AMANDA-B

Standard Operating Procedures

Steffen Richter

Abstract

The Standard Operating Procedures for AMANDA-B are intended to be a guideline for summer and winter scientists. The current detector setup and the data acquisition system are described briefly. The operation of the detector is described and common problems and their solutions are outlined.

Contents

List of Figures

Nomenclature

ADC Analog to digital converter

CAMAC originally a palindromic name. Later it acquired the phrase Computer Automated Measurement and Control

CPU Central processing unit

DAQ Data acquisition

IPC Inter Process Resources. Used by UNIX processes to communicate with each other.

LAN Local Area Network

MAPO Martin A. Pomerantz Observatory

SCSI Small Computer Systems Interface

TDC Time to digital converter

VME Versa Module Europa, a flexible open-endedbus system which makes use of the Eurocard standard.

VSB VME subsystem bus, a secondary bus for use with VME

1 Data Acquisition System

With the deployment of three new strings during the 1997/98 summer season, the detector now consists of 428 optical modules on 13 strings. To keep up with this growing number a new data acquisition system (DAQ) had to be installed installed during the summer season 1997/98.

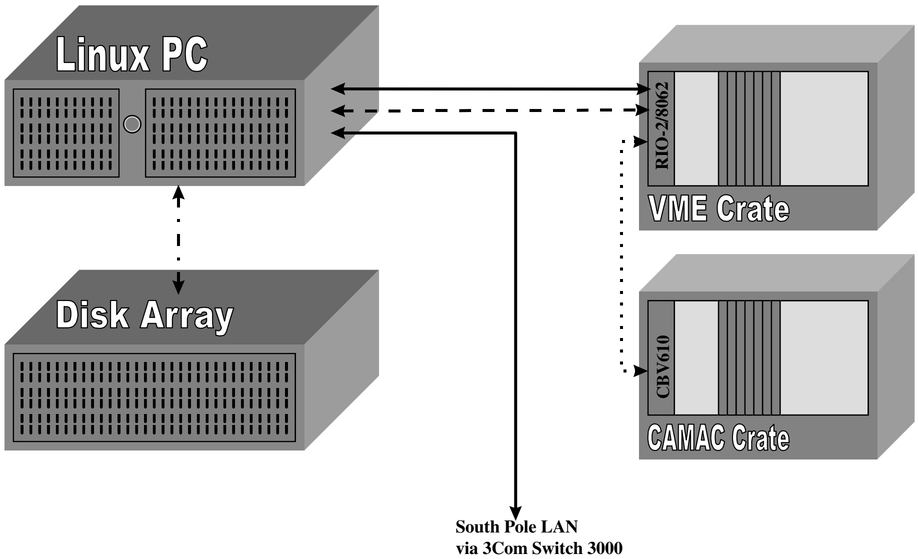

Figure 1: Simplified block scheme of the AMANDA–II DAQ system. Details of the detector electronics and high voltage control system are omitted. Only one CAMAC crate is shown.

Figure 1 shows the principal scheme of the DAQ. Details of the detector electronics end the high voltage control are omitted in this picture for sake of simplicity. Only one of the three CAMAC crates is shown.
The backbone of the new DAQ is the VME CPU Board. It is a RIO–2/8062 board with a PPC604/200 MHz CPU, SCSI, network, and VSB interface. A decision was made to stay with the existing CAMAC TDCs and ADCs, which determine the AMANDA trigger dead time. The CAMAC crates (currently

3) are interfaced to the RIO-2 via a VSB branch. A CBV-610 controller, manufactured by Struck, is used on the CAMAC side.
The VME board is connected to the DAQ PC via a TCP/IP and a serial link. Data collected from the VME and CAMAC modules by a process running on the VME board is transfered to the DAQ PC for on-line analysis and storage using the TCP/IP connection. The serial link is used for booting the board and setting various parameters. It is connected to a serial port of the DAQ PC. This allows convenient remote access by using a terminal program.
The DAQ PC runs a program for on-line analysis and. The PC is connected to the South Pole LAN and allows access to the DAQ from other computers on station and the rest of the world (if satellite coverage permits). The DAQ can be controlled by a Client/Server application.
Figure 2 shows a connectivity graph of the VME crate, the CAMAC crates, the DAQ machines, their peripheral devices as well as all other AMANDA–B related computers in MAPO. The grey shaded machines (pamanda2 and ariadne1 [1]) are spares and are only used for DAQ development in the summer. Pamanda3 is the HV control host. It has a DAT drive and a CD–ROM connected. Besides the off-line machines [2] this tape drive can be used for writing data. Abrafax is quite old but can still be used as an X-server.
Additional LAN drops (10Base2 and 10BaseT) were installed during the winter. They are available at every desk. Summer personnel should not attempt to install new cables. The AMANDA network has had a lot of erroneous connections which caused a lot of trouble on different subnets. The station network administrator (call extension 217) should be consulted before any changes are made The connection of the AMANDA subnet to the South Pole LAN is shown in figure 3. The additional Hub in Back of Science is only necessary because two of the DEC Alphas are unable communicate with the 3Com Switch for unknown reasons.

1.2 DAQ Software

Only a very simplified explanation of the DAQ software can be given here. The gory details should not be of concern to the user who only wants to take

[1] Since the VME CPU is connected to the Linux PC via a private Ethernet, which is only visible from pamanda1 or pamanda2 respectively, both the DAQ machine and the spare can have the same host name.

[2] The off–line computing, including taping, should be covered by the report of the winter-over responsible for off–line computing

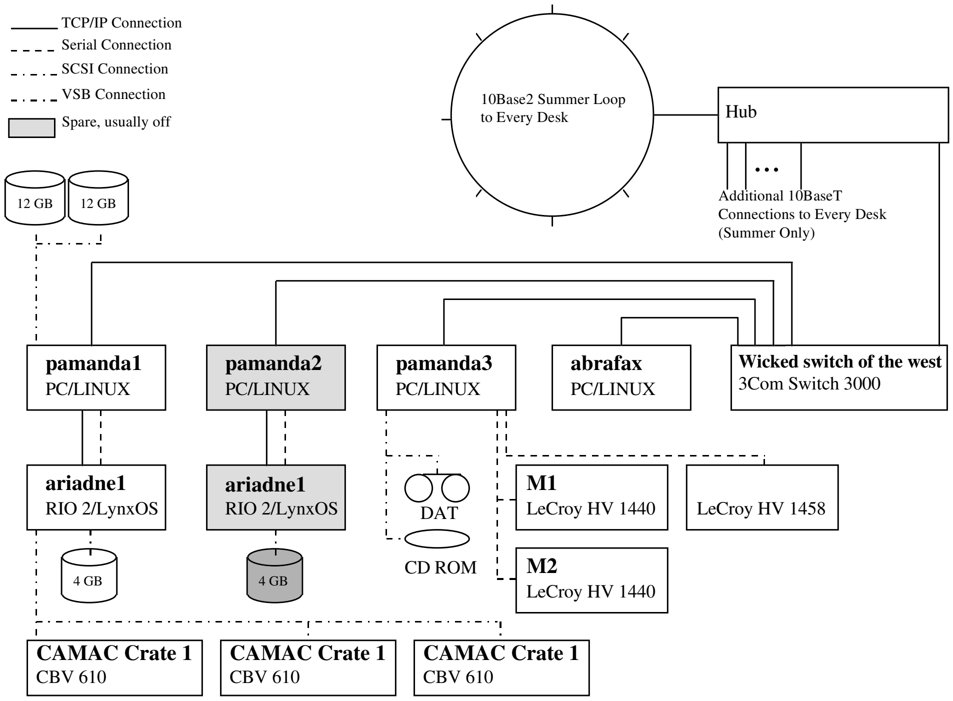

Figure 2: Connectivity chart for all DAQ crates, computers and peripheral devices.

data. The intention is to give a general idea of what all the different processes are doing. Software is running on the PC/Linux and the VME/LynxOS side of the DAQ. The following processes involved:

- **Processes running on the PC/Linux:**
  - **daqcontrol:** Mother of all processes. Daqcontrol starts and stops all other processes on the PC/Linux side of the DAQ. It also communicates with its VME counterpart vmecontrol. This process needs to be running in the background of the DAQ PC. It waits for incoming commands from a DAQ client program.
  - **dispatcher:** Distributes messages between all DAQ processes. The dispatcher also keeps the error and run log and send error

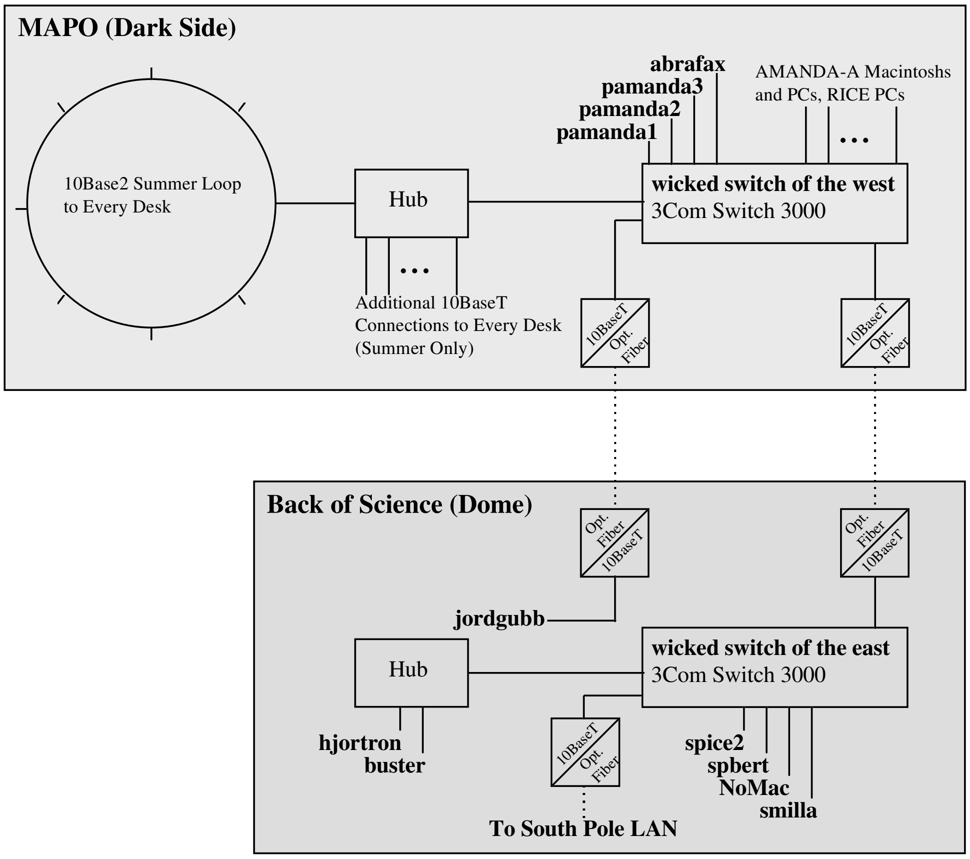

Figure 3: Complete AMANDA subnet

messages via email. The dispatcher is automatically started by daqcontrol.

– **comserver:** Is started by daqcontrol if a DAQ client initiates a connection. It handles all interaction with the client. The comserver shares memory with the dataprocess. The memory holds histograms which can be requested by a client.

– **dataprocess:** Receives the raw data via a TCP/IP connection from datatransport running on the VME side. It unpacks the raw data for on-line analysis and writes the raw data stream to disk. The histograms produced by the on-line analysis are hold in shared memory and can be requested by a client connected to the

DAQ.

- **Processes running on VME/LynxOS:**
  - **vmecontrol:** The VME counterpart of daqcontrol. This program receives commands from daqcontrol and is responsible for starting and stopping all other processes running on the VME side of the DAQ.
  - **datacollector:** This process checks for a trigger and reads out all VME and CAMAC modules when a trigger occurs. The data read from each module is written to one of two raw data buffers. The raw data buffers are in shared memory and can be accessed from both the datacollector and the datatransport. Access to the buffers is controlled via semaphores.
  - **datatransport:** Sends the data in the buffer, which is currently not used by the datacollector, via a TCP/IP connection to the Linux PC. If the whole buffer was sent, the process waits for the other buffer to be filled by the datacollector. When datacollector has filled the buffer, they are simply switched in both processes.

2 Detector Operation

2.1 Starting and Stopping a Run

Is is assumed, that **daqcontrol** is already running on the DAQ PC and **vmecontrol** is running on the RIO–2. If this is not the case go to section 2.3.
The DAQ works as a server/client application with the AMANDA–B operator being on the client side. To start a run:

1. Log into pamanda1, pamanda2, or pamanda3 as user **daq**.
2. Start **moniclient** in the daq home directory. This is the DAQ X–client. A window as shown in figure 4 should appear on the screen.

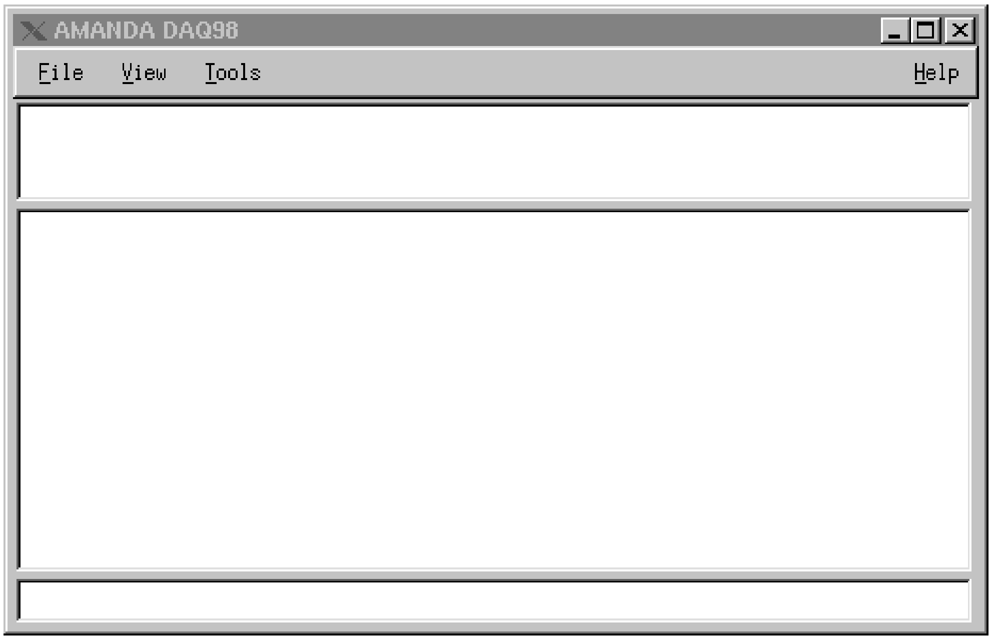

Figure 4: Moniclient window

3. Click **Tools/Run Start** or press **CTRL+ALT+R** alternatively. A login window as shown in figure 5 shows up. Enter **pamanda1** as host and use your login and password on pamanda1. A short welcome message is printed and the run control window pops up (figure 6).

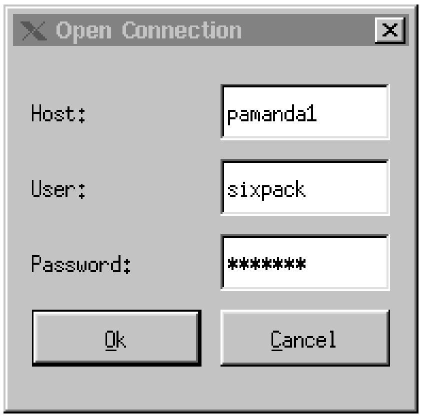

Figure 5: Moniclient login window

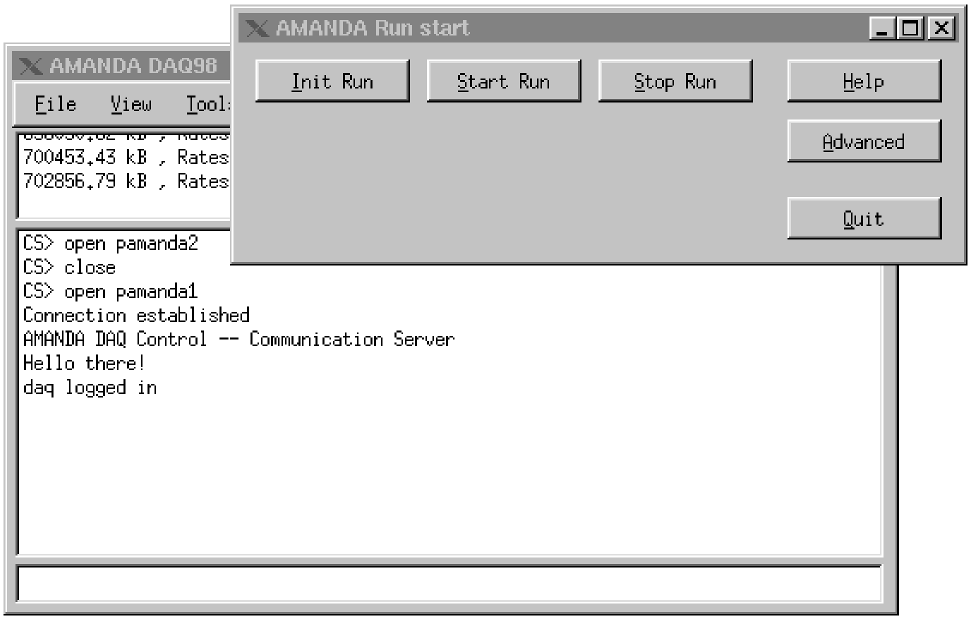

Figure 6: Welcome message and run control window after a successful login

4. Before you start a run, make sure that there is not already one in progress. If data is taken, the current event and data rate is displayed every 20 seconds in the upper part of the moniclient windows. If you

see those messages, you have to stop the current run by pressing the **Stop Run** button before you can start a new one.

To start a run, first press the **Init Run** button. Initialization of the full detector takes about 10 seconds. After a successful initialization the message **Dataprocess initialized** appears in the lower part if the moniclient window. Check the information given in that window. Sections 2.4 and 2.5 explain how to change a run name and other parameters. If the initialization was successful the run can be started by pressing the **Start Run** button and stopped at any time by pressing the **Stop Run** button.

See sections 2.2 and 2.3 if you encounter any problems.

2.2 Killing the DAQ

Normal run operation is quite simple. The DAQ has proven to be very reliable with an up-time of more than 98% last winter. However, calibration and test runs are a bit different. Changing connections during a run can leave a module in an undefined state and cause the DAQ to block. If this should occur, the DAQ has to be killed and restarted from scratch. Several processes and IPC resources are involved in running the DAQ. They have to be cleaned before the DAQ can be restarted. To kill the DAQ:

1. Try to shut down the DAQ the normal way by pressing the **Stop Run** button in the run control window of moniclient (see section 2.1). If this does not work and the moniclient freezes up proceed with step 2.

2. Log into the DAQ PC (**pamanda1**) as user **daq**. Normally the DAQ runs as user daq and you should have permission for all the operations described below. If you get permission denied messages, you should try to find out under what user ID the DAQ is running and log in as this user or login as root if nothing else helps.

3. Change to the directory from where the DAQ is running:

   ```
   /home_local/daq/current_daq
   ```

   If a run with a special version in a different directory is made, cd to that directory.

4. Kill all DAQ processes:

   ```
   daqkill
   ```

   This script kills all running processes, deletes lock files in the /tmp directory and also frees all IPC resources (shared memory and semaphores). Check with:

   ```
   daq_watch
   ```

   It should display the message

   ```
   No DAQ processes found
   ```

   The IPC resources can be checked with:

   ```
   ipcs
   ```

   An empty resource list like this should be displayed:

   ```
   ------ Shared Memory Segments --------
   shmid     owner     perms     bytes     nattch    status

   ------ Semaphore Arrays --------
   semid     owner     perms     nsems     status

   ------ Message Queues --------
   msqid     owner     perms     used-bytes  messages
   ```

5. Open another xterm and telnet to **ariadne1**. This is the VME board. Log in as user **daq**.

6. Change to the directory from where the DAQ is running

   ```
   /home/daq/current_daq).
   ```

   If a run with a special version in a different directory is made, cd to that directory.

7. Look up the running DAQ processes:

   ```
   ps -x
   ```

   Look for processes called **datacollector**, **datatransport**, and **vmecontrol**. Try to kill them the soft way:

   ```
   kill -TERM PID
   ```

   Where **PID** is the process ID of the DAQ process as displayed by the ps command. Kill **vmecontrol** last. Check again with

   ```
   ps -x
   ```

   If DAQ processes are still running they need to be killed the hard way with

   ```
   kill -9 PID
   ```

8. Remove remaining IPC resources with

   ```
   killshm
   ```

   Check the resources with

   ```
   ipcs
   ```

   An empty resource list like this should be displayed:

   ```
   IPC status from /dev/mem as of Wed Nov 11 02:08:14 1998
   T     ID     KEY        MODE       OWNER    GROUP
   Message Queues:
   Shared Memory:
   Semaphores:
   ```

9. Remove look files:

   ```
   rml
   ```

10. Go back to the DAQ PC terminal window

11. The DAQ allocates several ports which need to be freed before the DAQ can be started again. The system needs some time to do that. The ports can be watched with

    ```
    wp
    ```

    One needs to wait until no ports are displayed by the wp command

2.3 Starting the DAQ from Scratch

After the DAQ was killed as described in section 2.2, it has to be started from scratch. If any problems are encounter during the steps described below, the DAQ was not killed completely. In that case all steps described in section 2.2 should be repeated. To start the DAQ:

1. Log into the DAQ PC (**pamanda1**) as user **daq**

2. Change to the directory where the DAQ programs are installed:

   ```
   /home_local/daq/current_daq
   ```

   If a run with a special version is to be made you have to cd to that directory.

3. start **daqcontrol**

   (a) For short calibration runs it is Ok to start **daqcontrol** by just typing:

   ```
   daqcontrol&
   ```

   (b) For longer runs **daqcontrol** should run in the background, so that the user can log out:

   ```
   /usr/bin/nohup daqcontrol&
   ```

   You have to give the full path of nohup. There is a nohup built into the shell and that is not what we want. Since all processes started with nohup automatically run with nice, they have to be reniced. The DAQ should run with at least normal priority.

```
[pamanda1]> su
<enter root password here>
[pamanda1]# ps
[pamanda1]# renice 0 DAQCONTROL_PID DISPATCHER_PID
```

4. Open another xterm and telnet to **ariadne1**. This is the VME board. Log in as user **daq**.

5. Change to the directory where the DAQ programs are installed:

   ```
   /home/daq/current_daq
   ```

   If a run with a special version is to be made, change to that directory.

6. start **vmecontrol**

   (a) For short calibration runs it is Ok to start **vmecontrol** by just typing:

   ```
   vmecontrol&
   ```

   (b) For longer runs **vmecontrol** should run in the background, so that the user can log out:

   ```
   /bin/nohup vmecontrol&
   ```

   You have to give the full path of nohup. There is a nohup built into the shell and that is not what we want.

Now the DAQ is ready and you can proceed as described in section 2.1.

2.4 Run Parameters

Section 2.1 explained how the detector can be operated via a DAQ client from a remote machine. As explained there, the commands issued by pressing the three buttons in the simple operation mode are controlled by simple scripts, so called **AMANDA DAQ Scripts** (*.ads). Upon initialization a couple of parameters can be given to the DAQ. To change them, you need to find out which script is used for the detector initialization. Moniclient looks for a configuration file called **moniclient.cnf** in

1. the local directory where moniclient was started

2. the home directory
3. the **/etc** directory

in that order. Find the one that the Moniclient you are running is using. The script file used for initialization is set with the parameter **InitRunFile**. Open the script file in an editor and look for a the command **DP init**. The following parameters can be given to the command:

−a, −−all Initialize all processes involved. This parameter is mandatory for normal runs and should only be left out for debugging runs.

−A, −−auto−restart The run will be automatically restarted after the run time has eclapsed.

−f, −−f2000=*file* Path of the F2000 output file. This file can be used to by Eview in DAQ remote mode.

−c, −−filecount=*num* In debug mode the amount of data written can be limited. With *num* the number of datafiles is set. The DAQ always keeps the first file and the last $num - 1$ files.

−h, −−histo Do on–line analysis and book histograms.

−n, −−name Set base name of the run (see section 2.5)

−N, −−no−data No data is written to disk

−−no−rundate Run name will not contain the day of year

−−no−runnumber Run name will not contain the run number

−s, −−size=*size* Size of each data file to be written. Use k for KBytes, M for MBytes, G for GBytes (example: **50M** for 50 MBytes).

−−run−comment=[*comment*] Description of the run. This comment is part of the run info header contained in every data file.

−−run−time=[*time*] Duration of the run. Use s for seconds, h for hours, d for days (example: **12h** for 12 hours).

2.5 Changing the Run Name

It is possible to change the name for individual runs. Filenames for AMANDA–B runs consist of several parts. An example for a filename is:

```
ab_234_56_3.data
```

The first part of the filename (**ab**) is given at run start by the operator. This part it referred to as **base name**. This is the only part of the filename that can be changed by a remote operator. The second part of the filename is the current run number (**234**). The number is incremented with every run and can not be set by a remote operator. However, it is possible to preset the number on the DAQ machine. The third part is the current day of the year (**56**). Days are counted starting with day one. A run can consist of several files. The fourth part of the name is the number of the file in a run (**3**). The first data file of a run has number 0. The suffix **.data** can not be changed.

2.5.1 Changing the Base Filename

See section 2.4 to find out how to change run parameters. The parameter –**name** is the base part of the run file name. Change it according to your needs. It has to be one word without any spaces. Make sure the whole **DP init** command is one line.

2.5.2 Viewing on–line histograms

If a run was started with option –**histo** (see section 2.4, on–line histograms can be fetched with the **moniclient**. The following histograms are available:

- Miscellaneous histograms
  - **100** Trigger per optical module (ADC)
  - **200** Trigger per optical module (TDC)
  - **300** Number of hits (ADC)
  - **400** Number of hits (TDC)
  - **500** CAMAC trigger register
  - **600** VME trigger register (not booked yet)
  - **700** GPS time difference between events

  - **1000** Number of OMs in array
  - **1000** + ***NUM*** Number of OMs in string *NUM*
  - **2000** Rate vs time in array

- ADC histograms

  - **100000** + ***ID*** ADC spectrum for channel *ID*

- TDC histograms

  - **200000** + ***ID*** all edges for channel *ID*
  - **250000** + ***ID*** —LE2 – LE1— for channel *ID*
  - **300000** + ***ID*** Time over threshold for channel *ID* (not booked yet)
  - **350000** + ***ID*** Number of edges for channel *ID*

Please note, that this list is subject to change.
To fetch a histogram enter **CS gethisto HISTO_ID** at the moniclient command line at the bottom of the window. The first part of the command, the process identifier **CS** is case sensitive and has to be in upper case. When a histogram is received by the moniclient, PAW is started and the histogram will be ploted from PAW. At the same time a PAW command window is displayed and all PAW commands can be issued in that window.

2.5.3 Changing the Run Number

The run number should not be changed. In case something happens to the detector, we need to find out at what point the change was made. With different base filenames, the run number is the only way to put the data files in an order.
However, the run number can easily be set should it be really necessary. The current run number is kept in file called **runnumber.dat** in the local DAQ directory on the DAQ PC (currently pamanda1.spole.gov). To change it, you have to know in what directory the DAQ was started. This is the directory where the process **daqcontrol** was started. Open the file **runnumber.dat** in an editor and change the number in the first line of this file according to your needs. The DAQ will increment the number in that file by one for the next run. That means you have to set **runnumber.dat** to **0** if you want to start with run number **1**.

2.6 Power Outage

2.6.1 Preventing Damage After a Power Outage

If you are not in MAPO go to section **Remote Shutdown**.
When the power comes back after an outage surges are very common. If you happen to be in MAPO when a power outage occurs try to prevent any damage to the detector electronics by following the steps below:

1. Turn off the high voltage crates:

   - Rack 1, crate 2, LeCroy HV1440, M2. Use the big switch on the front panel.
   - Rack 2, crate 3, LeCroy HV1440, M1. Use the big switch on the front panel.
   - Rack 5, crate 5, LeCroy HV1458. Turn the key on the front panel all the way to the left.

   It is essential that you turn off the high voltage first!

2. Turn off all other crates and devices, except for the VME crate (rack 7, crate 1), the VME Controller hard disk (rack 7, device 3), the DAQ PC (rack 7, device 1), the DAQ disk array (rack 7, device 2), and the HV control PC (pamanda3.spole.gov). These crates and devices are connected to a UPS (rack 7, device 4). Some of the newer CAMAC crates have the power switch at the back (rack 3, crate 1 and crate 2; rack 5, crate 2).

If the power outage lasts more the 10 minutes you need to shut down the computers. Depending on where you are you can either log in from a remote machine or do it locally.

Local Shutdown:

1. Log into your account or the daq account on pamanda1.spole.gov.
2. Start **minicom**
3. In minicom, log in on **ariadne1** as root.
4. Enter the command **reboot**. You should see the message

```
enter any character to stop auto boot...
```

As soon as this message appears turn off the VME crate (rack 7, crate 1) at the small red toggle switch on the right hand side of the front panel. Push the switch down shortly.

5. Turn the VME controller hard disk on top of rack 7 off. The switch is at the back.

6. Quit minicom by pressing **CTRL+A Q**.

7. Shut down the DAQ PC:

```
[pamanda1]> su
<enter root password here>
[pamanda1]# halt
```

8. Turn the computer off when the message

```
system halted
```

appears on the screen.

9. Turn the DAQ disk array off (rack 7, device 2)

10. Repeat steps 1, 7, and 8 for the HV control PC (pamanda3.spole.gov).

Remote Shutdown:
All network routers, switches, and hubs are connected to a UPS for this kind of emergency. You should be able to log into the machines in MAPO from the UPS powered machines in Back of Science. Although you can not turn off the machines, you should still shut the system down to prevent disk errors in case the UPS fails.

1. Telnet to your account or the daq account on pamanda1.spole.gov.

2. Start **minicom**

3. In minicom, log in on **ariadne1** as root.

4. Enter the command **reboot**. You should see the message

```
enter any character to stop auto boot...
```

As soon as this message appears press **ENTER** to stop the boot sequence.

5. Quit minicom by pressing **CTRL+A Q**.

6. Shut down the DAQ PC:

```
[pamanda1]> su
<enter root password here>
[pamanda1]# halt
```

7. Repeat steps 1 and 6 for the HV control PC (pamanda3.spole.gov).

8. Get dressed and go out to MAPO.

2.6.2 Starting the Detector After a Power Outage

1. Turn on high voltage control PC (pamanda3.spole.gov) if off.

2. Turn on DAQ disk array (rack 7, device 2) if off.

3. Turn on the DAQ PC (rack 7, device 1) if off.

4. Turn the VME controller hard disk on top of rack 7 on if off. The switch is at the back.

5. Turn the VME crate (rack 7, crate 1) on if off.

6. Turn on all other crates and devices if they are off. Some of the newer CAMAC crates have the power switch at the back (rack 3, crate 1 and crate 2; rack 5, crate 2). **It is essential that the SWAMP crates are on before the high voltage is turned on.**

7. Turn on the high voltage crates if off:

   - Check again that all SWAMP crates are on
   - Rack 1, crate 2, LeCroy HV1440, M2. Use the big switch on the front panel.

- Rack 2, crate 3, LeCroy HV1440, M1. Use the big switch on the front panel.
- Rack 5, crate 5, LeCroy HV1458. Turn the key on the front panel all the way to the right.

8. If the high voltage control PC (pamanda3.spole.gov) does not come back for some reason, you need to go out to MAPO. Disconnect the serial cables coming from the high voltage crates to the control PC and connect them to the VT100 terminal. There are two cables: One connected to both LeCroy HV1440 crates (rack 1, crate 2; rack 2, crate3) and one connected to the LeCroy HV1458 crate (rack 5, crate 5). Ones the cable is connected to the VT100 (of course only one at a time) you can issue the same HV commands as described below for control via minicom (steps 12–20 and steps 23-29).

   Also make sure to connect the serial cables back to pamanda3 when the machine comes on-line.

9. Log in to your account or the daq account on pamanda3

10. Start minicom:

    ```
    minicom hv1440.dfl
    ```

11. The HV crates are case sensitive. Therefore it is a good idea to press the **CAPS LOCK** key first.

12. Connect to crate M1:

    ```
    M1
    ```

    You should get

    ```
    Mainframe 1 responding
    ```

    If not, type **M2** and then **M1** again. If there is still no response check the cable to the HV crates.

13. Check the status:

```
ST
```

The crate should respond with:

```
HV Disabled
HV off
```

14. Check all channels:

```
R E A
```

The crate returns a four column table of the form:

```
Reading Demand Backup Actual
C   1   1707    1745   1750
```

⋮

If the value in the last column (Actual) is not 0 for all channels, issue:

```
W 0 A
```

15. Turn high voltage on:

```
ON
```

Check the status again:

```
ST
```

The crate should respond with:

```
HV Enabled
HV on
```

16. Ramp up the high voltage in steps of 300 volts. This is necessary to prevent the SWAMPs from getting damaged. Check the status of the HV crates

```
W 300 A
W 600 A
W 900 A
W 1200 A
```

17. Set the final value:

    ```
    U
    ```

18. Read all channels again:

    ```
    R E A
    ```

    The actual value should be close to the backup value. If not, the crate probably lost its memory and the backup values need to be restored. Refer to the LeCroy HV1440 manual for instructions on how to do this. The HV values for every channel can be found in the OMDB[3].

19. Connect to mainframe 2:

    ```
    M2
    ```

20. Repeat steps 13 – 18 for mainframe 2

21. Quit minicom with **CTRL+A Q**

22. Start minicom for HV1458:

    ```
    minicom hv1458.dfl
    ```

23. Start a session:

    ```
    1450
    ```

24. Enter VT100 mode:

    ```
    vt100
    ```

[3] http://pamanda3.spole.gov/~amanda/omdb

A screen similar to the one below should be seen:

```
+------------------------------EDIT-+  +--------- VT Key Map ----------+
|      0.0                      En |  |      q  Quit VT Screen Mode   |
+-----------------------------------+  |      h  Help                  |
+o-------- Channel vs Value ---HV ON--  |    PF1  Prev Page             |
|Channel S  Meas uA   Meas V Target V>  |    PF2  Next Page             |
|    0.0 *   1132.3   1523.0   1520.0>  |      i  Increment             |
|    0.1 *    428.3   1753.1   1750.0>  |      d  Decrement             |
|    0.2 *   1113.7   1501.6   1500.0>  |      p  +/- (Change Polarity) |
|    0.3 *    440.5   1801.9   1800.0>  |      e  Escape                |
|    0.4 *   1083.6   1461.5   1460.0>  |      [  Channel Enable        |
|    0.5 *    416.7   1703.3   1700.0>  |      ]  Channel Disable       |
|    0.6 *   1004.8   1352.5   1350.0>  |      {  HV ON                 |
|    0.7 *    390.5   1600.3   1600.0>  |      }  HV OFF                |
|    0.8 *   1001.0   1349.3   1350.0>  |  s (c)  System (Chan)         |
|    0.9 *     19.5      3.1      0.0>  |Shft0-F  Slot0-15              |
|   0.10 *   1020.0   1375.0   1370.0>  | PF3(4)  Prev (Next) Display   |
|   0.11 *    398.1   1631.8   1630.0>  |      u  Display Up            |
|                                    >  |      >  Select                |
|           Meas uA   Meas V Target V>  |      /  Delta                 |
|    1.0 *    414.9   1699.9   1700.0>  |  S (R)  Save (Restore)        |
|    1.1 *    421.5   1724.5   1720.0>  |      w  Toggle Screen Width   |
|    1.2 *    410.0   1678.1   1680.0>  +-------------------------------+
|    1.3 *    440.1   1801.1   1800.0>
|vvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvv
```

25. The high voltage should be off. The crate keeps six files with backup values, which are preset for ramping up SWAMP–save. Press **R** (must be upper case). A menu will appear:

```
+ ---------Restore-------------+
|                              |
| 0) Up      19Feb98 18:24:21  |
| 1) Down    19Feb98 18:27:39  |
| 2) Strange 19Feb98 18:30:42  |
| 3) Charm   19Feb98 18:33:09  |
| 4) Bottom  19Feb98 18:35:57  |
| 5) Top     19Feb98 18:38:05  |
| 6) Clear Power Up Save Set   |
|                              |
| ESC) Close/Return            |
|                              |
+------------------------------+
```

Load file **Up**.

26. Turn high voltage on by pressing **{**.

27. Load backup files in the following order: **Down, Strange, Bottom, Top, and Charm**. **Charm** must be last, this is not a mistake.

28. Quit VT100 by pressing **q**.
29. End session:

    ```
    quit
    ```

30. Quit minicom with **CTRL+A Q**
31. Proceed as described in section 2.3.

Index