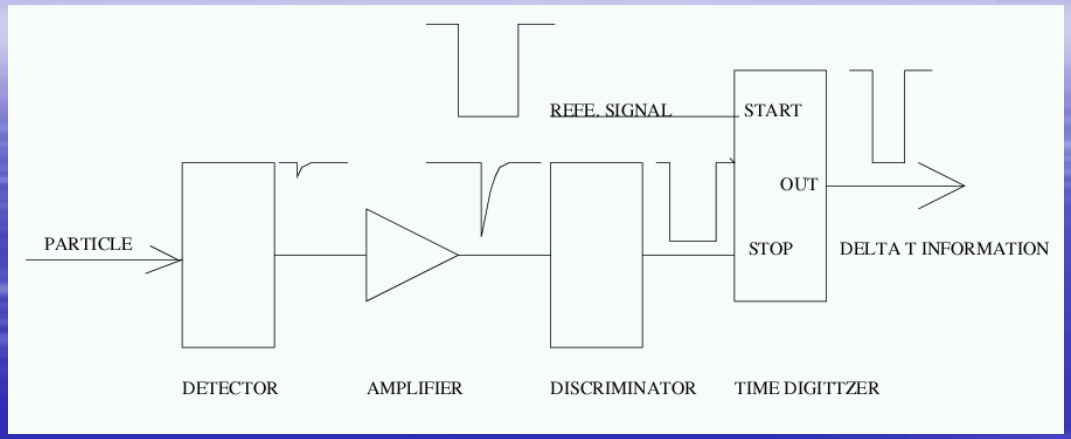
DBA based multi-channel devices

Mircea Ciobanu

NoRDHia Meeting 5-6 July 2004

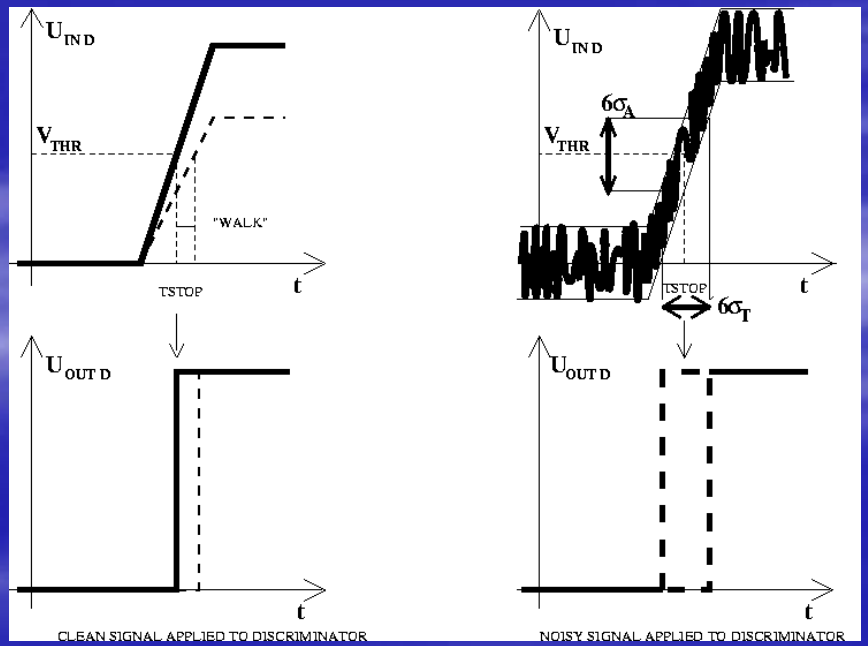
GSI-Darmstadt

Basic components of a Timing Channel



Typical Errors

" WALK "



$$\sigma_t = \frac{\sigma_n}{\left.\frac{dV}{dt}\right|_{V_{THR}}}$$

$$\sigma_t = \frac{\sigma_n}{\left.\frac{dV}{dt}\right|_{V_{THR}}} + \delta t$$

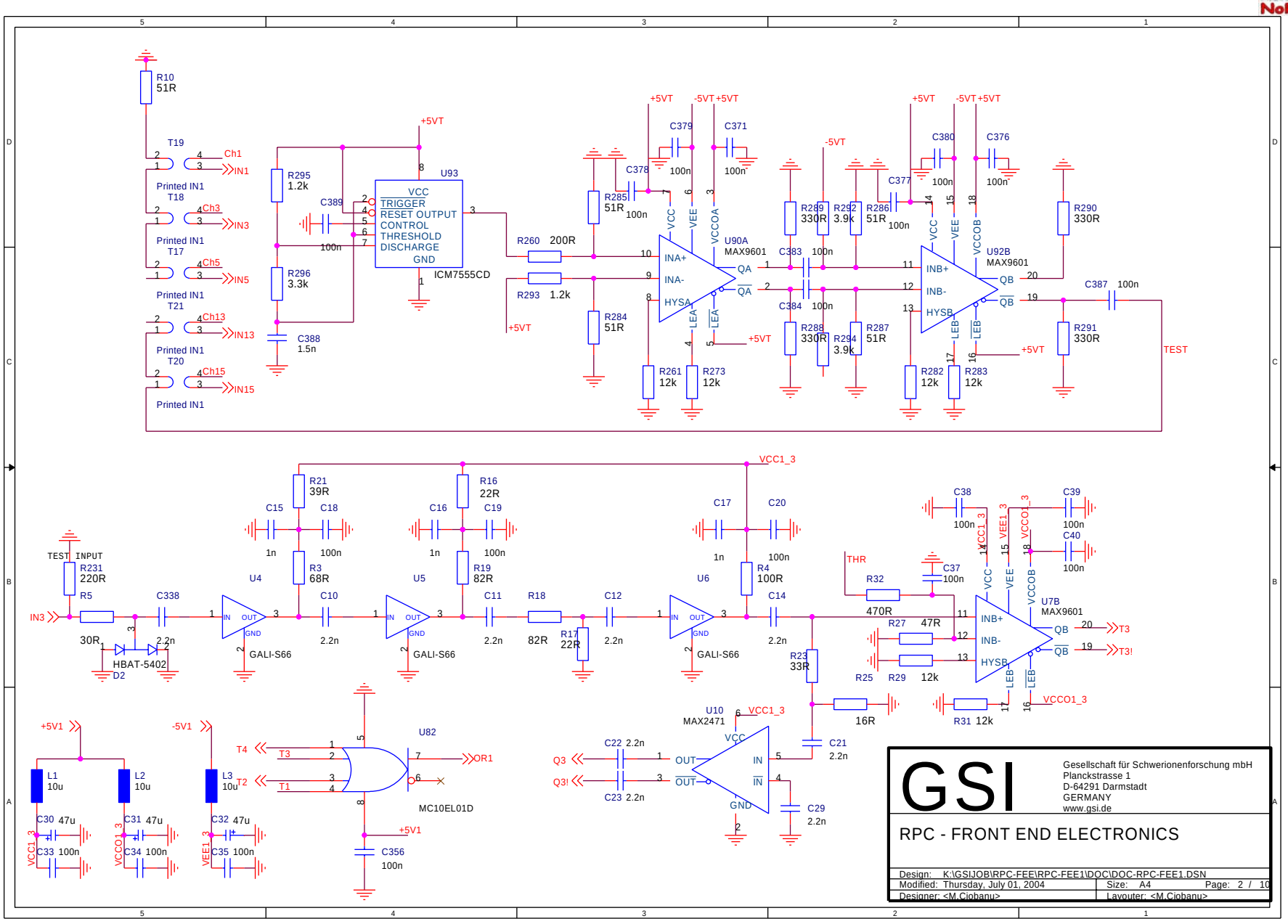
" JITTER"

$$\sigma_t \approx \frac{\sqrt{t_c}}{V_o}\underbrace{\sqrt{\frac{t_c}{t_{ra}} + \frac{t_{ra}}{t_c}}}$$

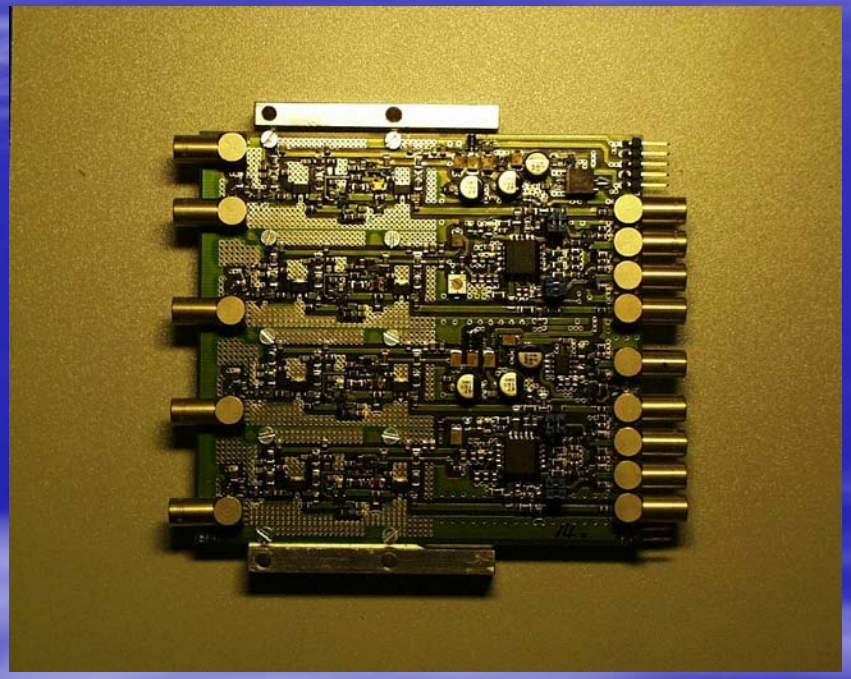
has a minimum for

$t_c = t_{ra}$

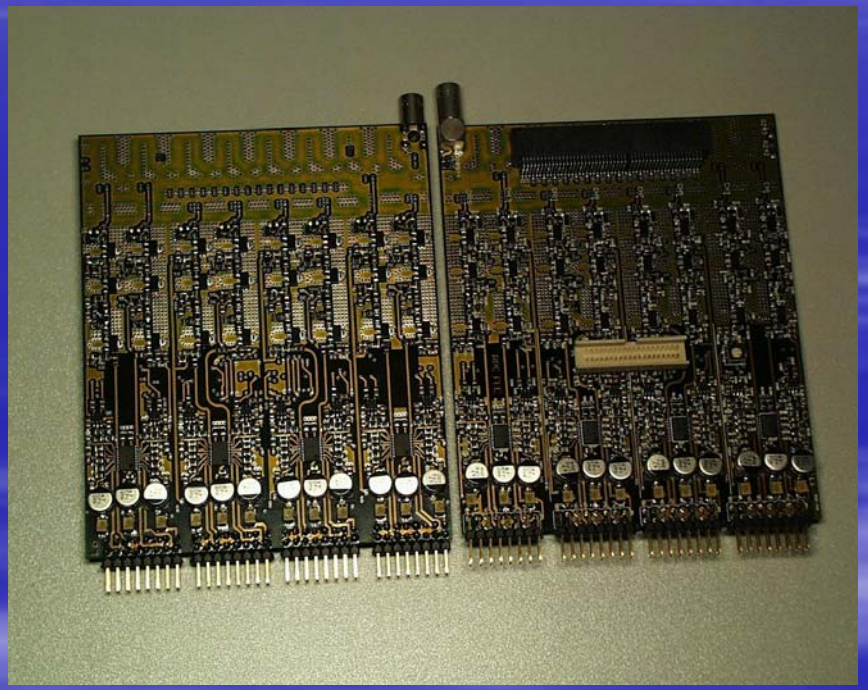
FEE2 SCHEMATICS



RPC-FEE1 and FEE2

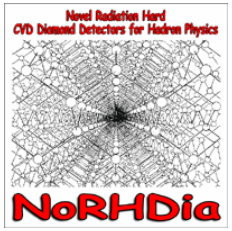


FEE1

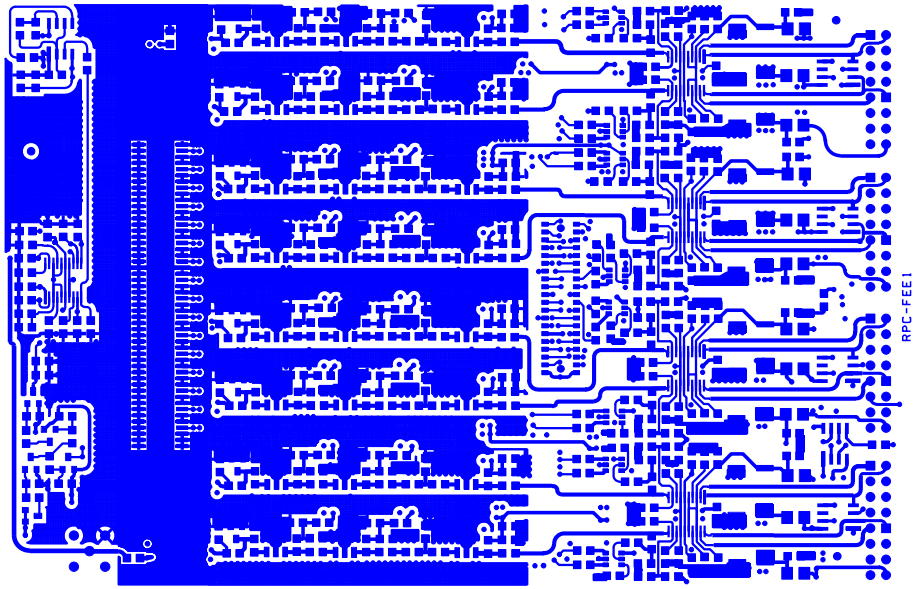


FEE2

FEE2



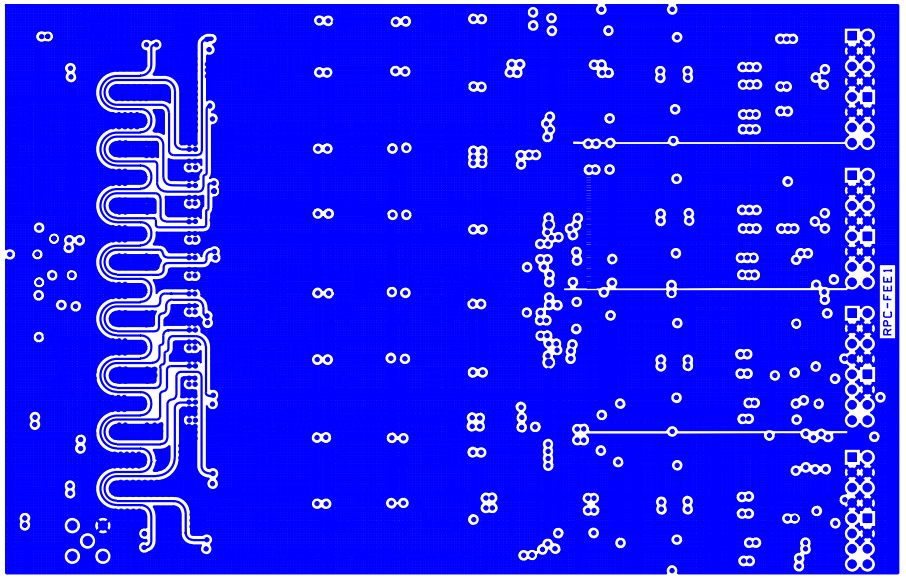
PCB TOP-LAYER



Jobname Date Designer Layouter
RPC-FEE1 1.9.2003 Ciobanu@gsi.de Ciobanu@gsi.de

Layer Nickname Top

PCB INNER1-LAYER

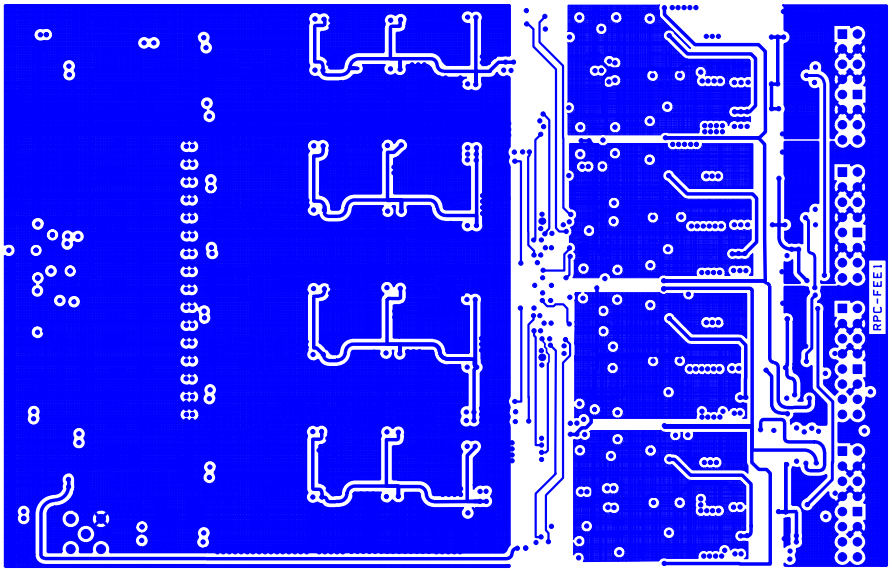


Jobname Date Designer Layouter
RPC-FEE1 1.9.2003 Ciobanu@gsi.de Ciobanu@gsi.de

Layer Nickname In1

FEE2

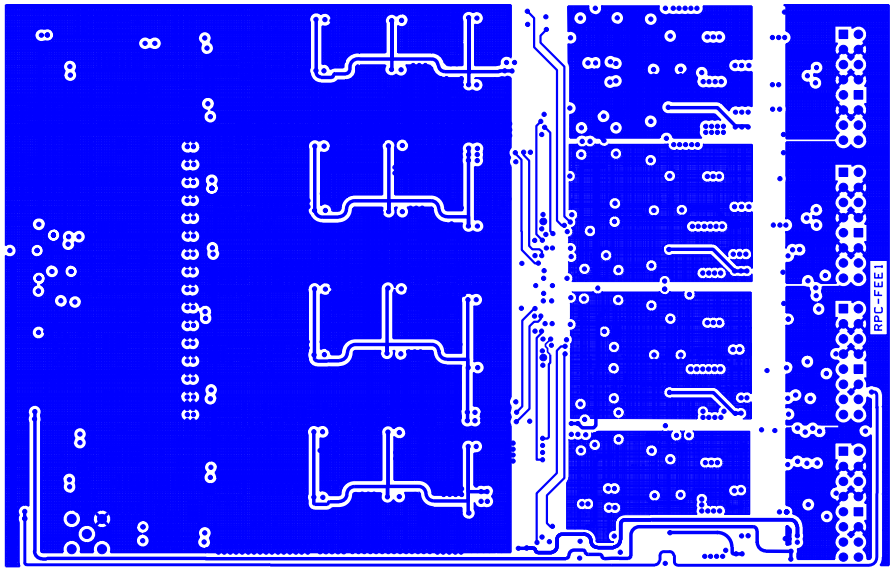
PCB INNER2-LAYER



Jobname Date Designer Layouter
RPC-FEE1 1.9.2003 Ciobanu@gsi.de Ciobanu@gsi.de

Layer Nickname
In2

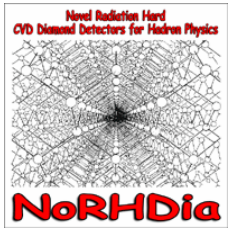
PCB INNER3-LAYER



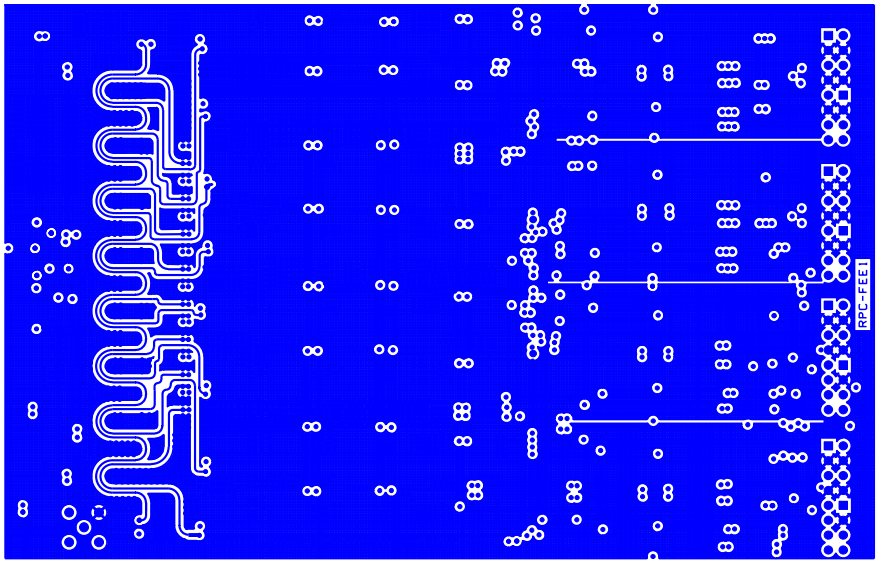
Jobname Date Designer Layouter
RPC-FEE1 1.9.2003 Ciobanu@gsi.de Ciobanu@gsi.de

Layer Nickname
In3

FEE2



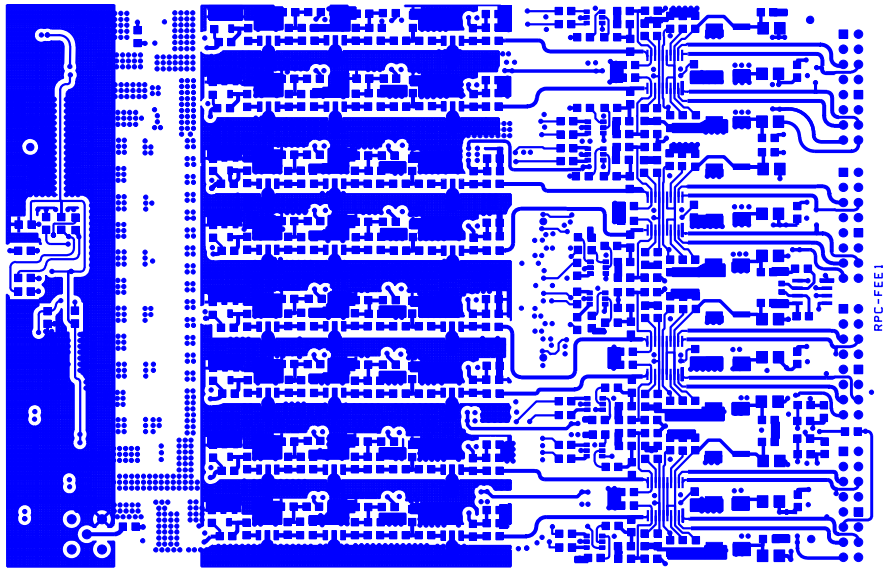
PCB INNER4-LAYER



Jobname Date Designer Layouter
RPC-FEE1 1.9.2003 Ciobanu@gsi.de Ciobanu@gsi.de

Layer Nickname
In4

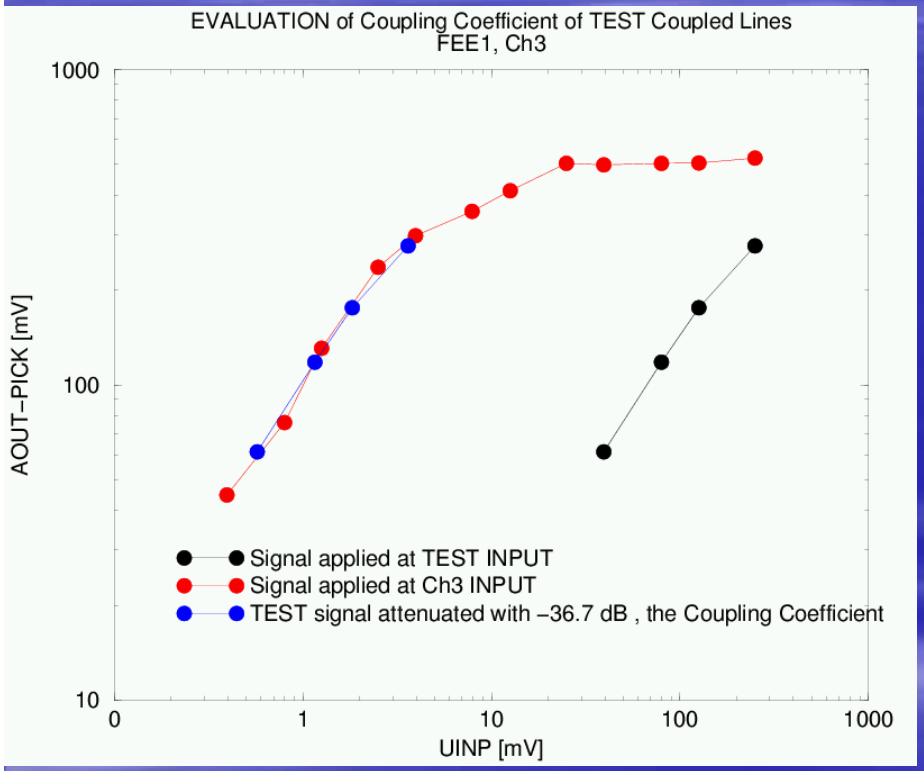
PCB BOTTOM-LAYER



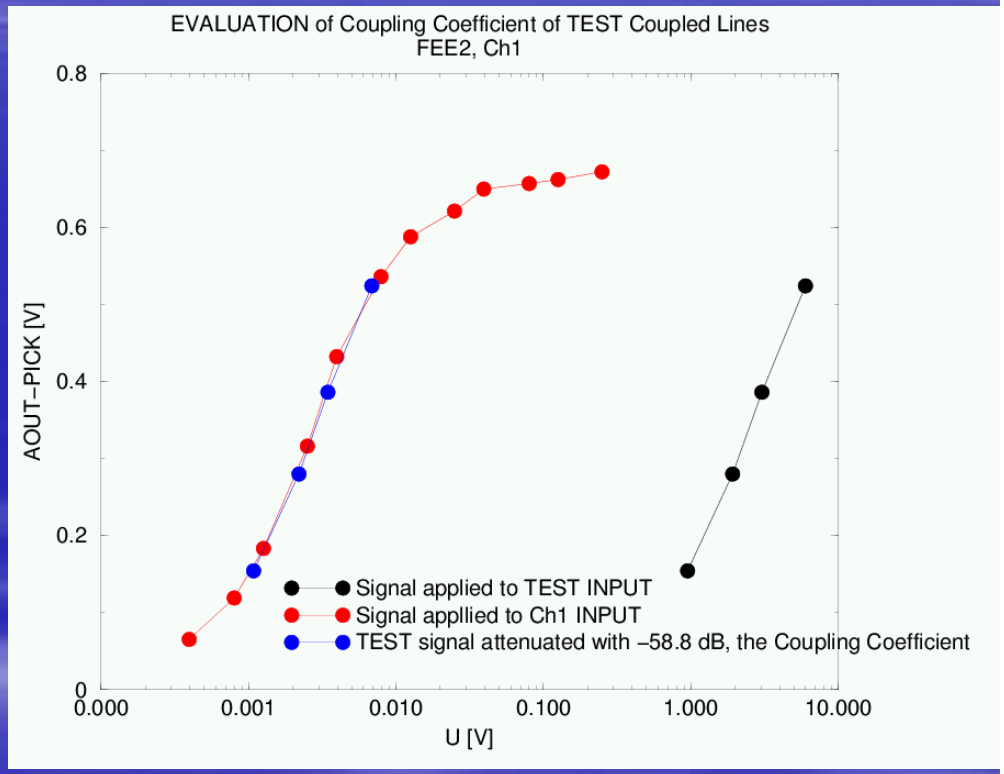
Jobname Date Designer Layouter
RPC-FEE1 1.9.2003 Ciobanu@gsi.de Ciobanu@gsi.de

Layer Nickname
Bot

Test Line Couple Coefficient

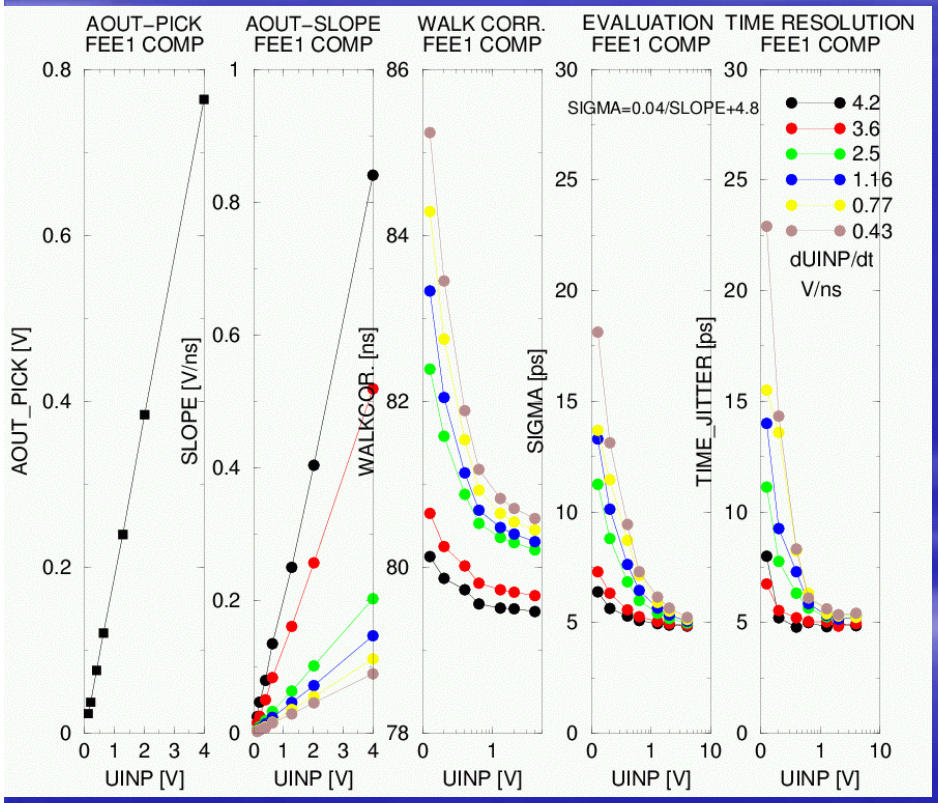


FEE1

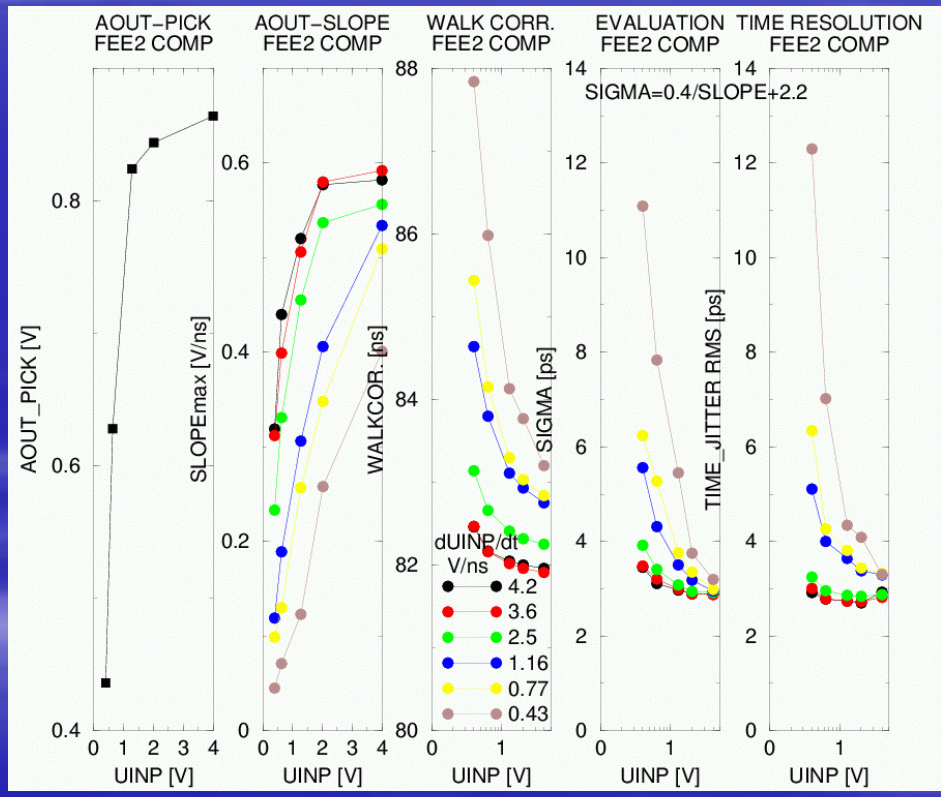


FEE2

Discriminator Timing Resolution (including the setup error)

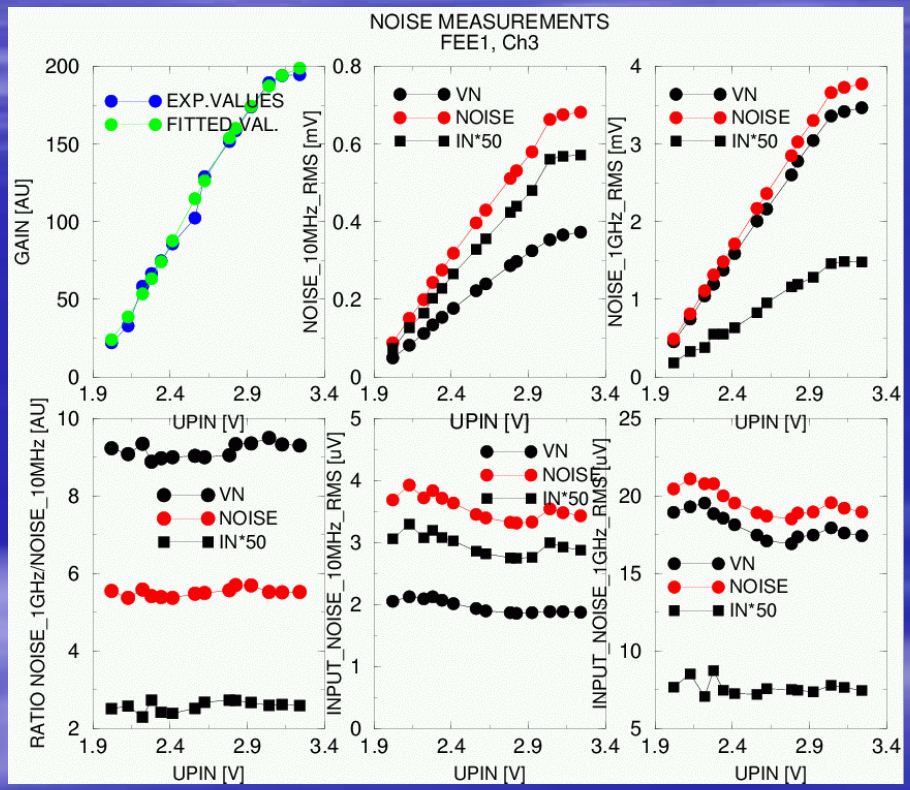


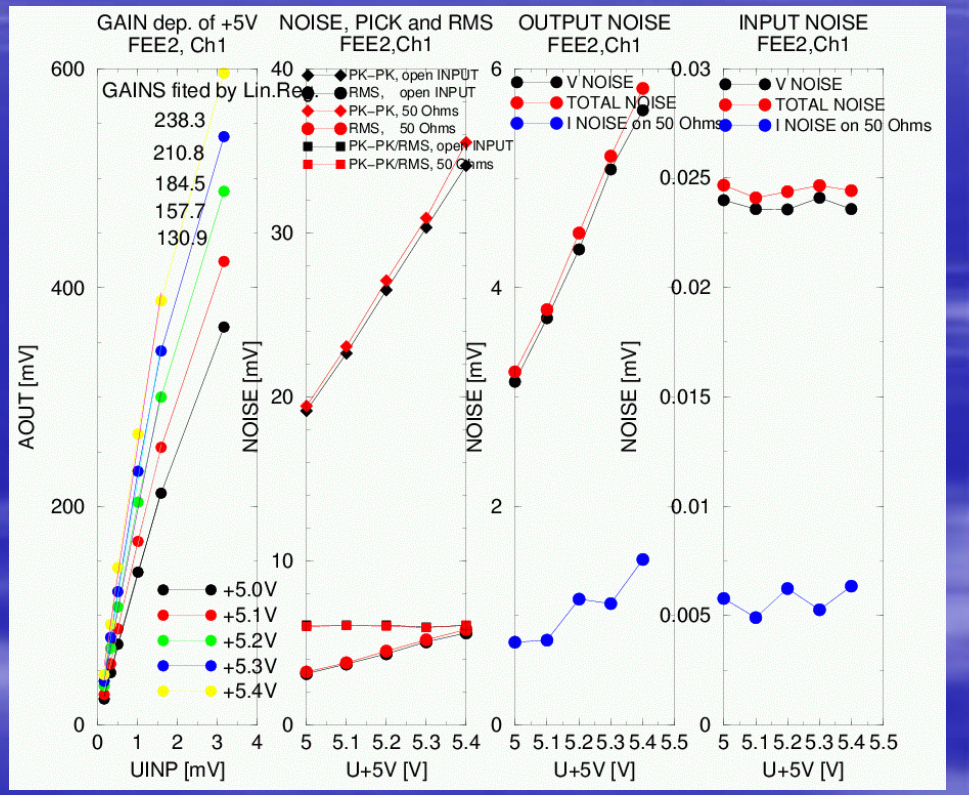
FEE1



FEE2

Noise Measurements

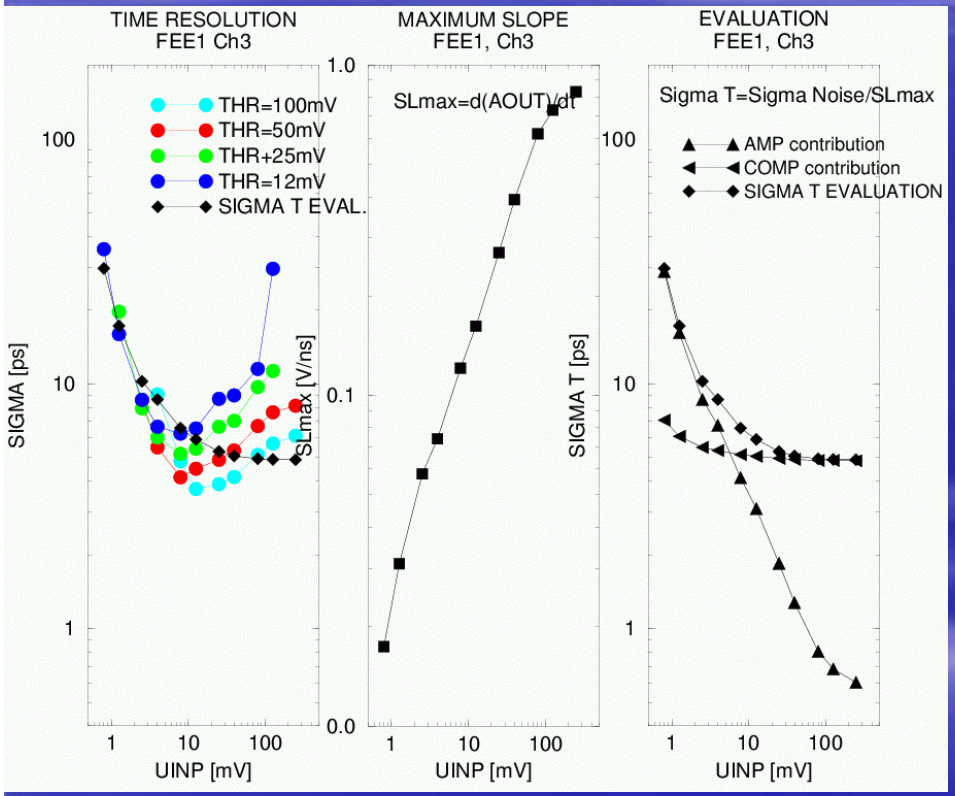




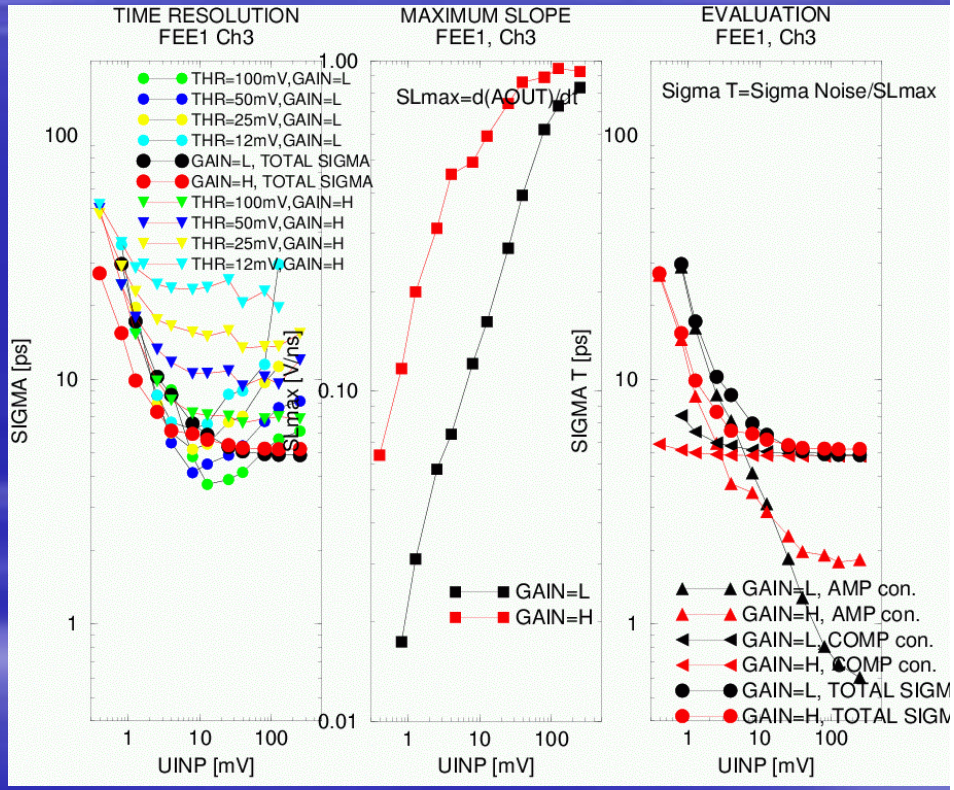
FEE1

FEE2

FEE1 TIME RESOLUTION

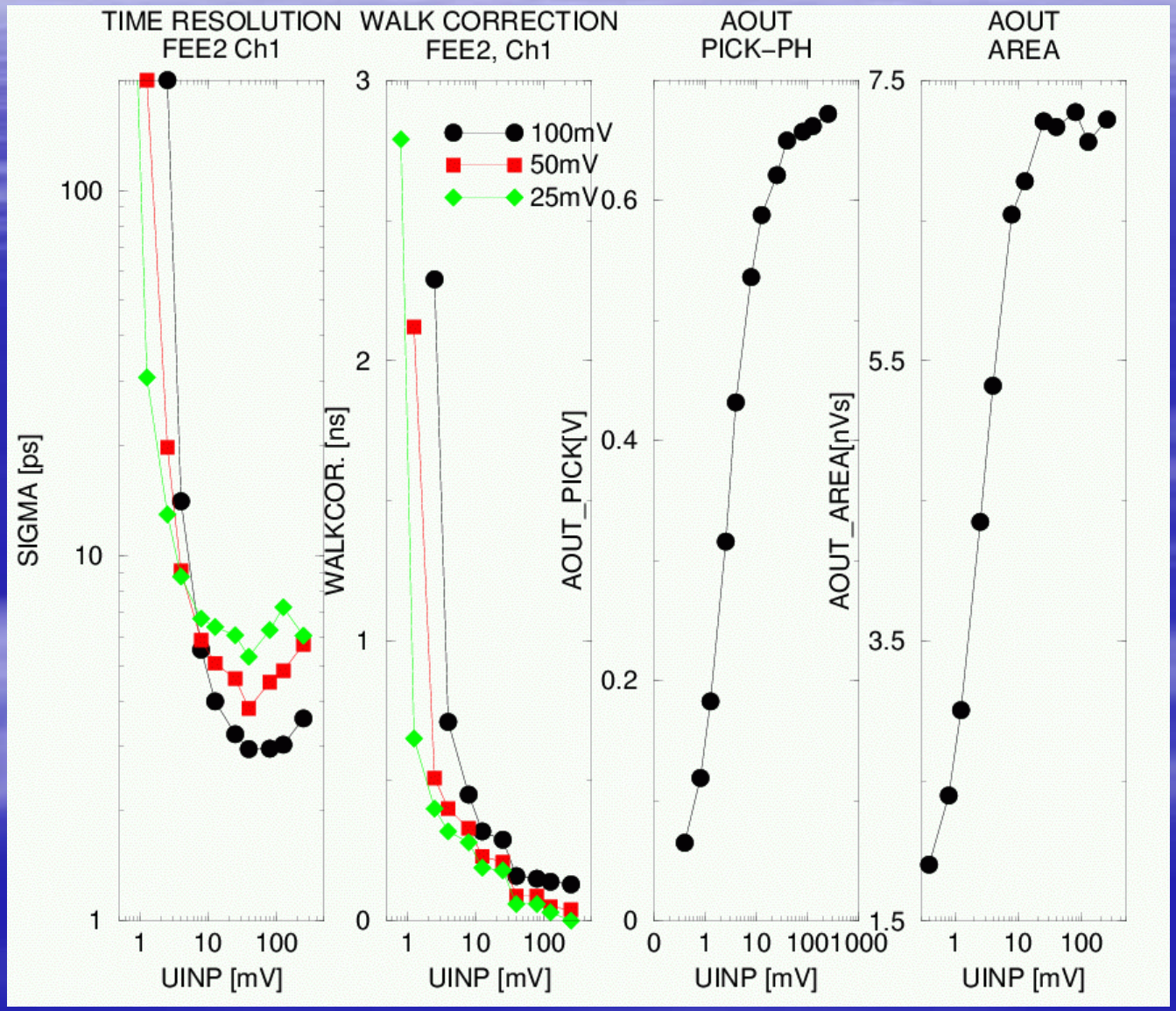


Low Gain, different Thresholds



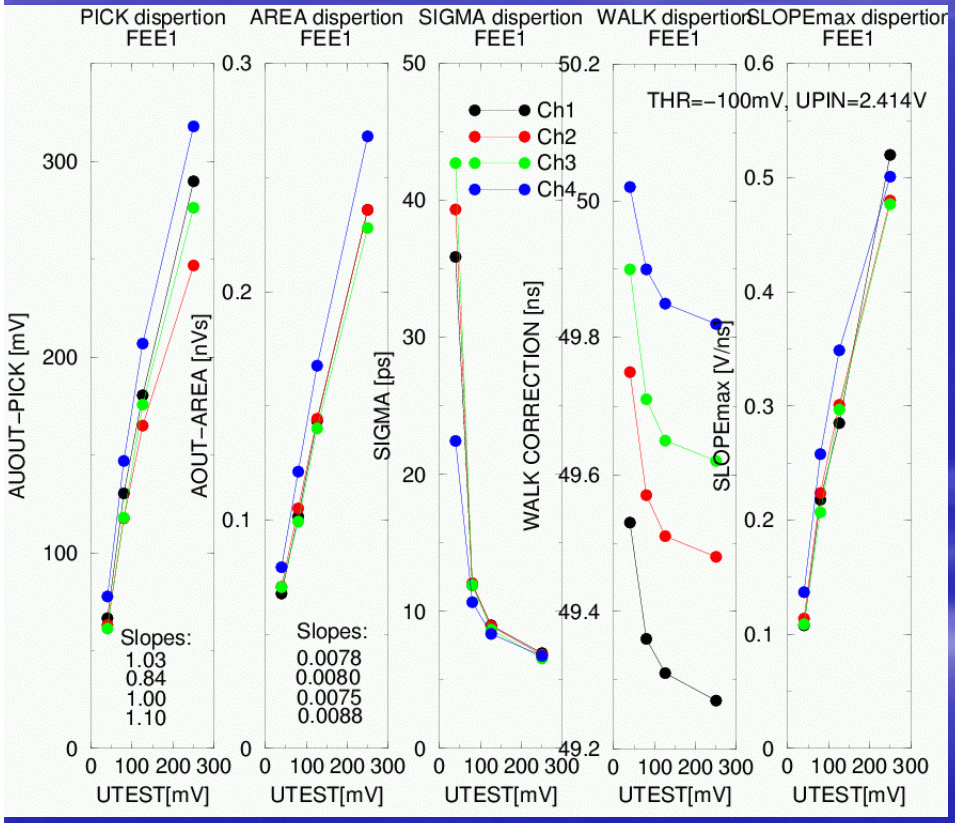
Low and High Gain, different Thresholds

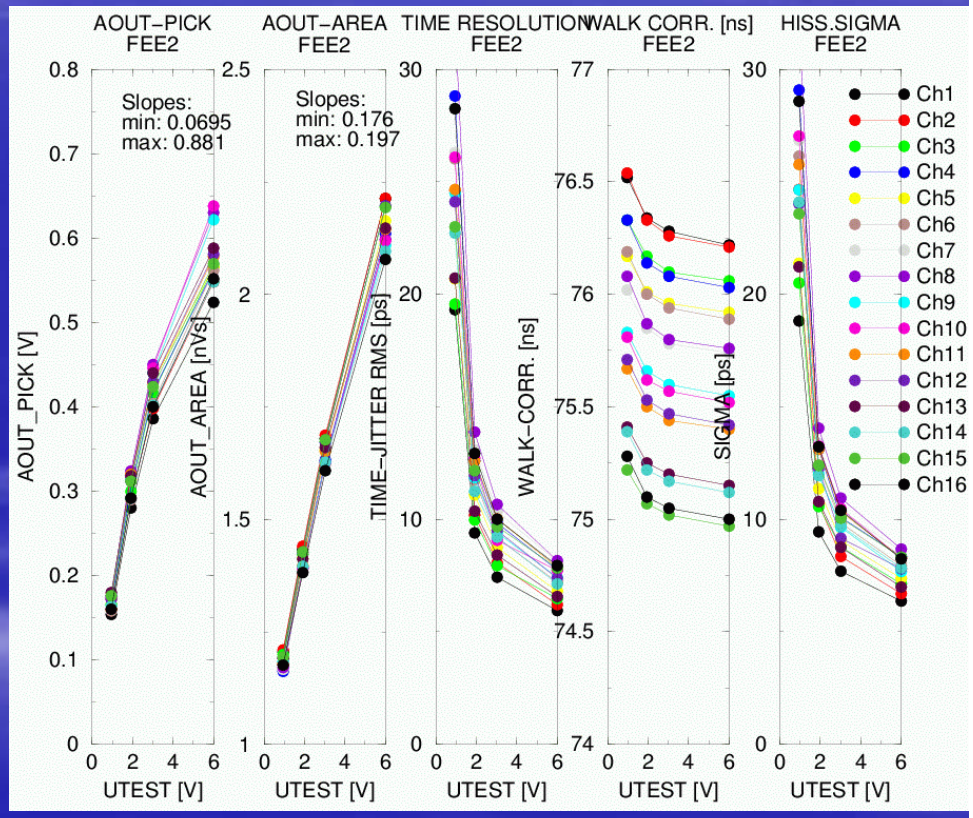
FEE2 TIME RESOLUTION



different Thresholds

Spread between channels

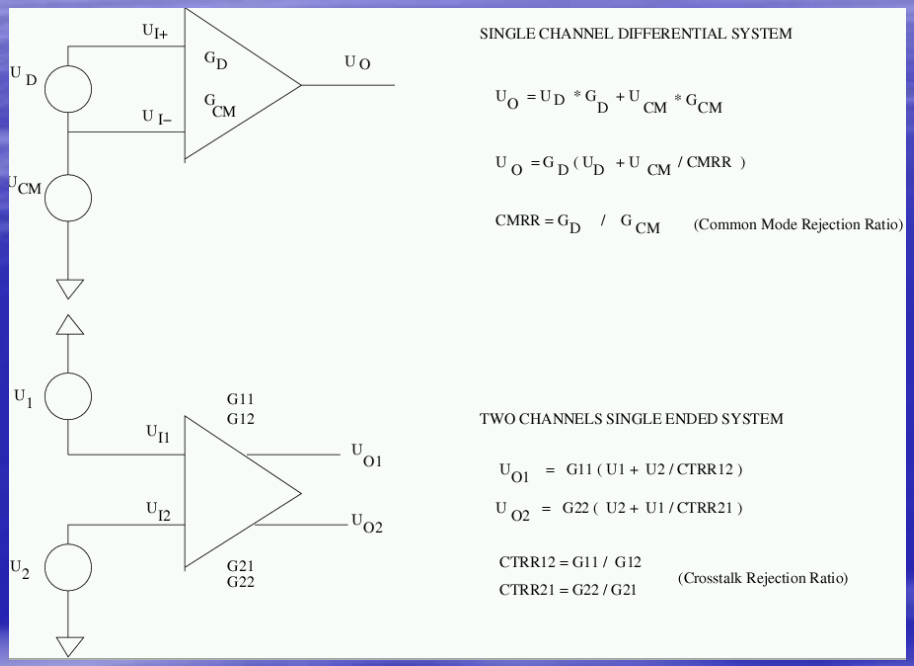


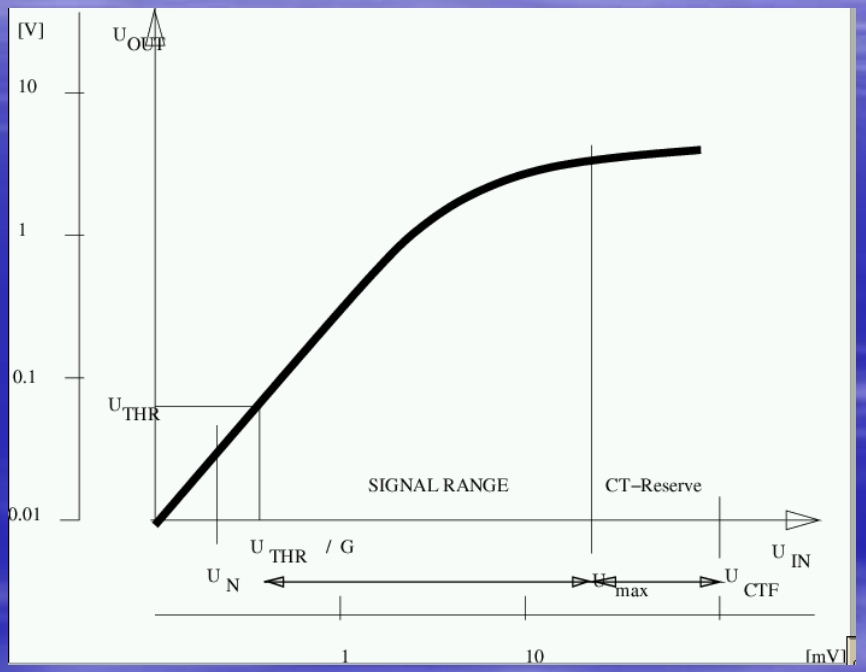


FEE1

FEE2

CROSSTALK and COMMON MODE REJECTION RATIO

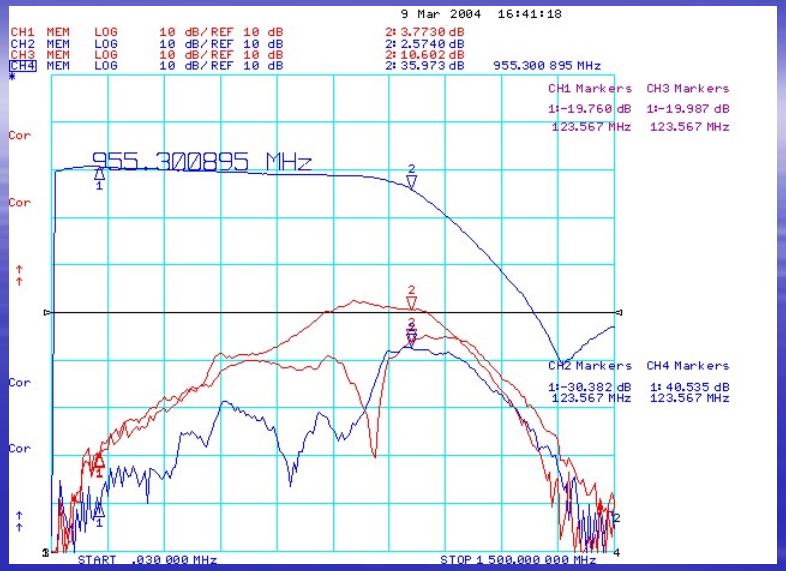




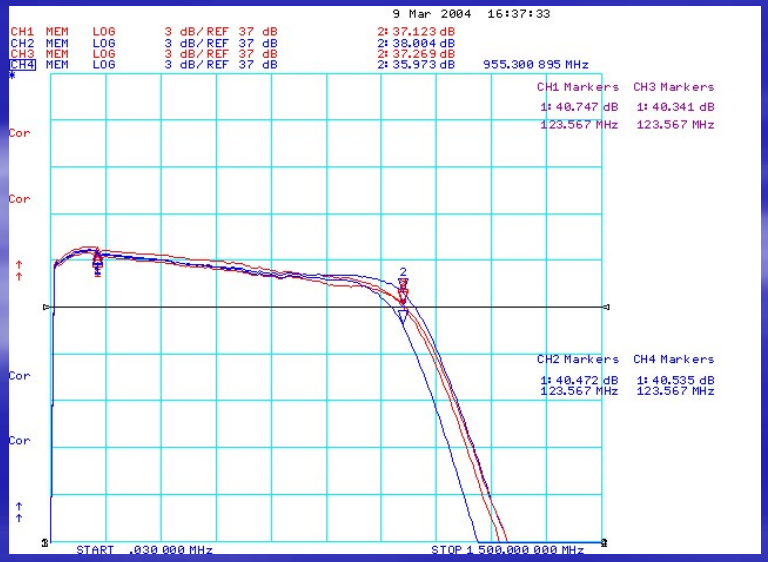
	G11	G21	G31	CTRR21 [dB]	CTRR31 [dB]	CMRR [dB]
FEE1	100	0.03	0.025	70.5	72	-
FEE2	-	-	-	43.8	50	-
FEE2 + Flat Cable + LEMO Adapter				39.5	45.5	-
NINO FEE	-	-	-	42.3	55.7	29.8
NINO + 50cm Twisted Pair Cable				35.5	53.7	29.8

A OUTPUT Frequency Dependence

Crosstalk Between Channels



Gain Spread for 4 Channels

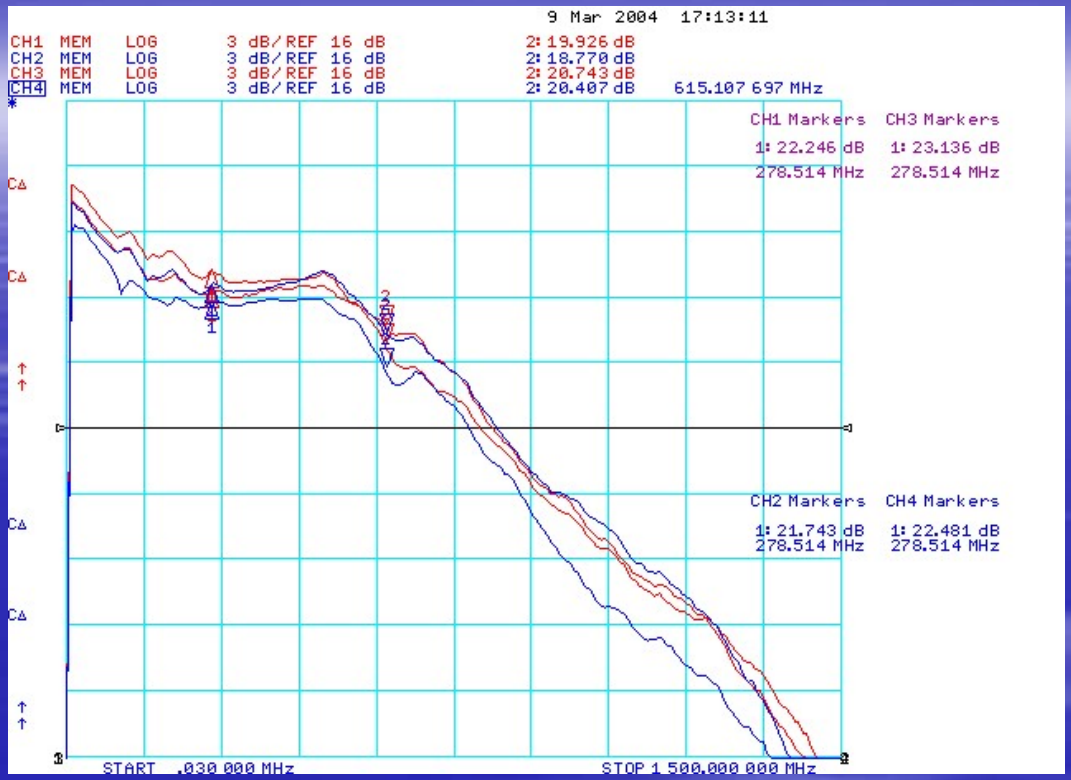


RF MEAS.
FEE1

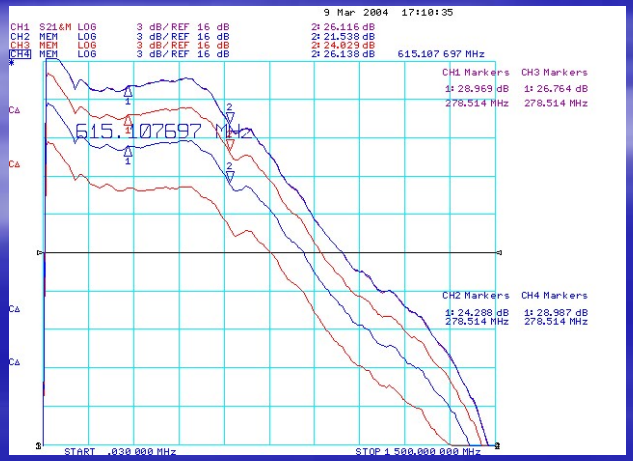
Gain + Couple Coefficient Spread

RF MEAS.
FEE2

A OUTPUT Frequency Dependence, 4 channels



Gain Sensibility
to +5V



Test Line
Couple Coeff.

FEE Comparison (25.06.2004)

	FEE1	FEE2	NINO_FEE
1.	4 Channels	16 Channels	24 Channels
	AC Amp., LE Disc., 4*OR, THR and GAIN man. adj.	AC Amp., LE Disc., 16*OR, TEST Gen., THR software	3 * (8 Channels) Chip, 24*OR THR, HISS, ToTHR man. adj.
2.	+6V, +12V, -6V	+5V, -5V	+2.5V
	1.85 W/Channel	0.51 W/Channel	0.036 W/Channel
3. Dim.:	110mm * 95mm	149 mm * 95 mm	190mm * 100mm
4.INP.:	4 LEMO	16 Single Ended, con. MEC1	24 Diff., con. EURO
	1 LEMO TEST	ENA/DIS signal for TEST Gen.	1 LEMO TEST
		THRESHOLD Voltage	
5.OUT.:	4 NIM for TIME	16 Diff. PECL for TIME	24 Diff. LVDS for TIME and
	4 LEMO Amplitude	16 Diff. for Amplitude	Time over Threshold
	1 LEMO OR	1 OR	1 LEMO OR
6.AC: - GAIN	~ 0-200	~160	-
- Bandwidth	~ 1GHz	~1.5GHz	-
- Noise	~ 20µV	~25µV	-
- Rise Time	~ 350ps	~250ps	-
7. Disc.:- Noise	~ 40µV	~ 400µV	-
- Rise Time	~ 500ps	~400ps	-
- Res. Jitter	~4.8ps	~2.2ps	-
8. Time Res.:	30-10-5-4-4 [ps]	128-17-11-8-6 [ps]	68-24-15-11-8 [ps]

Preliminary measurements for Input Signal Dynamics 1 - 3 - 10 - 30 - 100 [mV]

Some ideas for Future FEE
(25.06.2004)

1. The main limitation for the use of actual design together with Diamond Detectors for MIP detection is the Signal to Noise Ratio. The Single Crystal Diamond Material is very promising if the Sensitivity of the detection can be increased.
2. To increase the Signal to Noise of FEE, the first AC cell can be replaced by a Fast Charge Sensitivity Amplifier.

CAN BE USED A PRIVATE CHIP?

3.The actual level of performances is obtained with discrete elements and the critical parts are IC top on the Market: MAXIM9601(500ps comp),GALI -S66(Advanced Silicon Techn.), DC-3GHz Amp., 2.7dB NF, 20dB Gain.
4. It is very promising the DIFFERENTIAL pick-up of the signal and the use of an 110 Ohms cheap flat cable – Major Changes in Input stage of FEE.
5. Very attractive and effective: The test of NINO chip for ToF-ALICE.