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On-Line Display Used For Calorimeter Experiment

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June 15, 1993

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1. Description

The CAMAC-based Data Acquisition System which used at the TTR uses a SPARC station and VxWorks real-time operating system. It is a powerful equipment for a lot of experiment in GEM. The calorimeter experiment is one of it.

In the calorimeter experiment, we use three 12-channel ADC to record the data of PED flag, LED flag and 19 towers. The arrangment of these three ADC see Figure 1. If the ADC code of Pedestal or Led is greater than 900, we consider it is a "PED" or "LED" event. Otherwise we consider it is a "MUON" event. Figure 2b show you how to arrange the 19 towers in this experiment, figure 2a show you the data of an example of a muon event. The project of on-line display is to show three dimentional histogram of 19 towers during data acquisition.

We use the LabVIEW for Sun to design this on-line display software. The reason is as follows: LabVIEW is a powerful combination of old and new programing ideas. All the power and features of traditional programing language are harnessed in a new, friend enviroment that replaces lines of cryptic code with intuitive graphic objects.

On-line display program is an important software in calorimeter experiment, which can give the data of any event and graphically show three dimentional histogram of this event (see Figure 3-5). The advantage of this program is when you run this software you don't need to worry about if this software will influence the main program of data acquisition. You just load the data file from mass storage media which is produced by the main DAQ system. When data acquisition process lasts, this data file expanded gradually. So you can load the same data file again and again and can monitor the latest events if you like. This software is convenient to operate. You can load the data file at any time.

The on-line display application is written in LabVIEW for Sun in one main program and six subroutines. The name of the main program is cal-dispnj.vi, the six subroutines are as follows:

a. gsub1.vi
b. gsub2.vi
c. gsub3.vi
d. shelf.vi
e. total.vi
f. back.vi

The main window is divided in three parts, the upper part is the event data display area, the lower left corner is the drawing area which used to display the three dimentional histogram and the lower right corner is the control area. We'll described this three parts in detail .

2. Control area

While running "cal-dispnj.vi", 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 display on the "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.

Under the "DATA FILE" block,there is a "EVENT SELECT" block. Enclosed in this block You can see 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 half 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 switch back "SELECT DONE" button from "on" to "off",other-wise you can't get the next one event or back one event later.

Under the "EVENT SELECT" block.there are two buttons. "Graph Display" button is used to display the three dimentional histogram of the event which data is on the upper part of the main window. While the state of this button is "on", then at the time you switch the "NEXT" button from "off" to "on", event data will be appeared on the upper part of the screen,at the same time,there will be displayed a three dimentional histogram in the drawing area.If the state of this button is "off",then this area will be changed nothing. The name of another button is "QUIT". You can switch it from "off" to "on" to quit this program.

3. Event data display area

When you select an event in the control area and switch the control button ("NEXT" or "BACK") from "off" to "on",main program will show you the data of this event on the upper part of main window. The event format structure for the TTR DAQ system 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
Marker8	48 * U16
Data	

The last two U16 words are "65535". If the data of "PED" or "LED" is greater than 900, then a dialog window appears to show you this event is not the "Muon" event.

4. Drawing Area

In the drawing area, nineteen cilinders are displayed in five rows, which correspond the position of nineteen towers of this experiment. The height of this cilinders are equal to corresponding ADC code and the scale of coordinate of this diagram will be automatically set by main program. Two different cross section of these cilinders used to distinguish with neighbour rows.Figure 3-5 show you three examples of this experiment.

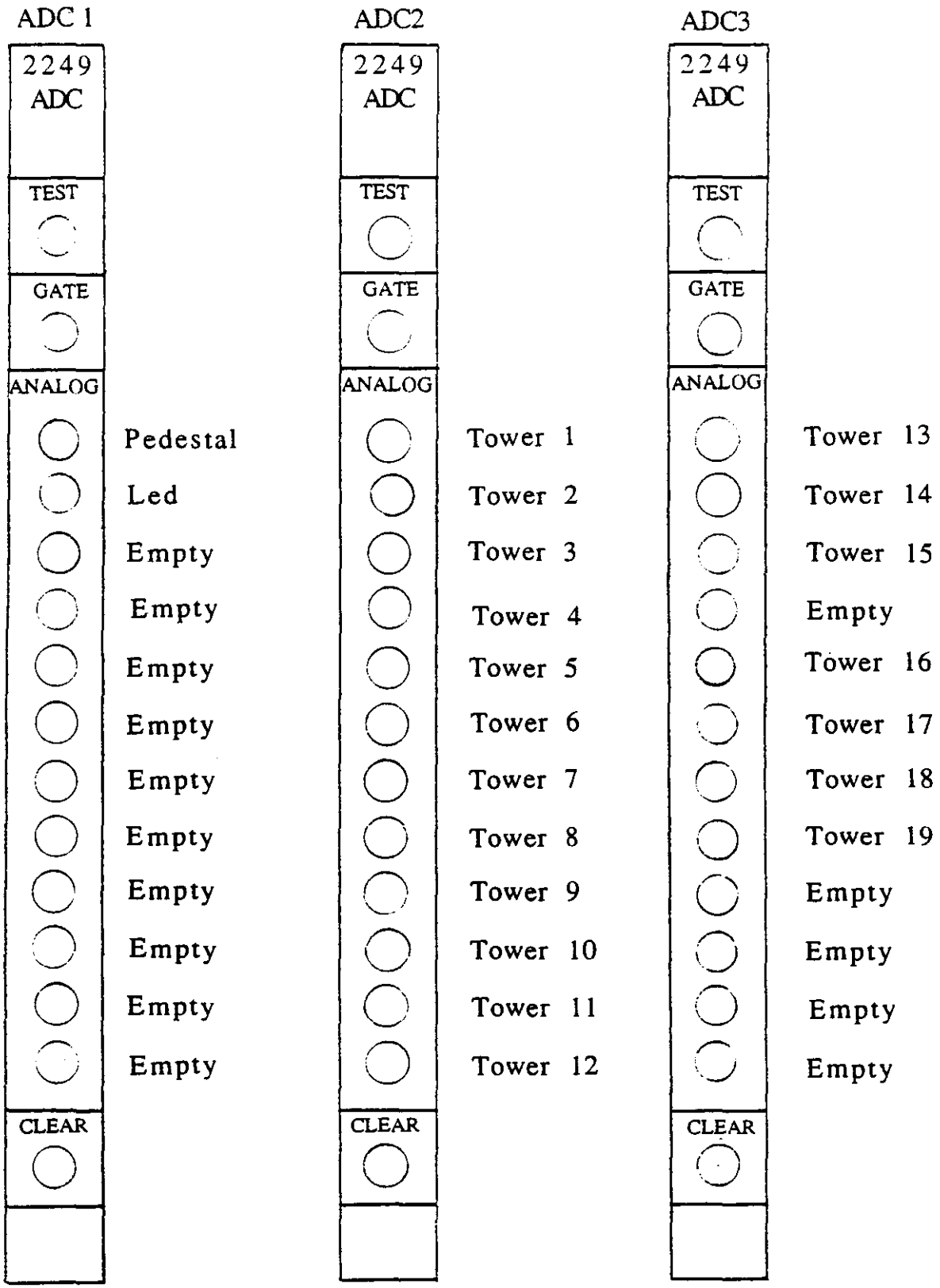
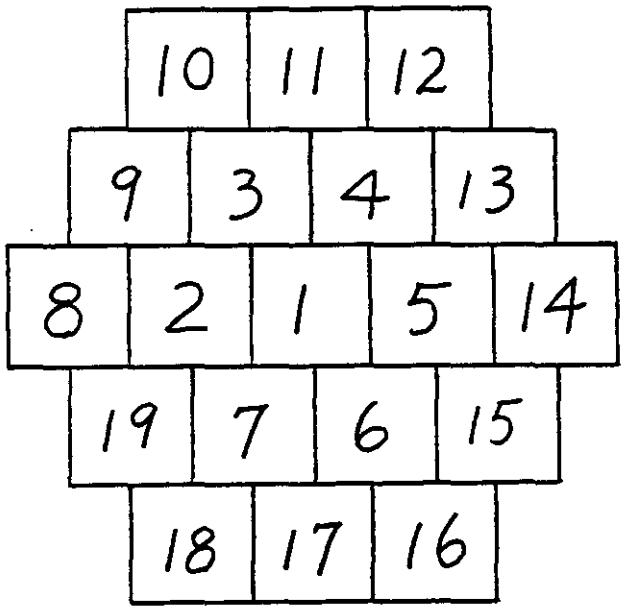


Figure 1 The arrangement of the three ADCs in calorimeter experiment

```
CONSIDERED REAL:
Plane number: 1
   Paddle number: 1   Tube A:      50      Tube B:      29
   Paddle number: 2   Tube A:      41      Tube B:      23
   Paddle number: 3   Tube A:      54      Tube B:      35
   Paddle number: 4   Tube A:      36      Tube B:      31
   Paddle number: 5   Tube A:      36      Tube B:      32
   Paddle number: 6   Tube A:      48      Tube B:      49
 Plane number: 2
   Paddle number: 1   Tube A:      41      Tube B:      29
   Paddle number: 2   Tube A:      34      Tube B:      31
   Paddle number: 3   Tube A:      55      Tube B:      49
   Paddle number: 4   Tube A:      44      Tube B:      32
   Paddle number: 5   Tube A:      41      Tube B:      34
   Paddle number: 6   Tube A:      55      Tube B:      49
 Plane number: 3
   Paddle number: 1   Tube A:      34      Tube B:      23
   Paddle number: 2   Tube A:      68      Tube B:      60
   Paddle number: 3   Tube A:      33      Tube B:      21
   Paddle number: 4   Tube A:      34      Tube B:      22
   Paddle number: 5   Tube A:      45      Tube B:      23
   Paddle number: 6   Tube A:      37      Tube B:      23
 Plane number: 4
   Paddle number: 1   Tube A:      34      Tube B:      20
   Paddle number: 2   Tube A:      36      Tube B:      26
   Paddle number: 3   Tube A:      34      Tube B:      22
   Paddle number: 4   Tube A:      35      Tube B:      23
   Paddle number: 5   Tube A:      33      Tube B:      23
   Paddle number: 6   Tube A:      34      Tube B:      21
Filling spake now
     ADC(1, 0) =      77
     ADC(1, 1) =      88
     ADC(1, 2) =      31
     ADC(1, 3) =      32
     ADC(1, 4) =      34
     ADC(1, 5) =      35
     ADC(1, 6) =      38
     ADC(1, 7) =      35
     ADC(1, 8) =      36
     ADC(1, 9) =      40
     ADC(1,10) =      39
     ADC(1,11) =      37
     ADC(2, 0) =      31
     ADC(2, 1) =      31
     ADC(2, 2) =      31
     ADC(2, 3) =      31
     ADC(2, 4) =      38
     ADC(2, 5) =      41
     ADC(2, 6) =      39
     ADC(2, 7) =      34
     ADC(2, 8) =      30
     ADC(2, 9) =      49
     ADC(2,10) =      43
     ADC(2,11) =      37
     ADC(3, 0) =      37
     ADC(3, 1) =      31
     ADC(3, 2) =      35
     ADC(3, 3) =      51
     ADC(3, 4) =      36
     ADC(3, 5) =      37
     ADC(3, 6) =      37
     ADC(3, 7) =      34
     ADC(3, 8) =      43
     ADC(3, 9) =      43
```

(a)

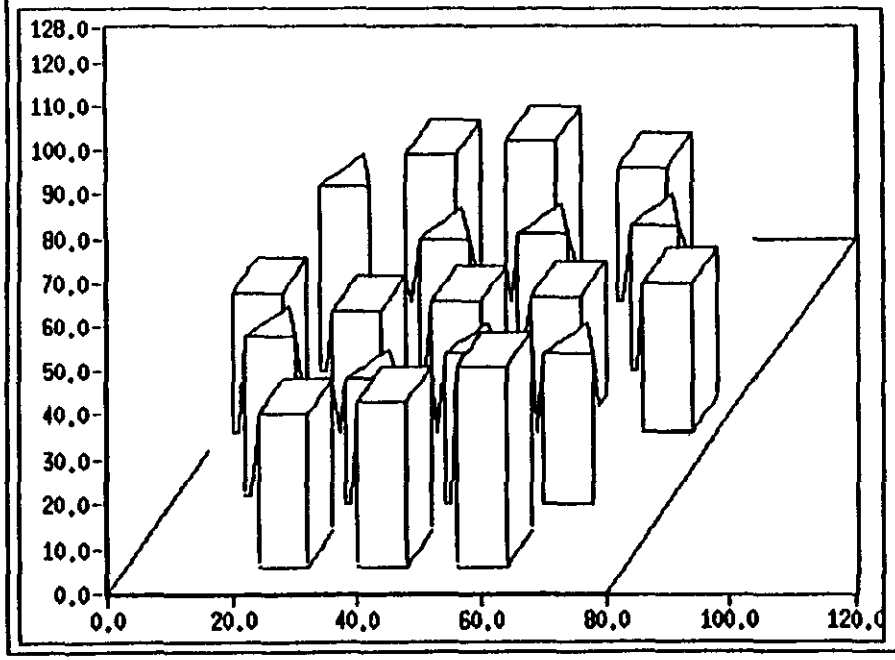


(b)

Figure 2 (a) The data of muon event(example)
(b) The arrangement of 19 towers

DATA

0	174	32	0	1497	0	18000	42956	4595	68	12	258	1026	1	4097	8193	12289
16	16385	24575	24577	28673	35232	36865	40961	45057	49153	53249	57345	61441	1	4097	8193	12289
32	16385	24575	24577	28673	35787	40959	40961	45057	49153	53249	57345	61441	4095	5837	8193	16383
48	16385	20481	24577	28673	32769	36865	40961	45057	49153	57343	57345	61441	2294	6428	8192	12288
64	16384	20480	24576	28672	32768	36864	40960	45056	49152	53248	57344	61440	52	12	262	1025
80	43	31	32	30	30	33	30	28	38	35	43	30	29	27	29	30
96	30	33	27	31	41	32	35	29	32	33	33	34	44	36	33	35
112	33	34	32	33	22	23	21	23	24	24	20	26	23	23	24	22
128	40	14	266	769	1130	83	35	35	37	38	41	38	39	43	42	40
114	32	33	22	23	21	23	24	24	20	26	23	23	24	22	40	14
160	36	37	37	33	43	43	40	42	4	13	1042	264	65535	65535	..	..



DATA FILE
File Size 6387988
Total Events 18356
Event Size 174
Error 0

EVENT SELECT
Event number 18000
BACK
NEXT
Select Event Number 18000
Select Done

EVENT GRAPH
Graph Display

QUIT

Figure 3 Event data and it's histogram(example 1)

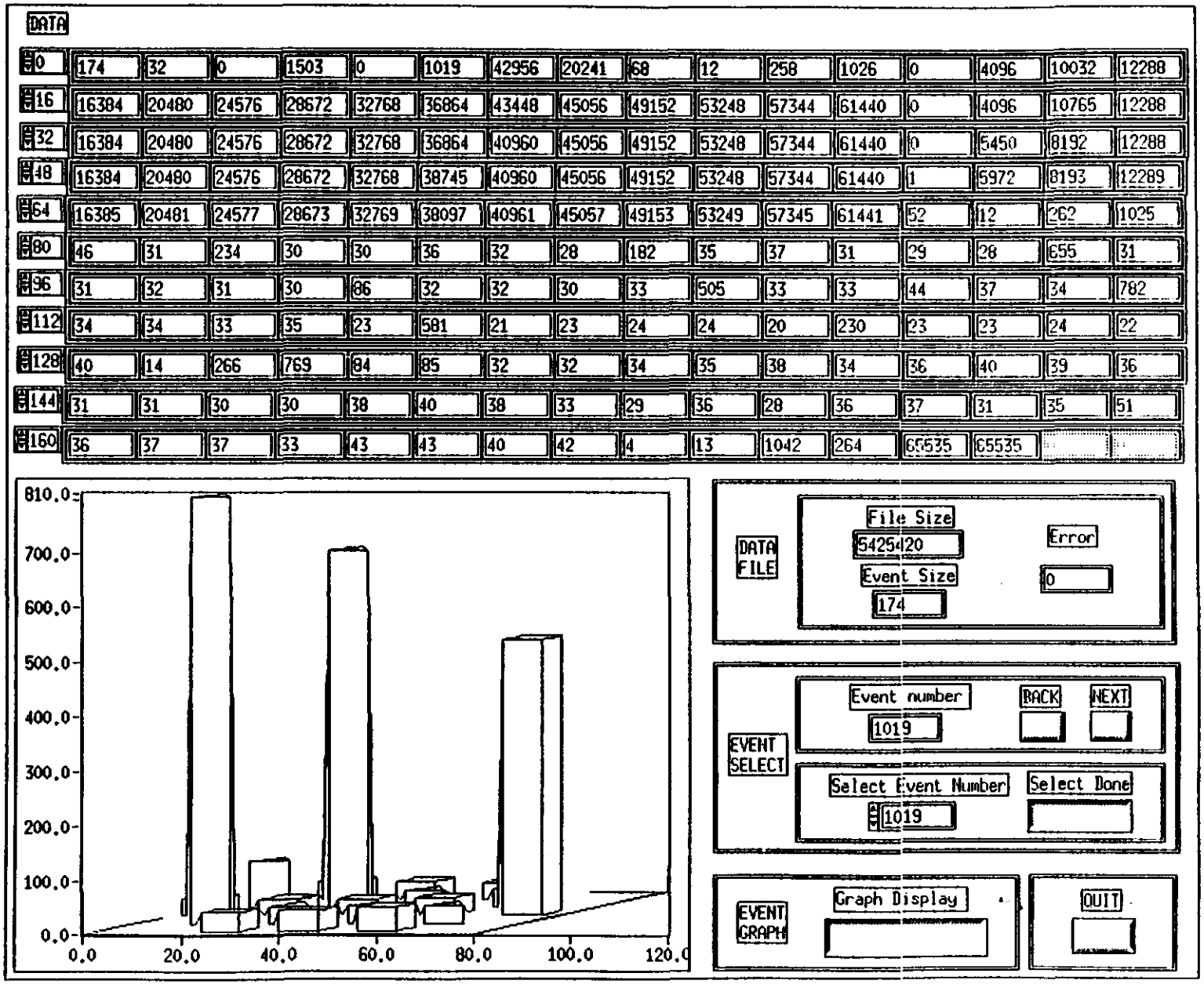
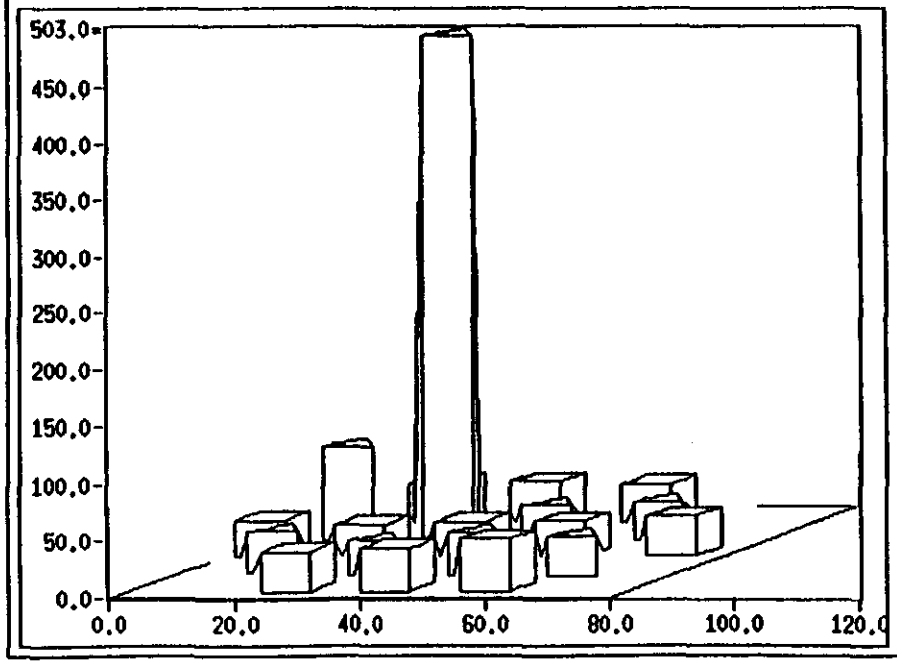


Figure 4 Event data and it's histogram(example 2)

Front Panel

DATA

0	174	32	0	1497	0	1007	42954	62678	68	12	258	1026	0	4096	10117	12288
16	16384	20480	24576	28672	32768	36864	43453	45056	49152	53248	57344	61440	0	4096	10753	12288
32	16384	20480	24576	28672	32768	36864	40960	45056	49152	53248	57344	61440	1	4097	0193	13644
48	16385	20481	24577	28673	32769	36865	40961	47027	49153	53249	57345	61441	1	4097	8193	14218
64	16385	20481	24577	28673	32769	36865	40961	46362	49153	53249	57345	61441	52	12	262	1025
80	44	32	266	31	31	33	33	30	138	38	42	31	30	28	445	31
96	31	37	30	32	83	35	36	33	34	34	34	420	45	37	34	36
112	35	724	33	35	23	24	22	591	25	24	21	27	24	266	25	23
128	40	14	266	769	83	90	31	32	33	35	38	34	35	39	39	36
114	33	35	23	24	22	591	25	24	21	27	24	266	25	23	40	14
160	36	37	36	33	42	43	40	42	4	13	1042	264	65535	65535		



DATA FILE

File Size: 6387988

Total Events: 18356

Event Size: 174

Error: 0

EVENT SELECT

Event number: 1007

BACK

NEXT

Select Event Number: 1007

Select Done

EVENT GRAPH

Graph Display

QUIT

Figure 5 Event data and it's histogram(example 3)