XCAM Controller Unit (XCU-A)

Introduction

XCAM have developed an XCAM Controller Unit (XCU-A) which operates almost any type of CCD imaging sensor; being fully flexible it is perfect for use for CCD evaluation studies, or used as the basis for a custom CCD camera system.

XCAM Controller

- Drives any e2v Technologies ***CCD*** or ***EMCCD***
- Drives 2, 3 or 4 phase CCDs
- Drives ***Swept Charge Devices*** (SCDs)
- Drives other manufacturer's CCDs with interface box; it has been used to drive Kodak and Atmel (now e2v Technologies) CCDs
- Allows complete control of the clock and bias voltages and timings
- Enables operation in unusual operating modes
- Can be fitted with one of a selection of ADC cards each optimised for their application
- Has trigger input and outputs to allow synchronisation with your experiment
- Driven through the XCAM .dll using either the XCAM GUI, MatLab or by user's custom acquisition code, such as C++

Figure 1 XCU-A Controller

Controller Applications and Flexibility

The controller is well-suited to a wide range of uses, but it is particularly popular for use by customers who want to perform CCD evaluation and characterisation studies, and as a basis for the design and manufacture of custom CCD camera systems for science experiments.

Some examples of past controller use, which demonstrates this flexibility are:

- CCD evaluation for space science work, characterising the flat-band voltage change of a CCD before and after irradiation
- Driving an e2v Technologies CCD4290 in a custom camera head for a laser plasma experiment
- Driving an L3 (EMCCD) custom sensor for an X-ray experiment at a synchrotron
- Driving an e2v Technologies CCD203-84 CCD in a cryogenic chamber for characterisation studies
- 3 units used to drive 3 e2v Technologies CCD44-82 CCDs simultaneously in a custom camera head design for XFEL experiments
- Used to drive an e2v Technologies CCD57-10 in an unusual high-timing operating mode for analysis of volatile atmospheric constituents

Controller Construction

ADC card (CDS card)
The ADC/CDS card is the card which takes the CCD output and measures the charge in each pixel and converts it to a digital number.

The Interface Card
The interface card is the card which bi-directionally handles all communication between the drive box and the PC, both for issuing commands to the drive unit e.g. *grab image*, and for receiving data back to the host PC.

The Sequencer Card
The sequencer card is the card which produces the clock waveforms for the CCD. This is achieved by the use of a digital signal processor, which is easily reprogrammed, and this enables the system to be modified to drive alternative CCDs.

The Bias Card
The bias card generates the programmable DC bias voltages to the CCD and clock upper level voltages, which are then modulated by the sequencer card.

Temperature Controller
We anticipate being able to include an integrated temperature controller unit in the future, but for the current time we recommend an external stand-alone temperature controller or power supply for cooling of the device.

Noise performance and Speed of Operation

The current sequencer card can operate at pixel frequencies of approximately 2MHz, although this may be lower depending on the sequencer program that is operating the CCD and various factors such as number of phases of operation of the CCD and degree of flexibility required. The clock frequency of the sequencer enables programming in 33-25 ns steps.

Noise performance is dependent on the choice of CCD, the speed of operation, and the ADC sampling method. Typical values for noise, together with frequency of operation are given below in the table.

ADC Card	Speed	Noise
1MHz, 2 channel, Correlated Double Sampling using Clamp and Sample	To 2 MHz per channel	Approximately 7 electrons rms. (depending on sensor noise and preamp gain) at 1MHz
200KHz, 4 channel, Dual Slope Integrator	To 200 kHz per channel	Sensor noise limited if all voltages and timings optimised ~ 2-3 electrons rms.

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