Primož Lemut

Libera Bunch-by-Bunch Front End

primoz@i-tech.si

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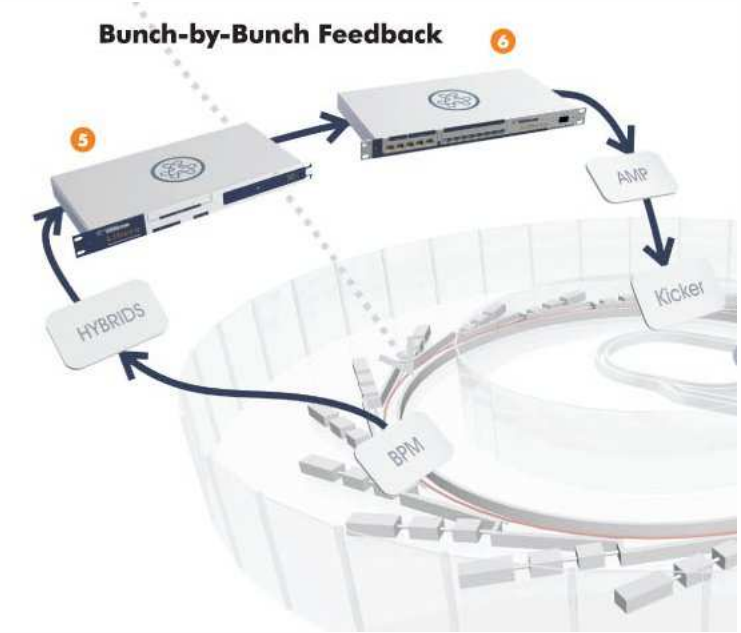
Libera Bunch-by-Bunch Front End Basic information

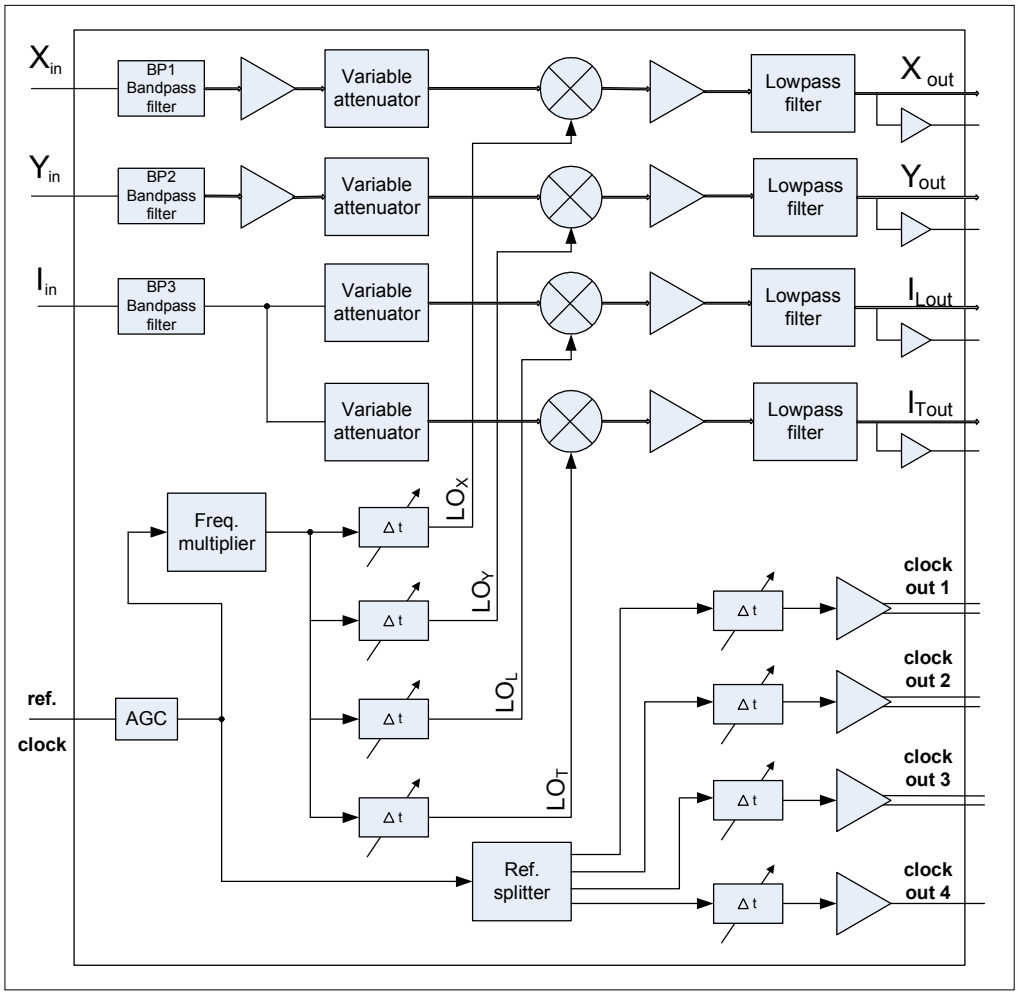
Libera Bunch-by-Bunch Front End (5) is a multi channel unit that provides amplitude or phase demodulation of the bunch position signals from the hybrids and passes demodulated signals to the processing unit (6).



Libera Bunch-by-Bunch Front End Block diagram

Main blocks:

- **Input BPF**
- **RF gain block**
- **Mixers**
- **IF gain**
- **Output LPF**
- **Reference input**
- **Freq. multiplier**
- **Phase shifters**



Libera Bunch-by-Bunch Front End Principle of operation

Transverse instabilities→ Amplitude modulation

Mixing: $A(t)\ \sin(3\omega_{RF}t)\ \sin(3\omega_{RF}t) = A(t)\ (\cos(0) - \cos(6\omega_{RF}t))$

After LPF: $A(t)$

Longitudinal instabilities→ Phase modulation

Mixing: $\sin(3\omega_{RF}t + \varphi(t))\ \cos(3\omega_{RF}t) = \sin(6\omega_{RF}t) + \sin(\varphi(t))$

After LPF: $\sin(\varphi(t)) \rightarrow \varphi(t)$

[3]

Libera Bunch-by-Bunch Front End Specification (1)

Center Frequency
Fc=1.5 GHz (1.408GHz for f_{RF}=352 MHz

Noise Figure
≤ 5 dB for X, Y and I signal chains

Filters BP1, BP2, BP3
1db bandwidth: ± 575 MHz
3dB bandwidth: ± 1150 MHz

Conversion Bandwidth
1 dB bandwidth: 300±15 MHz
3 dB bandwidth: 525±25 MHz
20 dB bandwidth: 1120±60MHz
Return Loss > 15 dB

X, Y Signals Input Power
-60 dBm to -20 dBm

I Signal Input Power
-50 dBm to -10 dBm

Reference Signal Frequency (f_{RF})
500 MHz (352 MHz)

Reference Signal Strength
0dBm ± 3 dBm

Libera Bunch-by-Bunch Front End Specification (2)

Typical X,Y, and I Output Signals
Amplitude: 2 Vpp (+10 dBm @ CW signal)

REFout
Reference output 500 MHz:
- 3.3 V PECL (differential)
- min. +7 dBm (single-ended)

Libera Bunch-by-Bunch Front End Level Setting

- Separate for X, Y and I channels
- -20 dBm to -60 dBm for X and Y
- -10 dBm to -50 dBm for I

Libera Bunch-by-Bunch Front End Demodulation angle setting

- **Separate LO angle setting for X, Y, I_L and I_T ($-\pi$ to $+\pi$)**
- **Additional common angle setting for all channels**
- **1 degree step**

Common phase setting

Local oscillator Y phase setting

Libera Bunch-by-Bunch Front End Status Information

Over temperature protection

Internal temperature

Voltages

Fan RPM

Libera Bunch-by-Bunch Front End
Clock phase setting

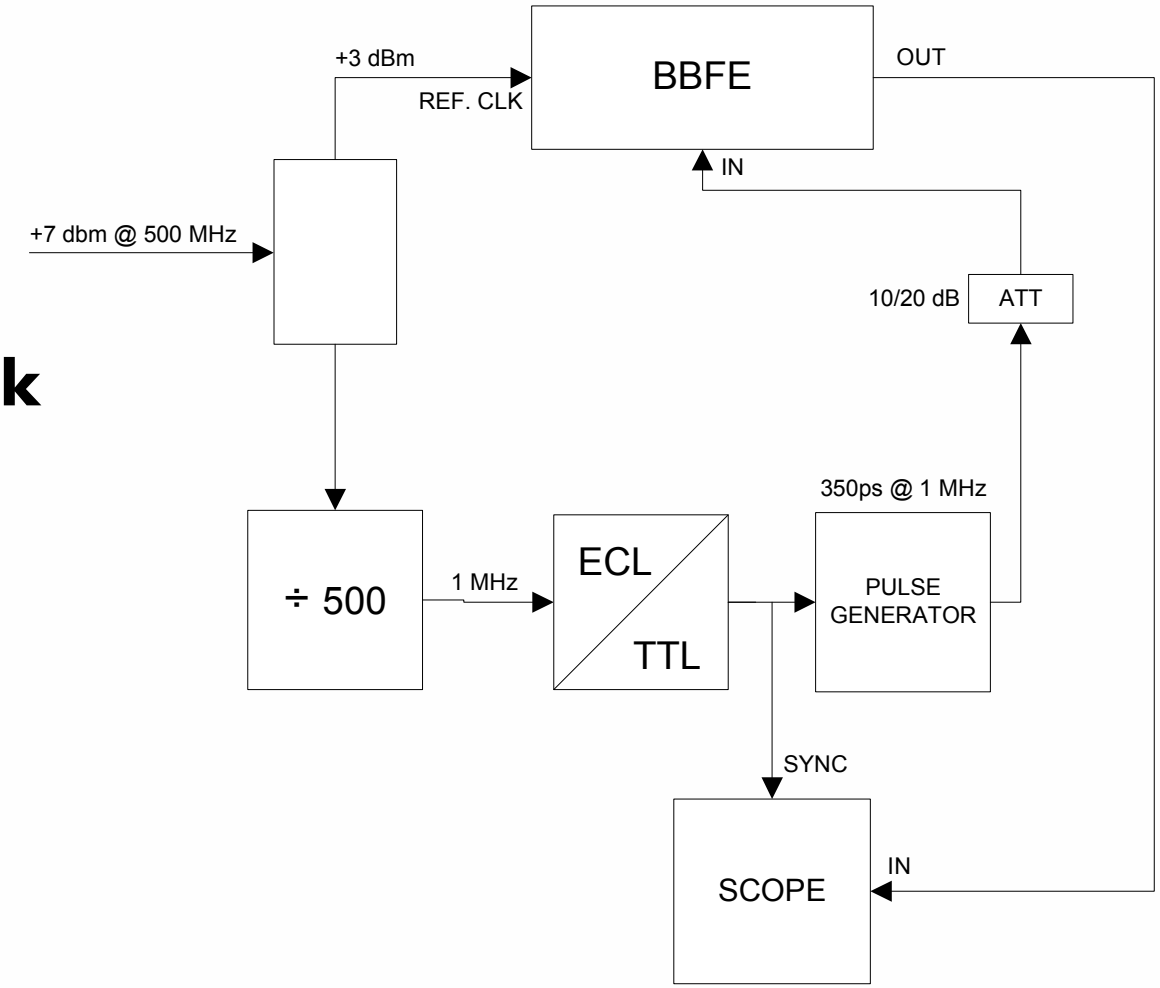
- **3 differential, 1 single-ended outputs**

- **separate phase setting for any of the four outputs (-π to +π)**

Clock phase setting

Libera Bunch-by-Bunch Front End Live Demonstration

Setup block diagram



Libera Bunch-by-Bunch Front End Software

•The SW release, shipped with first units is fully functional regarding the signal properties

•Software is upgraded through the serial port on the front panel, very simple procedure

•Current SW does not yet support Ethernet communication, planned by the end of the year.

Libera Bunch-by-Bunch Front End Conclusion

- The unit is now fully available

- First units were manufactured in summer and shipped to customers in September 2008

References

[1] Instrumentation Technologies, Libera Bunch-by-Bunch Front End User's Manual, 2008

[2] Instrumentation Technologies, Libera Bunch-by-Bunch Front End Specification, 2008

[3] M. Lonza, Multi-bunch feedback systems, Elettra Synchrotron Light laboratory, CERN Accelerator School 2007 proceedings