Development of a Compact Readout System for Optical CCD in Higashi-Hiroshima Observatory

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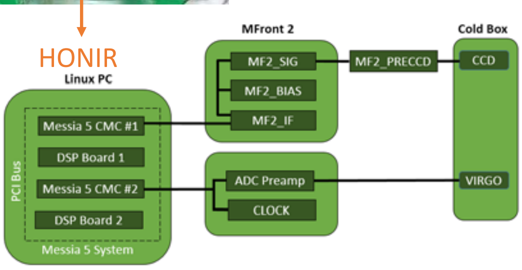
Introduction

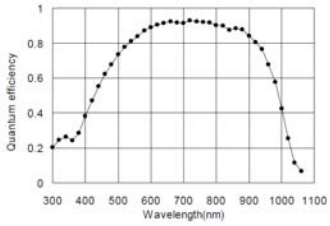
We designed a new readout system, based on the Kiso Array Controller (KAC) system. Our aim is to design a simple, cheap and compact system which is assembled mainly with widely-used, comercial-base parts for convenient maintain. We devised the structure of the readout system and drew schematic and printed circuit board diagrams. This system will be installed to the optical channel of HONIR (Kanata Telescope) after testing all the performances. Moreover, the system is general archetype which can be used for various types of optical and near-infrared detectors.

Background

Optical Band Detector: Hamamatsu 2Kx4K
Wavelength Coverage(um) :0.5-1.0
Field of View (arcmin): 10x10
Size of the whole FOV(mm)at telescope focus plane: 53.8x53.8
Size of the whole imaging area(mm) on the detector: 30.7x30.7
Filters : B,V,Rc,Ic,Y



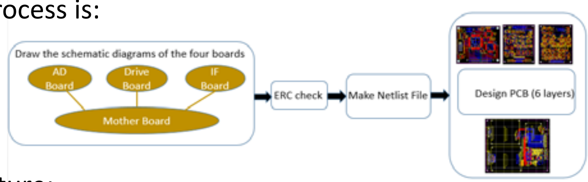
HPK CCD Detector



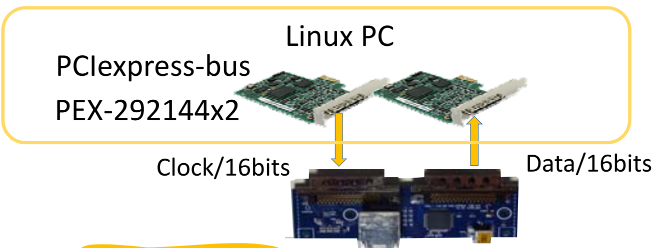
CCD Structure : FFT
Pixel Size : 15umx15um
Vertical clock phase : 3 phases
Horizontal clock phase : 2 phase
Outputs : 4ch
Light Area: 30.72mm(H)x 61.44(V)
Full Well capacity: >150ke-
Dark : <5e-/pixel/hour @-100℃
Readout noise : <5e- @130KHz

Circuit and Structure Design

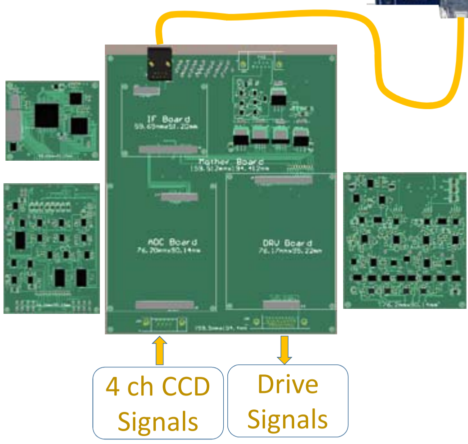
We use Protel software to design the whole system, and the process is:



Structure:



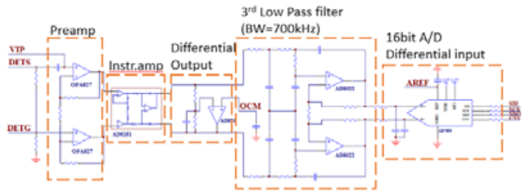
LVDS Board
(1)LVDS boards convert serial signal (AD) to parallel signal (PC).
(2)Convert the parallel signal (CCD clock)to serial signal and send it to analog processing unit.



Noise Suppression

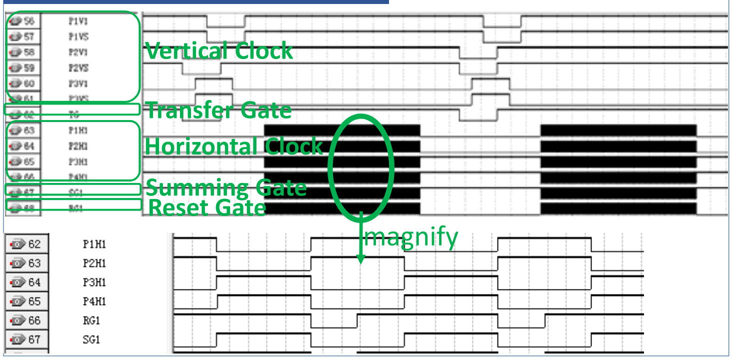
We used some methods to suppression the readout noise:

1: Transfer the CCD signal to differential signals.
2: Use 3rd low pass filter to suppress high frequency noise



3: The PCB adopted 6 layers arrange technology , separated signal , power and GND layer form each other.
4: Select the low offset voltage drift chip as the power supply (e.g., LT1211)

Pixel Transfer Simulations



Reference

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[3] Takahiro Ui, et al., Proc. of SPIE Vol. 9147 91476C-1(2014)
[4]加藤拓也, 汎用CCD読み出しシステムKAC 及び木曽広視野カメラKWFCの開発と性能評価,修士論文,2011,東京大学

Future work

Make PCB boards and weld components, test the whole system, get the performances. Install it to Kanata telescope, and communicate these with the current operation system.