



MicroTCA.4 Based Controller for CMOS Detectors (10th MTCAWS)

Public



Abstract

The Extremely Large Telescope (ELT) is under construction on Cerro Armazones in Chile. MicroTCA.4 will be used as a basis for the new modular ESO detector controller (NGCII) for all future visible and infrared scientific detectors. Specifically, IR CMOS detectors are the most commonly used detector type for the ELTs first generation of instruments. The presentation gives an insight into how commercial components and modules developed in-house are used to control infrared CMOS detectors and some of the challenges encountered while integrating MTCA.4.

Extremely Large Telescope

Credit: ESO/P. Lapeyre

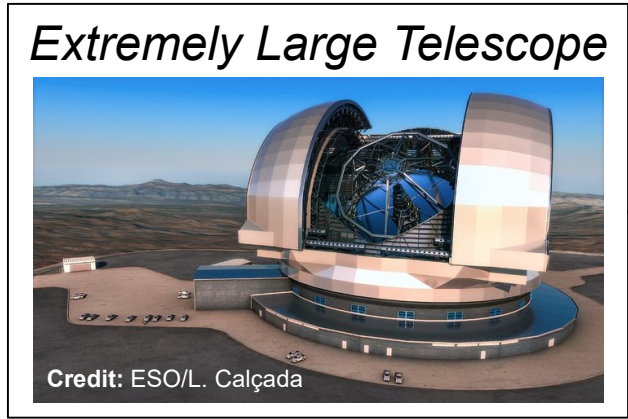


Credit: ESO/L. Calçada



- Location: Cerro Armazones, Chile
- Primary Mirror: 39.3m
- Primary Mirror Area: 978m³

Instruments and Detectors



HARMONI

Credit: ESO/L. Calçada & Olga Cucciati et al.
(e.g. High Red-Shift Galaxies)

METIS

Credit: ESO/L. Calçada
(e.g. Protoplanetary Disk)

MICADO

Credit: ESO/L. Calçada
(e.g. Black Holes)

17x Detector

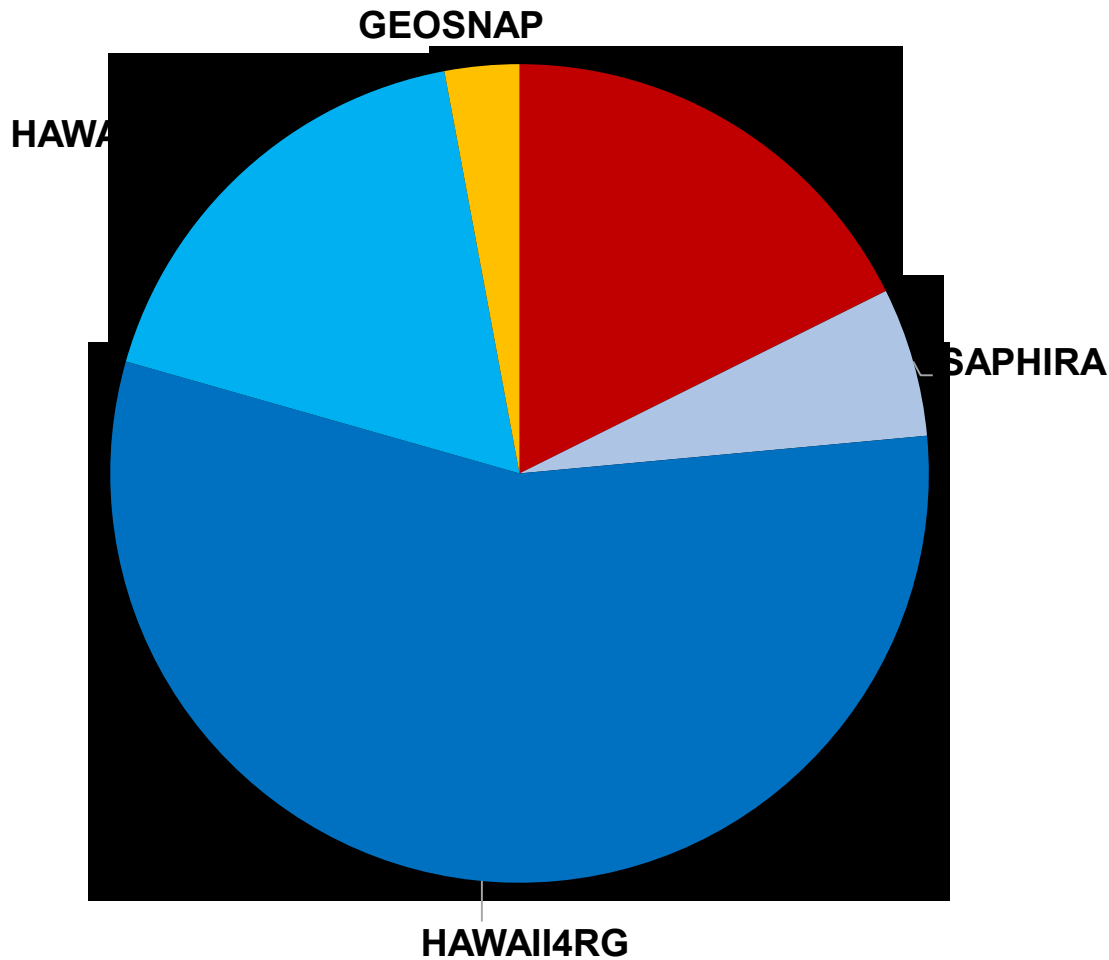
8x Detector

9x Detector

<https://www.eso.org/public/teles-instr/elt/instruments/>



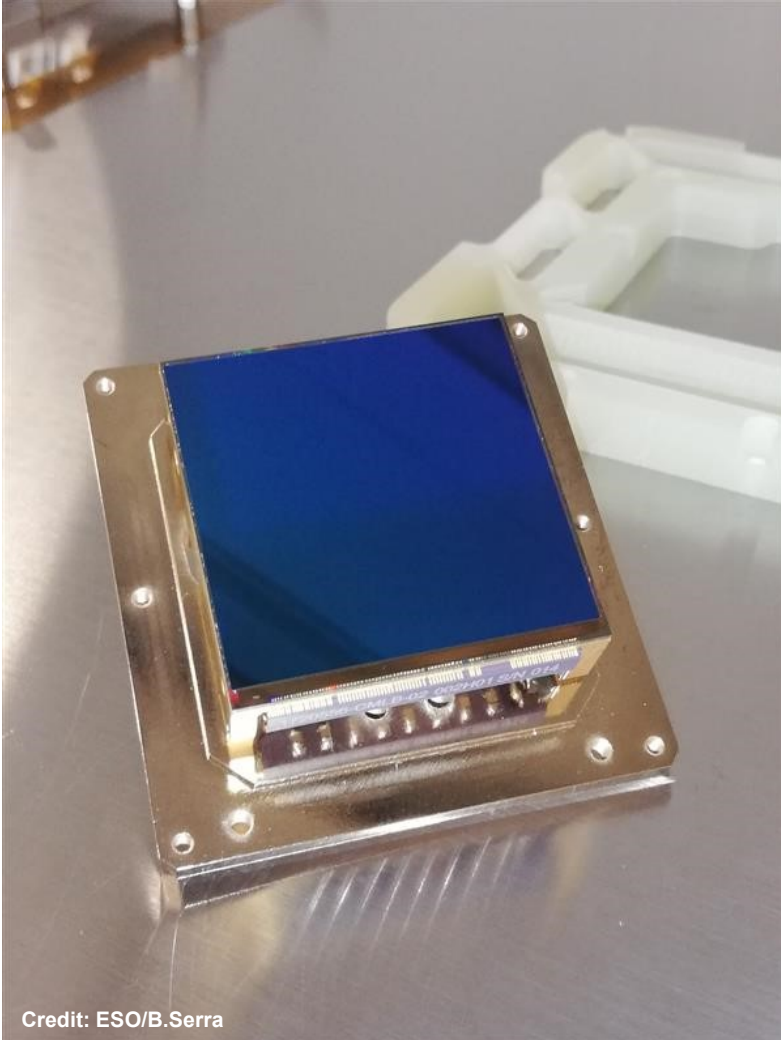
Detector Types



- Majority of Initial ELT Detectors are Analog CMOS Detectors
 - HAWAII4RG
 - HAWAII2RG
 - SAPHIRA

- Primary Focus on First Light CMOS Detectors

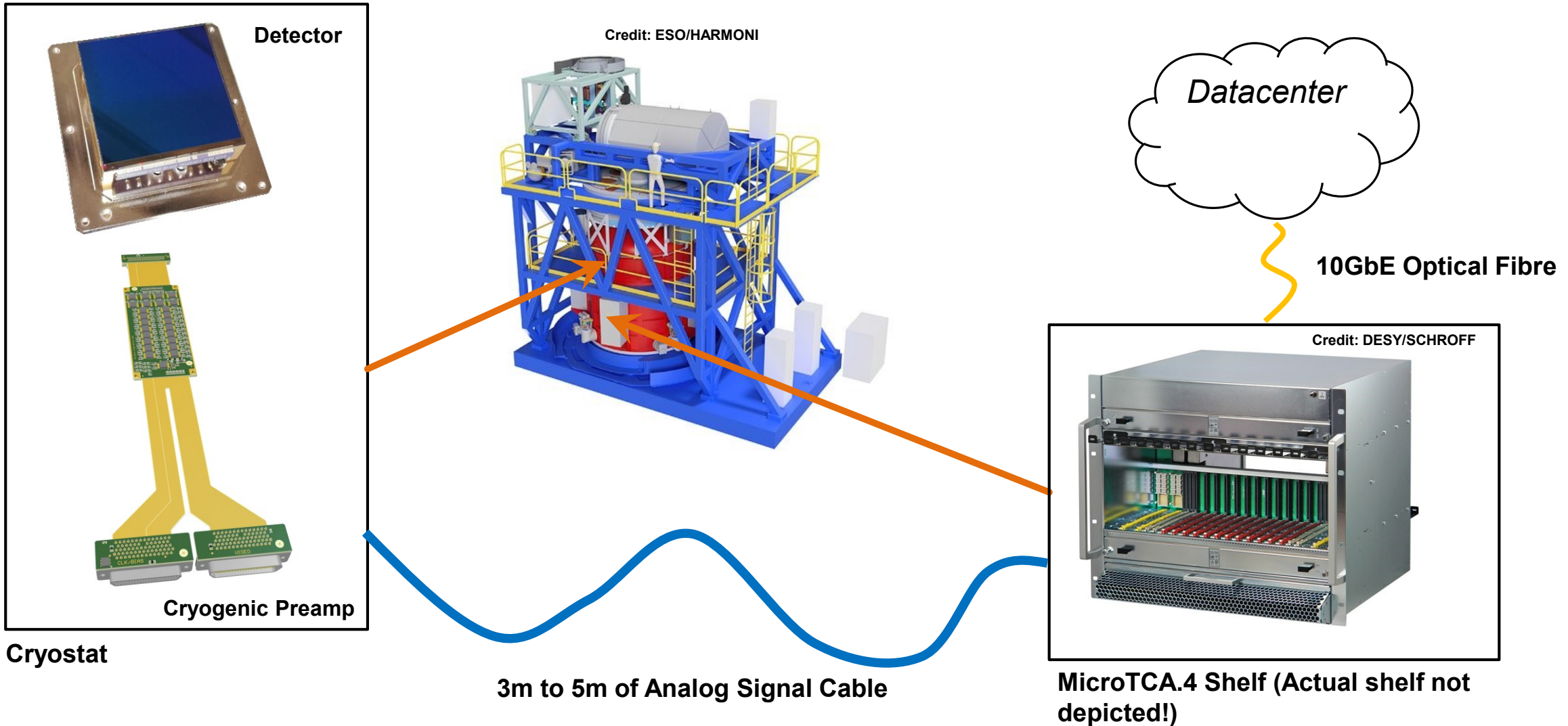
HAWAII2RG / HAWAII4RG



Credit: ESO/B.Serra

- IR Detectors from Teledyne Imaging Sensors
 - H2RG 2048x2048 ~40mm 32CH + REF
 - H4RG 4096x4096 ~60mm 64CH + REF
- Photodiode based
 - HgCdTe (Mercury Cadmium Telluride) Sensor
 - 1.1 μm to 2.5 μm sensitivity
 - Sensitivity can be custom tuned in factory
- CMOS Silicon ROIC
 - Connected with Indium bumps

Detector Connection



MTCA.4 Based Controller

Single 65 Ch.

	AMC	Zone 3	RTM	Det.
1	Zynq US+ AMC	D1.x	CMOS C20B20 RTM	A
2	AQ22 AMC	EA.24	CMOS AQ22 RTM	A
3	AQ22 AMC	EA.24	CMOS AQ22 RTM	A
4	AQ22 AMC	EA.24	CMOS AQ22 RTM	A
5	Artix AMC	D1.x	APD Bias RTM	A
6	-	-	-	-

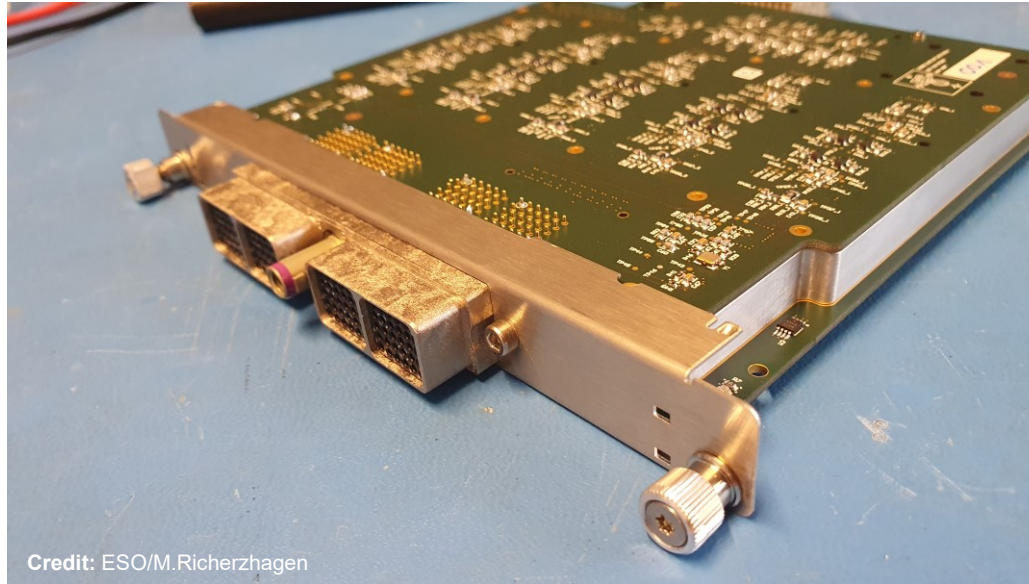
Dual 33 Ch.

	AMC	Zone 3	RTM	Det.
1	Zynq US+ AMC	D1.x	CMOS C20B20 RTM	A
2	AQ22 AMC	EA.24	CMOS AQ22 RTM	A
3	AQ22 AMC	EA.24	CMOS AQ22 RTM	A/B
4	AQ22 AMC	EA.24	CMOS AQ22 RTM	B
5	Artix AMC	D1.x	CMOS C20B20 RTM	B
6	Artix AMC	D1.x	APD Bias RTM	A/B

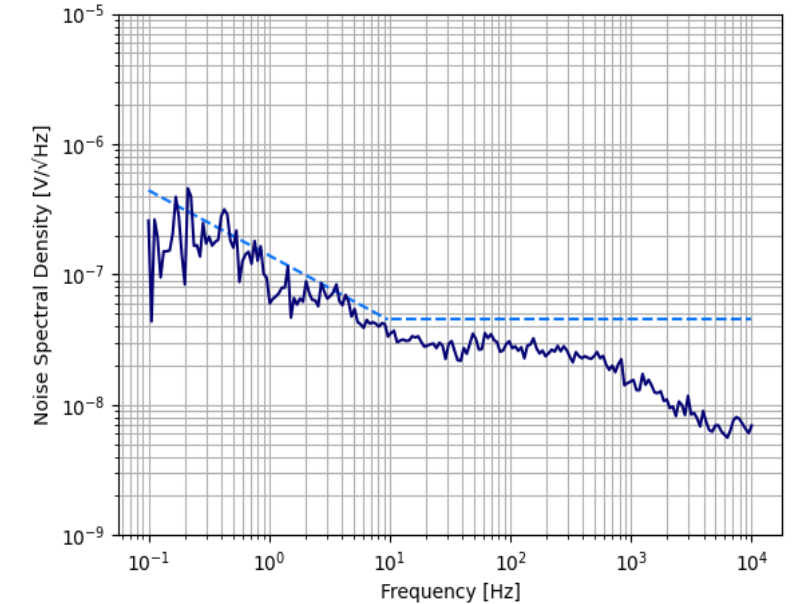
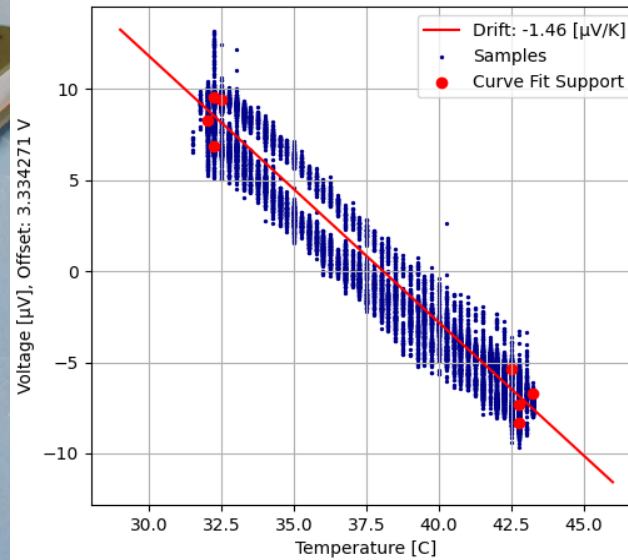
- 6 Slot Air Cooled
 - See talk from ANU for liquid cooled option
- Commercial Modules
 - Zynq US+ AMC
 - Artix AMC
 - Shelf + MCH + PSU
- ESO Modules
 - C20B20 RTM
 - AQ22 AMC
 - CMOS AQ22 RTM



CMOS C20B20 RTM



Credit: ESO/M.Richerzhagen



■ 20x CMOS Clock

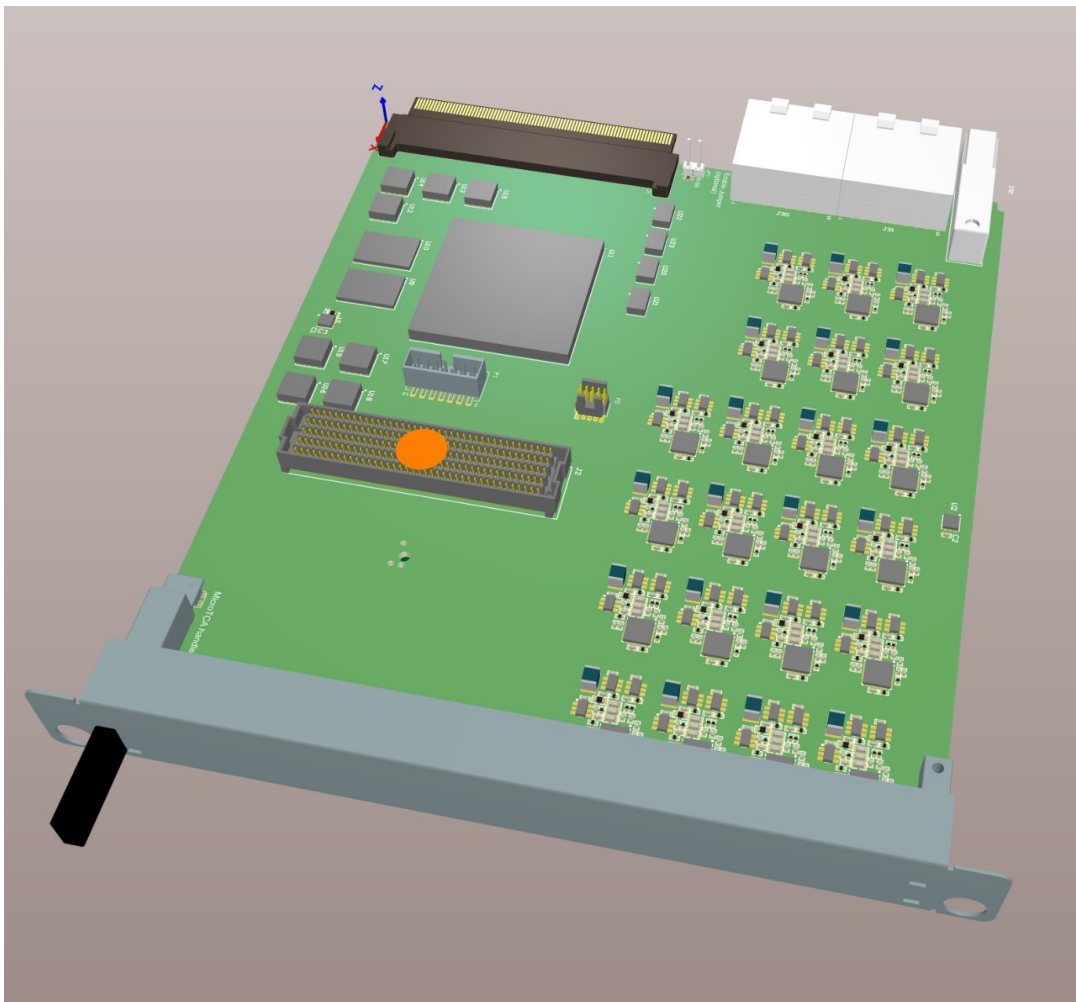
- 10MHz, Adjustable High Level 2.0V to 5.5V

■ 20x CMOS Bias

- Very Low Noise/Drift DC Supply 0V .. 5.5V

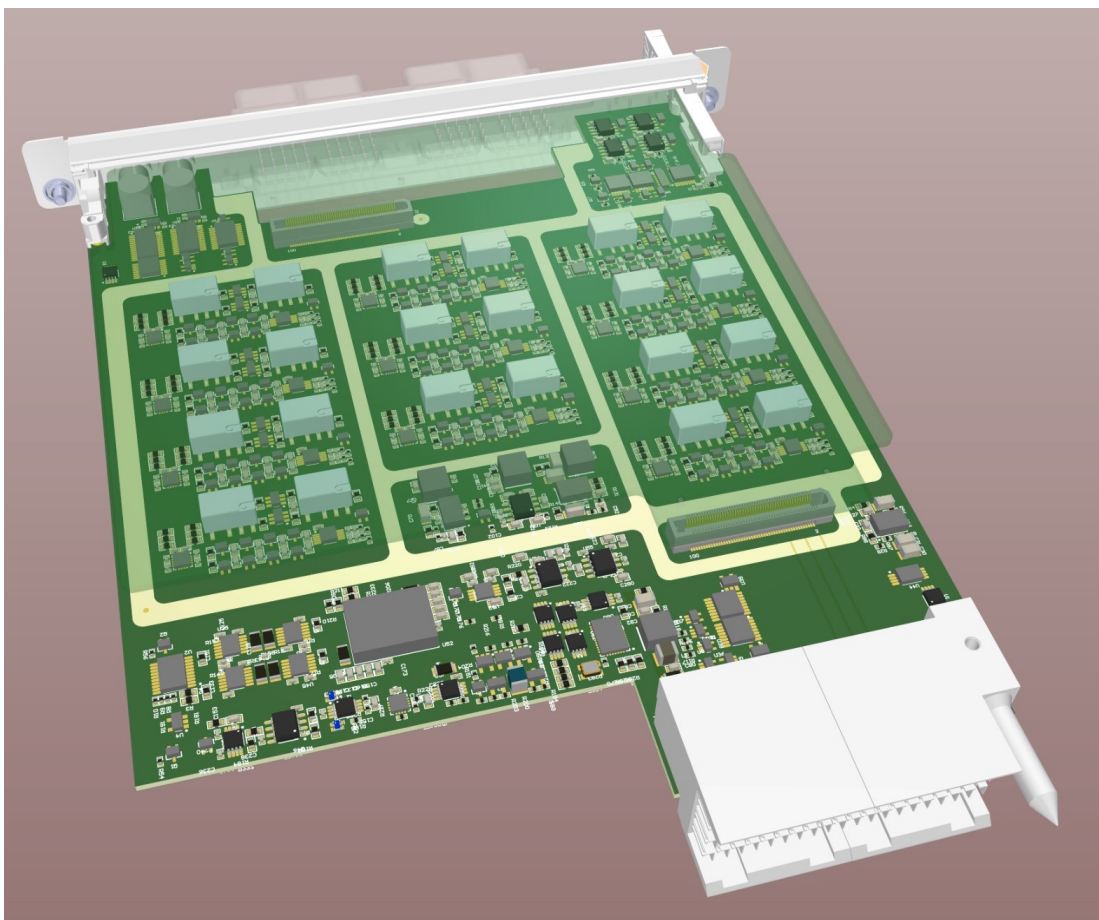
$< \pm 2 \mu\text{V/K}$ Drift
 $< 1 \mu\text{V}_{\text{RMS}}$ White Noise (10Hz to 1kHz)
 $< 0.5 \mu\text{V}_{\text{RMS}}$ Pink Noise (1mHz to 10Hz)

AQ22 AMC



- 22 Ch. Acquisition AMC
- Generic
 - All Detector (CCD/CMOS) specific circuits on RTM
- 18bit, 15Msps SAR ADCs
- Artix 7 FPGA
- DDR Memory
- 1x LPC FMC Slot

CMOS AQ22 RTM



- 22 Ch. Acquisition RTM
- Specific
 - Only for CMOS.
 - CCD will get it's own RTM.
- Fully Differential Signal Path
- Switchable Gain
 - $\pm 2.048\text{V}$ or $\pm 1.024\text{V}$ full scale input range
- Switchable LPF
 - Open, 10, 5, 1, 0.5 MHz

- Challenging Environment
- 3100m Operating Altitude
- Cold Start from -10C
- 8kV ESD Contact Discharge
- 16kV ESD Air Discharge

Credit: G.Hüdepohl (atacamaphoto.com)/ESO