



ALLEGRO meeting

# PCB measurements with grouding sheet on top

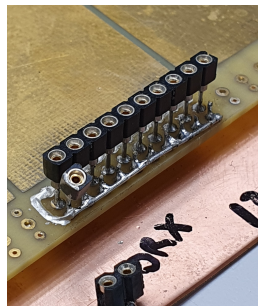
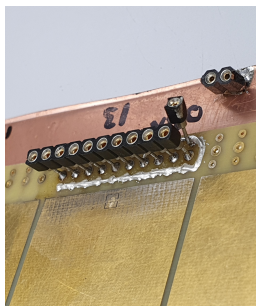
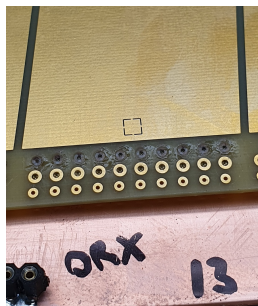
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CERN

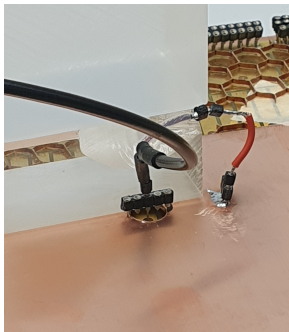
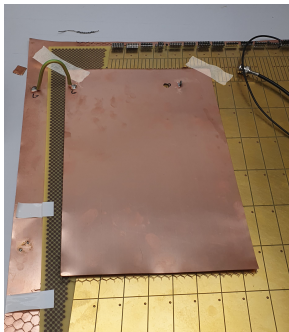
January 25, 2024

# Tower 13 grounding connectors fixed



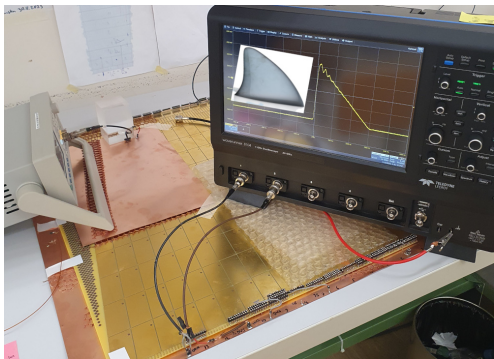
- ▶ Row of grounding pads broke off due to bad user error
- ▶ Now fixed at the CERN PCB lab with silver ink
  - Also all ground shields connected
- ▶ Tower 13 with long signal traces ready for measurements
  - Helps understanding phenomena with long signal traces traversing under many cells (e.g. persistent oscillations)

# New lab setup



- ▶ New setup with a copper sheet also on top of the PCB
- ▶ Copper sheets below and above the PCB with  $\sim 2$  mm spacers represent absorbers, top sheet gives a good near grounding for the injection probe
- ▶ Injection through a hole cut to top sheet
- ▶ Cu sheets, voltage source & scope in same potential

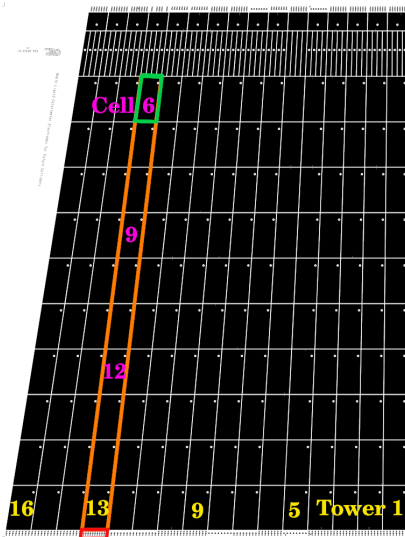
# New lab setup



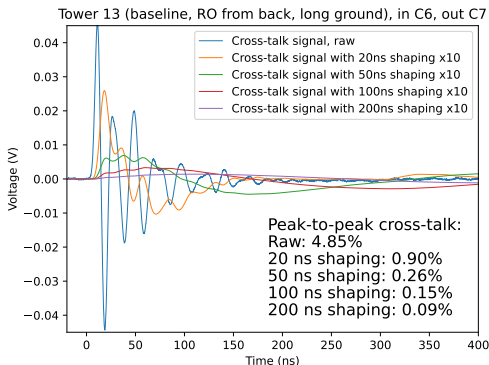
- ▶ Otherwise setup as before
  - 300 ns wide 1 V shark fin pulses at 5 ms intervals
  - Injection straight to signal pickup pad
  - Cables as short as possible
  - Also injection trace terminated to scope
  - Scope signal averaged over 10 triggers (is this OK?)

# Reminder: cell numbering convention

- ▶ Cells numbered 1 to 15 starting from inner edge
  - Narrow strips are cells 2 to 5
- ▶ Today we study unique tower 13: baseline shielding with cells 6-15 read out from outer edge
  - Long signal trace, traversing under many cells
  - Unfortunately no outer edge readout of strips in this proto
- ▶ For next PCB proto plan is to have readout from outer edge only

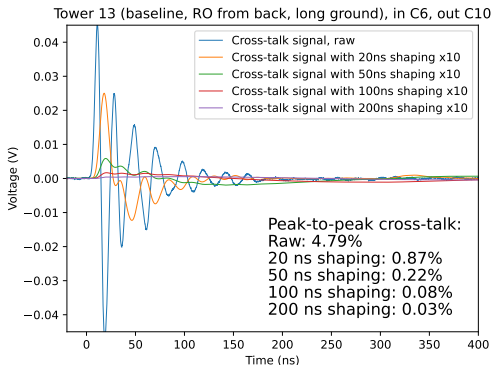


# Reference case: T13 with old-style long grounding



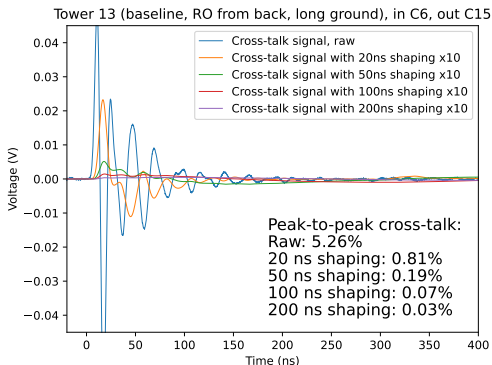
- ▶ Using **old style setup with long grounding cable**
- ▶ Inject to cell 6, read out from cell 7
- ▶ Strong but fairly symmetric oscillation
- ▶ X-talk from 0.9% to 0.1%

# Reference case: T13 with old-style long grounding



- ▶ Using old style setup with long grounding cable
- ▶ Inject to cell 6, read out from **cell 10**
- ▶ Strong but symmetric oscillation
- ▶ X-talk from 0.9% **down to 0.03%** - lower than ever!
  - Symmetric oscillation flattened out by shaping

# Reference case: T13 with old-style long grounding



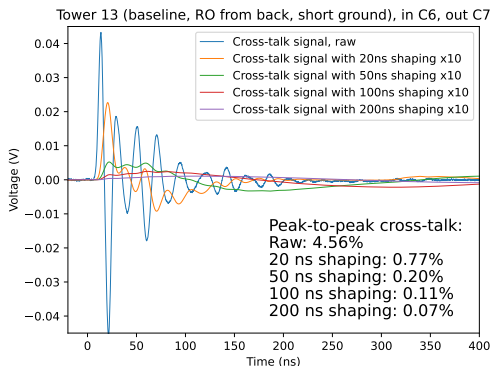
- ▶ Using old style setup with long grounding cable
- ▶ Inject to cell 6, read out from **cell 15**
- ▶ Strong but symmetric oscillation
- ▶ X-talk from 0.8% to 0.03%



# The new case: grounding/absorber sheet on top

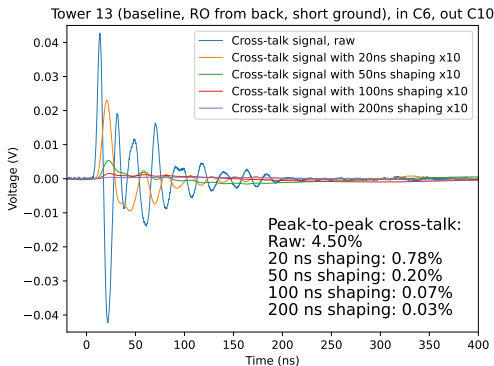


# The new case: T13 with grounding on top absorber



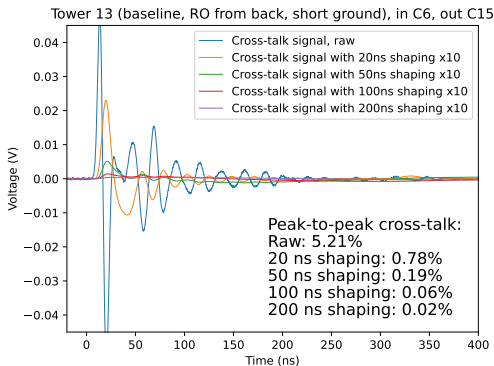
- ▶ Inject to cell 6, read out from cell 7
- ▶ Oscillation still present
- ▶ X-talk from 0.8% to 0.07%
  - 15% less than with old setup!

# The new case: T13 with grounding on top absorber



- ▶ Inject to cell 6, read out from **cell 10**
- ▶ Oscillation still present
- ▶ X-talk from 0.8% to 0.03%
- ▶ Improvement from old grounding scheme

# The new case: T13 with grounding on top absorber



- ▶ Inject to cell 6, read out from **cell 15**
- ▶ Oscillation still present
- ▶ X-talk from 0.8% to 0.02%
- ▶ Improvement from old grounding scheme

# Conclusions 1/2

- ▶ Adding "absorber" on top and using it for grounding reduces x-talk
  - The copper sheet beta version not full length, some more improvement possible with bigger sheet
  - Standard setup from now on. Need some work at the lab for making full-size top absorber with injection holes.
- ▶ Previously seen oscillations persist
  - Feature of long readout scenario and not a flaw in setup?
  - Period of oscillation  $\approx 22$  ns, but varies between 17-28 ns
  - 22 ns corresponds to  $\sim 6$  m of propagation of electric signal. Hard to find such long reflection paths from the setup.
  - Would the time constant of the capacitors formed by cells be in this range?

## Conclusions 2/2

- ▶ In inner edge (C7 to C6) measurements we don't see high-amplitude oscillations
- ▶ In zero- and 1-shield scenarios there's less oscillation
  - Oscillations some reflection phenomenon with shields?
- ▶ Anyway, oscillations not a real problem; x-talk is very low. Just academic interest to understand what's going on...
  - Now working on outer edge simulation - acid test to see if oscillation is a feature
- ▶ With x-talk down to 0.02% level, safe to assume that x-talk is not a problem for strips either when reading signals from the outer edge in the next prototype