



Instrumentation
Technologies

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Libera Single Pass

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Libera **WORKSHOP**
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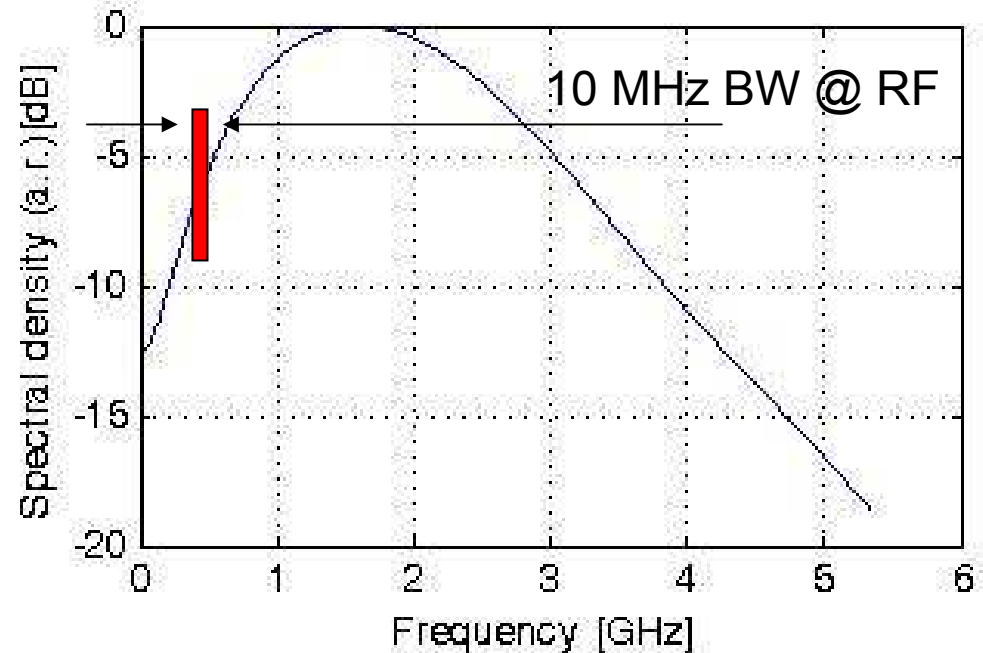
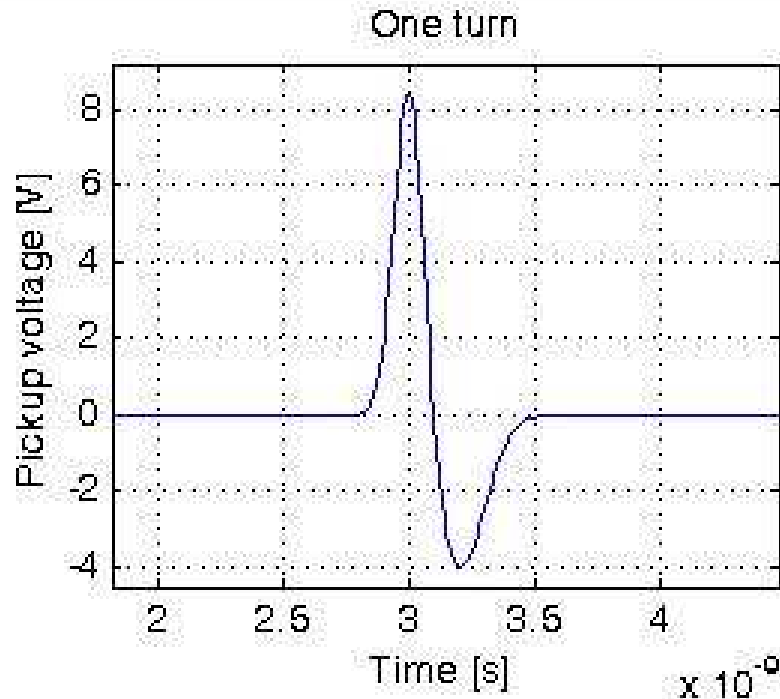
Contents

- **Single pass pickup overview**
- **Measuring Concepts**
- **Libera Brilliance Single Pass**
- **Unveiling New Libera Single Pass**

Pickup Review, 1

Button BPMs:

- Storage rings, linear machines
- slow pulse repetition rates (10 Hz – 5 MHz)



Pickup Review, 2

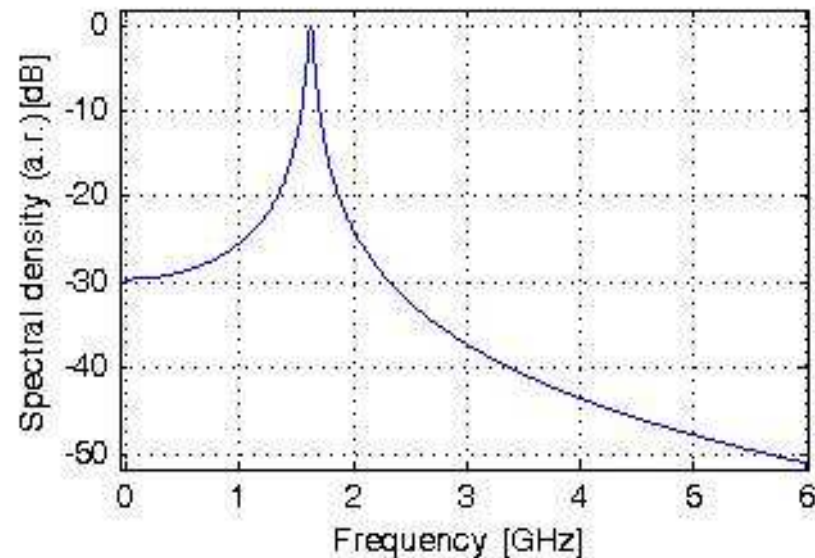
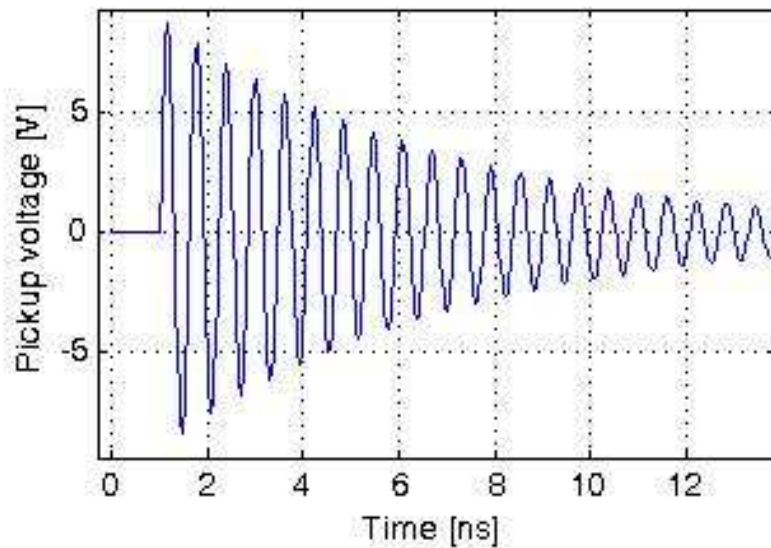
Resonant stripline BPMs:

(XFEL)

$f_0 = 1625 \text{ MHz}$

$\text{BW} = 54 \text{ MHz}$

$$x = k \frac{V_c - V_a}{V_c + V_a}$$



Pickup Review, 3

Cavity BPMs: (Fermi FEL)

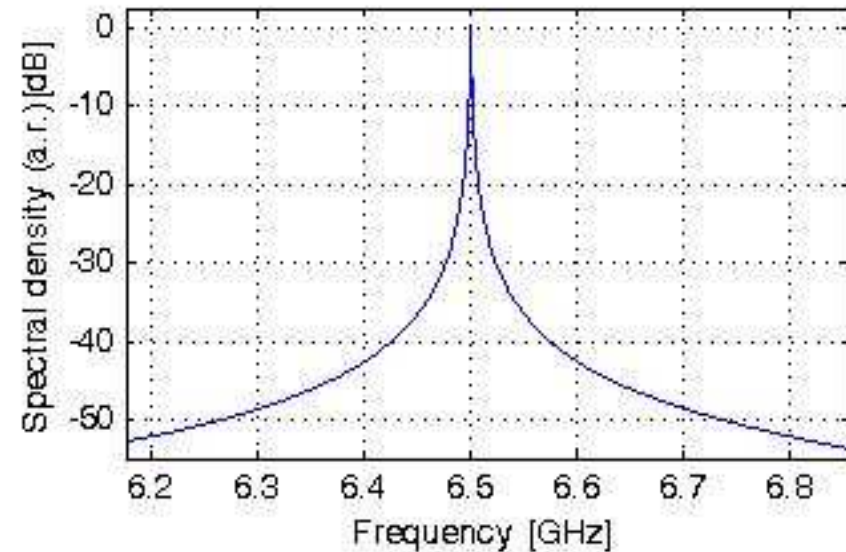
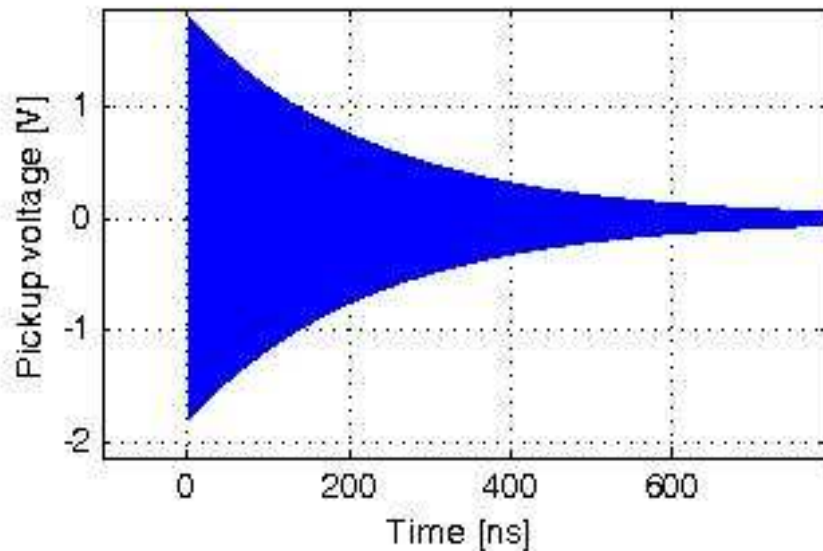
fo = 6500 MHz

BW = 1.4 MHz

$$x = k \frac{V_{dip}}{V_{mon}}$$

$$V_{dip} \propto qx$$

$$V_{mon} \propto q$$



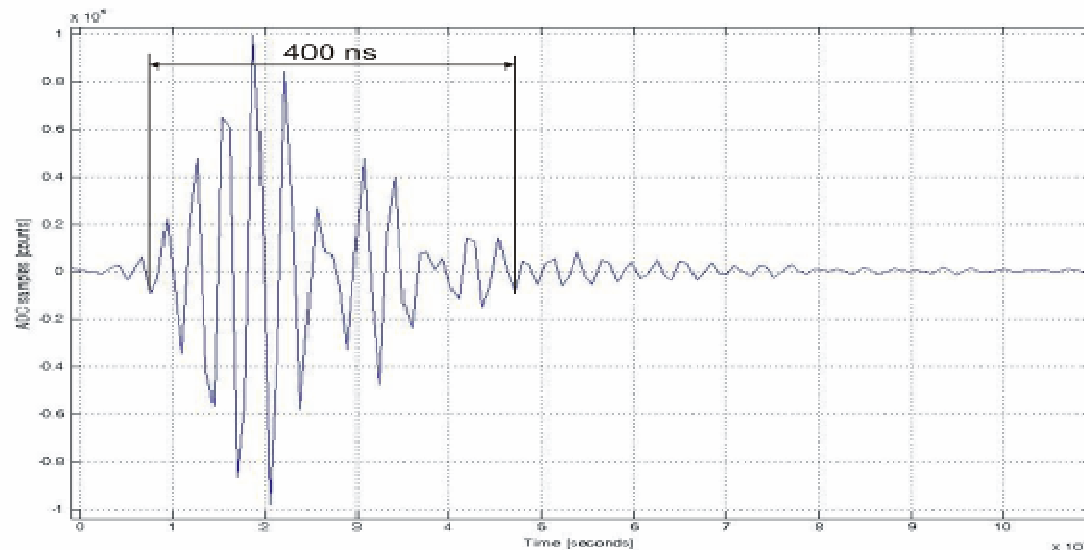
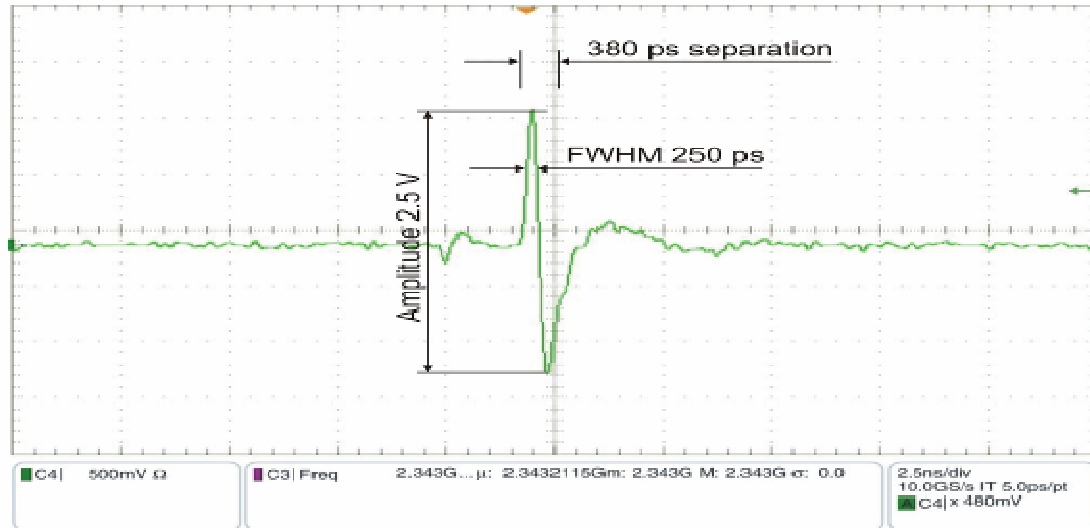
Libera Brilliance For Single Pass

- **Few micron resolution.**
- **Usable on Buttons and Stripline pickups.**
- **12dB of attenuation was stripped from original Brilliance analog board.**

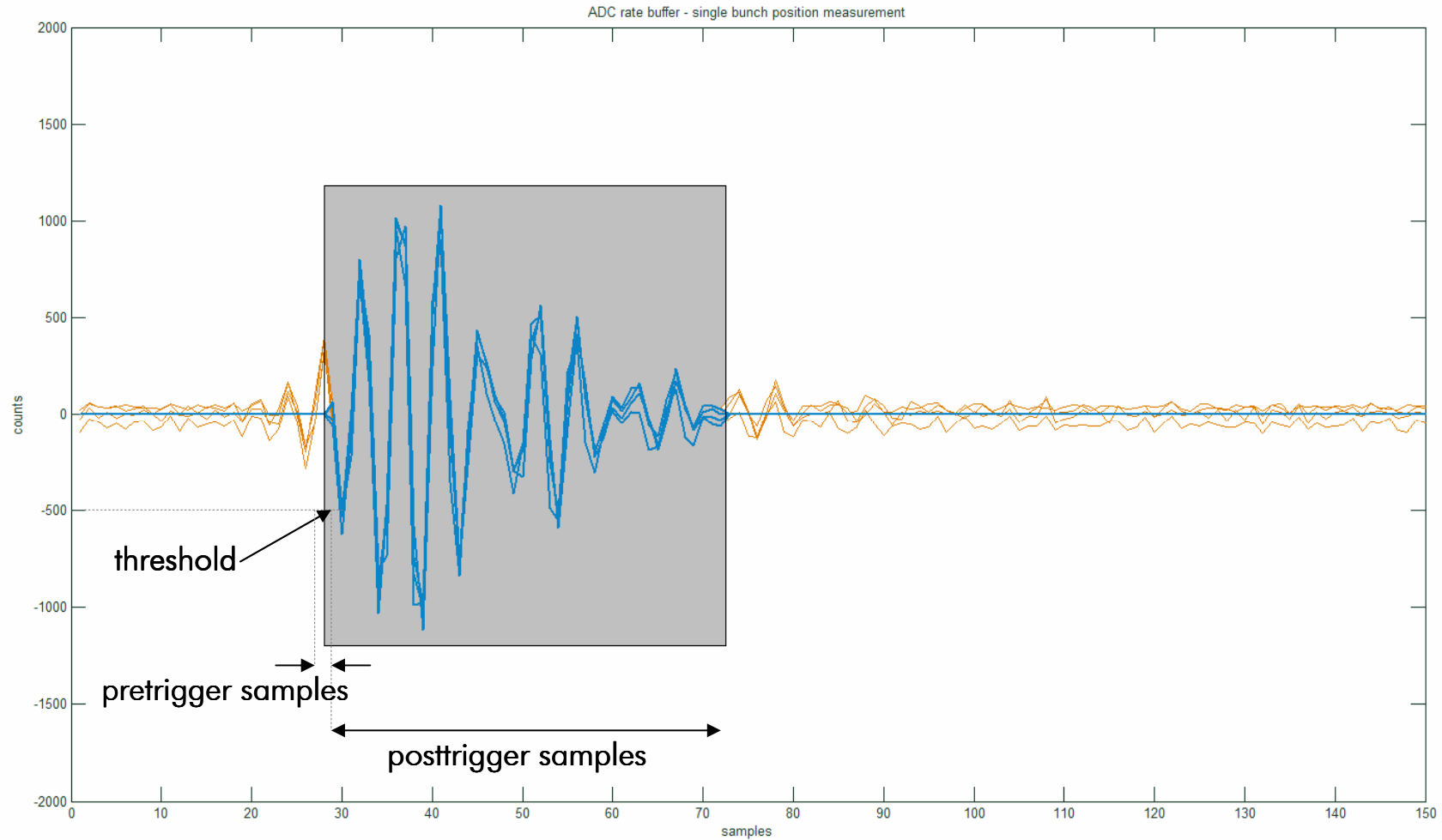


Stripline BPM Signal

The 1.3 GHz stripline BPM signal reproduced in laboratory (top) and acquired by Libera Brilliance (bottom).

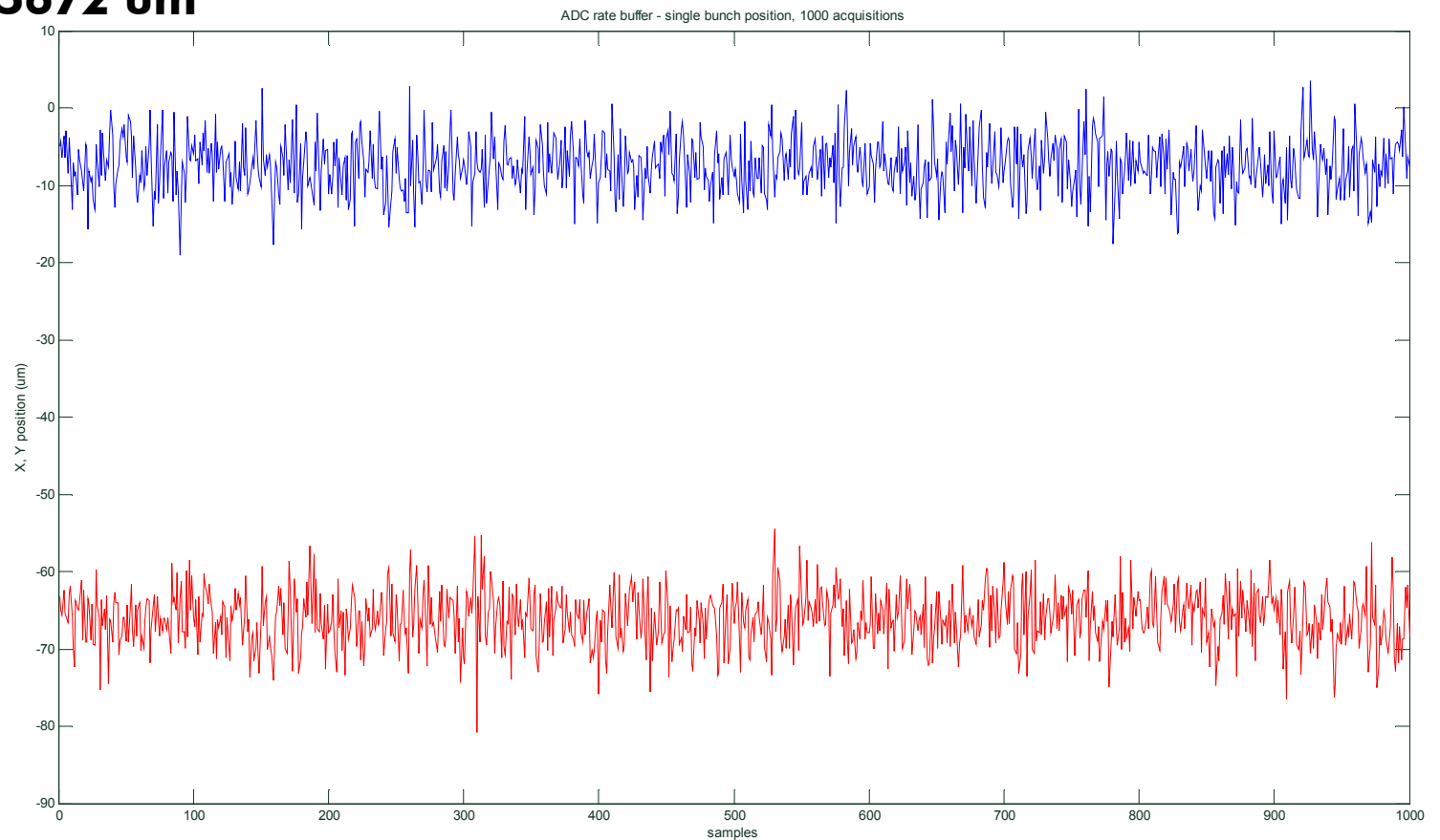


Calculation of Amplitudes and Position



Performance

- Train of 1000 bunches
- Tested repetition rate up to 50Hz
- $X_{rms} = 3,5045 \mu m$
- $Y_{rms} = 3,5672 \mu m$



Libera Single Pass

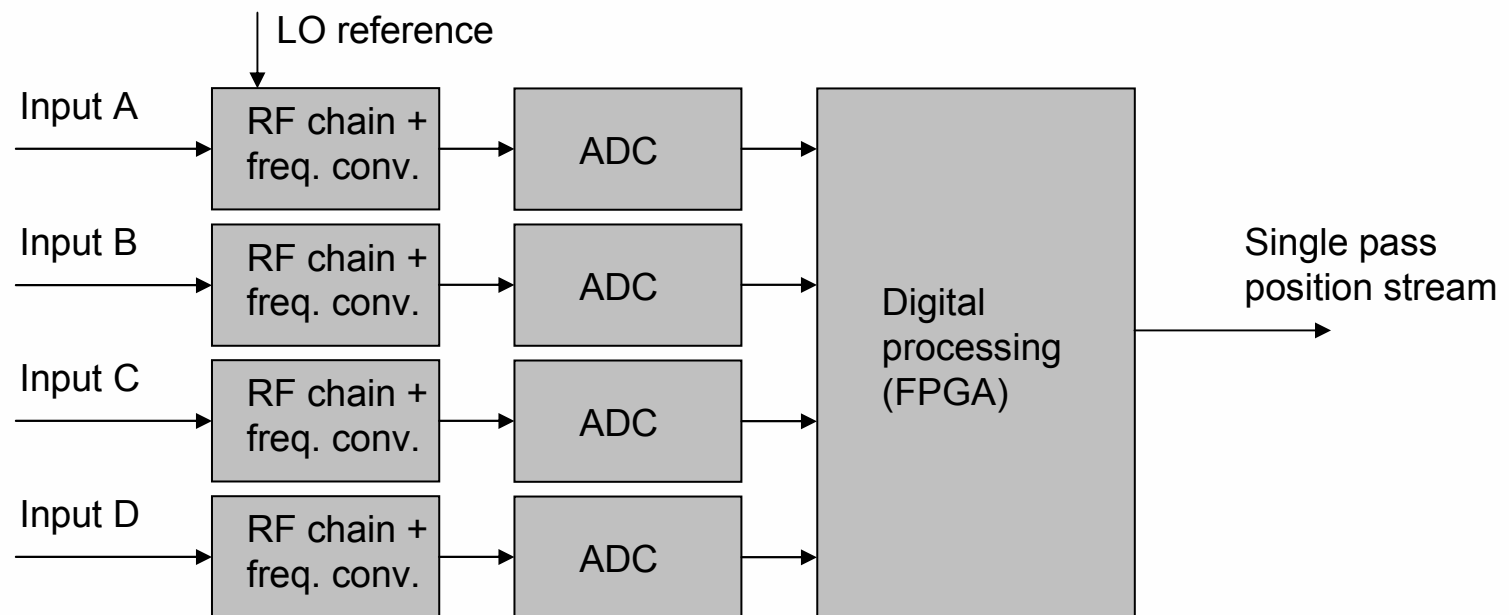


Parameters

- **Input chanel** -16(4 per module)
- **ADC resolution** -16 bits
- **Max ADC sampling clock** -130 MHz
- **Memory size per module** -up to 8 Gbits
- **Customizable topology** -4 BPMs per unit
- **Customizable RF input** -up to 12 GHz
- **LO for downconversion** - internal

Measuring Concepts, 1

The pulses are converted to intermediate frequency and processed by means of analog RF chains. After that, they are digitized and processed by the FPGA.



Features

- **Low phase noise tunable local oscillators are used to compensate resonant pickup frequency drifts.**
- **Frequency corrections are computed in real time and applied before next pulse arrival.**
- **Temperature drifts in electronics are compensated by means of pilot tone signal.**

Requirements and Preliminary Results

Fermi FEL:

pickup type: Cavity BPM 6.5 GHz
rep. rate: 10-50 Hz
bunch charge: 100 pC-1 nC



Resolution requirement: $< 1 \mu\text{m}$
Foreseen resolution: 300 nm

Conclusion

- **Libera Single Pass shares the same platform as Libera LLRF, combining analog and powerful digital signal processing with extreme connectivity options.**
- **It will be available in mid 2009.**