

Nordic Optical Telescope



Detector Controller User Requirements

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1 Introduction

This document describes the user requirements for a new detector controller to be used at the Nordic Optical Telescope (NOT).

The requirements are specifically defined based on the current suit of detectors in use at the NOT, but this is also expected to cover the requirements for possible future detectors. The requirements are split in two part. In the first part we define the general requirements for the detector control system, while in the second part we detail specific requirements.

Beyond these basic requirements we also define some capabilities which are not essential, but we consider desirable.

2 General requirements

Here we define the general requirements for the detector control system. They mostly refer to necessary properties of the system.

1. **Detectors:** The controller should be capable to control both CCDs and IR arrays. Specifically, it is should be able to control:
 - E2V CCD42-40 $2k \times 2k$
 - 2x2-mosaic of 4 Loral/Lesser $2k \times 2k$
 - Hawaii-1 $1k \times 1k$
 - SITe TK1024A $1k \times 1k$ (desirable)
 - E2V L3CCD (desirable)

2. **Read-out modes:** The following read-out modes are required to be available:
 - Shuttered exposure
 - Single window
 - Same size multi-window (desirable)
 - External (GPS) synchronisation of exposures (desirable)
 - Reset-read-read (Hawaii-1 array)
 - Ramp-sampling (Hawaii-1 array)

3. **Image acquisition software:** With the controller an image acquisition software program should be provided that can acquire images from both CCD and IR detector systems. It should:
 - Run on a Linux platform and be configurable
 - Provide the images in standard FITS format
 - Be capable of scientific image acquisition (similar capabilities as the present BIAS versions are highly desirable).

4. **Environment:** The controller will be mounted on the instrument attached to the telescope in a dome and it should be able to operate:
 - At temperatures in the range $(-10^\circ) - 30^\circ$ C and humidity up to 90%

5. **Operation and maintenance:** To be able to operate and maintain the controllers after delivery we require:
 - Documentation, including a:
 - User manual
 - Maintenance manual
 - Technical manual
 - Customer support for troubleshooting, software upgrades, spare parts, and supply of additional units for a number of years

3 Specific requirements

Here we define the specific requirements for the detector control system. They mostly refer to necessary capabilities of the system.

1. **Detector limited performance:** The controller and its connection to the data acquisition computer should not significantly affect the manufactures specification for the detectors mentioned as for:
 - Read-out speed
 - Read-out noise
 - Non-linearity
 - Charge transfer efficiency
2. **Read-out performance:** The baseline requirements for the read-out of the detectors are the following:
 - Hawaii-1 array $1k \times 1k$: Full frame read-out in 1 sec ($4 \mu\text{sec}/\text{pixel}/\text{channel}$) with $10e^-$ read-out noise
 - E2V CCD42-40 or Loral/Lesser $2k \times 2k$: Full frame, single channel read-out in 25 sec ($6 \mu\text{sec}/\text{pixel}/\text{channel}$) with $3.5e^-$ read-out noise
 - Cross talk between channels $<10000:1$
3. **Detector parameters:** The following parameters for the detectors are required to be selectable in software:
 - Bias voltages
 - Gain: at least 2 settings (only for CCDs)
 - Binning: at least 1,2 and 3 in either axis (only for CCDs)
 - Ability to implement an artificial over-scan (only for CCDs)
 - Fast read-out mode: Full frame, single channel read-out in <10 sec with corresponding increase in read-out noise (only for CCDs, desirable)
 - Detector temperature (desirable)