Mar165 CCD Detector Pool Guide
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Quick Start

- Connect data cable from Detector to Computer PCI card
  - Mar165 A and B have orange fiber optic cable
  - Mar165 C has a black SCSI-like cable.

- Turn on the Detector power supply
  - Use the power strip next to the chiller

- Connect Ethernet to Computer!

- Turn on computer and Login
  - user name: dpuser
  - password: (ask DP Staff)
  - Alternatively, log in with any LDAP account

- Start Software using EPICS Launcher
  - select ‘Mar165’ and click Load
  - Open MARCCD by clicking on Start

*GUI can be started with this desktop icon:
Quick Start - Reboot Detector

- Within marccd, you must Reboot the CCD controller & start cooling:
  - Locate the menu bar
  - Click on ‘Configure’ → ‘Detector’
  - Select ‘Reboot’
    (should hear 2 beeps from the controller)
  - If Pressure < 1.0 Torr, then click ‘Yes’ in cooling dialog box
  - Compressor should start about one minute after you say ‘Yes’
  - NOTE: cool down to -70C will require approximately 2hrs
Quick Start - Enable Remote Mode

- Before the EPICS IOC can function, the detector software must be placed in Remote Mode
  - Locate the marccd menu bar
  - Click on Acquire → Remote Control
  - Click on “Start” in dialog box

Now you can start the EPICS software from the launcher:
- start IOC
- start MEDM

To view images in real time:
- start ImageJ
Important Notes

- **Take a Background image, first and frequently!**
  - If your file size is only 4096 bytes, then you probably did not take your first background, which marccd stores in the controller memory.

- **ImageJ**
  - To change contrast, use the shortcut **Ctrl-Shift-c**
  - To generate a line profile, use the ‘line’ drawing tool from the toolbar, then type **Ctrl-k**
  - To get statistics on the full image or a box, type **Ctrl-m**
  - For additional information, see [http://rsbweb.nih.gov/ij/](http://rsbweb.nih.gov/ij/)

- **Format**
  - 2048 × 2048 array
  - Images are saved in the .tif format
  - Each pixel is binned 2x2 to a size of 80 × 80 µm²
    (resolution is limited by the scintillator and fiber-optic taper so there is no 1x1 option)
  - Each pixel has a depth of 16-bits
Common Problems/Solutions:

Advanced Photon Source, Argonne National Laboratory
Common Problems/Solutions:

- **Plugins**
  - Under ‘All’, make sure that ‘Image1’ is enabled

- **Readout**
  - Check that binning is 2x2

- **Collect**
  - Check that ‘Array Callbacks’ is enabled

- **File**
  - Check that the current ‘File Path’ exists
  - Check that the ‘Filename format’ is correct

- **ImageJ**
  - Click the ‘Start’ button to activate the EPICS AD Viewer Plugin
  - Check that the PVprefix matches the MEDM screen
    - If you edit this text, you need to type ‘Enter’ to reconnect with the new PV
    - The box will appear green when connected (red if the PV is unreachable)
    - If the box is white, you need to click on it, and type ‘Enter’
  - You can close the plugin and restart it from the ‘Plugins’ menu of ImageJ
Remote access to the MarCCD computer

You have 2 different options:

(1) ssh login
   • You will need the IP address of the computer
     – Open a terminal, run command: /sbin/ifconfig
   • On the remote computer:
     – open a new terminal
     – Run the command: ssh –Y det@[IP address]
       (For example: ssh –Y det@164.54.101.69)
     – The password is the same you logged in with locally!
     – Run the command: ~/start_gui
   ▪ If that fails, try: /local/DPbin/wxDPStartup/start_gui

(2) run MEDM and ImageJ remotely
   • You will need the correct EPICS PV prefix (eg. dp_mar165_xrd78)
   • You will need access to the APSshare network disk from the remote computer:
     – You can mount it from your sectors local dserver
       (eg. At sector 2, look for s2dserv.xray.aps.anl.gov:/export/APSshare)
     – Within /APSshare/DetectorPool you will find the appropriate startup scripts
     – e.g., /APSshare/DetectorPool/start_medm_mar165 dp_mar165_xrd78
   • NOTE: marccd and the IOC cannot be remotely started or stopped using this method.
Storing Data:

- It is strongly recommended that you write your data to network mounted disk space. Locally mounted /disk2 is a large HDD that can be used for storing your images, however, DP computers see a lot of heavy use. We cannot guarantee that you will not have a disk failure.

- Network disk space is a more stable option. The transfer of images over the network is fast enough to keep pace with the fastest detector frame rates.

- Other disk resources may be available at your sector (consult beamline staff), and users are always welcome to mount their own media (large flash drives, USB-HDD, etc).

NOTE: If you do choose to save data locally, please copy (and delete) files before returning our equipment so that disk space is available for the next user.
# Tech Specs

<table>
<thead>
<tr>
<th>Technical Specifications</th>
<th>CCD165</th>
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<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Single CCD; single fiber-optic taper</td>
</tr>
<tr>
<td><strong>X-ray Sensitive Surface</strong></td>
<td>Round, 165mm diameter (21,380mm²)</td>
</tr>
<tr>
<td><strong>DQE (Detective Quantum Efficiency)</strong></td>
<td>Up to 0.8 for 8keV to 12keV radiation</td>
</tr>
<tr>
<td><strong>PSF (Point Spread Function)</strong></td>
<td>FWHM = 100µm; FW 1%M = 300µm</td>
</tr>
<tr>
<td><strong>Gain</strong></td>
<td>6e⁻/12keV photon</td>
</tr>
<tr>
<td><strong>Read Noise</strong></td>
<td>9 e⁻/pixel @ 3.5 sec. readout; 13 e⁻/pixel @ 2.5 sec. readout</td>
</tr>
<tr>
<td><strong>Dark Current</strong></td>
<td>&lt;0.01 e⁻/pixel/sec. @ 2048 × 2048 pixels</td>
</tr>
<tr>
<td><strong>Full Well Capacity</strong></td>
<td>400,000 e⁻/pixel = 65,000 12keV photons/pixel @ 2048 × 2048 pixels</td>
</tr>
<tr>
<td><strong>Dynamic Range</strong></td>
<td>16 bits</td>
</tr>
<tr>
<td><strong>Fiber-optic Taper</strong></td>
<td>2.7:1 demagnification ratio</td>
</tr>
<tr>
<td><strong>CCD Chip</strong></td>
<td>61mm × 61mm; 4096 × 4096 15µm pixels</td>
</tr>
<tr>
<td><strong>CCD Operating Temperature</strong></td>
<td>−70° C</td>
</tr>
<tr>
<td><strong>Cooling</strong></td>
<td>Closed-cycle refrigeration</td>
</tr>
<tr>
<td><strong>Readout Electronics</strong></td>
<td>4-channel readout; 16-bit ADCs</td>
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**Readout Options (Software Selectable):**

<table>
<thead>
<tr>
<th>On-chip Binning</th>
<th>Pixel Size</th>
<th>Readout Time</th>
<th>Number of Pixels in Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 × 2</td>
<td>80µm</td>
<td>2.5 sec.</td>
<td>2048 × 2048</td>
</tr>
<tr>
<td>4 × 4</td>
<td>160µm</td>
<td>1.0 sec.</td>
<td>1024 × 1024</td>
</tr>
<tr>
<td>8 × 8</td>
<td>320µm</td>
<td>0.5 sec.</td>
<td>512 × 512</td>
</tr>
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**Computer Interface**

Proprietary PCI full-frame DMA; single fiber-optic cable

**Physical Dimensions:**

- **Detector Head**: 21.5cm diameter × 34cm; weight: approx. 20kg
- **Electronics/Cooling Assembly**: 72cm × 43cm × 64cm; weight: approx. 60kg