Operational Status Of The Transverse Multibunch Feedback System At Diamond

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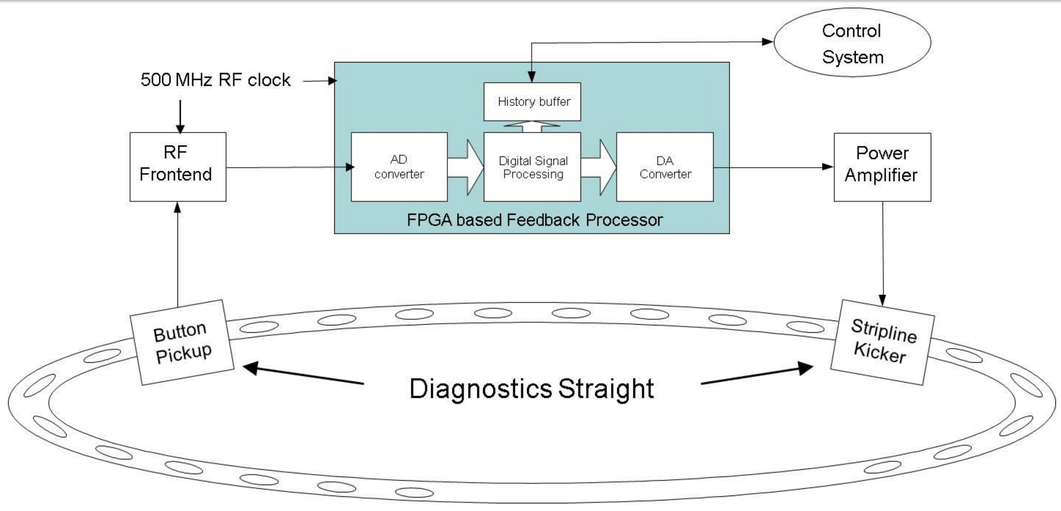
A transverse multibunch feedback (TMBF) system is in operation at Diamond Light Source to damp coupled bunch instabilities up to 250 MHz in both the vertical and horizontal planes. It comprises an in-house designed and built analogue frontend combined with a Libera Bunch-by-Bunch feedback processor and output stripline kickers. FPGA-based feedback electronics is used to implement several diagnostic features in addition to the basic feedback functionality.

Introduction

The 3 GeV Diamond storage ring is currently serving photon beam for users with a current of 250 mA in a multibunch fill with 900 bunches. In addition, a hybrid mode where 3/4 of the ring filled with normal intensity multibunch train and a high intensity single bunch sitting on the opposite side is run for certain experiments. Multibunch instabilities have been clearly observed and studied at Diamond from the early days of commissioning. Therefore, it was necessary to create a transverse multibunch feedback system to combat the instabilities towards achieving our final target current of 300mA in multibunch mode.

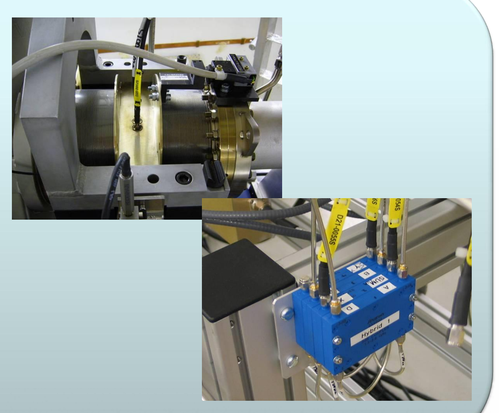
TMBF System Architecture



System Components

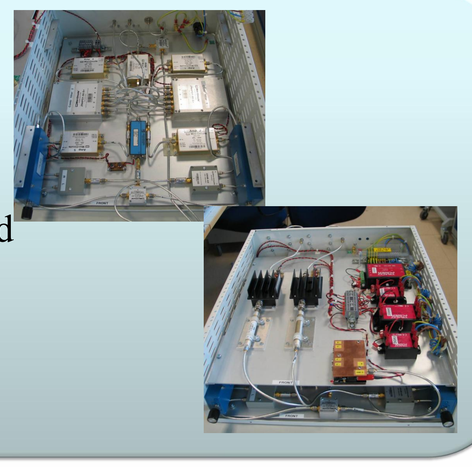
Pickups and Hybrids

- Hybrids mounted in tunnel.
- Short cables of precise length connect buttons to hybrids (keep phase).
- X/Y/Σ signal run to racks.



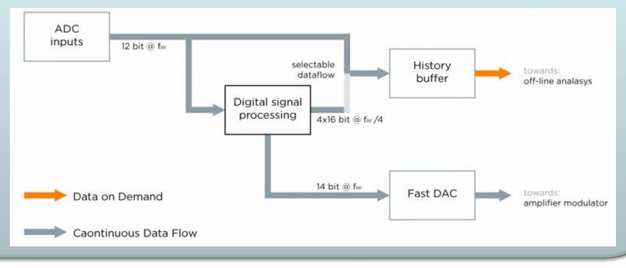
RF Front End

- In-house developed.
- Occupies 3U 19” Rack.
- Full of minicircuits components and power supplies.



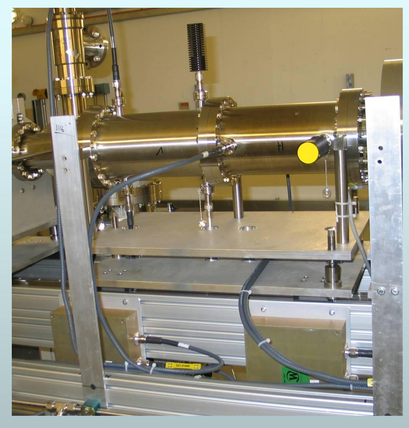
Libera Bunch-by-Bunch

- Digital signal processing, data sampling and data storage at 500 MHz rate.
- 12-bit fast ADC.
- 12-taps FIR Filter.
- 14-bit fast DAC.



Drive Amplifiers and Striplines

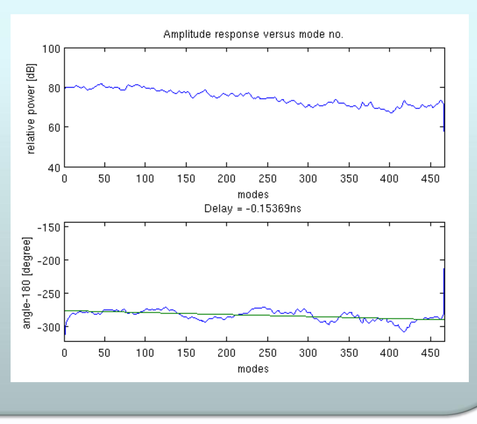
- 100 W each (3dB compression)
- 250kHz-350MHz.
- Driving striplines in differential mode through power hybrids.



System Performance

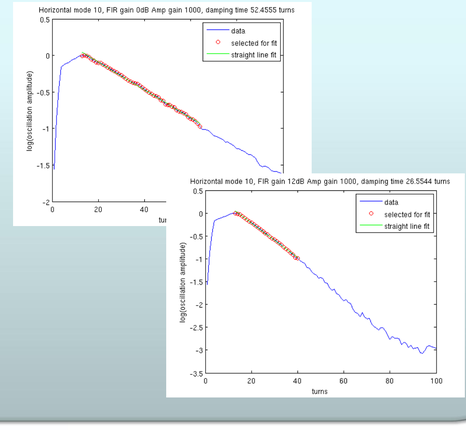
Open Loop Performance

- Excite the beam at each mode frequency in turn using the internal NCO,
- Measure the amplitude and phase response of the open loop at the output of the feedback FIR filter.

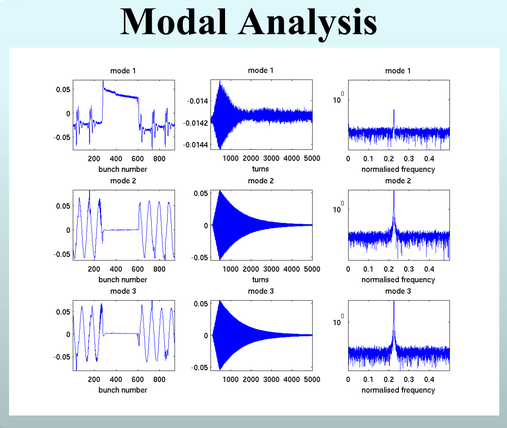


Grow/Damp Measurement

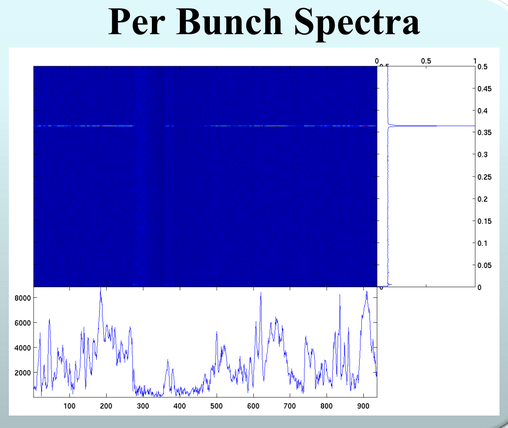
- Excite a mode for a brief period,
- Switch off excitation, close loop record mode amplitude,
- Straight-line fit decay,
- Repeat for different modes,
- Vary gain.



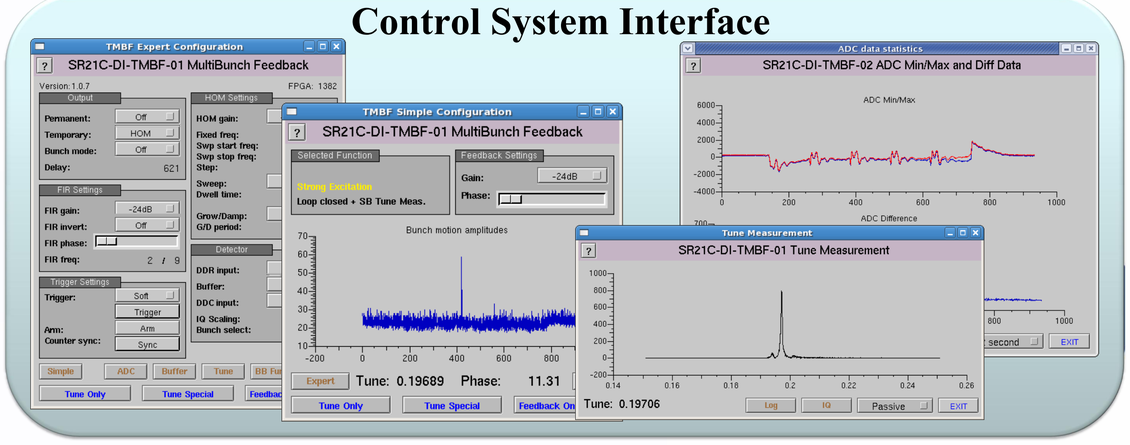
Modal Analysis



Per Bunch Spectra



Control System Interface



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