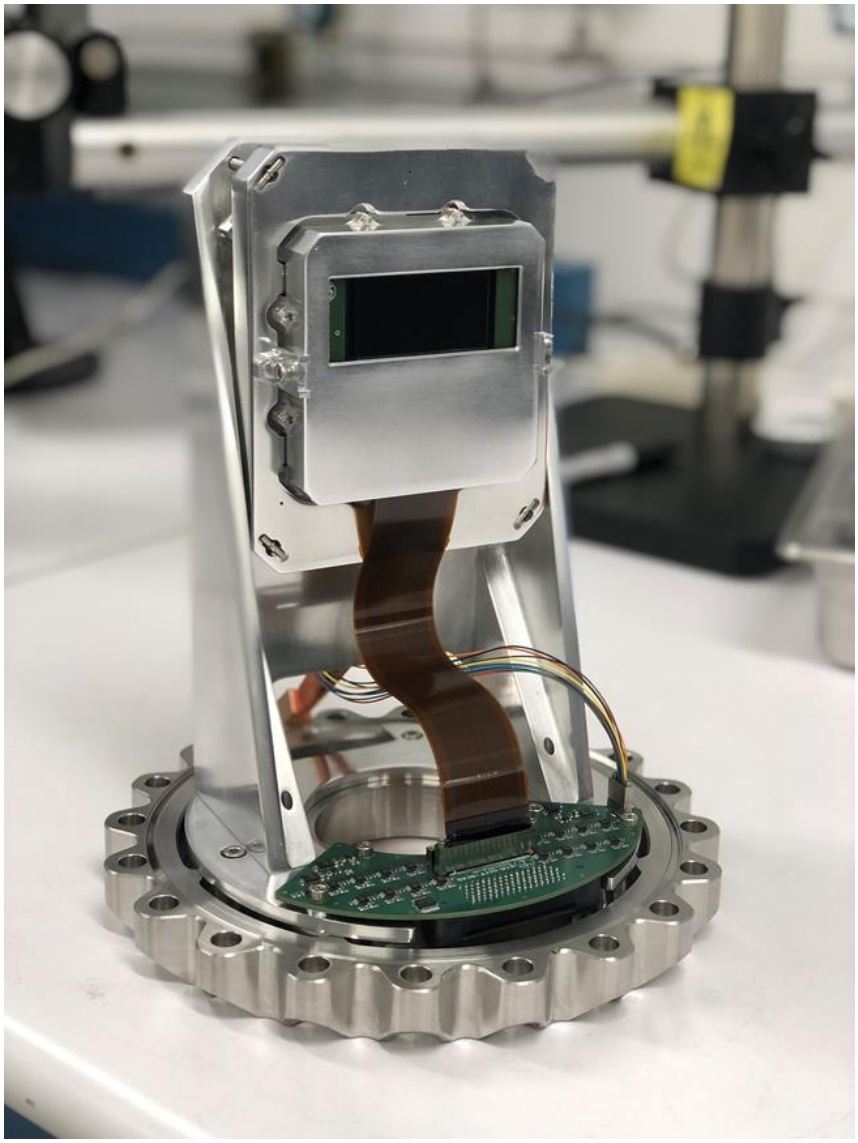
RIXS

STA5200 RIXS CST-1100v03 CAMERA MANUAL



Rev A – August 27, 2021

1241 Puerta Del Sol, San Clemente, CA 92673
(949) 481-1595 – http://www.sta-inc.net – customerservice@sta-inc.net

Table of Contents

Introduction 3

Critical Precautions 5

Software Installation 6

Hardware Installation 6

Archon System Architecture 7

Software Operation 8

- Parameters Tab 9
- CCD Power 10
- Image Tab 10
- RAW/FITS Images 10
- Plot Tabs 10
- HeaterX Tab 10
- VCPU Tab 10

Introduction

The RIXS STA5200 Camera is a high performance imaging system developed by Semiconductor Technology Associates, Inc (STA). The camera is based on a backside illuminated STA5200A CCD and an STA Archon controller. This manual provides a description of the camera hardware and software.

Different views of the camera are shown in the figures below, with the important parts labeled for reference.

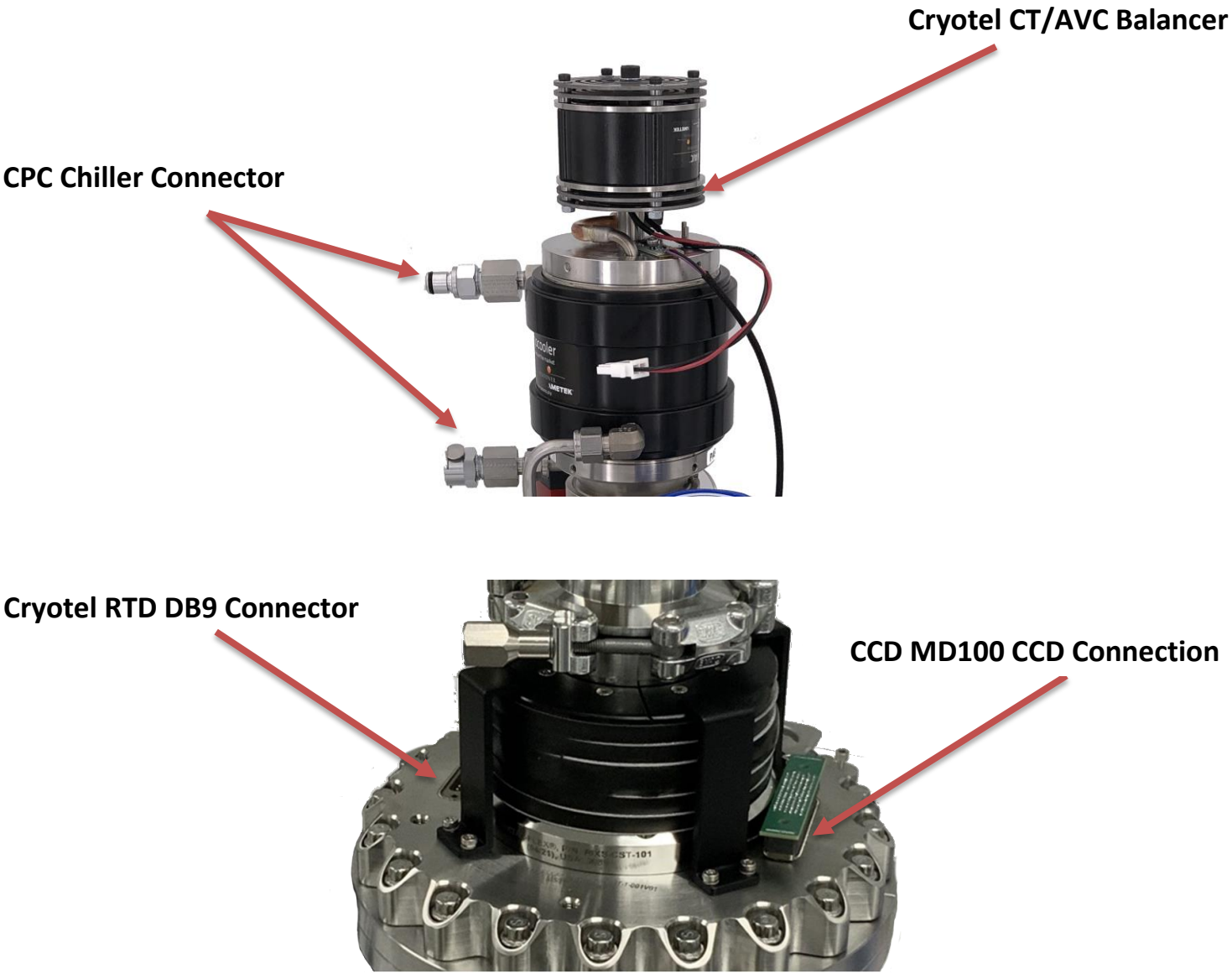


Figure 1: Cryotel and Flange Connections

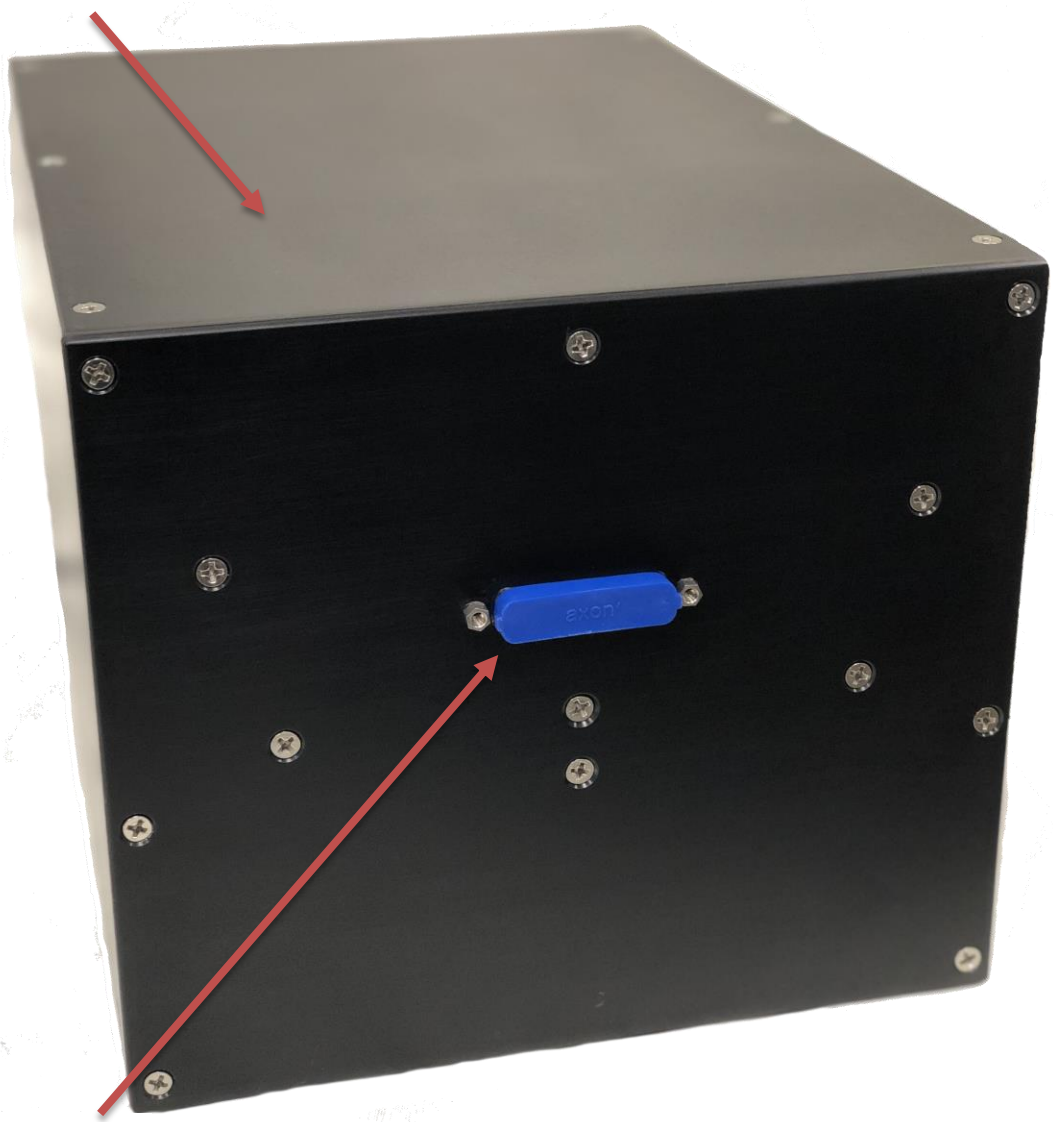


Figure 2: Archon Controller

Figure 3: Cryotel AVC Controller

Critical Precautions

1. Ensure power to the CCD has been turned off in the control program and the Archon power switch has been turned off before attaching or detaching the cables.
   ➔ If power is on when a cable is detached or attached, permanent damage to the CCD or controller can result.
2. Only use an oil-free (dry) vacuum pump for pumping the cryostat.
   ➔ Oil-based pumps can stream oil back into the cryostat, causing CCD contamination.

3. Only open the cryostat vacuum valve when the vacuum pump pressure is lower than the internal cryostat pressure. Close the vacuum valve before turning off the pump.
   ➔ Air flow from the pump into the cryostat can occur if the vacuum pump pressure is not lower than the cryostat pressure. This can cause CCD surface contamination, broken wirebonds (if the pressure differential is large), condensation (if the CCD is cold), and CCD destruction (if the CCD is powered and condensation occurs).
4. Only cool the CCD if the cryostat vacuum is less than about 5E-4Torr.
   ➔ Higher pressures in the cryostat can lead to condensation, which causes surface contamination and possible CCD destruction if the CCD power is on.
5. Turn power to the CCD off and warm the CCD up (change the temperature set-point to +25C in the control program) if the cryostat vacuum pressure rises above 3 mTorr.
   ➔ Higher pressures in the cryostat can lead to condensation, which causes surface contamination and possible CCD destruction if the CCD power is on.

Software Installation

1. Install Qt and Qwt (installation files on DVD).
2. Copy the GUI folder on the DVD into a new folder on host machine.
3. From a Qt prompt, run qmake and then make.
4. Run the resulting archongui executable.
5. Power on the Archon controller.
6. Click the “Connect” button in the top left. The Archon power-up messages should appear in the log window, and the CCD temperature should be updating.
7. Under File, load the correct configuration file.
8. Click the “Apply Configuration”
9. Configure a serial port for RS232 communication to the Cryotel cooling system using the following:

   Baud Rate 9600
   Data Bit 8
   Parity ..... none
   Stop Bits 1
   Flow Control ..... none

Hardware Installation

1. Remove CST-1100v03 from the shipping flange and install on the instrument.
   ➔ Note: Unit under positive pressure with N2 gas. Open valve slowly.
2. Insure transfer takes place in a cleanroom environment.
3. Install the network cable into the host computer, and set the IP address to 10.0.0.1.
4. Connect the network cable from Archon to the host computer.
5. Connect the power cable to the Archon controller.

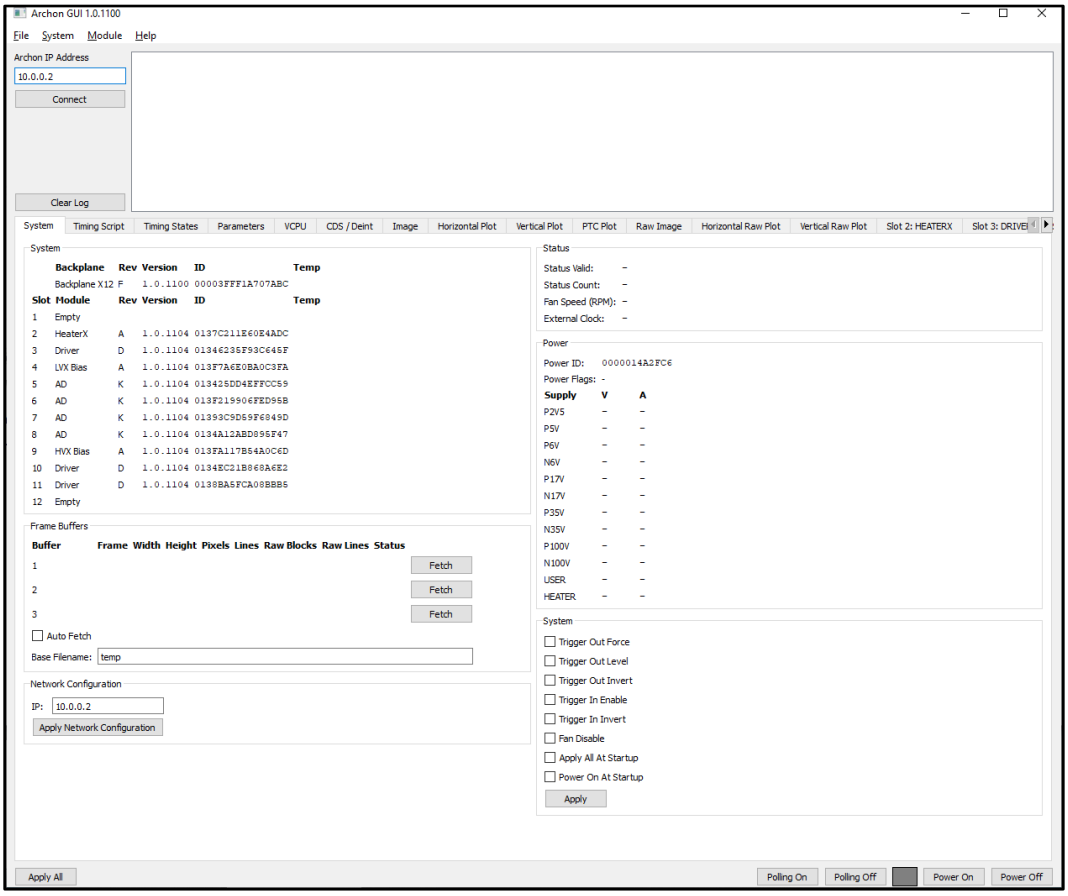
6. Wear **ESD** protection during cable assembly. Connect all signal cables as seen in the previous images, followed by the Temperature/Cryotel cables. Note: MD100 uses a SAE Hex Driver for installation and all others use a standard slotted screwdriver for installation.
7. Power on the Archon controller, connect using the Archon GUI, and apply the configuration file.
8. Attached the chiller to the cryostat and run the chiller at 20C with a flow rate of 15mL/s.
9. When the cryostat pressure is < 0.01 mTorr, turn on cooling via cryotel COOLER=ON command.
   ➔ Note: Cool the device to operating temperature prior to closing the vacuum valve. Refer to the Sunpower AVC System Manual for full list of commands.

Archon System Architecture

The Archon CCD controller consists of a backplane with gigabit network interface, power modules for generating the system power rails, bias modules for CCD biases, driver modules for CCD clocks, and an AD module for digitizing the CCD outputs. All of these modules are configured based on a textual configuration file uploaded to Archon by the GUI. The GUI allows users to load configuration files at startup (the *.acf files), and uploads the appropriate file selected to Archon when the “Apply Configuration” button is clicked.

Software Operation

After starting the ArchonGUI program and turning on Archon power, click the “Connect” button in the top left of the interface.



Select the desired readout speed under open in the file drop down menu, and click “Apply All” and “Power On”. This loads the correct configuration file, writes the settings to the Archon controller, and enables power to the CCD.

Parameters Tab

Continuous Exposure: If “Continuous” is set to one, frames will readout continuously.

Exposure Count: Enter the number of consecutive exposures desired in “Exposures”.

Sweep Count: Set the sweep count to 0 to disable sweeps (clearing all charge from the CCD before an exposure sequence), or to one or greater to set the number of sweeps to execute.

Integration Time: Set the IntMS as desired in milliseconds (integer value). Note that very short exposure times (< 10 ms) will have some uncertainty due to the mechanical shutter motion.

Integration Delay Time: Set the NoIntMS as desired in milliseconds (integer value). This is to provide a delay to allow the mechanical shutter motion to complete closure prior to reading out the detector.

Prescan Pixels: Number of pixels to discard at the beginning of each line. This defaults to 4, the number of prescan pixels physically present in the CCD serial register.

Active Pixels: Number of active pixels per line. This defaults to 1320 for binning 1x1.

Postscan Pixels: Number of pixels to discard after the active pixels.

Overscan Pixels: Number of pixels to store at the end of a line, as a dark reference.

Prescan Lines: Number of lines to discard at the beginning of each frame.

Active Lines: Number of active lines per frame. This defaults to 5280 for binning 1x1.

Postscan Lines: Number of lines to discard after the active lines.

Overscan Lines: Number of lines to store as a dark reference.

Binning Mode: Choose the desired binning. Higher binning modes have lower resolution, but higher readout speeds and sensitivity.

Note that the settings above apply per CCD output. Therefore, selecting 264 active pixels and 1024 active lines per output yields a final image size of 4224x1024, since there are sixteen outputs.

Change Exposures to the desired number of images to be collected. Press the “Apply” button within the parameters tab to begin capturing frames with the entered settings.

CCD Power

Power to the CCD is enabled or disabled using the “Power On” and “Power Off” buttons in the bottom right corner of the GUI. The power indicator will be grey if the system is not connected, red if power is disabled, and green if power is enabled. It’s best to click “Power Off” to do a controlled power off before powering down Archon with its power switch.

Image Tab

Captured images are displayed in the image tab. Moving the cursor over the image displays X, Y, and pixel values in the lower right corner of the GUI. Left click to select the X and Y plot locations (visible under the Horizontal Plot and Vertical Plot tabs). Right click and drag to draw a signal statistics box, and middle click and drag to draw a noise statistics box. Statistics are displayed at the bottom of the GUI. Zoom in and out with the Zoom buttons. Adjust the image brightness and contrast with the sliders at the bottom of the image tab, and reset to the defaults with the “Reset LUT” button. Save and load raw image data with the “Save Frame” and “Load Frame” buttons.

RAW/FITS Images

Check the “Save FITS” box to have each arriving frame saved to a FITS file. Check the “Save Frame” box to have each arriving frame saved to a 16bit RAW file. Under the System Tab, enter the desired base filename in the box.

Plot Tabs

Left click and drag to zoom on a plot. Middle click to restore the display to the full plot. Right click and drag to pan.

HeaterX Tab

The HeaterX tab contains many detailed information on cryostat temperature. This tab reports feedback on the two RTDs in the cryostat, allows the user to enable/disable the heater power, and also provides I/O control for the vacuum gauge. Temperature sensor assignments are as follows:

Sensor C / Heater A: Detector Temperature

VCPU Tab

Each module with digital I/O lines contains an embedded 100 MHz real time 16-bit CPU, called a VCPU (virtual CPU). The VCPU is programmed by including a simple textual VCPU assembly language program in the Archon configuration. Each module can have a different VCPU program loaded. The Archon controller compiles the program internally, and runs it on the VCPU. Each VCPU instruction executes deterministically in 10 ns.