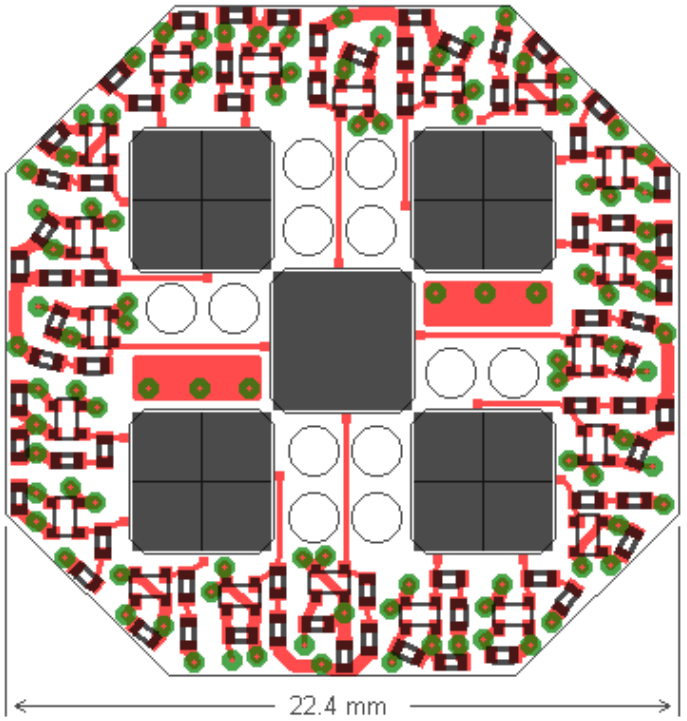
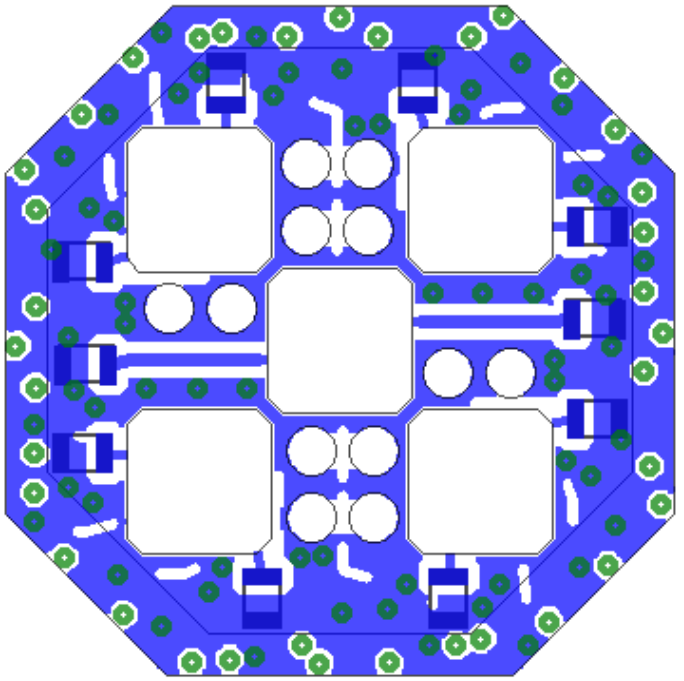
A start detector design for a pion beam based on standard single crystal diamonds

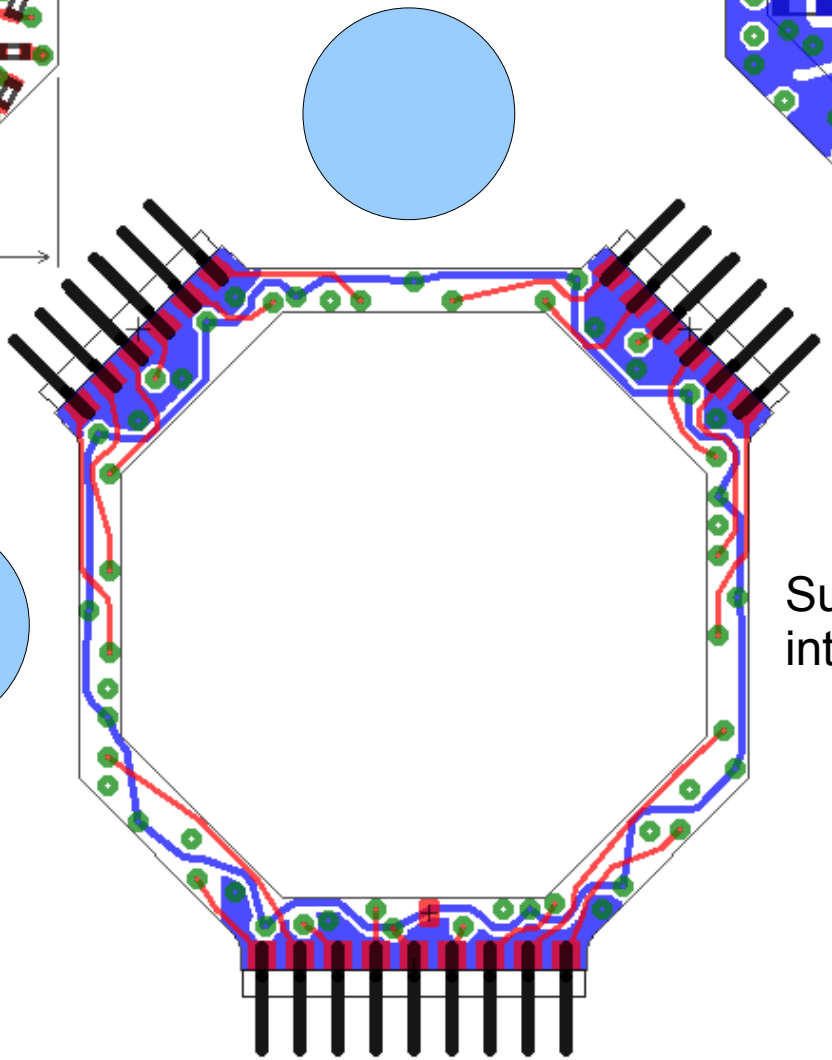
Wolfgang Koenig , March 2013

- 10 standard single crystal diamonds of size 4.6 * 4.6 mm² and thickness 300 um are currently available.
- Nine diamonds will be used in a 14*14 mm² start detector array with 36 pixels.
- This results in a position resolution of 0.67 mm (sigma) in each dimension.
- Two boards with 5 and 4 diamonds respectively will be mounted as close as possible to the target (40 cm upstream inside the LN2 target, 5 cm upstream in case of the solid target test-beamtime for better focus monitoring).
- The readout consists of a preamp (charge sensitive) directly attached to the diamonds and a booster/shaper module outside the vacuum (this concept is based on existing modules but requires a redesign due to space limitations).
- Power consumption of the diamond boards amounts to 60 mW (1,65 mW /preamp)
- Final signal discrimination is performed via a standard NINO discriminator board already employed in previous beamtimes.



1st Diamond board
Left: Top side
Right: Bottom side





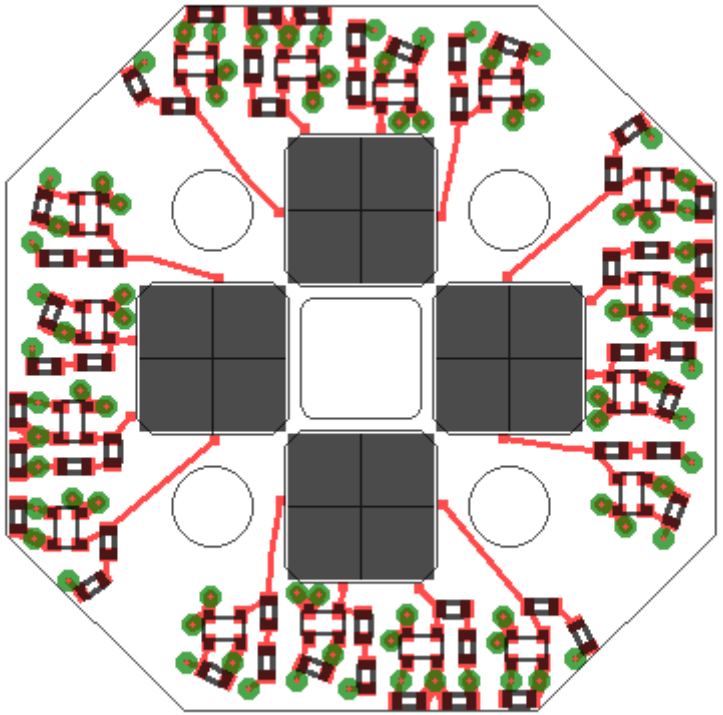
LH_2 supply lines
(schematically)

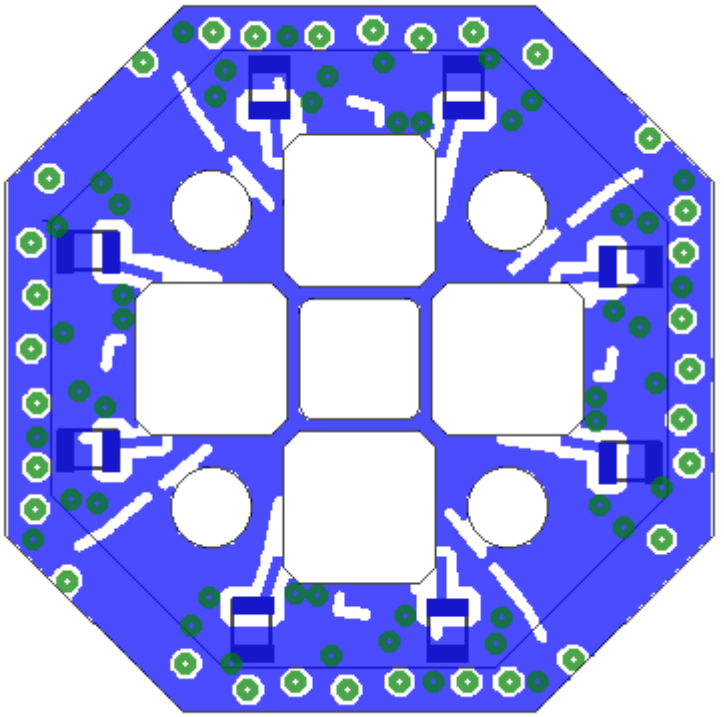
Support frame with readout
interface to 3 support rods

2nd Diamond board

Left: Top side

Right: Bottom side





Readout electronics for diamond start detector (Pion Beam)

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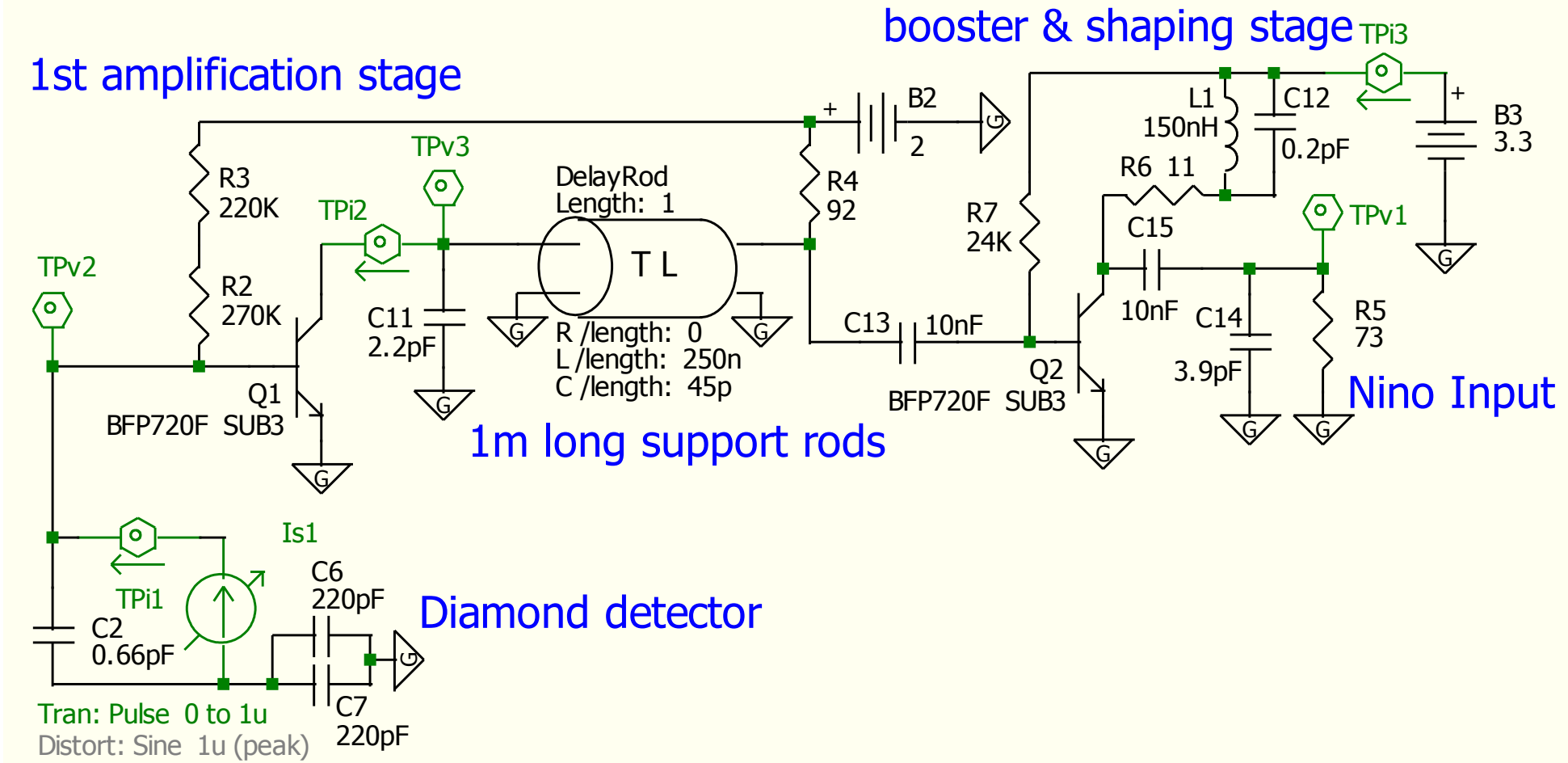
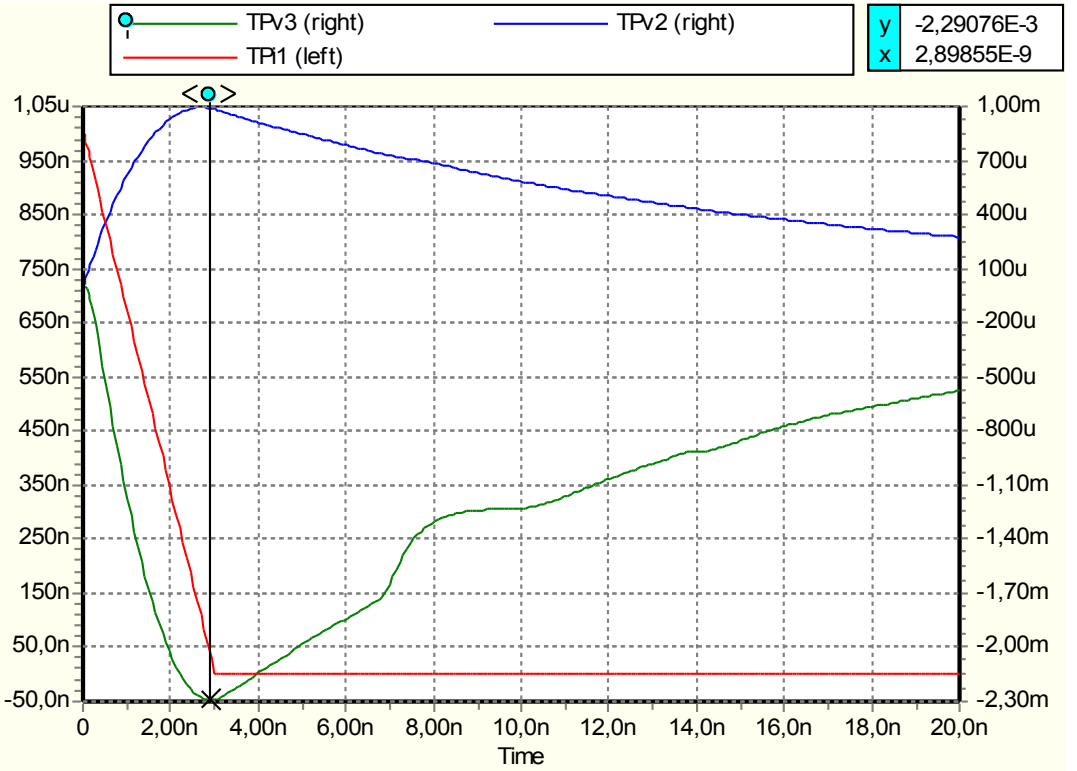
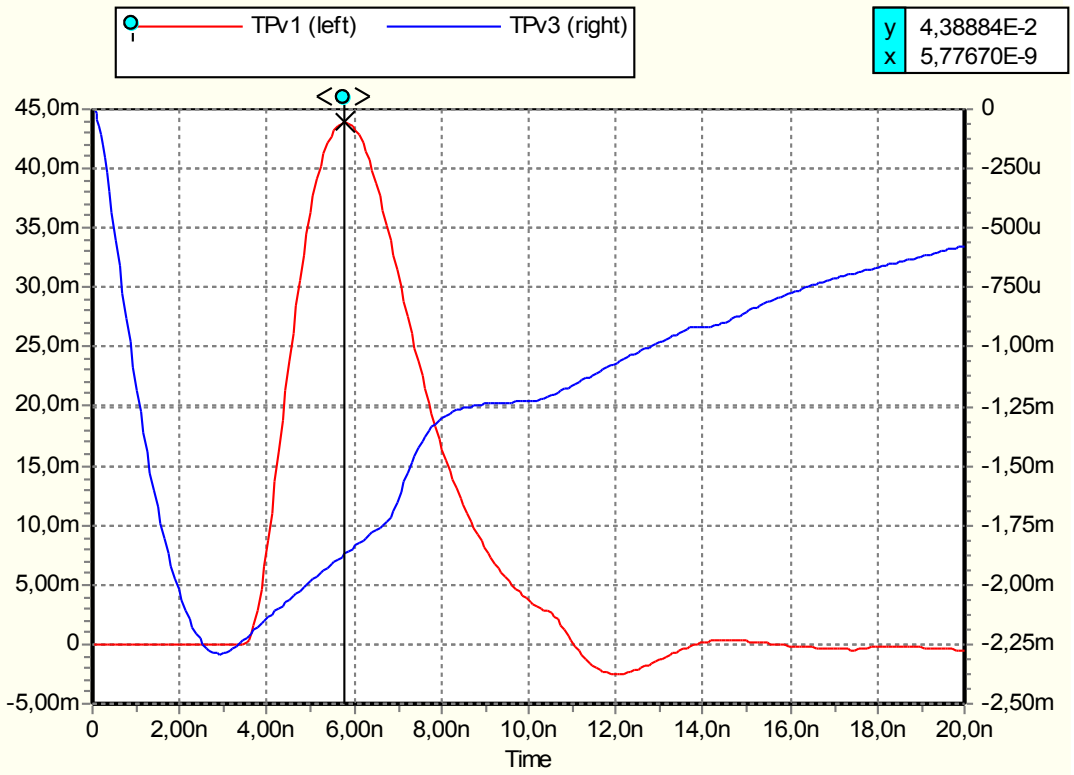


Red: MIPS current signal from 300µ diamond, left scale
Blue: Voltage signal at diamond (0.66 pF)
Green: Output signal of amplifier attached to diamond (reflections from transfer line).
Blue & Green: right scale

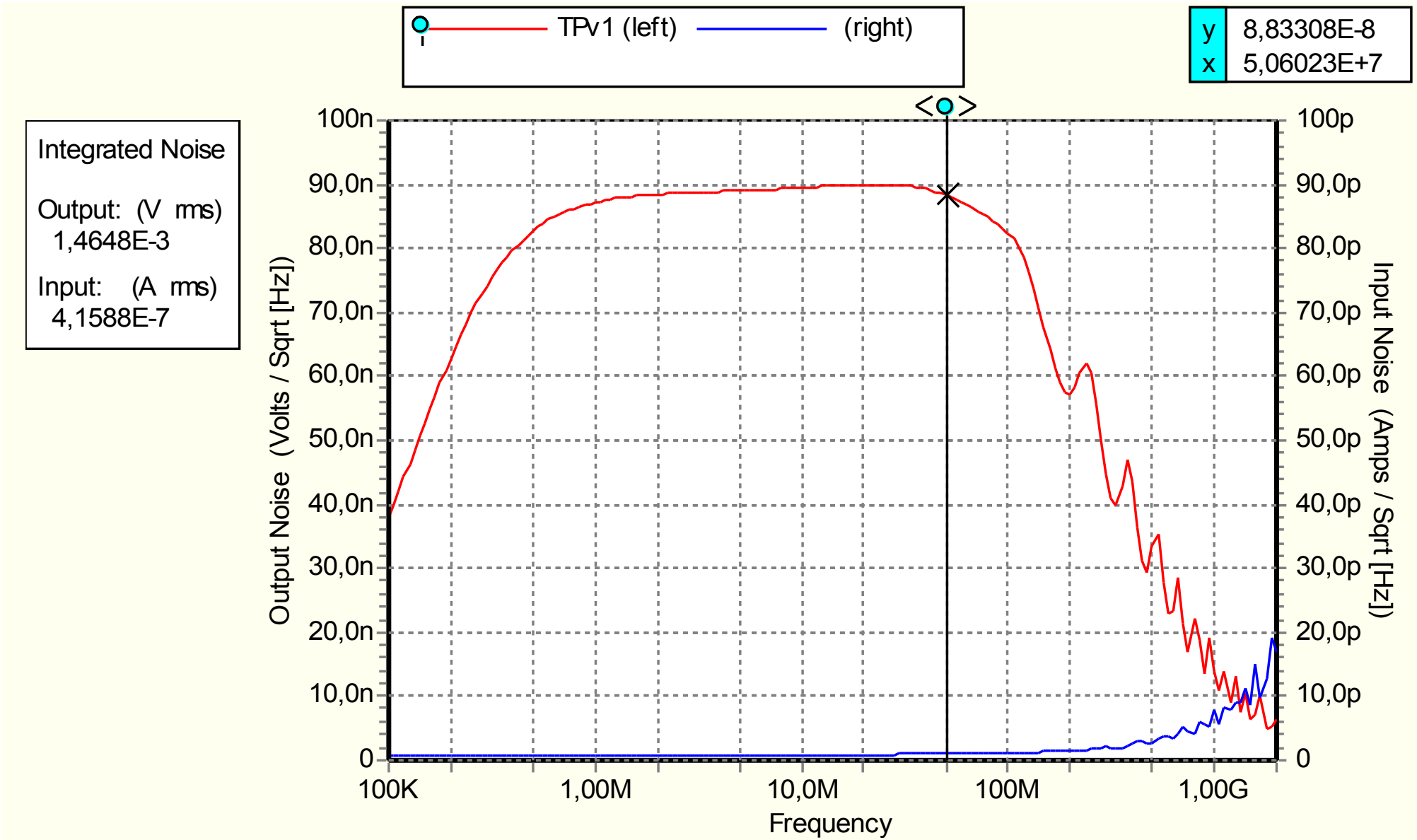


Blue:Input signal into booster/shaper, right scale

Red: Output signal of booster/shaper, left scale
1.35 ns rise time, S/N 30 : 1
Expected resolution: ≤ 100 ps



Electronic Noise distribution



Red: Noise spectrum at Booster / Shaper output.
Spikes are due to frequency dependent impedace mismatch between transfer line and booster/shaper input
Blue: Input noise (diamond is noise free)

Effect of the shaper on:

- the pulse shape (upper fig.)
- the frequency response (lower fig.)

Blue: before shaping
Red: after shaping

The effect of the transport line between preamp and booster/shaper is not included.