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On-Line Display Used For laser Experiment

Songjiang Xia

June 10, 1993

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1.Description

On-line display is an important function in Laser Experiment, which can graphically show three kinds of histogram,see Figure 1-3. It is designed to work up to 14 histogram diagram on-line display(12 channels,$\sum Q$ & X-cog)and can save the data file in TTR format(see Figure 6).The main window is divided into two parts,the upper part is the control area,and lower part is the drawing area. The control area contains a number of digital control, two control buttons and some digital indicater. The drawing area can display the histogram of any channel,$\sum Q$ or X-cog.

Control Area.

On the upper left corner of the control area are three digital control which used to select GPIB number("GPIB #"),slot number("Slot #") and N events("N triggers"). Close to these three digital control, there are five digital indicater. The first two indicater used to show how many events have been entered ("N accumulated") and the speed of data acquisition("Rate"). Next two digital indicater show the S deviation value and mean value of any one channel which is selected at digital control "Channel #".The last one shows the error number while saving the data file.

On the upper right corner of the control area are two control buttons. The name of left button is "GRAPH", usually it is in "off" state.When it turns to "on" state, you can display one of 14 histograms in the drawing area which is selected by "HISTOGRAM SELECT" and "Channel #" of the control area.The other button is "Continue/Pause". The process of data acquisition will be stopped when you switch it to "on" state. You can continue data acquisition when you set this button back. In the middle of control area, there is a "HISTOGRAM SELECT" switch under the "Rate" indicater. This switch used to select one of three kinds of histogram:channel,cluster and cog. You can click the right arrow to change it from channel to cluster, or cluster to cog. If you click the left arrow, the direction of change is vice versa.

Close to the "HISTOGRAM SELECT" switch is digital control "channel #" ,you can change the number from 1-12 at any time. For example,the number is 8. Then the digital indicater "Counts" displays the current ADC code of channel 8, and the histogram of channel 8 is displayed on drawing area. When "HISTOGRAM SELECT" switch set to "channel", two digital control("Min channel" and "Max channel") used to determine the abscissa of the channel histogram and can change these two values at any time. The function of "Min cluster" and "Max cluster" is the same. The abscissa of the cog histogram is fixed at 0 and 1200."Min X-cog" and "Max X-cog" are used to select the region which you want to find the maximum X-cog value in 12 channels.

Drawing Area

You can display three kinds of histogram in the drawing area. Before displaying the histogram,we must change the 12 ADC codes(12 channels) of every event from N_i to Q_i as follows:

$$Q_i = A_i + B_i N_i \quad (i = 1-12)$$

All the A_i ,B_i values should put into two arrays in subroutine "transfer".

The three kinds of histogram are described as follows:

a. channel histogram

You can select any one of 12 channels(channel 1-12) and display the histogram of it on the drawing area.

b. cluster histogram

In this case, the histogram which display in the drawing area is as follows:

$$Q_{cluster} = \sum_{i=1}^{12} Q_i$$

c. X-cog histogram

$$X_{cog} = \frac{\sum_{i-1}^{i+1} X_i Q_i}{\sum_{i-1}^{i+1} Q_i} * 100$$

The subroutine "cog" can calculate the X_{cog} value automatically. The first step is to find the maximum Q_i value from the region between X_{Min} ("Min X-cog")and X_{Max} ("Max X-

cog"), then calculate the X-cog value from X_{i-1} ,Q_{i-1} ,X_i ,Q_i and X_{i+1},Q_{i+1}.

2. How to start it

The on-line display application can be used from a Macintosh computer which is logged the LabVIEW software. The first step you should do is to click the icon "12 DAQ one" (or "12 Q_STOP one") from desktop to put this program into current window. Then set the digital control "GPIB #","Slot #" and "N triggers"with the correct values (The default values are "1" , "17" , "1000" respectively). Then you may run this program.

3. How it works

The on-line display application is written in LabVIEW for Macintosh in one main program and four subroutines. We have two versions of main program:

a. 12 DAQ one : Using single transfer mode.
b. 12 Q_STOP one : Using Q_STOP mode.

The four subroutines are as follows:

a. transfer
b. cog
c. set
d. save

The function of first two subroutines are described as above. "set" and "save" are used to save the data file in TTR format after data acquisition.

As mentioned above, before running main program, you must set two arrays in subroutine "transfer" (the default value of A_i is 0,B_i is 1). The another work you must do

before running main program is to set the correct value in "set" subroutine.

When you open the subroutine "set", you can see 11 digital control in the front panel. These 11 digital control are used to set values of "Event Size","DAQ Mask","Trigger Mask","Run Number","Group Size", "Group Mask","Technology Type","Crate Number","Start Module","Number of Module" and "Module Type" respectively. The default values are 26, 0,1,1,16,0,7,1,17,1 and 1.

During data acquisition, this main program can monitor 3 parameters and 14 histograms on-line as follows:

a. Number of events which have been received ("N accumulated").
b. The speed of data acquision ("Rate").
c. The current ADC code of the pointed channel ("Counts").
d. 14 histograms which selected by "HISTOGRAM SELECT", "Channel #" and "GRAPH" button.

We suggest you don't put the "GRAPH" button at "on" state for a long time because the speed of data acquisition will be seriously reduced. You may put this button "on" for a short time, as soon as the new histogram appear, you put this button "off",then you can observe this histogram carefully,even using the cursor tool.

You can change "HISTOGRAM SELECT" , "Channel #" , "GRAPH" button at any time. Other six digital control such as "Min channel" , "Min cluster" , "Min X-cog" can also change if you need. The scale of coordinate of 14 histograms is automatically changed.

When the number of "N accumulated" equal to the number of "N triggers" ,the process of data acquisition is ended. Then you can give the name of the data file though a dialog window. You can stop the process of data acquisition

manually by click the mouse at the LabVIEW quit button, but in that case, you can't save the data(which have been received)as a data file into the disk.

After saving the data file, the two digital indicator "S Dev" and "mean" will show you the corresponding value.

When you want to pause the process of data acquisition, you may switch the "Continue/Pause" button from "off" to "on". That cause the process of data acquisition stopped. You can rerun it by switching this button from "on" to "off".

4. Eight drawing areas on-line display application

Figure 7 will show you another on-line display application. In place of one drawing area on the front panel of Figure 1, there are eight drawing areas in Figure 7. They are cluster, cog and six channel histograms respectively. Each diagram has a switch control, its function is the same as "GRAPH" in Figure 1. In the upper left middle of the front panel, there is a "ch Region Select" switch which used to select six of twelve histograms: ch1-ch6,ch2-ch7 and so on. You can select the region of interest which you want to monitor on-line. You may change this region at any time if you like.

The name of this main program is 12 Q_STOP_8. The five subroutines are transfer, cog, set, save and channel.

Appendix A

Off-line 14 histogram display

This appendix described a program which used to display 14 histograms from a data file (in TTR format).This data file can come from "12 DAQ one" , "12 Q_STOP one" or TTR data acquisition program which is based on a Macintosh and has worked for more than one year.

The name of the main program is "12 ch_one". It includes two sub-routines "transfer" and "cog". Figure 4 is the front panel of this program.

The operating method of "12 ch_one" is almost the same as the main program of on-line display. The difference will be described below:

1. Before running "12 ch_one", you must set the number of "Start Event" at the front panel (the default value is 1). When "12 ch_one" runs, the digital indicater of " Number of Dis" will show you the number as follows:

   "Total Events" - "Start Event" + 1

This number is the new total events which will be used to off-line display and all the events before the number of "Start Event" will be cancelled.

2. When running "12 ch_one", You must select a data file from a directory in a dialog window.

Appendix B

Event Data Readout from a Data File

This appendix described a program which used to readout any event data from a data file (in TTR format). Figure 5 is the front panel of this program. The name is "rdata".

The upper part of the main window is the event data display area and the lower part is the control area. While running "rdata", a dialog window appears and you can select a data file from it. If the data file is in TTR format,four parameters of this data file will be displayed on the upper left of the control area,they are "FILE SIZE" (in bytes), "TOTAL EVENTS" , "EVENT SIZE" (in words) and "ERROR" . At the same time, the event data display area will show you the data of the first event.

On the middle of the control area,there are three control buttons,one digital indicater and one digital control."EVENT NUMBER" used to show which event appears in the event data display area.You can check this number with the corresponding data in this event. When you want to show the next event data, you may switch "NEXT" button from "off" to "on", after one second or so, switch back this button from "on" to "off", you will see the next event data on the upper part of the screen, and "EVENT NUMBER" is one more than the former. The function of "BACK" button is the same as "NEXT",only the direction is reverse. When you want to select a event number which is larger or smaller two or more than the former one, you may set "SELECT EVENT NUMBER" with this number, and switch the "SELECT DONE" button from "off" to "on", then operate the button "NEXT" as above, you can see the digital indicater "EVENT NUMBER" show you the same number of "SELECT EVENT NUMBER" and the data of this event is displayed on the upper part of the screen.

You must put back "SELECT DONE" button from "on" to "off" ,otherwise you can't get the next one event or back one event later.

On the upper right of the control area, there is a "QUIT" button. You can switch it from "off" to "on" to quit this program.

The event format structure(see Figure 5) for the TTR format is as follows:

Event Size	U16
DAQ Mask	U16
Trigger Mask	U16
Run Number	U16
Event Number	U32
Date and time	U32
Group size	U16
Group Mask	U8
Technology Type	U8
Crate Number	U8
Start Module	U8
Number of Modules	U8
Module Type	U8
Marker	48 * U16
Data	

The last two U16 words of anyone event are "65535". The event format structure of The Laser Experiment is the same as above,but cancel the marker,see Figure 6.

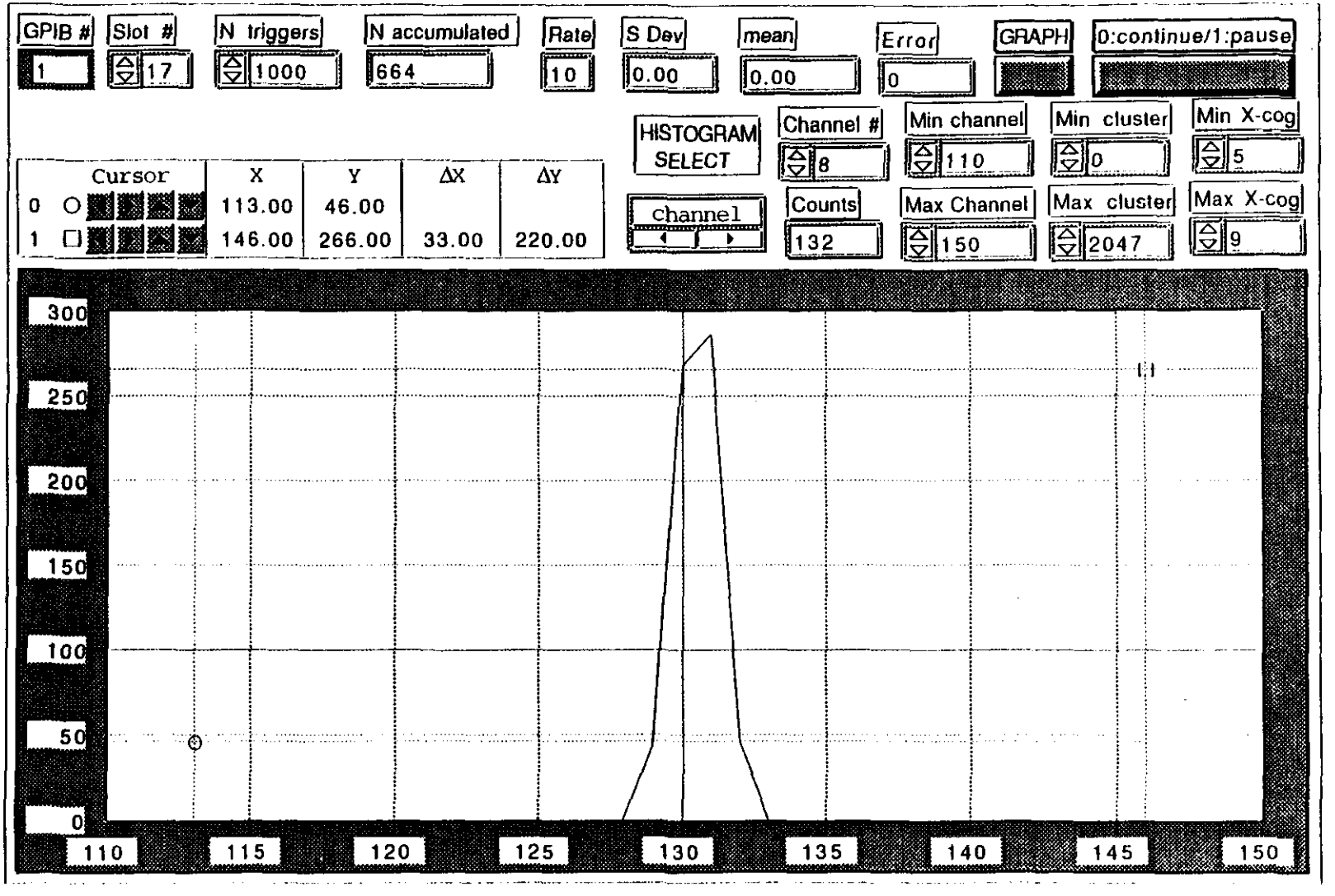

Figure 1 The front panel of on-line display program (Histogram Select is set to "Channel")

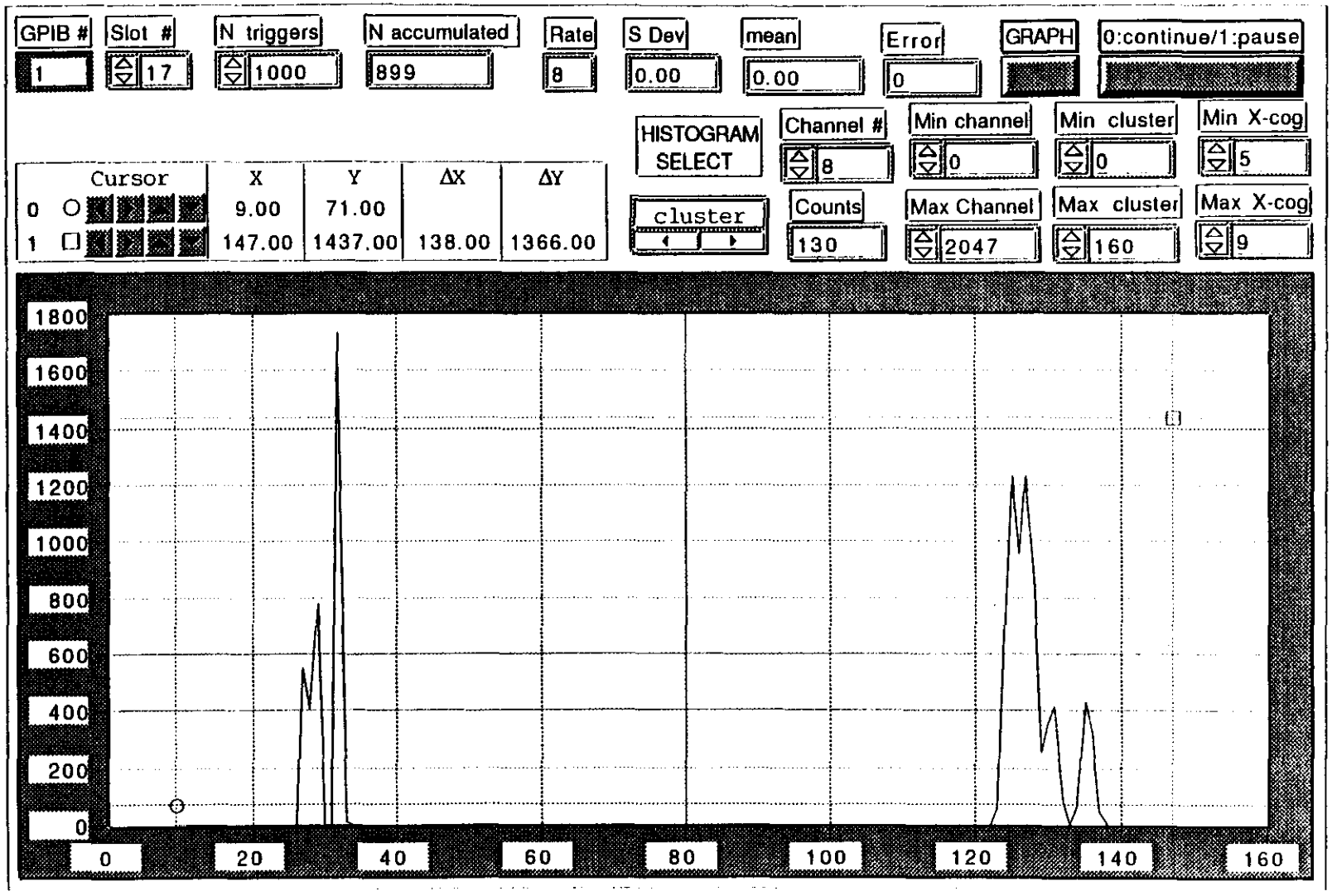

Figure 2 The front panel of on-line display program (Histogram Select is set to "Cluster")

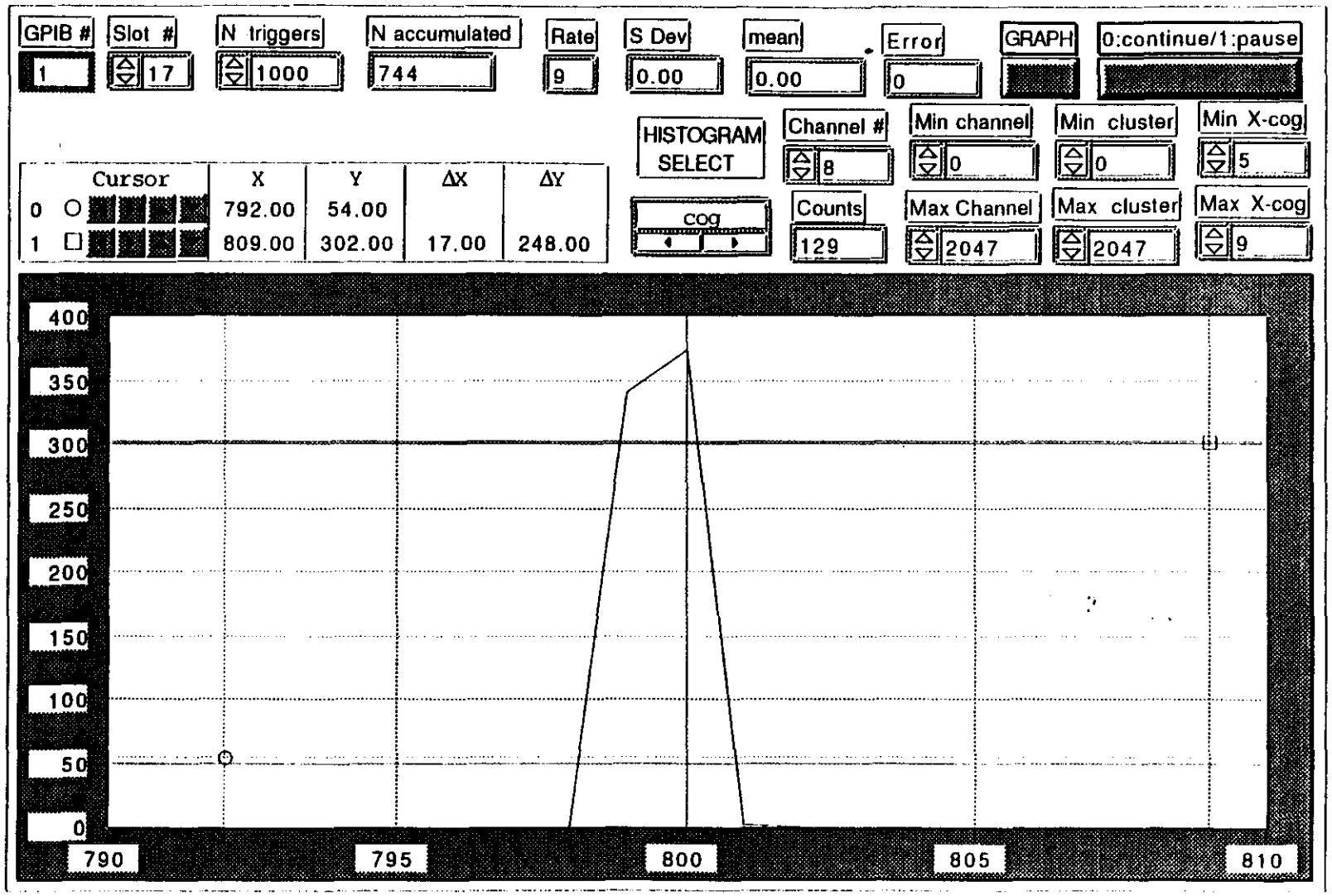

Figure 3 The front panel of on-line display program (Histogram Select is set to "Cog")

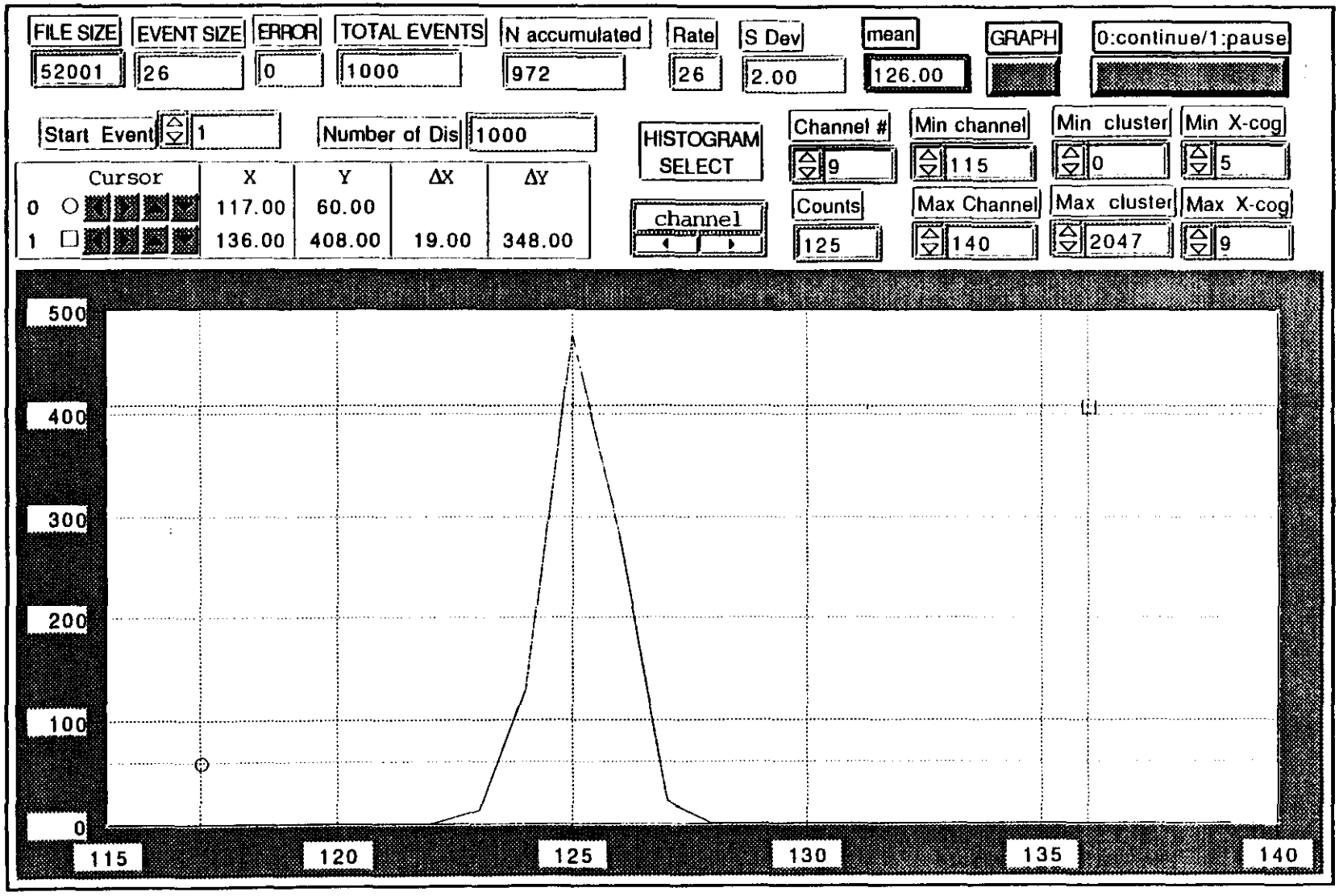

Figure 4 The front panel of off-line display program

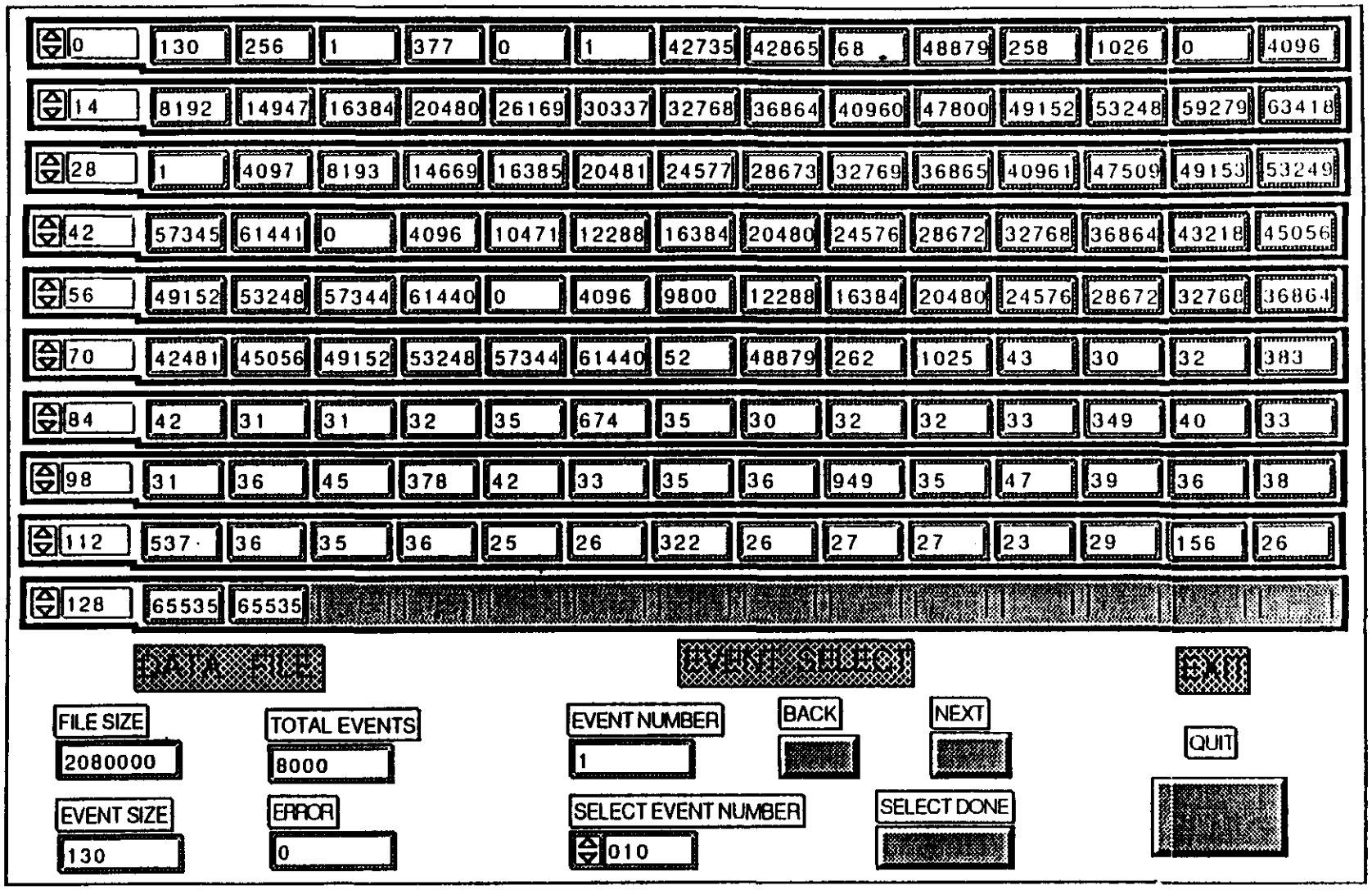

Figure 5 The front panel of event data display (Normal type)

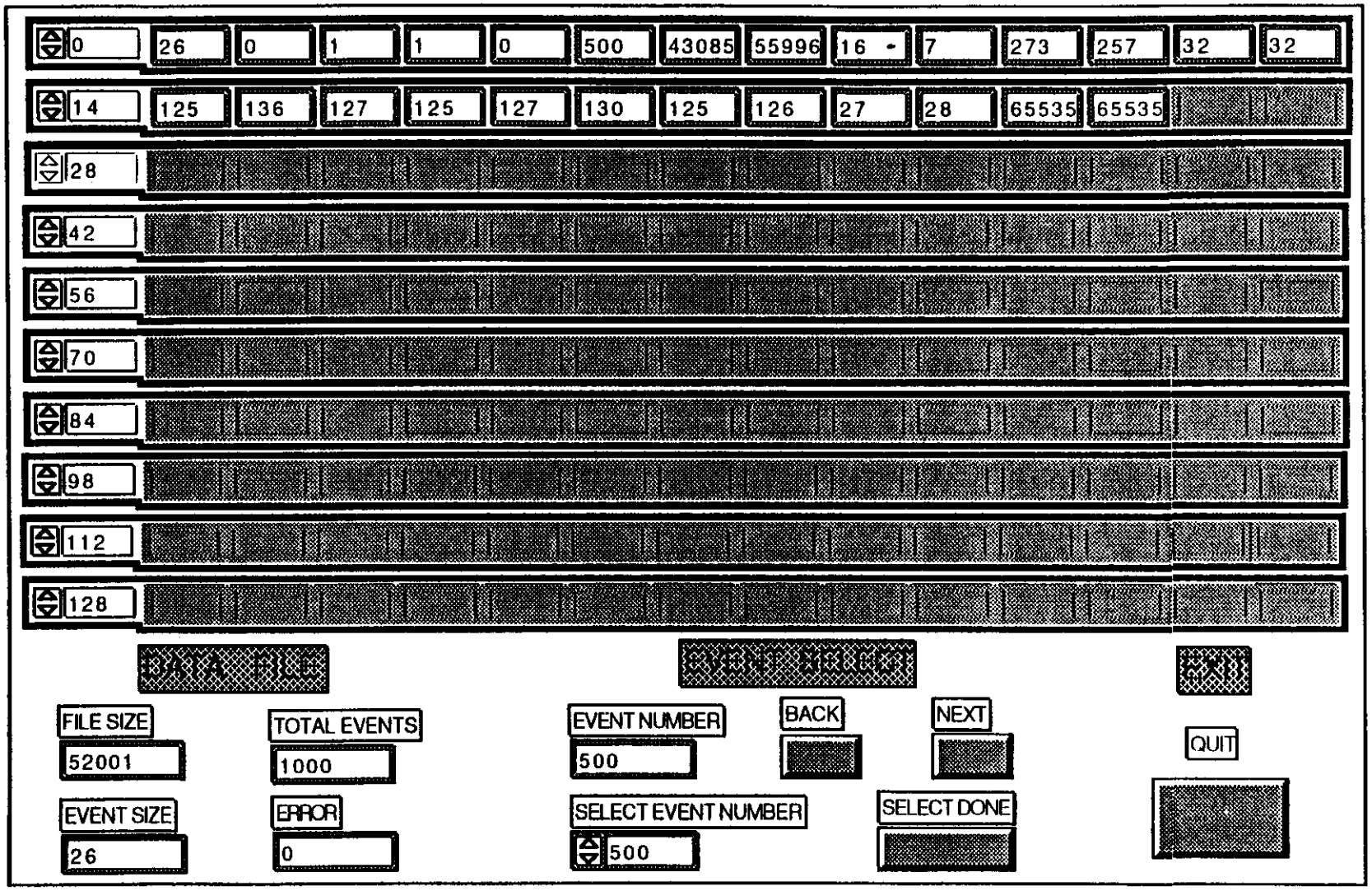

Figure 6 The front panel of event data display (Laser Experiment)

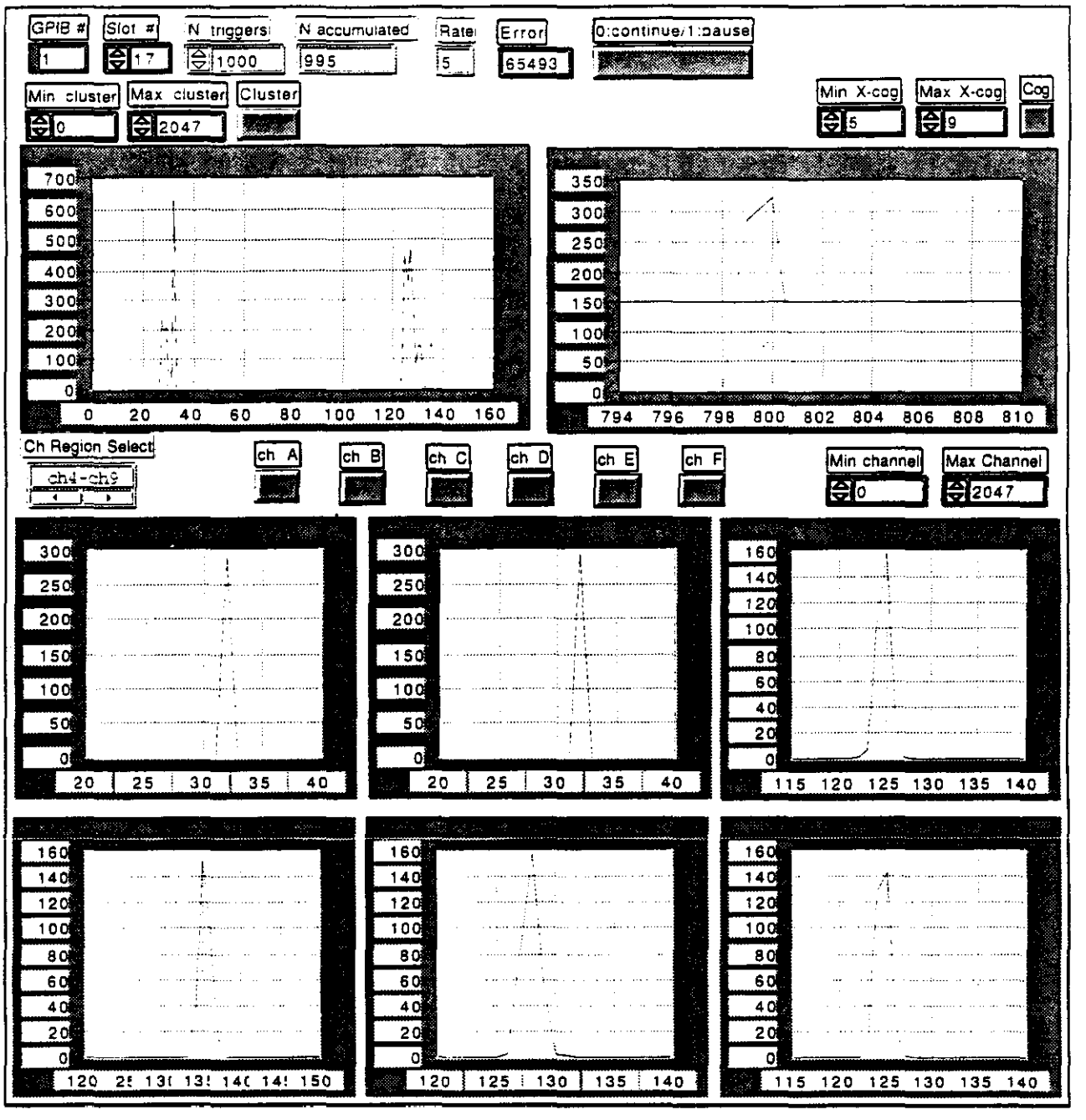

Figure 7 The front panel of 12 Q_STOP_8