Brief on ANSEL Data Acquisition with the DDC-8 DSP

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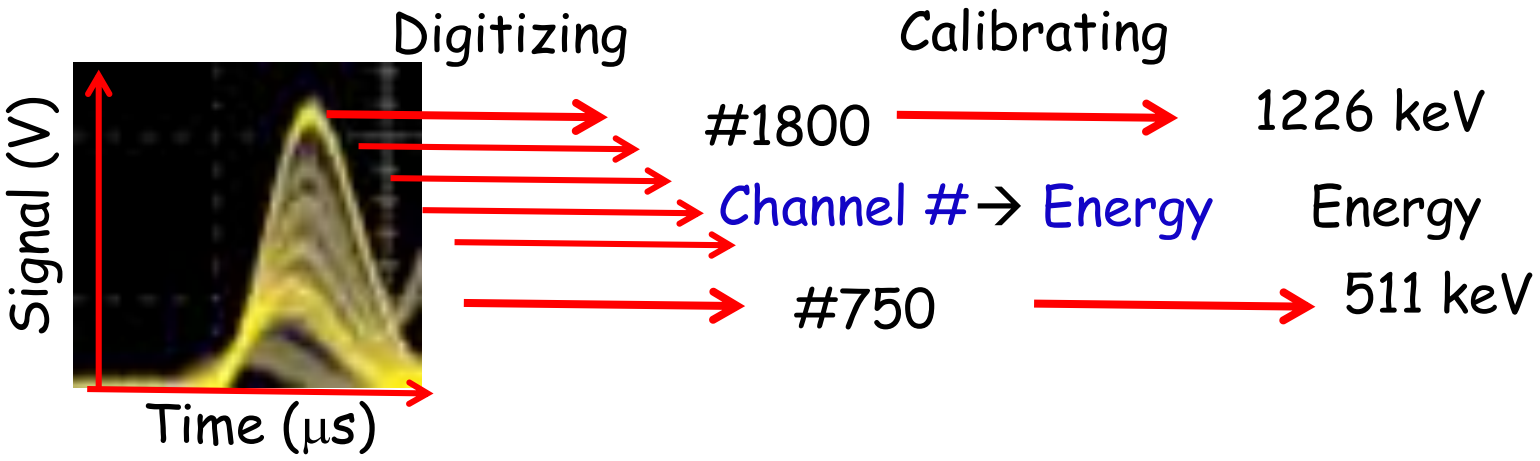
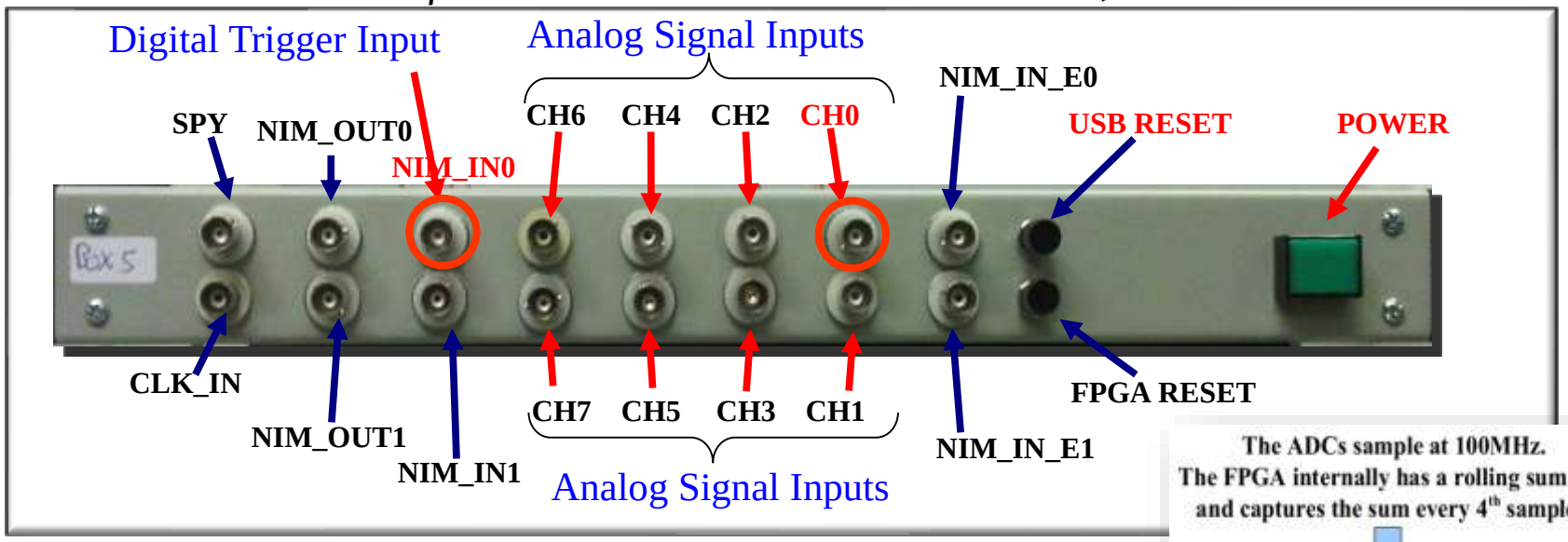
Data Acquisition with DDC-8 Digitizer



$2048 = 2^{11} \rightarrow +2V \triangleq$ *full scale* $\rightarrow +1.0V \triangleq 10\,000\,000\,000, +1.5V \triangleq 11\,000\,000\,000$



+/- 1V (maximum amplitude = 2V)

The ADCs sample at 100MHz.
The FPGA internally has a rolling sum of 4 and captures the sum every 4th sample.

Effective sampling = 25MHz
(1 sample covers 40ns)

Precaution

ALWAYS inspect analog and trigger signals on the oscilloscope, check relative timing --

BEFORE connecting the cables to the DDC-8 channels !

Signals >>2V have the potential of damaging the circuitry of the instrument (a very expensive mistake!)

DDC-8 Software

“BlackBox” programming environment

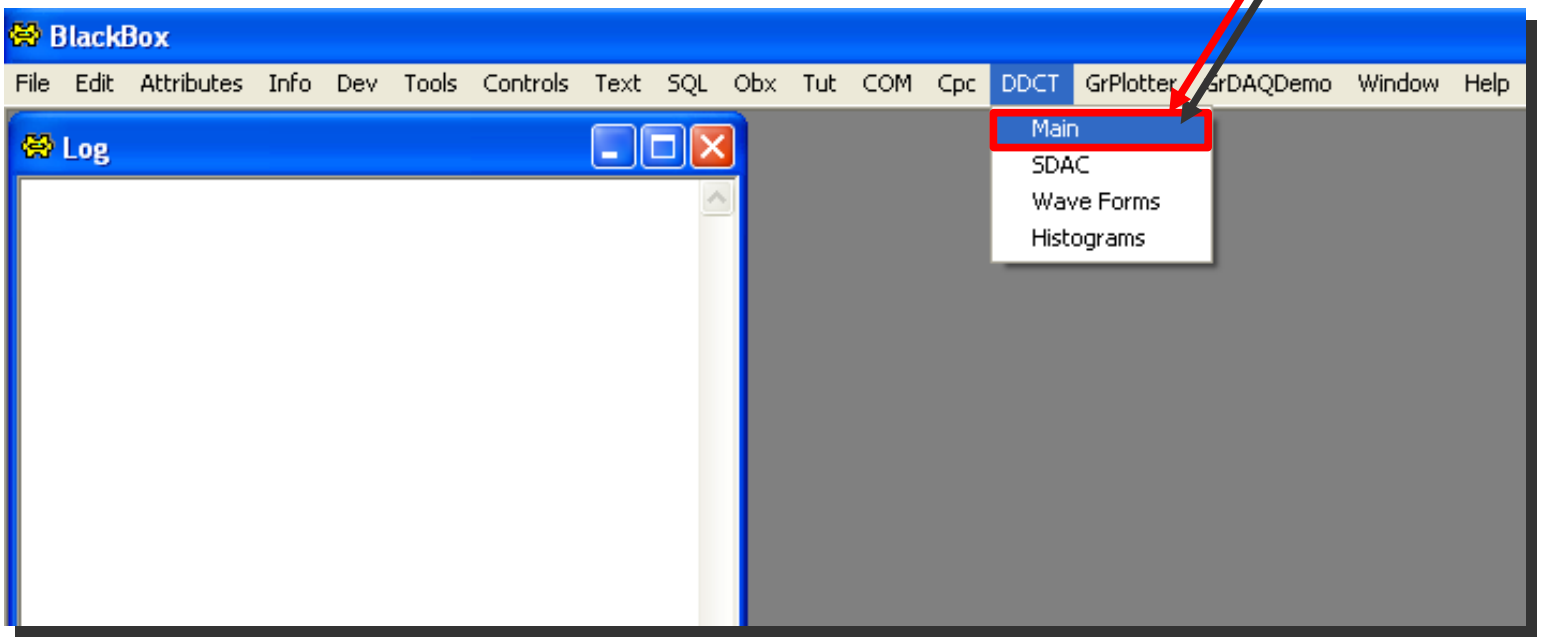
Graphical user interface for controlling the DDC-8DSP

Preinstalled on all ANSEL computers

Using the BlackBox DDC-8 Interface

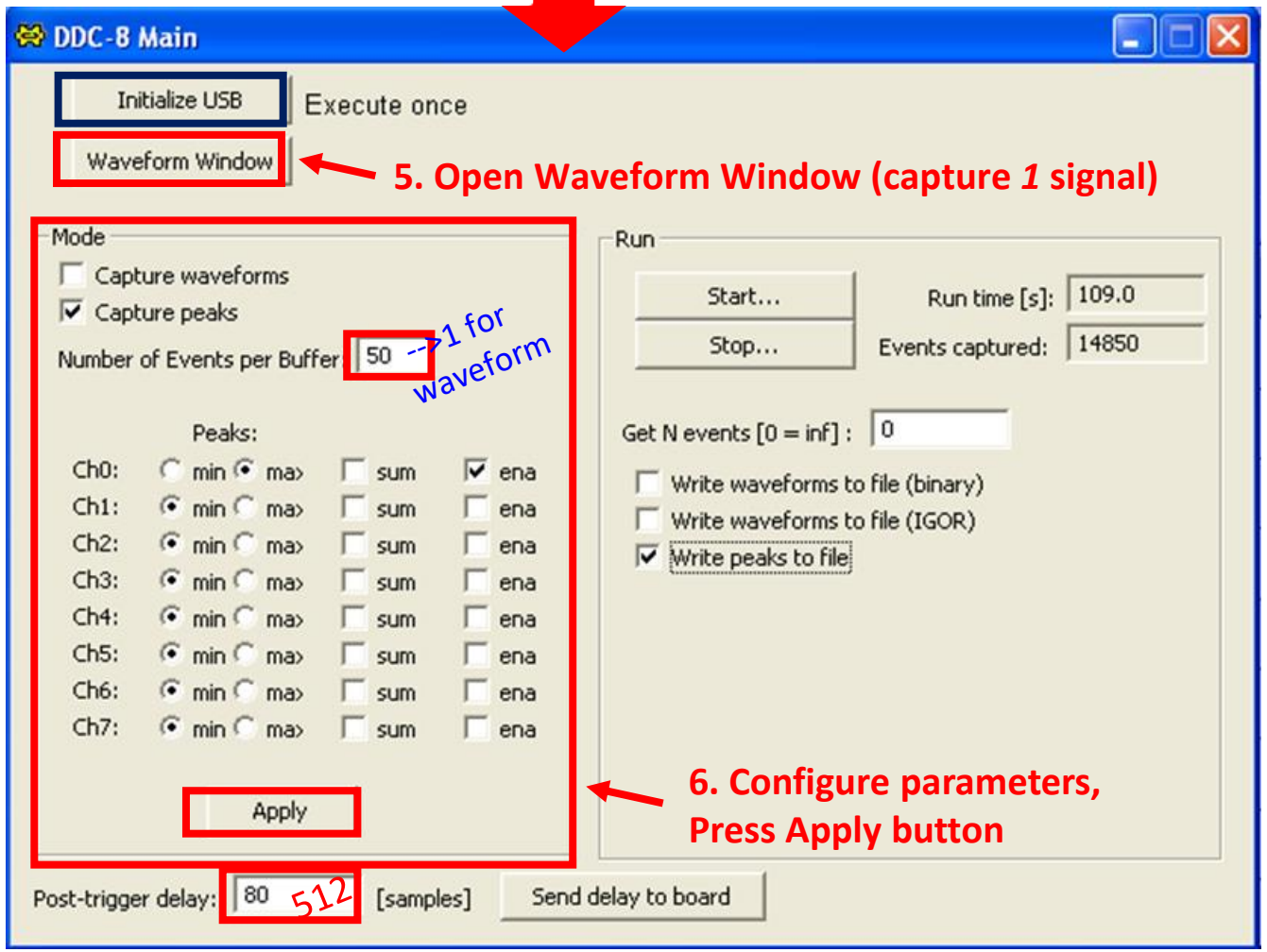
1. Start BlackBox ANSEL

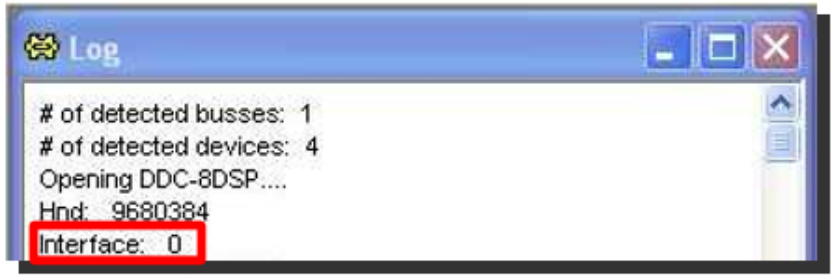
2. Open main control panel



Using the BlackBox interface

3. Initialize the connection with the DDC-8DSP board (press only once)





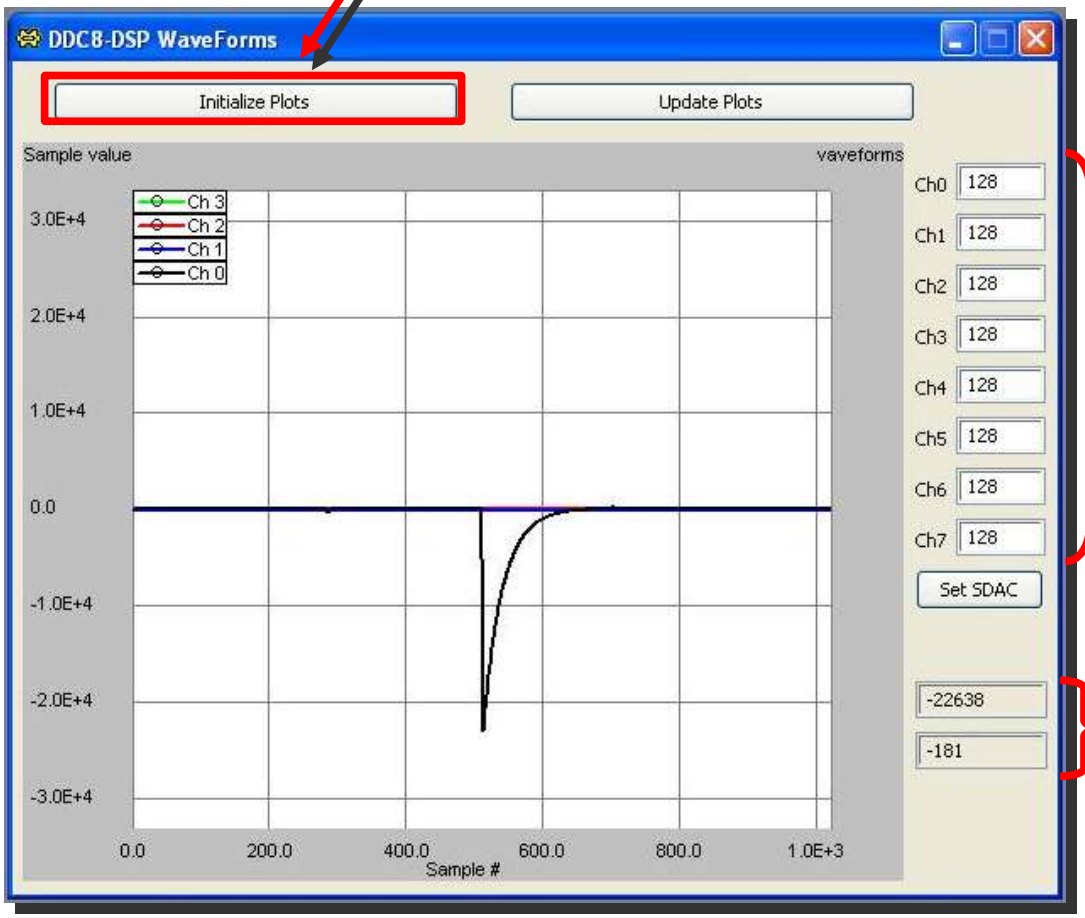
4. You should see a "zero".
If you see a -22 then:
- Close BlackBox
- Reset the USB with the button on the front panel
- using Cypress EZ-USB reprogram the USB chip
- Start-up BlackBox again

If you see a -5 then probably you pressed The Initialize USB button more then once
- close and reopen BlackBox

Using the BlackBox DDC-8 Interface

7. Initialize the Waveform Preview (#Events/Buffer =1)

Waveform Preview



Set the offset for each input channel :

32 = -1V Use 32 for unipolar signals >0

128 = 0V

225 = +1V

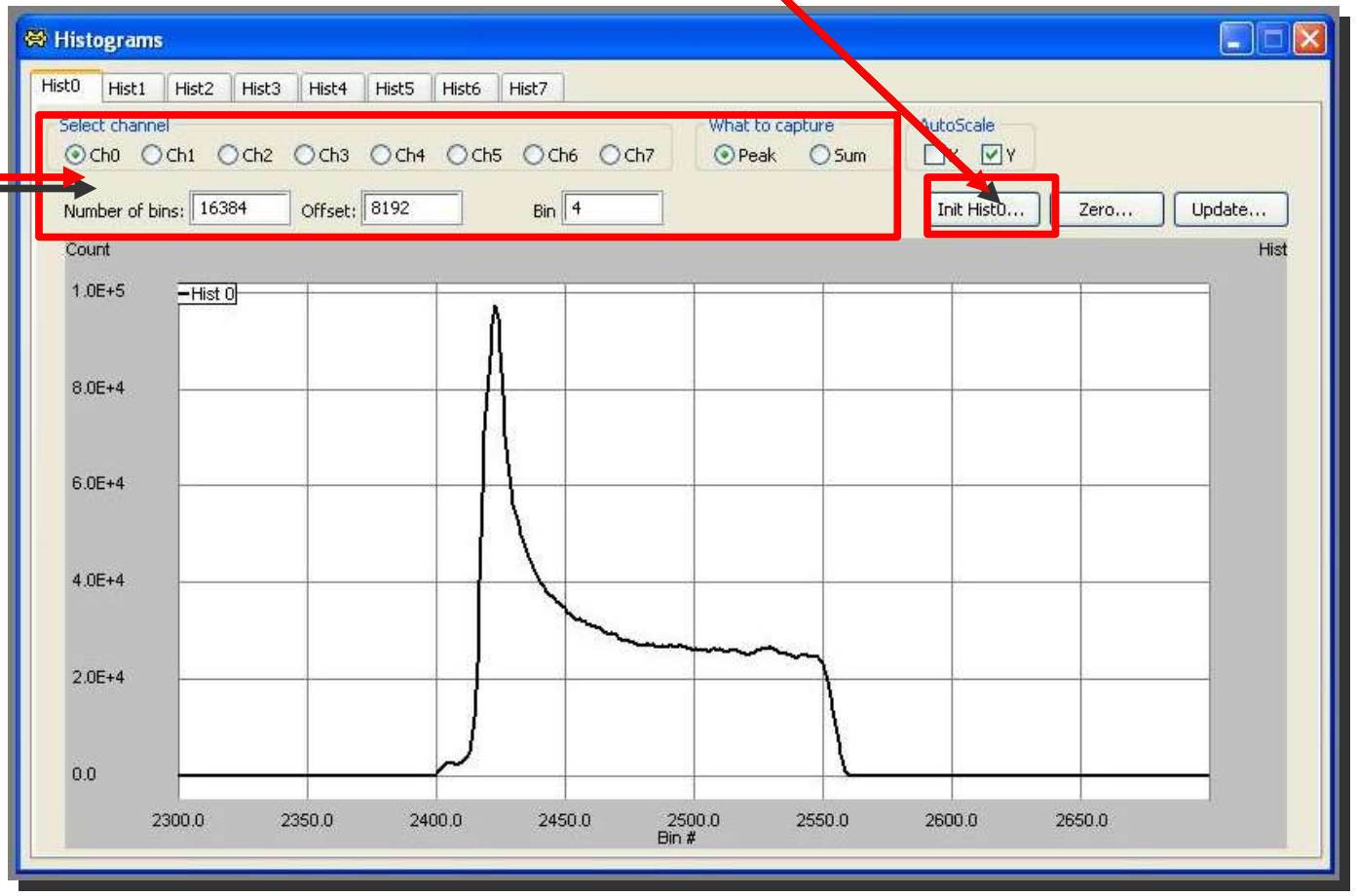
Preview of the Peak values for Ch0 and Ch1

Using the BlackBox DDC-8 Interface

Histogram Digitized Spectrum (Bar Diagram of Frequency vs. Amplitude)

9. Initiate histogram

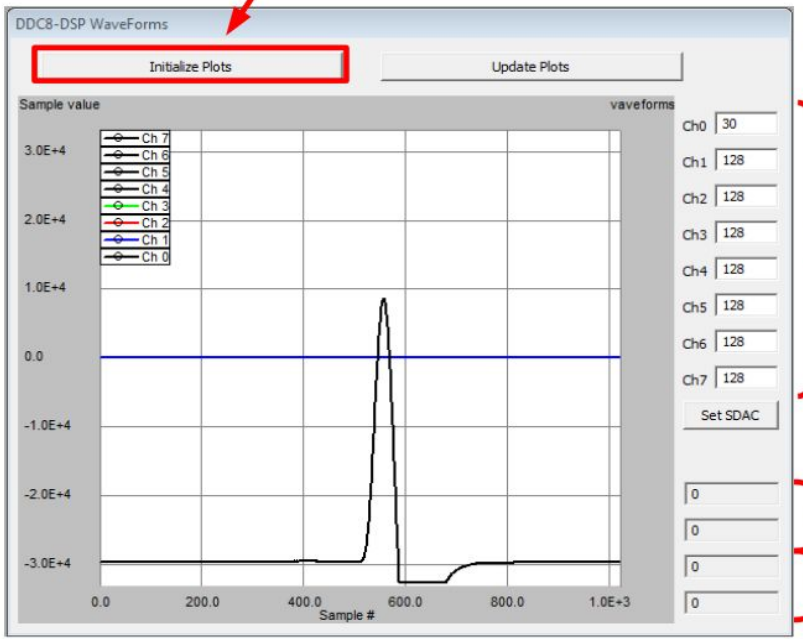
8. Configure desired parameters:
Normally
# of Bins: 4096 (4kB)
Offset 2048
Bin(width): 16



Using the BlackBox DDC-8 Interface

7. Initialize the Waveform preview

Set # of events per Buffer to 1



Waveform values range between: -32768 to 32764

Control the offset (30 = -1V, 128=0V,225=1V)

Input signal + offset => ADC

Preview of the Peak values for Ch0 and Ch1

Preview of the Sum values for Ch0 and Ch1

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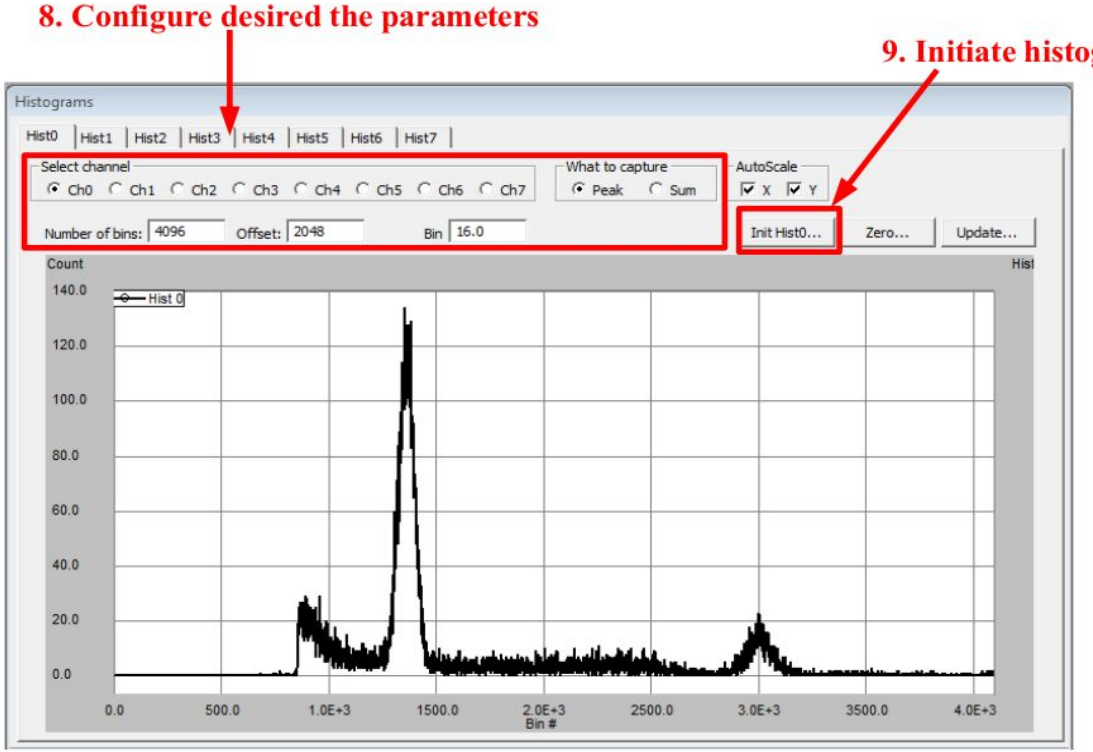
BlackBox DDC-8 Interface: Experiment NaI(Na-22)



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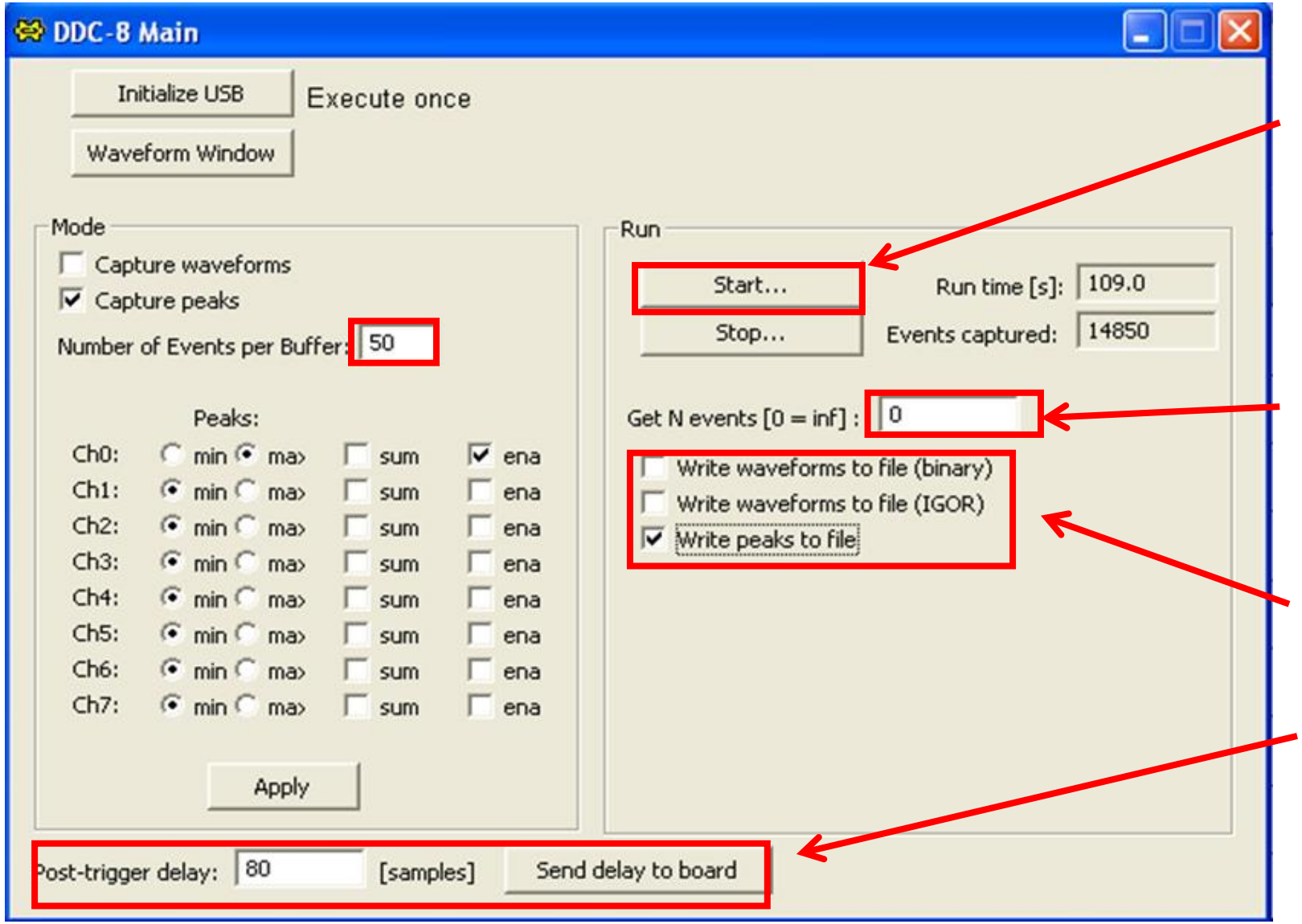
Using the BlackBox interface



13. Start acquiring data

10. Set number of events to capture, 0 = infinte

11. Configure file outputs

12. Number of samples to define signal and peak. Should be long enough to avoid pileup.

DDC-8/Blackbox Quickstart User's Guide

1)Turn on the DDC-8. Wait to hear **3 dings** come from the computer speakers
2) Open up blackbox and choose **DDCT>Main** from the top menu
3) Begin the initalization procedure
    a) click on Initialize USB (only once!). You should see "**Interface: 0**" in the log window
        If you see something else (possibly -5 or -22), close Blackbox, push the button labeled "Reset USB" on the front panel of the DDC-8 (or power-cycle the device)
    b) Open the waveform preview window, click "**Initialize Plots**"
        Several flat lines should appear, as well as a legend
        Double click on the plot to auto-arrange the legend
    c) Choose the offsets for each channel with the boxes on the right hand side.
        For most cases you will want to input "**32**". This will make the offset approx -0.8V, enabling full scale digitization of ~1.8V pulses.
        Other offsets can be used here (namely if negative [use "**225**"] or Bipolar [use "**128**"] pulses are to be expected.) For now, stick to an offset of "**32**".
4) Inspect the waveform and ensure the DDC-8 is reading the proper signal.
    a) Attach the signal to be measured to **Ch_0** and the trigger signal to **NIM_IN_0** BNC panels
        Remember to inspect them in the scope first to ensure they are <2V!
    b) Check the box for "**capture waveforms**"
    c) Choose a value for **# of events/buffer**.
        This adjust how often the GUI will update information from the FPGA. **25-50** is sufficient for high count rates. If the event rate is low, you can bring this down to single digits.

DDC-8/Blackbox Quickstart User's Guide

d) Set each desired Ch#s to **max** and **ena**

e) Press Apply to save all of the settings adjusted so far.

f) Adjust the post trigger delay

This lets the DDC-8 know after how many samples (40ns ea.) after the trigger it should stop capturing the waveform. **80** is a good value to start with, but you can explore the effect by changing it!

g) Click "send delay to board".

h) Click run to see the waveform of the signal. (don't bother saving it)

5) After observing that the waveform is correctly displaying, you want to see a histogram of pulse heights

a) From the top menu, select **DDCT>Histograms** to display the histogram window

b) Configure the histogram parameters, then initialize the histogram

Good settings to use are **4096** Bins, **2048** Offset & **16** Bin. These should be the default

c) This is just for the initial preview, you will be able to re-bin your data in **Igor** at home

d) Back in the main menu, Uncheck "**capture waveforms**" and check "**capture peaks**"

ensure that you have set the "**max**" and the "**ena**" of the proper channels, if you indeed want to collect the peak height. The device is too slow to capture waveforms and peak heights simultaneously.

e) Click "**Apply**", then "**Send Delay to board**" to collect data and **view the histogram**.

6) After ensuring the waveform & histogram are properly displayed, it is time to collect data by checking the "**Write Peaks to File**" box. You may set a specific # of events to collect for a simple energy spectrum (**60,000** - **120,000** should be sufficient depending on the activity of your source and detector used)

Or you can put "**0**" to stop collection manually.

Tips/Troubleshooting

1) After changing any setting, you need to press "**Apply**", then "**Send delay to board**" before starting data collection. This finalizes the changes in the software, then sends them to the FPGA.

2) Be sure to write down in your logbook the Runtime & # of events collected after each run.
    a. Don't worry if you forget, however, as this information is accessible from the output file.

3) Be sure to save all of your data on the EXPERIMENTAL_DATA partitions on the hard drives. Most of the C: drives will fill up quickly.
    a. This was a common problem in previous years for students. If you data is not saving correctly, be sure to check and make sure the HDD isn't full. your

4) Keep an eye on the Log Window. If the machine starts to display "**-5**"'s, there is likely a problem with the connection and its better to power cycle the instrument and reinitialize.

5) Sometimes, you will hear the "ding" of the USB disconnect. This happens occasionally via static discharge or jostling of cables. Power cycle the box & reinitialize to continue

6) If you want to quickly export the histogram from Blackbox, double click on the legend entry for "**Hist_0**" and a window will appear with the bin values in a list. This makes for easy importation into IGOR, but you will want to get used to doing the histograms manually on your own.

7) If you want to adjust the scaling on the histogram to zoom to a particular region, double click on either axis to bring up the menu.
    a. Be sure to uncheck the "**autoscale**" box in order to change the scale of a particular axis.

Experimental Setup

- Main Question: What do we want to measure?
  - Is it energy? Is it a timing function? etc.
- Questions to ask before you start:
  - How many events do you need?
  - How long will it take?
  - What could go wrong? How do you know your experiment is proceeding correctly?

- Record keeping is critical for good results. What else should you record?

- All entries should be dated. **NO** entries on loose sheets.

- **ALL** relevant parameters of your experiment and analysis should be recorded in your log book. Do not leave empty pages to complete later. Complete it **NOW.**

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Experimental Setup

- What do you record:
  - Type and size of detector and operating condition (e.g. HV setting).
  - Type, location, and strength of sources used.
  - Electronics setup (record model numbers of modules being used).
  - Settings of modules (gain – course and fine, switches).
  - Relative timing of signals, signal shapes (capture scope-screen images).
  - Run conditions (e.g. run length, file name for data, recording mode).

- While you are collecting data, does it make sense?
  - What are checks you can do to ensure data collection is going smoothly?

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Experimental Setup

- Signal Chain:
  - PMT -> (50-Ohm term.) Amplifier:
    - Unipolar out -> DDC8 Channel 0
    - Bipolar out -> TSCA -> Gate Generator -> DDC8 Trigger In 0
  - ***At every step** look at the signals. ***
  - Set up the DDC8. Follow **every step** of handy-dandy instruction sheet.
  - Don’t cut corners.

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