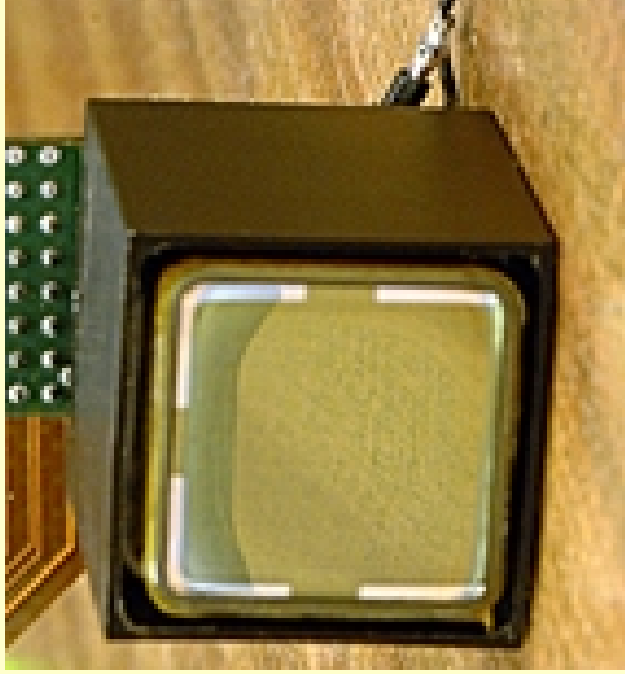
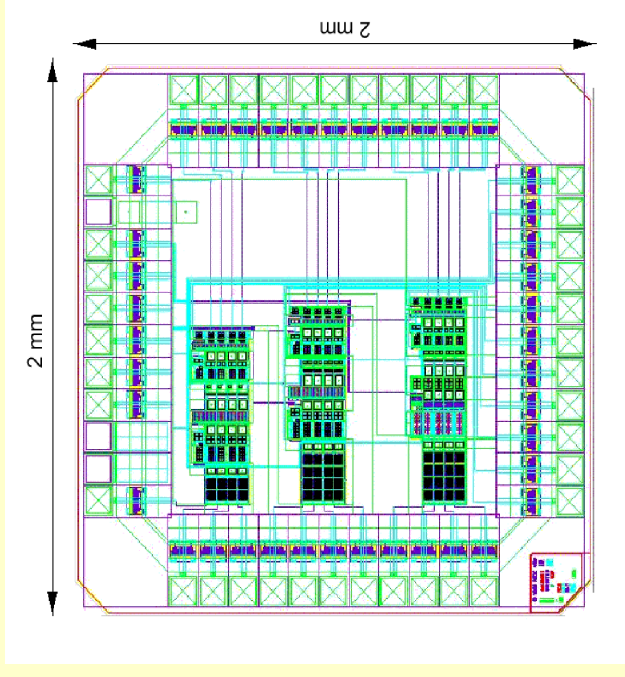


# Hamamatsu R7600 03 M64 9C23A4 Mapmt / BeetleMap1.0 Test Structure

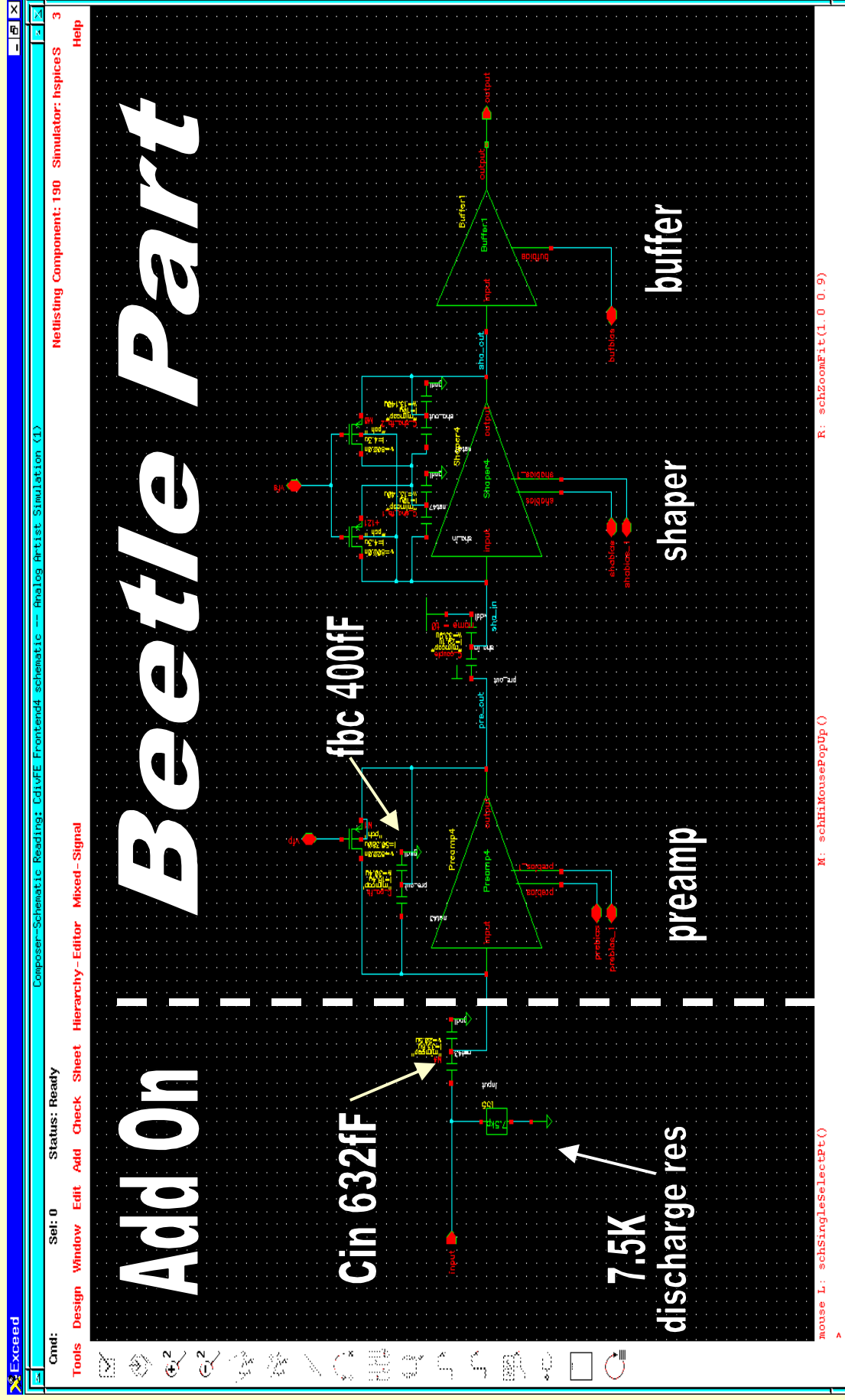


Size 30x30x50mm<sup>3</sup>



Size 2x2mm<sup>2</sup>

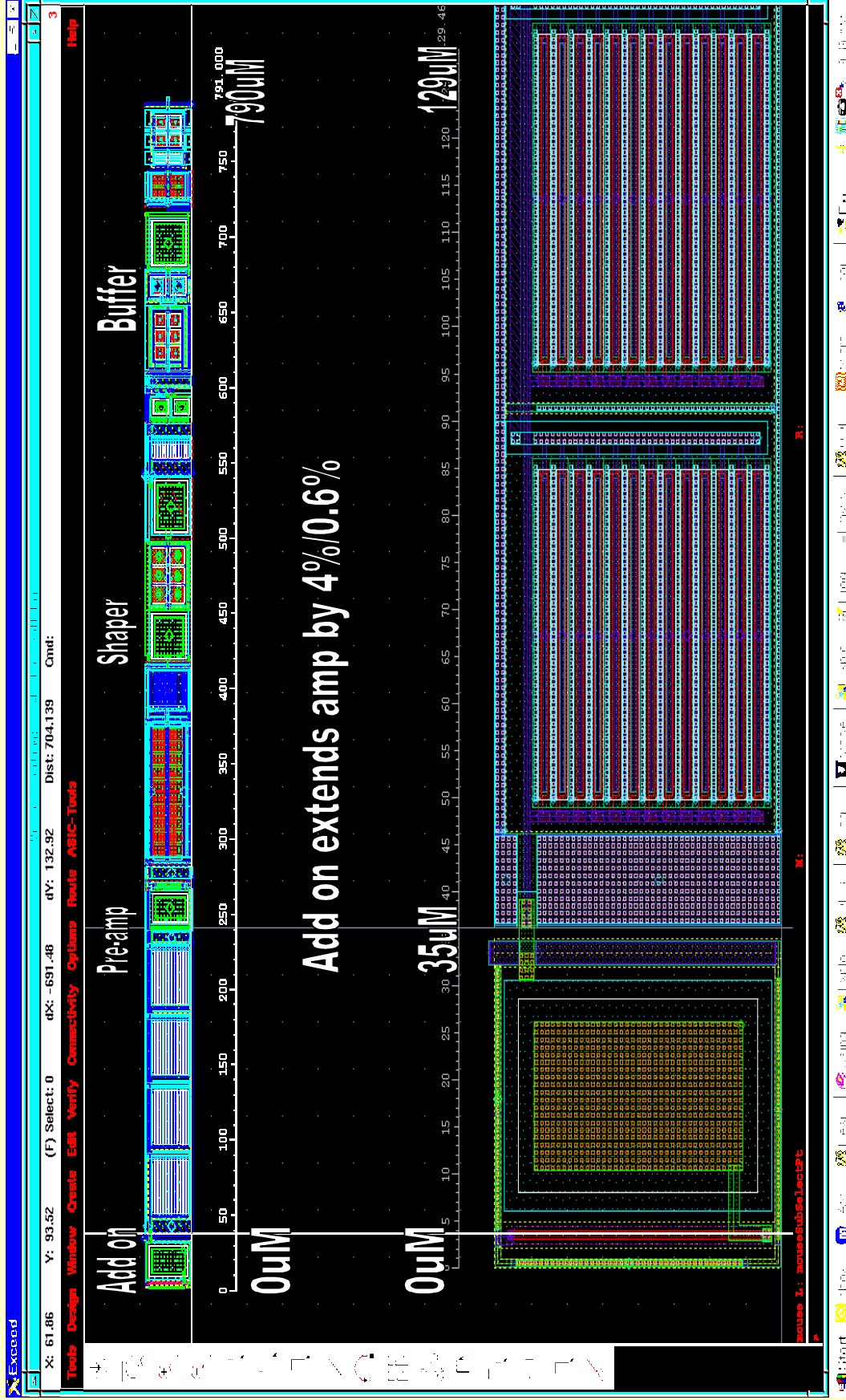
# BeetleMap1.0 front-end schematic



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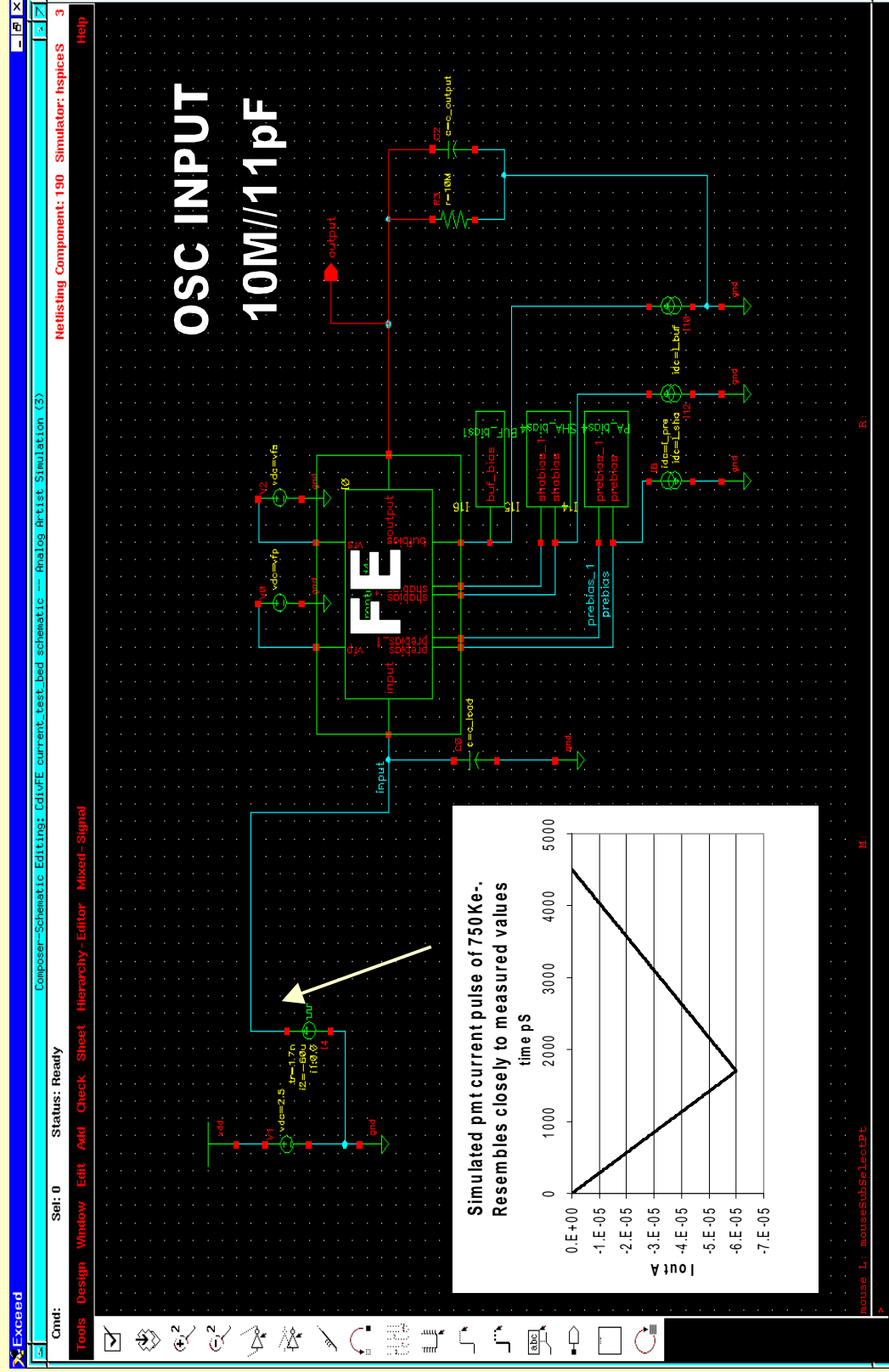
# BeetleMap1.0 front-end silicon layout



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# Simulation Test Bed For 750K e<sup>-</sup> I Pulse 40pF Load

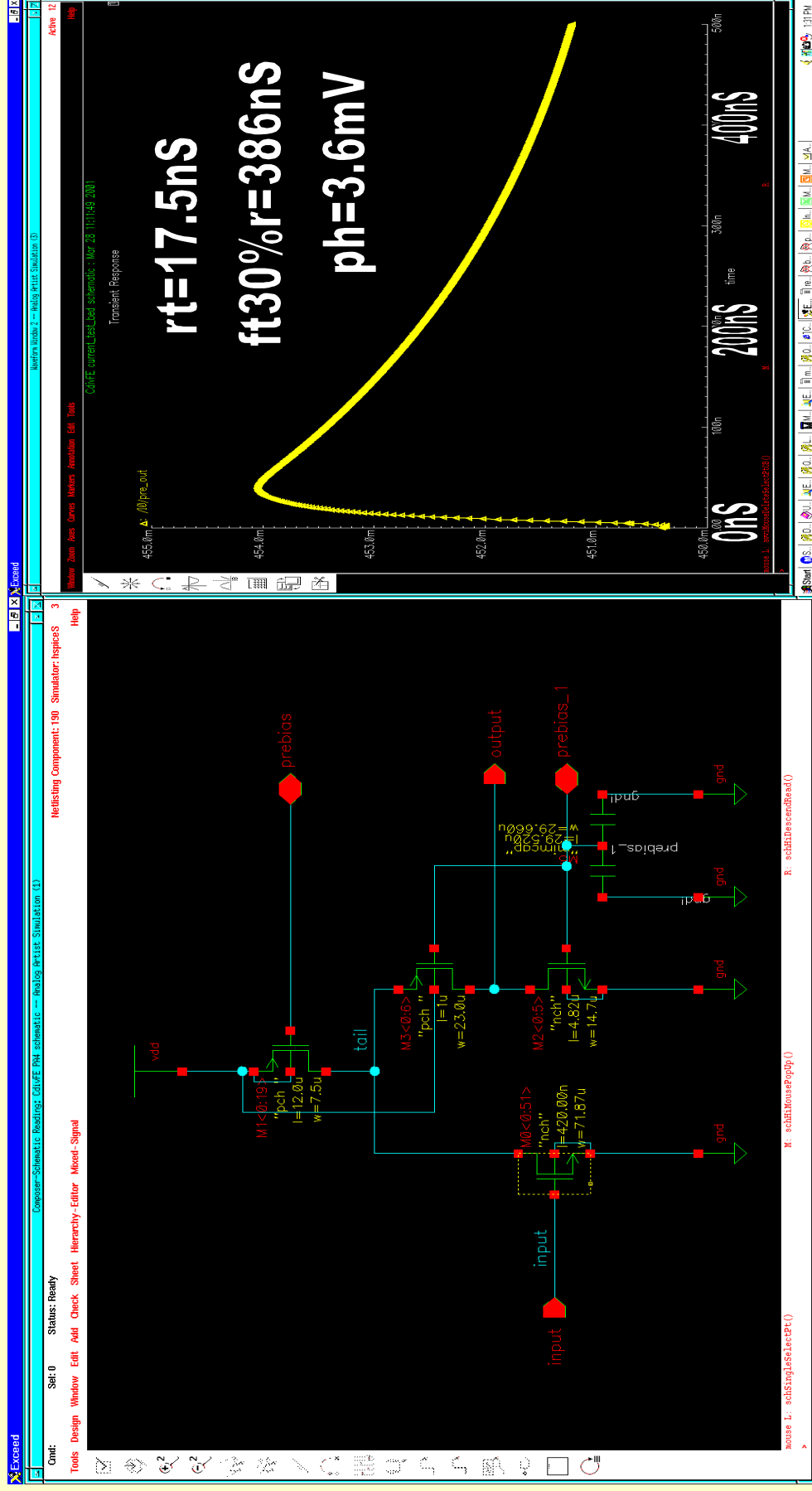


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# Simulation of Pre-amp

$750,000e-1$  pulse in,  $v_{fp}=1V$ ,  $prebias = 300\mu A$

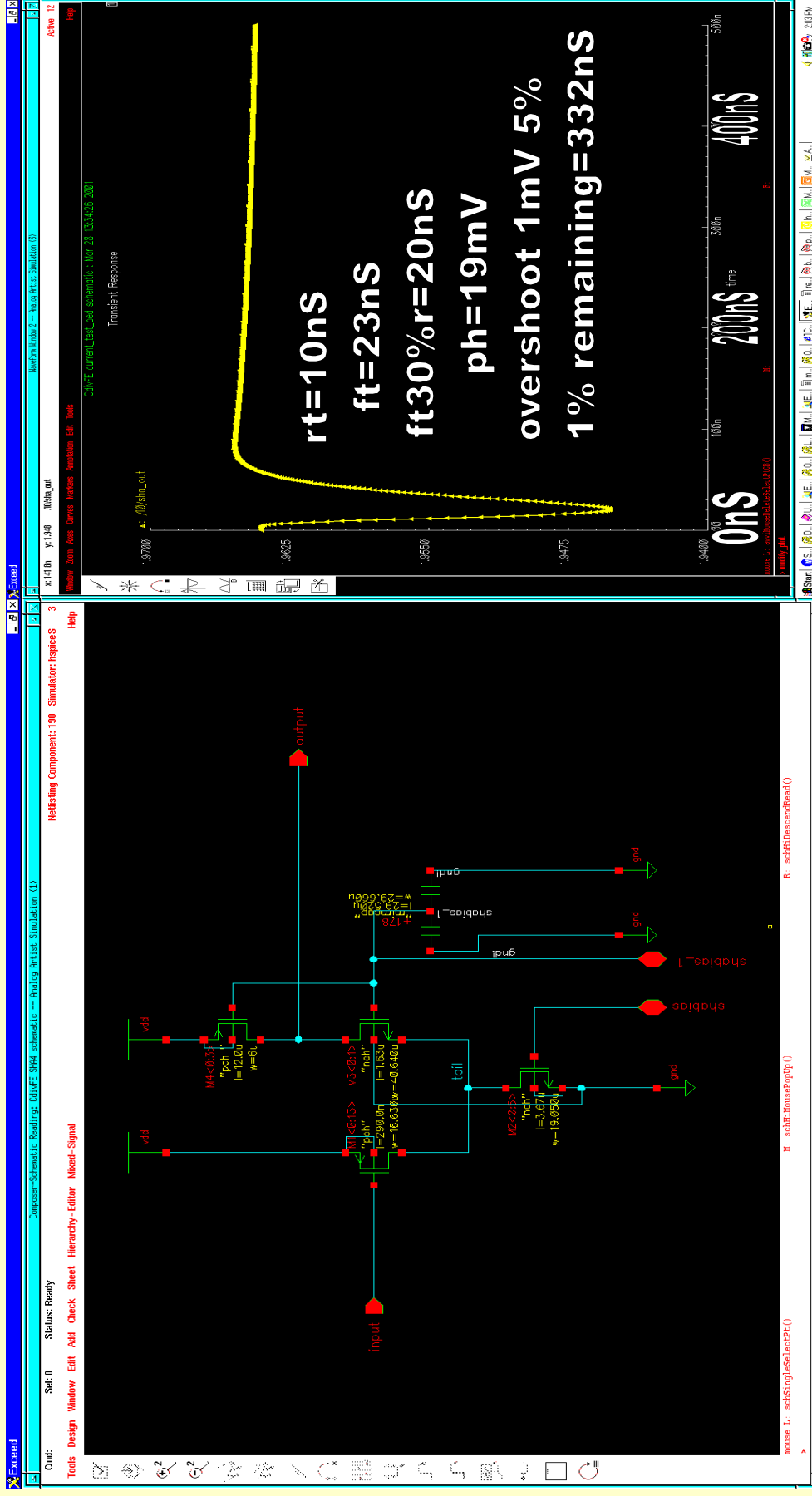


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# Simulation of Shaper

750,000 e- I Pulse in, vfs=0.1V, shabias=200uA

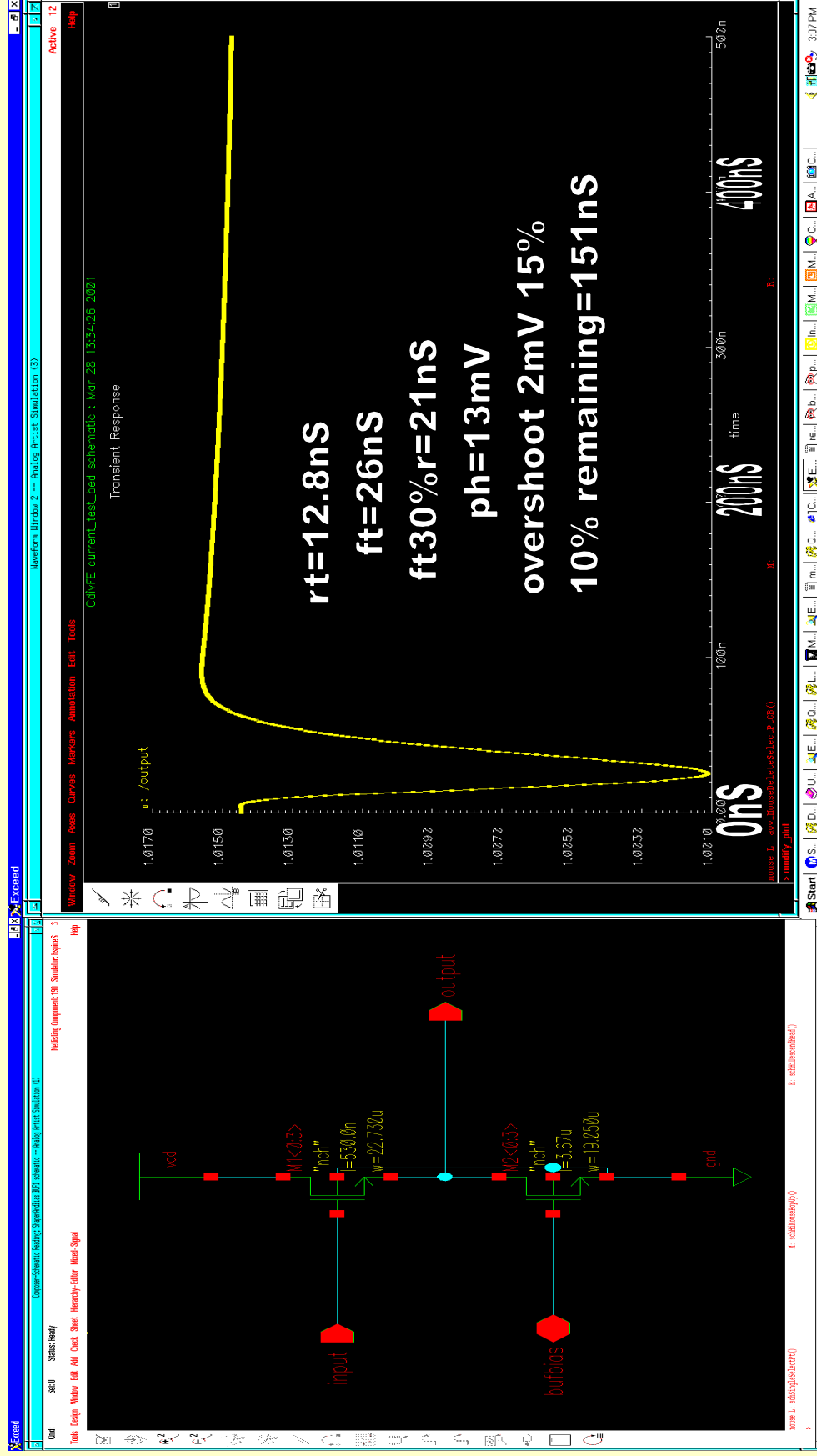


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# Buffer/Output

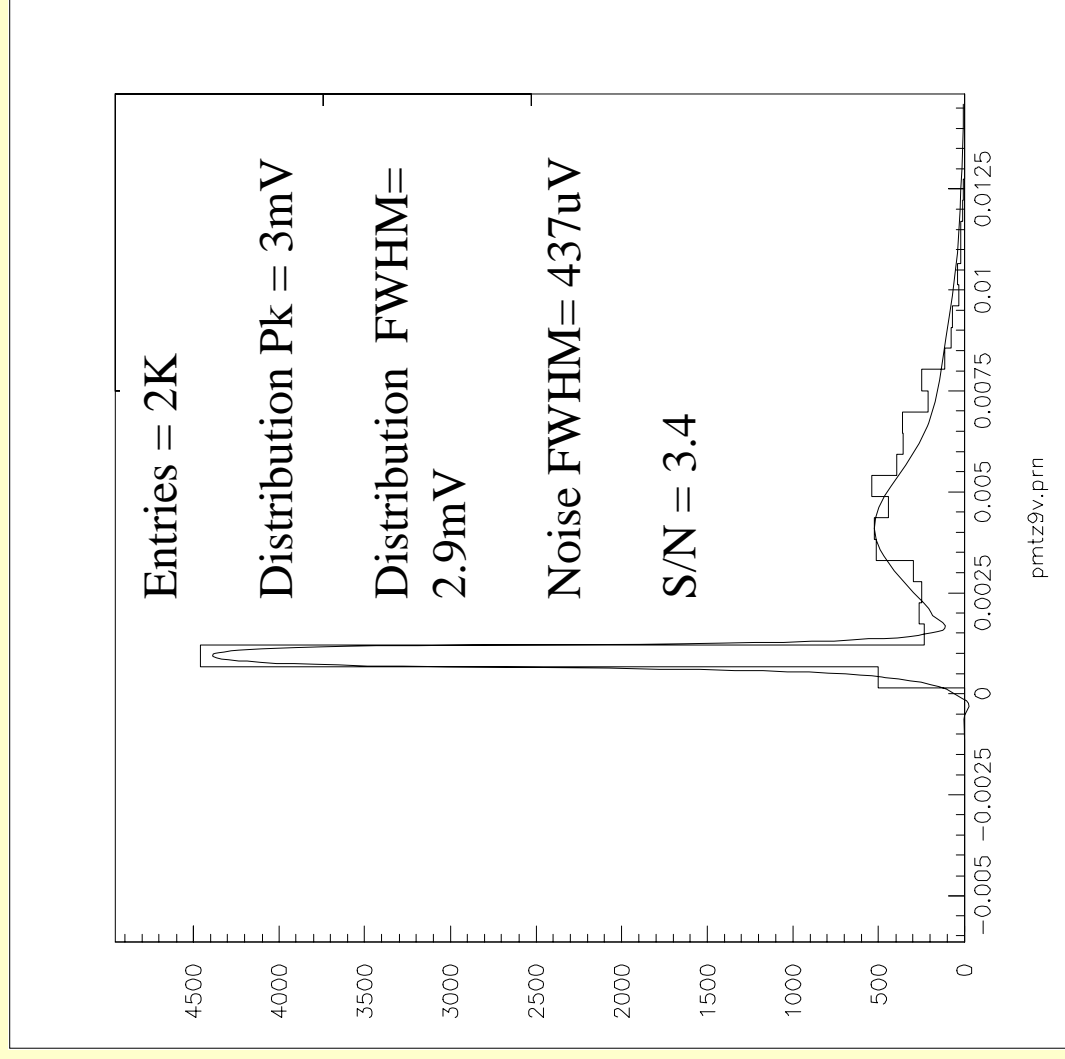
750,000 e- I Pulse in, bufbias =150uA



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# MApmt Connected Directly To 50 Ohm Scope.

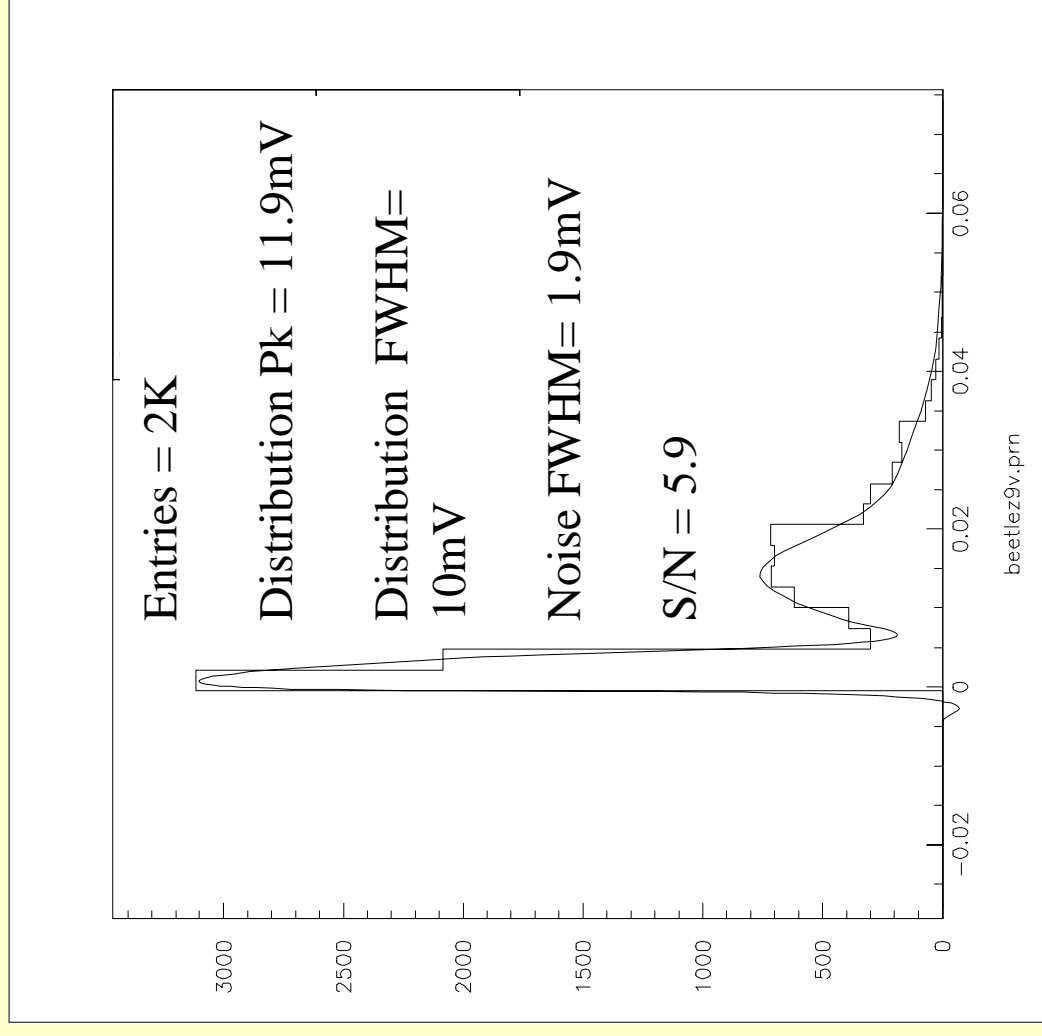


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# MAPmt Connected To BeetleMap & 40pF Load.

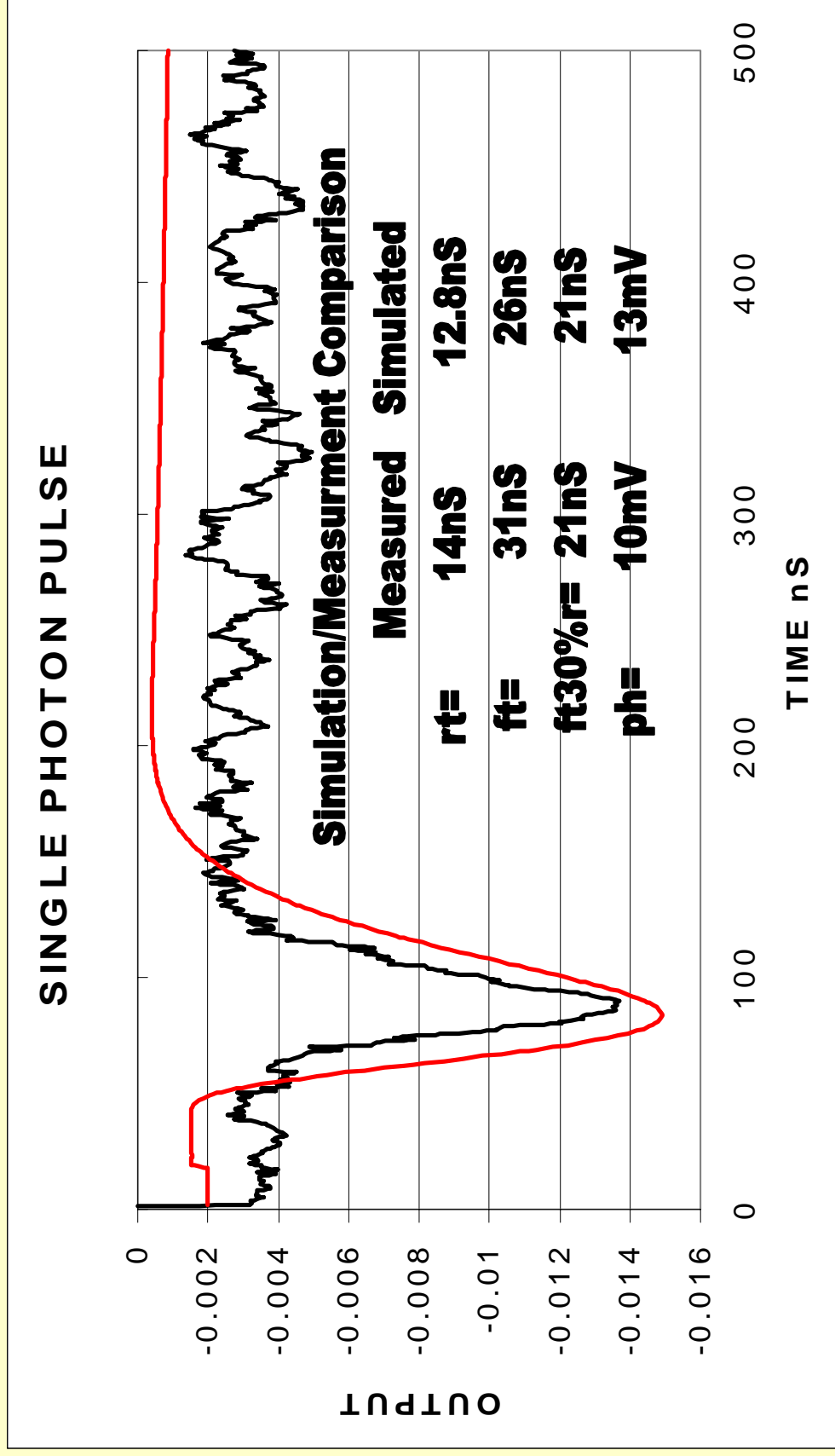


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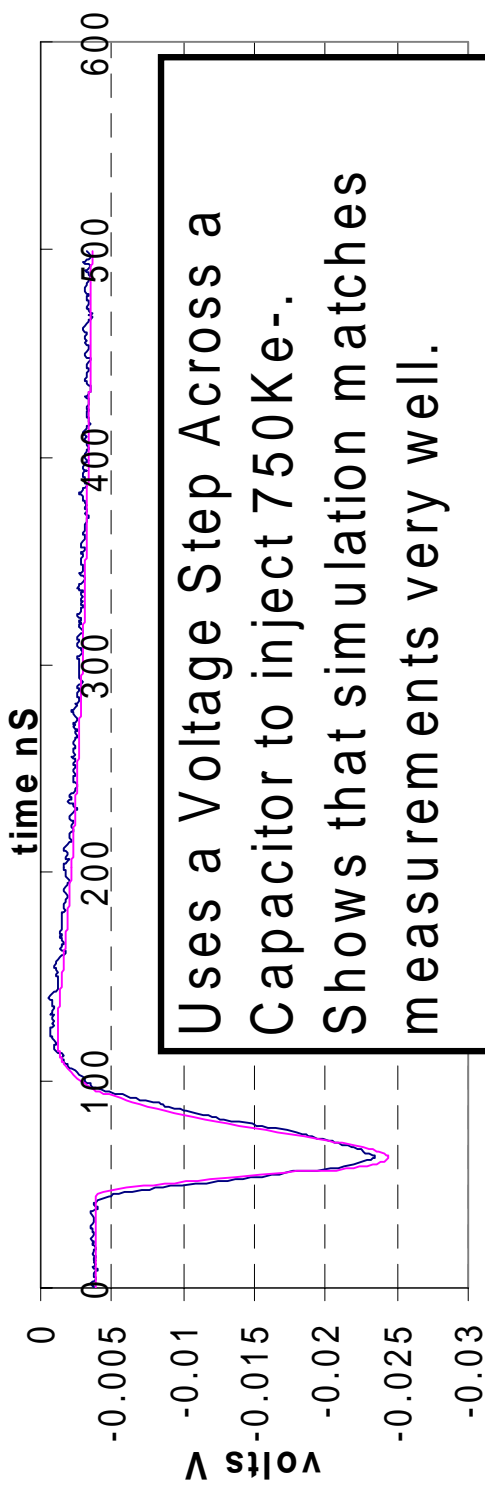
# Buffer Output Simulated & Measured

750,000 e- in Pulse, bufbias = 150uA



# Bench Test With Fixed Capacitor Charge Injection 750,000 e- in & 20pF Load

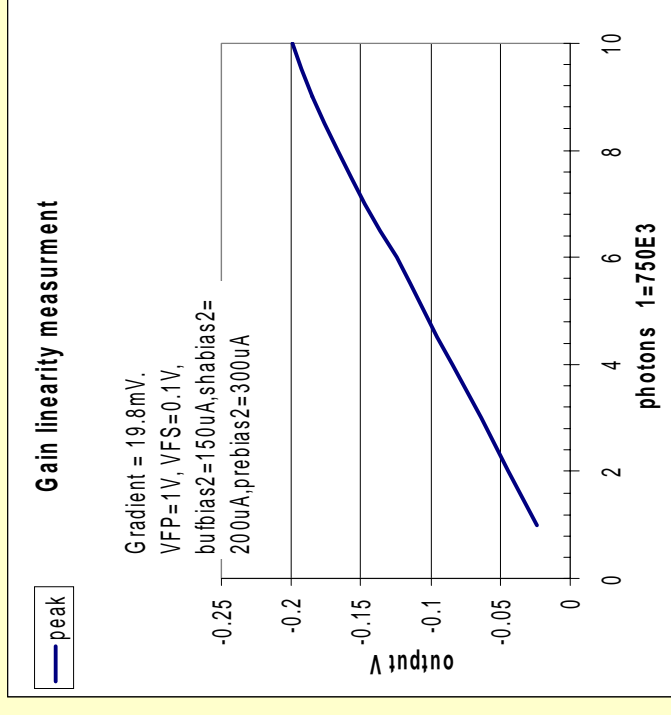
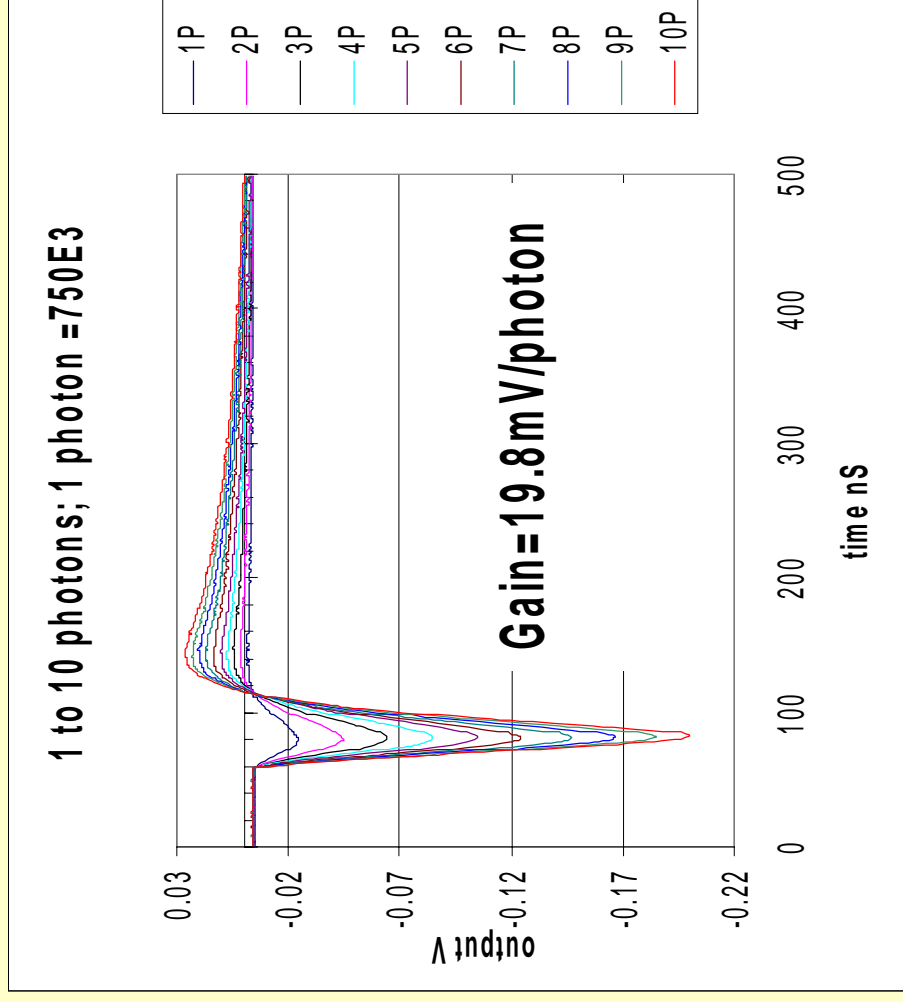
**Measured Average Pulse 6:1 and Simulated Single Pulse.**



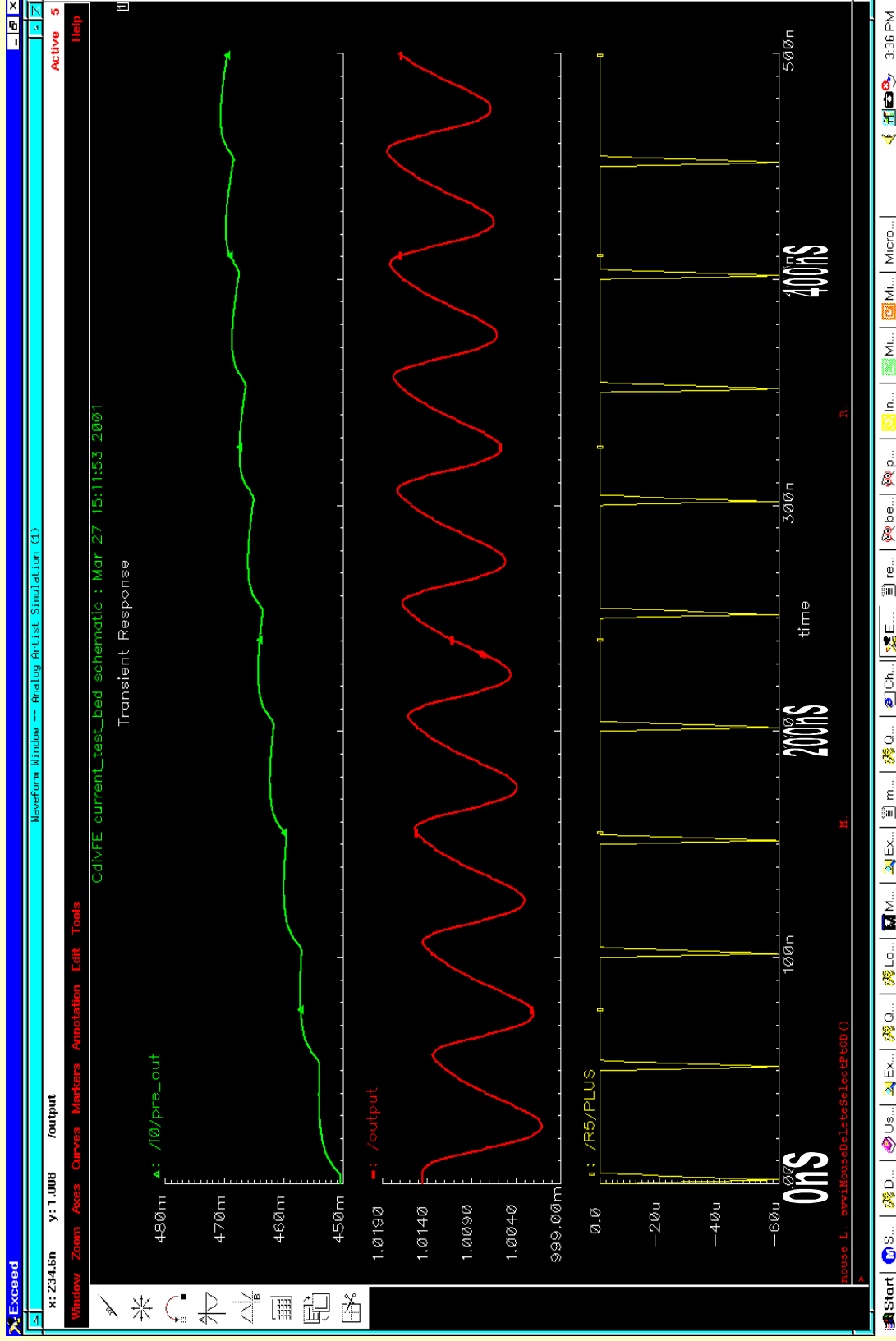
Uses a Voltage Step Across a Capacitor to inject 750Ke-. Shows that simulation matches measurements very well.

— Measured output — Simulated output

# Gain functionality for 750,000 e- Using TestBed Charge Injection & 20pF Load



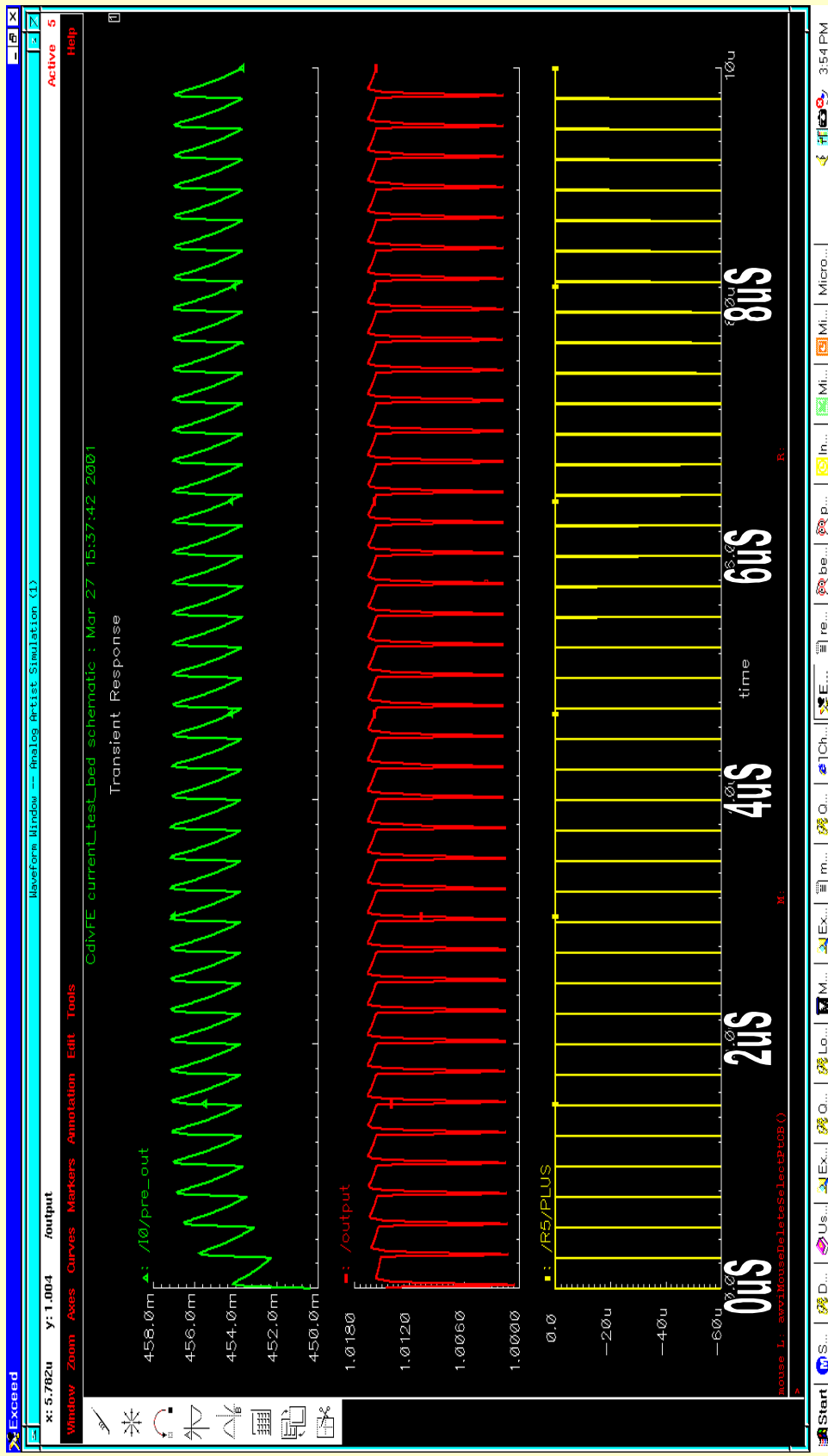
# A Photon Hit (750Ke<sup>-</sup>) Every 50nS



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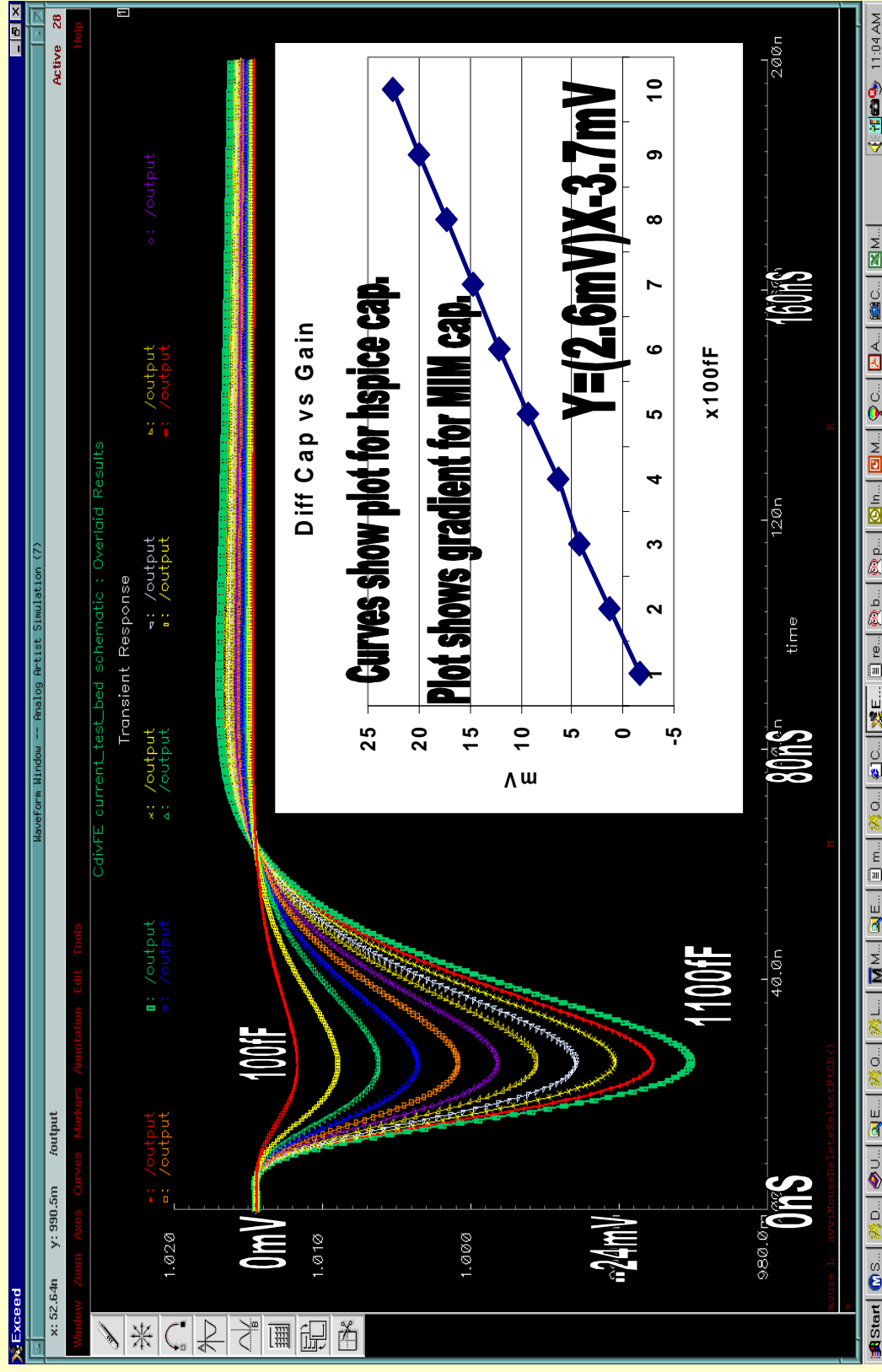
# A 10% Occupancy Results in A 1mV Shift In The OutPut



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# Effects Of Cin Capacitance. 100fF To 1100fF In Steps Of 100fF

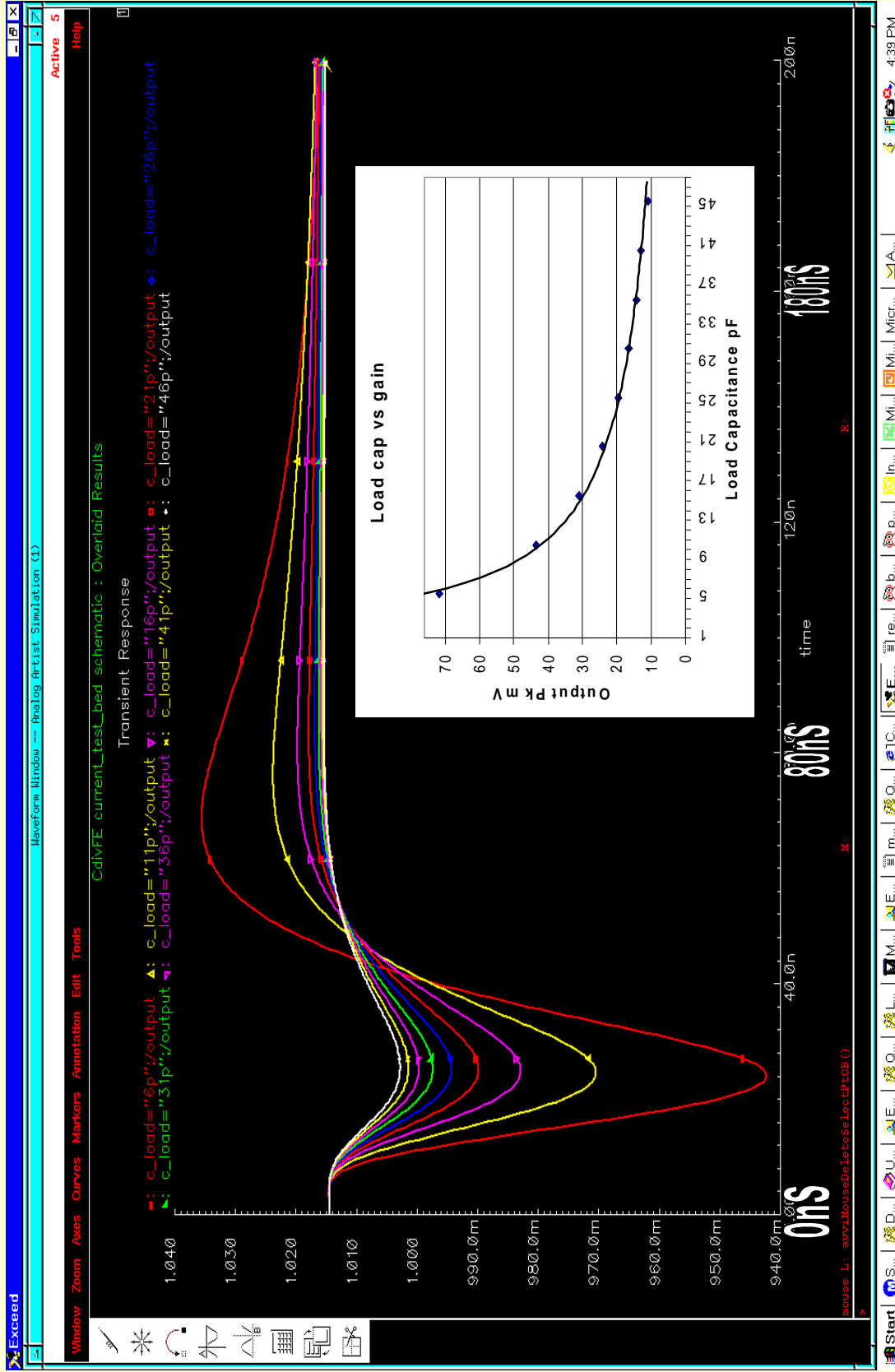


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# Effects Of Load Capacitance

## 6pF To 46pF In Steps Of 5pF



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## Conclusion

BeetleMap can be easily integrated into the current Beetle.

Simulation can be relied upon.

+/- 10x750,000e<sup>-</sup> is achievable.

10% single channel occupancy is o.k.

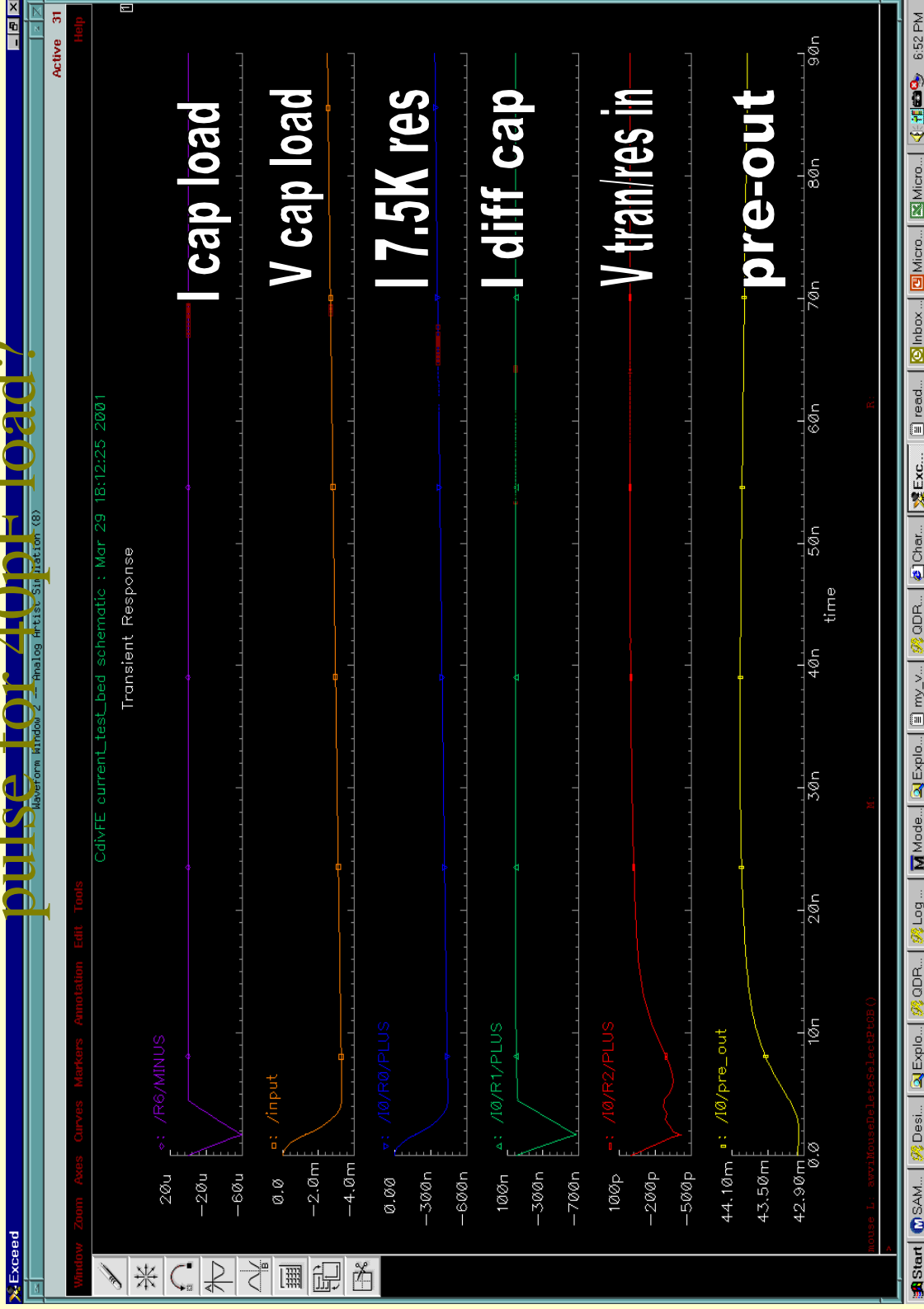
Will be able to operate in a analogue or binary mode.

Communication with Heidelberg continues and MPW's are frequent.

Load capacitance is important with respects to gain and gain variation.

10-20% overshoot exists depending on gain chosen.

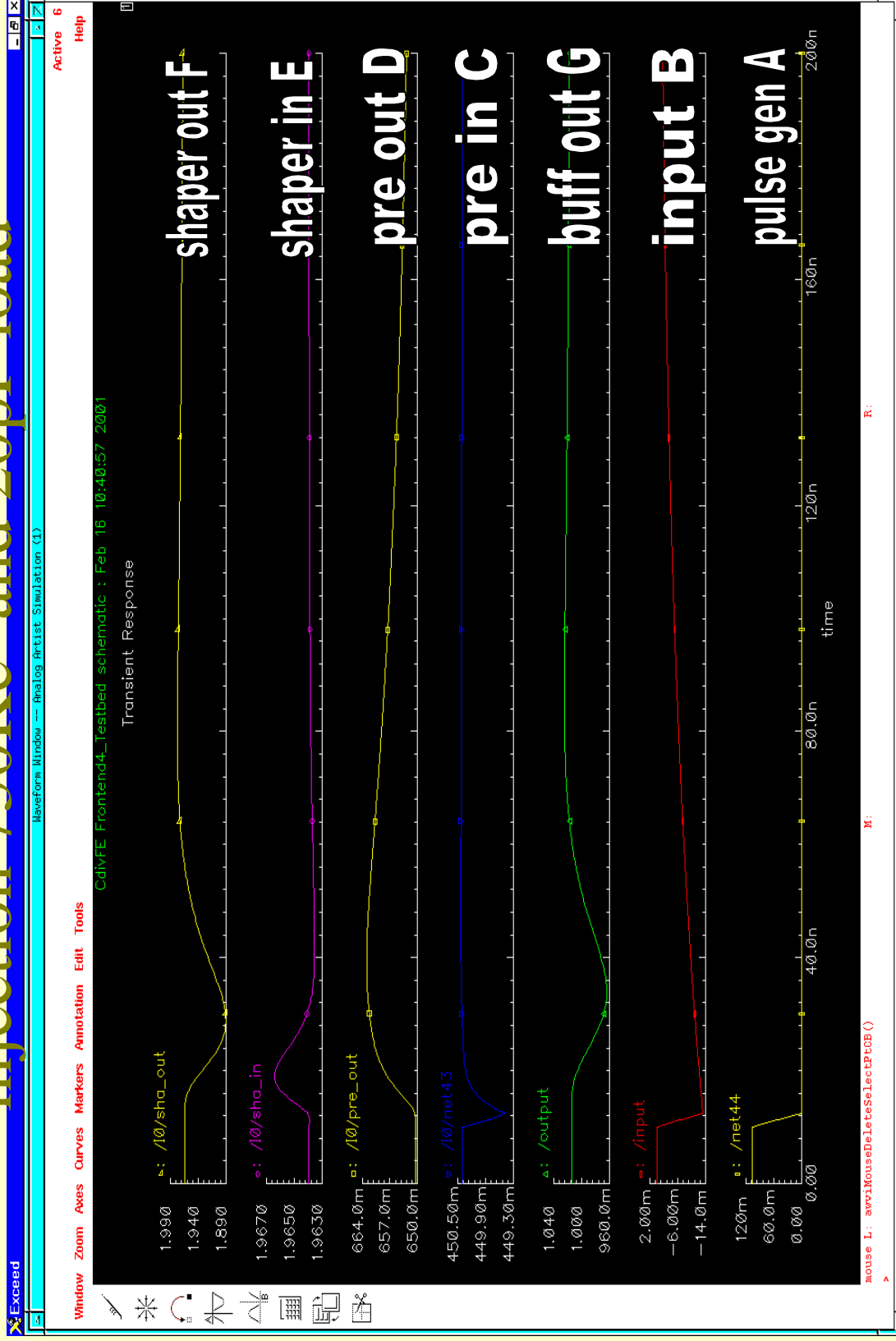
# Voltage pulse shapes for 750K e- current pulse for 40pF load?



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# Voltage pulse shapes for capacitor charge injection 750Ke- and 20pF load



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