256 channel data acquisition system
for VISTA focal plane to readout sixteen 2k x 2k VIRGO detectors

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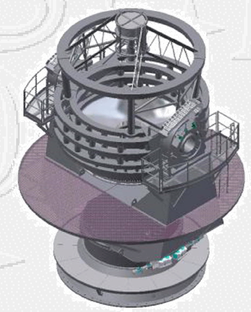
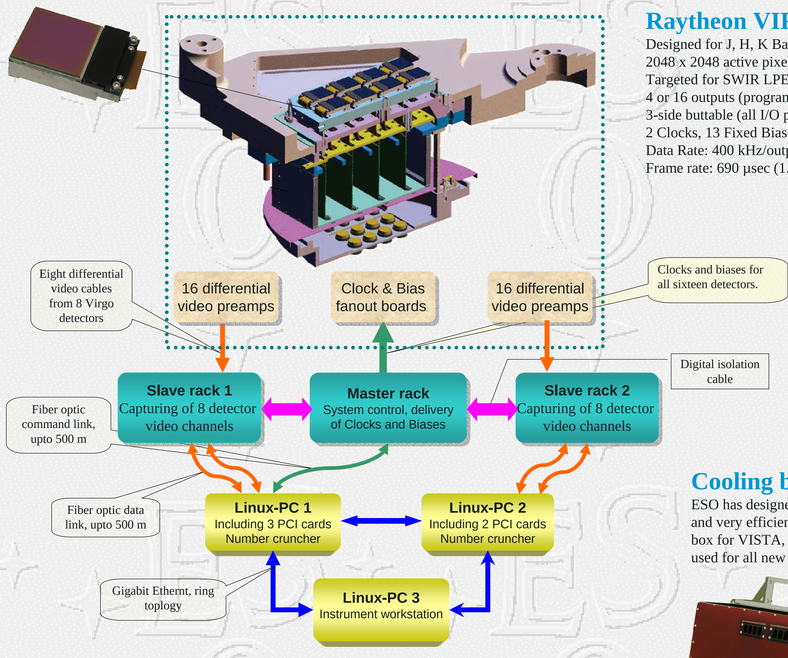


Introduction

The **V**isible and **I**nfra-Red **S**urvey **T**elescope for **A**stronomy (VISTA) is a 4 m diameter wide field survey telescope, which is being built for the delivery by late 2006. When completed in 2006 it will be the worldís largest telescope dedicated to ground based survey work and will become part of ESO's Cerro Paranal Observatory. The VISTA IR Camera will use a mosaic array of 16 Raytheon 2K x 2K VIRGO detectors at its focal plane. Each detector has 16 parallel video output channels. In total 256 video channels have to be processed resulting in a readout time for the complete focal plane of less than 1 sec. In order to control these detectors, the ESOís standard Infrared Array Control Electronics, IRACE, is used to control and read out the VISTA focal plane. The IRACE system is modular and has been adapted for VISTA IR camera requirements.

System description

To build up a 256-channel system, all boards, in total 27, are distributed over three separate racks, 19 inch wide. The main rack, called master rack, contains Clock- and Bias-driver boards, Sequencer, Giga-Link and Sync boards. The other two racks, called slave racks, contain sixteen ADC boards. Each board is accommodating 16 video channels. Because of the bandwidth limitation of the IRACE-PCI card (up to 65 MB/s) we had to split the backplane into two groups. Each group contains four ADC boards and one Giga-Link board, which capture and transport the data over the fiber optic to the host PCI card. To avoid any timing jitter of ADC convert pulses, the master clock and convert pulses have been distributed by the master rack to the two slave racks.



Raytheon VIRGO 2K x 2K detector

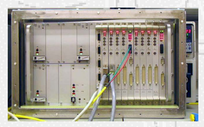
Designed for J, H, K Band Ground-Based Astronomy.
2048 x 2048 active pixels with 20 mm micrometers .
Targeted for SWIR LPE HgCdTe/CdZnTe
4 or 16 outputs (programmable)
3-side buttable (all I/O pads on one edge)
2 Clocks, 13 Fixed Biases
Data Rate: 400 kHz/output (2.5 µsec/pixel/sample)
Frame rate: 690 µsec (1.43 Hz) in 16 output mode

Master rack

Contains two Clock- and Bias-drivers, one Sequencer, one Sync and one Giga-Link modules. Here the Giga-Link module is only used for the command interface to the whole system (i.e. downloading configuration-files, setting voltages, reading telemetry data and status bus controlling). To reduce the number of required boards, several Clock- and Bias-voltages have to share one source. The Sync-Board distributes the 20 MHz system clock, the convert pulses, the reset signal and four status bus signals to the slave racks.

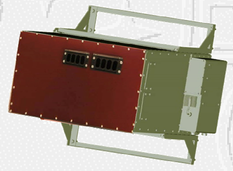
Slave rack

Contains eight ADC-Boards divided in two groups by splitting the backplane. The ADC-Board accommodates 16 ADCs with a resolution of 16 bit at 500 ksps from Linear Technology. Each ADC-Board can also be operated in simulation mode, which means that each board can send its channel number or counter value over the backplane. In that way the digital chain can easily be checked, which is essential for the maintenance of a system with such a high number of channels.



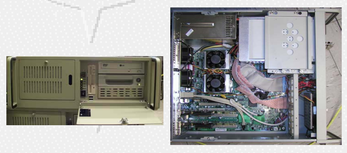
Cooling box

ESO has designed a new compact and very efficient water cooling box for VISTA, which will also be used for all new instruments.



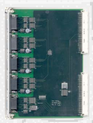
Linux PC

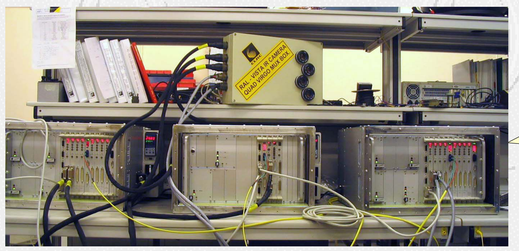
Is a rack mountable PC (double 3 GHz CPUs and 3 GBytes of memory). It contains at least three PCI-cards, which are the host interface of the system, equipped with a full-duplex optical link, operating at one GBauds. One of them is used for the command interface and the other two for just data capturing. The PCI-card has a 32 bit, 33 MHz interface with a net data rate of 65 MB/s. All three PCís are connected together via Gigabit Ethernet in a ring topology.



Digital isolator

To avoid any ground loops between the racks, an additional Sync-Board has been developed. The main component is a digital isolator based on Analog Devices iCouplerÆ technology (ADuM1401). These isolation components provide outstanding performance characteristics superior to alternatives such as optocoupler devices, operating at 100 Mbps. The signals have been also driven by a deferential line driver to be able to use long cables (up to 8 meters).





In the test phase the system has been operated with four VIRGO bare multiplexer at RAL, Rutherford Appleton Laboratory.

Detector Control Software

The IRACE software has been expanded and adapted to the requirements of VISTA. The DCS controls all five PCI cards. Two data acquisition tasks are launched on each Linux PC. Special effort needs to be taken to guarantee data integrity on the four parallel data streams.

Four Real Time Displays visualize simultaneously the incoming data. Each display shows a group of four detectors.