

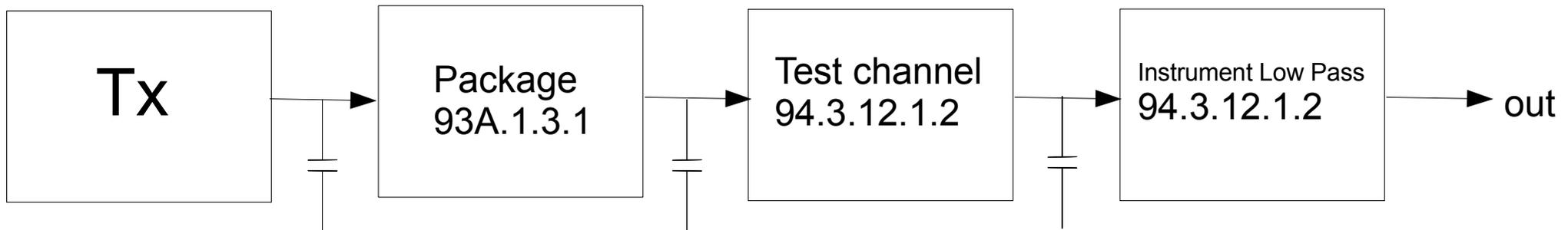
Defining Tx bandwidth with pulse gain VS rise time

With illustration for clause 94

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2012 October 24

Basic Tx model simulated

Based on specification on how Tx is measured.



Square wave
PRBS13 PAM4

Multiple of
Package model

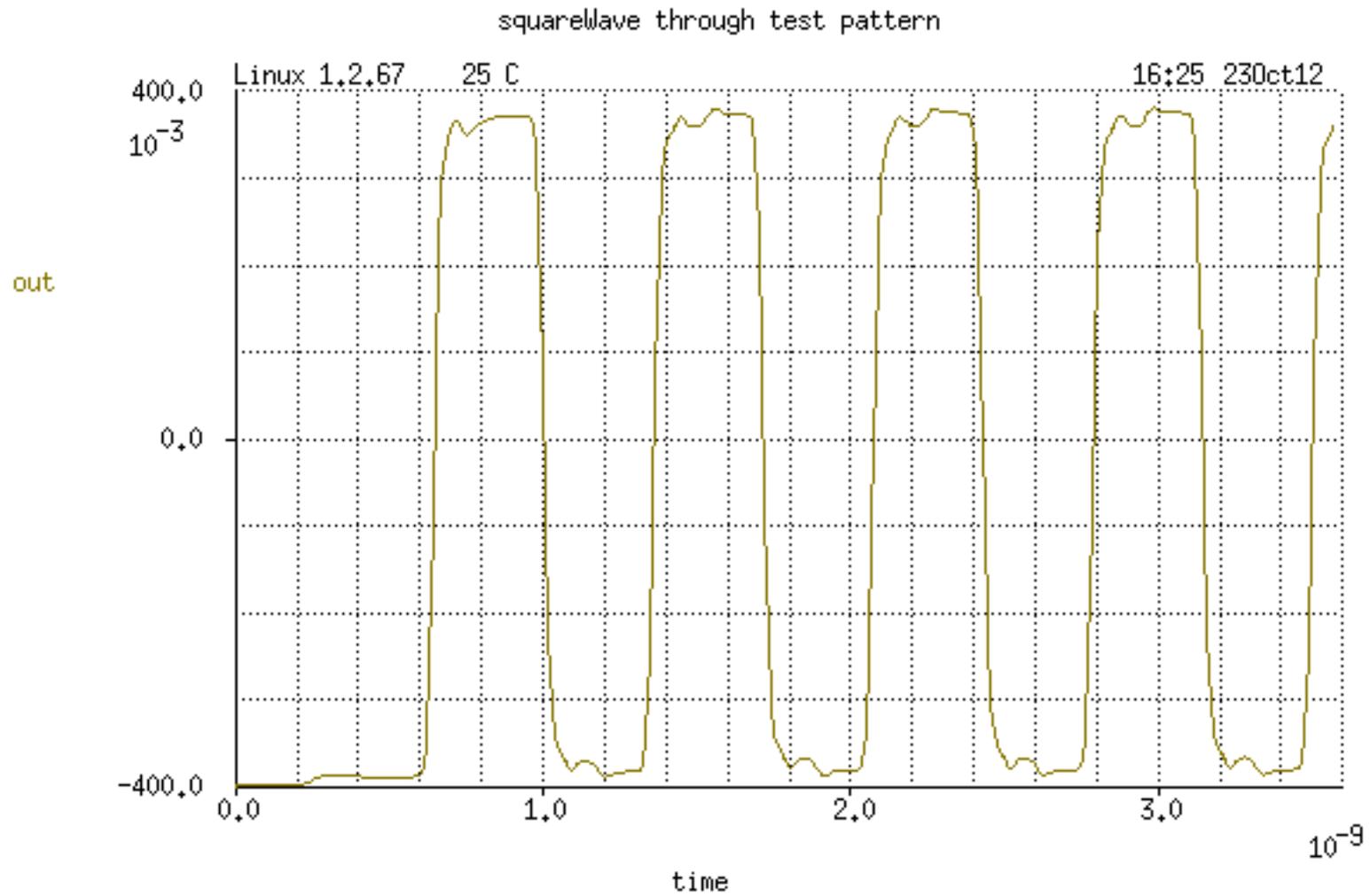
Per spec

4th order Bessel

Trapezoidal
Rise time:
0.1 UI
0.5 UI

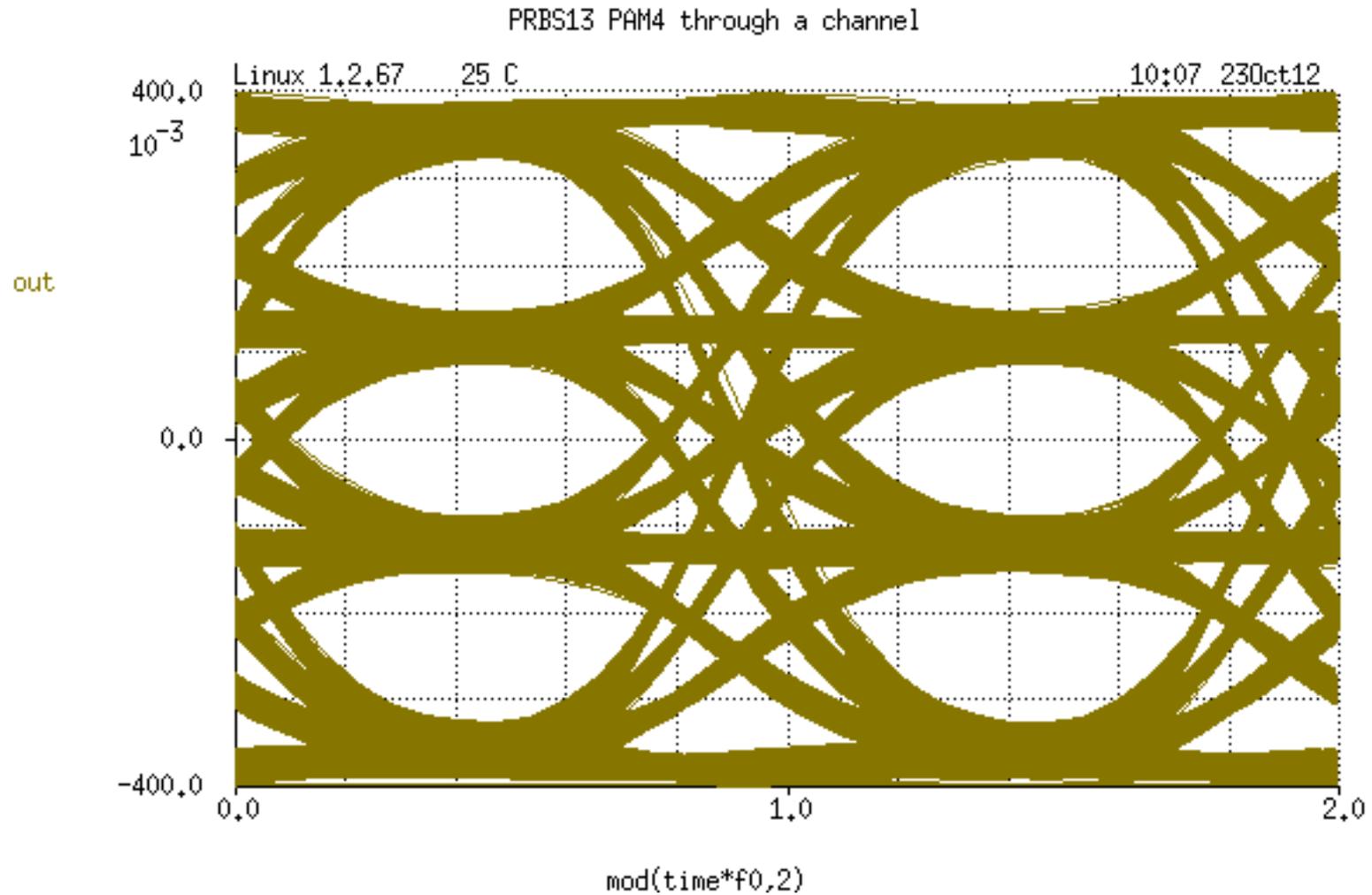
Capacitors represent reflections

Square wave with baseline measurement channel



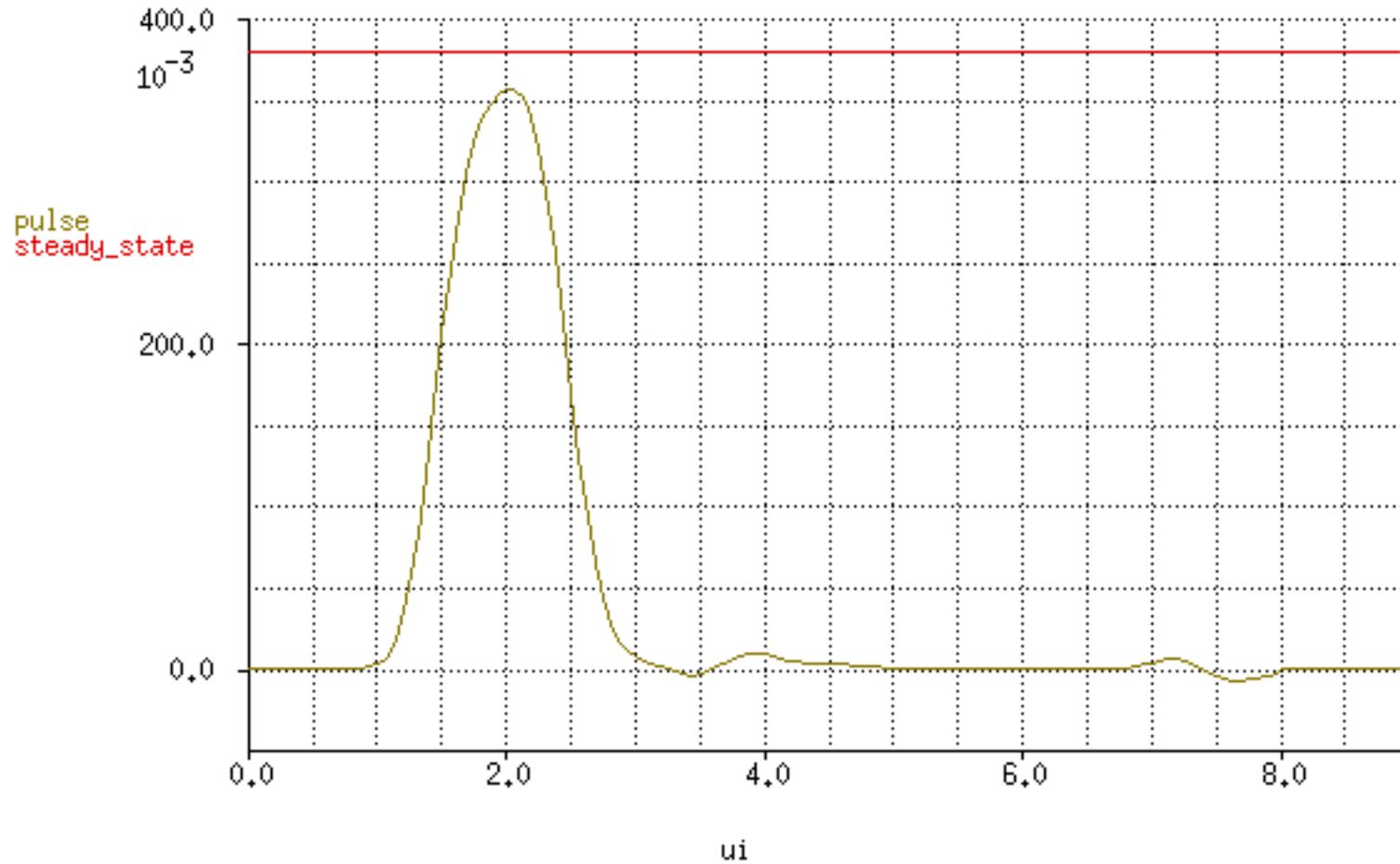
Rise time: 31.4ps

PAM4 PRBS13 eye with baseline measurement channel



Eye: 0.65 UI x 170 mV

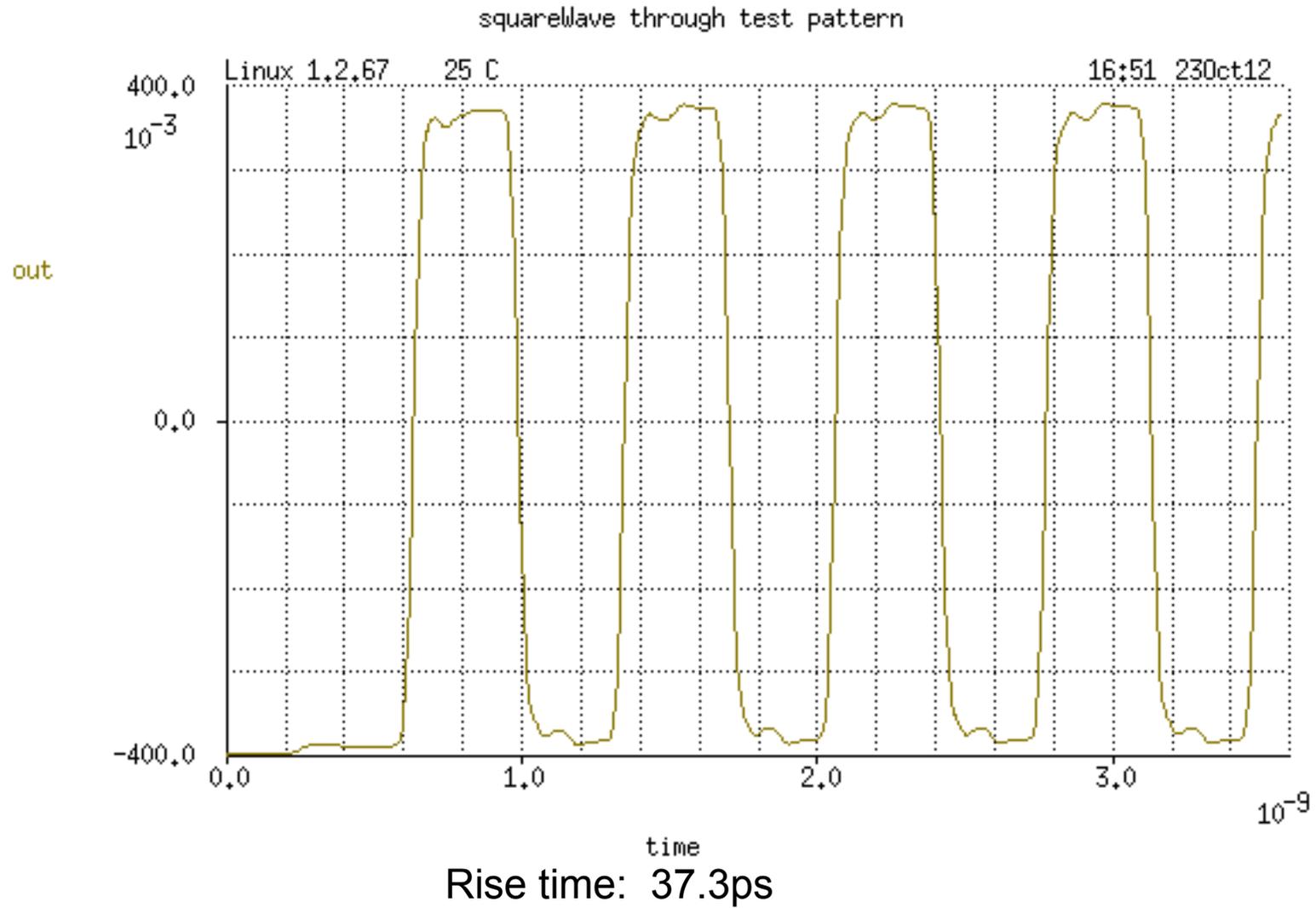
PAM4 PRBS13 linear fit pulse with baseline measurement channel



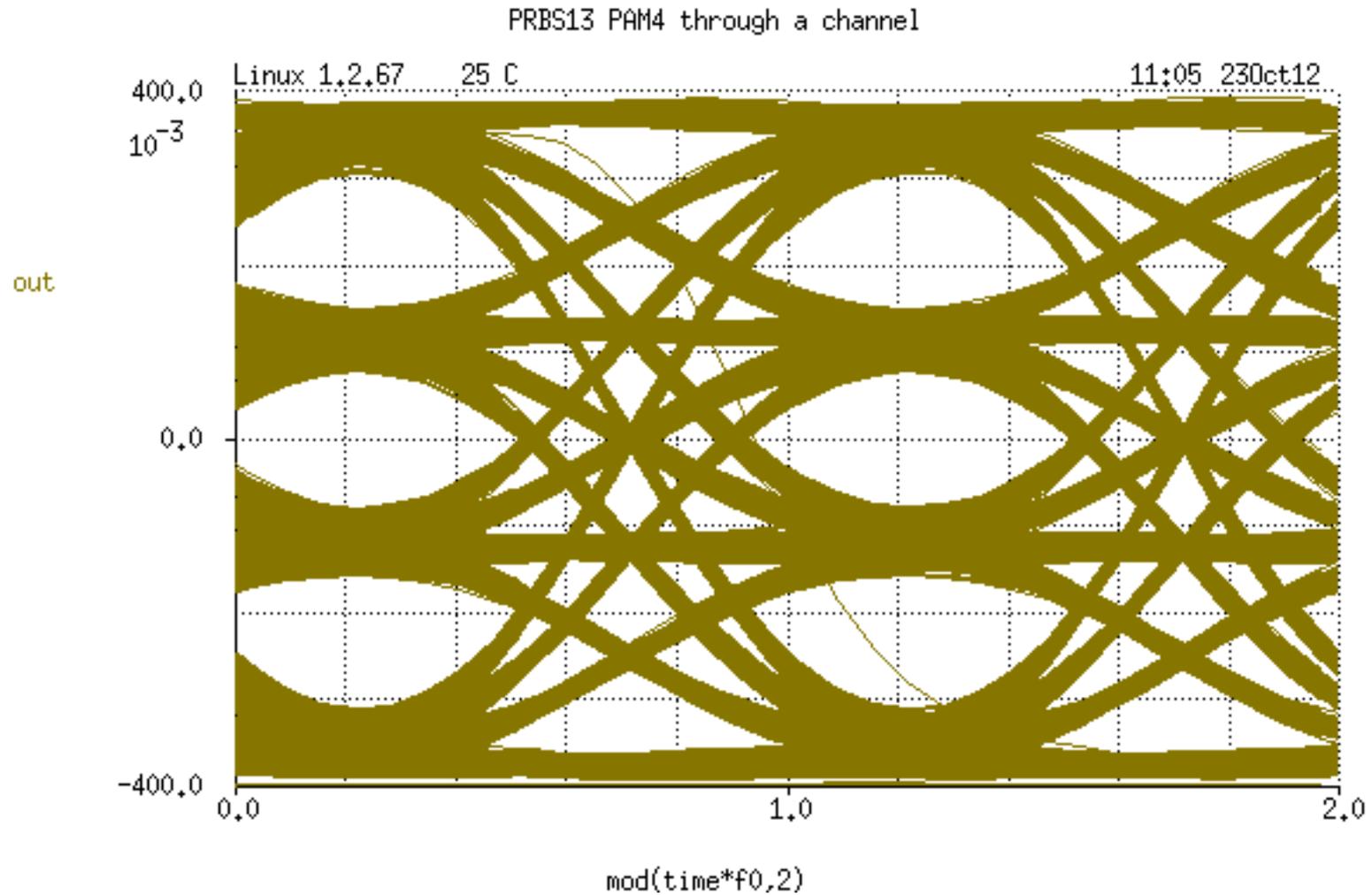
Rise time: 28.5p

Peak pulse / steady state: 0.94 \rightarrow -0.56 dB

Square wave with baseline measurement channel and 0.5 UI rise time

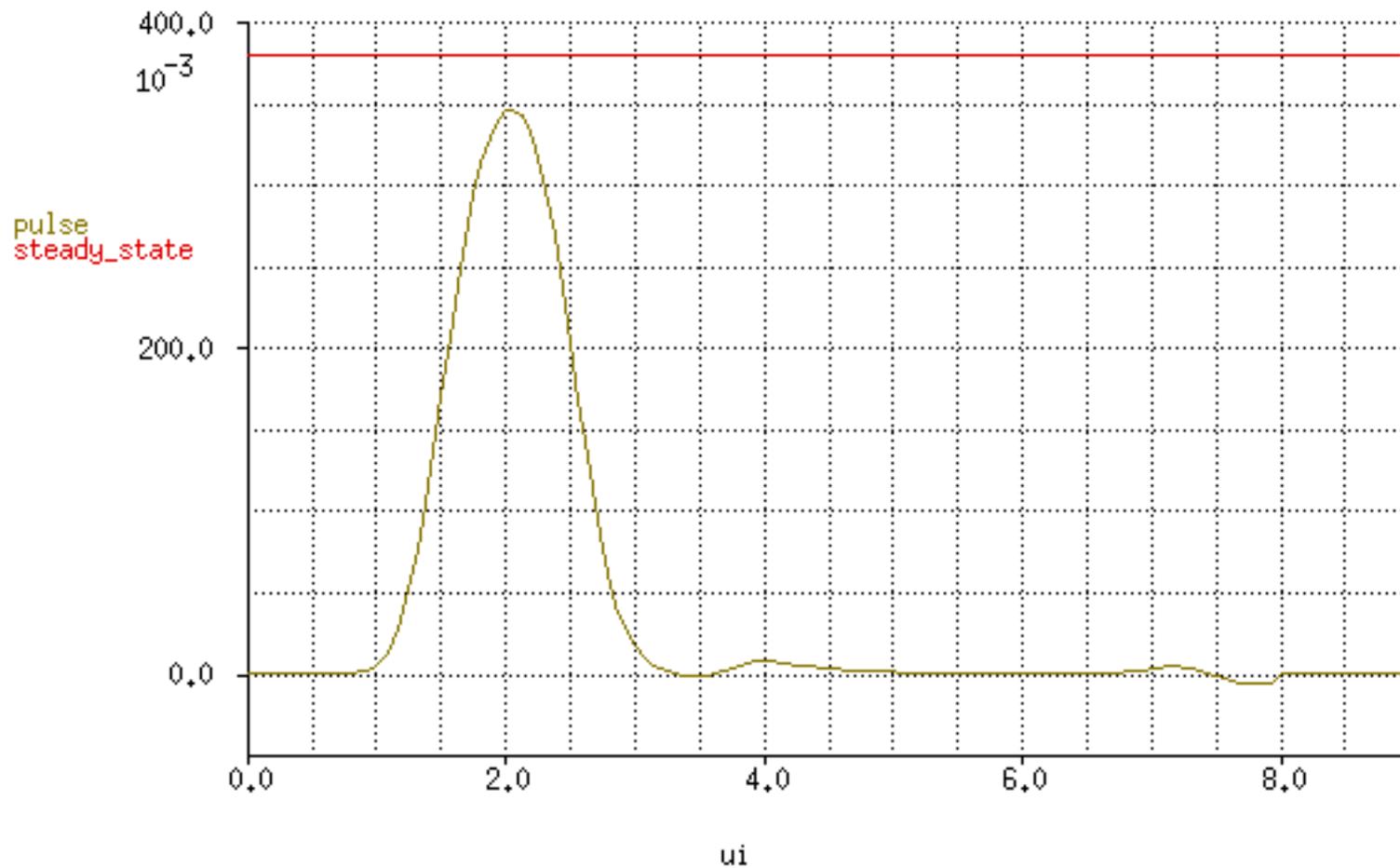


PAM4 PRBS13 eye with baseline measurement channel and 0.5 UI rise time



Eye: 0.57 UI x 154 mV

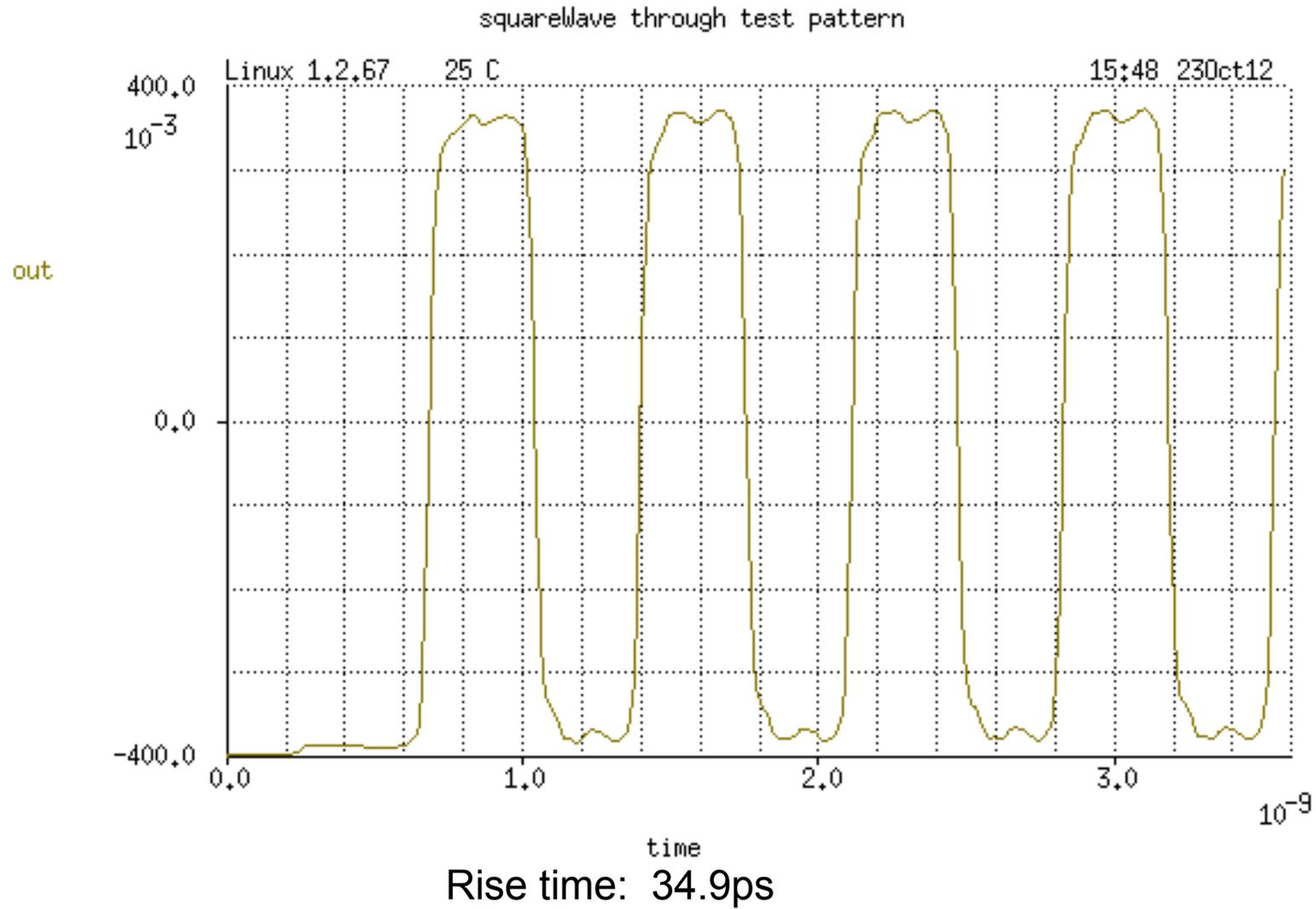
PAM4 PRBS13 linear fit pulse with baseline measurement channel



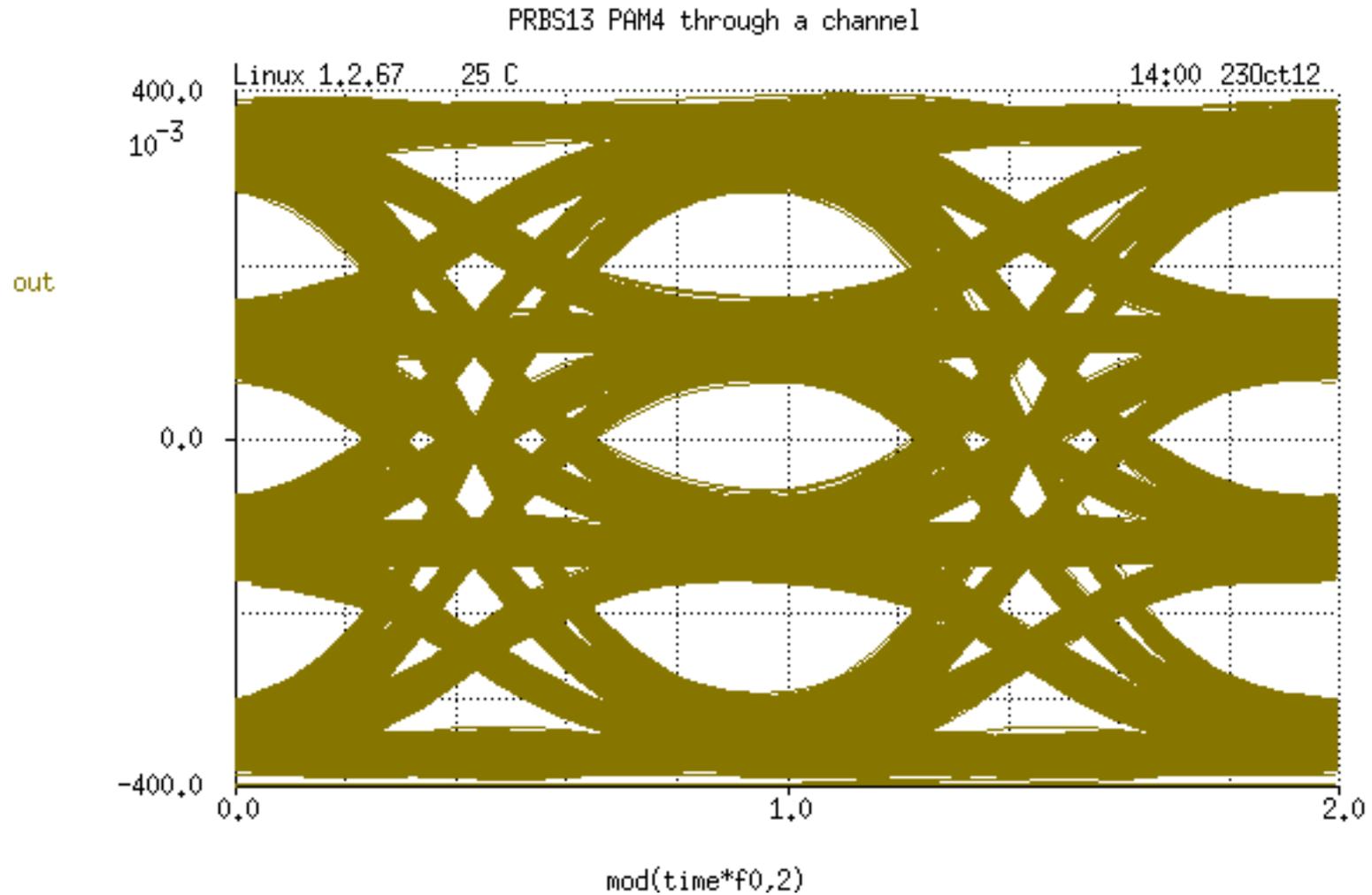
Rise time: 34.4 ps

Peak pulse / steady state: 0.912 \rightarrow -0.80 dB

Square wave with baseline measurement channel and long package

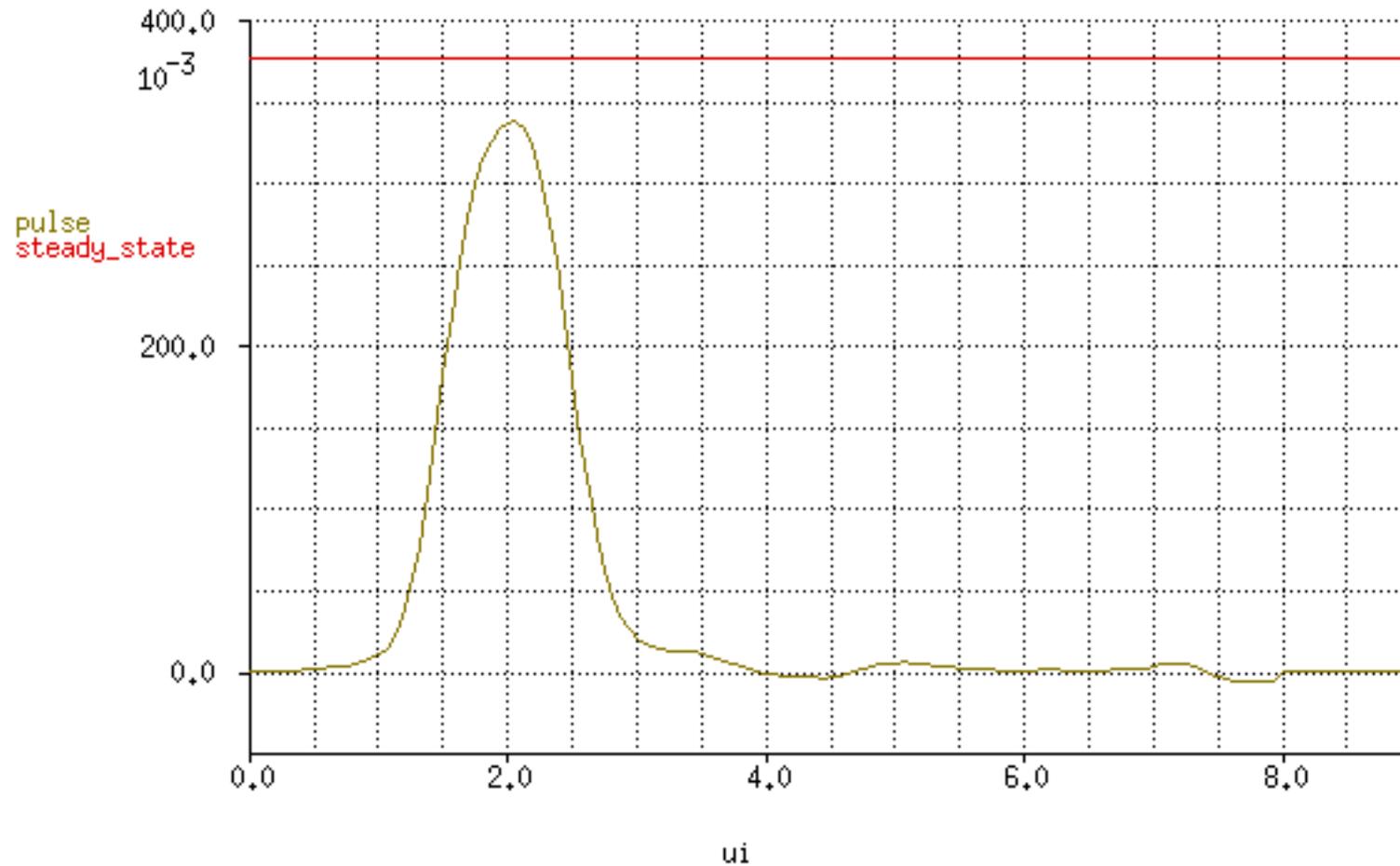


PAM4 PRBS13 eye with baseline measurement channel and long package



Eye: 0.57 UI x 117 mV

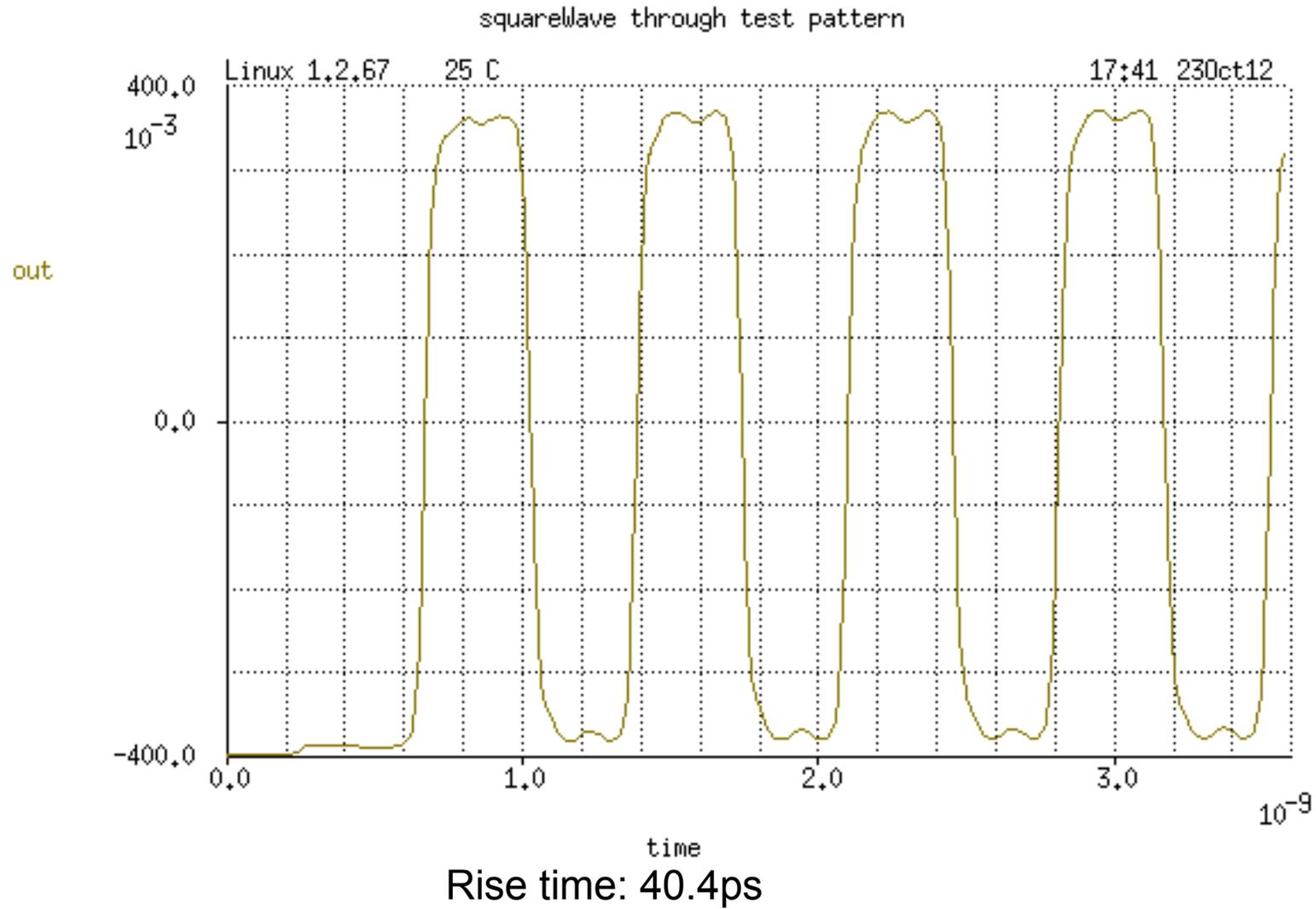
PAM4 PRBS13 linear fit pulse with baseline measurement channel and long package



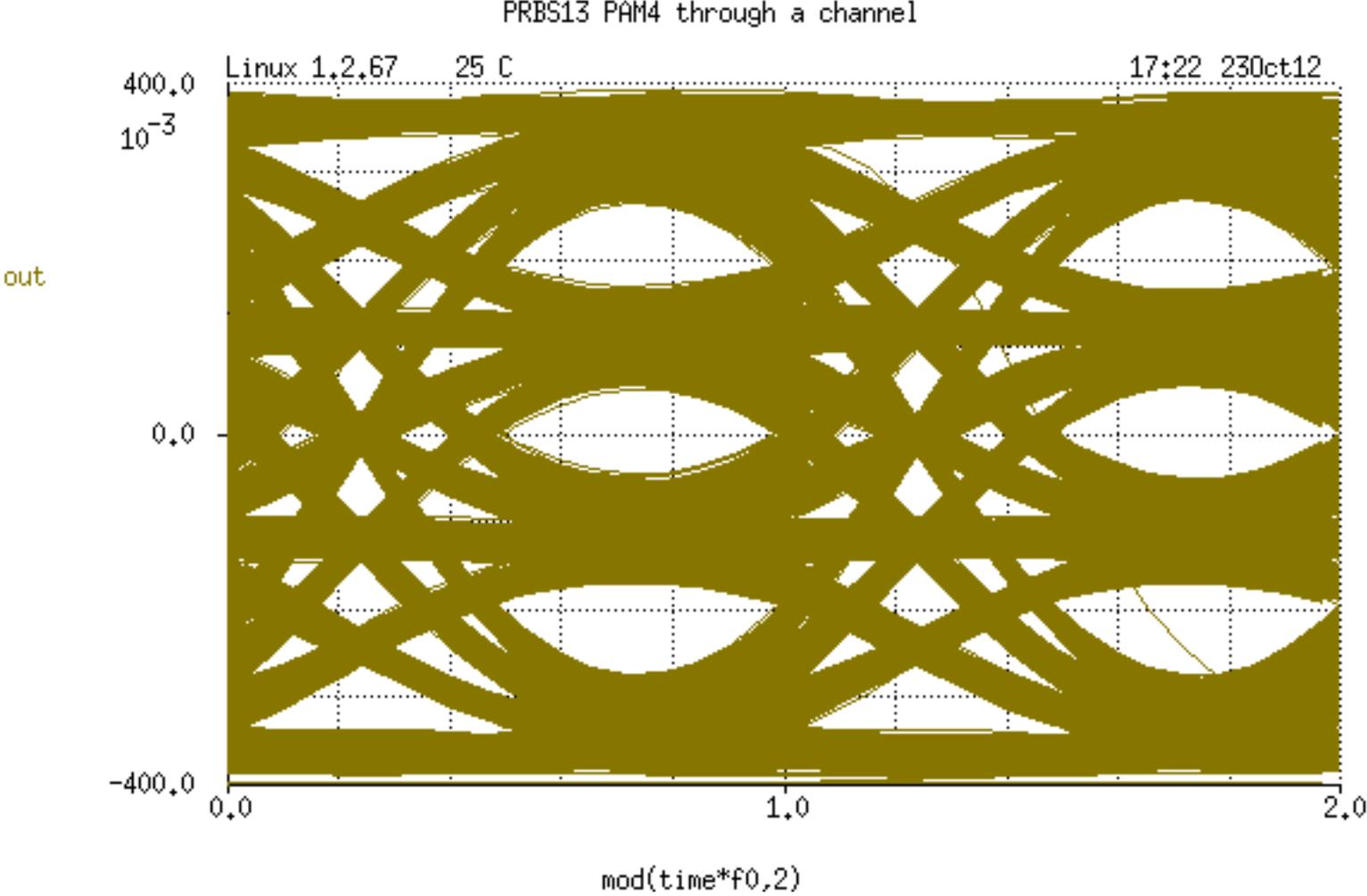
Rise time: 33.0 ps

Peak pulse / steady state: 0.895 \rightarrow -0.96 dB

Square wave with baseline measurement channel and long package and 0.5 UI rise time

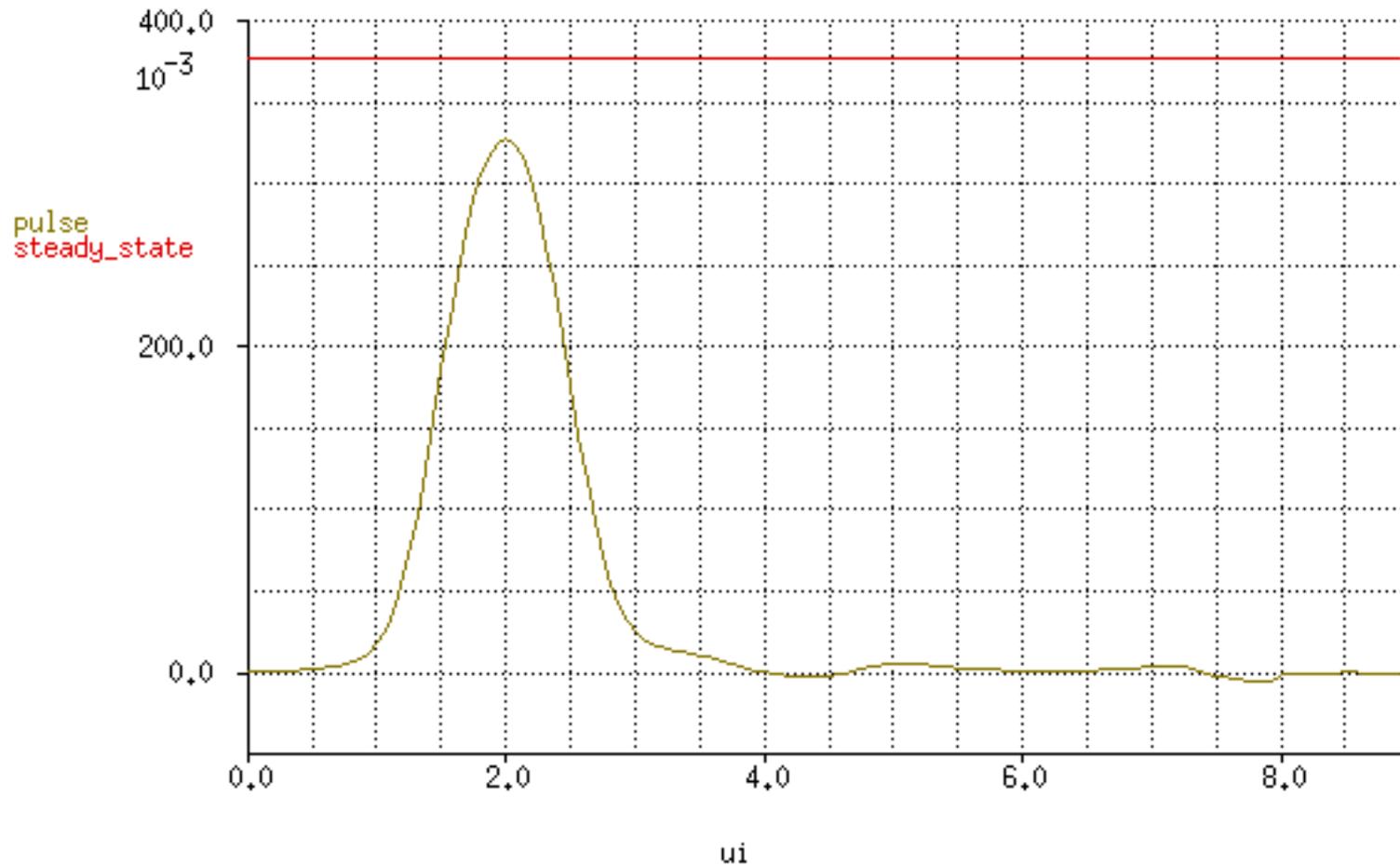


PAM4 PRBS13 eye with baseline measurement channel and long package and 0.5 UI rise time



Eye: 0.51 UI x 91 mV

PAM4 PRBS13 linear fit pulse with baseline measurement channel and long package and 0.5UI rise time



Rise time: 39.0 ps

Peak pulse / steady state: 0.868 \rightarrow -1.23 dB

Summary of simulations

	Eye width	Eye Height	Rise time _{square}	Rise time _{pulse}	Pulse gain	dB pulse gain
clean	.65 UI	170 mV	31.4 ps	28.5 ps	.94	-0.56 dB
Slow rise	.57 UI	154 mV	37.3 ps	34.4 ps	.912	-0.80 dB
Long package	.57 UI	117 mV	34.9 ps	33.0 ps	.895	-0.96 dB
Slow rise and Long package	.51 UI	91 mV	40.4 ps	39.0 ps	.868	-1.23 dB

Conclusions

- Rise time is not a very good predictor of eye quality
- Measured rise time using specified test method are unlikely ever to be shorter than a reasonable EMI based limit ~18 ps
- Pulse gain, ratio of peak linear extracted pulse to steady state voltage, seems to be a better predictor of eye quality
- Drop rise time specification and use pulse gain.
- Recommend minimum pulse gain of 0.85