Alternative BPM Processing Scheme – May08 Demo

C.Perry – 08jan09

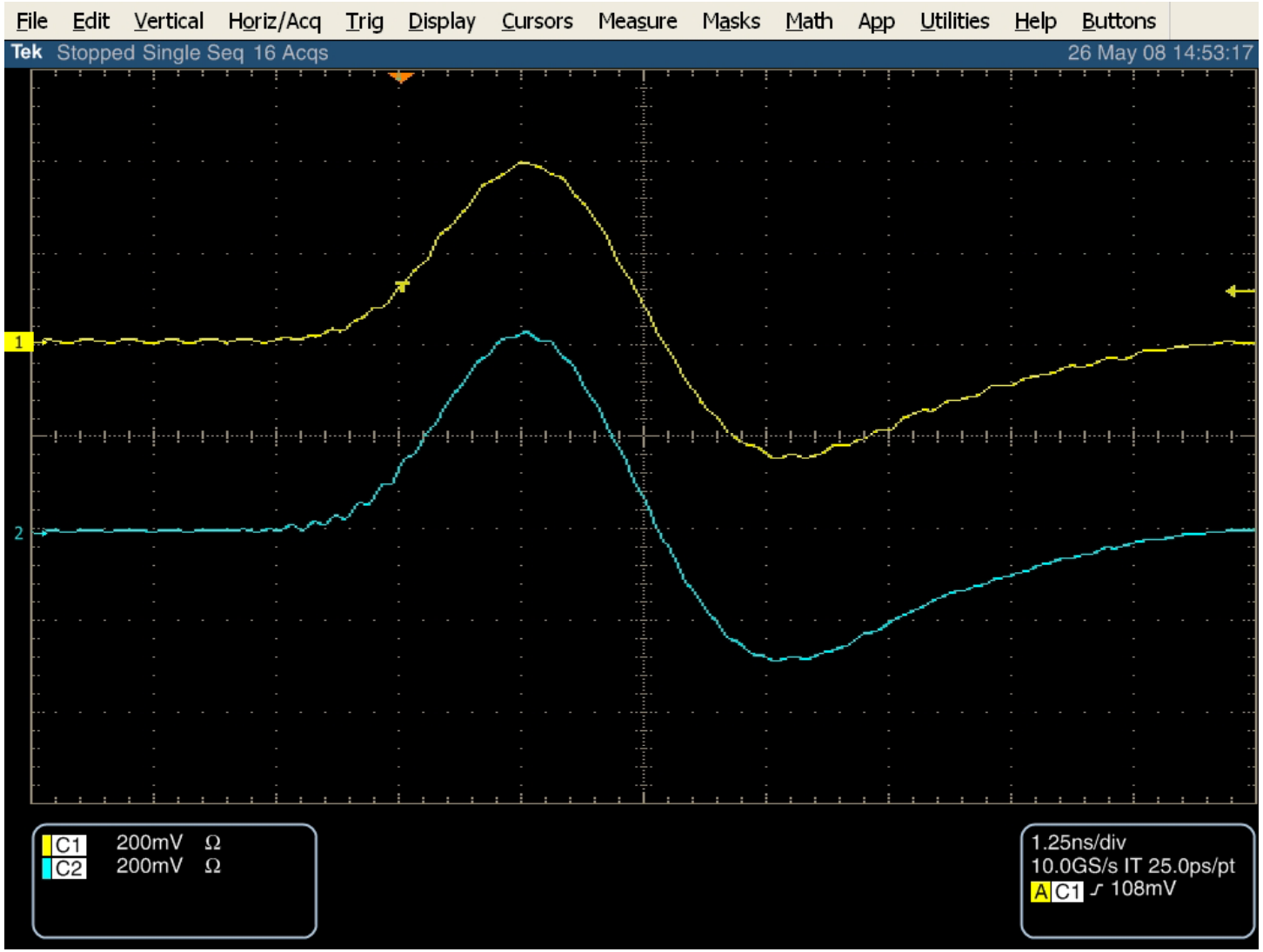
Signals from Striplines via LPF

Bunch charge ~0.6e10

Peak V 400mV

Peak spacing (+ to -) 2.6ns

Bandwidth ~120MHz (200MHz + 156MHz filters in series)



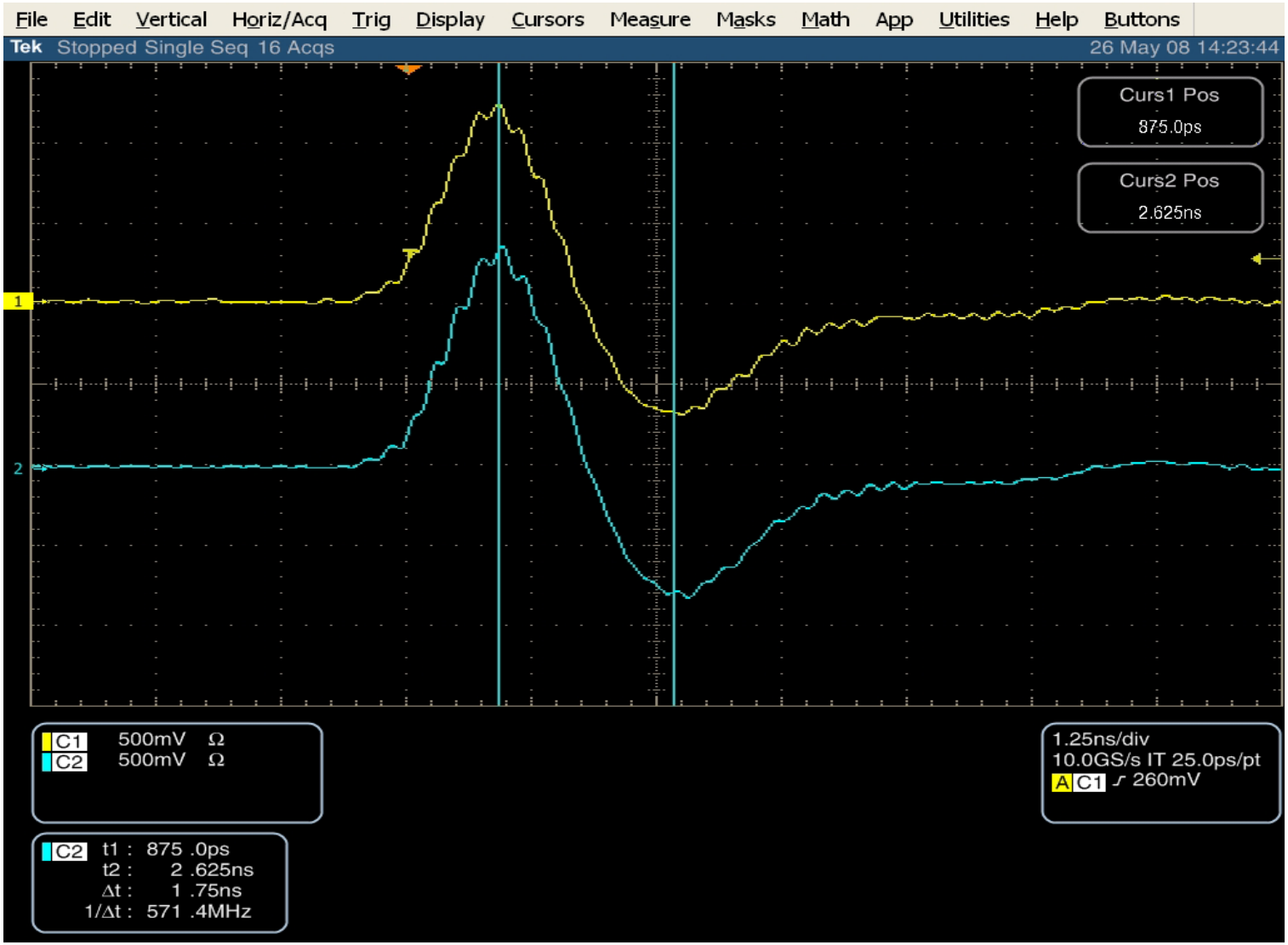
Signals from Striplines via LPF – Effect of Bandwidth

Bunch charge ~0.6e10

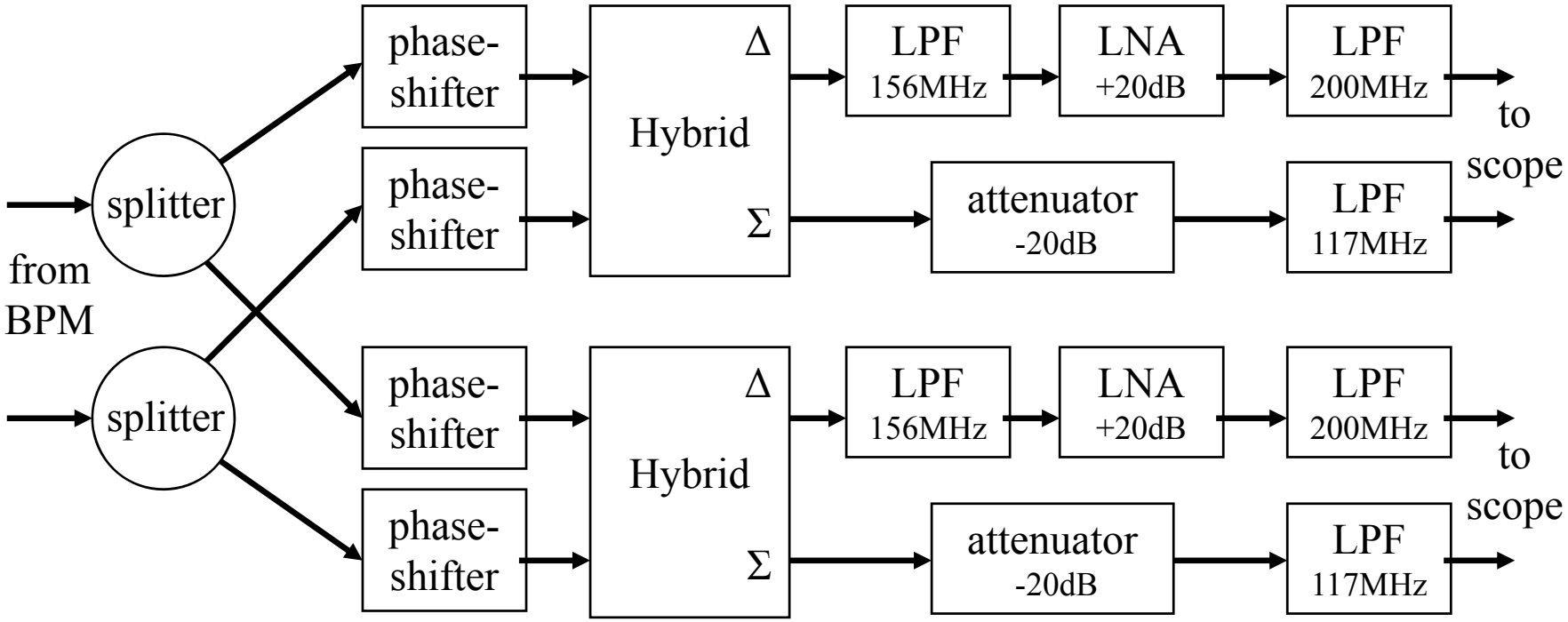
Peak V 1250mV

Bandwidth 200MHz

Note how rapidly amplitude varies with bandwidth



Test Configuration

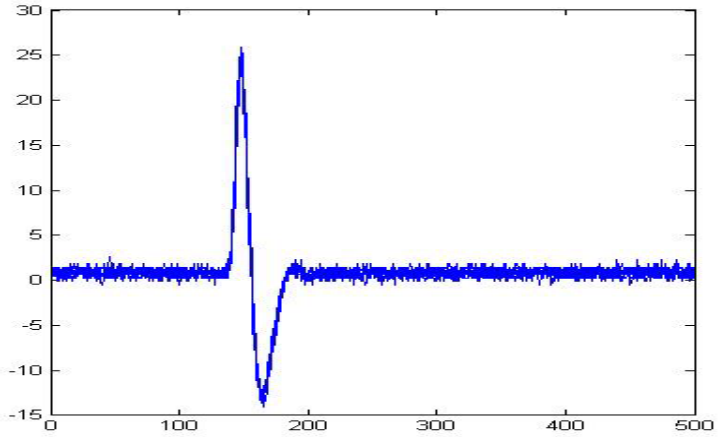


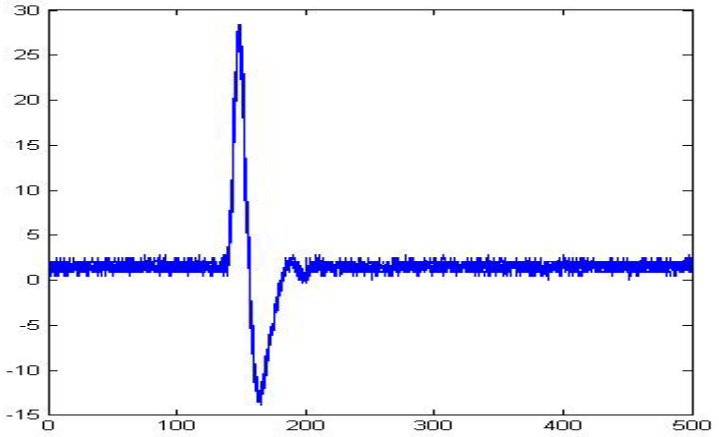
Hybrid: custom built composite unit
LNA: MiniCircuits ZX60-4016E: 20MHz-4GHz, +20dB, NF 3.9dB
Filters: MiniCircuits SBLP series
Phase shifters: Weinschel mechanical
Splitters: resistive

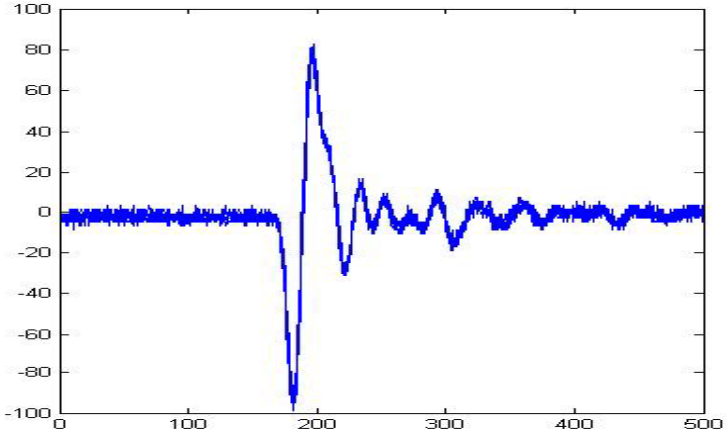
Main data runs: 3, of 50 pulses each, at 0.9E10 bunch charge (from BPM10, I think...)
Data statistically consistent, merged in the analysis

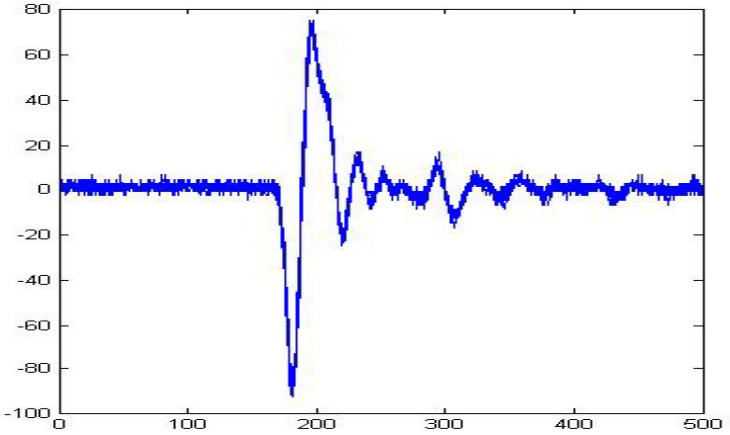
DAQ data - beam offset - unprocessed

top: sum, bottom: diff; X span 100ns; Y in mV uncorrected for gain/attenuation



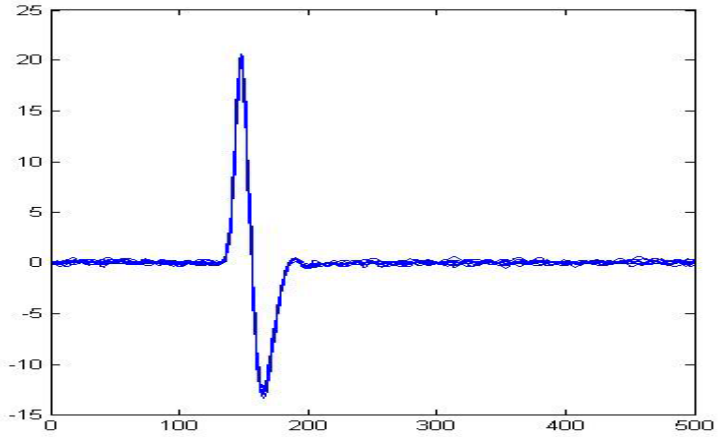


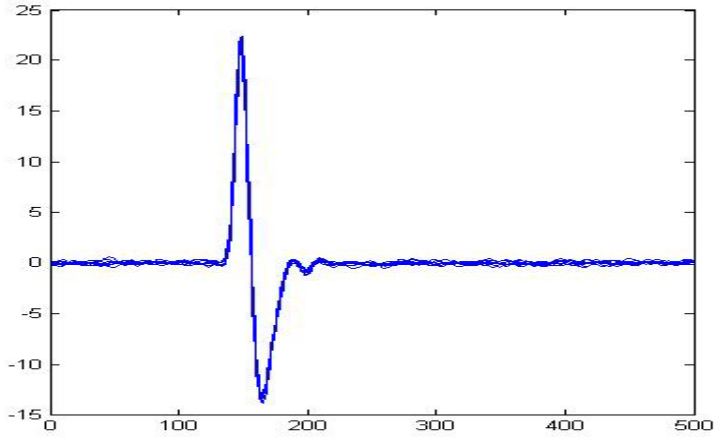


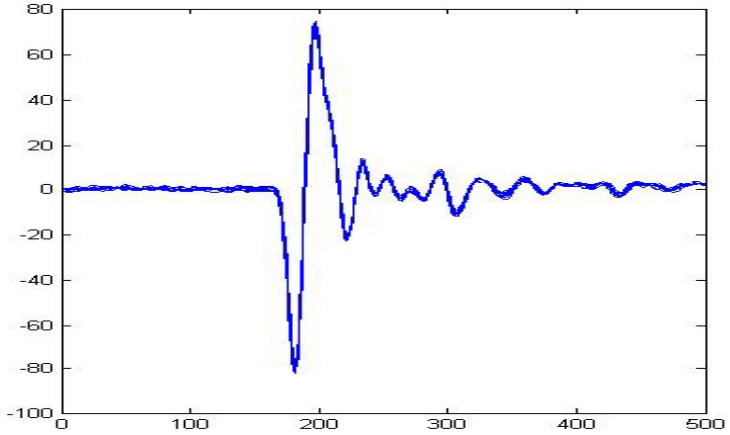


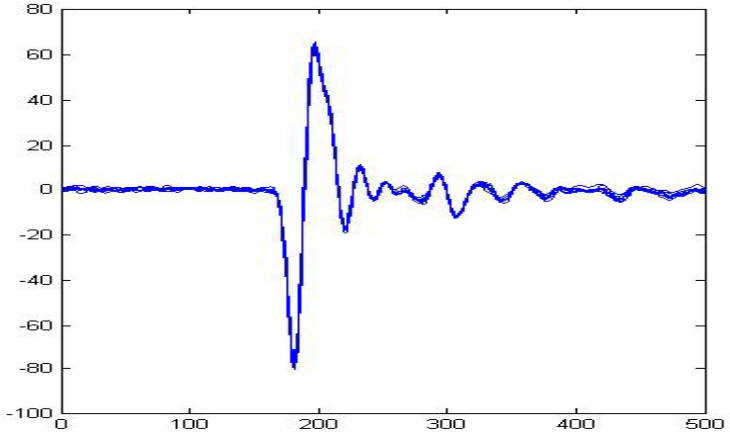
DAQ data - beam offset – filtered and zeroed

top: sum, bottom: diff; X span 100ns; Y in mV uncorrected for gain/attenuation



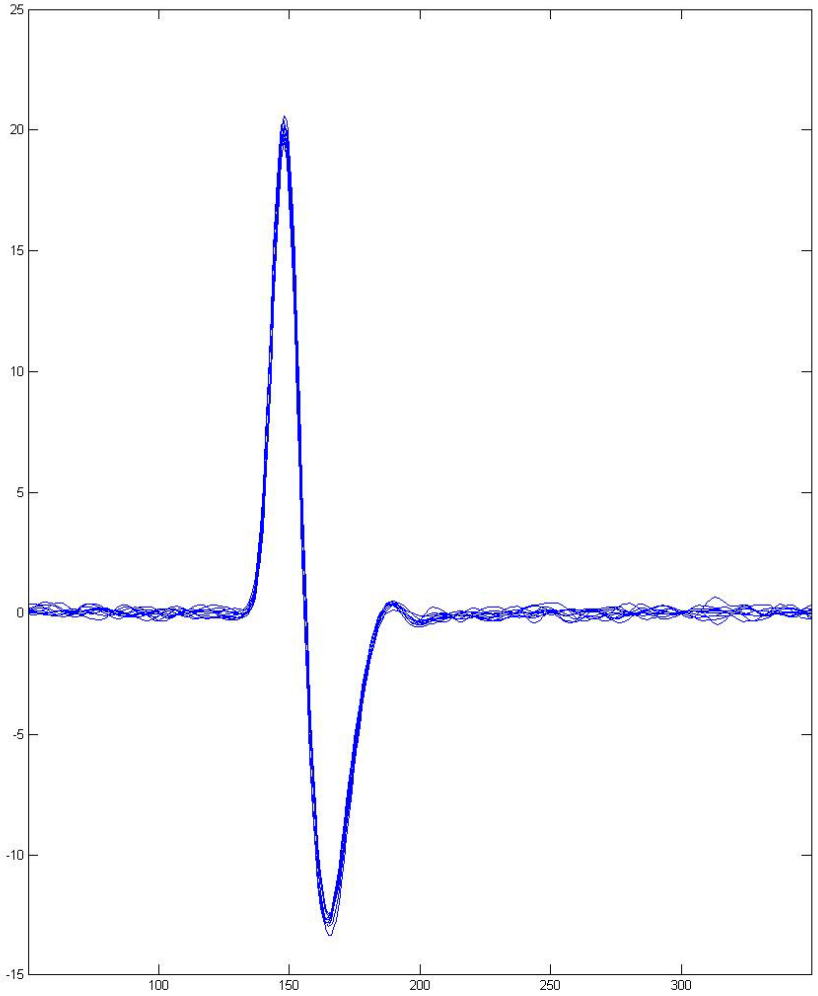


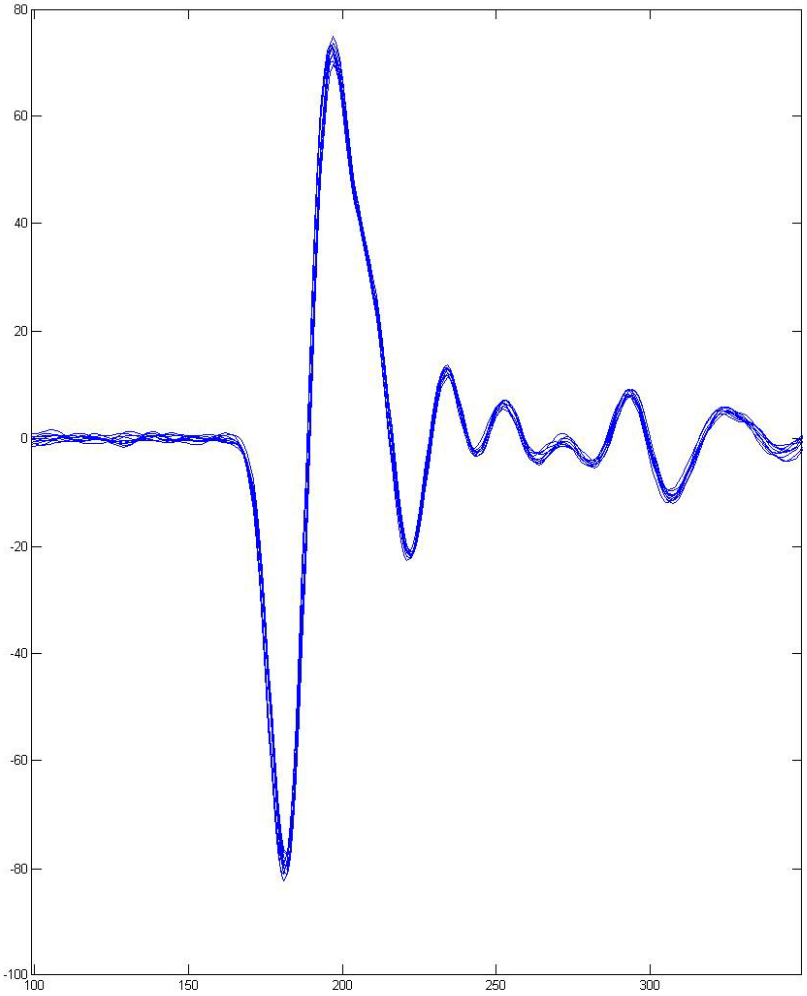




DAQ data - beam offset – filtered and zeroed

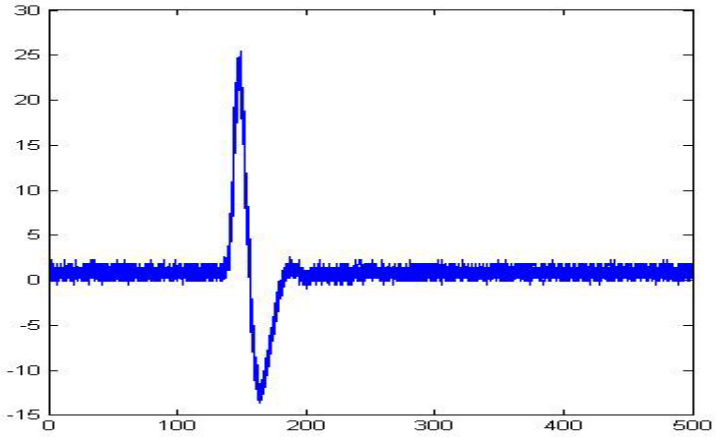
left: sum, right: diff; X span 50ns; Y in mV uncorrected for gain/attenuation

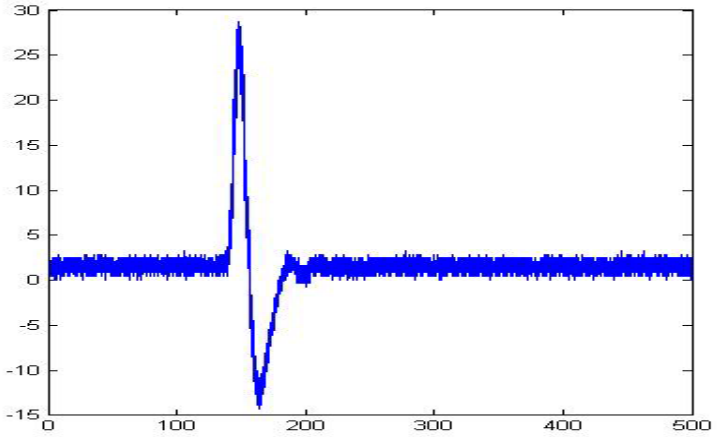


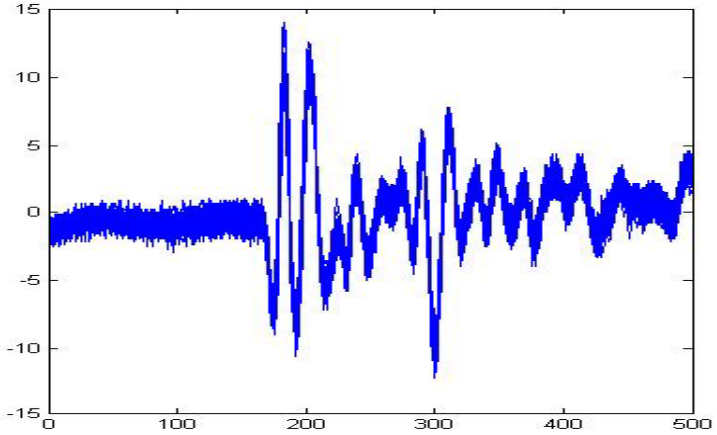


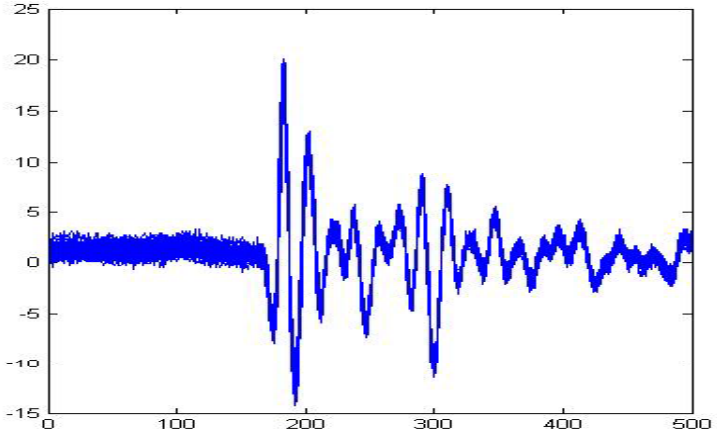
DAQ data - beam centred - unprocessed

top: sum, bottom: diff; X span 100ns; Y in mV uncorrected for gain/attenuation



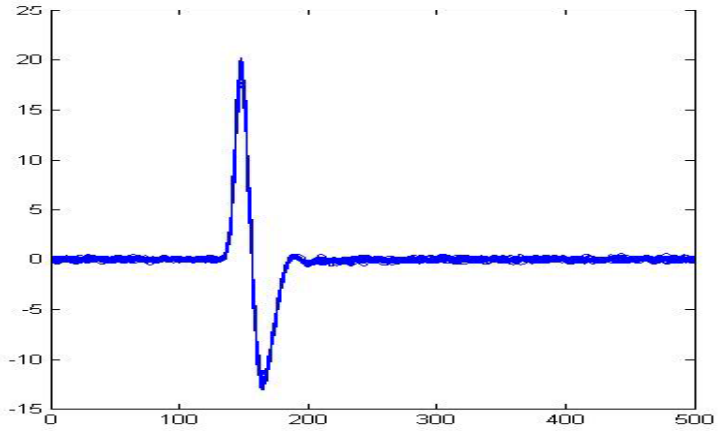


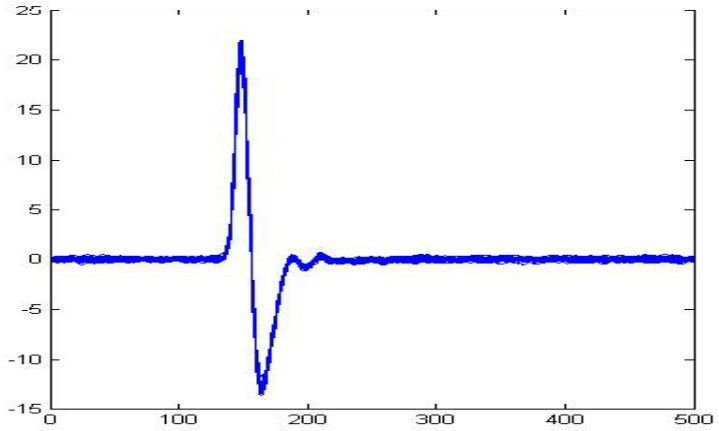


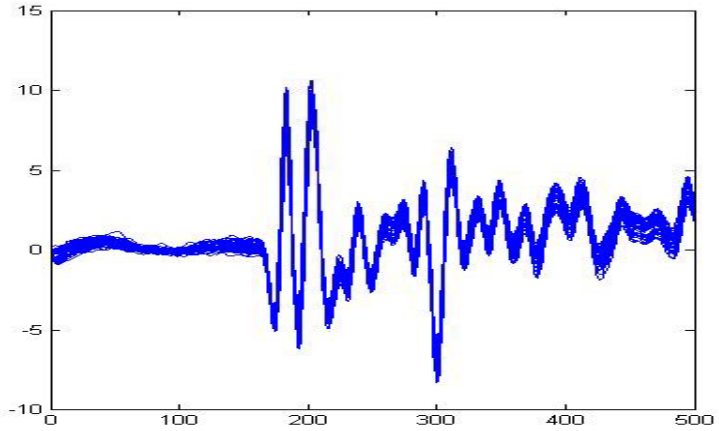


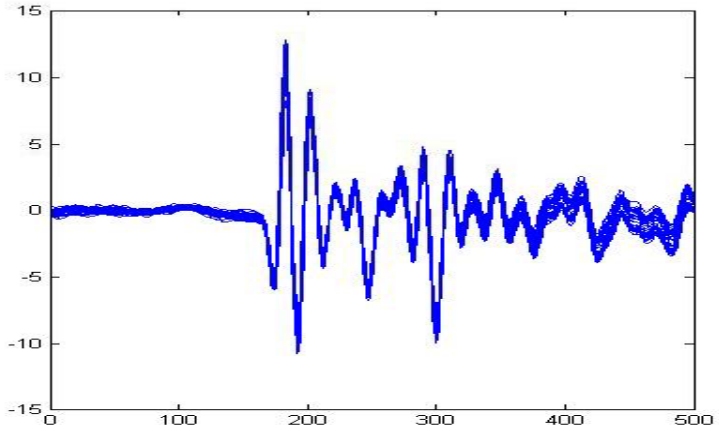
DAQ data - beam centred – filtered and zeroed

top: sum, bottom: diff; X span 100ns; Y in mV uncorrected for gain/attenuation





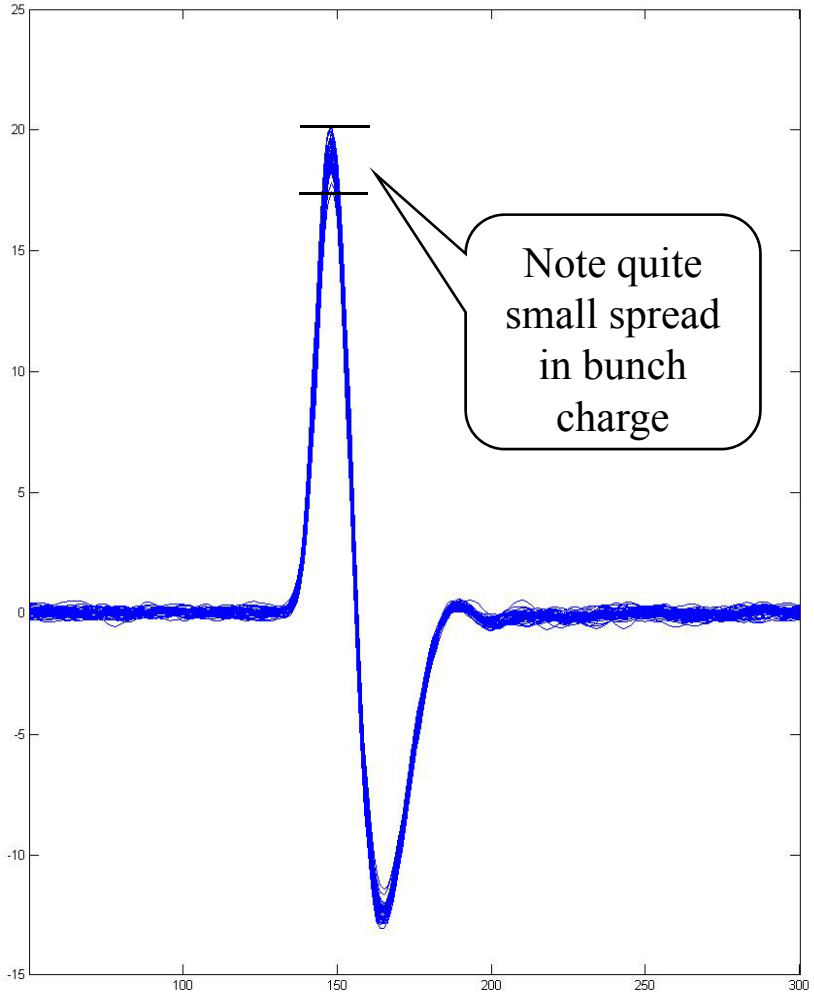


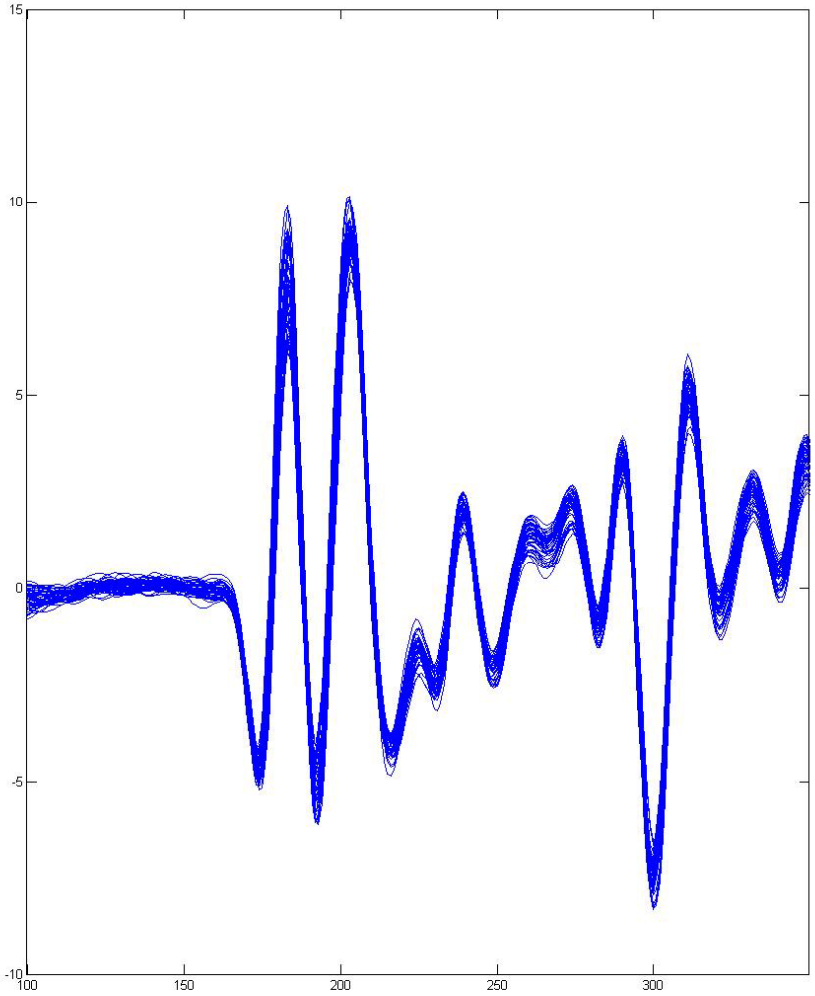


DAQ data - beam centred – filtered and zeroed

left: sum, right: diff;

X span 50ns; Y span 40mV (left), 25mV (right) (uncorrected for gain/attenuation)

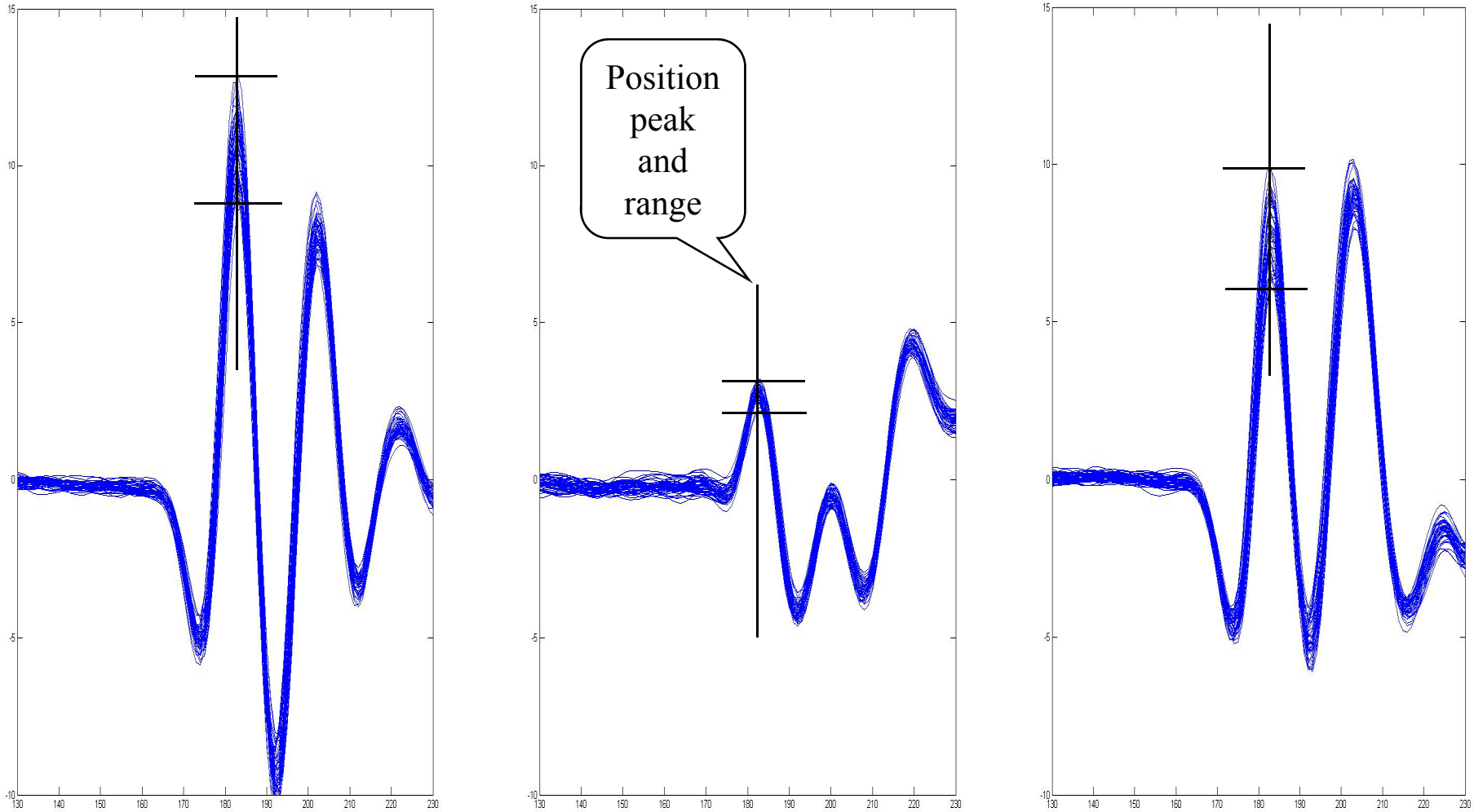




DAQ data - beam centred – filtered and zeroed

left, right: processor difference outputs; centre: difference between the two

X span 20ns; Y span 25mV (uncorrected for gain/attenuation)



Analysis

From data filtered and zero corrected (taking diff signal at fixed position):

sum: mean peak 19.8mV

diff signal: std dev 1.00mV each channel, 0.25mV difference between channels

assume equal noise from each channel => 0.18mV rms noise on diff output

Corrections:

20dB atten in sum => 198mV at output of hybrid

20dB gain in diff => 18uV noise referred to output of hybrid (measured gain: 20.2dB)

NB this is almost exactly the expected noise from the amplifier

hybrid design gives 3dB less sum output than an ideal device => ideal sum signal 280mV

hybrid gives 1.7dB loss at diff output => noise is equivalent to 22uV at ideal hybrid

NB the filters on sum and diff signals differed, but this is measured to be negligible

Equivalent position jitter:

expected position signal for 1mm offset from axis: (A-B)/(A+B) = 0.17

we have (noise in difference)/sum = 22uV/280mV = 7.8e-5

this is equivalent to a position jitter of 7.8e-5/0.17 = 4.6e-4mm = 0.46um

NB a beam jitter of about 3um rms is implied