



LLRF World Wide

LLRF Lecture Part 3.7

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ITER / DESY

Evolution of Hardware at SNS

1st Generation
Control Chassis



MEBT Rebunchers
4 installed, 1 spare

Retrofitted with FCM
Nov 04

2nd Generation
Control Chassis



RFQ & DTL
7 installed, 3 spares

Retrofitted with FCM
Jul 04

3rd Generation
Field Control Module



CCL, SCL & HEBT
Retrofit to MEBT, RFQ & DTL
98 systems + spares

Evolutionary Development: build on proven concepts, hardware and software

October 10, 2005



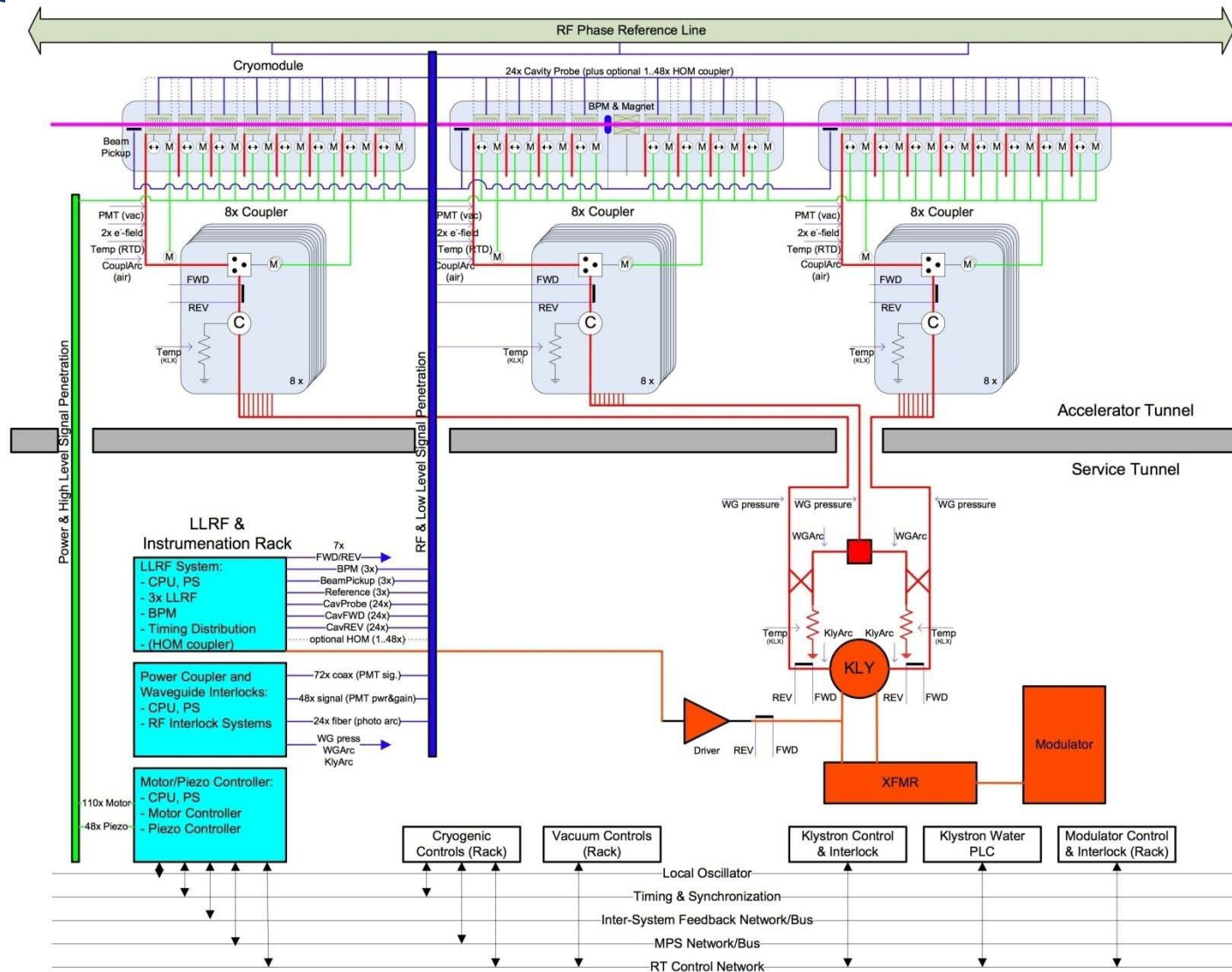
Lesson Learned at SNS



Advice for Hardware Development

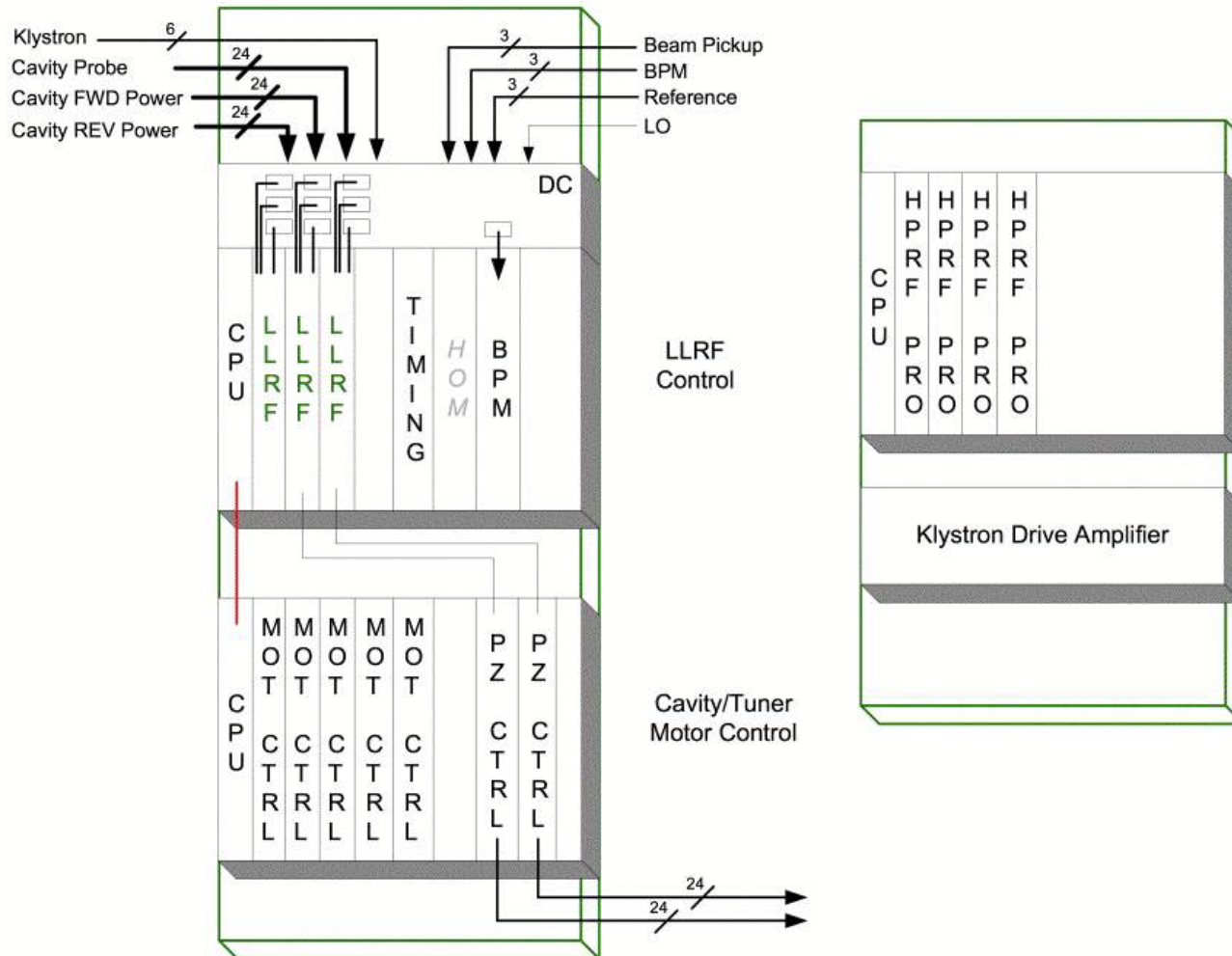


RF Station with 3 Cryomodules

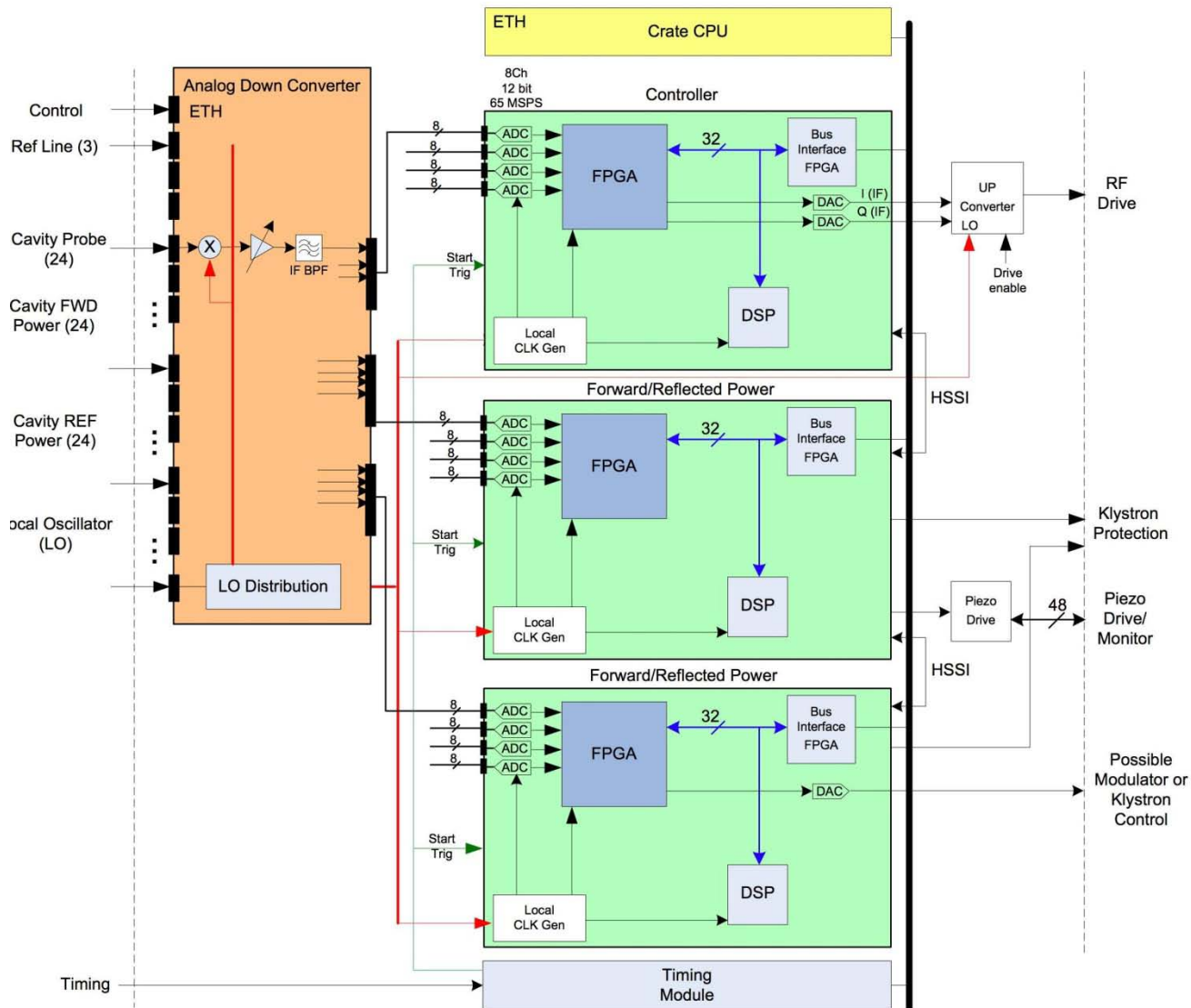


Rack Layout

LLRF/Instrumentation Racks

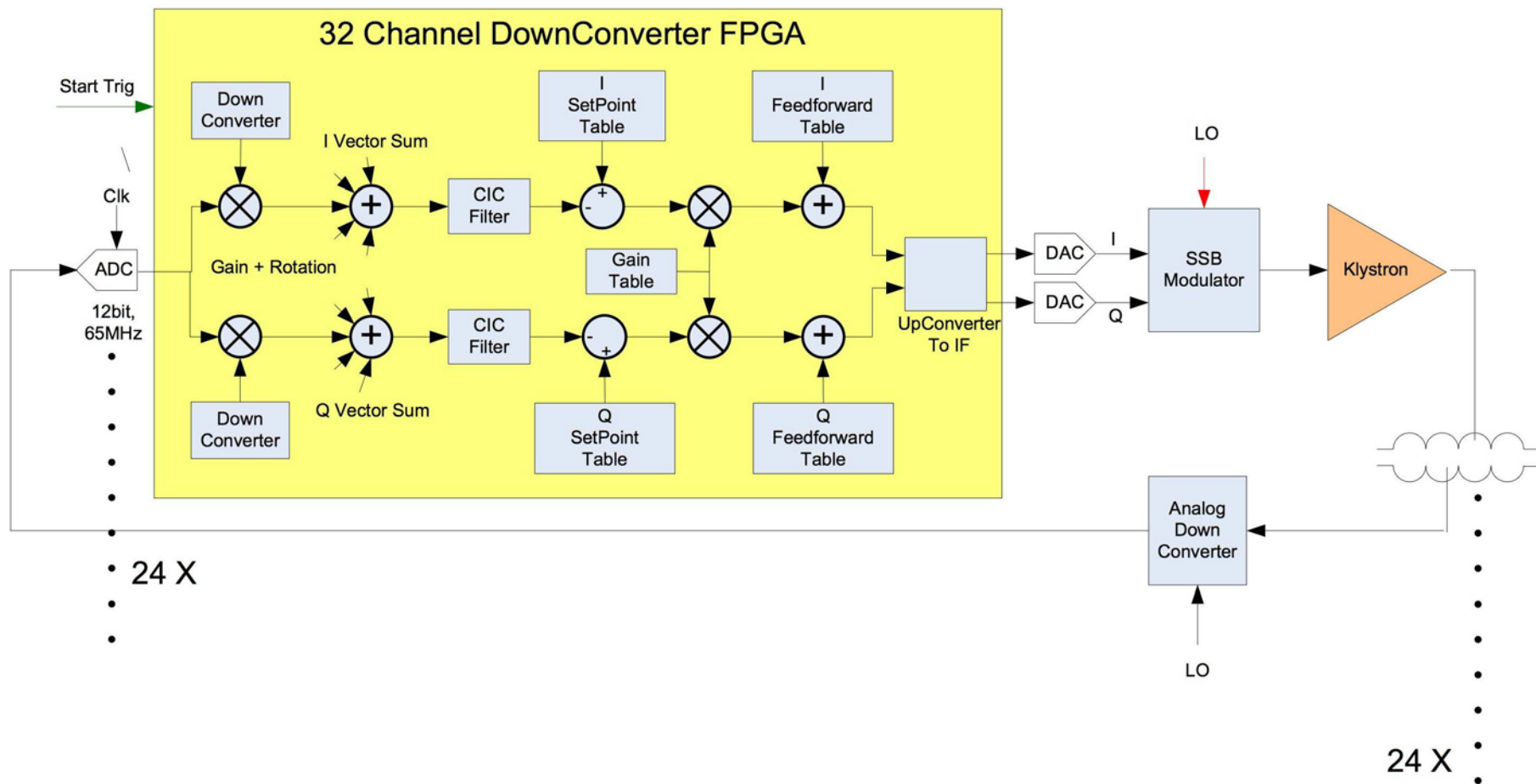


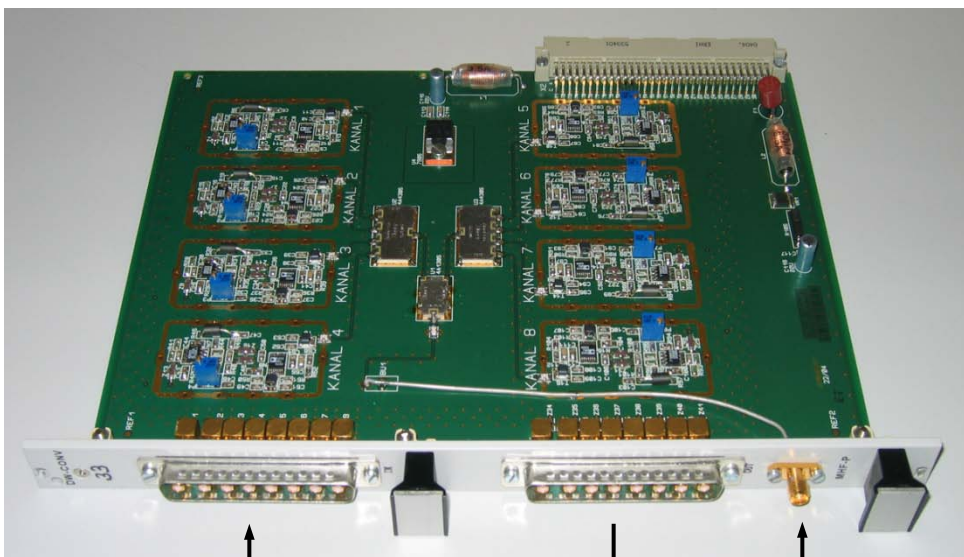
LLRF Rack Detail



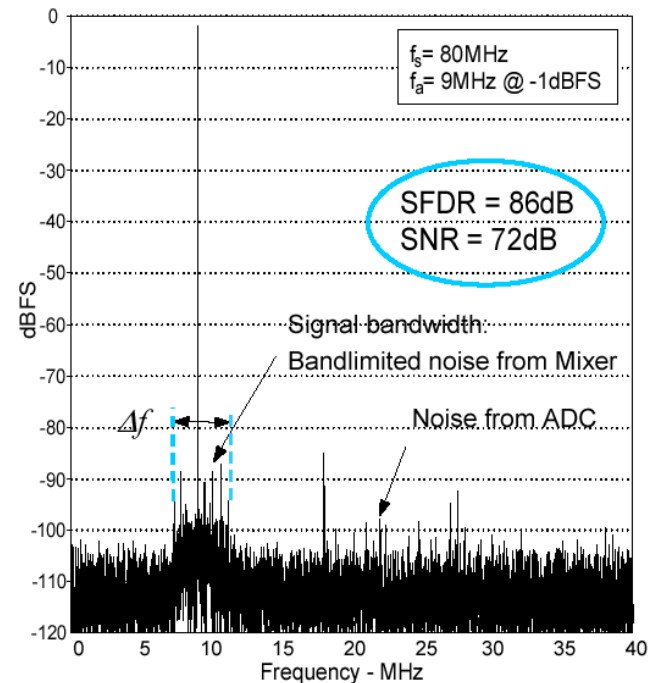


LLRF Field Module Controller





• SNR for oversampling :

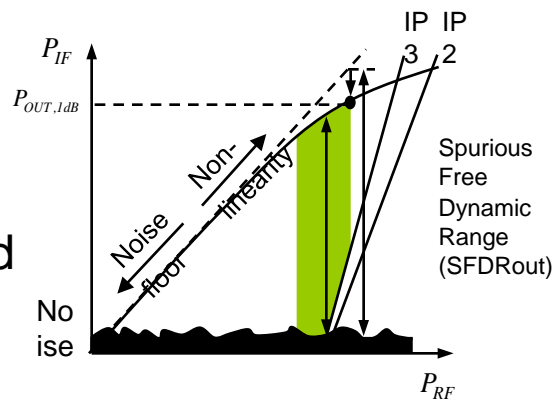


8-channels from cavity probe :

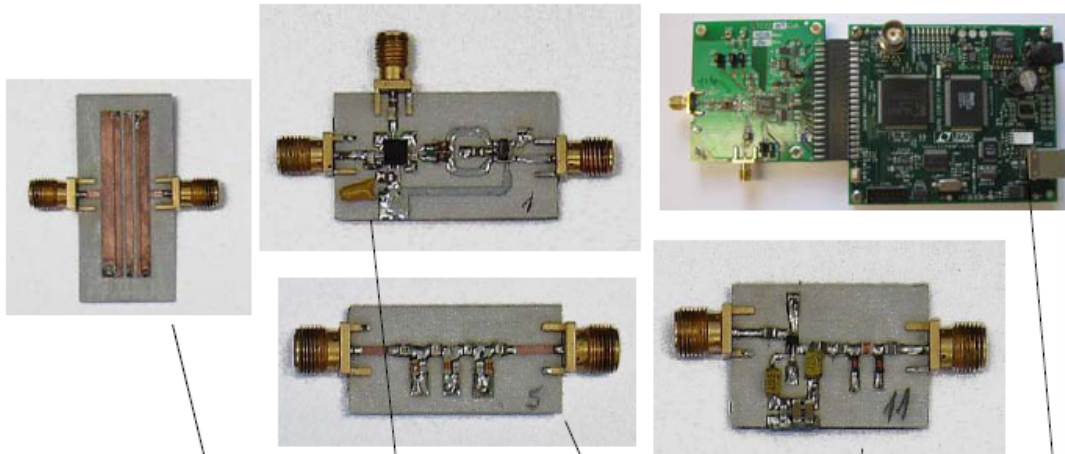
8-channels to ADC-Board :

LO-Input :

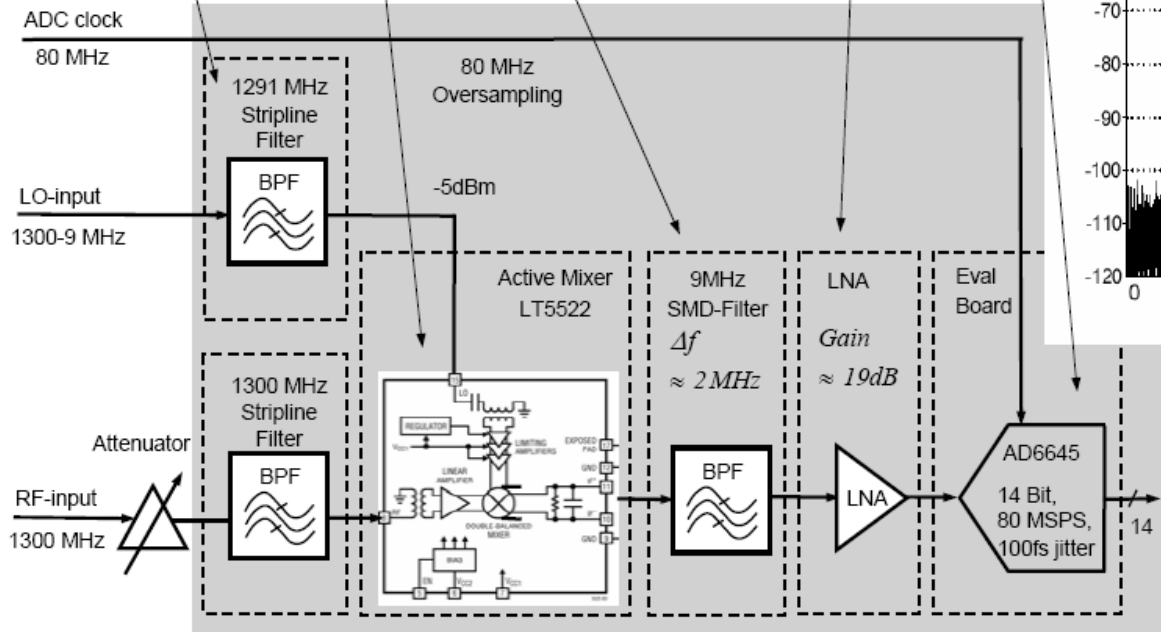
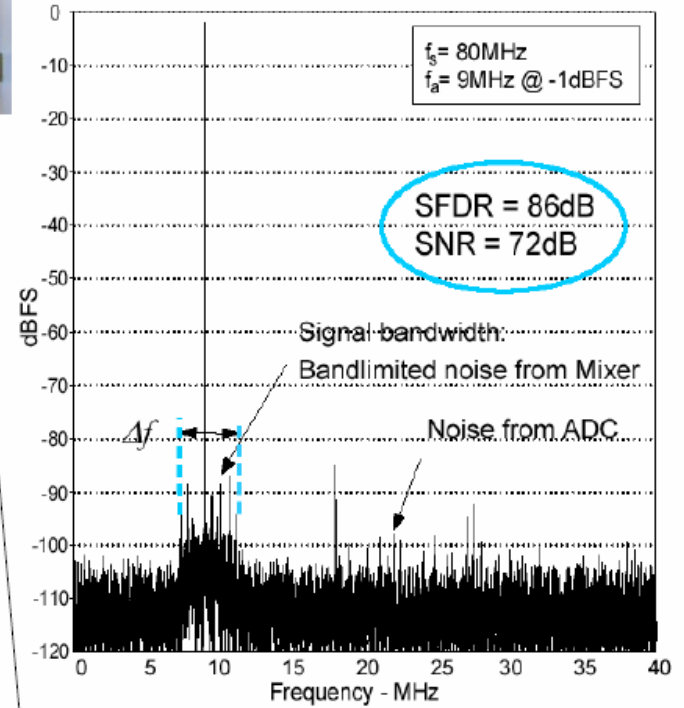
Compromise between noise and linearity



Gilbert Cell Mixer

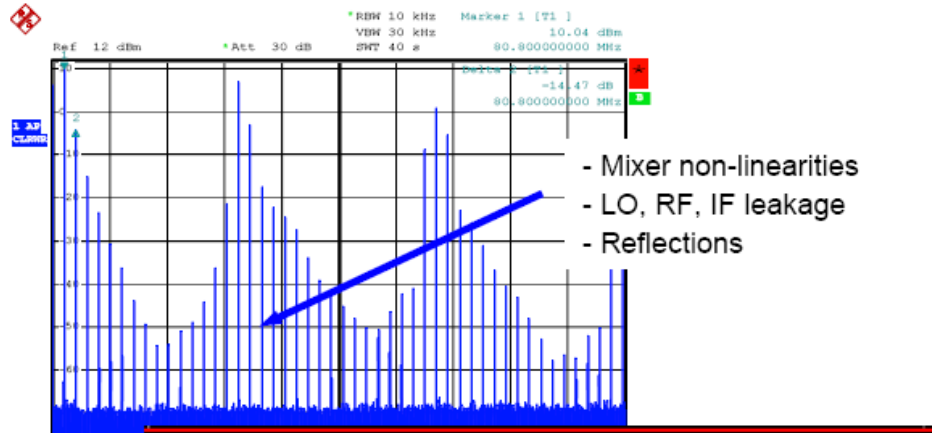
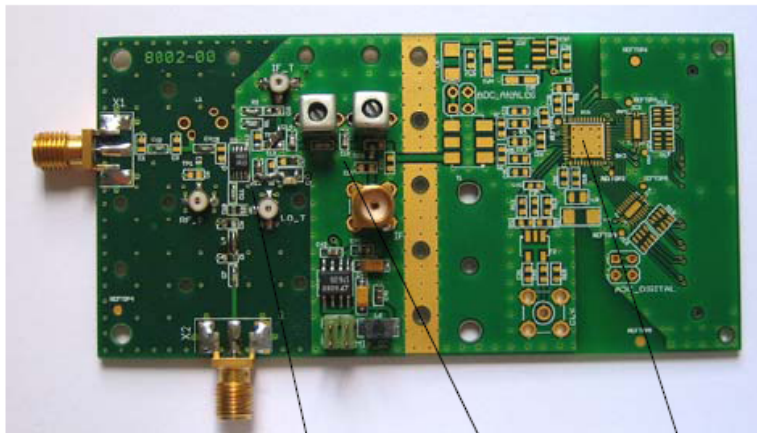


● SNR for oversampling :

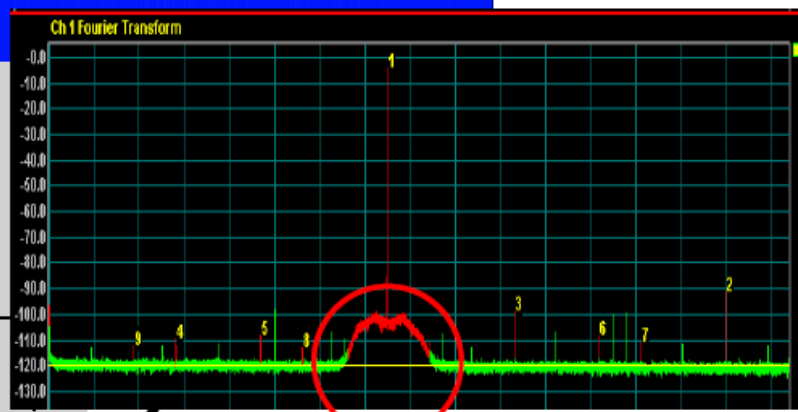
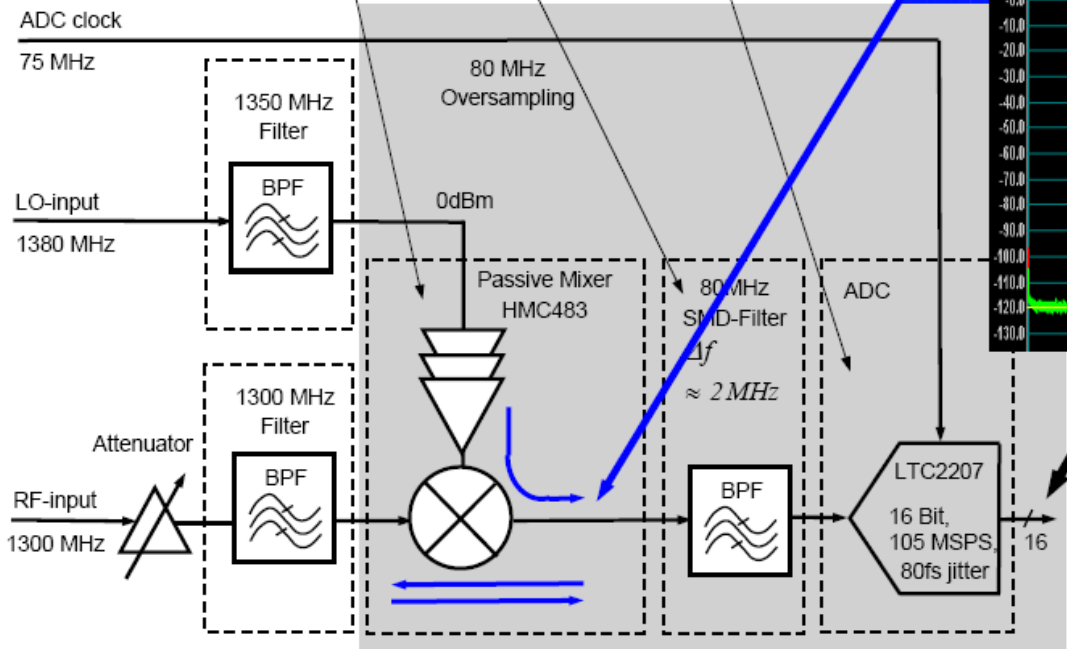


SNR is limited to 72dB by the
 NF of the front end mixer.
 (SNR of about 70dB from
 JLAB using HMJ mixers.)

Passive Mixer

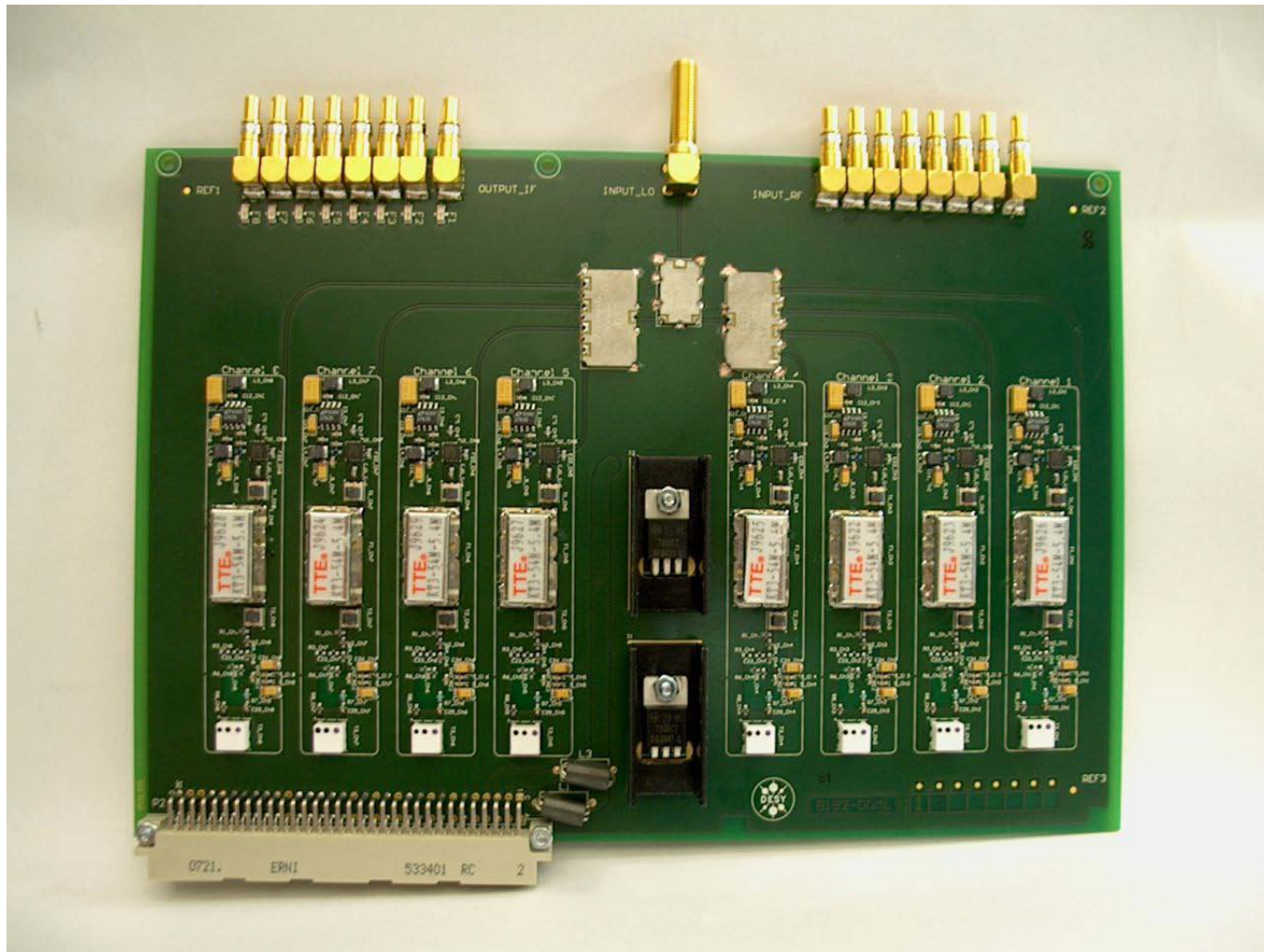


- Mixer non-linearities
- LO, RF, IF leakage
- Reflections



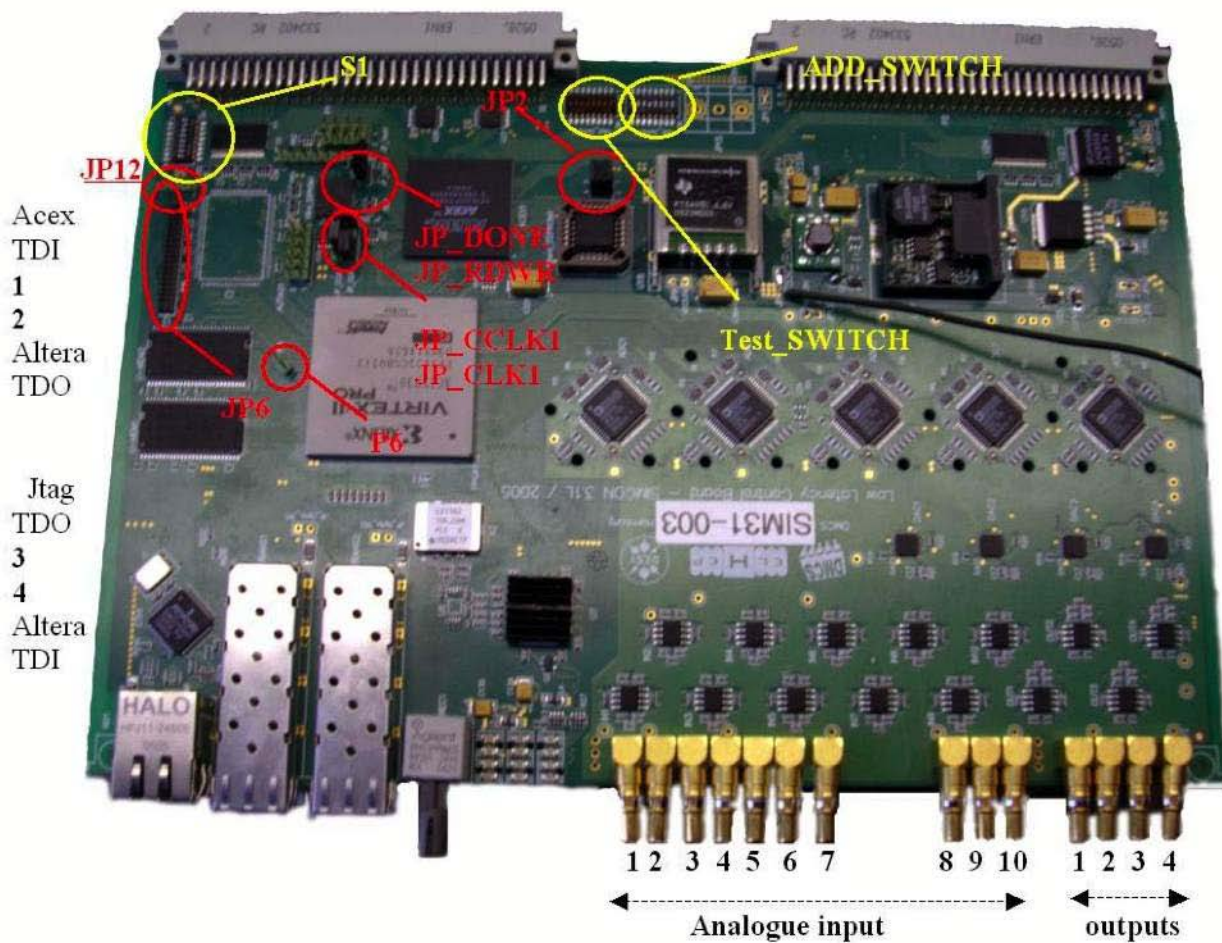
- SNR of 73dB is limited by the reference signal generation of RF and LO.
- Test setup with fs resolution.
- Diplexer design to reduce distortions.

8-channel downconverter



DESY SIMCON 3.1 Controller

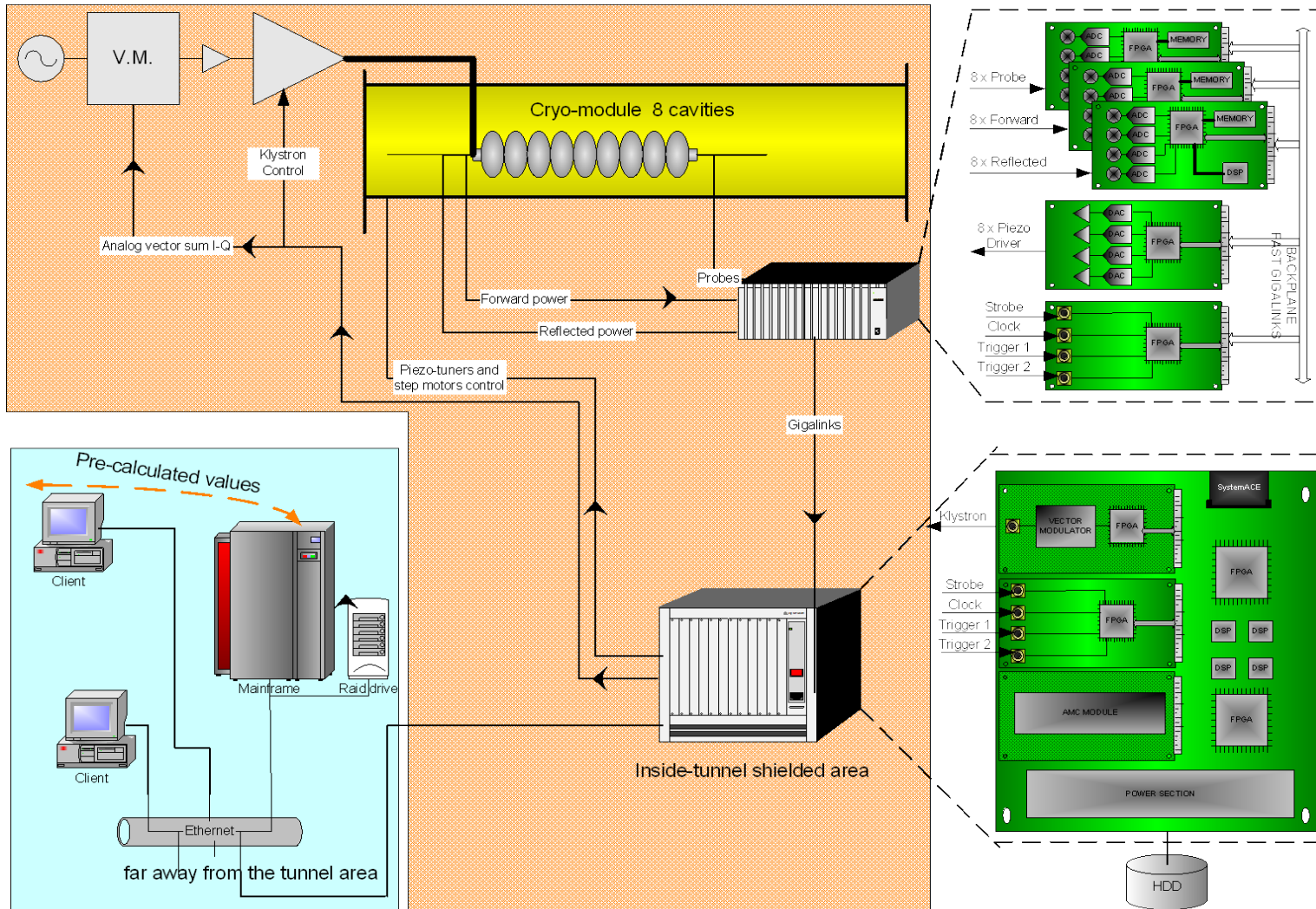
2.SIMCON3.1 board description and schematics.



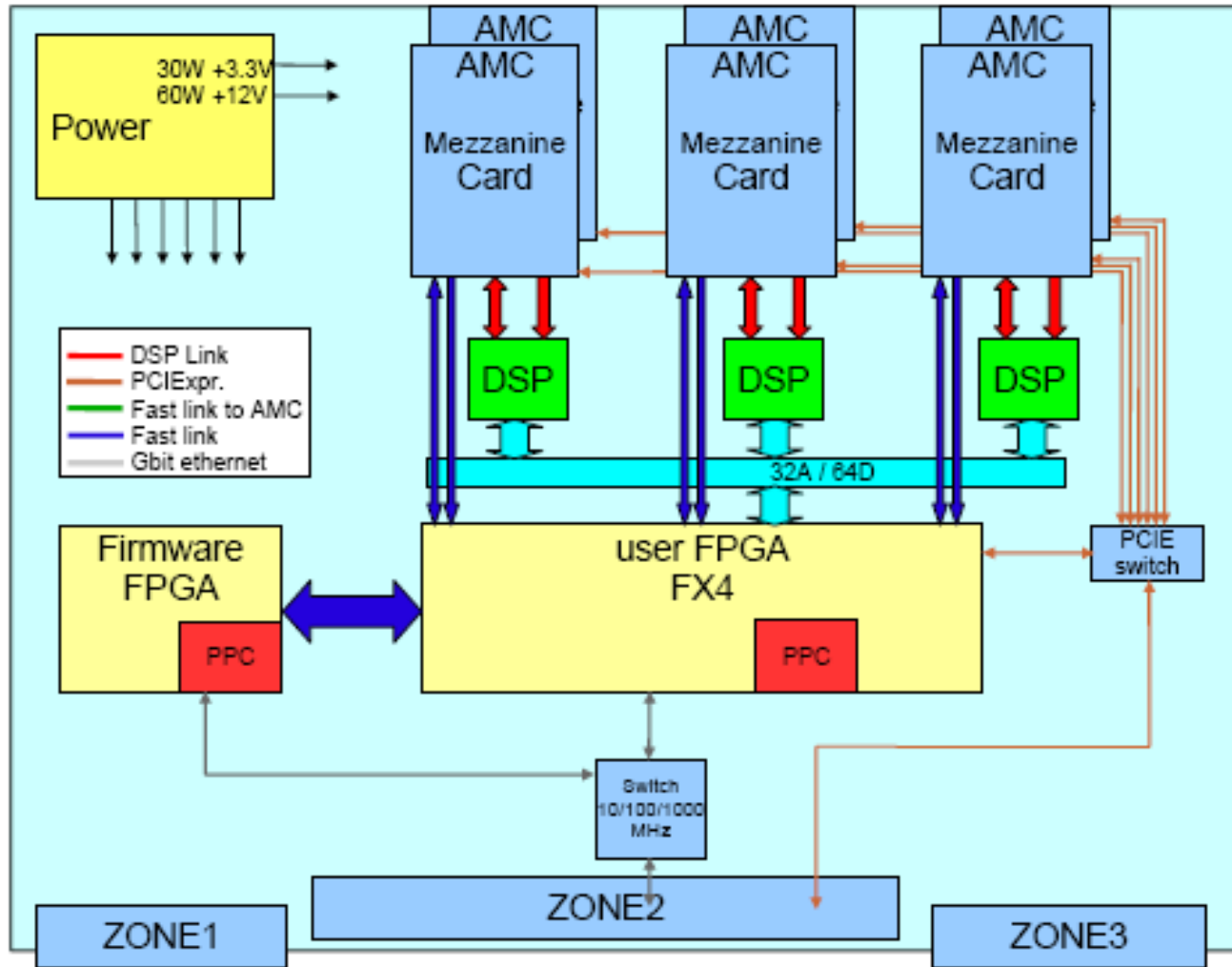
Next generation: SIMCON DSP



Next generation: ATCA



Architecture of Carrier Board



All modules:

- IPMI v. 1.5
- PCIExpress
- Fast link to the carrier (10 differential pairs)
- Virtex 5

8 channels "slow" ADC board

- 14 bits
- BW 200 MHz
- SF ext. & int. up 105 MHz

2 channels. "fast" ADC board

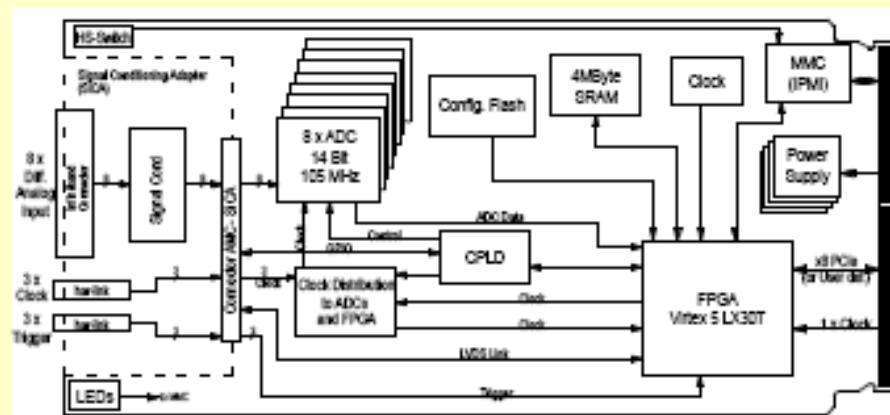
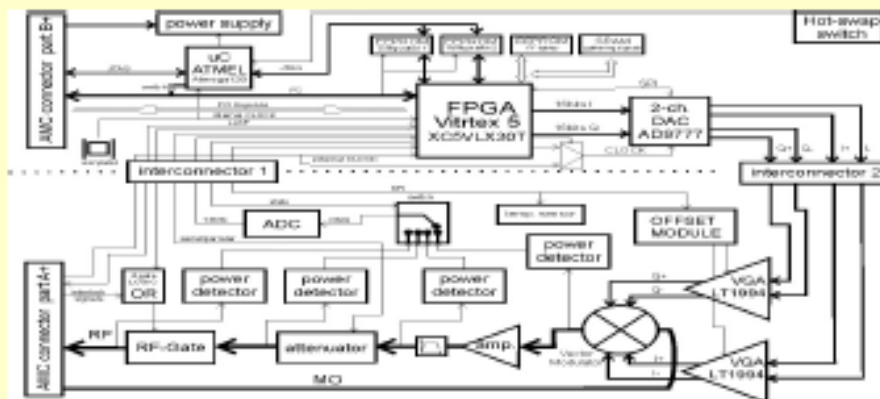
- BW 1 GHz
- 10 bits
- SF 1-2.5 GHz

Timing Module

- Receive coded clock signal, produces 6 different clocks

Vector Modulator

- Digital input
- 1.3 GHz, 0dBm





Reference

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- [4] A. Regan et al., “Newly Designed Field Control Module for the SNS”, Proceedings of the 2003 Particle Accelerator Conference, Portland
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- [7] T. Plawski, T. Allison, J. Delayen, C. Hovater, T. Powers, “Low Level RF System for Jefferson Lab Cryomodule Test Facility”, Proceedings of the 2003 Particle Accelerator Conference, Portland
- [8] S. Michizono et al., “Digital RF Control System for 400-MeV Proton Linac of JAERI/KEK Joint Project”, Proceedings of the 2002 Linac Conference, Gyeongju, Korea



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- [15] S. Michizono, et al, “Digital RF Control System for 400-MeV proton Linac of JAERI/KEK Joint Project,” Linac 2002, Gyeongju, Korea, Aug. 2002.
- [16] S. Michizono, et al, “Digital Feedback System for J-PARC Linac RF Source,” this conference.
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- [18] M. Champion et al, “The Spallation Neutron Source Accelerator Low Level RF Control System,” PAC03, May 2003.



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- [19] M. Crofford et al, “Operational Experience with the Spallation Neutron Source High Power Protection Module,” PAC05, May 2005.
- [20] M. Piller et al, “The Spallation Neutron Source RF Reference System,” PAC05, May 2005.
- [21] K. Kasemir et al, “Adaptive Feed Forward Beam Loading Compensation Experience at the Spallation Neutron Source Linac,” PAC05, May 2005.
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