BROOKHAVEN NATIONAL LABORATORY
Instrumentation Division

eV PRODUCTS II-VI Inc.

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A Generation of Readout ASICs for CZT Detectors

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The BNL-eV Cooperation
CZT readout : discrete or ASIC ?

Cost
- multi-chip project ≈ $35/ch (compare ≈ $75/ch)
- large numbers ≈ $1/ch
- R&D : C.R.A.D.A.

Manufacture
- time savings
- board simplification
- reduced number of process steps

Reliability
- reduced external interconnects
- lower exposure

Size
- ≈ 1 mm^2/ch (compare ≈ 700 mm^2/ch)
- opening to new applications

Power
- ≈ 10 mW/ch (compare ≈ 300 mW/ch)
- reduced detector temperature
- opening to battery operation

Performance
- reduced parasitics
- high order shaping
- additional processing

ASIC's key **requirements**

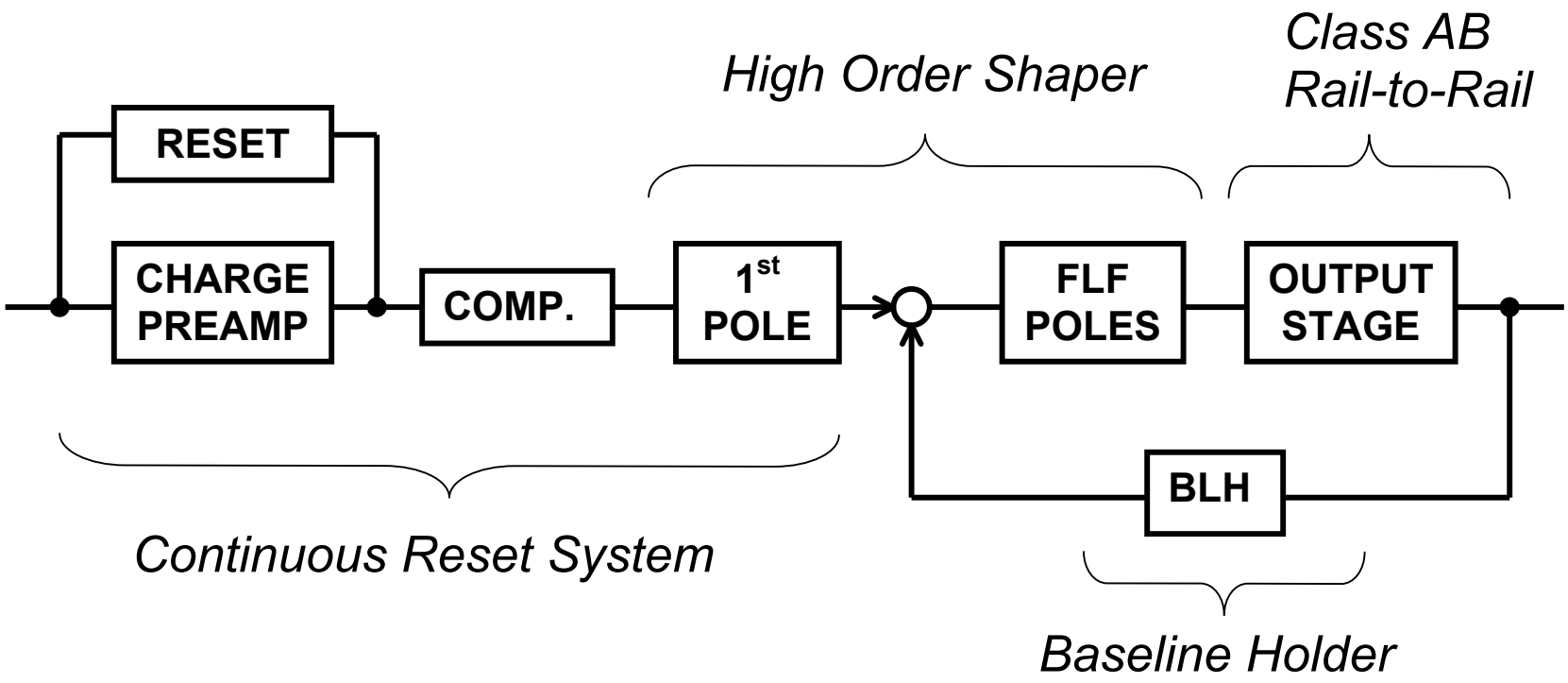
- low noise
- high linearity
- programmability
- low power

- low noise dc coupling
- high order shaping
- high driving capability
- high baseline stability

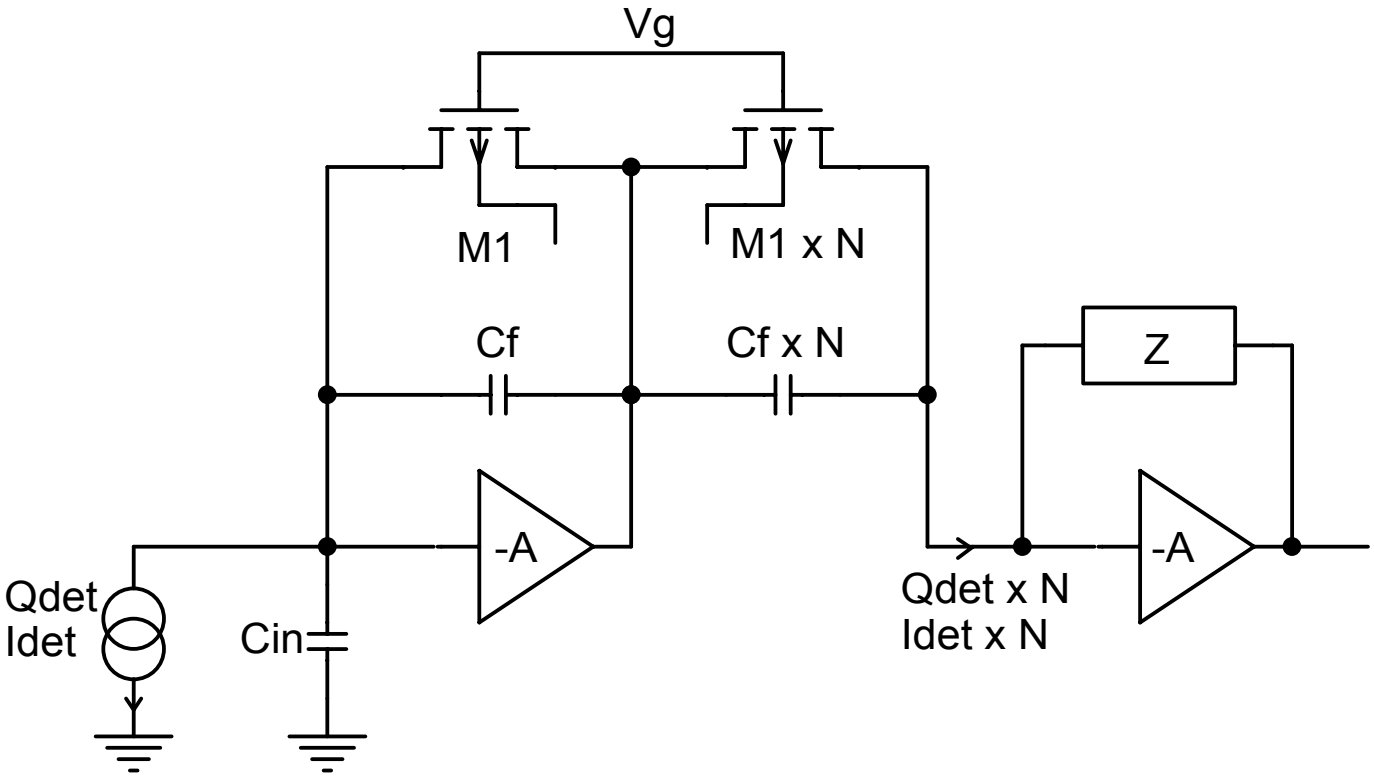
⇓

A generation of ASICs

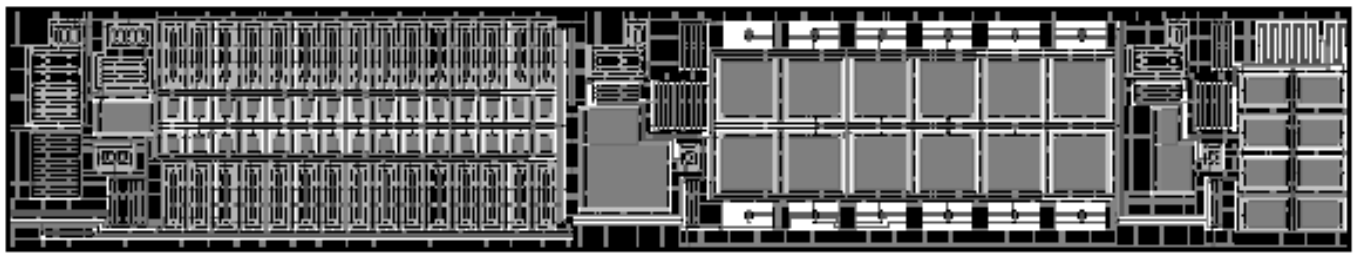
Channel Simplified Schematic



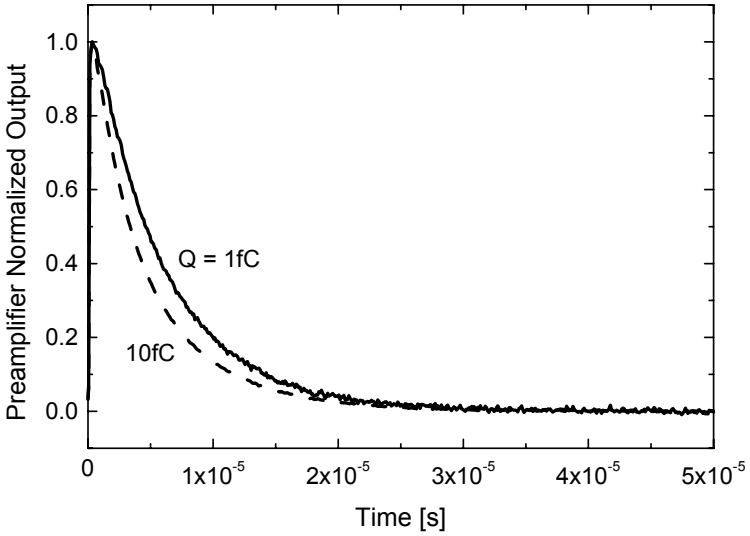
Reset System

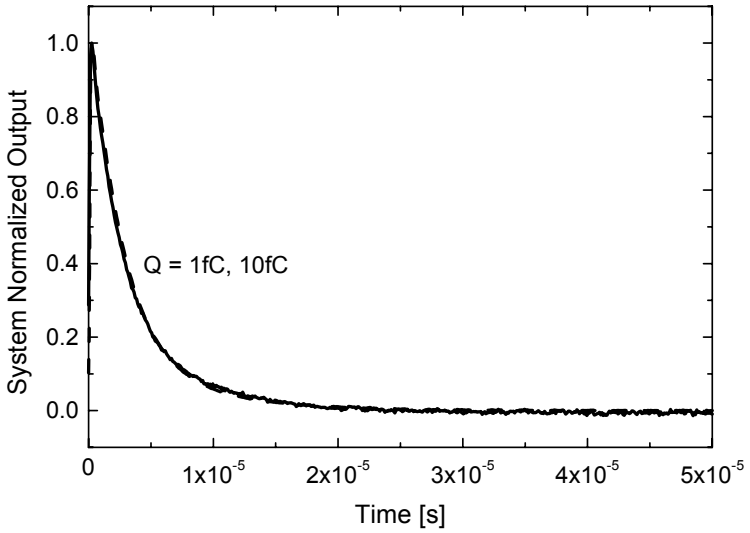


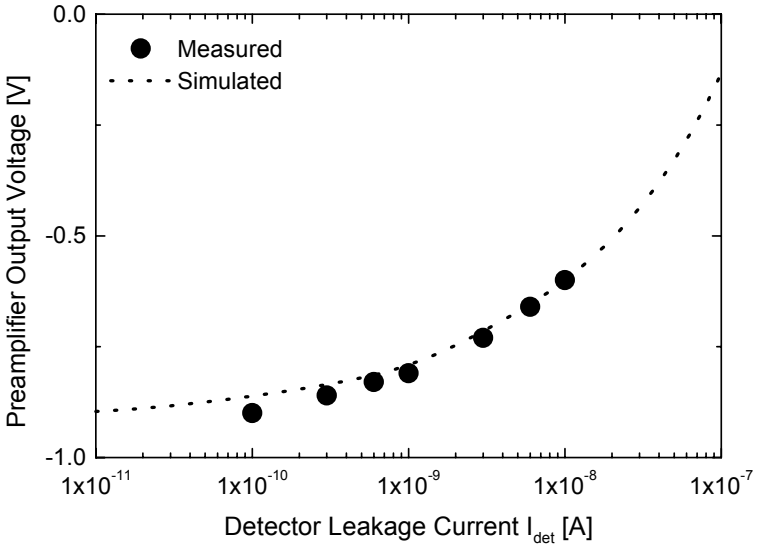
$N_1 = 24$ $N_2 = 6$

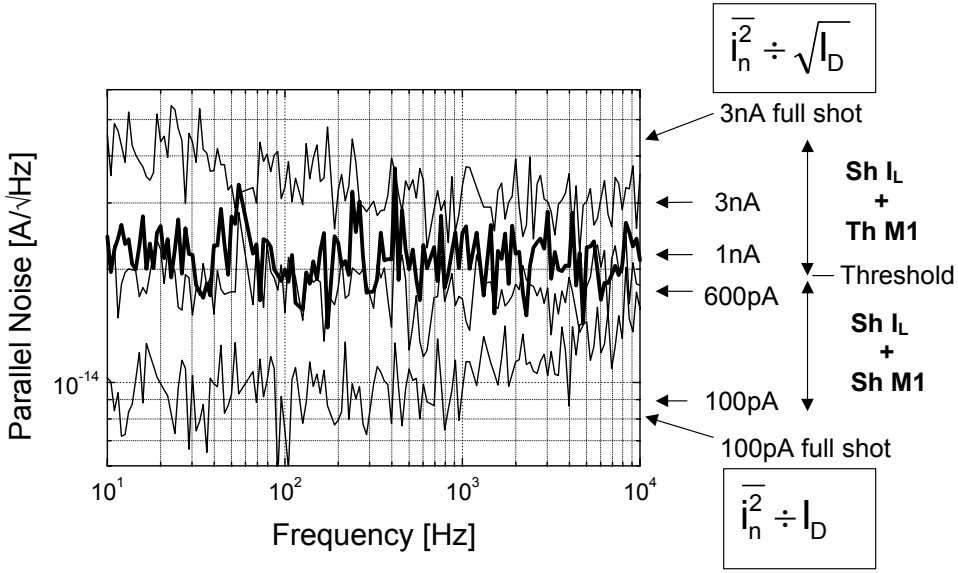


Reset System: Experimental Results

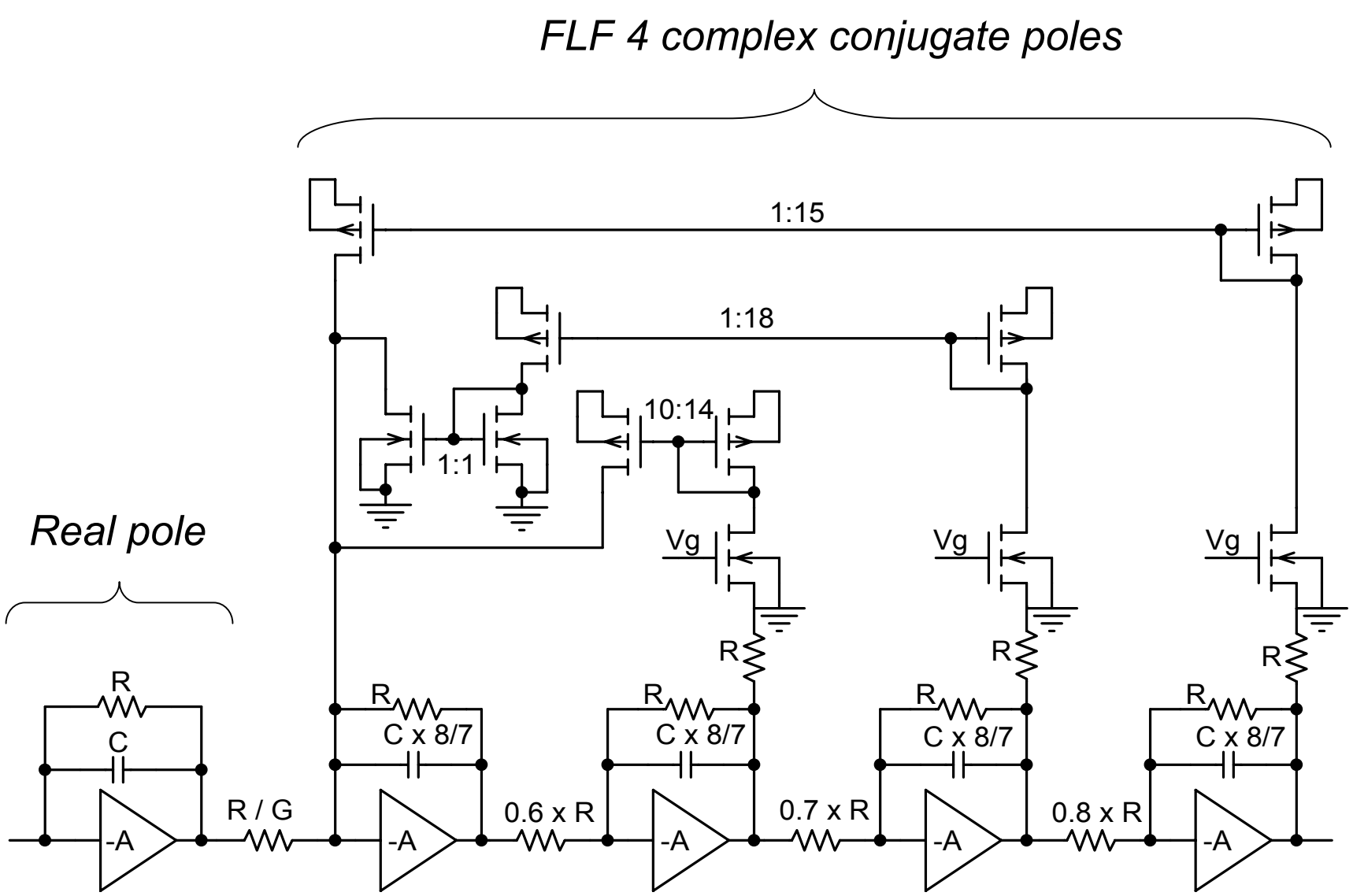




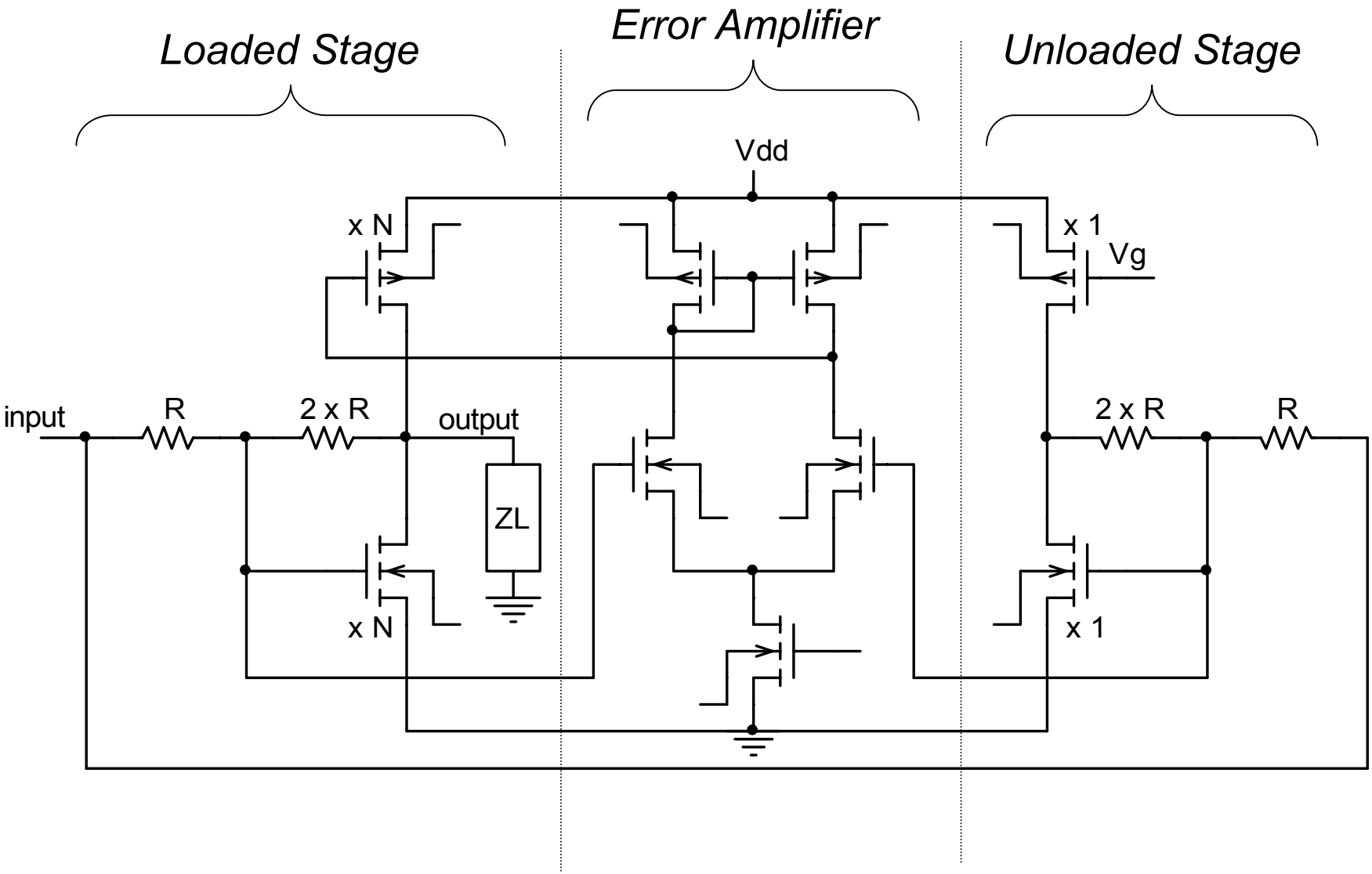




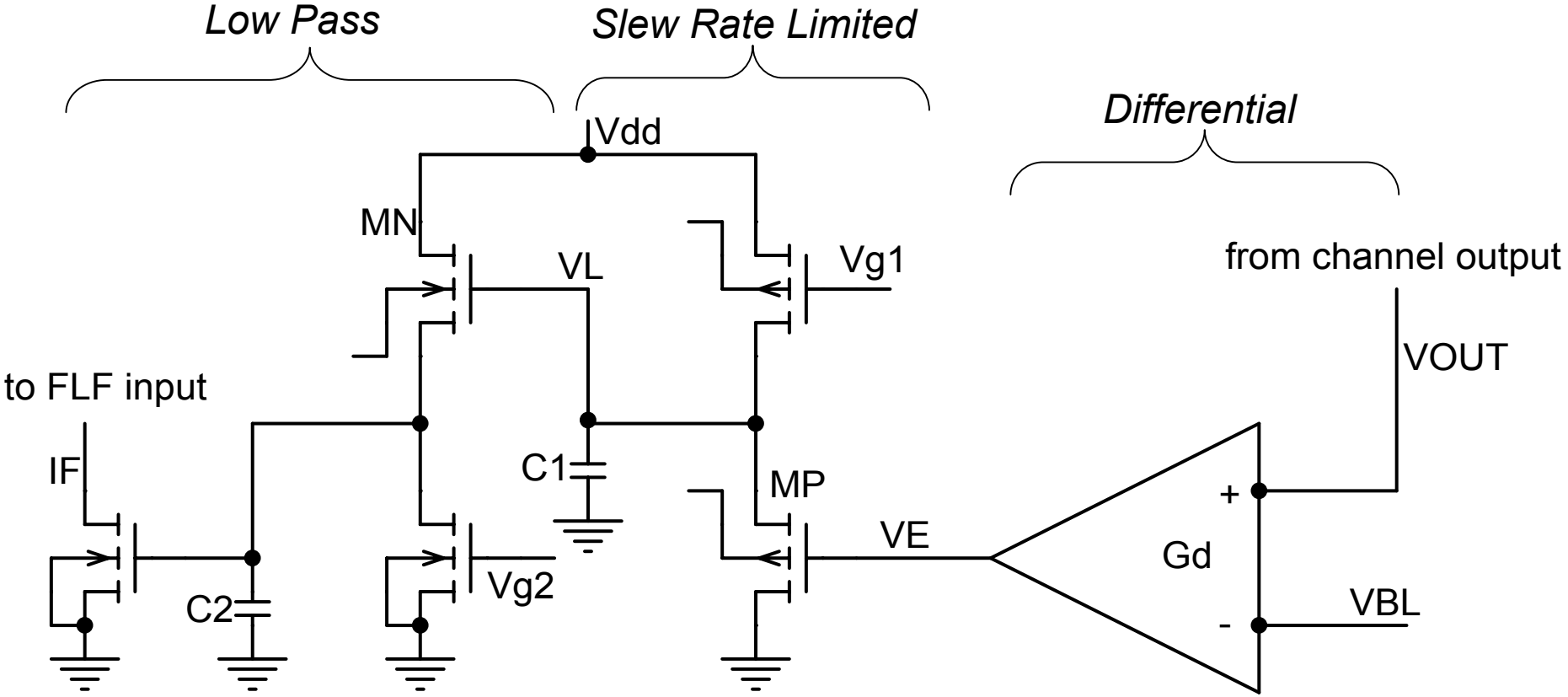
Shaper Amplifier: 5th order complex semigaussian

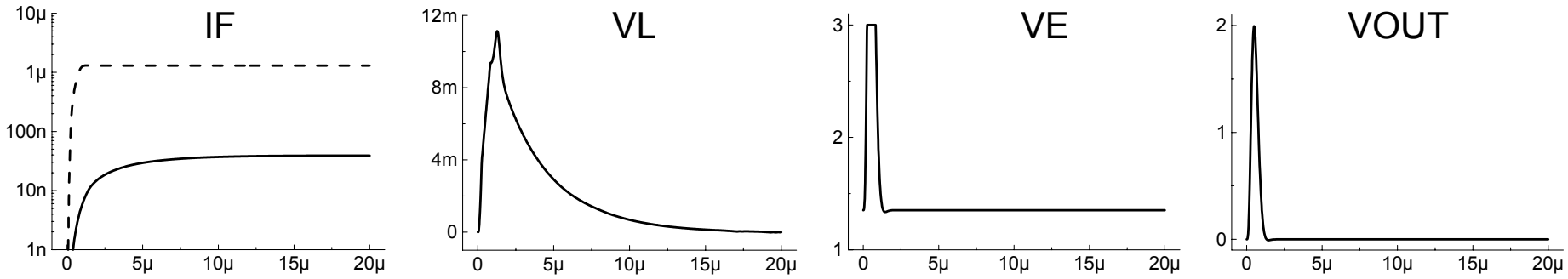


Output Stage

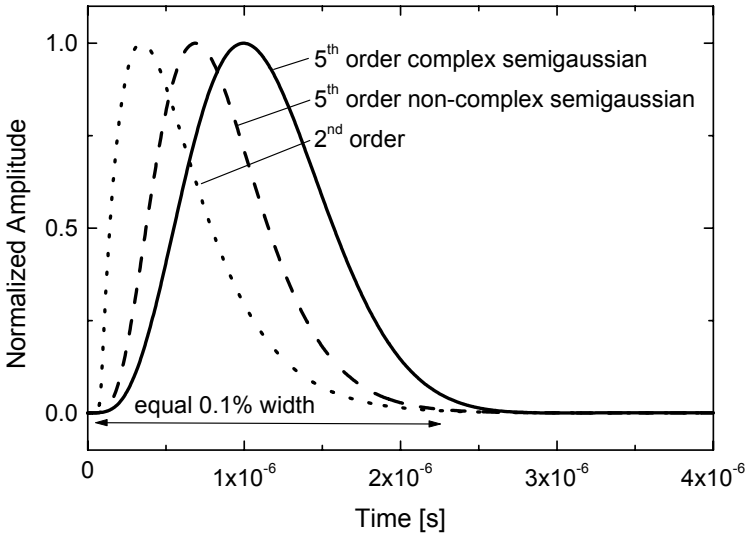


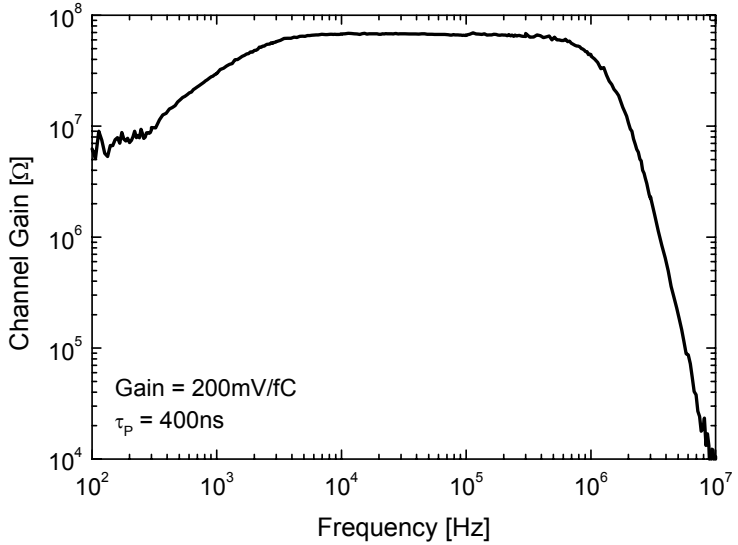
BLH (Baseline Holder)

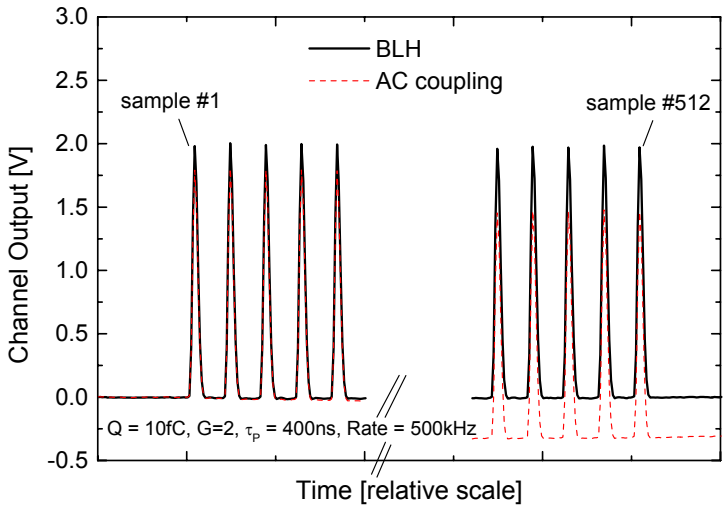


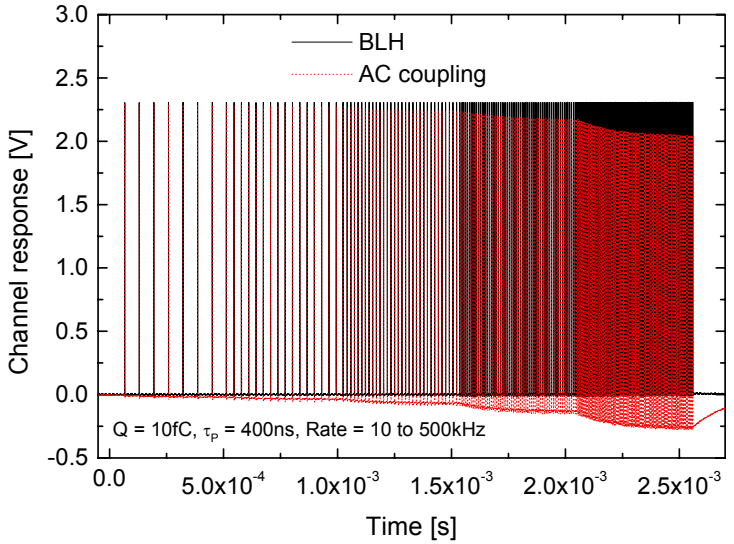


SHAPER / BLH (Baseline Holder): Experimental Results









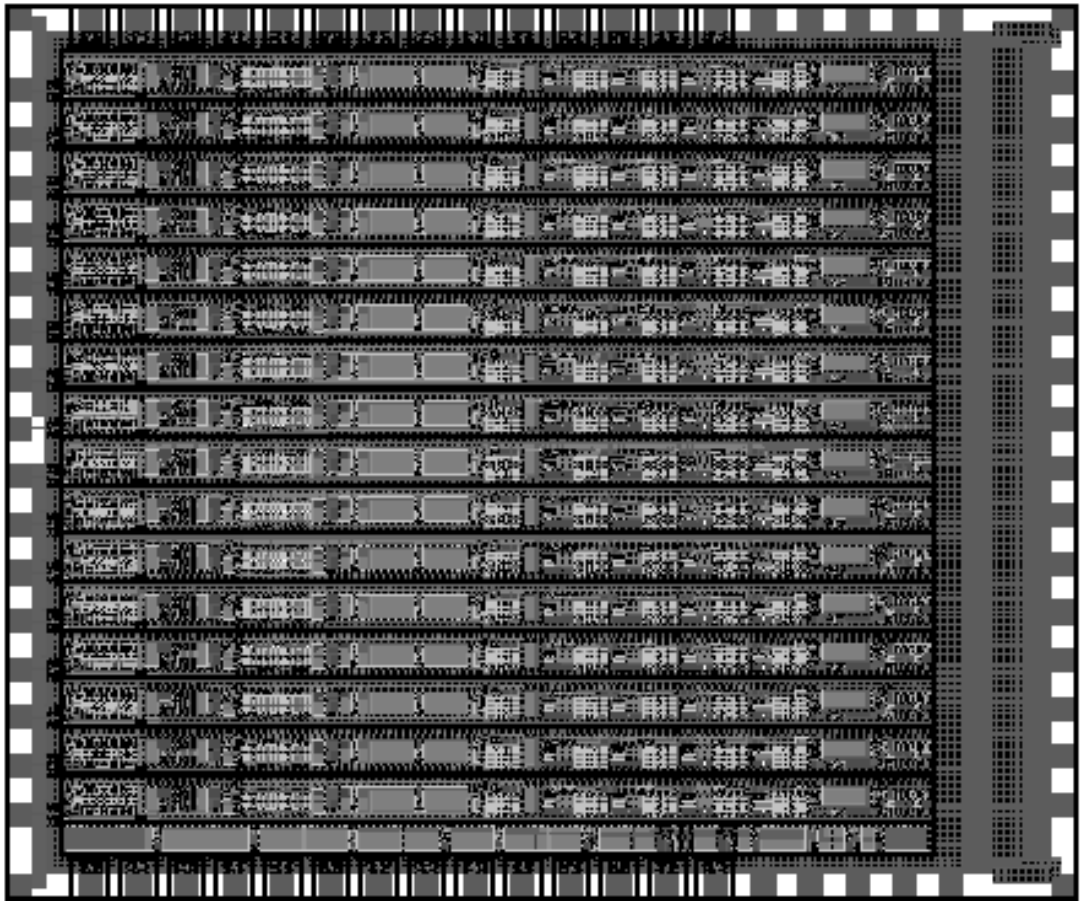
Prototypes

	application	*channels*	*shaping*	*gain [mV/fC]*	*pk time [μs]*
IC45	B,D,E	2	UNI	200	0.4
IC46	B,D,E	2	UNI	200	0.4
IC48	B	2	BIP	260	0.2
IC49	B,D,E	4	UNI	200	0.4
IC54	A	16	UNI	30-200	0.9 - 1.2
IC55	C	8	UNI	26-180	2.25 - 3.0
IC56	B	4	BIP	260	0.2
IC59	D,E	4	UNI	200	0.4
IC60	A	16	UNI	30-200	0.6 - 4.0

A general purpose
B bone densitometry
C intra-operative probe
D baggage scanning
E down-hole logging

Typical

Size 5.1mm × 3.7mm
Ch.s 16



Gain	30mV/fC, 50mV/fC, 100mV/fC, 200mV/fC
Pk Time	0.6μs, 1.2μs, 2.4μs, 4.0μs
ENC^2 (@ 1.2μs, 200mV/fC)	$35^2 + 35^2/pF^2 + 55^2/\sqrt{nA} + 0.2Q/q$
Integral Linearity Error	< 0.3%
Cross Talk	< 0.4% (< 0.1% non adj.)
Power	≈ 4mW + 18mW/ch.
Baseline Adjustment	-100mV ÷ +400mV

Test With CdZnTe Detector

Conclusions and Future Work