



LLRF World Wide

LLRF Lecture Part6

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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

- Document the system requirements.
 - Avoid feature creep.
- Document the development plan.
- Make a resource-loaded schedule and budget.
- Use proven solutions. Don't reinvent the wheel. Resist the “not invented here” syndrome.
- Keep it simple.
- If your schedule is at risk, ask for help.
- Your team must “take ownership” of the system.
- Software support and development is an integral and essential part of the process.
- Be willing to cross functional and subsystem boundaries.
- Avoid dictating the choice of software tools and languages if possible.

Ref. M. Champion



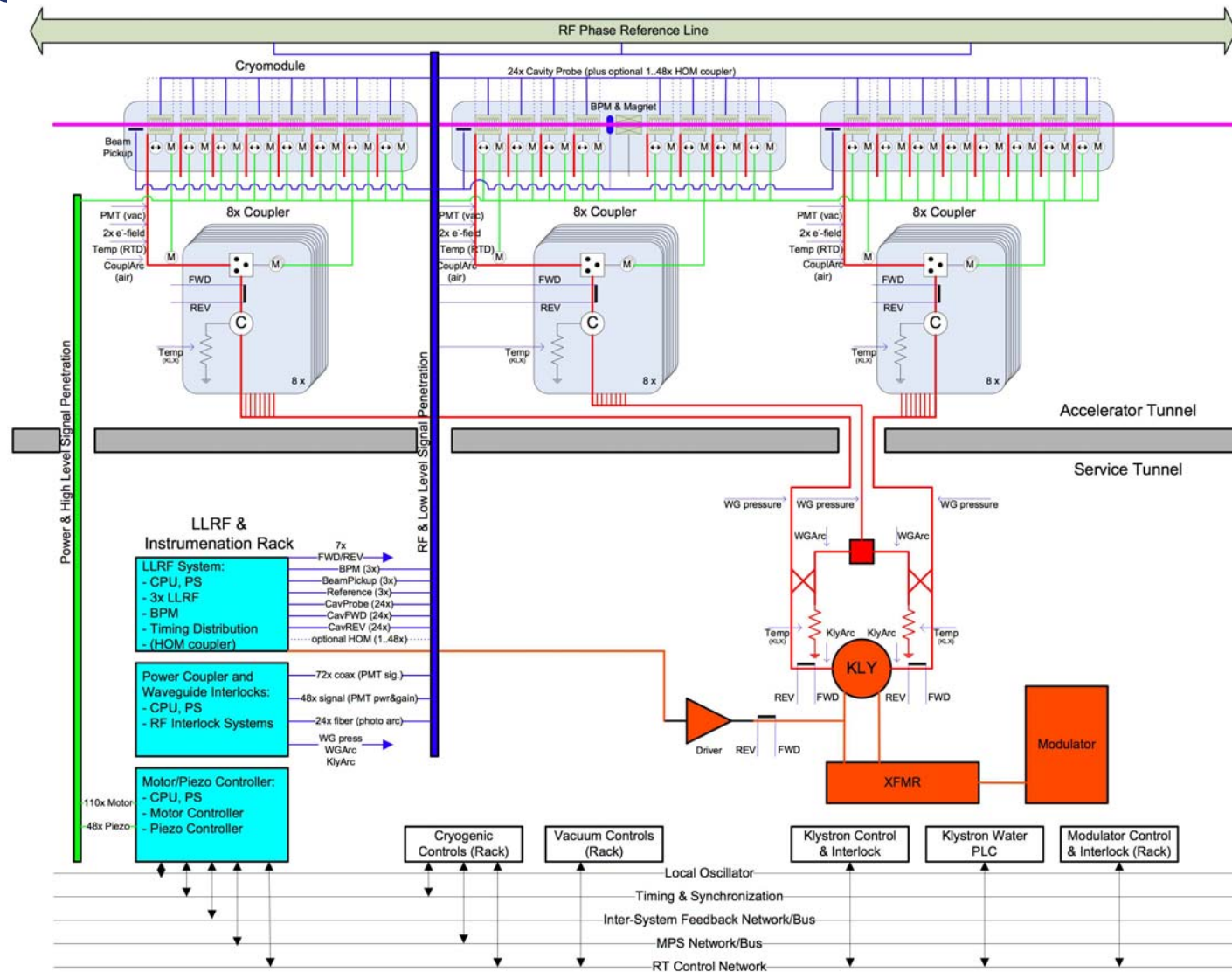
Advice for Hardware Development

- Avoid early parts obsolescence.
- Install a RF PIN switch diode on your RF output.
- Install extra channels – you will need them later!
- Verify your parts can withstand a wet wash process following SMT assembly.
- Do not use epoxy-mount components (difficult to replace)
- Provide adequate shielding between motherboard and daughterboard.
- Provide “clean” DC power to your circuits.
 - Beware of DC-to-DC switching supplies. The switching frequency (usually 200 kHz) will find its way into your system!
- Don't waste your time building cables. Let a vendor do it.
- Use a symmetric layout for your ADC clock distribution and pay attention to impedance matching.
- Think about how you will test, troubleshoot and repair your circuit boards when you do your board design and layout (not after you receive the circuit boards)

Ref.: M. Champion



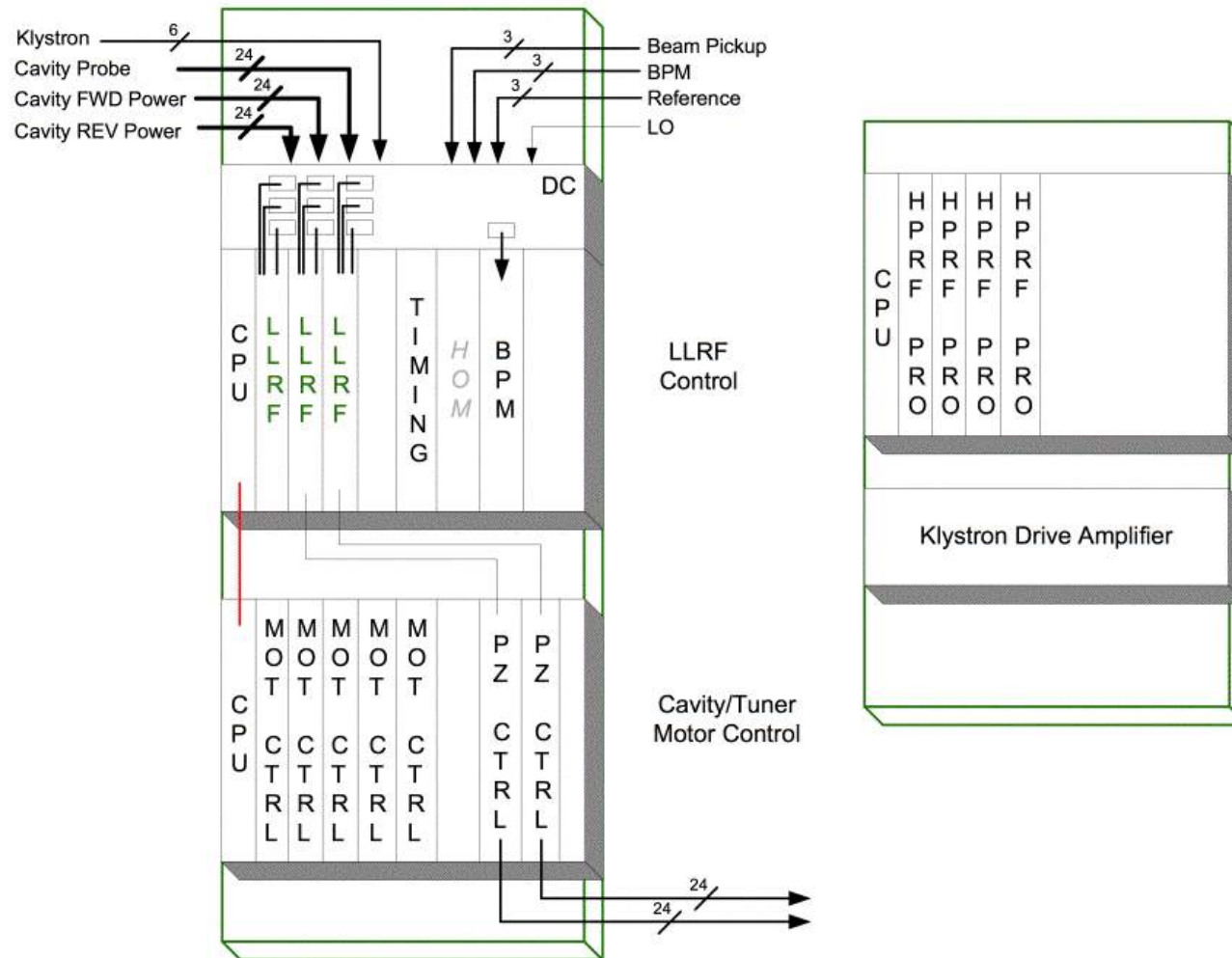
RF Station with 3 Cryomodules





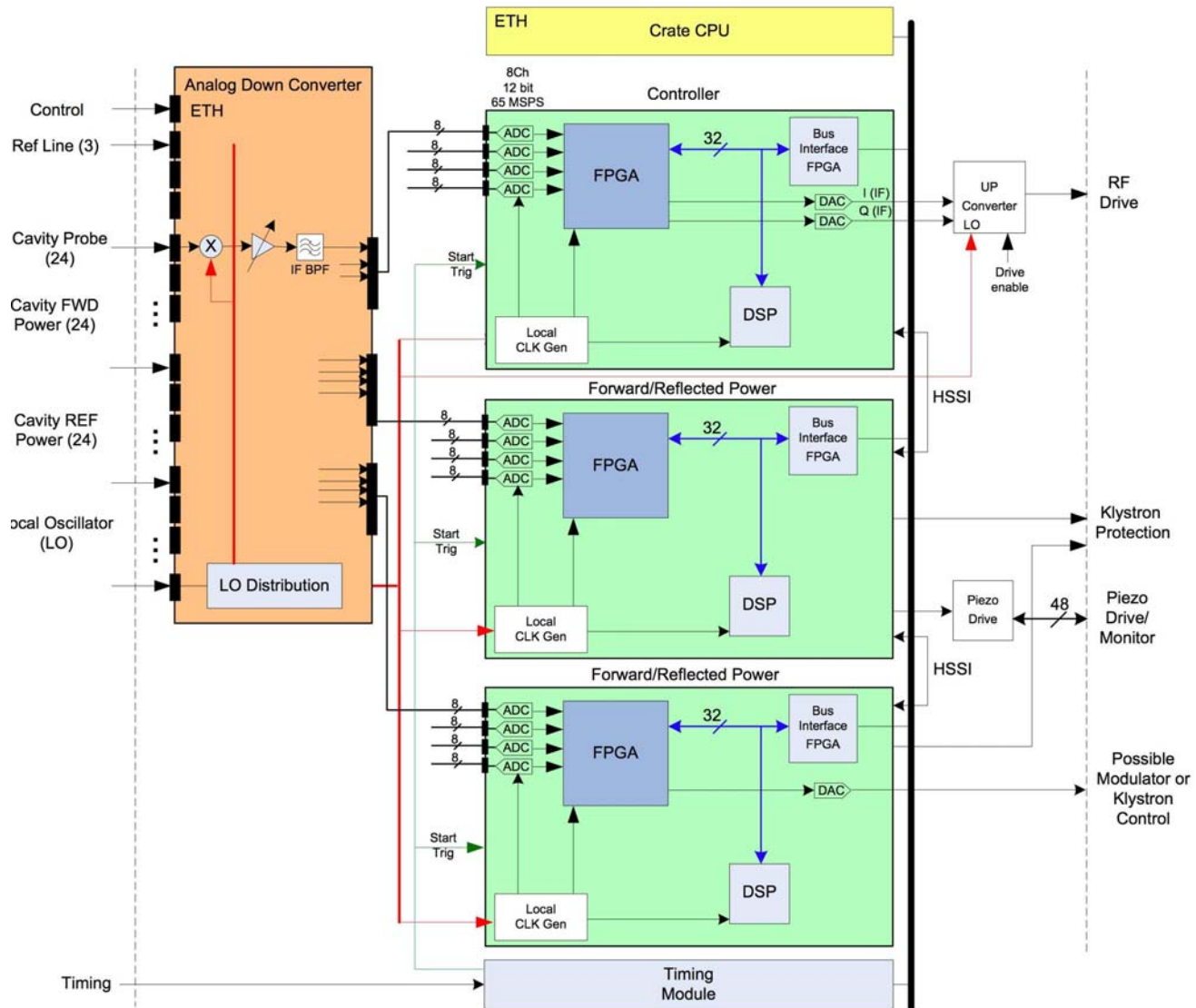
Rack Layout

LLRF/Instrumentation Racks



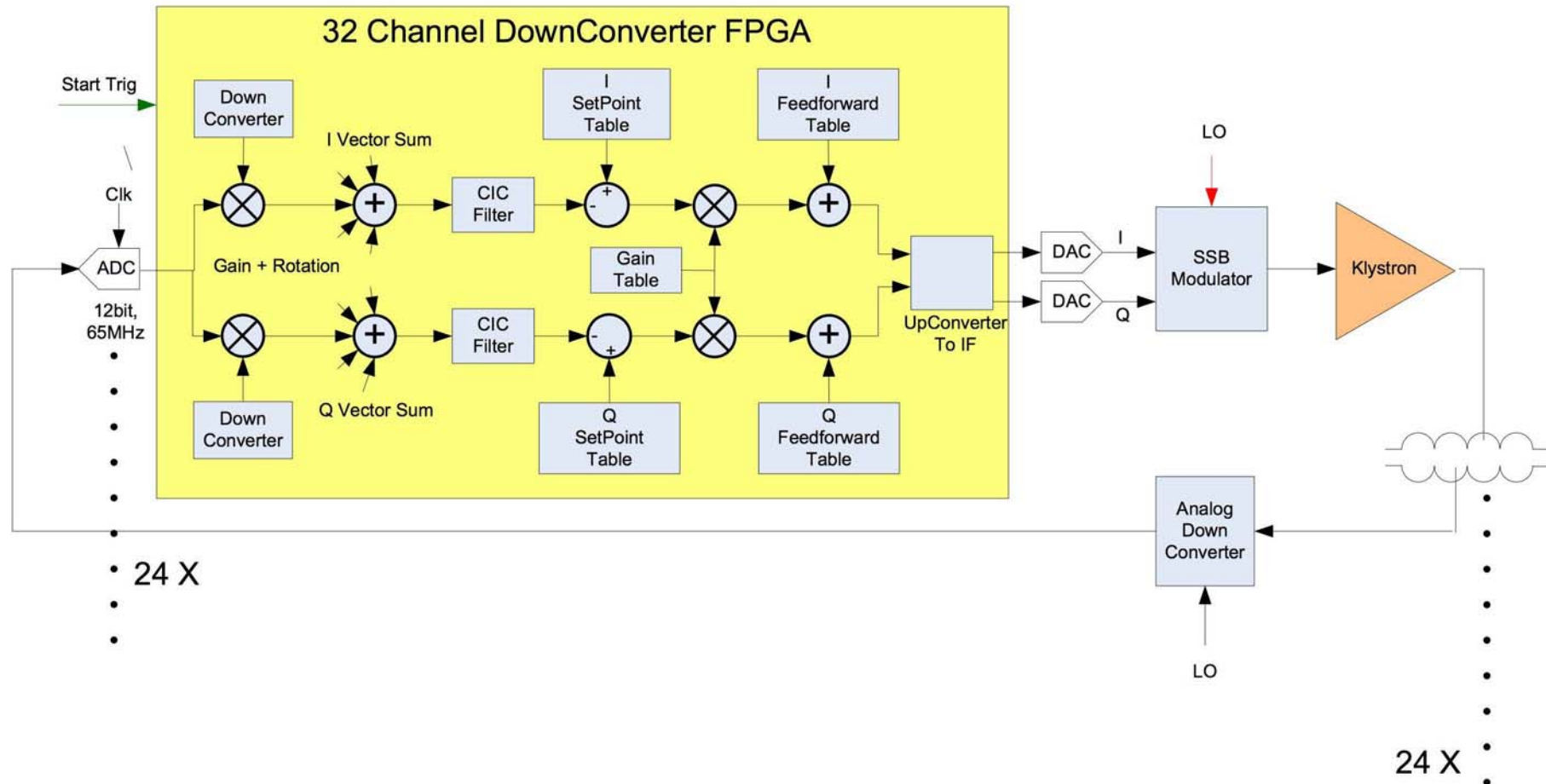


LLRF Rack Detail



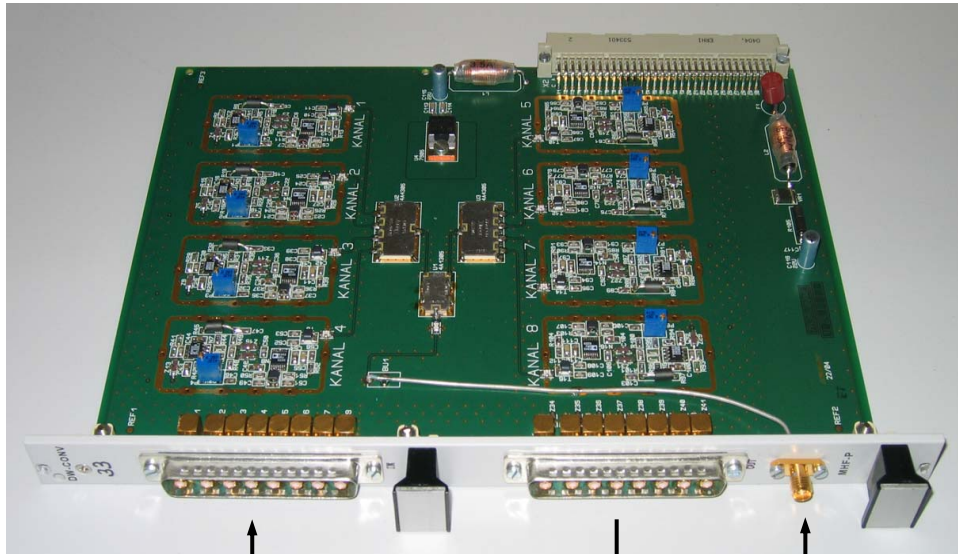


LLRF Field Module Controller





Downconverter

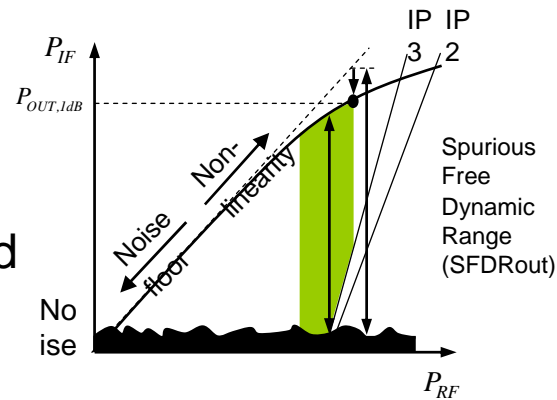


8-channels from cavity probe :

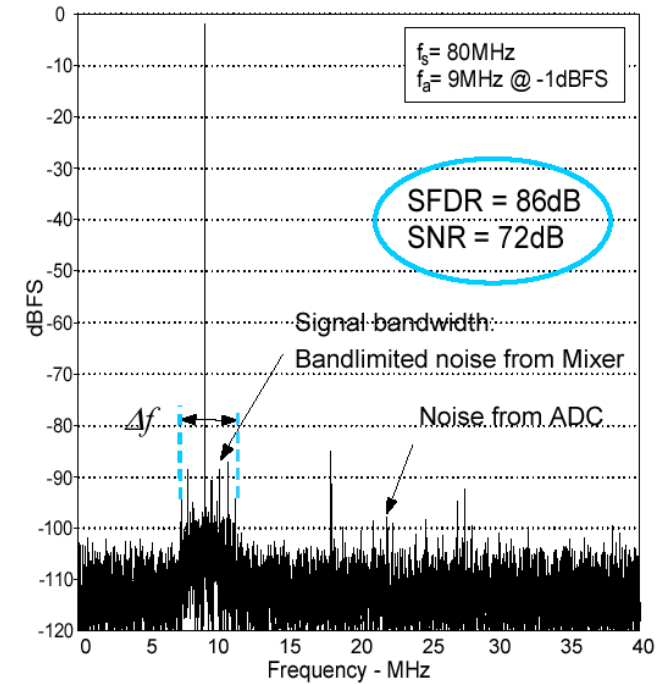
8-channels to ADC-Board :

LO-Input :

Compromise between noise and linearity

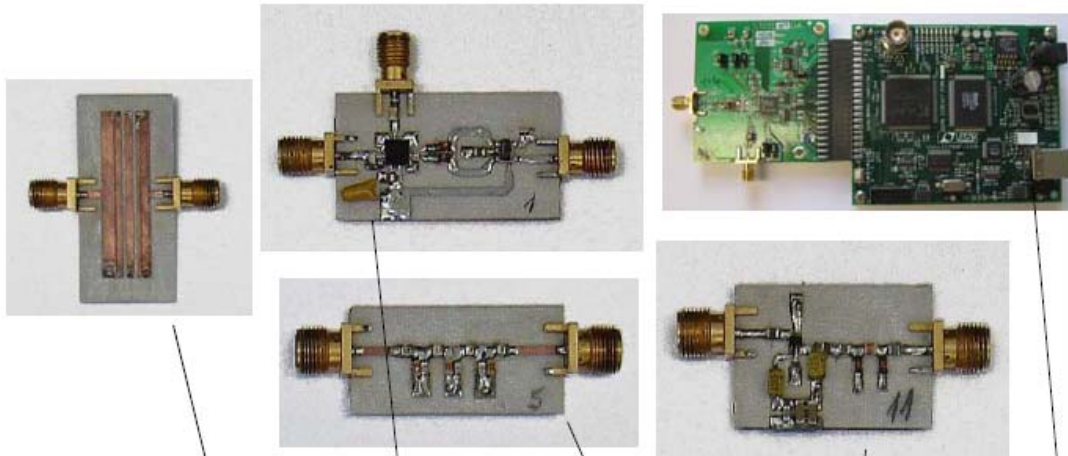


• SNR for oversampling :

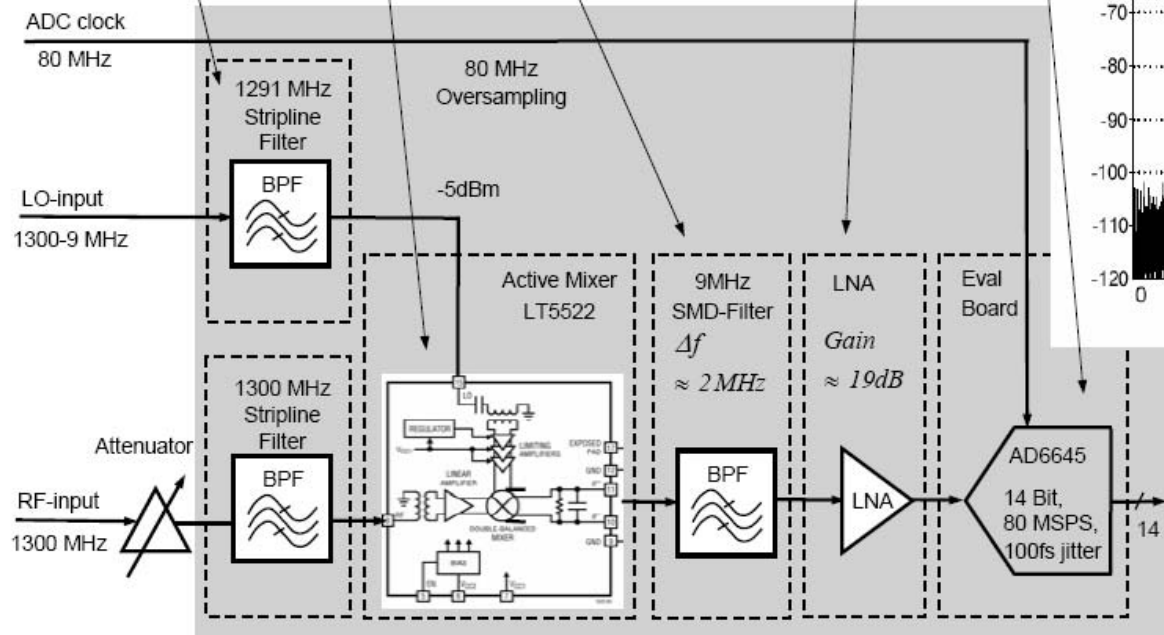
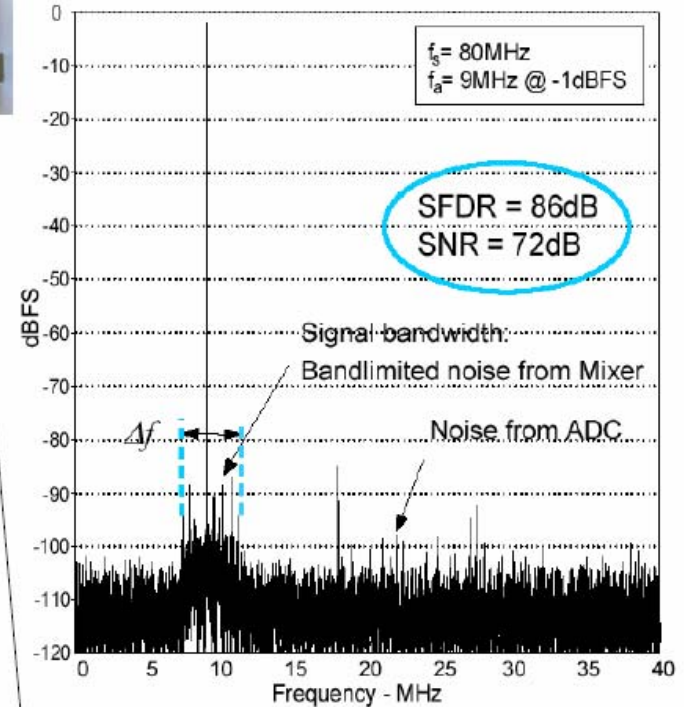




Gilbert Cell Mixer

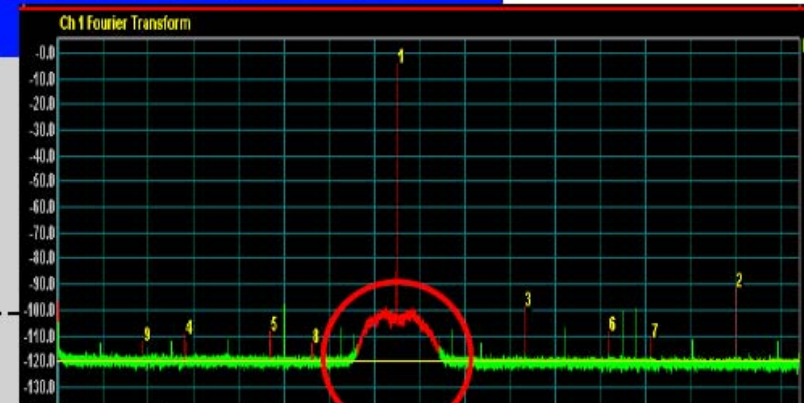
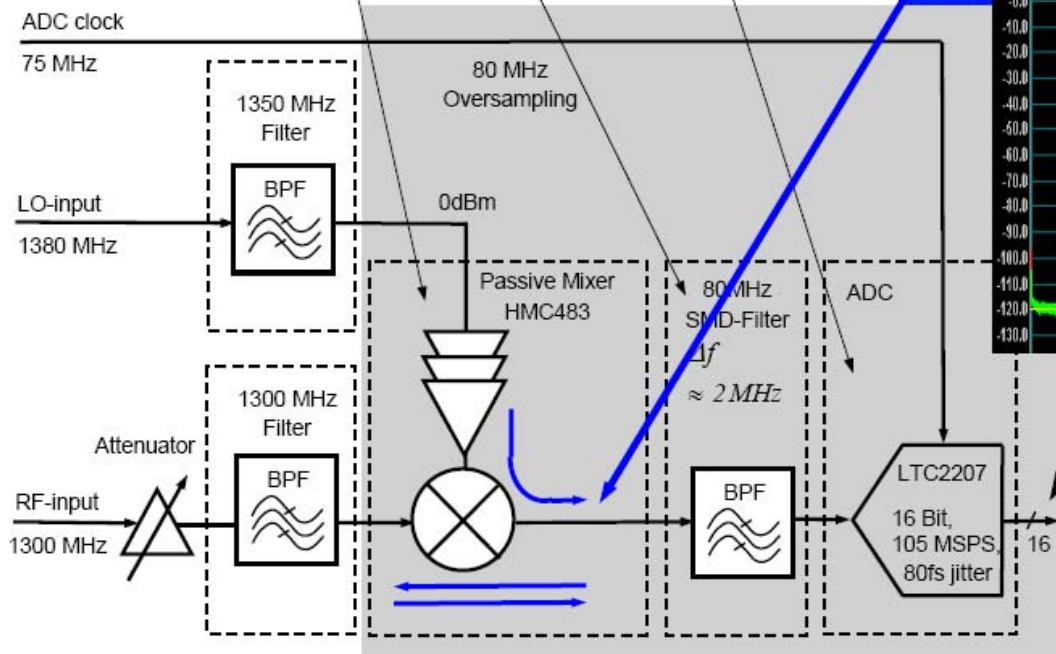
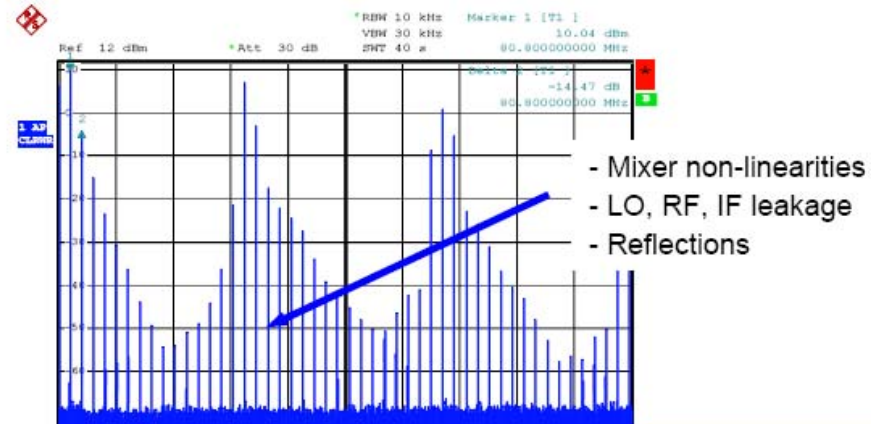


● SNR for oversampling :



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

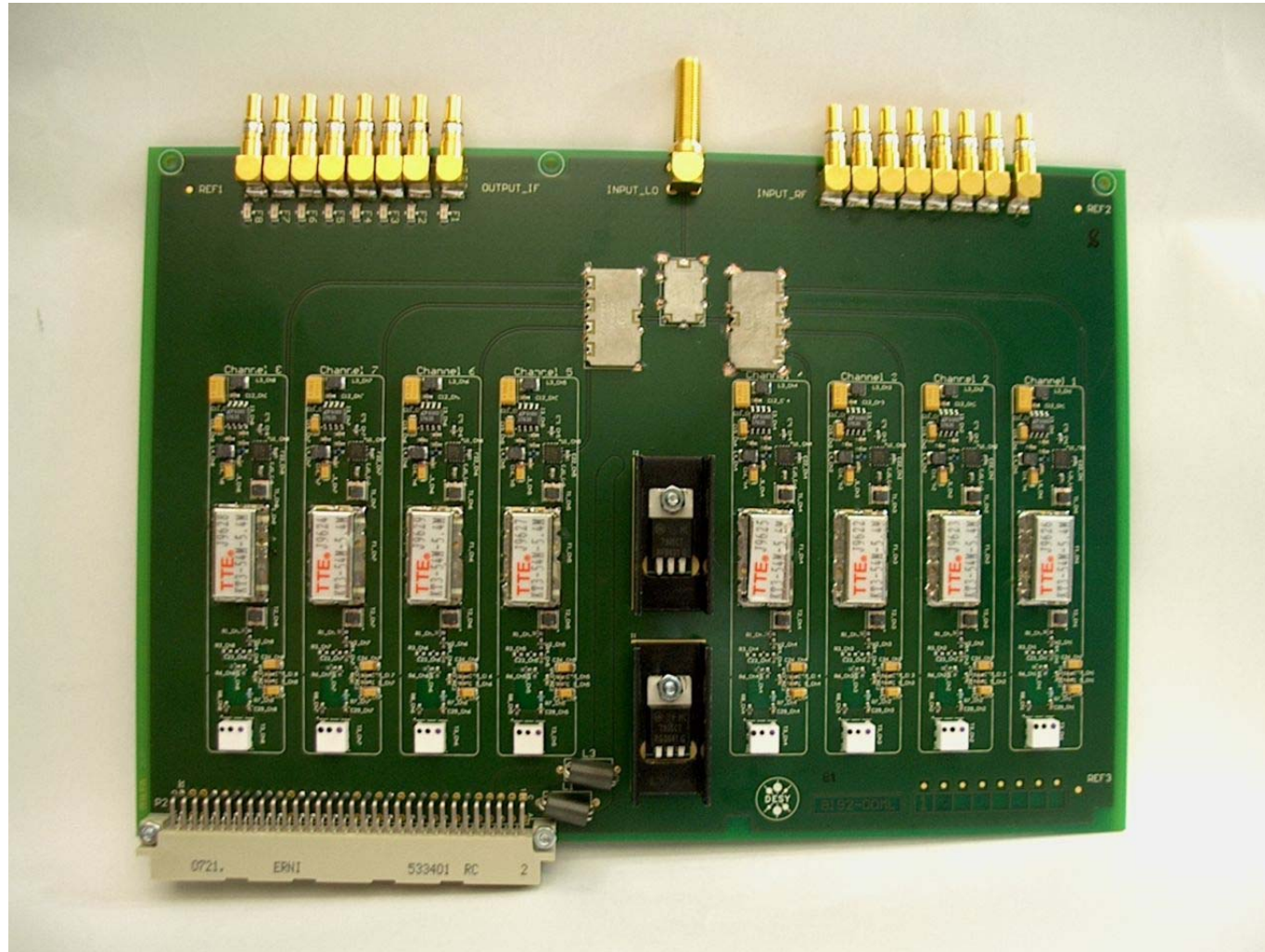
Passive Mixer



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



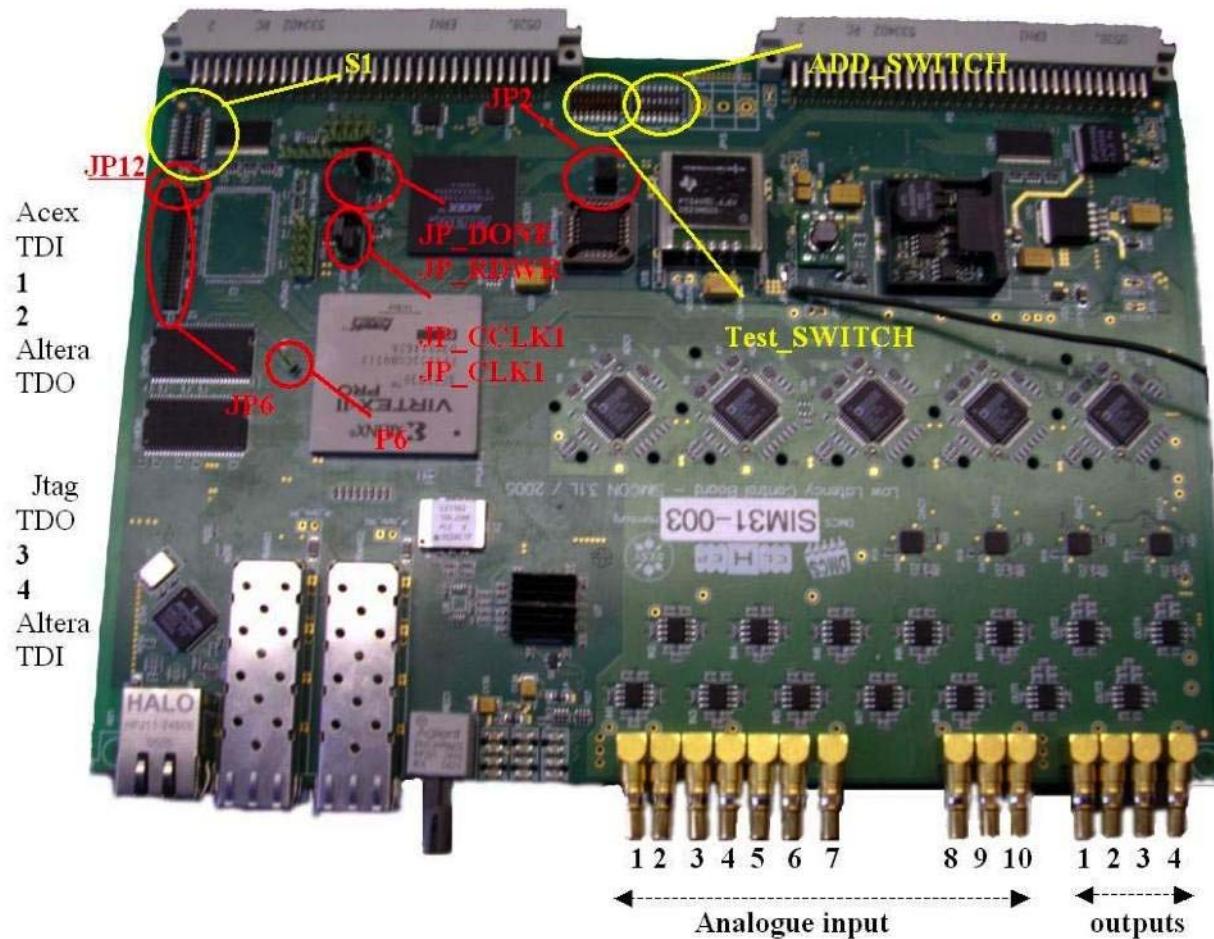
8-channel downconverter





DESY SIMCON 3.1 Controller

2.SIMCON3.1 board description and schematics.



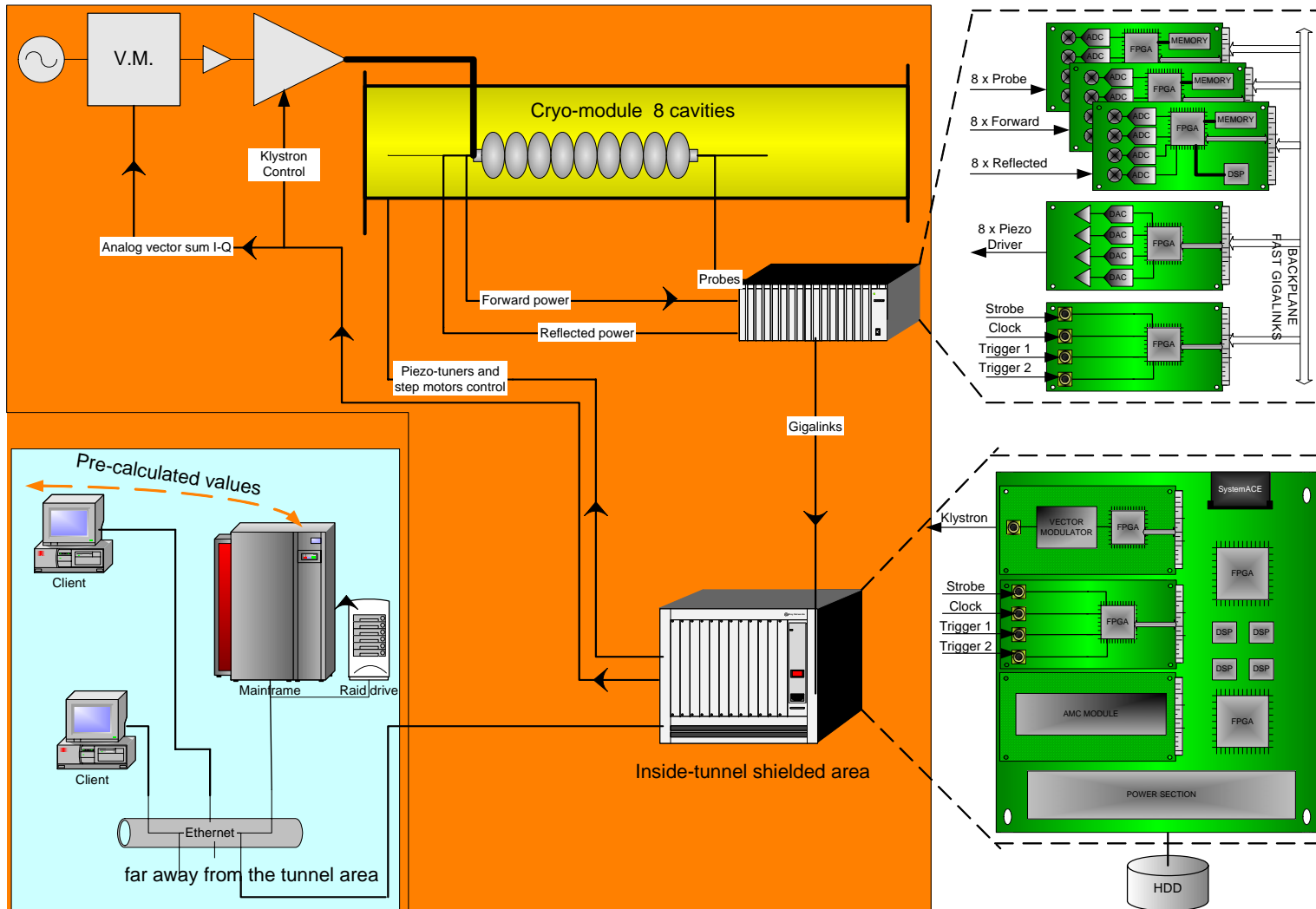


Next generation: SIMCON DSP



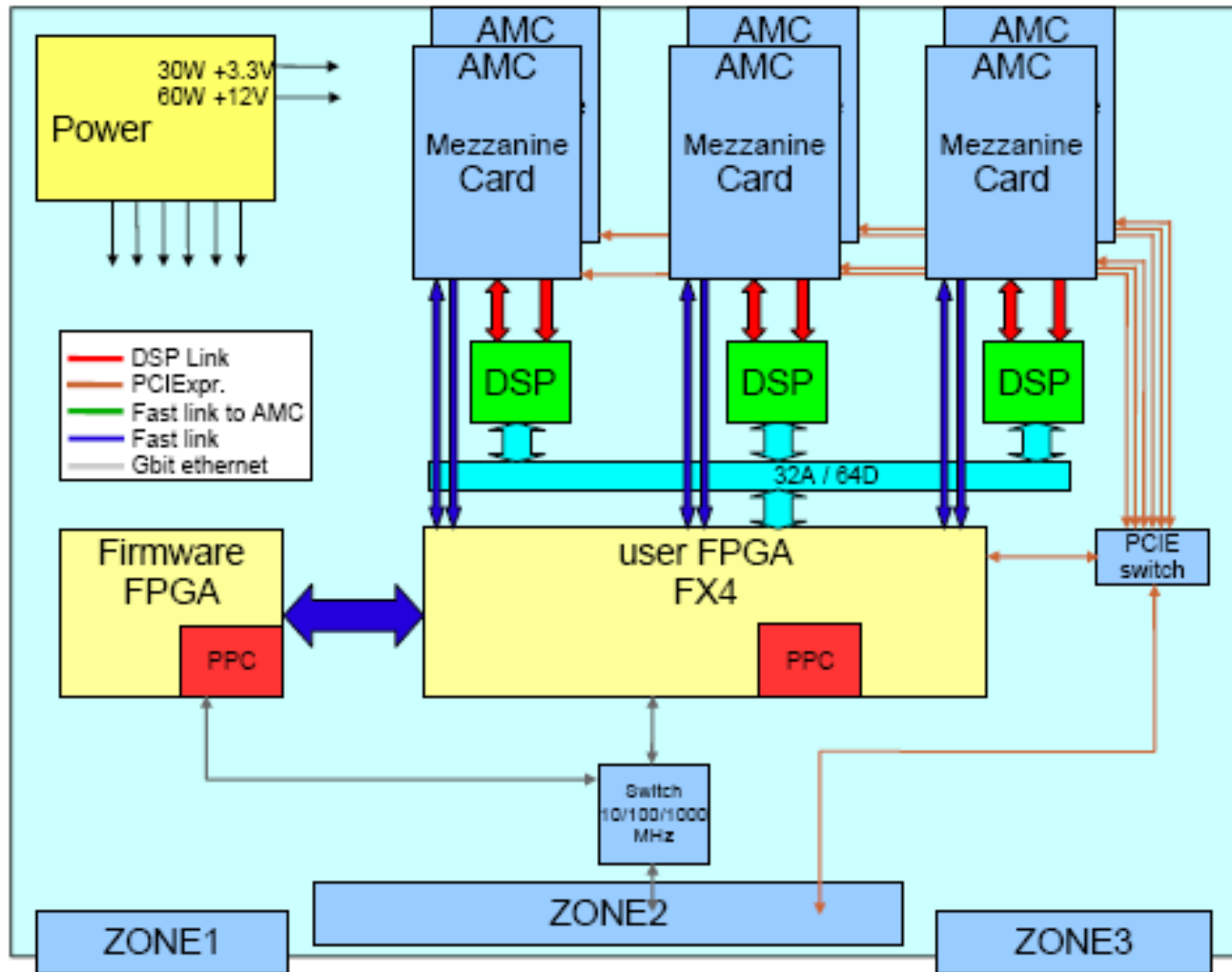


Next generation: ATCA





Architecture of Carrier Board





AMC Modules

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

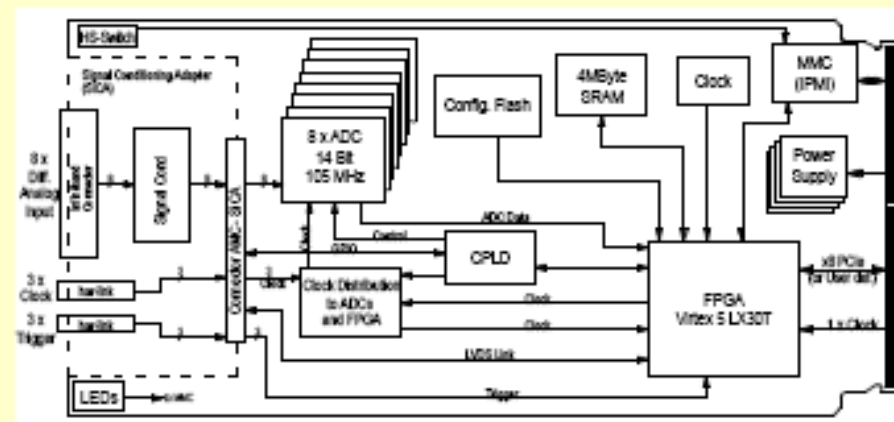
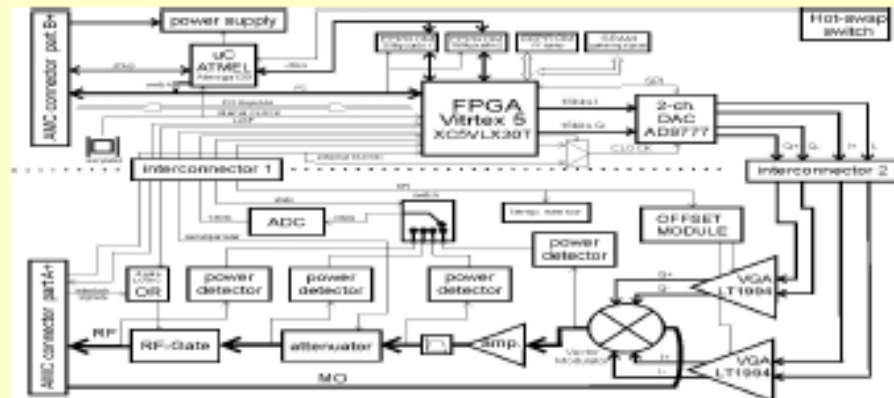
- ➔ BW 1 GHz
- ➔ 10 bits
- ➔ SF 1-2.5 GHz

Timing Module

- ➔ Receive coded clock signal, produces 6 different clocks

Vector Modulator

- ➔ Digital input
- ➔ 1.3 GHz, 0dBm





Reference

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