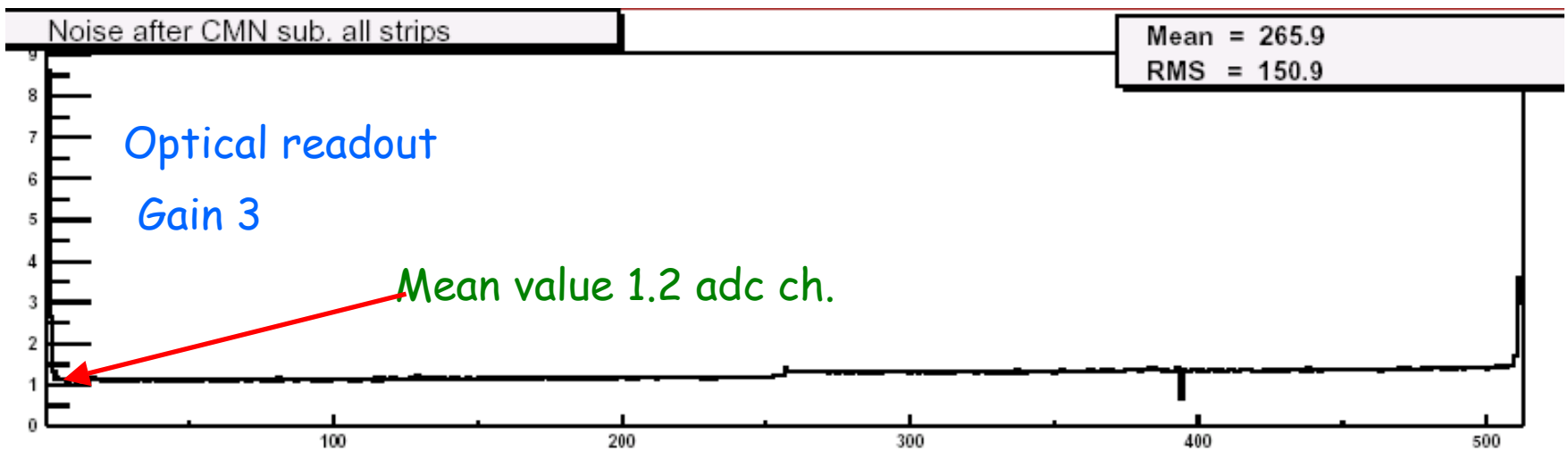
Noise(ADC counts) vs Strip number in Deconvolution

A first look....

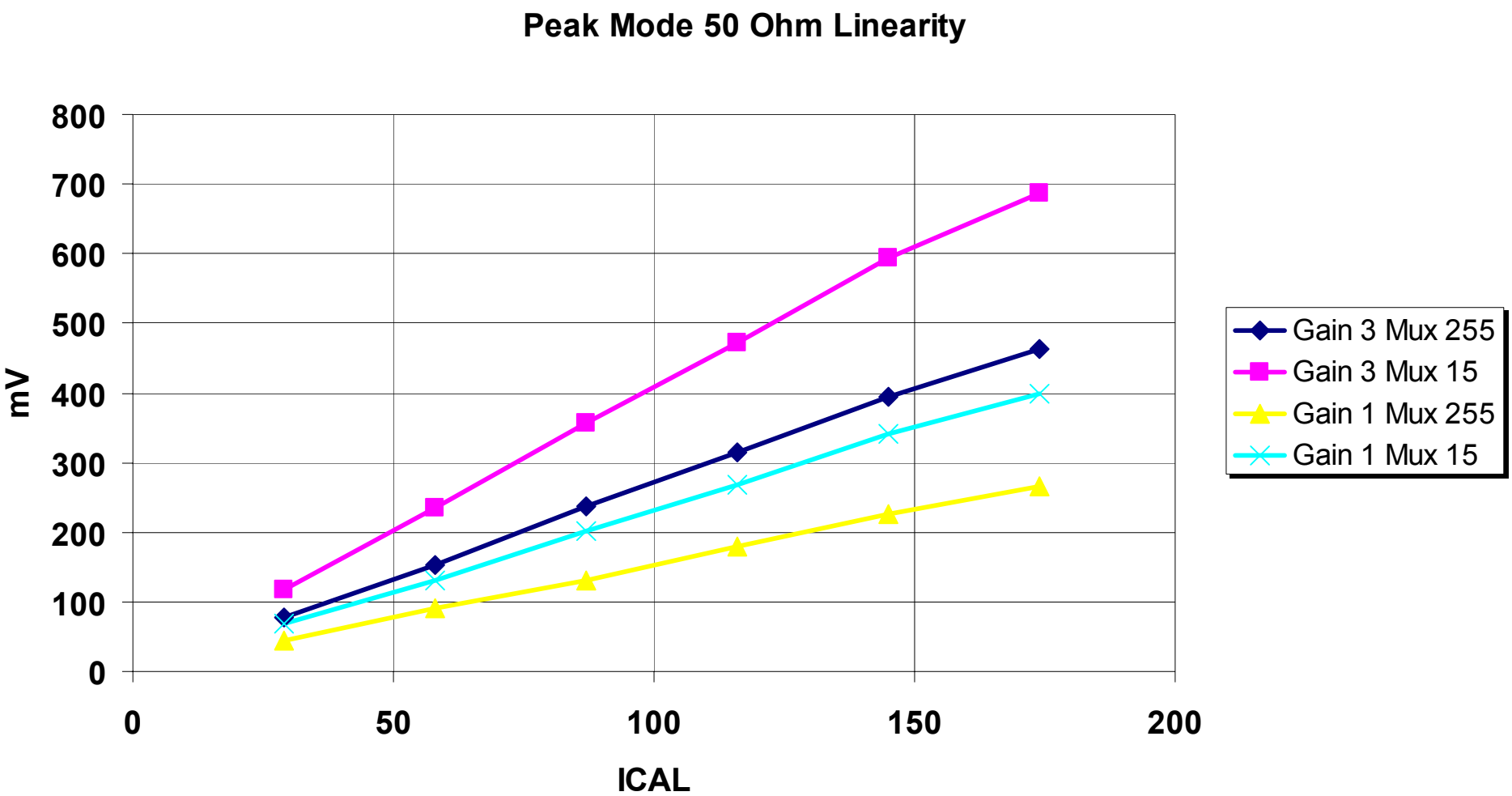
50 Ohm, MUX 255

Plots from standard ModTest macro





Optolink Results



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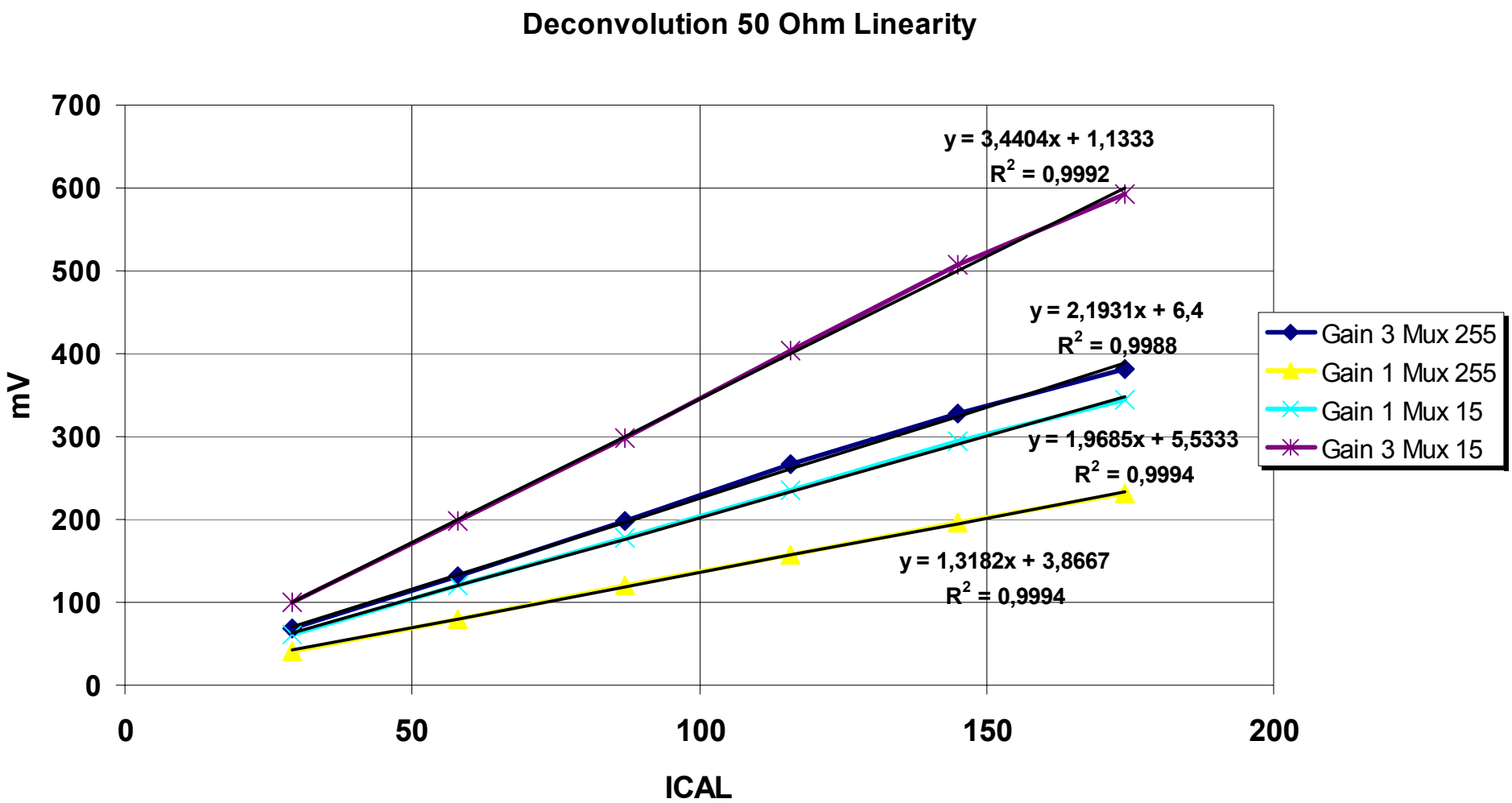

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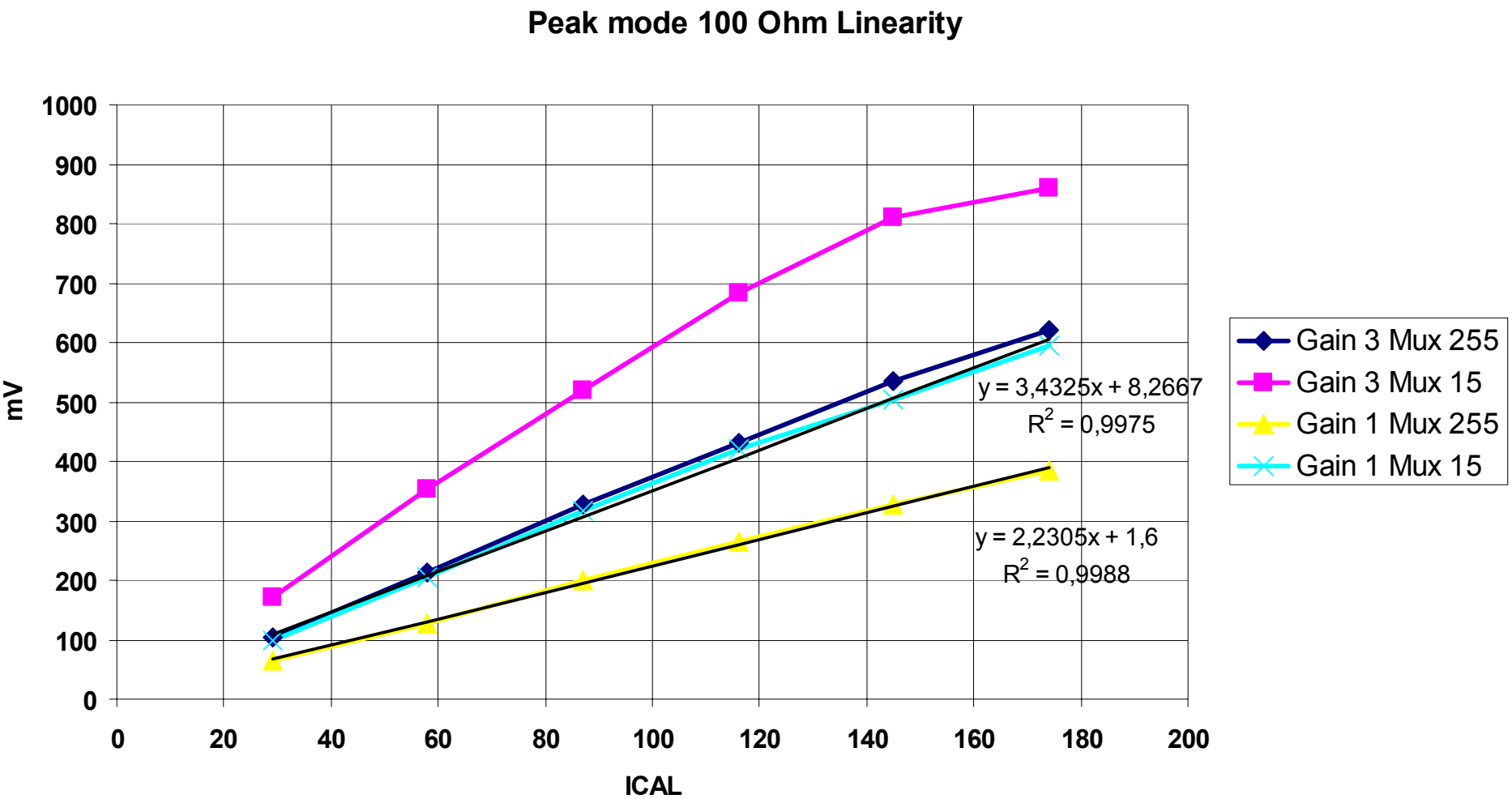

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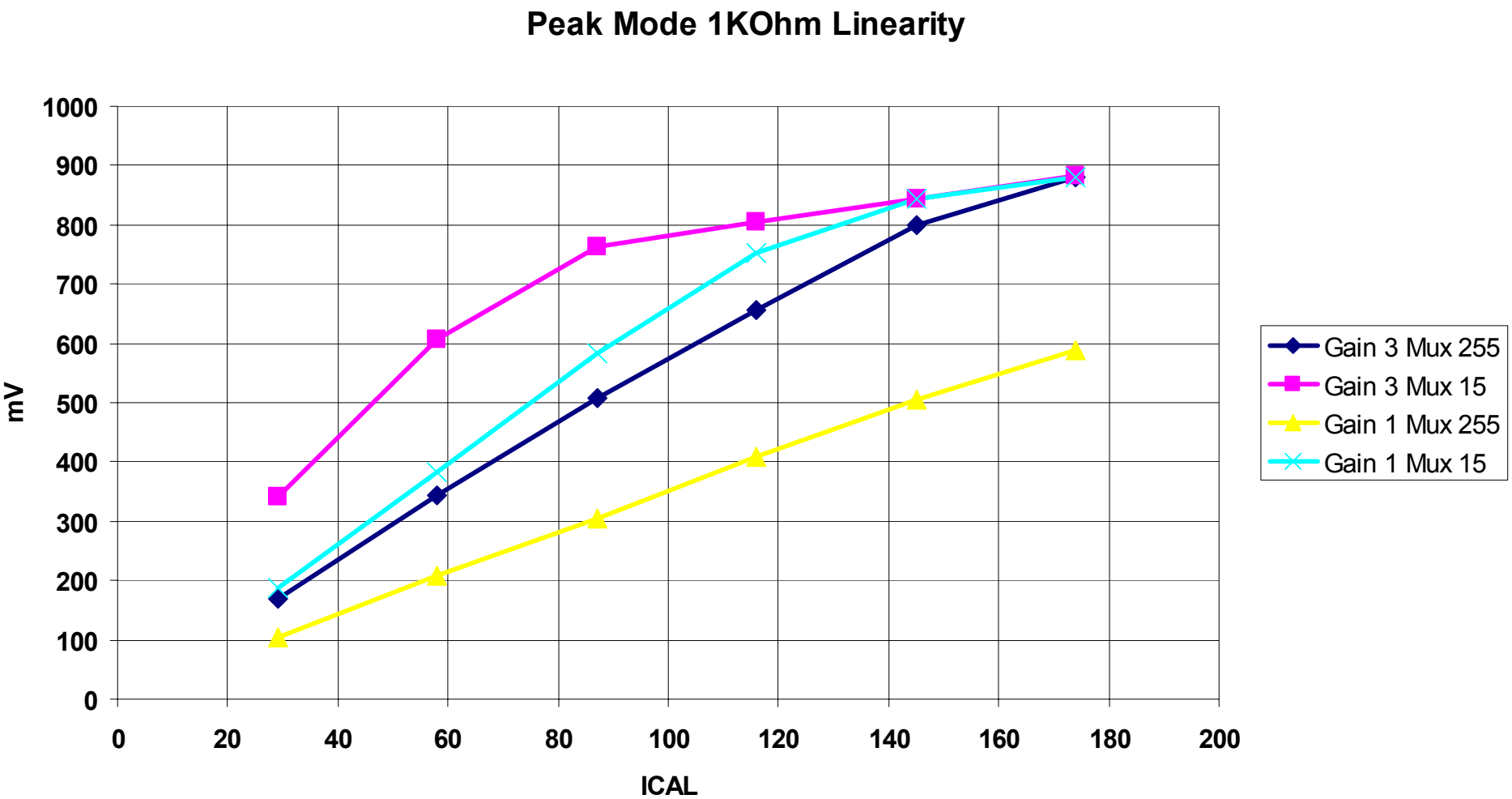
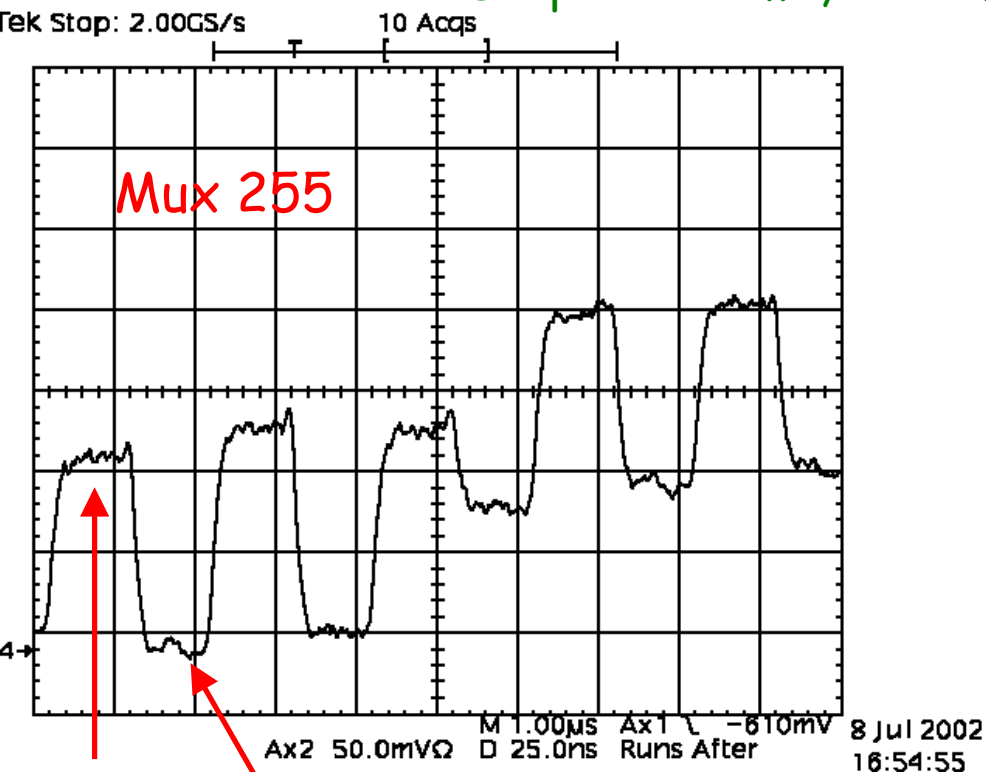


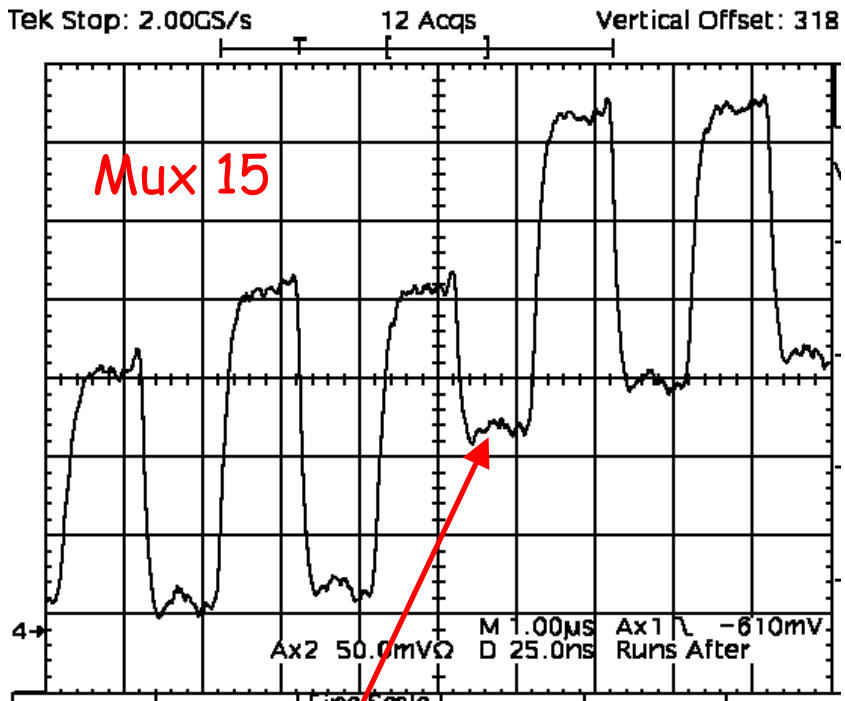
Looking at the Scope

Single ended output of the Optoreceiver

Optolink 100 Ohm, gain3, bias22

Scope at 50 mV, 25 ns /div, NO AVERAGE





APV 1 APV 2 Enhanced pedestal difference

First cal pulse

Considerations on Noise (1)

- The noise will scale according to gain and terminating resistors
- In addition to the previous measurements, we have taken calibration data runs (in peak and dec mode) to measure noise and APV internal calibration response with OH gain 1 and gain 3, changing MUX Resistor and OH resistor as seen before

Considerations on Noise (2)

- We obtain the following "limits" on noise:
- In peak mode
- MAX at gain 3, mux15, OH 1K => 3.80 ADC counts
- MIN at gain 1, mux255, OH 50 => 0.70 ADC counts
- In deconvolution mode
- MAX at gain 3, mux15, OH 1K => 4.92ADC counts
- MIN at gain 1, mux255, OH 50 => 0.86 ADC counts
- The MIN values are definitely below 1, so they probably suffer due to the intrinsic resolution of the FED (quantization error)

Considerations on Signal to Noise

- We analized our data to look for a "good" signal to noise, calculated using internal calibration at ICAL=80 (I define here equivalent Signal to Noise ESN the ratio S/N for ICAL 80).
- With this definition we have seen the effect of the worsening of S/N for low gains and/or low resistors
- It results that with 50 Ohm on the AOH the only acceptable performance is with MUX15 and gain 3, where we get ESN = 72, all others giving poor ESN
- The best performance is obtained with 100 Ohm on the AOH, MUX15 and gain 3, where ESN = 82

Conclusions

- We have collected a lot of data with a full optical readout chain and digital optolink for TIB system test
- Results give indication that the noise performance and the linearity are very good
- If we want to get the best out of our detector we should carefully choose terminating resistors on the AOH; 100 Ohm is quite good for TIB, wait for TOB and TEC tests
- If, after this presentation, you need more details, please ask me. I can flood you with plots and numbers.... Do you really ?

A trailer.....

Tomorrow morning on CMS screens !

The full optical readout chain with a Module powered at 2.5 and 1.25 V from 150 meters away !

Look at the Long Cable !