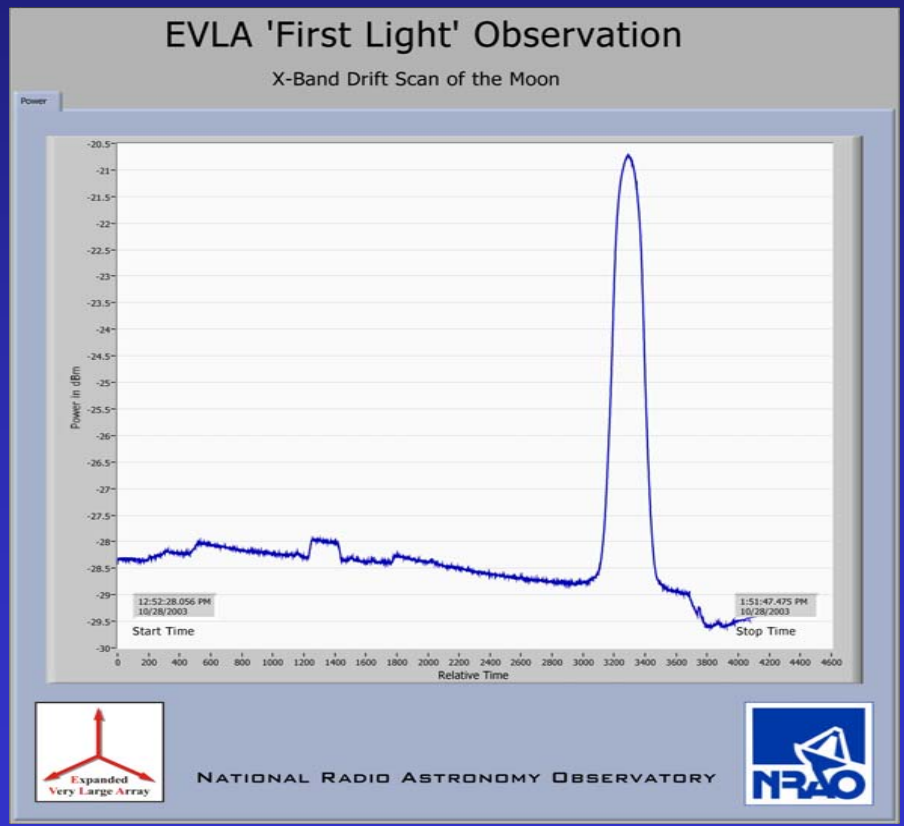
EVLA LO/IF/FO Critical Design Review

Jim Jackson, Hardware Systems Engineer

System Status

First Light
(X-Band)
October 2003



System Status

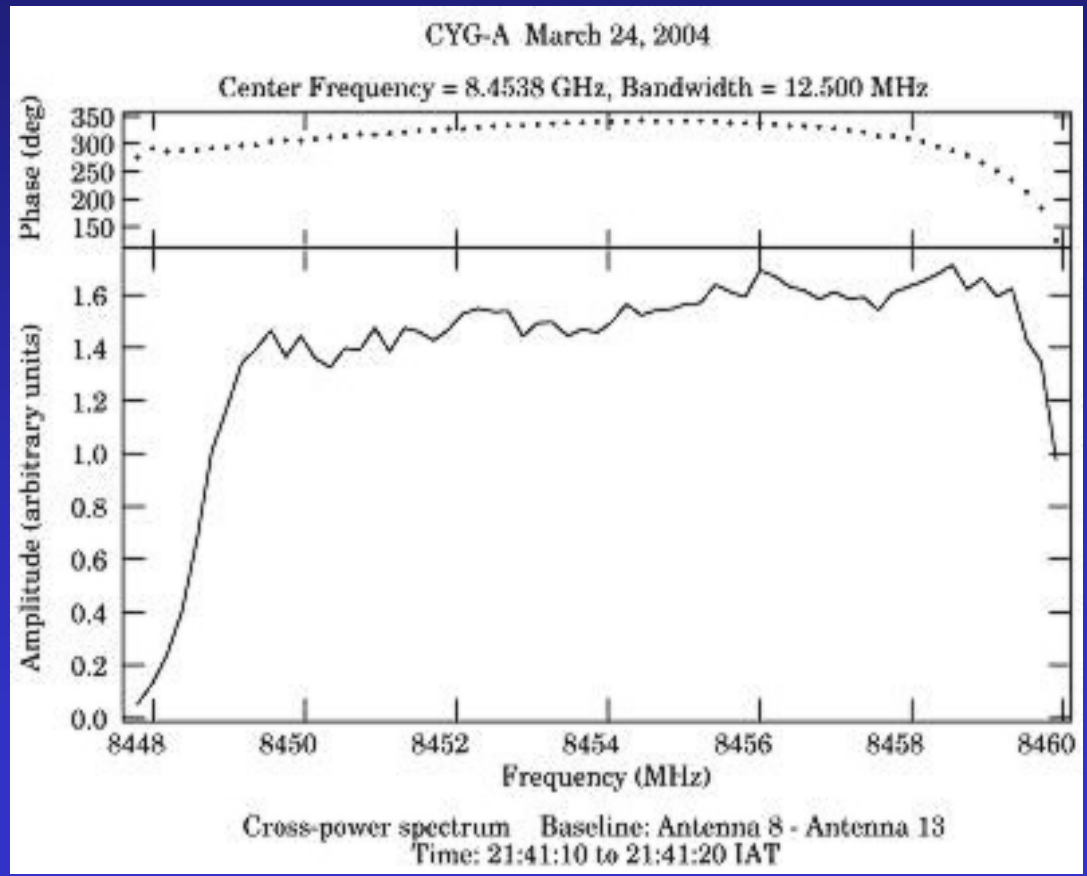
- First Fringes (X-Band) – March 2004
  - EVLA Prototype (Antenna 13) with VLA
  - Tests and evaluation on-going
  - Additional Bands available soon

First Fringes

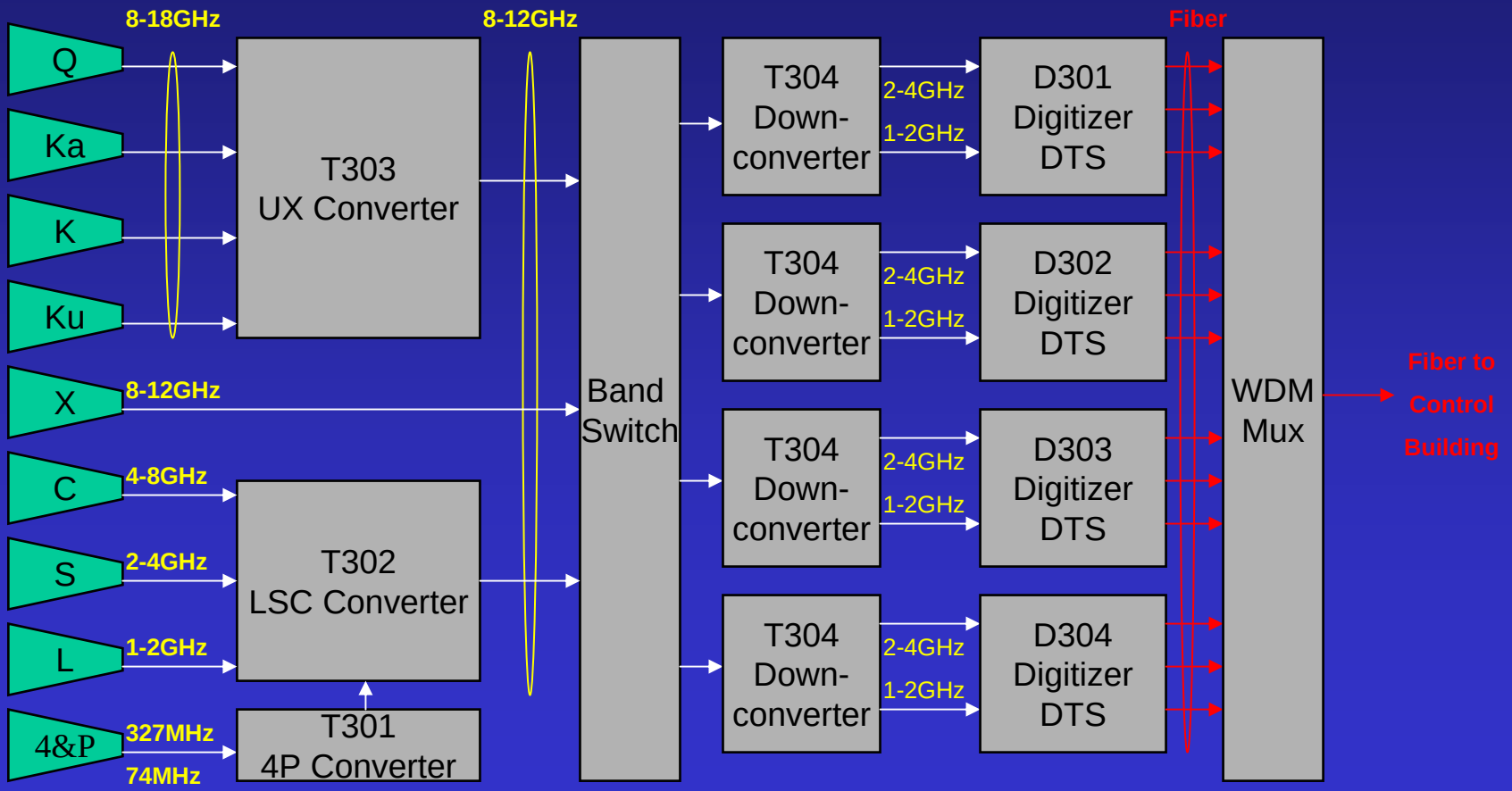
Phase Relationship

Bandpass Shape

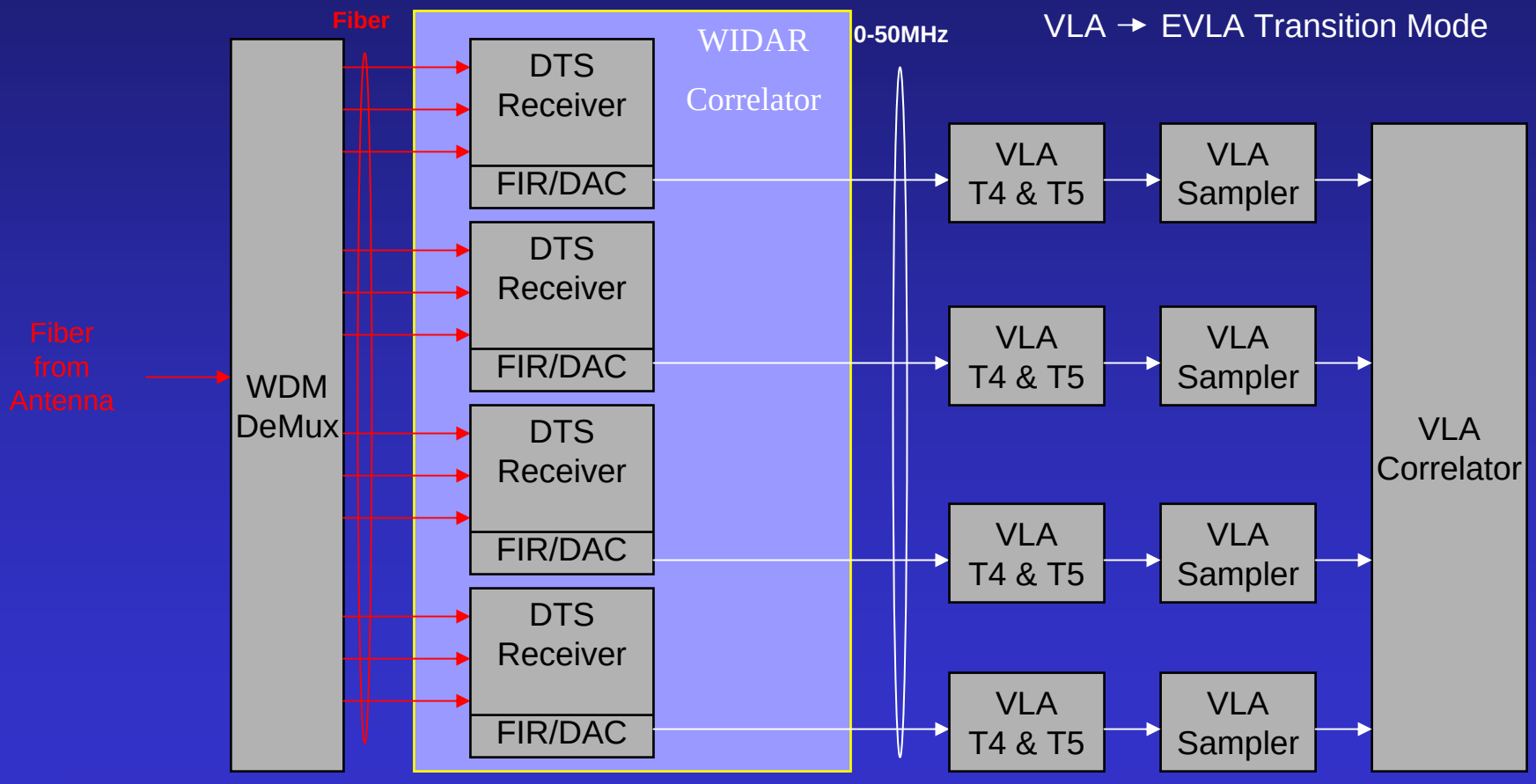
- From VLA T5
- BW = 12.5MHz



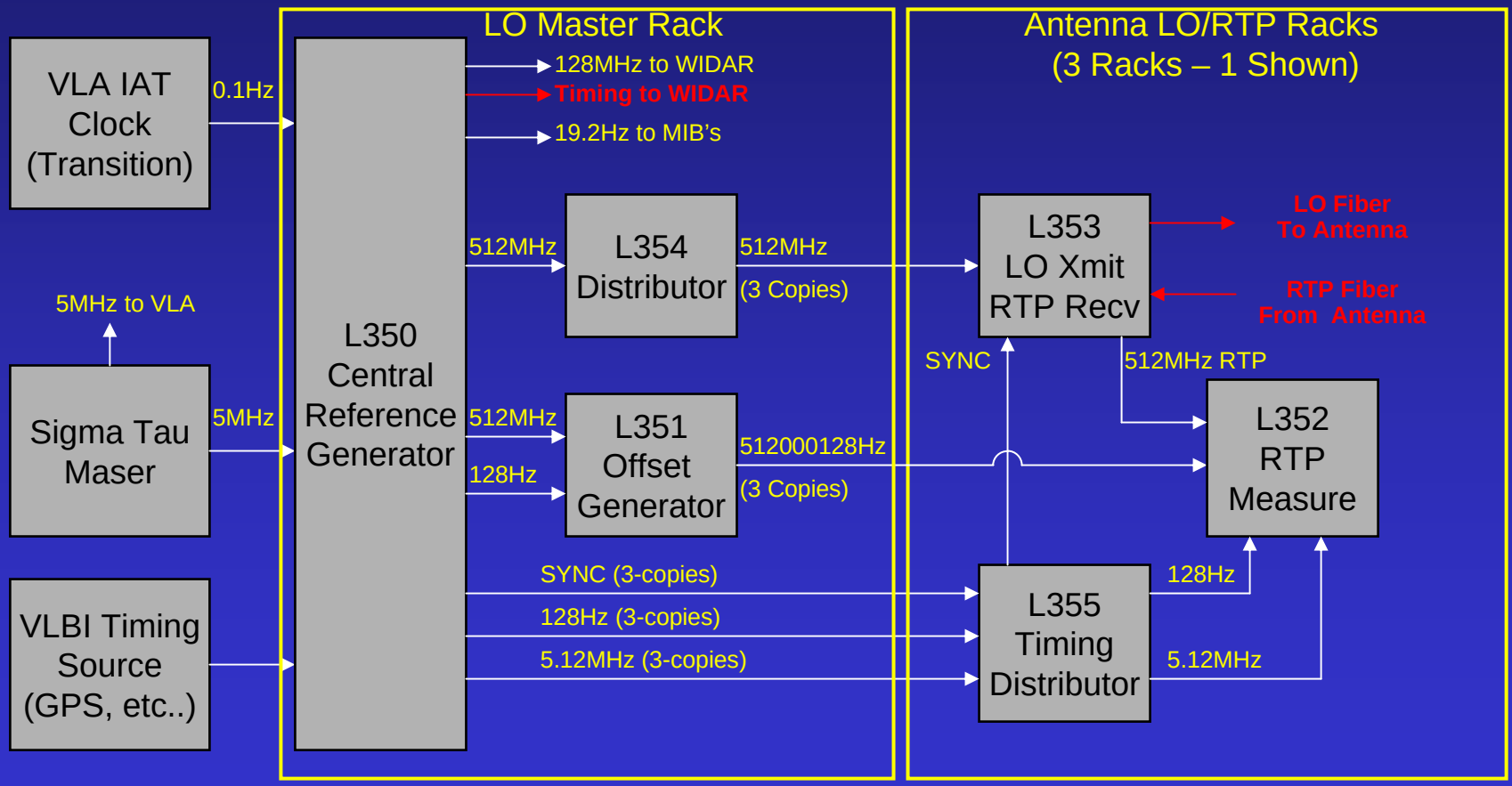
EVLA Antenna IF Diagram



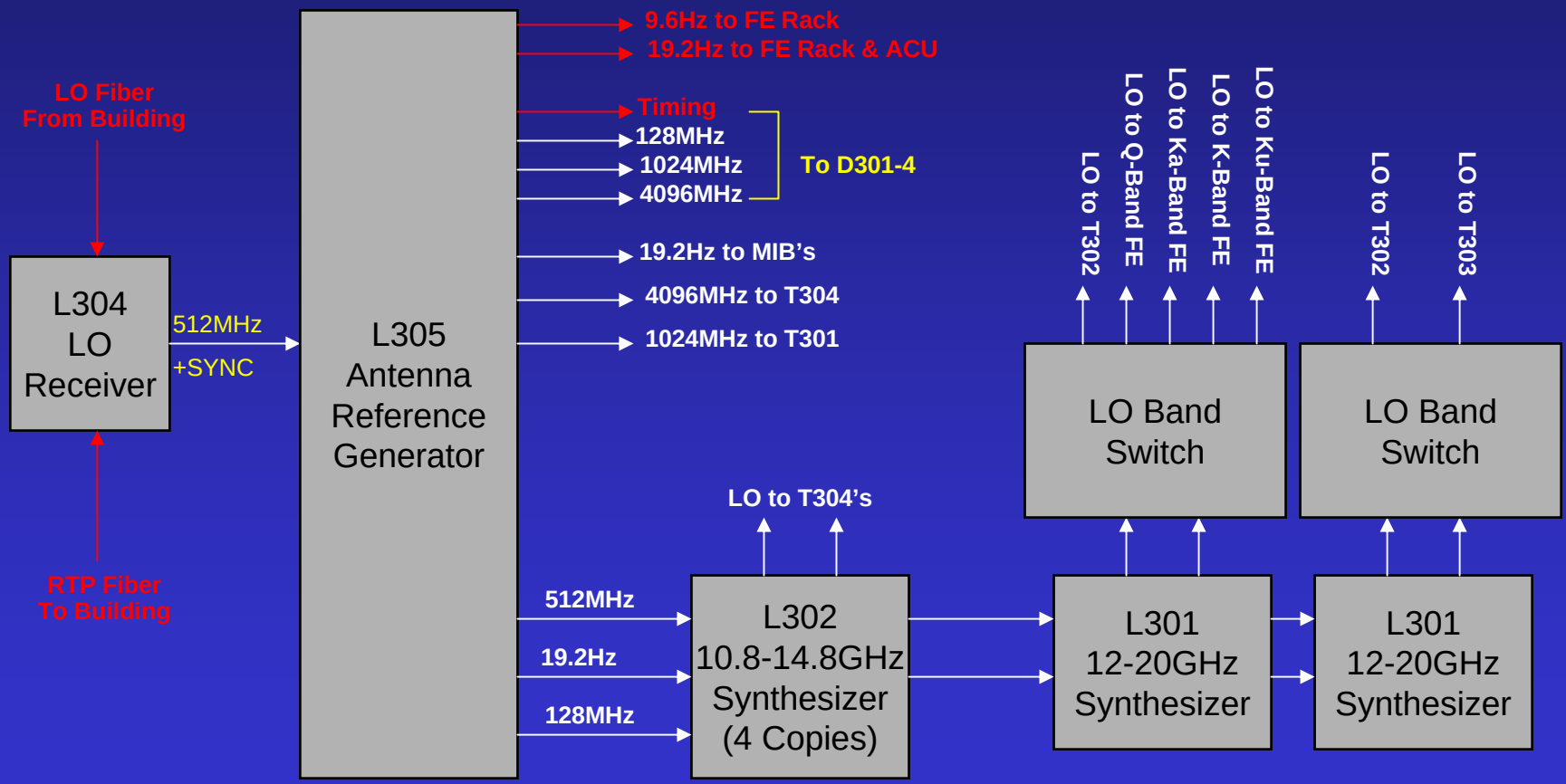
EVLA Control Building IF Diagram



EVLA Control Building LO Diagram



EVLA Antenna LO Diagram



Hardware Status

- Hardware currently installed and operating in the VLA control building:
  - L350 Central Reference Generator
  - L351 Master Offset Generator
  - L352 Round Trip Phase Measurement
  - L353 LO Transmitter
  - DTS Receiver Board
  - P301 Power Supply
  - 48 VDC Bulk Power Supply and Batteries

Hardware Status

- Hardware currently installed and operating in Antenna 13:
  - L301/L302 Synthesizers
  - L304 LO/Reference Receiver
  - L305 Antenna Reference Generator
  - T304 Downconverter
  - D301 Sampler/DTS Module
  - P301 Power Supply (2)
  - 48 VDC Bulk Power Supply and Batteries

Hardware Status

- Fiber optics
  - Fiber burial on all three arms complete
  - Antenna 13 connected and operational at master pad
  - Fiber spliced to end of west arm for round trip phase testing
  - LO/Reference fiber phase characterization continuing

RFI Protection

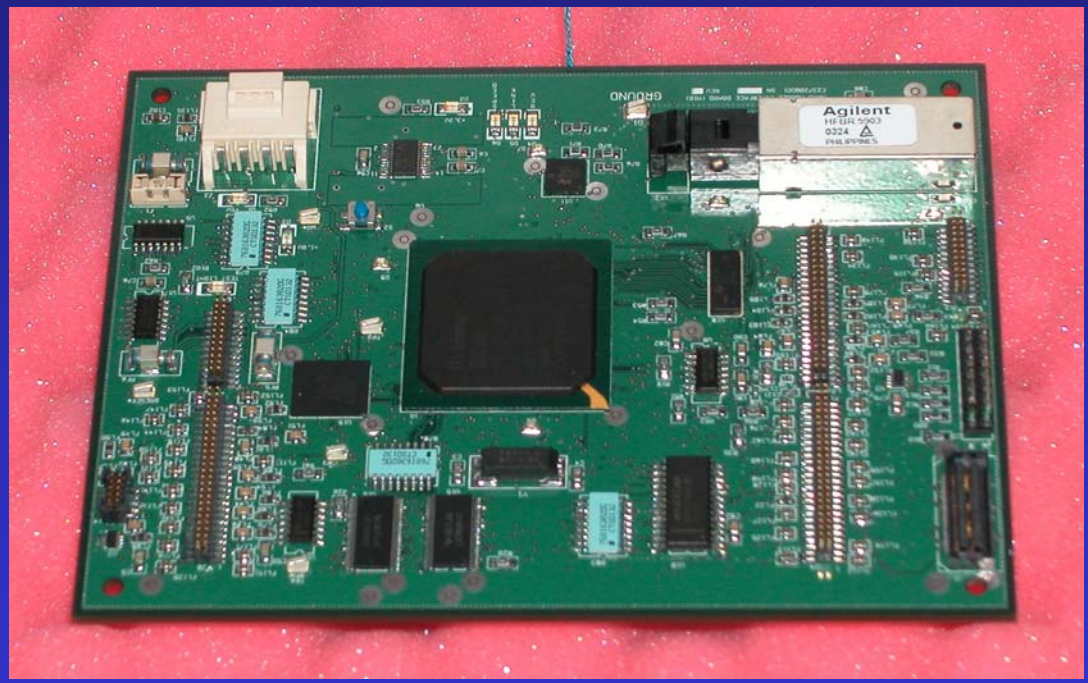
- Layered approach
  - Implement low noise PCB design techniques
    - MIB, DTS and other PCB's exceptionally quiet
  - Custom shielded and filtered enclosures
  - Use of DoD "Tempest" certified RFI racks
  - Use of differential signaling or fiber for digital signals
  - RFI chamber tests of all hardware

PCB Design

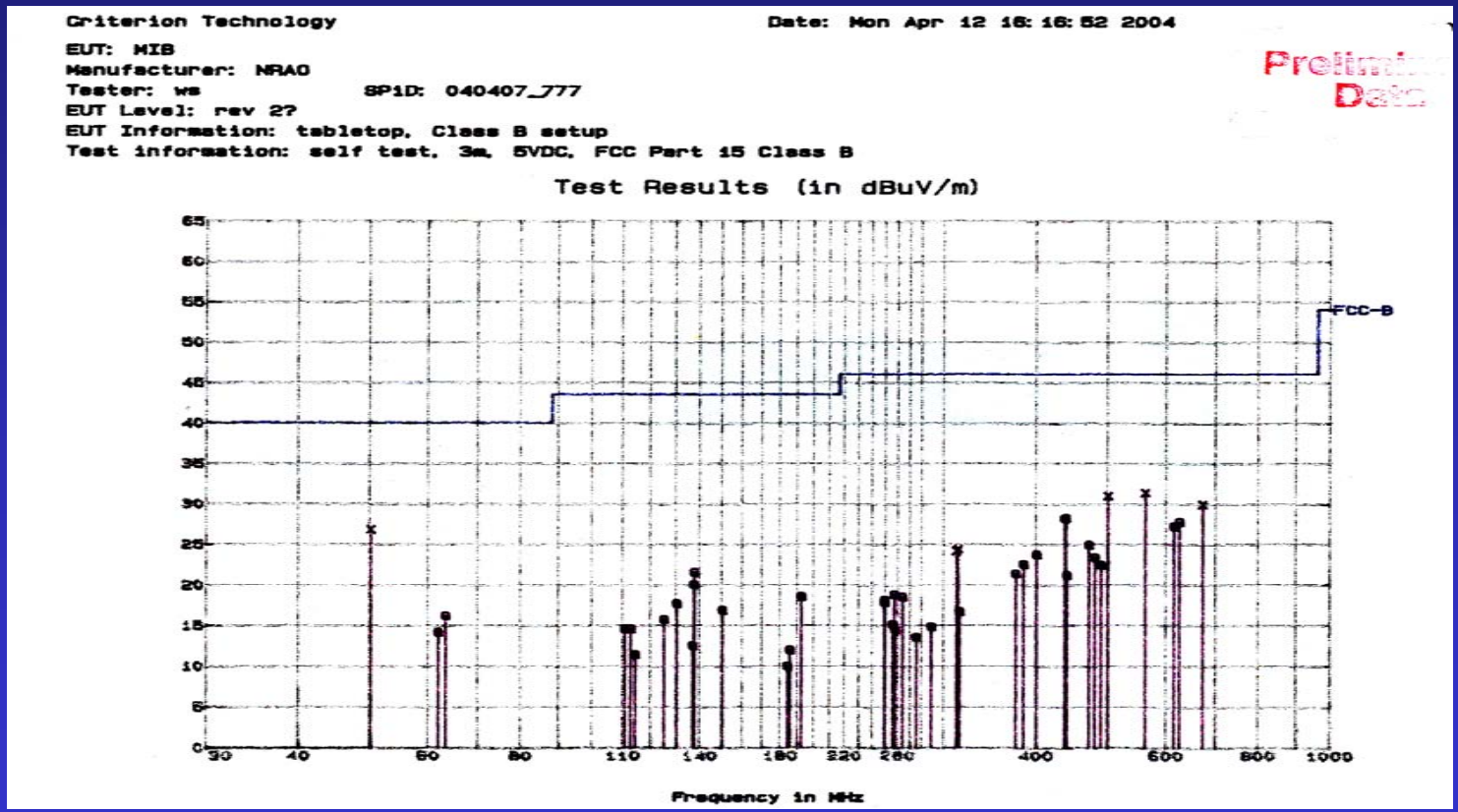
- Low noise printed circuit boards
  - Ground planes
  - Impedance matched traces
  - High speed traces on inner layers
  - Stitched vias
  - Differential signaling (LVDS/ PECL)
  - Layered voltage regulators
  - Final regulators at load
  - Filtered I/O signals

PCB Design

Module Interface Board



PCB Design


Criterion Technology
Date: Mon Apr 12 16:16:52 2004
EUT: MIB
Manufacturer: NRAO
Tester: ws
SPID: 040407_777
EUT Level: rev 2?
EUT Information: tabletop, Class B setup
Test information: self test, 3m, 5VDC, FCC Part 15 Class B
Test Results (in dBuV/m)
FCC-B
Frequency in MHz

Electronics Packaging

- LO/IF/FE Modules
  - Set of hardware components configurable to produce a number of enclosure types
  - Integrated RFI/EMC gaskets and filters
  - Heatsinks for thermal control
  - Fit existing VLA bins
  - Recent decision eliminated all blind mate connectors from EVLA electronics

Electronics Packaging

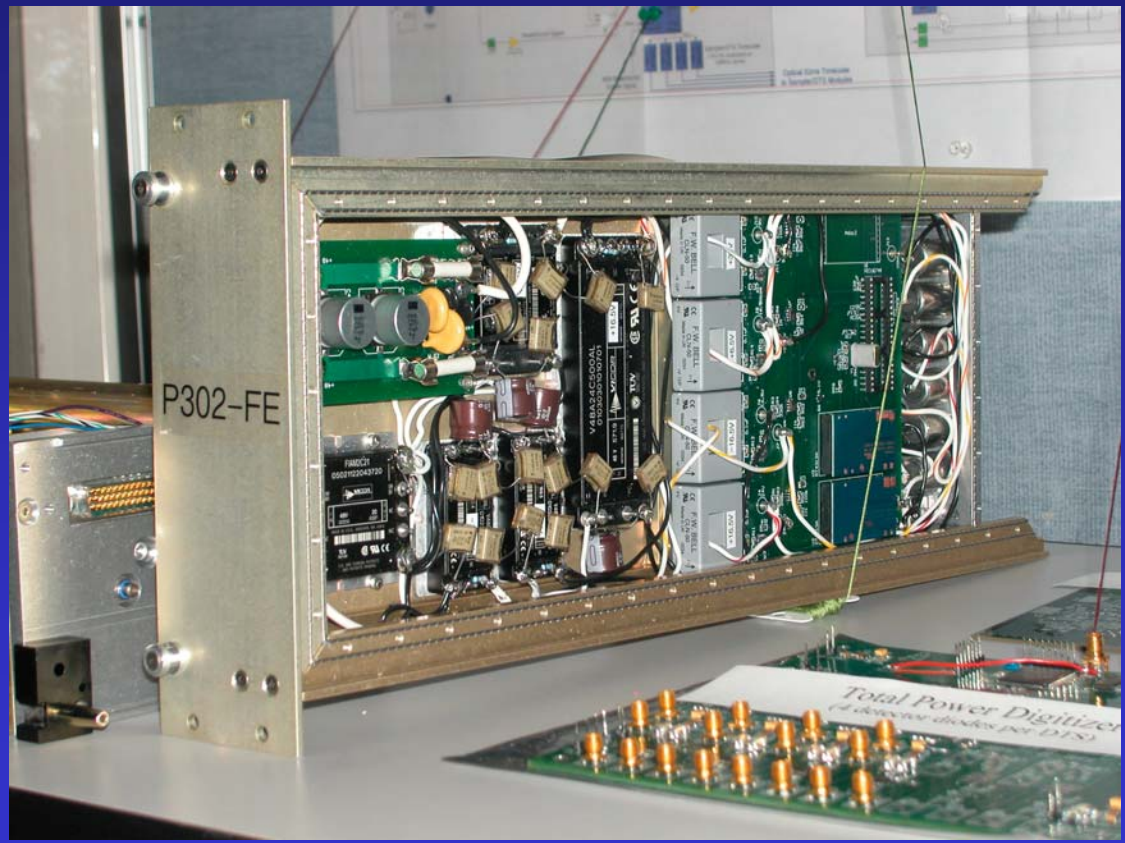
Typical LO/IF Module

Hardware

DC-DC Converter Housing

Electronics Packaging

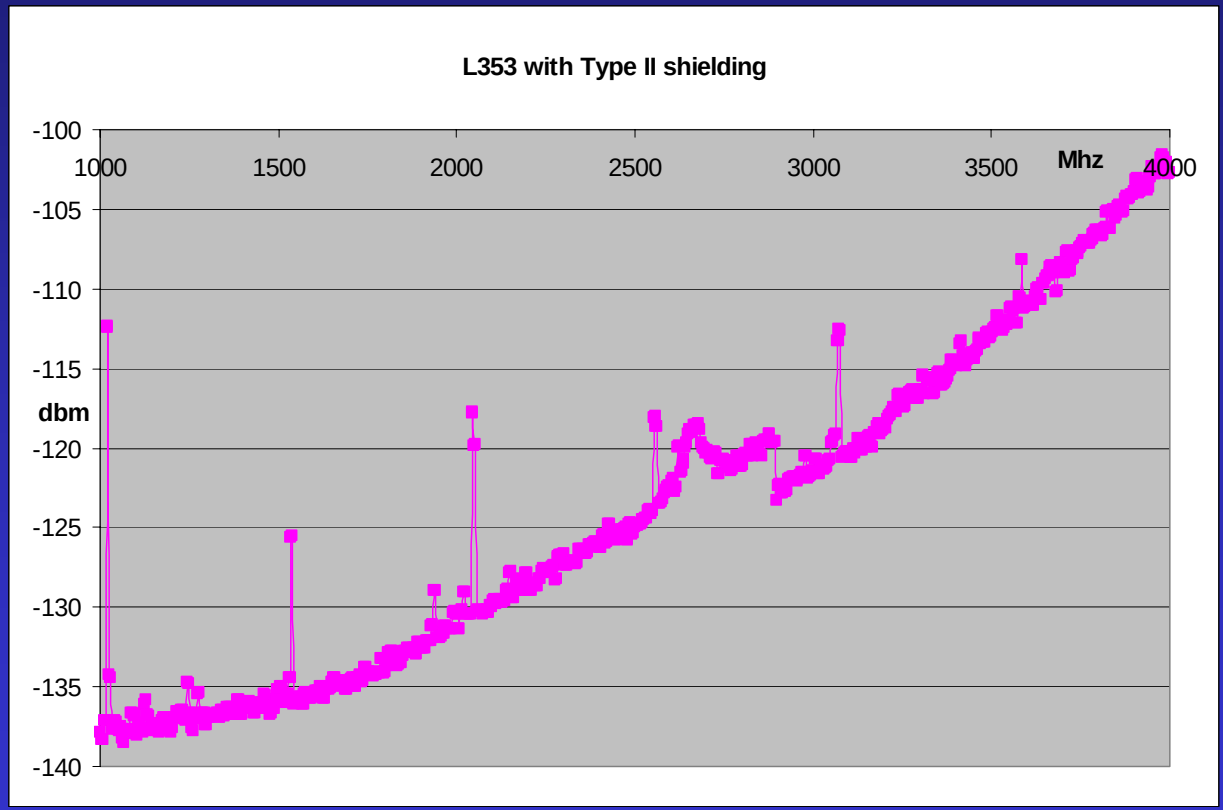
P302
DC-DC
Converter



Electronics Packaging

L353

Chamber Results

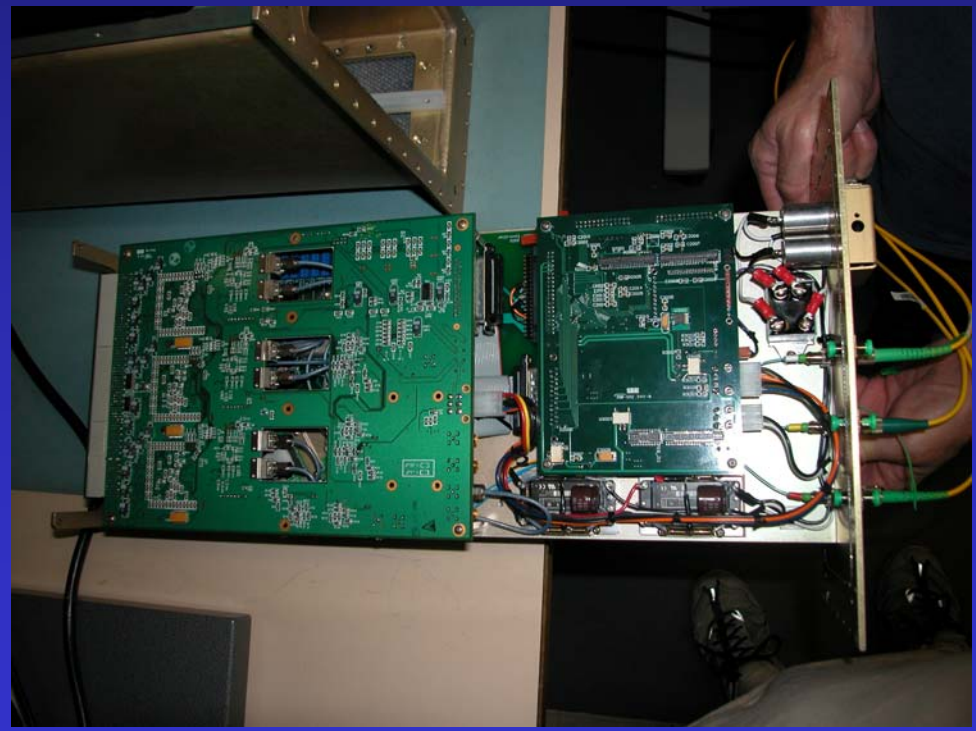


Electronics Packaging

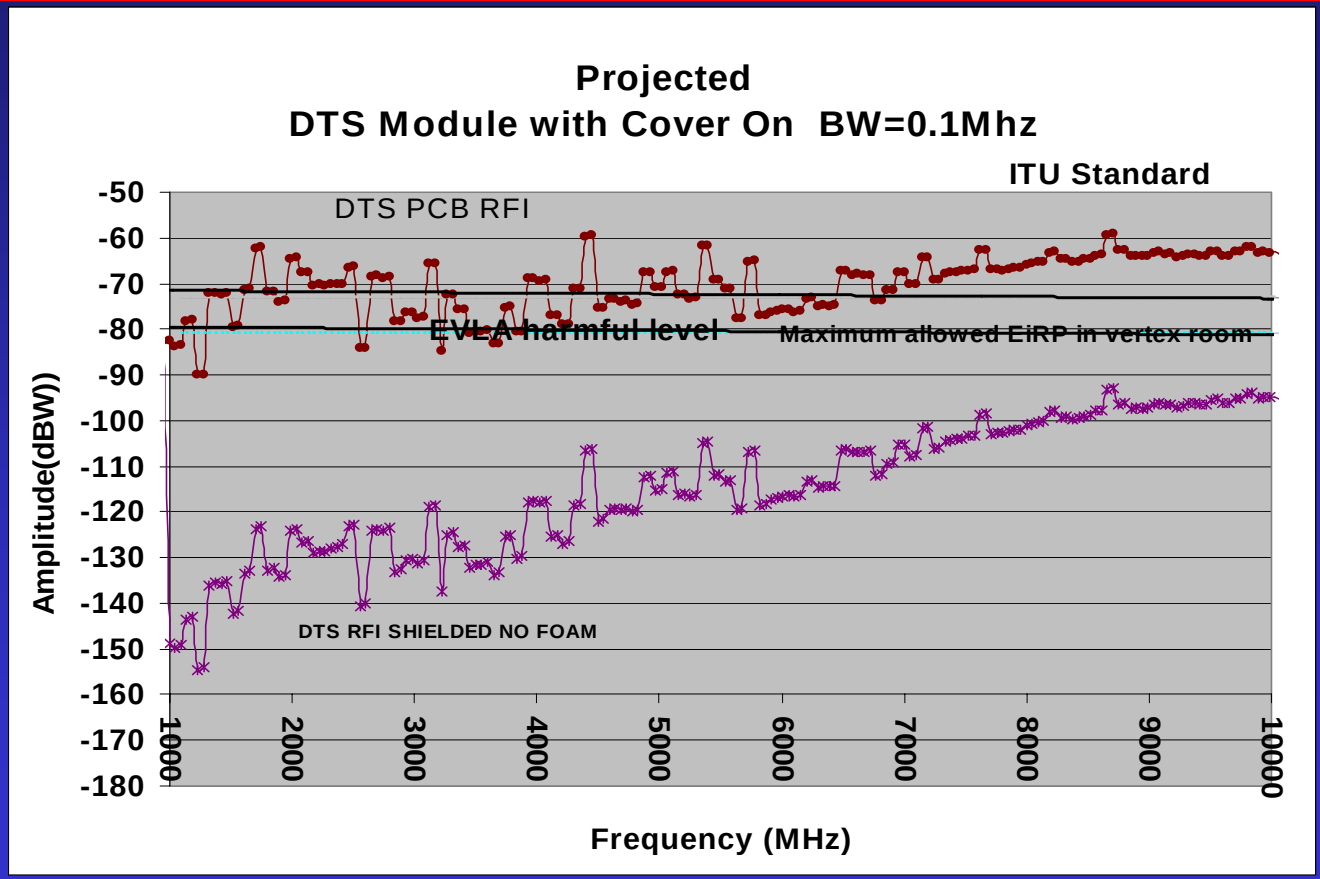
- D301-4 DTS/Sampler Modules
  - Highly shielded module designed to contain digitizers and data transmission system
  - Better than 80dB shielding
  - Brass honeycomb filters for high air flow
  - All I/O on fiber and coax

Electronics Packaging

- D301-4 DTS/Sampler Module



Electronics Packaging



Racks

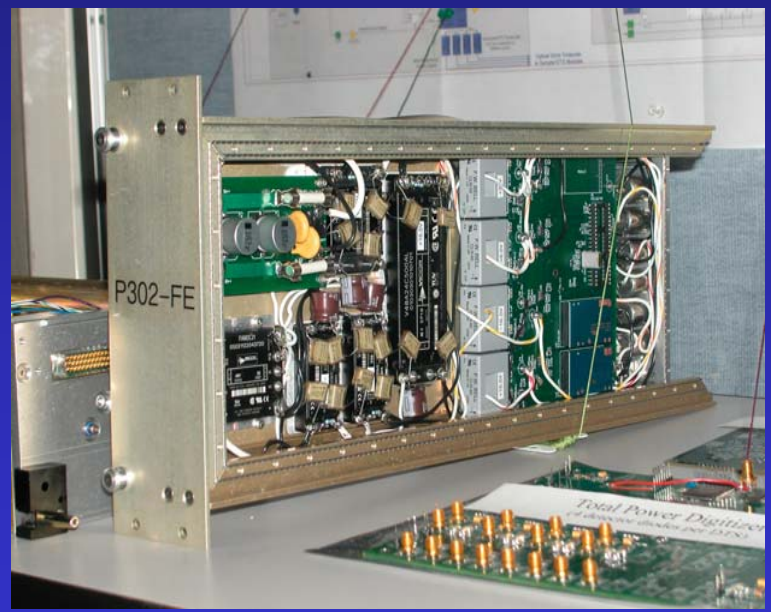
- LO/IF and Front End Racks
  - Commercial RFI racks
  - DoD “Tempest” rated
    - (approx 55dB @ 5GHz)
  - All I/O signals filtered or on fiber

DC Power

- -48 VDC power system
  - Commercial bulk power products
  - Designed for telecom
  - 52.5 Amp cont. capacity
  - N+1 redundant design for reliability
  - Battery backup for 1 hour
  - Installed in “Tempest” rated RFI shielded rack in antenna pedestal room
  - Reuses existing Square-D “QO” breakers and panels

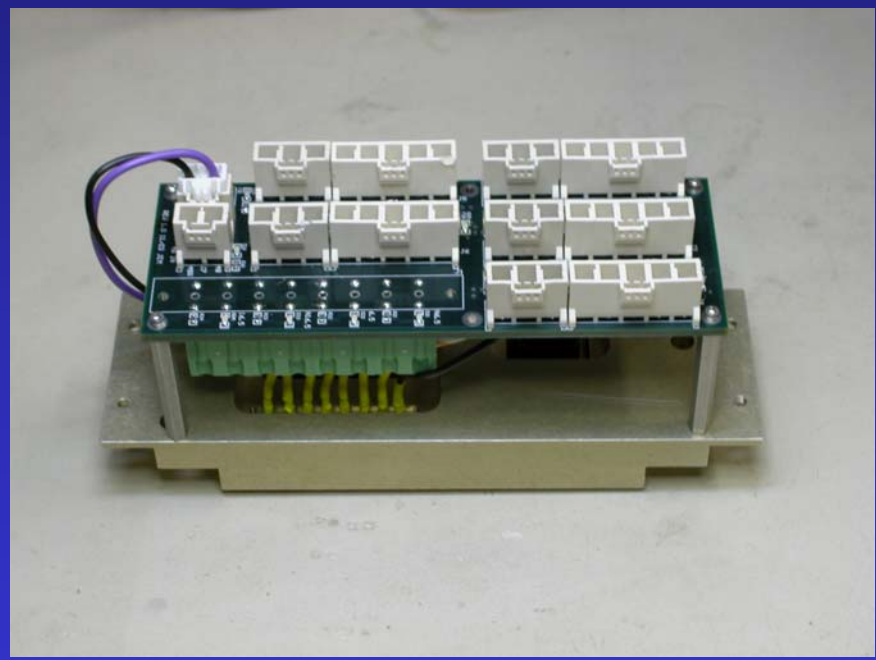
DC Power

- P301/302 DC/DC Converter
  - Using 2'nd Generation Vicor DC-DC converter modules- low noise, zero switching design
  - Extensive input & output filtering
  - New flexible PCB design allows for various configurations
  - Used for antenna and control building electronics
  - Provides voltage & current monitoring, protection



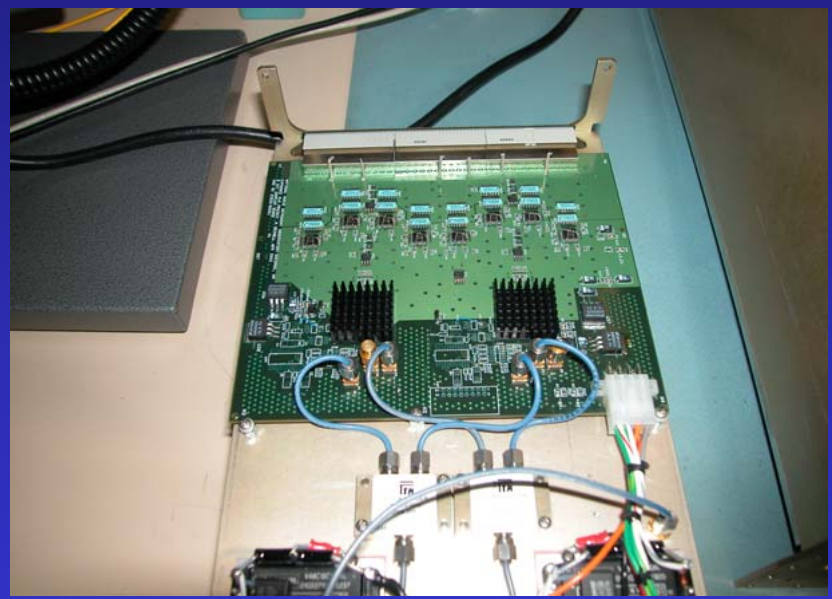
DC Power

- DC Power Distribution PCB
  - Attaches to back of P301/302 modules
  - Quick connection of modules
  - Individual fusing
  - Power on and blown fuse indicators



Digitizers

- 8-bit, 2 Gsps digitizer
  - Installed in DTS module and in use on Antenna 13
  - Dual Maxim MAX104, each running at 1Gsps
  - New single chip design in progress using Atmel 8 bit, 2 Gsps device
  - Used for transition and observation in high RFI bands



Digitizers

- 3-bit, 4 Gsps digitizer
  - ALMA device under development in France
    - Prototype being tested in DTS lab
- Potential alt source of high speed A/D
  - Atmel - 8 bit, 4 Gsps, 4GHz BW A/D in development
    - This device could replace both EVLA digitizers

Questions?