

How to read out the Multichannel Analyzers

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A Multi-Channel Analyzer (MCA) is sort of a “histogram machine”. The MCA records the number of pulses received of a given pulse height (voltage). The data are stored in the form of a histogram, where each histogram bin contains a count of the number of pulses received where the pulse height is within the relatively small range associated with that bin. As used in this Laboratory the pulse height is generally taken from the output of a Time to Amplitude Converter (TAC), so that the histogram stored in the MCA is a measurement of the distribution of the length of the time intervals measured by the TAC.

It is possible to read out the data “by hand” from the MCA simply by moving the channel cursor from channel to channel using a knob on the front panel. This is fine for collecting data from a small Region of Interest (ROI), but it is very tedious for reading out the entire MCA or a full segment of the MCA memory, either of which may cover several thousand channels. It is therefore preferable to read out the data from the MCA into a computer file. These instructions tell you how to do that using a computer using the Unix operating system.

We presently use two different models of MCA, and the instructions are slightly different for each model. The differences are:

Tracor TN-7200:

Requires a “null modem” cable, with the serial port set to 300 baud, 8 data bits, and no parity check.

Canberra Series 35 plus:

Requires a regular serial cable (not “null modem”), with the serial port set to 9600 baud, 7 data bits, and even parity.

The data file will be transferred to a floppy disk, so you should have a DOS formatted disk available. An unformatted floppy disk can be formatted on the computer.

The general steps required to read out the MCA are:

1. Connect the cables
2. Set the output parameters on the MCA
3. Set the serial port parameters on the computer
4. Off-load the raw data from the MCA to the computer
5. Convert the raw data format to a histogram file
6. Copy both files to a floppy disk

These steps are described in more detail in the rest of this document.

1. Connect the cables

The devices all use an EIA protocol called RS-232, though the older MCA manuals refer to this as simply “*the* EIA” protocol. The MCAs have 25-pin female connectors, while the computer serial port has a 9-pin male connector. You therefore need an RS-232 cable with a 25-pin male connector at one end and a 9-pin female connector at the other end.

The Tracor TN-7200 requires a “null modem” cable, which crosses the signals for TD (“transmit data”) and RD (“read data”). There is a 25-pin to 25-pin null modem adapter available in the lab for use with the TN-7200. Do not use the null modem adapter with the Canberra MCA.

2. Set the Output Parameters on the MCA

You need to make sure that the output parameters are set correctly on the MCA. You only need to do this once when the MCA is turned on, or when you want to change a parameter. The way you change the output configuration depends upon which MCA you are using:

2.1. *Tracor TN-7200:*

- Press the “Setup” key and the buttons will blink for all subsystems you can configure. Press the “Out” button to configure the output parameters.
- You can select the value or item on the screen just by pressing the Yes/Enter button. If a value is incorrect press No to move to the next selection. Numerical values are entered via the keypad.
- You want to select output to “Print” (not “Display”), an output speed of 300 baud, and an output field 80 characters long.
- When you are finished with the setup sequence press “Setup” again to exit setup mode.

2.2. *Canberra Series 35 plus:*

- The output parameters of the 35 plus can be changed at the time you dump the data to the computer. When you press “Read Out” a dialogue appears on the bottom of the screen. Press “Yes” if the parameters are okay. Press “No” if you want to change something and a cursor (marked by an asterisk) will move to the next item or value.
- The output mode should be “EIA”. You can either dump the entire memory or a “ROI” (Region of Interest). To dump just a ROI you push the “ROI” button, move the cursor back and forth to highlight the channels in the ROI, and then push the “ROI” button again.

3. Set the Serial Port Parameters

On Linux the first serial port device is called `/dev/ttyS0` (teletype/serial port zero). You need to configure the port to the correct baud rate, number of data bits, and parity setting.

You must first log in to the computer using an account that has the proper permissions to change the serial port settings (*i.e.*, write access to `/dev/ttyS0`). In the Modern Physics Lab use the “millie” account.

You can inspect the serial port settings with the command

```
% stty -a </dev/ttyS0
```

(The % represents the Unix prompt, you do not type it. The real prompt is probably something longer.) To set the serial port for the Tracor TN-7200 to 300 baud, 8 data bits and no parity, give the command:

```
% stty 300 cs8 -parenb </dev/ttyS0
```

To set the serial port for the Canberra Series 35 plus to 9600 baud, 7 data bits, and even parity, give the command:

```
% stty 9600 cs7 parenb -parodd </dev/ttyS0
```

(The `paren` turns on the use of a parity bit, and the “-” in front of “`-parodd`” turns off odd parity and thus implies even parity.)

4. Off-load the raw data from the MCA

It is useful to use the Unix “`tee`” command to read out the data. The “`tee`” command reads its input and writes it both to a file named on the command line and to the standard output. This allows you to see the data as it comes out of the device but also save it to the file at the same time. An example is:

```
% tee run047.d </dev/ttyS0
```

This saves the raw data to the file `run047.d`. You should use your own unique and distinguishable name for each separate data file.

When this command is given the computer will wait for the data from the MCA. Press the appropriate button sequence to send the data to the serial port:

Tracor TN-7200:

Press “Stop” to turn off data acquisition, and then press ‘Out’.

Canberra Series 35 plus:

Press “Collect” to turn off data acquisition, and then press “Read Out” and verify the offered parameters at the bottom of the screen. Press “Yes” to start data output. (Press “No” if you need to change parameters and it will step you through the parameters.)

When the readout is done, press “Control-C” on the computer keyboard (hold down the “ctrl” key and press the “C” key) to terminate the `tee` program. The data output from the MCA will be saved in the file named on the command line of the `tee` command (eg. `run047.d`).

5. Convert raw data format to histogram file

The data file produced by the MCA is a “raw” data file which is not necessarily ideal for feeding to another analysis program. You may therefore wish to run the data through a filtering program to change the format.

It is always a good idea to save the raw data file exactly as it was created, and only to copy the data to some other file in some other form. You can do this using a program called “daqmca”, written in Perl, which will read the data file from the MCA and write the data values to an output file, one value per line. Here is an example:

```
% daqmca < run047.d > run047.h
TN-7200 X01A
**      LT=24586  RT=   90122
**      0      0 1024      0 1024
#       0 1024
      END
Read/Wrote 1024 channels
```

The command reads data from the input file `run047.d` and sends the output to the file `run047.h`. Any line in the input file which does not contain histogram data is echoed to the terminal rather than being sent to the output file.

Be sure to use a name appropriate to your data set, and don't use the same name and extension as the raw data file, or else you will overwrite the raw data file.

6. Copy files to a floppy disk

To copy the files to a floppy disk you have to insert the disk and mount the filesystem on the disk, then copy the files, then unmount the filesystem, then eject the disk. The details are as follows:

First insert the disk into the drive, then give the command to mount the filesystem on the disk:

```
% mount /mnt/floppy
```

You must use a computer account that is authorized to control the floppy drive (such as the “millie” account), and the mount point must be properly defined in the file `/etc/fstab`.

If you find that your floppy disk won't mount because it is not already formatted then you can format it with the command:

```
% /sbin/mkdosfs /dev/fd0
```

This will erase all the data already on the disk. If you have trouble with this command see your instructor. Once the floppy has been formatted then mount the disk as `/mnt/floppy` as shown above.

Once the disk is mounted you can copy files to it with the Unix copy command. Here is an example:

```
% cp run047.d run047.h /mnt/floppy
```

This copies several files at once to the floppy disk. It is better to copy the files rather than moving them, so that you still have a backup copy on the computer.

Finally, you must unmount the floppy disk before you remove it from the drive. The command is:

```
% umount /mnt/floppy
```

Note the terse spelling – it is “umount” not “unmount”. Then pop the disk out. Please do not pop the disk out without giving this command, as it confuses the computer.