A Monitor and Control System for the GBT K-Band Focal Plane Array

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RadioNet

SEVENTH FRAMEWORK PROGRAMME

Multi Pixel Camera Receiver Workshop 16-17 November 2009
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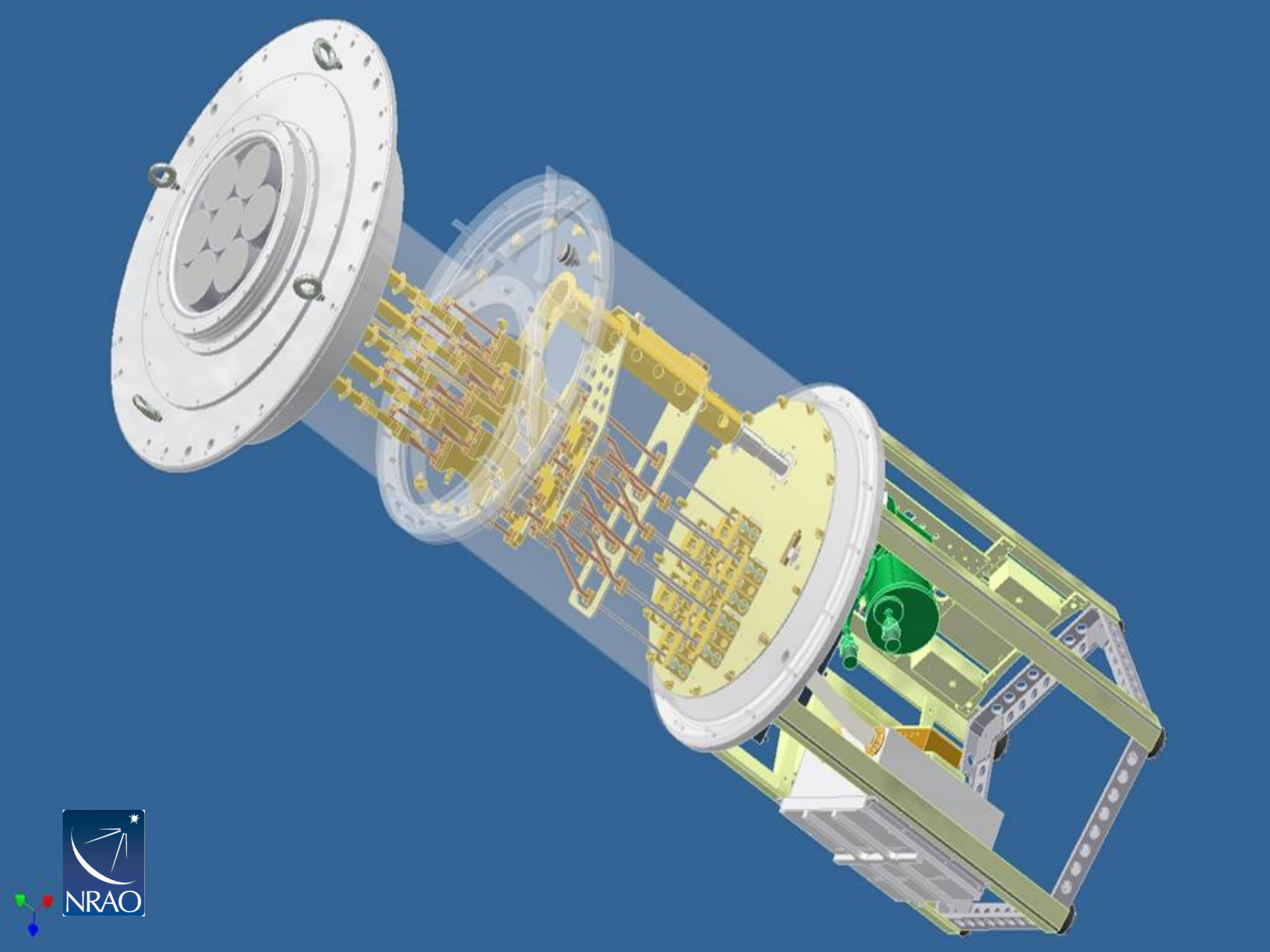
Atacama Large Millimeter/submillimeter Array
Expanded Very Large Array
Robert C. Byrd Green Bank Telescope
Very Long Baseline Array

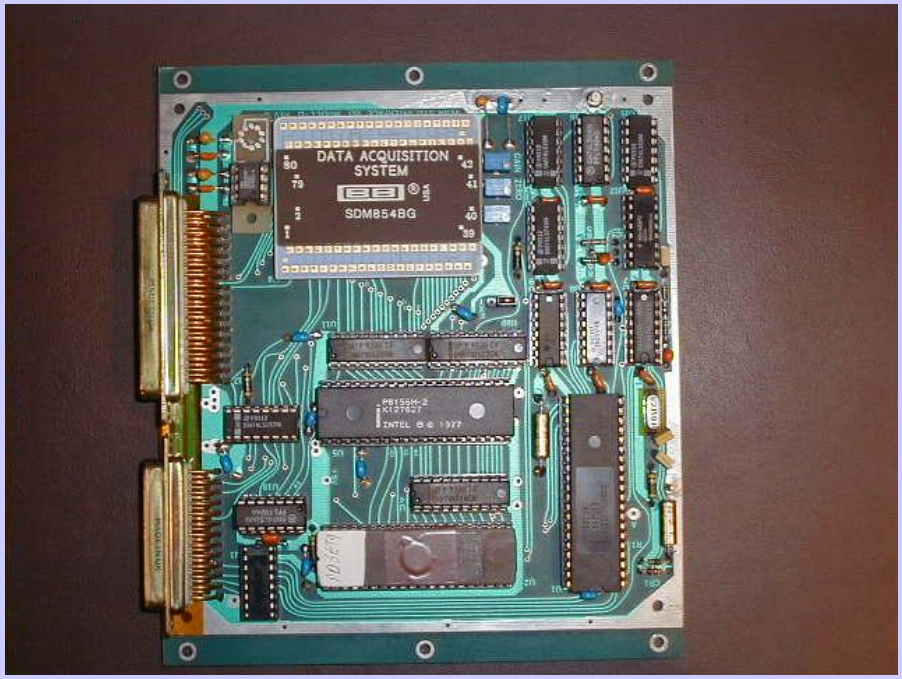
NRAO


NRAO

NRAO Monitor and Control, A Short History

VLBA Standard Interface Board

- Developed by NRAO
- 8032 Microcontroller at 11 MHz
- 256 Control bits
- 256 Monitor bits
- 8-64 S/D 12 Bit Analog Channels
- RS-485 at 57 kHz



NRAO GBT Monitor and Control, GBT Receiver MCB Interface

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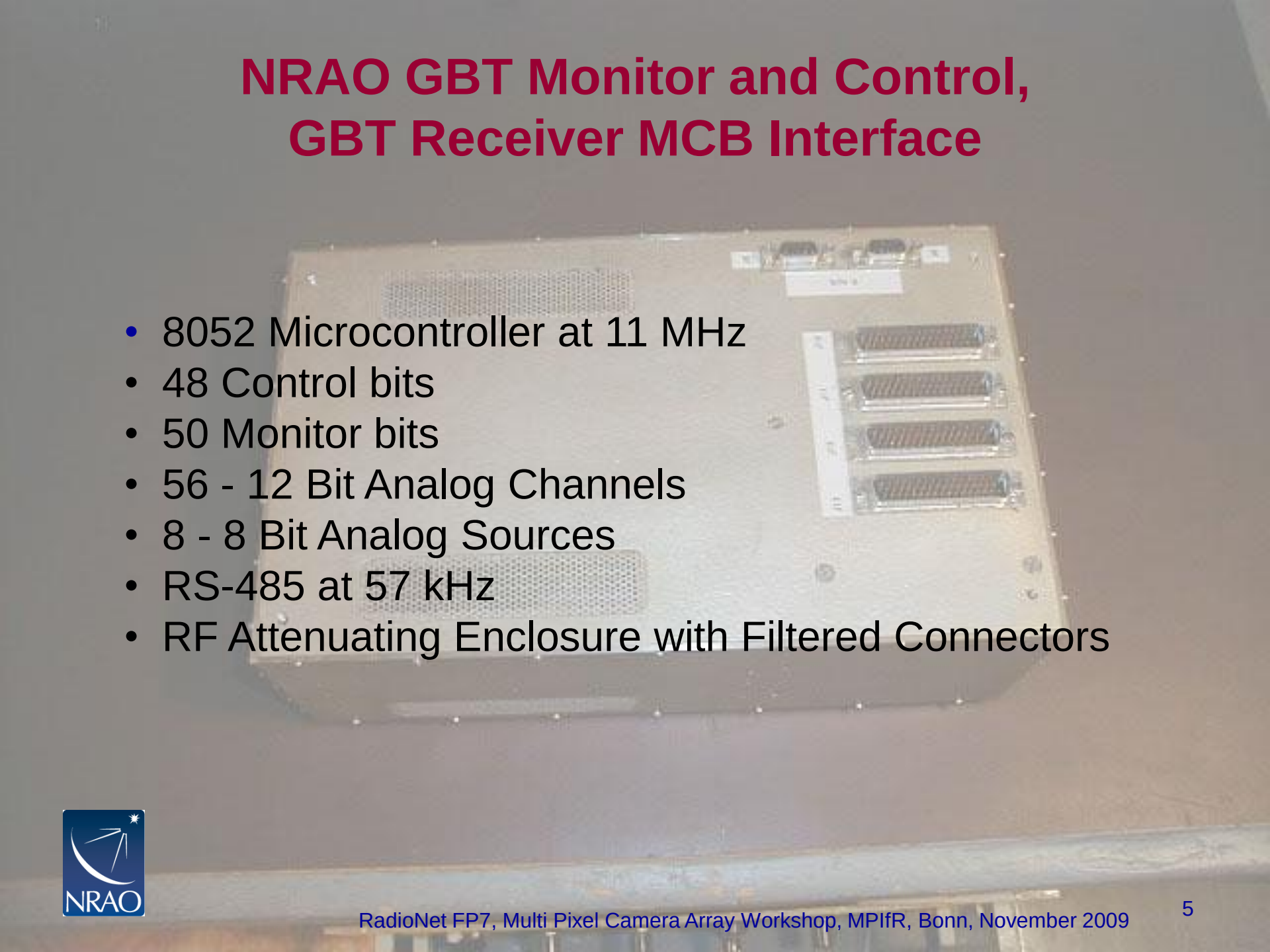
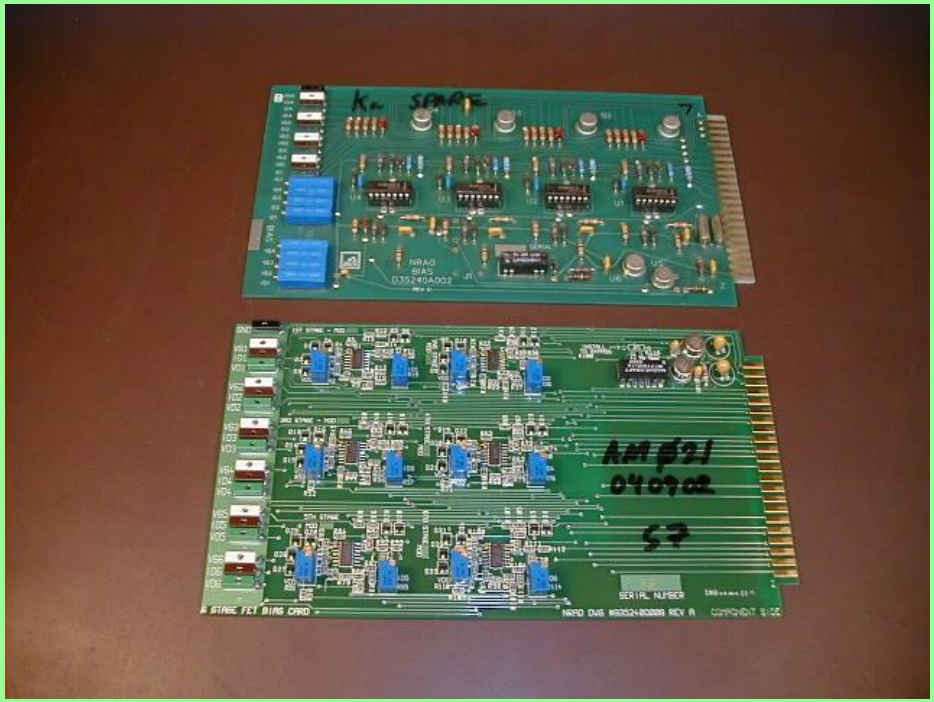


- 8052 Microcontroller at 11 MHz
- 48 Control bits
- 50 Monitor bits
- 56 - 12 Bit Analog Channels
- 8 - 8 Bit Analog Sources
- RS-485 at 57 kHz
- RF Attenuating Enclosure with Filtered Connectors

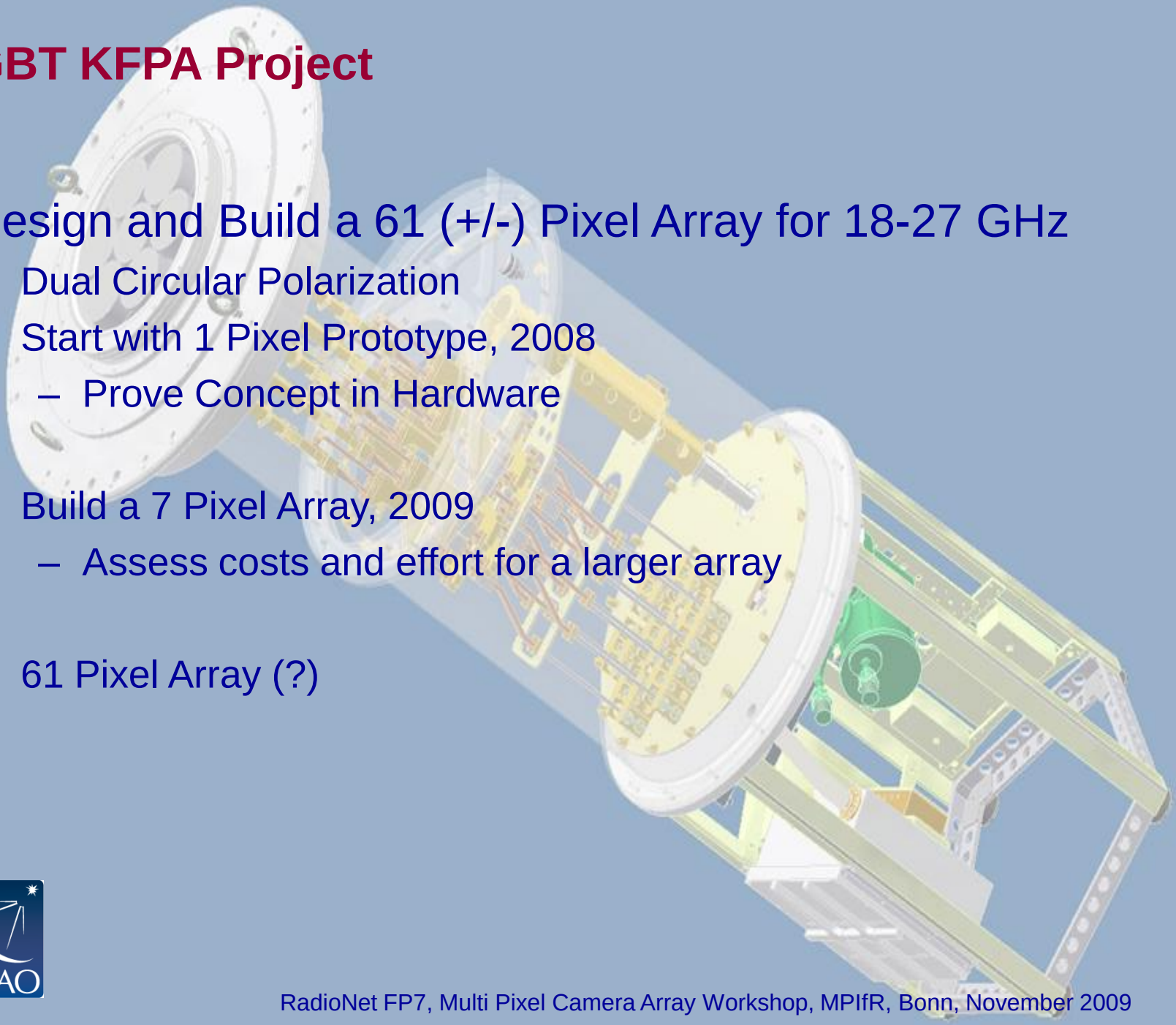
NRAO Cryogenic Amplifier Bias, Traditional

Cryogenic LNA Bias Cards

- Four stage, later six stage
- 2 Wires per stage + Ground
- Manually adjusted Vd, Id
- Vg controlled by Id setting
- Passive M+C Monitoring
- Carried in a Card Cage



GBT KFPA Project



Design and Build a 61 (+/-) Pixel Array for 18-27 GHz

- Dual Circular Polarization
- Start with 1 Pixel Prototype, 2008
  - Prove Concept in Hardware
- Build a 7 Pixel Array, 2009
  - Assess costs and effort for a larger array
- 61 Pixel Array (?)

KFPA Monitor and Control Requirements
61 Pixel Array

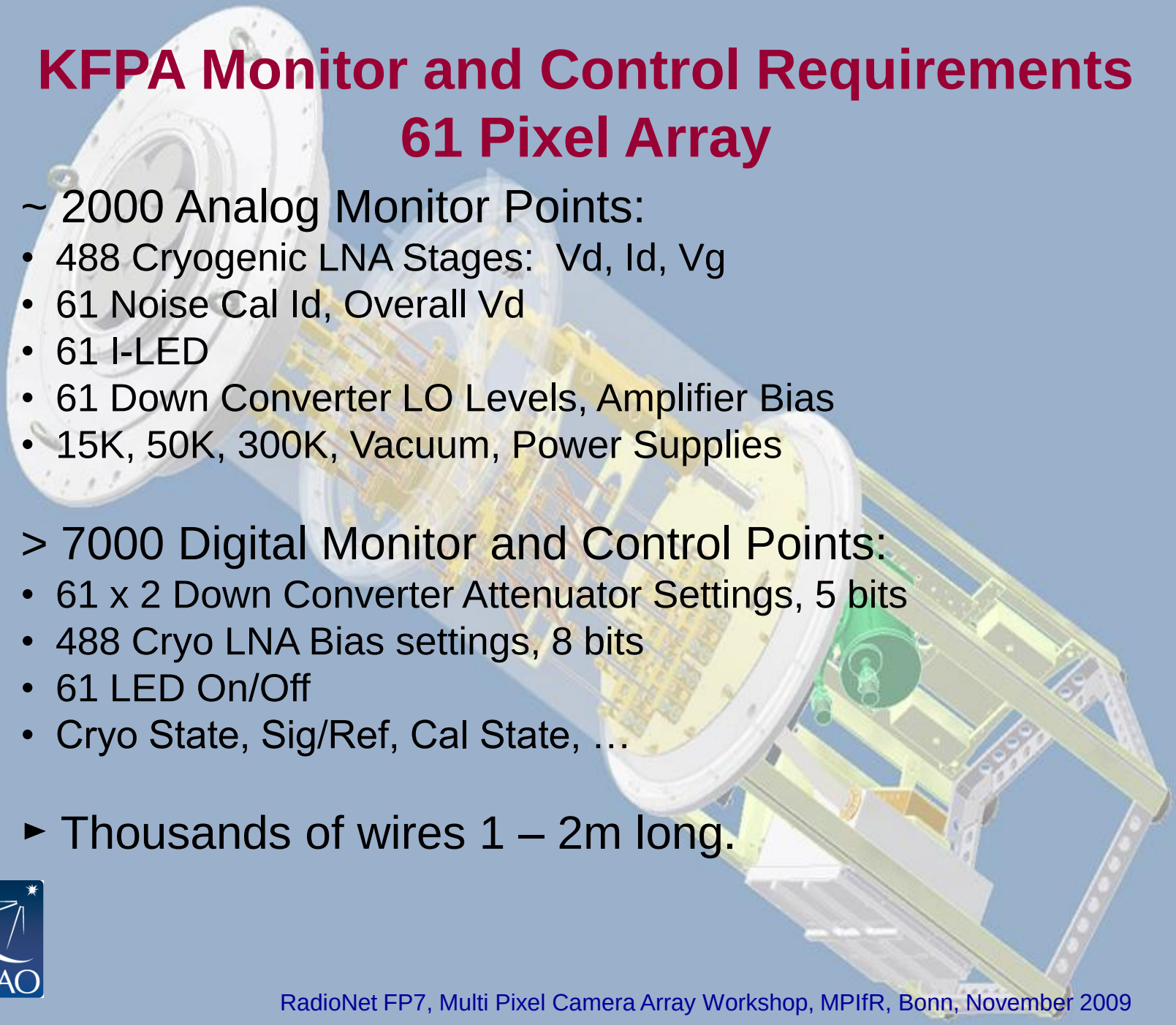
~ 2000 Analog Monitor Points:

- 488 Cryogenic LNA Stages: Vd, Id, Vg
- 61 Noise Cal Id, Overall Vd
- 61 I-LED
- 61 Down Converter LO Levels, Amplifier Bias
- 15K, 50K, 300K, Vacuum, Power Supplies

> 7000 Digital Monitor and Control Points:

- 61 x 2 Down Converter Attenuator Settings, 5 bits
- 488 Cryo LNA Bias settings, 8 bits
- 61 LED On/Off
- Cryo State, Sig/Ref, Cal State, …

► Thousands of wires 1 – 2m long.



KFPA Monitor and Control Requirements

Distribute Monitor and Control Over the Receiver

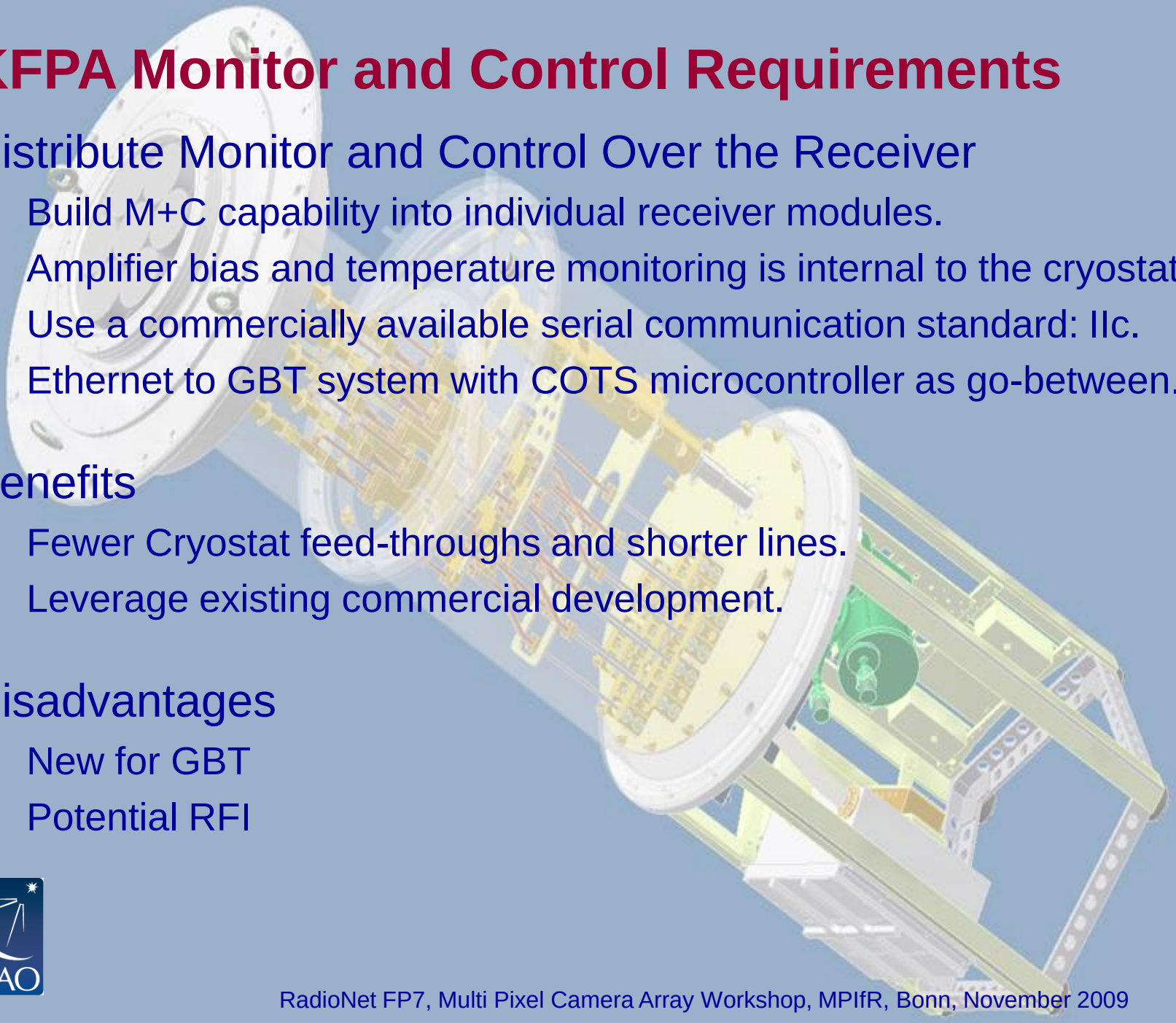
- Build M+C capability into individual receiver modules.
- Amplifier bias and temperature monitoring is internal to the cryostat.
- Use a commercially available serial communication standard: IIc.
- Ethernet to GBT system with COTS microcontroller as go-between.

Benefits

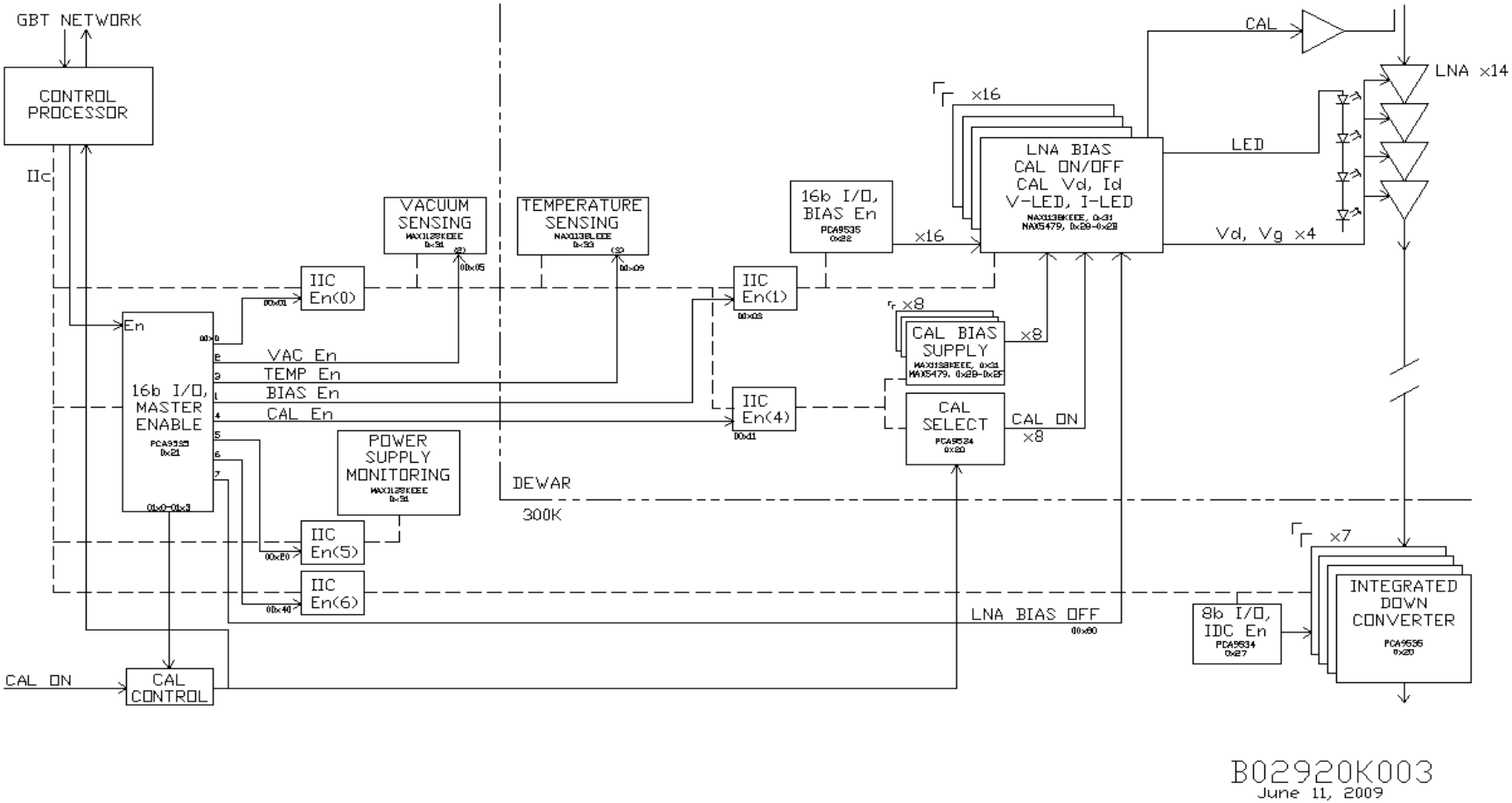
- Fewer Cryostat feed-throughs and shorter lines.
- Leverage existing commercial development.

Disadvantages

- New for GBT
- Potential RFI



7 Pixel M+C Block Diagram



Control and Interface Processor

NetBurner MOD5270

- 32 Bit 5270 at 147 MHz
- 2 MB SDRAM
- 512 kB Flash
- 64 kB SRAM
- 10/100 BaseT via RJ-45
- $79.00
- www.netburner.com

IIc Components

MAX1138(EEE/KEEE/LEEE) 10 Bit ADC

- 12 Channels, Internal Reference, External Clock
- Bias Cards, Temperature, Vacuum, Power Supply

MAX5479 Dual, 256-Tap, Non-Volatile Digital Potentiometer

- EEPROM-Stored Settings
- Bias Cards, Noise Cal Bias

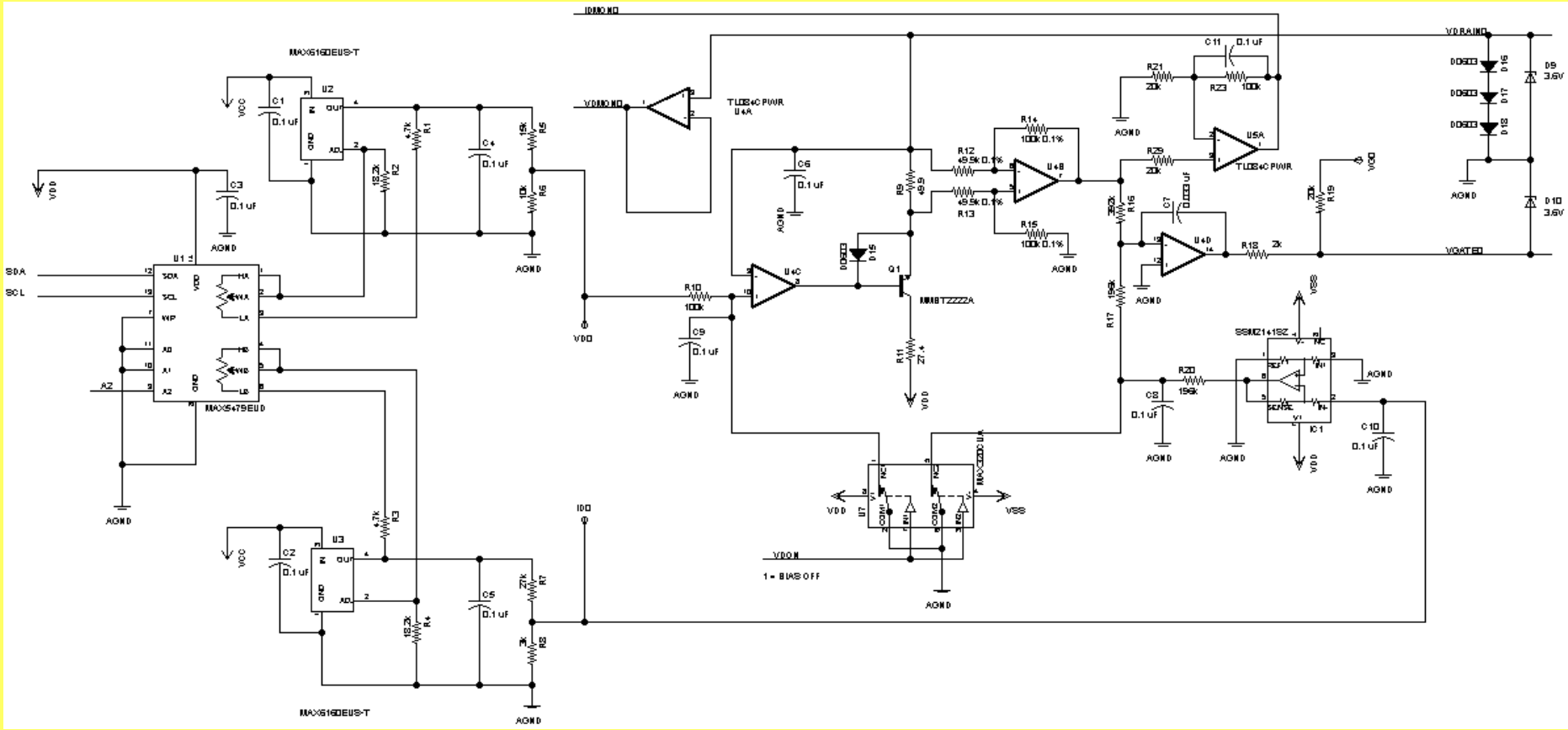
PCA9534, PCA9535 I/O Expanders

- Bus control
- Module Enable

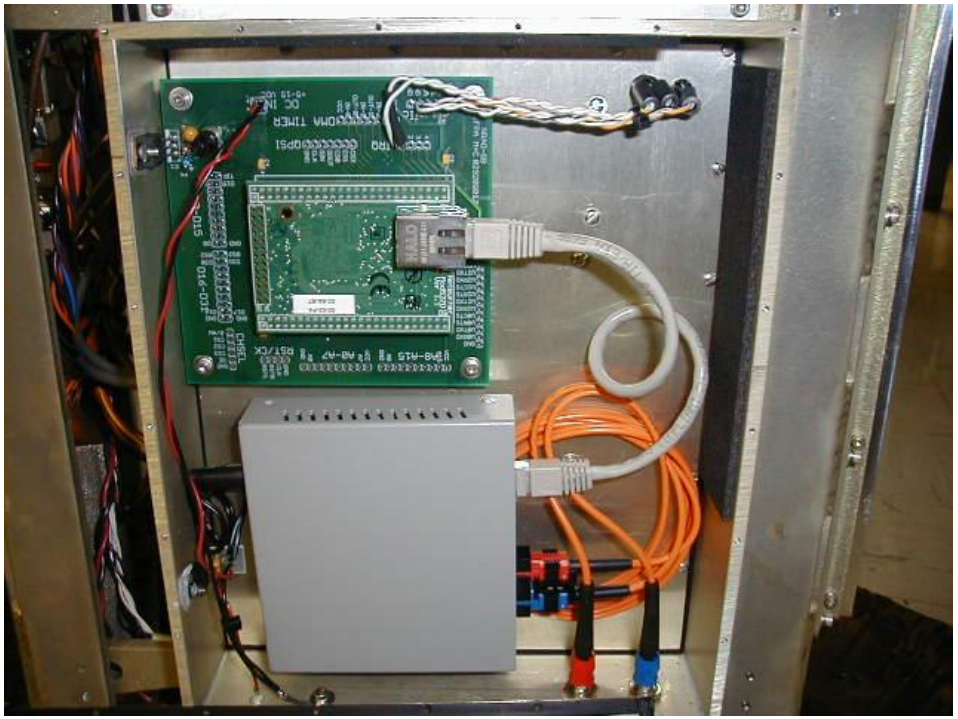
IES5501 Bi-Directional IIc Bus Buffer

- Bus Isolation

Bias Circuit
One Stage



Pictures
Control/Interface Processor



Pictures
Bias Card Box