

News from Module Test

Marco Meschini

General Introduction

- Many interesting presentations during Module Test Meeting, cannot be reported in detail here, please see

<http://agenda.cern.ch/fullAgenda.php?ida=a04915#s3>

you can find there already now all talks (they will also be on

<http://hep.fi.infn.it/CMS/moduletest/wg.html> next week)

- Progress since last TK week:
 - Modules in cold LT problem solved
 - New LT sw release
 - ARC 7.1 release almost ready (next week ?)
 - New results from irradiated modules
- Studies on:
 - Microdischarges
 - Latency effects in Module tests
 - New SW tool: Defect analyzer

I set up a NEW mailing list for error reports from Module Test
It's linked from main Modtest Webpage, together with Wim's list

Please use those lists, both for sending messages about
errors you find and retrieving infos

The Error Report Mailing List

The LT SW Support Mailing List

Module Test Working Group

Last Update: [Marco Meschini](#) 4 Mar 2004

Links to Procedures, HOWTOs and Results

Link to Module Test Error Report Web Site

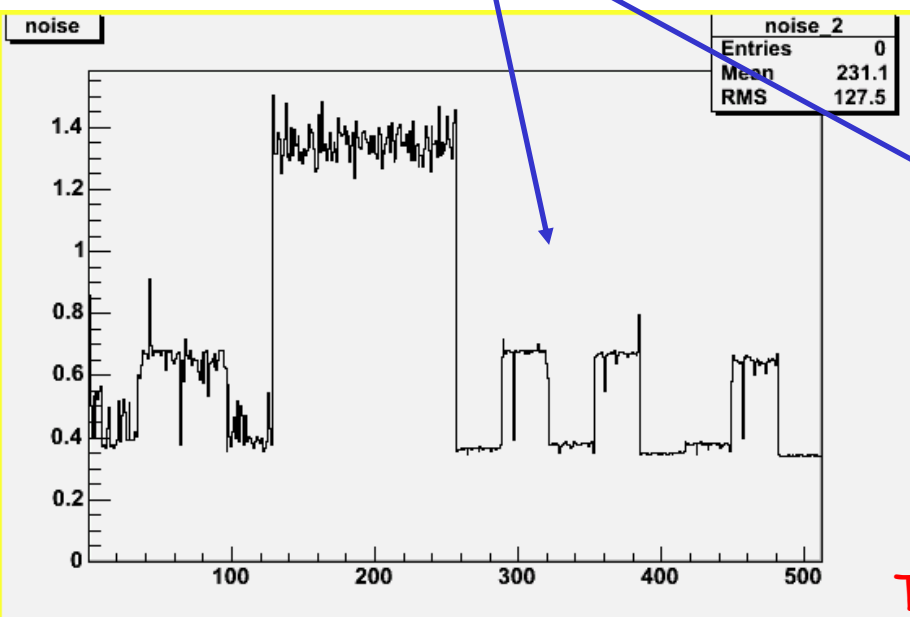
Link to Wim Beaumont Module Test Software Support Web Site

10 Feb 2004 Meeting presentations: [Agenda](#), [Introduction and Overview](#), [Pierre Van Hove](#), [Pierre Van Hove](#), [Wim Beaumont](#), [Thomas Keutgen](#), [Tony Affolder](#), [Paul Tipton](#), [Riccardo Ranieri](#), [Cristiano Marchettini](#), [Wim Beaumont](#), [Michael Poettgens](#), [Simone Paoletti](#), ([link to Talk at Mod. Constr. Meeting, M. Meschini](#))

OLDER STUFF
below

Introduction: The Problem

- As reported at last ModTest meeting modules were "lost" during LT in cold cycles and then flagged **BAD**
- Everything started observing a strange behaviour in APV noise, associated with error messages from FecServer - Modules excluded from DAQ



```
fec Exception: Mon Feb 16 17:42:20
2004
FecDevice::writei2cDevice(single
byte write extended (RAL) mode):
Register acces
FEC Functions error code: 205
Position: FEC 0x0 Ring 0x0 CCU 0x4
Channel 0x6 I2C address 0x3F
```

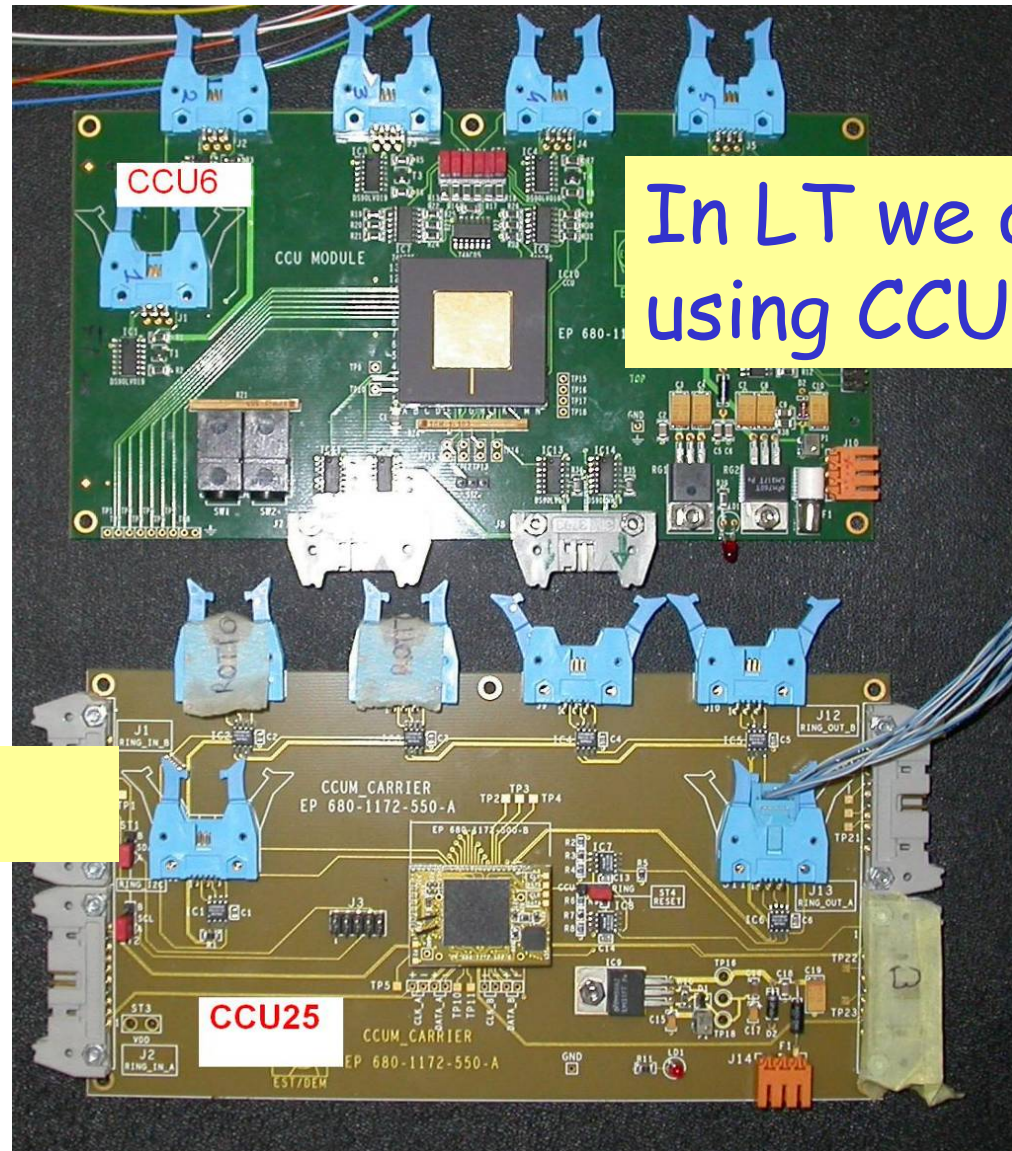
The same problem has been reported first in TIB centers, and then in TOB too

CCUs

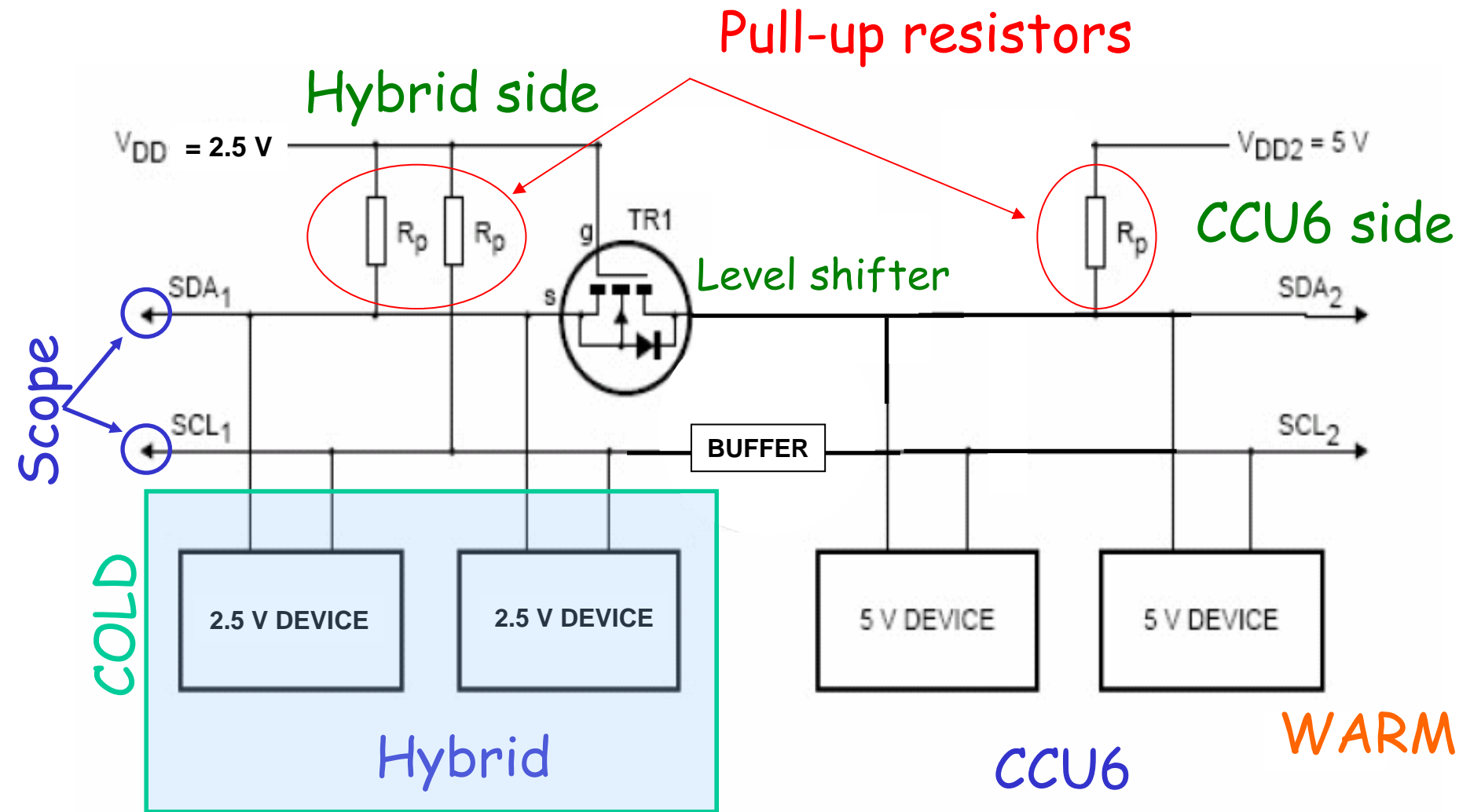
The origin of the faults was traced back to I2C communication between CCU6 and hybrid asics in cold

In LT we are all using CCU6

Not CCU25!!!

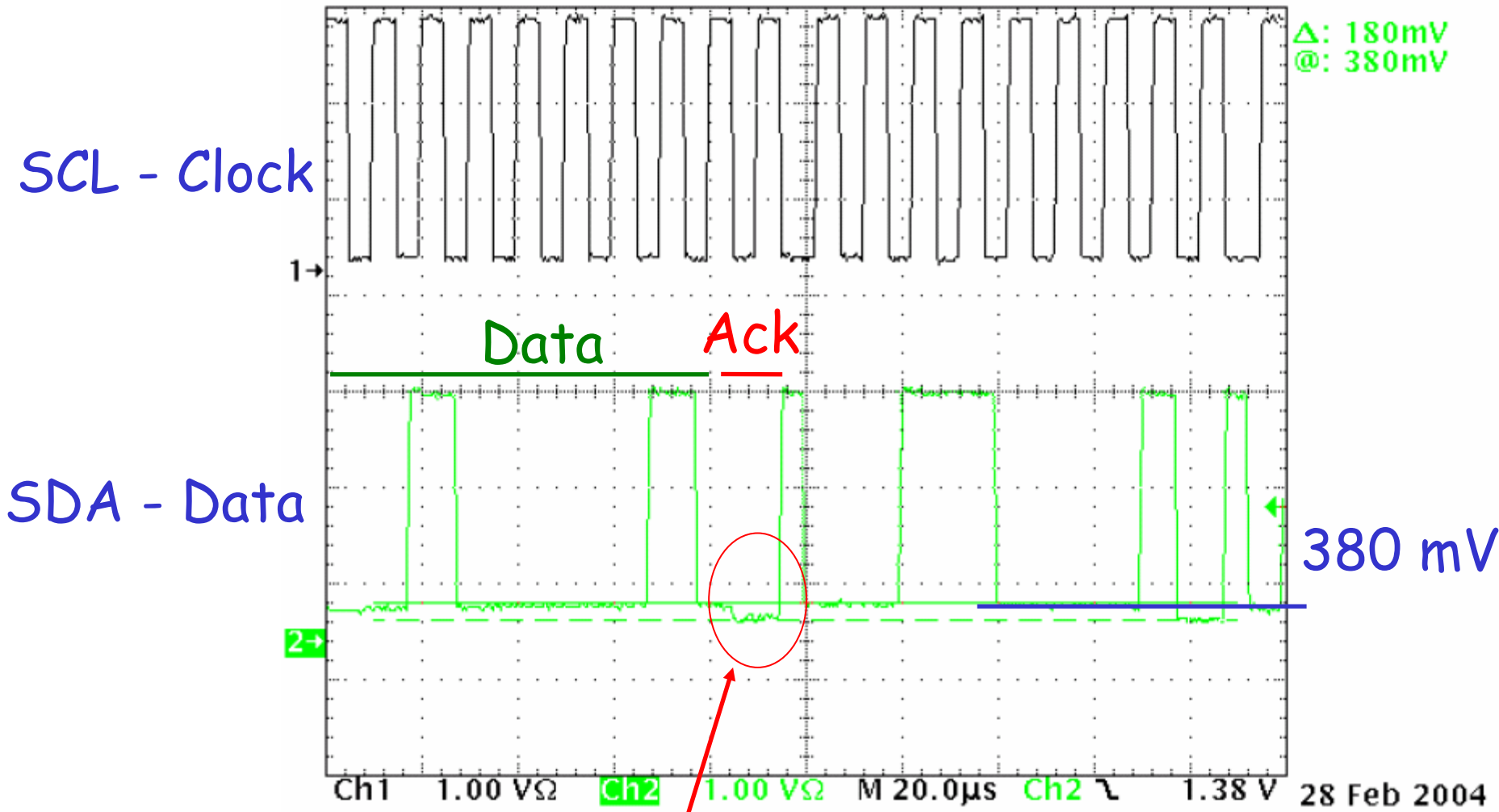


I²C Bus Configuration



From Philips I²C Bus Specification

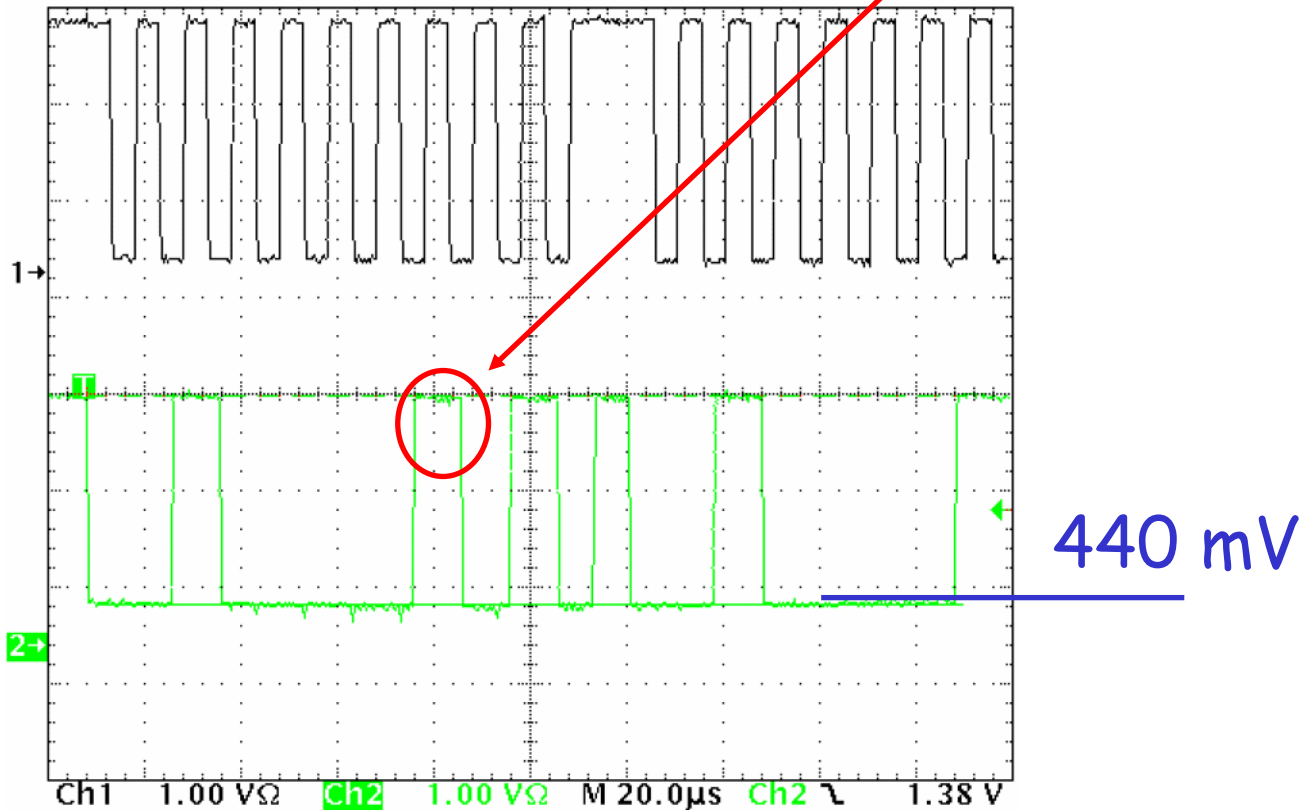
The Standard Situation



Acknowledge bit = 0 means that the APV is understanding the I²C communication

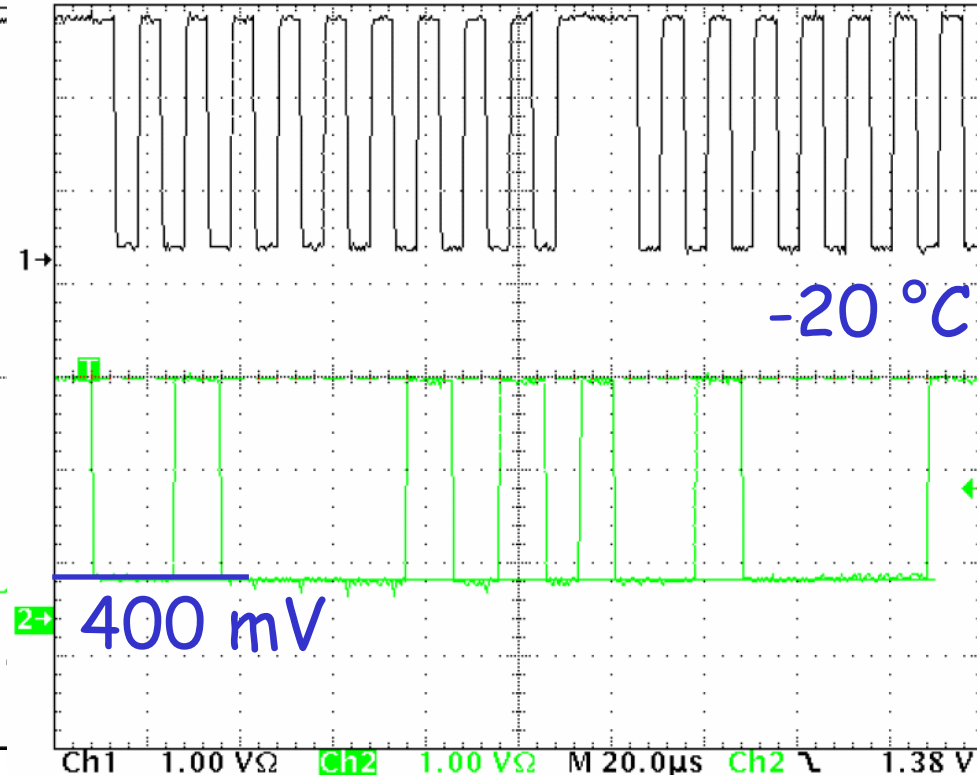
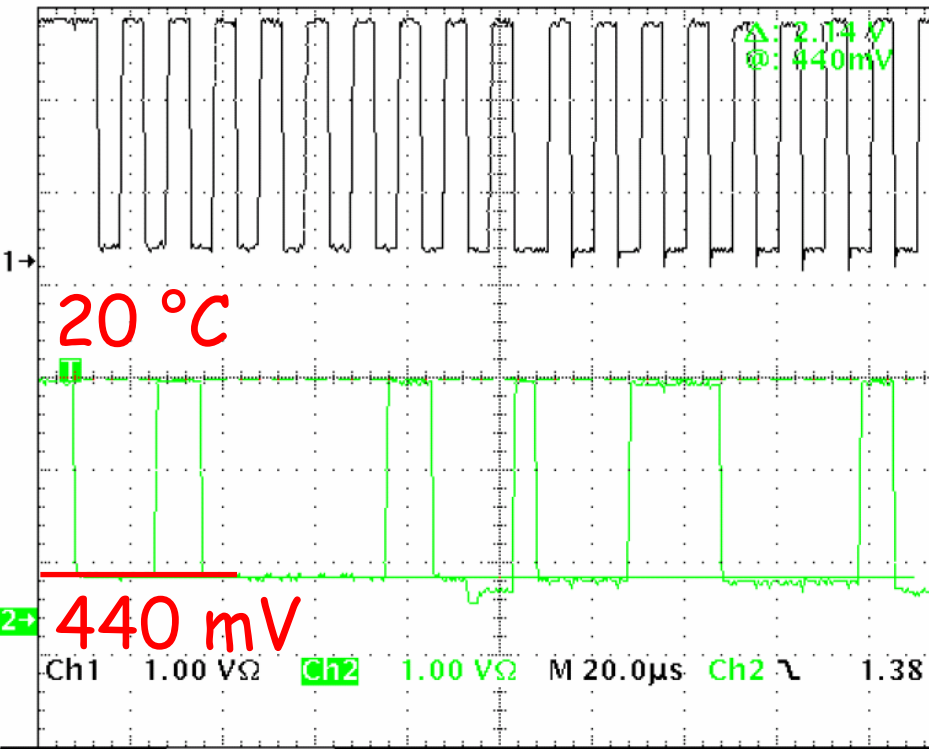
A Bad Situation

- In this case the acknowledge bit is HIGH
- The APV is not understanding the I²C signals and then it goes into an unpredictable state



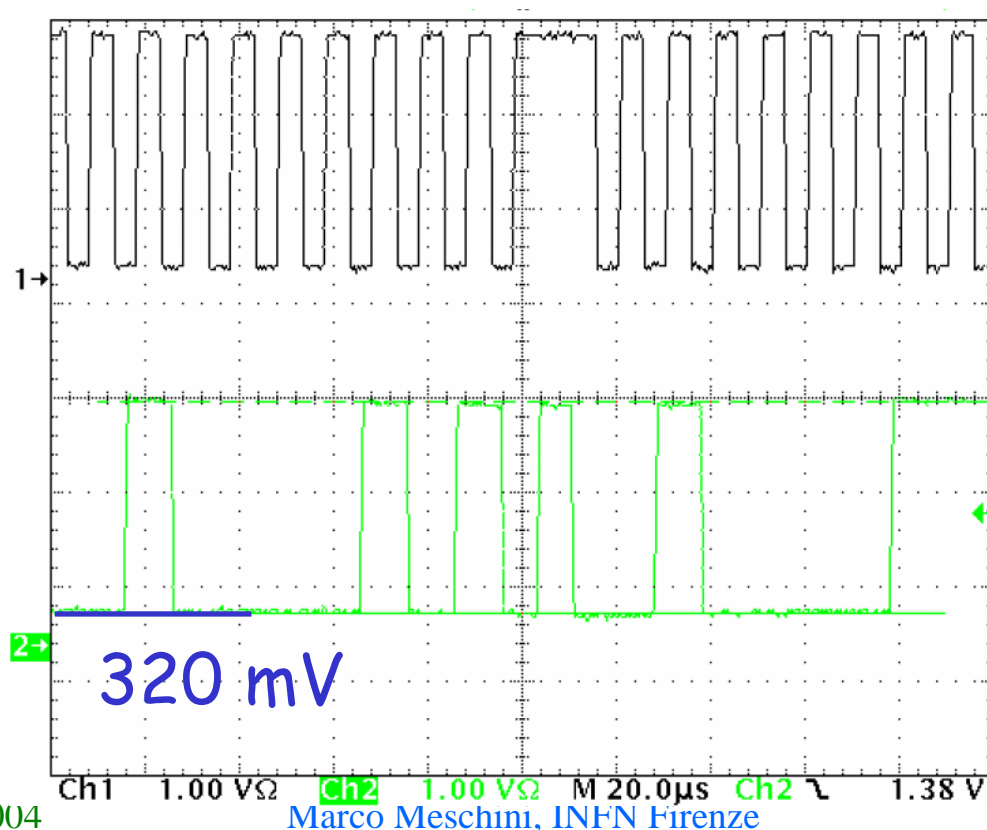
Warm and Cold

- Varying the working temperature, the APV doesn't recognize the same LOW level



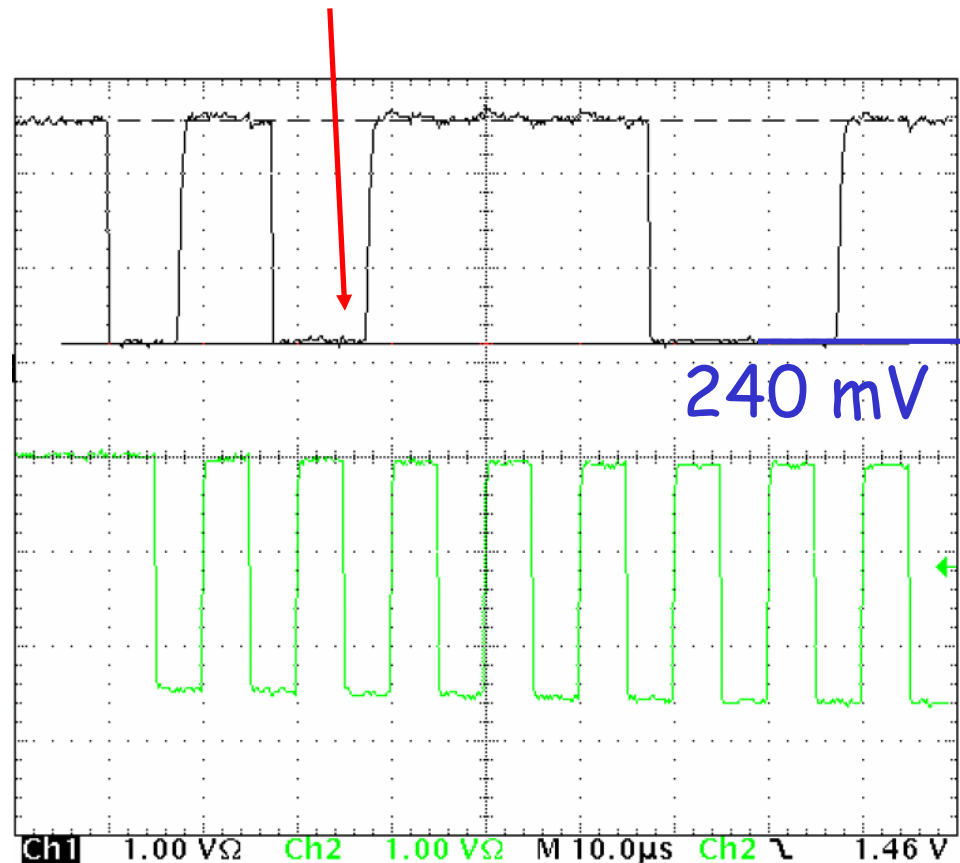
Problems in Cold

- One chip at low temperature doesn't work even pulling the LOW level down to 320 mV
- With 2200 Ω pull-up resistors even this chip is completely recovered



Conclusions on I2C

- Not all APVs behave in the same way: different sensitivity to LOW thresholds leads to loss of communication → **WE WERE RIGHT!**
- To avoid this problem we chose to increase the pull-up resistors on the data line of the CCU6 from 1500 Ω to 2200 Ω . All R1 through R12 on the CCU6 boards have to be replaced
- With this modification no I²C errors appear, both on new tested modules and on previously failing modules which are then recovered
- The line speed of the I²C bus in our case is 100 kHz. Is it safe going to higher speed?

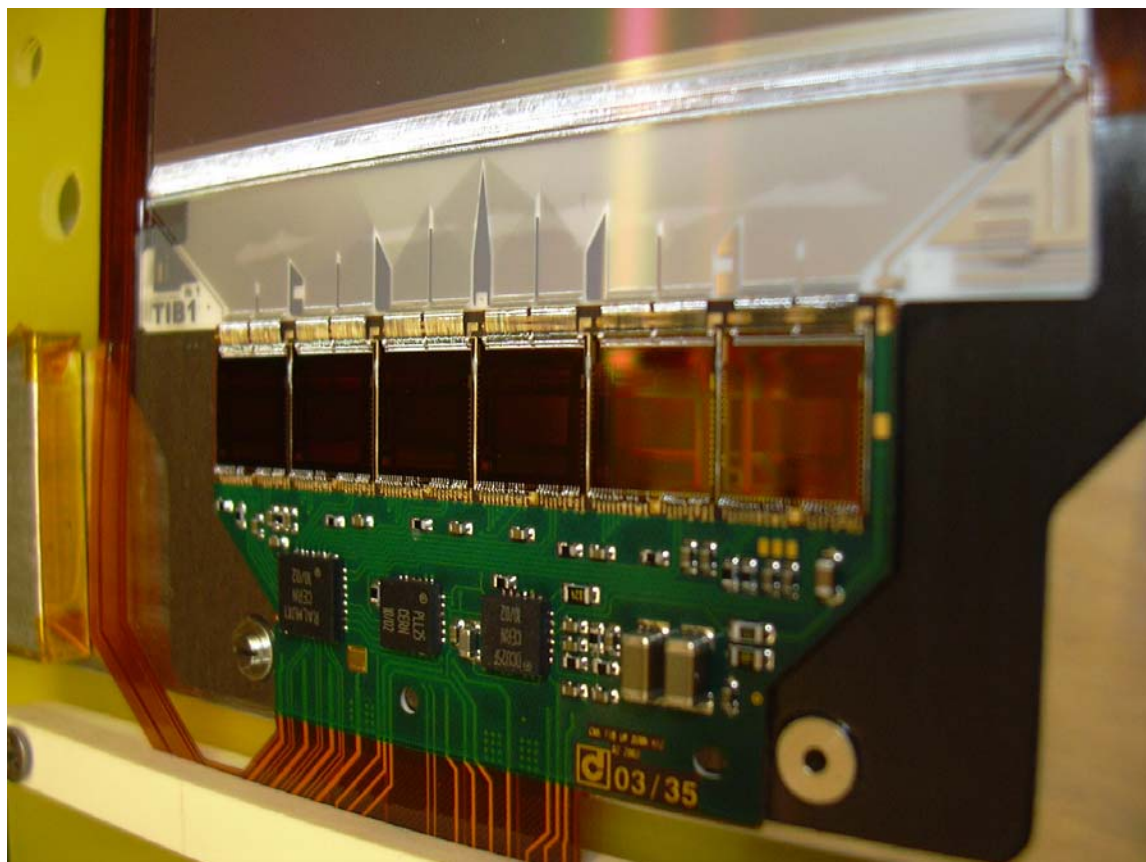


Important Remarks on I2C Problem

- The fix we found for LT applies only to CCU6
- It has only little "common points" with the I2C problems seen in TOB and TEC system tests, like timing problems on SCLK lines, series resistors etc.
- The info about the fix has been immediately sent by email to all L3 module test responsible persons (on Friday Feb 27th) and sent to the error reports mailing list

The First TIB1 ib1 Modules

- TIB1 modules
 - layer 1
 - 6" single sensor
 - $61 \times 117 \text{mm}^2$
 - 6 APVs
 - $6 \times 128 = 768$ channels
 - $80 \mu\text{m}$ strip pitch
 - ib1 Pitch Adapter
 - TIB.1.1 (rφ)



TIB1 modules bonded (up to 11th March): 9.

5 in Bari, 4 in Firenze

All modules are OK and ready for Long Term

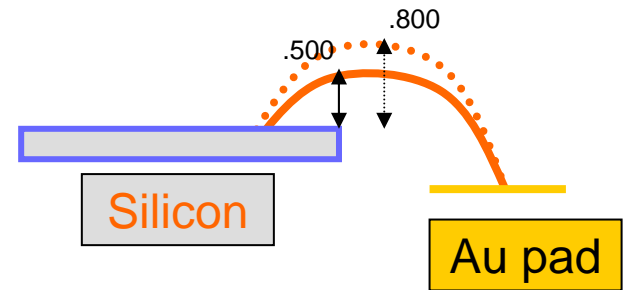
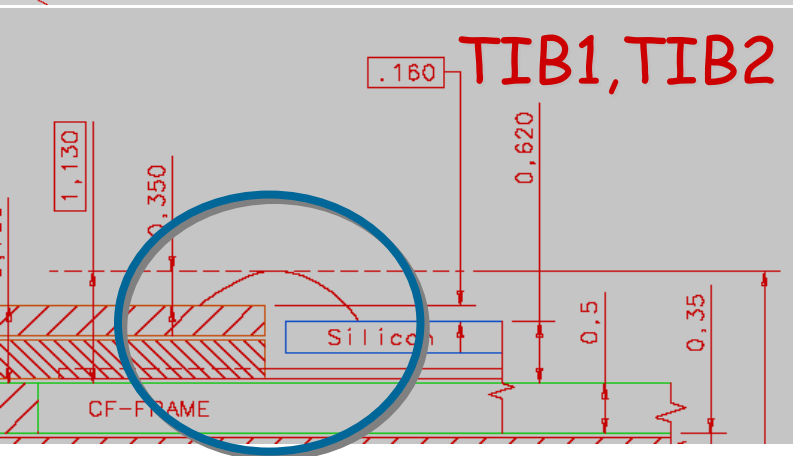
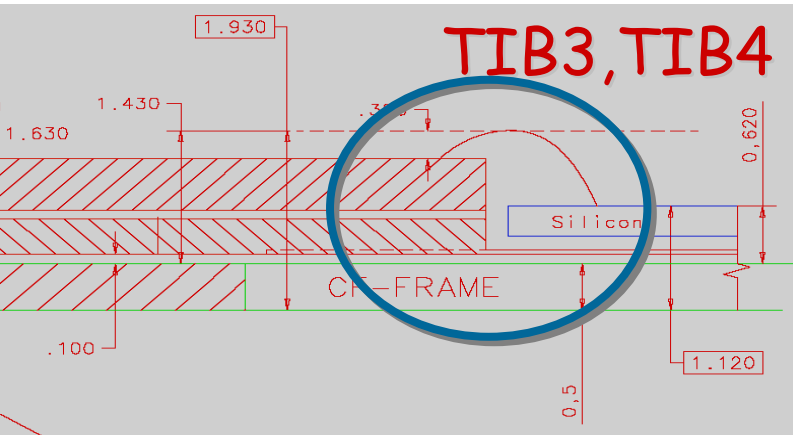
1 module has a pinhole

R. Ranieri

Bonding

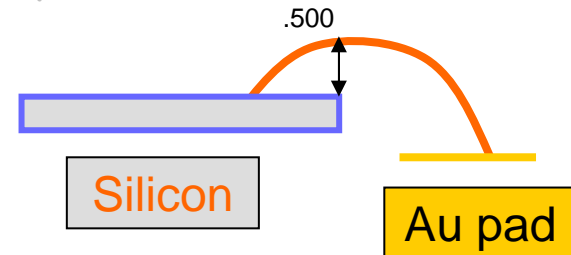
R. Ranieri

- Different bonding procedures for Layer 1 modules
 - strong constraints from mechanics
 - in Florence new automated program for Delvotec 6400 by Mirko Brianzi ready



bonding Bias Ring -
Filter Capacitor

Pictures courtesy of
S. Costa



Root Macros to Analyze Data

- Same cuts as TIB3 (4 APVs, 512 strips) can be applied
- These cuts can be applied also to other types 1 sensor modules (TEC)
- Some minor changes/bugfixes of ARC and LT root macros, correction of some bugs related to the presence of 6 chips instead of 4
 - where to download new version of the macros (thanks to Cristiano and Riccardo for very frequent webpage updates):
 - <http://hep.fi.infn.it/CMS/marchett>

R. Ranieri



Software packages

- “Classic” long term module test software
current version lt_1_24
- Structure Long term test software including long term module test. Current
test version ls_0_07
- Defect analyzer package (see talk L. Neukemans)

For detailed information, installation instructions see

<http://www.hep.ua.ac.be/cms/testing>

W. Beaumont



Long term module test version lt_1_24

- Is a “patch” of the version lt_1_22. During the diagnosing process for the I2C errors some useful and “less strict” checking were introduced. This is introduced in the version lt_1_24:
 - More information in log file, with time stamp (All warnings and error message that where before only seen on the terminal).
 - error counts for I2C errors and DAQ errors in root file
 - More actions during data acquisition loop recovery like : set the mux position again. APV reset (101)
 - After an I2C also the other I2C devices are set again.
 - Some errors in the data base result file filling are corrected.

LtStruct software status

- Two (binary identically) programs
 - mainMonitor for long term module test
 - structMonitor for long term sub structure test
- mainMonitor should works same as the current version of the mainMonitor beside some improvements. At the moment beta test in Firenze (soon Paduva)
- structMonitor under test in Karlsruhe and UCSB
- To be done
 - automatic tuning (laser , timing)
 - Integration of the DefAna package (both)
 - Final structure for root , data base (StructMonitor)
 - Multi FED + MUX (6 double sided rods)

Status of ARCS 7.1

Michael Poettgens

Changes in ARCS 7.1:

1. Environment Settings are filled also when Fast Test is done first
2. All APV Modes are used to flag bad channel
3. Backplane Pulse Test implemented
 - See Talk last Tracker Week
4. Pipeline Gain Test
 - See Talk last Tracker Week
5. Changes in testsettings.xml
6. Changes in DB Parser

Changes in testsettings.xml

Michael Poettgens

Added <TestObjectProperties>

Extract:

```
<TestObjectProperties name="IB_1"
NumberOfAPVs="6"      NumberOfSensors="1"
channelOrder="normal" Type="Module" />
<TestObjectProperties name="OB_2"
NumberOfAPVs="4"      NumberOfSensors="2"
channelOrder="normal" Type="Module" />
<TestObjectProperties name="W1_TEC"
NumberOfAPVs="6"      NumberOfSensors="1"
channelOrder="reverse" Type="Module" />
<TestObjectProperties name="W2_TEC"
NumberOfAPVs="6"      NumberOfSensors="1"
channelOrder="reverse" Type="Module" />
<TestObjectProperties name="W7_TEC"
NumberOfAPVs="4"      NumberOfSensors="2"
channelOrder="normal" Type="Module" />
<TestObjectProperties name="W1_TID"
NumberOfAPVs="6"      NumberOfSensors="1"
channelOrder="reverse" Type="Module" />
```

- The Tag indicates Properties of the Test Object
- Very useful for Fast Test
 - Number of Sensors for DCU Test
 - Number of I2C Devices
- Allows to adjust Output of bad Channel
 - Great help for Bonding Technicians
 - No Changes for Root File

Changes in DB Parser

Michael Poettgens

Almost all Tags are filled in XML File:

Channel Flagging:

<chflag> filled correctly with #channel #flag

Ileak in nA

Ipinhole in nA

.....

Still not filled:

Status Flags:

to fill these correctly some
tests still have to be implemented

New Version will be released this week if download to
DB works ok!

Summary:

TEC Ring 6 Module was tested at room Temperature and at low Temperature

- No mechanical Damage found on leaky Strip
 - Same observation was made by US
- TEC Ring 6 Module shows strong Dependency between Leakage Current and Time at Room Temperature
 - Consistent with reports last Tracker Week from Italian Group
 - Microdischarge Effect is not stable at Room Temperature
- In CMS Environment
 - Increase of Leakage Current @-25°C
 - Never switch off the Tracker
 - Slow decrease of Leakage Current @-10°C
 - Module may recover after some time
- Microdischarge Effect is strongly correlated with increase in Leakage Current – 2nd kink
 - Reported from US Group last Tracker Week
- Operation of Module under CMS environment may be stable at -10°C but not at -25°C

Conclusions:

- The only conclusion is that we have to be careful when doing tests
 - The unstable behaviour of a module on longer timescales can cause faults to be easily undetected
 - Longterm Scenarios with a duration of a few weeks are worth to be done
 - Tests done at conditions of the CMS Tracker environment are very important to assure that modules can be used in detector
 - More Tests have to be done to understand Microdischarge Effect and it's implications
 - Influence of Humidity
 - Effects on APV



Results



- **All modules with DAQ errors passed retest with bug fix in place**
- **All modules with I2C errors passed retested with CCU hardware fix in place**
- **One module with real problem in the cold**
 - **One module still losses bias in cold**
- **Visual comparison of Lt histograms to ARCS bad channel list shows good agreement**

Steps in Pulse Shape

- Typical signature

- Often reported:

– ARC

– LT

- Effect similar (?) but less evident (*Double peaks*)

...our investigations
focused on ARC



Dead Pipeline Column (2)

Campagnari - Oct2003

- Other symptoms of dead pipeline columns

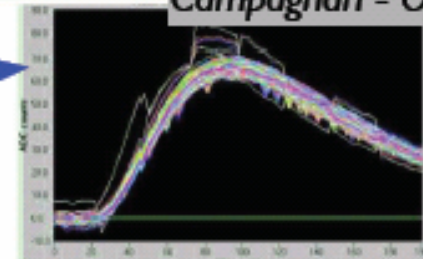
- Pulse Shape Test

• No calibration injection 0.5% of events

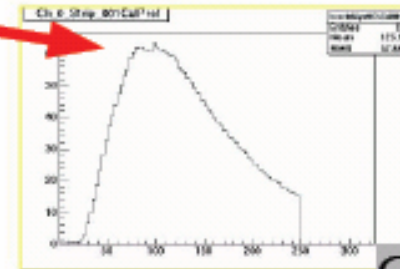
- Causes dips in pulse shapes

- Pinhole Test

- 1 in 192 chance of having no calibration injection, causing



Rise Time Calculation



Gartung - Dec2003

- **Center of max bin (v1.20)**

- Max bin not always at peak

- **Interpolation of max bin nearest neighbors (v1.21)**

- **Gaussian fit to max bin and 10 nearest neighbors**

- **ARCS like fit**

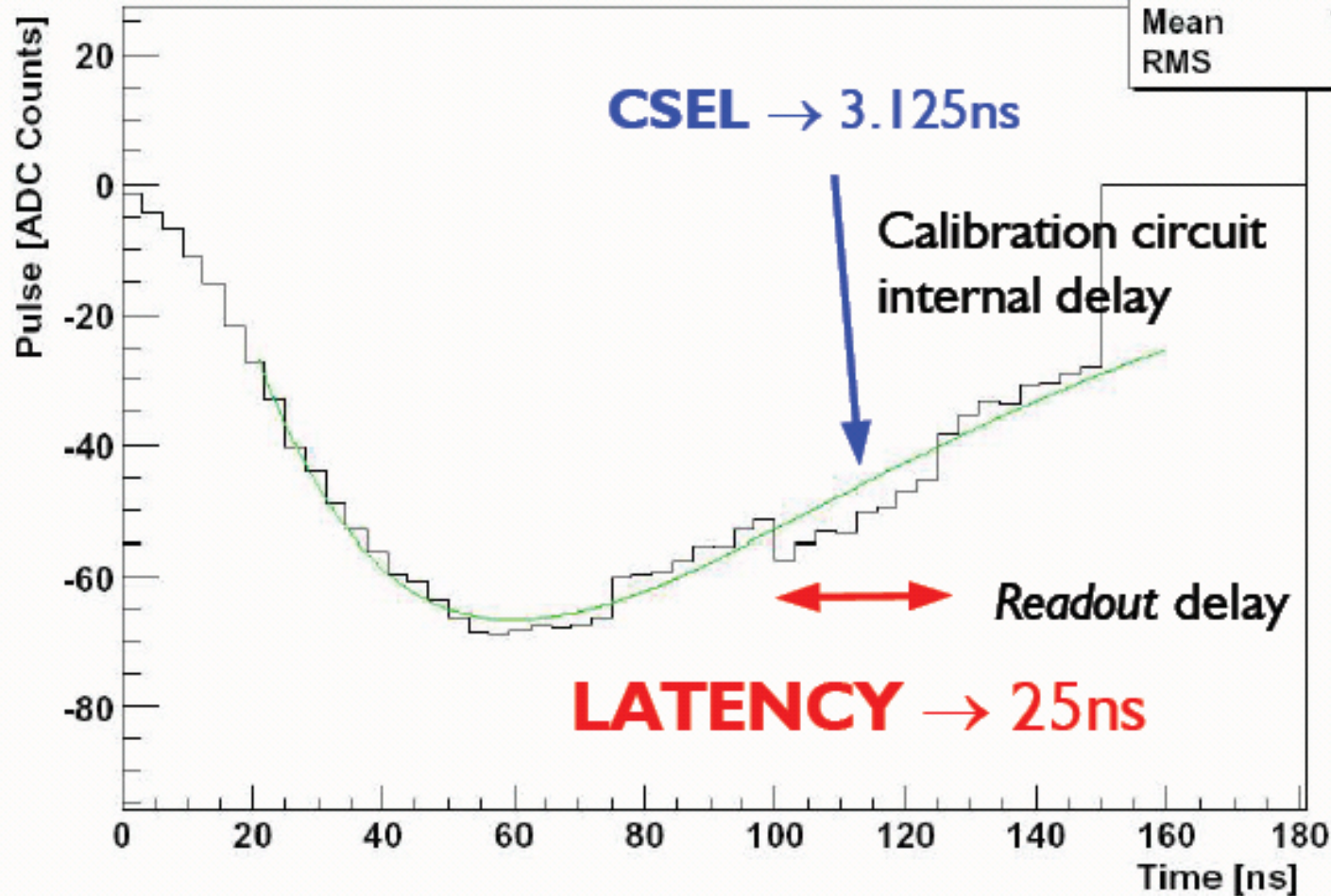
- Deconvolution mode : gaussian

- Peak mode : $c \cdot X \cdot \exp(1-X)$ where $X = (t - \text{offset}) / \tau$

- Peak time = offset + tau

Pulshape scan

Calibration Pulse vs. Time



PulseShape_0x40_0	
Entries	160
Mean	78.35
RMS	35.3

Steps
latency
related (?)

Conclusions

- Lessons learned
 - Latency scan: **unexpected** (and not understood) **latency dependence in ARCS measurements**
 - Critical latencies ($\sim 15-20$) \Rightarrow more noise and pedestal shifts on APV edge channels
 - no useful hints from Latency vs. TRG-RES scan
- Open issues
 - (partial) explanation of bigger noise on APVs edge channels?
 - LT system? **Effect present also in LT plots, but latency is very different (100)!**
- Remarks
 - CMS uses much higher latencies...
 - ...tests may use them as well (but would be nice to understand)



Summary

- 2 outer barrel modules (to outer barrel fluence) and hybrid (to inner barrel fluence) irradiated with protons (in Karlsruhe)
- 1 outer barrel module irradiated with neutron (in Louvain-la-neuve)
- hybrid with globtob fixation for bonds will be irradiated this week
- further annealing steps on the modules will be done

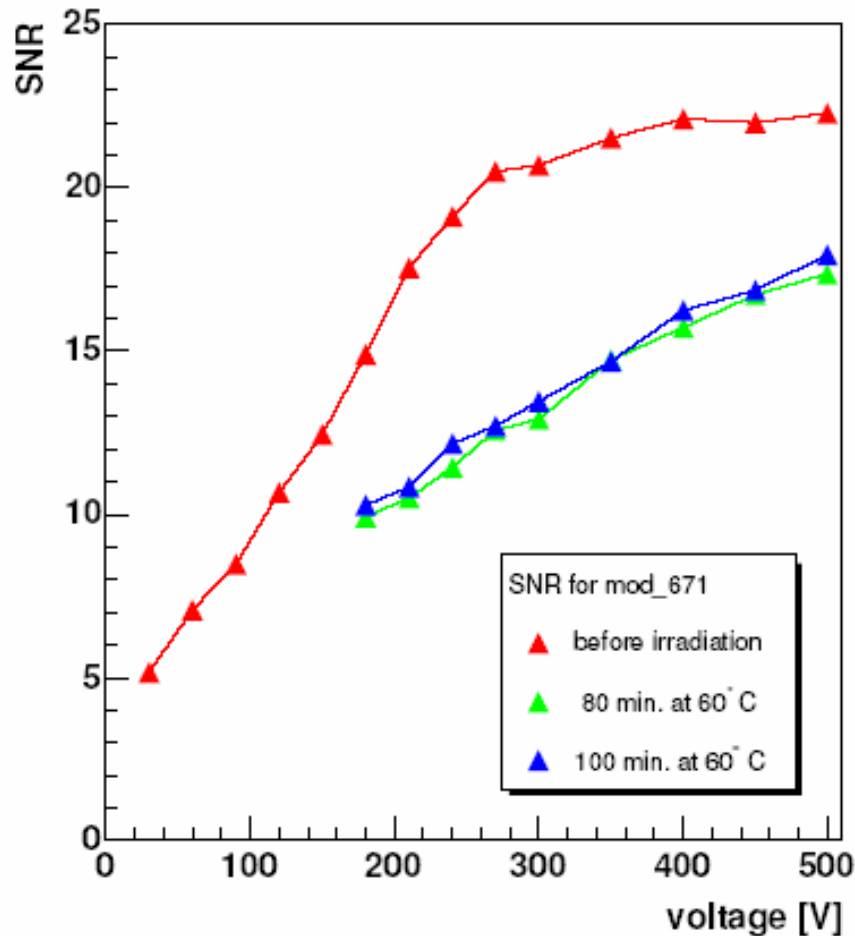
Karlsruhe Irradiation



IEKP Universität Karlsruhe



SNR vs. Voltage in Dec. Mode



Module 671

- SNR before irradiation ≈ 22 for voltages > 250 V
- SNR after irradiation > 15 for voltages > 400 V
- no saturation in SNR seen up to 500 V for irradiated module