Telescopio Nazionale Galileo

TNG CCD CONTROLLER STATUS: Proposal of a new acquisition system

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V1.0		First version	

Contents

1 Introduction

1.1 Scope

This document is intended to give some information about the state of the CCD controller at the TNG and propose an upgrade of the whole system (hardware and software)

1.2 Additional information

No additional information, at the moment.

1.3 Contact information

Feedback on this document is encouraged. Please email to cosentino@tng.iac.es

1.4 Reference documents

[RD01] **Documentazione per il montaggio del preamplificatore per i CCD del TNG V2.2**

[RD02] **Documentazione per il montaggio della scheda clock per i CCD del TNG V2.0**

[RD03] **The sequencer board: SPC A100 V1.1**

[RD04] **Analogic board; CDS A100 V1.1**

[RD05] **Specification to Use the DLL to communicate with the CCD controller-V1.2**

[RD06] **ColdPCI - Il software stand-alone per la gestione del CCD controller di nuova generazione**

[RD07] **CCD Controller Server Design specifications**

[RD08] **CCD Service Design specifications**

[RD09] **DOLORES: The Graphical User Interface Manual**

[RD10] **UCam User Manual V0.3.2**

[RD11] **CCD Controller ligth LAN**

[RD12] **NBI Generation 3 Array Controller**

1.5 Applicable documents

2 System Overview and considerations

2.1 The Hardware

The first model of the CCD controller in use at the TNG was developed in the frame of collaboration between INAF and Skytech. The actual version is an evolution of this first version and was developed by Skytech.

The following hardware parts compose the CCD acquisition system (CCD Controller):

- Preamplifier board
- Clock board
- CDS board
- Sequencer board
- PCI board

2.1.1 The preamplifier board

The preamplifier [RD01] is the first electronic element of the chain and is connected to the CCD, very close to the detector. This board provide the bias to the CCD and perform the first amplification of the CCD output (4 channels).

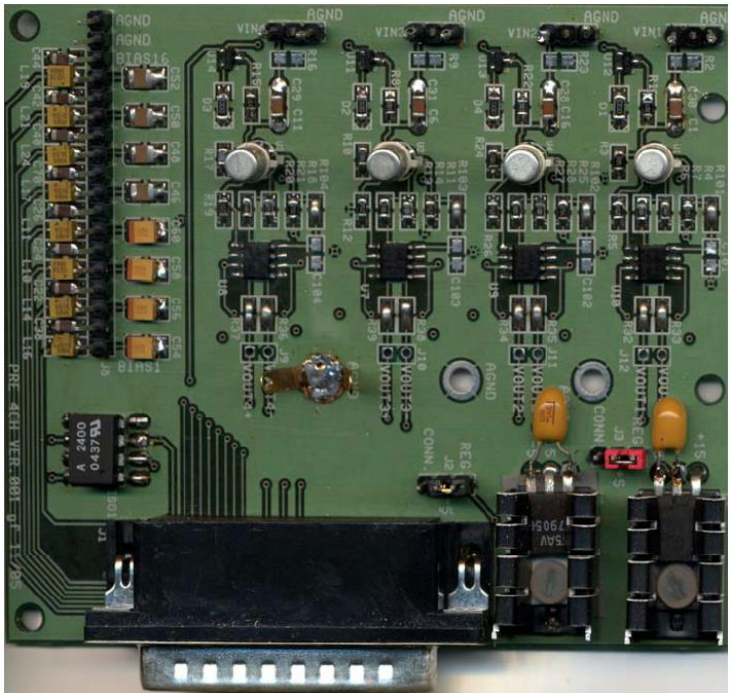

Figure 1 - The preamplifier board

2.1.2 The clock board

The 'clock filter board' [RD02] is the interface between the 'sequencer' (SPC A100) and the CCD. It is located close to the CCD detector and is used to filter the clock sequences.

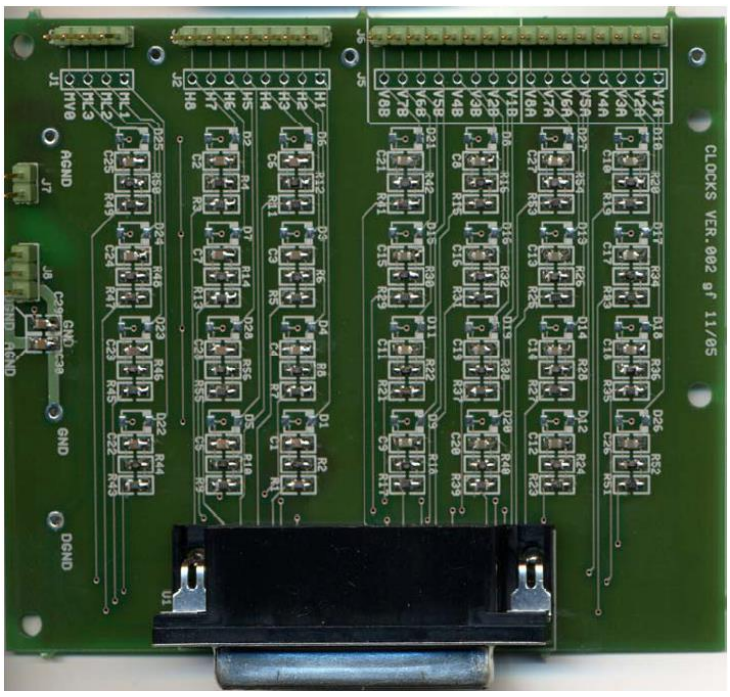

Figure 2 - The clock board

2.1.3 The CDS board

The CDS A100 board [RD04] is responsible for generating the bias voltages, the CCD signal processing (correlated double sampling) and the telemetry of the bias voltages and clock. This card has been operating for more than ten years at the TNG and the extreme operating conditions of the telescope (variation of temperature, humidity and mechanical stress) has contributed to the deterioration of components, welding and contacts that have introduced intermittent errors. This problem worsens with the passing of time and the solutions adopted so far could be not effective in the future.

Figure 3 The CDS A100 board

2.1.4 The Sequencer board (SPC)

The SPC A100 board [RD03] provides the generation of CCD phases, the clock voltages and communication with the PCI card through optical fibres. In the same way of the CDS A100 board, the sequencer has suffered the same deterioration problem with the aggravating circumstance of the criticality of the fibres contacts that introduced intermittent errors in the CCD data transfer.

Figure 4 - The SPC A100 board

2.1.5 The PCI board

This board is the responsible of the data and command transfer between the CCD controller and the remote computer. It is plugged in the PCI bus of a PC, running with XP operative system. The main problem of this part of the acquisition chain is the obsolescence of this electronic board and the limited compatibility with the hardware of the personal computer and with the latest operative systems.

Figure 5 - The PCI board

2.1.6 Hardware Conclusion

The hardware is obsolete, is critical due to the deterioration of the component and is incompatible with the new platforms (hardware and software). In the last years many efforts to maintain the operations and reliable system were made but the solutions adopted so far could be not effective in the future.

2.2 The software

The software of the acquisition system is made up by a low-level software (drivers and dynamic library) and high level software. The low level software was provided together with the hardware and is platform dependent (windows XP) while that the high level software was developed at TNG and is not strictly dependent by the platform.

The following software parts composed the software system:

2.2.1 The drivers

The drivers (PCI_S100Drv.sys) can run only on Windows 2000 and Windows XP operative system. These operative systems are not supported by Microsoft and this means that the acquisition system is frozen to work with these operative systems and the corresponding hardware. These conditions are unacceptable if we need reliability of the system. One solution could be to try the installation or re-compilation of the drivers in order to be compatible with a supported operative system (windows7 or windows 10).

2.2.2 The dynamic library (DLL)

The DLL provide the function to interface the high level software to the CCD controller, through the driver. The specifications of the DLL are described in [RD05].

2.2.3 The stand-alone software

This software can be used to test or use the CCD controller in stand-alone mode; it is described in [RD06]

2.2.4 The CCD controller server

The CCD controller server [RD07] interacts with the CCD Controller by using a PCI board. This board is connected to the CCD controller with an optic fiber. In addition, the CCD controller server communicates with the external world with a plain sockets, through the socket are sent xml-like commands, whose are sent for execution and return response as appropriated.

2.2.5 The CCD service

The CCD service [RD08] connects with the CCD controller to send commands to the CCD. In addition it is in charge of checking the arriving of the image from the CCD controller server computer and creates the final FITS image

2.2.6 The User interface GUI (Dolores)

The DOLORES user interface [RD09] contains all the tools that allow the user to manage the instrument, include the CCD and to asses quickly the quality of the data obtained. In the management of the CCD controller the GUI communicate with the CCD service.

2.2.7 Software Conclusion

To achieve a full reliability of the system we have to abandon the obsolete operating systems (Windows 2000 and Windows XP) and upgrade the hardware of the personal computer that hosts the PCI board. This implies an effort of the IT department in the installation or re-compilation of the drivers in order to upgrade the whole system to other operative system. This operation is essential for the reliability of the CCD acquisition system.

2.3 General conclusion

Considering the Hardware and the Software aspects of the CCD acquisition system in use at TNG in the focal plane instruments, it is very urgent to upgrade the CCD controller and consequently the software environment of the instruments to allow a long term reliability and to minimize the occurrence of critical fails during the scientific observations.

3 A proposal for a new CCD acquisition system

I am analysing various CCD controllers and I am collecting technical and cost information about the currently available. The following paragraph gives a view of the models at issue.

3.1 CCD controller light LAN (Skytech)

The CCD controller light LAN [RD11] is an evolution of the CCD controller in use at the TNG. The main changes are in the size of the controller and in the data transfer. This controller doesn't need a remote board to communicate with the user and is platform independent. The communication (command and data) occurs through a LAN connexion.

The cost of this CCD controller is about 22.000 €

3.2 ARC CCD Controller (UK ATC)

The ARC CCD controller [RD10] was developed by the Astronomical Research Cameras Inc., San Diego, USA and is the controller in use in HARPS-N instrument at TNG.

I have requested the documentation and a quotation of this CCD controller.

The cost of a a typical CCD controller with 2 off 2-channel video processor boards is about 21.000 US$

3.3 NBI Generation 3 Array Controller (NBI Copenhagen)

The NBI Array controller [RD12] was developed by the Niels Bohr Institute of Copenhagen and is used in the CAOS spectrograph (OACT) and at NOT telescope (TBV).

I am collecting information about this CCD controller.

4 Conclusions

Taking into account the considerations of the previous paragraph, to guarantee a full reliability of the instruments that use CCD detectors is mandatory to remove the weaknesses of the acquisition system. The software issue can be fixed with an inversion of manpower but the hardware technical problem can be patched, but not fixed.

I propose to take into account the possibility of refurbish the CCD acquisition system, allocating an amount of money in order to buy one CCD controller for each instrument more one spare.

Appendix A – Document identification code

ORG-TYP-INS-NCOD

ORG = Originator field (i.e. TNG)
TYP = Document Type (see Table 1)
PRJ = project element (see Table 2)
NCOD= numeric code (i.e. 0001)

Example: TNG-MAN-HAN-0001

Table 1 - Document type code

AD	Assumption Document
AN	AN Analysis
COS	Cost Documents (Estimate/CaC/CtC, etc)
DD	Design Description
DP	Data Package
DRD	Document Requirements Description/Definition
DRL	Document Requirements List
DW	Drawing/Diagram
EID	Experiment Interface Document
FI	File (Software/Configuration/Network)
ICD	Interface Control Document
IRD	Interface Requirement Document
ITT	Invitation to Tender
MAN	Manual/User Guide/Handbook
MEM	Memo
MOM	Minutes of Meeting

MOU	Agreement/Memorandum of Understanding
MX	Matrix/Compliance
NCR	Non-Conformance Report
NOT	Note
OPS	Operations Document
PLN	Plan
PO	Proposal
PRE	Progress Report/Status Report
RFQ	Request for Quotation
SOW	Statement of Work
TOR	Terms of Reference
TN	Technical Note
TP	Test Procedure/Test Plan
TR	Test Report/Test Result
TS	Test Specification
VC	Verification Control Document
WBS	Work Breakdown Structure
WP	Working Paper
WPD	Work Package Description

Appendix B – project Element code (to be completed)

Table 2 – Project element code

CCD	CCD detector/electronic/software
HAN	HARPSN
TRK	Tracking

Appendix C – List of acronyms (Example)

ARC	Astronomical Research Camera
ATC	Astronomy Technology Centre
CCD	Charge Coupled Device
CDS	Correlated Double Sampling
DLL	Dynamic Link Library
GUI	Graphical User Interface
HARPS-N	High Accuracy Radial velocity Planet Searcher in the North hemisphere
LAN	Local Area Network
NBI	Niels Bohr Institute
NOT	Nordic Optical Telescope
OACT	Osservatorio Astrofisico di CaTania
PCI	Peripheral Component Interconnect
TBC	To Be Confirmed
TBD	To Be defined
TBF	To be fixed
TNG	Telescopio Nazionale Galileo