Meeting 25/01/17

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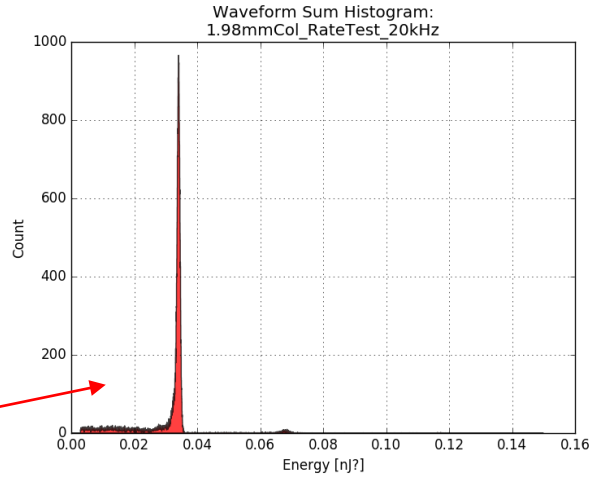
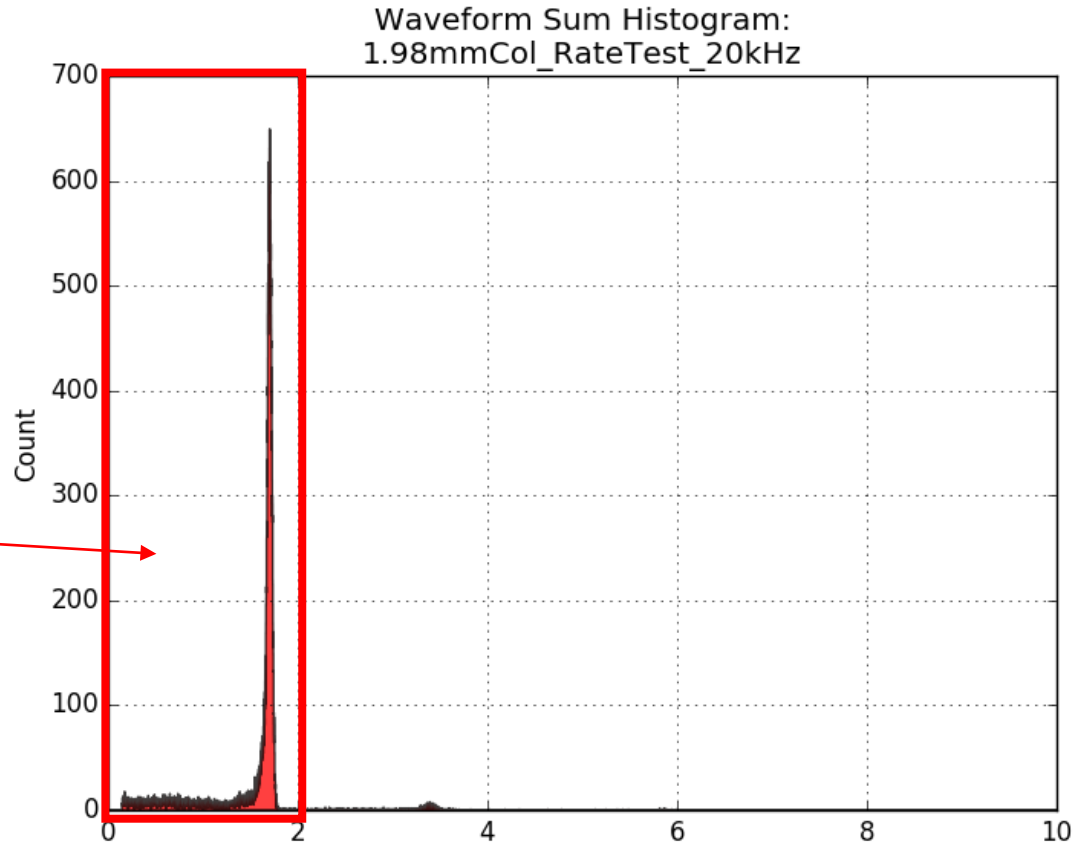
Spectra Scaling



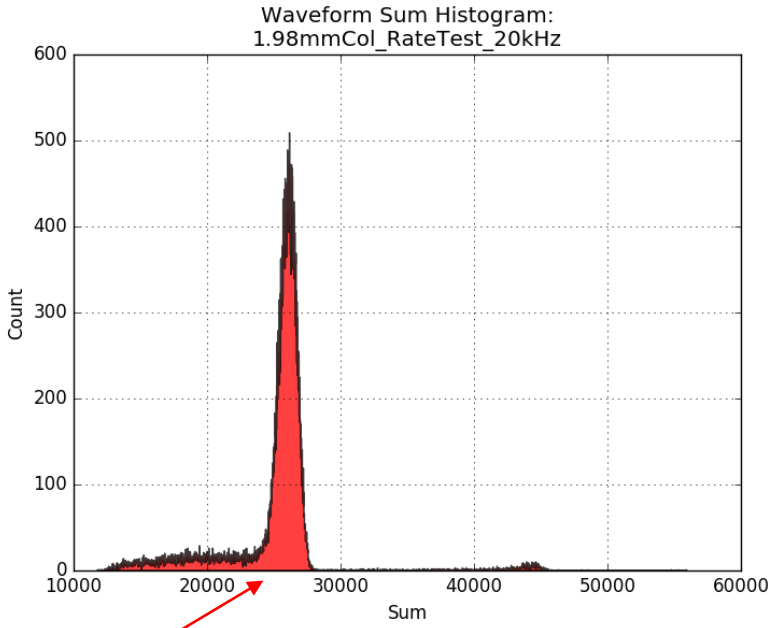
- Generate spectra using:
  - E = $\frac{1}{R}\int_0^T |v(t)|^2 dt$
  - Or $\int_0^T |v(t)|^2 dt$, $\int_0^T v(t) dt$
  - Where:
    - T = 1000.4 ns
    - dt = 0.4 ns
    - v(t) = voltage [mV]
    - R = 50 Ω
- Using set number of bins (10k) starting at 0.
- Cut end off spectra (cutting 2nd peak). i.e. first 2k bins here
- Use second peak scale to adjust pile up settings on emulator. This roughly reproduces the second peak.
- Scaled in emulator software

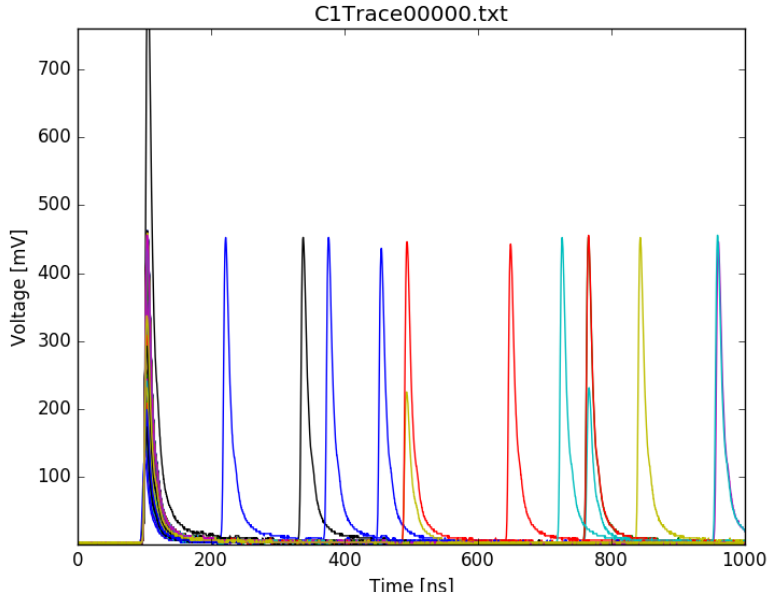


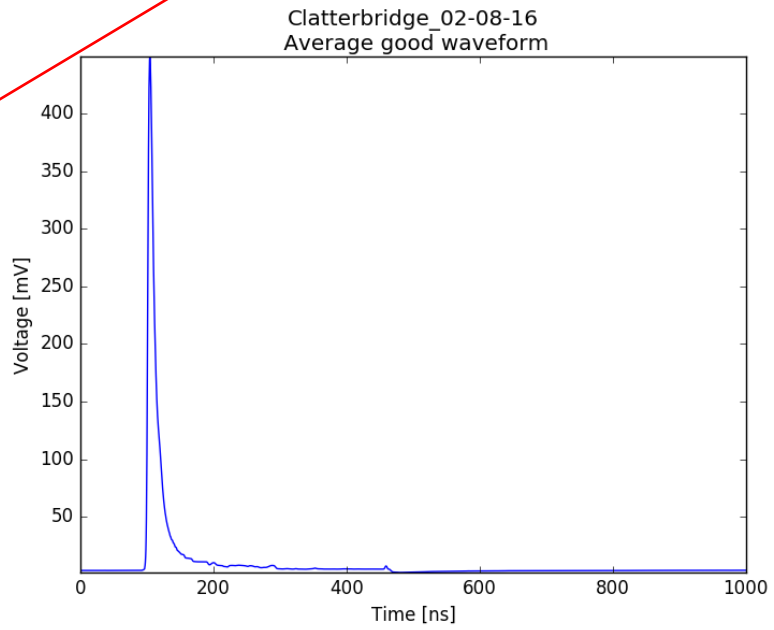
Signal Shape

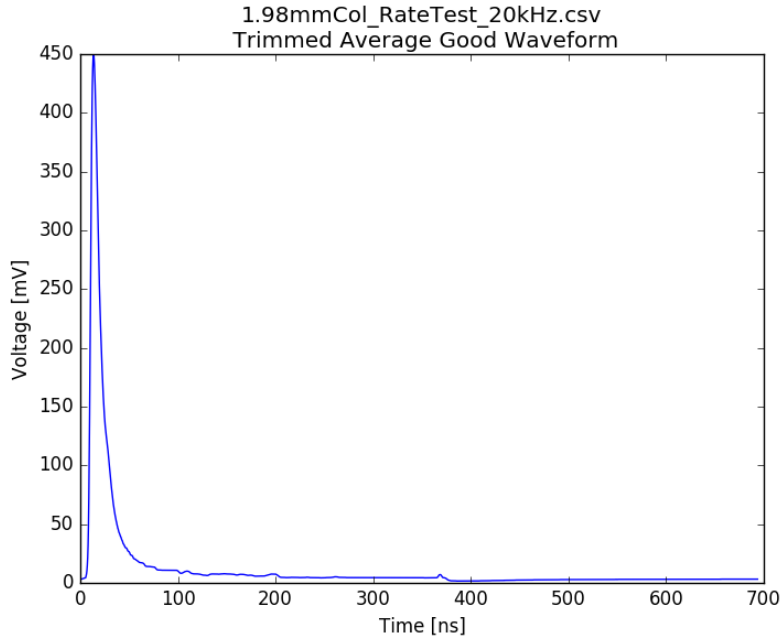
Choosing signal shape:

- Used lowest rate data from 02/08/16.
- Using sum histogram
- Picked out waveforms in most common region
  (25000 ⩽ Sum ⩽ 27000).
- Averaged these waveforms.
- Cut ends off average waveform.



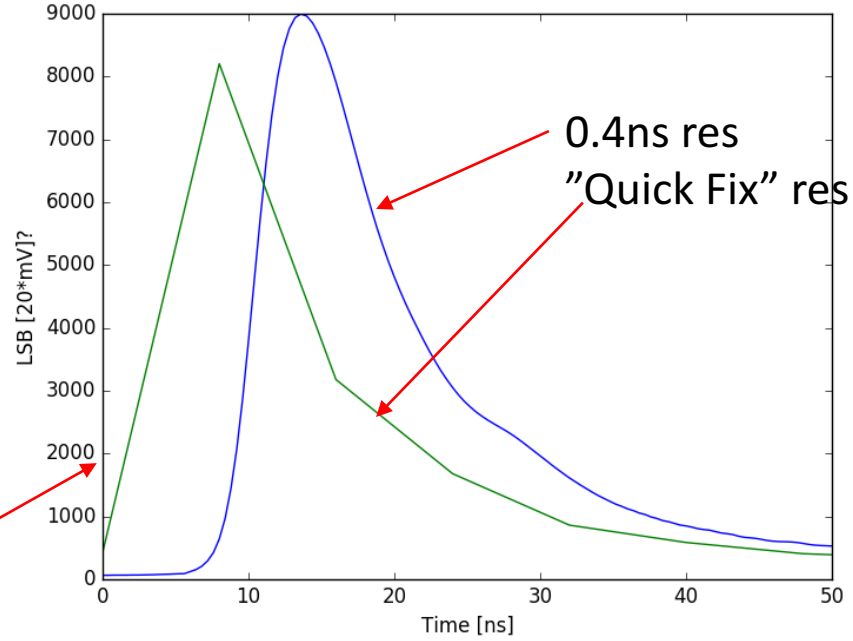


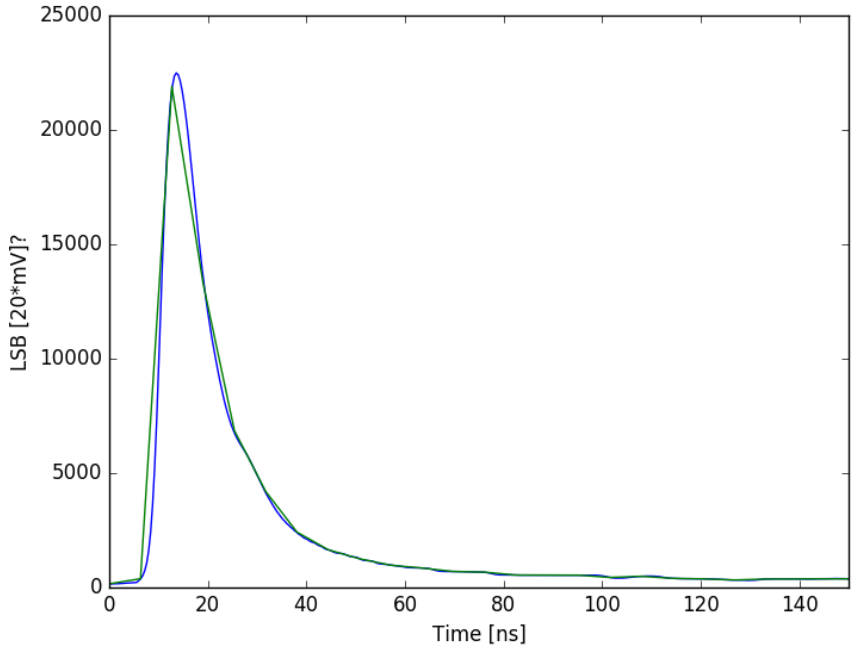




Scaling Issues

- When importing a signal shape file into emulator software you cannot define the time resolution. (i.e. The signal file is a single column .csv)
- At the recorded resolution (0.4 ns per value) causes the emulated signal to last ~14µs (rather than ~0.7µs).
- Used a “crude” way round this. Imported a new signal shape using every 20th value from original.
- This resolved time length issue but obviously severely effected the accuracy of the shape.
- This does however get “smoothed” out when on output.
- Possible fix:
  - Use fit to generate data points with correct time distribution. (Max shape length)/(max points) = 26µs/4096
- Outstanding Issues:
  - Amplitude (V to LSB)
  - See if there is a way to define signal shape with a higher resolution (Email CAEN rep)





Energy emulation features	• Single line (65535 selectable levels) • Spectrum emulation (16384 bins with 14 bit resolution) • ± 4 V output range, high impedence; ± 2 V, 50 Ω termination • 16 bit D/A converter
Time emulation features	• Constant rate emulation • Poisson distribution • Programmable statistical generation of events (256 bins, 8 bit resolution) • Up to 11 MCPS, both in constant and statistical emulation • Integrator circuit emulation without pile-up limitation • Up to 16 pile-up events in the memory based algorithm • Programmable dead-time and emulation of parallelizable and non-parallelizable machines • 20 ns to 10 ms exponential decay time
Signal shape	• 4096 points to store waveforms • Arbitrarily programmable shapes • Shape length from 64 ns to 26 µs (w/o interpolation) / 26 ms (interp.) • Separated rising and falling edge interpolation • Up to two separate shapes mixed on the same channel with independent statistic

Output signal quality parameters	• LSB = 4 V/2 16 ? • Accuracy - Differential Non Linearity (DNL): ±1.0 LSB - Integral Non Linearity (INL): ±2.5 LSB • Total Harmonic Distortion (THD): 0 dBFS –95 dB • Signal to Noise Ratio (SNR): 73 dB • Signal to Noise and Distorsion Ratio (SINAD)*: 72.9 dB *log10 ((SNR*THD)/(SNR+THD))