BCM1F Frontend

Limits of its current design

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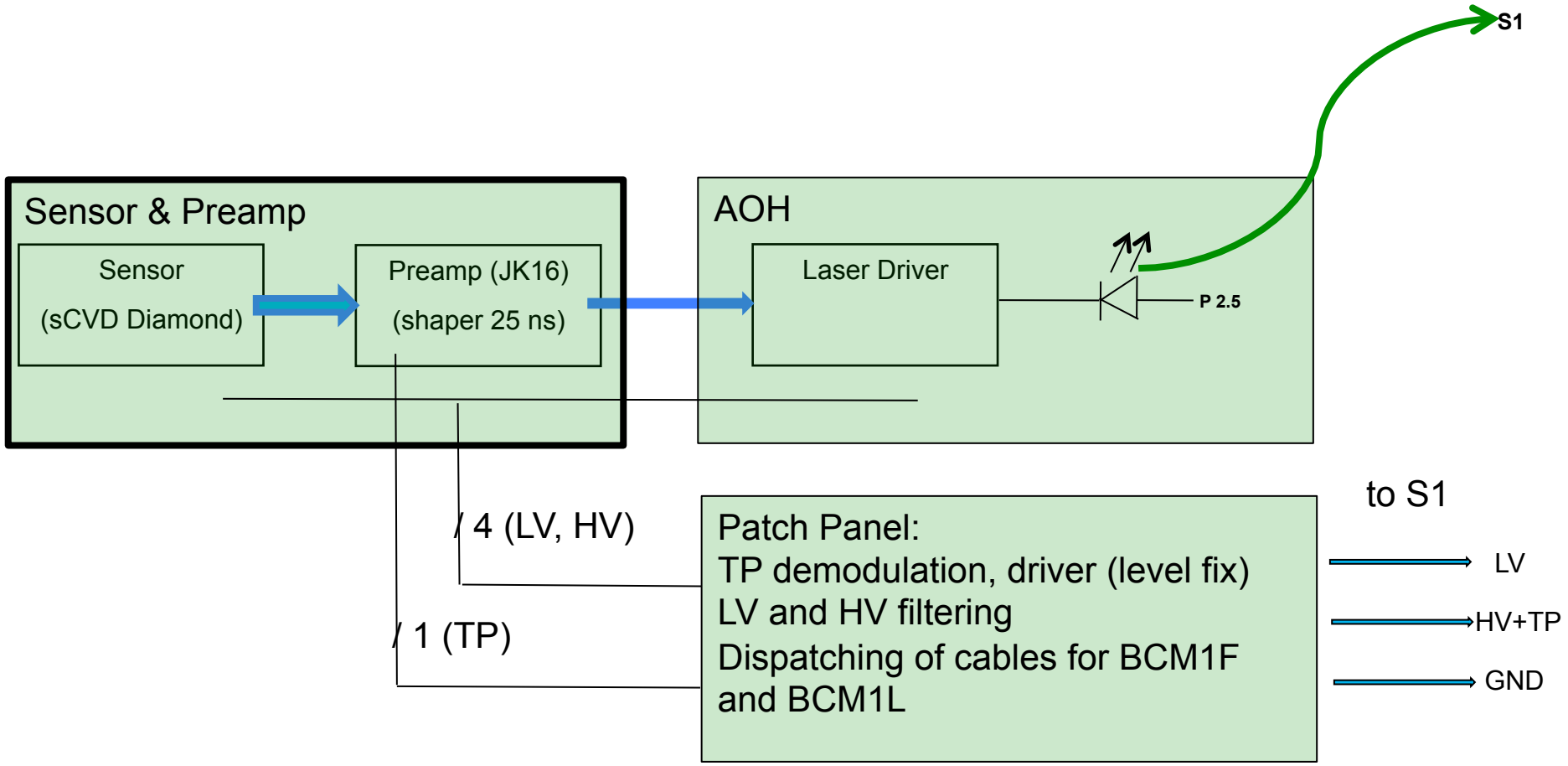
Initial Hardware Constraints

- Restricted volume at mounting position (replace 1 PLT module) on carriage (compactness)
- Only available: one cable with two pairs of wires (+ GND) per carriage half shell (has to supply LV, HV, test pulse)
- Optical signal transmission to S1 required (fibers existed)
- No cooling infrastructure (low power dissipation)
- No remote control / slow control infrastructure (operational point stable for a long time, parameters of frontend not adjustable)
- Use of CMS type components recommended

Hardware Configuration



Compromises, Disadvantages and *Advantages*

- Voltages need to be adjusted 'externally' from S1

  → (voltage drops on cables) → Danger! LVDS driver!

- Test pulse is modulated onto HV → filtering & pulse recovery needed
  → fixed pulse height (no calibration, only test)
- No slow control of laser driver (I^2C) – forseen for laser driver

  → dependent on temperature, radiation damage…
- No gain adjustment → each individual module has individual gain

- Availability of ***Analog Signal*** allows for ***analog AND digital*** *signal processing in S1*
- *Simple system – robust and stable*

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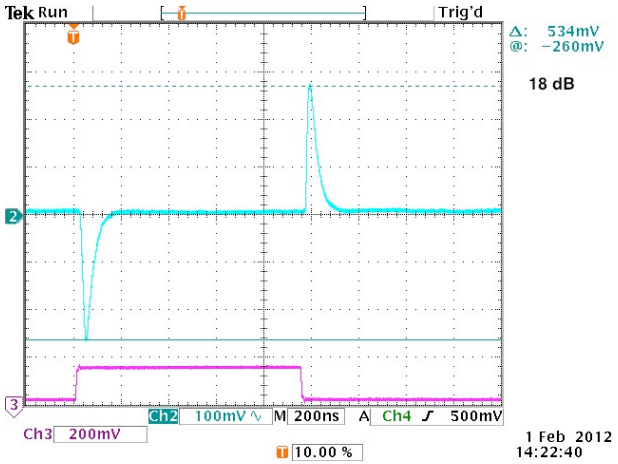
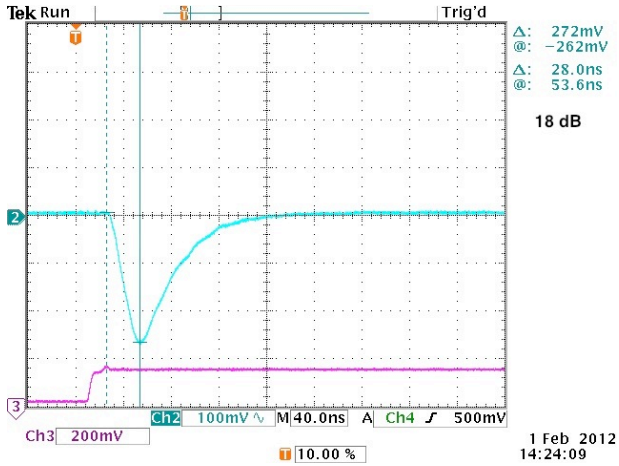
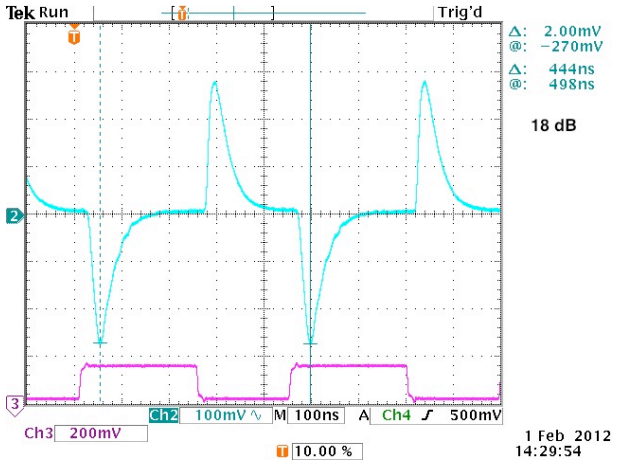
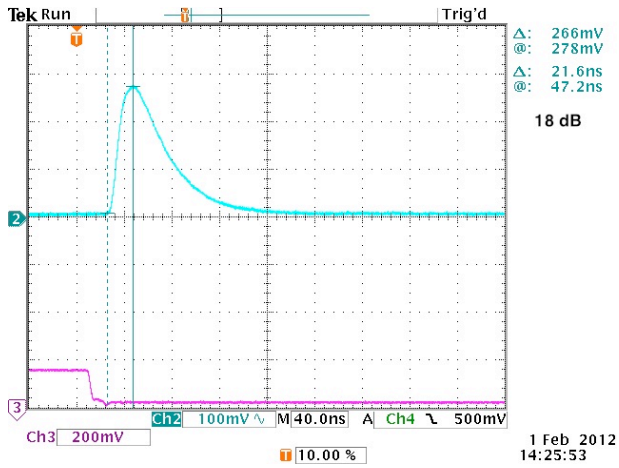
Signal Properties (1)

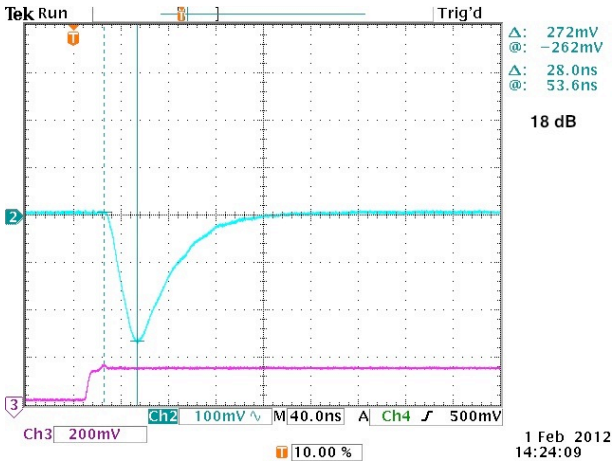




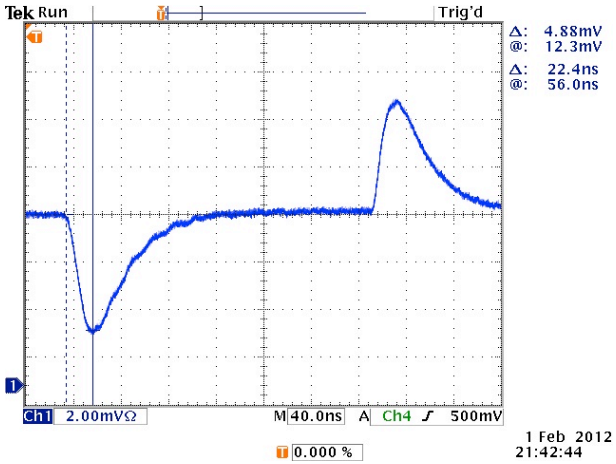




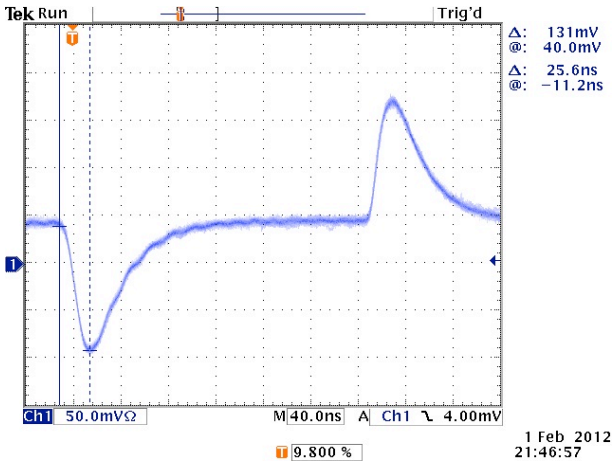
Signal Properties (2)



Direct output of preamp

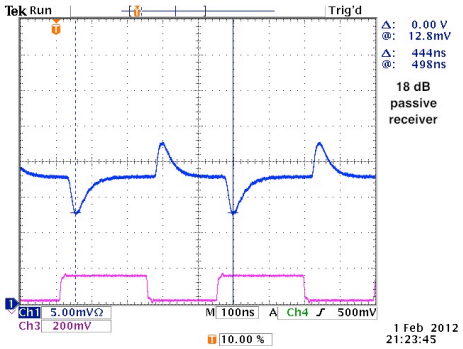


+AOH, fiber, converter



+AOH, fiber, Optobahn

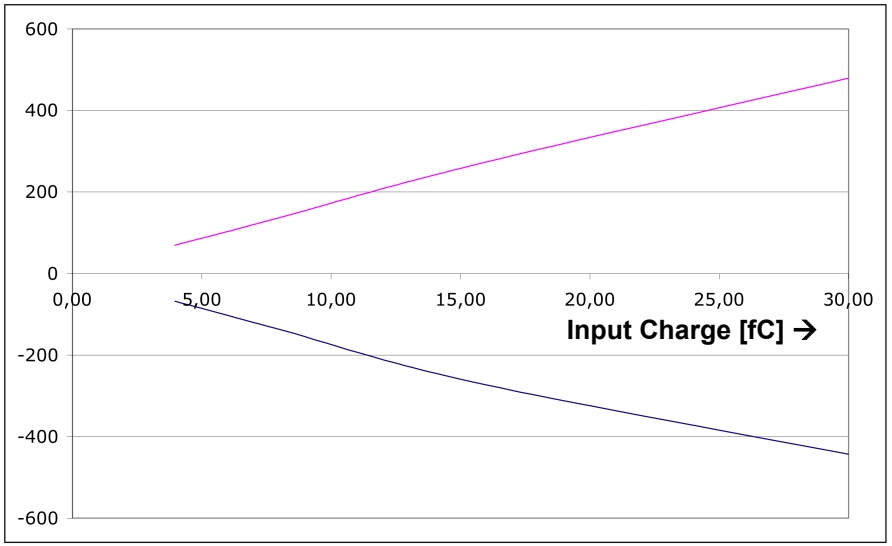
- preamp output is very weak → stray capacitances slow down signal
- bandwidth is NOT seriously limited by optical chain (contradicting previous measurements)
- 25 ns shaping time with a total signal length of ~ 120 ns limits rate capability (preamp)



→ f ≤ 5 MHz for periodic signals

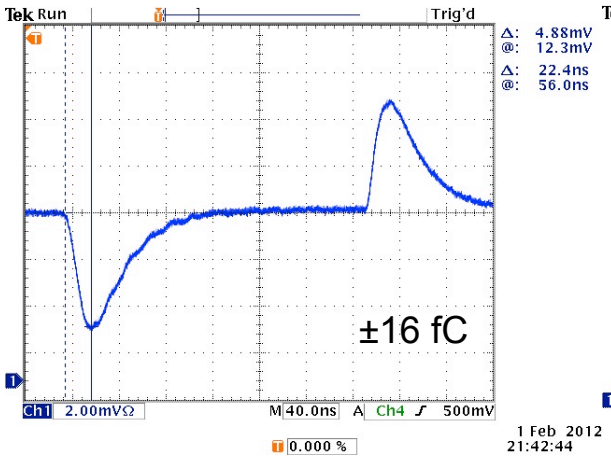
Dynamic Range

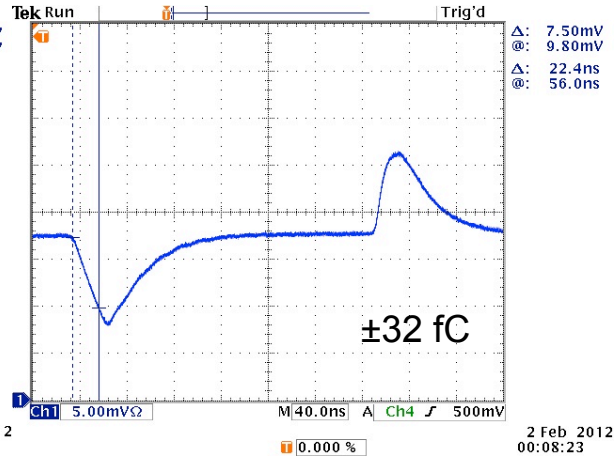
Direct output of preamp [mV] vs input charge [fC]

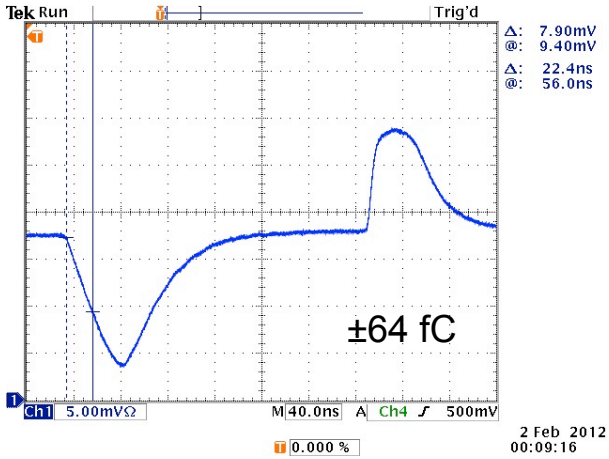


- dynamic range is limited by preamp's output stage ($V_{dd}/2$ ± signal)
- If minor nonlinearities are accepted the range is about ± 10 MIPs.
- positive pulse starts to saturate @ 30 fC
- negative pulse @ -50 fC (nonlinearity!)

From left to right: saturation behavior, measured with AOH + direct converter.







Conclusions

- Limiting element of the current design is the preamp (dynamic range, speed).
- Rather well matched to preamp: AOH (laser quiescent current (baseline) – max. signal); bandwidth high enough.
- Optobahn receiver is currently not limiting. For an optimal dynamic range the (laser) baseline should be adjusted/compensated for
- Degradation for BCM1F @ CMS observed, to be quantified (levels and/or gain)
- Cannot use this preamp for 25 ns bunch spacing (→ pulse shapes)
- Current system cannot handle signals with significant pile-up

Spare Parts

More spare parts currently not available.