Running Data Acquisition*

Stephen A. Wood, Marko Zeier

September 29, 1998

Abstract

We describe here what crates needs to be turned on to activate all detectors and acquire data from the HMS and the neutron detectors. The minimal software commands required to start data taking and to manage what disk the data is written to are also detailed.

This document does not contain information on Moller polarimeter data acquisition.

1 Introduction

Acquiring coincidence data in Hall C involves the use of 7 computers running CODA on unix type operating systems. In addition, the control of the High Voltage for the Wire Chambers and Phototubes, involves another 3 computers running the EPICS control system. With the exception of the Sun system (cdaqs1) used to record data, and the HP-UX system (cdaqh1) used to interface to the High Voltage control systems, these computers normally will automatically boot into the proper state when powered up.

2 What needs to be turned on

In order to acquire data from both the HMS and neutron counters, Fastbus, VME, NIM, CAEN HV, LeCroy HV and other voltage supplies must be turned on in several locations:

1. HMS detector Hut.
   - 5 Mod. Sy403 64 Channel High Voltage System crates supply high voltage to the phototubes and drift chambers. They are located in the short racks under the the lead glass shower counter. The Main power must be on and the HV Enable switch in the up position. The HV ON light will only light if at least one channel is on. Instructions for using the EPICS control system for turning the channels on are given below.

*/home/cdaq/documents/data_acquisition/running_daq_gen.tex

- Acopian power supplies supply ± 5 volts to the drift chamber disriminator cards. They are located in the short racks under the lead glass shower counter. All of these power supplies must be switched on.
- Tall Electronics rack. Everything in this rack must be power on. This rack contains.
  - Fastbus crate containing Lecroy 1877 multi-hit TDC's for the drift chambers. After powering up, the RESET button should be pressed on the VME CPU module to reboot this computer. The VME CPU is located inside the SFI (Struck Fastbus Interface) which is a several slot wide module. This module, with it's CPU, functions as the CODA Read Out Controller (ROC) 2 and has the internet address `sfihms`.
  - Dual backplane VME crate (only one backplane in use). The CPU, `vmec1`, an MV167, is the EPICS controller for the CAEN High Voltage System. It communicates with the HV crates using CAENnet. Its reset button should be pressed after the crate is powered up.
  - Both of these CPU's may be reset from the Counting House in rack CH03B10 (just to the right of the two racks containing the Sun/HP workstations and disks.)

2. Gen Neutron Detectors in Hall

- 2 LeCroy HV mainframes. Located in a rack downstream of the neutron detector shield house. These need to be turned on.
- Vme Crate. Located in same rack as the LeCroy HV mainframes. Contains `vmec14`, a MV162, the EPICS controller for the LeCroy High Voltage system. The reset button should be pressed after the crate is powered up. The CPU may also be reset from the counting house in rack CH03B10.

3. Hall C Counting House.

- Electronics Racks along wall with outside door. The electronics in these racks provide the trigger. Everything in these racks should be turned on. [Reference a layout of this rack]
  - Fastbus crate for HMS - `sfich1` (ROC 1) - rack CH03B07
  - Fastbus crate for GeN counters - `sfich2` (ROC 3) - rack CH03B05
  - Trigger supervisor/scalers VME crate (ROC 20) - rack CH03B06
  - Scalers VME crate (ROC 5)- rack CH03B04
- Electronics racks to the right of the main trigger racks. The following items must be powered.
  - Dual backplane VME crate located at bottom of left rack. (CH03B13) The left CPU, `vmec8`, an MV162, provides scalers that are used to read helicity

dependent scalers. `vmec8` is also used in the Moller polarimeter data acquisition system. The right hand backplane (which may or may not have a CPU) is not used at the present time. The reset buttons on the left CPU should be pressed after the crate is power up.

  - Other electronics used for raster magnet control and Raster/BPM event by event readout.

- Electronics racks to the left of the main trigger racks.
  - Leader variable power supplies supply a threshold voltage to the HMS drift chambers. They are located in the counting house in rack CH03B??. The recommended voltage is ???.
  - Reset Panel.
- Gen electronics racks. All crates should be turned on.
- Laser. Located in room above the cable shaft. (Near the refridgerator). Consult an expert.

3 Starting up Control Systems

The detector High Voltages are set from the X terminal (hallcxt13) just to the right of the center of the main control console. This X terminal should normally be logged on to `cdaqh1` with the `cvxwrks` account.

After logging on, HV control screens for the HMS and Gen must be started. Click the **left** mouse button anywhere on the screen background and select the "HMS HV" menu item and repeat for the "Gen HV" item. The control screens will take several seconds to start up. (If a screen fails to appear after 2 minutes, reboot `vmec1` for HMS or `vmec14` for Gen, wait 5 minutes and try starting the screen again. See the section on rebooting below.)

The operation of the HMS HV screen is menu driven and mostly self explanatory. To turn on the high voltage, the "group" menu must be used to pull up a control screen for each detector subsystem. A global ON option exists for each "group". (There is no ON button that turns on all the high voltage for the whole spectrometer) Turning on the high voltage will set the voltage last stored in the Caen High Voltage main frames. If these voltages are incorrect, they can be set with the group screens, or the restore menu item on the main screen may be used to retrieve a previous set of high voltage settings. If permanent changes are made to the high voltages, these new settings should be saved with the "Backup" menu item. Note: Backup and restore operations take an extremely long time (several minutes).

The Gen HV screen is of a different design from the HMS. More information can be found in the document `/home/cdaq/documents/slow_controls/gen_hv.txt`.

4 Reconfiguring the High Voltage system

From time to time, dead channels or High Voltage mainframes may necessitate the rewiring of the HV cables. In this case, the EPICS system for the appropriate spectrometer must be rebuilt. Consult with someone familier with this task. There is a document at

/home/cdaq/documents/slow_controls/hvcntl.text

that gives some more information about the CAEN HV Voltage system, but it should be used with caution as it has not been recently updated.

5 Setting Up Data Acquisition (Coda2.1)

For a short description of setting up and running data acquisition, also see the document at /home/cdaq/documents/data_acquisition/quickdaq_coda2.tex.

Data acquistion is run from cdaqs1. This machine has a fast ethernet network interfaces for high speed data acquisition from the Fastbus and VME front ends and a farm of high speed/capacity disk drives for data storage.

cdaqs1 is the 20 inch screen just to the left of the center of the main control console. This machine should be logged on with the username cdaq and a password that is known to the shift leaders.

First thing to do is to start up the CODA MASTER which allows to control and check coda processes and frontends. Use the middle mouse button on the background window and click on CODA MASTER. If this does not work, start up an "xterm" (left mouse button on background window!) and type in the command:

```
~/gen/tcl/codamaster.tcl
```

To enable buttons you have to choose Enable buttons in the Config menu of the CODA MASTER.

If starting up for the first time for a running period, the following things should be checked.

- Are all ROC's on-line. The following ROC's need to be working: sfich1, sfich2, sfihms, vmec3, vmec5, vmec8. Click the Get Status button in the CODA MASTER to obtain the status of the ROCs. They should either be "booted", "configured" or "downloaded". See section 8 (Trouble Shooting Procedures) if there is a problem.

- Is a disk drive with free space properly selected to receive data? Startup the diskwatch program with the menu selected by clicking the **middle** mouse on the background of the screen. There are four 18GB data partitions available for saving data. Make sure one with some free space is selected. See section 7 for details.

- Is the CPU free of any errant coda tasks? Do ps -ef | grep coda_ and kill any processes with the name coda_er, coda_eb and rcServer. The easiest way to get rid of all the coda processes is to push the KILL ALL button in the CODA MASTER

To start up CODA, several processes have to be started using the following steps:

- Push $\boxed{\textbf{Message Logger}}$ in the `CODA MASTER`. (If the message logger does not startup, start it from an xterm with `cmlog`.) In the window that pops up, click the $\boxed{\text{File}}$ menu and select $\boxed{\text{Connect}}$. In the menu $\boxed{\text{Options}}$ select $\boxed{\text{Update}}$. Hit <return> to ignore the dialog box that pops up.

- Push $\boxed{\textbf{Run Control}}$ in the `CODA MASTER` to start up the Run Control GUI. (If the window does not startup, start it from an xterm with `runcontrol`.) Run Control starts up the rcServer automatically in the background. There is still a window with rcServer messages in it, but it starts up iconized. Click $\boxed{\text{Connect}}$ to connect the GUI to the rcServer. An error message may pop up. It can be ignored.

- Push $\boxed{\textbf{Event Builder}}$ in the `CODA MASTER`. (If the event builder does not startup, start it from an xterm window with
  `coda_eb -i -s gen -n EB1 -t CDEB`.)

- Push $\boxed{\textbf{Event Recorder}}$ in the `CODA MASTER`. (If the event recorder does not start up, start rom an xterm window with
  `coda_er -i -s gen -n ER1 -t ER`.)

Once everything is running, click the $\boxed{\text{Configure}}$ button and select a run type. The standard run types available are

- `main21` (for regular DAQ with beam)
- `cosmics21` (for cosmic ray tests)
- `moller` (for beam polarization measurement).

Once configured, click on the $\boxed{\text{Download}}$ button. If after several seconds, a button labled $\boxed{\text{Prestart}}$ appears, then the system is ready to take data. Otherwise, look at the "Message Logger" window and consult an expert if necessary.

6 Taking data

Edit the file `/home/cdaq/gen/coda2/gen.flags` (`moller.flags` for moller running) to set/change flags. The keywords have to be on one line with no spaces inbetween. Don't forget to save the file. The values are downloaded at $\boxed{\text{Prestart}}$. The following keywords can be specified:
`sparse`: Turns on sparsification
`buf`: Turn on buffered mode
nped=: Number of pedestals to be taken at beginning of run
Trigger prescale factors:
`ps1=`: e Single
`ps2=`: B single (This trigger is currently not enabled)
`ps3=`: eB Coinc
`ps4=`: eB$\bar{P}$ Coinc

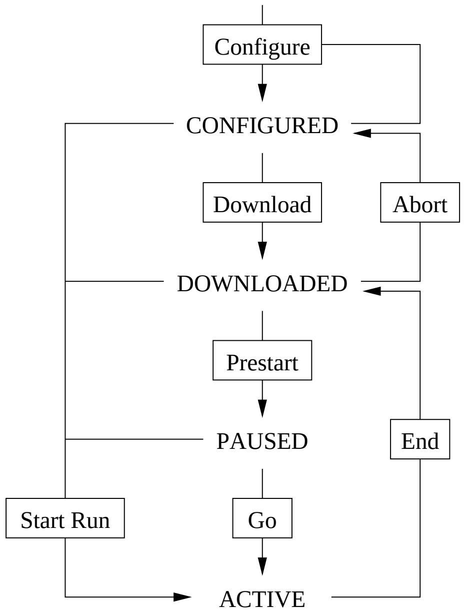

Figure 1: This figure shows the DAQ states and transitions which can be executed by pressing the appropriate buttons in the `Run Control` GUI

`ps6=`: Scaler (should be 1)
`ps7=`: Laser (ususally 1)
`ps8=`: Cosmics (has only an effect during `cosmics21` running, for `main21` this trigger input is disabled)

To start a data taking run, click the **Prestart** button. After a few seconds a **Go** button should appear. Click this button.

After **Go** is pressed, a "Run Info" form will pop up. This form should be updated to reflect the running conditions of the run about to be started. The form is filled with default values, but may be overwritten with the values from the last run by clicking on the **Last Run** button. The current values may also be save as default values if several runs with similar conditions are expected. When the **OK** button is clicked, the values held in the form will be written to the data file and the run will be started.

Please write sensible comments in the "Comments" field. The first line of the comments will appear in the title of the electronic log book entry made for the run, so it should be reasonable descriptive.

To modify the layout of this form, edit the file `~/rct20h1/runparms.default`, consulting an expert if necessary.

To pause/resume a run, use the **Pause**/**Go** buttons on the pause GUI. **The pause GUI may not yet be implimented. When it is available, it appear on the root window pop-up menu.**

A run will end if either you click the End button or the event limit or the data limit (whichever first) will be reached. Event and data limit can be specified in the `Run Control` GUI. Enter a number in the particular fields and hit <return>. UNIX files can't be larger than 2GB. An attempt to write a data file larger than 2 GB will result in a crash of the Event recorder and should be avoided. Don't set the data limit higher than 1.88GB. This takes overhead into account.

7 What to do when disk space runs out

`cdaqs1` has 4 disk partitions of 18 GB each. The usage of disk space can be monitored with the "diskwatch" screen which is started from the pop-up menu (middle mouse button on background window).

This windows shows the amount of disk space free on the current disk. If the free space is 1% or less, the [Change Disk] button should be pressed. "diskwatch" will then display an empty disk which should be confirmed with the "OK" button.

The data on these partitions is backed up to the mass storage silo automatically. Data is deleted from the Hall C data disks manually. Steve Wood will normally take care of deleting data from the disks, but users may delete data that has been backed up to the silo with the following procedure.

Type

```
partition_check N
```

where N is the number of next partition that you want to use for data taking. (For example, if data is currently being written to `/cdaqs1/data4`, the next partition to be used will be `/cdaqs1/data1` and thus the command `partition_check 1` should be issued.

If there are data files on the disk and it is safe to delete them, a prompt will appear asking all the files on the partition should be deleted. It is safe to type yes. At this point all the data files on that partition will be deleted so anyone trying to replay those runs will need to request them from the silo.

If `partition_check` does not give the option to delete the files, and no data has been written to the partition for more than 12 hours, please contact Steve Wood.

To check that the automatic backup is working, do `ls $STAGE` from time to time to see if it contains recent runs. The STAGE directory is where runs get queued up to be written to tape.

8 Trouble Shooting Procedures

When coda crashes usually one of the ROCs or one of the processes got sick and has to be restarted. The error messages are not always clear. It is recommended to try to execute the desired transition again before you start rebooting frontends. Often just the connection to the database got lost, which can be easily recovered (see below). If a transition gets stuck because a component failed, it usually takes some time until `Run Control` reports back that e.g. *Download failed.* You can try to stop a transition with the [Cancel] button in the `Run Control` GUI. After transition failure and after reboots you should always click the

Reset button in the `Run Control` GUI and configure the run type again, before you start downloading again.

- **The connection to the database got lost.**
  Occurs usually during “download” or “prestart”. Typical error message: *Failed to connect to msqld on cdaqs1*
  Click Reset in the Run Control GUI and then exit the `Run Control` GUI and restart it again. Press the Connect button and procede with Configure and Download.

- **Power Outage in the Hall/ sfihms problem** If Hall C looses power, sfihms (ROC2) (down in the HMS hut) usually looses its memory and has to be reprogrammed. Detailled description is found in section 8.3.

- **A ROC died**
  Reboot the particular CPU: See section 8.1 for information on rebooting ROCs.

- **EB or ER died**
  Kill EB **and** ER with *Ctrl-C* and restart. To check if they are alive go to the particular window and hit a few times <return>. The prompts *gen::ER1>* and *gen::EB1>* should appear. You can also use the Get Status in the `CODA MASTER` to check the status.

- **Download Failure** A possible reason for a fail during download is the following: Due to repeated downloads the memory of the CPUs gets fragmentated and in particular for the older boards with smaller memory it can happen that the allocation of the event buffers fails. If logged into the CPU one would see a message of the type:
  daLogMsg: partIncr: Cannot malloc a single memory Block for data bufs ...
  In this case one has to do a hardware reboot of the CPU. Try to Cancel and Reset the transition and proceed with Configure after the CPU is rebooted.

- **Prestart Failure** If Prestart fails some of the components might already have prestarted, i.e. they are in the *paused* state. If after eventual reboot, Cancel and Reset, i.e. before you try to Configure again, some of the components (including EB and ER) should still be in *paused* state, you have to reset them by clicking Exit in the `CODA MASTER` for the particular component. After the status of all componenets is either *booted*, *configured* or *downloaded* you can proceed with Configure.

- **End Failure** Similarly to the Prestart Failure a fail during End can leave components in a state *ending*. Exit the ROCs as described for Prestart Failure. Most End Failures make the Event Builder and/or Event Recorder unhappy. It’s always a good idea to kill and restart these two processes after an End Failure.

- **DD system** The DD system is the memory where the Event Builder writes to and the Event Recorder reads from. After a crash it is always a good idea to clean the DD system from possible contamination. In an “xterm” type the command `dd_cleanup`.

- **No trigger rate at beginning of run or trigger rate goes to 0 during run**
  First thing to do is to check the state of the Trigger Supervisor: Click $\boxed{\text{CHECK}}$ in the `CODA MASTER` and then $\boxed{\text{State}}$ in the window that pops up. This displays the current state of the TS. If `TS Go` and `TS TRIGGER` are enabled and `TS Busy` is 0 then the DAQ is waiting for triggers. The two most popular reasons for the absence of triggers are: HMS HV down (check the HMS HV display) and prescale factors set too high (Check the flag file: `~/gen/coda2/gen.flags`). Less likely is a hardware failure of one of the components in the electronics (e.g. the 8LM). In any case this is not a DAQ problem. A `TS Busy` equal to 1 indicates that the TS is not accepting triggers anymore which is a DAQ problem.
  The easiest thing to do in this case is to kill all processes (Use the $\boxed{\text{KILL ALL}}$ button in the `CODA MASTER`) and reboot all ROCs (hardware reboot recommended, see section 8.1). However people experienced problems with this radical strategy. The advanced idiot might try to recover the system in a more controlled way as described in the following.

  If the Trigger Supervisor (TS) does not accept triggers anymore, this can have two reasons:
  1. The buffers of the ROCs are full and are not flushed by the Event Builder. This indicates an EB or ER problem. The ROCs are most likely still ok.
  2. One of the ROCs died and the TS doesn't receive the Acknowledge from this ROC anymore.
  To see which of the two cases has occured use again the "ROC and Trigger Supervisor Checkout" window (if not up, click $\boxed{\text{CHECK}}$ in the `CODA MASTER`). Check the Buffer Status of all ROCs by clicking the approriate button. A listing of the allocated memory appears. In the third line (column 2 to 4) the number of total (allocated), free and busy (used) buffers in the event pool is displayed. If in one of the ROCs the number of free buffers should be 0, then it's most likely an EB or ER problem.
  If this is not the case, it is most likely one of the ROCs which has a problem. If you hit the button $\boxed{\text{State}}$ to get the TS state the Branch Status is displayed and at least on one branch the `Strobe` and `ACK` should be one, indicating that the sick ROC is on this branch. Unfortunately the TS does not provide the information which ROC it is. Use the $\boxed{\text{Get Status}}$ button in the `CODA MASTER` or login to the ROCs as described in section 8.2 to find out which ROCs have a problem.

  In any case you can still try to $\boxed{\text{End}}$ the run, which most probably will not work properly. You might have to kill Run Control and start it up again. Even if you use the $\boxed{\text{KILL ALL}}$ button in the `CODA MASTER` (which is probably the appropriate thing to do in this case) you might still have the problem that some of the ROCs will stay in the state *active*). In this case you have to exit them with the $\boxed{\text{Exit}}$ buttons in the `CODA MASTER`. If all the componenets are in the state *booted*, *configured* or *downloaded* you can proceed with $\boxed{\text{Configure}}$ and $\boxed{\text{Download}}$

- **Something that is alive is not necessarily not sick.** If it is not clear if all the coda components are working or not, or if you get confused about which components need to be restarted, all the components on the Sun can be killed with the KILL ALL button in `CODA MASTER` which is equivalent to executing the command:

  `~/gen/coda2/scripts/coda_cleanup`

8.1 Rebooting crashed/corrupt CODA Readout Controllers

A software reboot can be done with the Reboot buttons in the `CODA MASTER`. This does not always work. Sometimes it's necessary to do a hardware reboot. In very rare cases it is necessary to power cycle the crates. Hardware reboot of all the readout controllers can be done from the counting house. The CPU's located in the counting house are rebooted by pressing the RESET button on their front panels. CPU's located in the hall can be reset from reboot panels in the counting house. The main reboot panel is located in the rack (CH03B10) to the right of the HP CPU's and disks. It has three 10 position dials labled "HMS", "SOS", and "Pivot". Set the dial to the desired position and press the button next to the dial.

CPU	ROC #	CPU Location	Reboot button location
sfich1	1	Counting House CH03B07	Front Panel
'sfich2	3	Counting House CH03B05	Front Panel
sfihms	2	HMS hut	HMS 9
vmec3	20	Counting House CH03B06	Front Panel
vmec5	5	Counting House CH03B04	Front Panel
vmec8	8	Counting House CH03B13	Front Panel

Table 1: CODA Read Out Controllers reboot button locations

It might take a while for the CPU's to reboot. (The Fastbus CPU's are the slowest) The cmlog window will show a message when a particular ROC has rebooted.

8.2 ROC Login

To see if a ROC is alive you can telnet to the particular CPU. Go to the workspace `ROCs` and press the middle mouse button to select a CPU to connect to (if there is not already a window there). A window will pop up and you will be logged in. The prompt `->` indicates that you are on the vxworks shell. Type `i` and hit <return> to get a listing of the running tasks. The last item of this list should have the Name *ROC* and the Status *Ready* or *Pend*. If it does not exist or its status is *Suspended*, you have to reboot the CPU.
You can change to the ROC shell by typing `exit` and hitting <return> twice. A ROC specific prompt should appear, e.g. `gen::ROC1>` for sfich1. If this prompt does not appear

the ROC is sick and the CPU has to be rebooted most likely. With `ctrl-c` you can switch back to the vxworks shell. On the ROC shell a set of commands is available. As an example you can get the status of ROC1 by typing `ROC1 status`. This is identical to clicking the button Get Status in the `CODA MASTER` but more reliable. Be careful when you are logged into the CPU. Misstyped commands can hang up everything. To logout use `ctrl-]`. At the telnet prompt type `q`. Generally it's a good idea to keep a window for each ROC open all the times. In case of problems the displayed messages might be helpful.

8.3 Reprogramming sfihms

If HALL C looses power ROC 2 might have lost its memory. Already a short power glitch could cause this. A symptom is that the CPU doesn't reboot anymore. Reloading the memory can be done from upstairs with the following procedure:

Use an "xterm" to login to the terminal server with `telnet LATSRV`. Username is `cdaq` and Password is `cntrlme`. Access then the CPU with `set host/lat hcc2`. Password is `vx4daq`. Hit `<return>` and at the *[VXWorks Boot:]* prompt type `c` to change boot parameters. The following list displayes the correct boot parameters for ROC2:

```
boot device          : dc
processor number     : 0
host name            : cdaqs1
file name            : ~/KERNELS/vx2306_DECFD
inet on ethernet (e) : 129.57.168.183:fffffc00
inet on backplane (b):
host inet (h)        : 129.57.168.15
gateway inet (g)     :
user (u)             : cdaq
ftp password (pw) (blank = use rsh):
flags (f)            : 0x20
target name (tn)     : sfihms
startup script (s)   : ~/gen/coda2/boot/sfihms.boot
other (o)            :
```

The parameters are listed one by one. Each time you hit return the next one is listed until you are back on the *[VXWorks Boot:]* prompt. For each parameter that is wrong type in the correct one. Don't try to delete wrong parameters just type from there where the cursor is. If you misstype don't try to correct just hit return and when you are finished with the list start again. When you are done, go through the list again and check all entries. Back at the *[VXWorks Boot:]* prompt type `@` which boots the CPU.
Use `ctrl-\` to exit and then `lo` to logout from the terminal server.

9 Rebooting other stuff

There are also a number of CPU's running EPICS. If controls for High Voltage or Magnets are not functioning, they may need to be rebooted.

Function	CPU	CPU Location	Reboot button location
HMS HV	vmec1	HMS shield hut	HMS 6
HMS Quad controls	vmec2	HMS	HMS 7
Moller controls	vmec10	Near Power Supplies	SOS 3
Moller controls	vmec11	Near Power Supplies	SOS 4
Gen HV	vmec14	Hall C floor	SOS 5
Beam Current	vmec15	Near Power Supplies	CPU in CH03B12

Table 2: EPICSs IOC reboot button locations

10 Experts

The main data acquisition experts are Marco Zeier (Pager 849-5162), Steve Wood (x7367, Pager 849-7367) and Dave Abbott (x7190, Pager 849-7190). For data acquisition and controls related to the Moller polarimeter, contact Beni Zihlman (Pager 849-6016). For other EPICS controls problems, contact Steve Wood.