

ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE  
EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH  
Laboratoire Européen pour la Physique des Particules  
European Laboratory for Particle Physics



## PRINTER TEST

Jean-Noël Albert  
ALEPH Online

3 Nov 1988

This test measures the performance of different printing methods for VAX Station screen copy. One typical image is used, constructed by Joerg Richstein, from the TPC group.

### Presentation

#### Printers

This is the list of the tested printers and their characteristics.

LA100 - Dot printer.  
Can use 80 or 132 columns paper.  
Producer: DEC

LA50 - Dot printer.  
80 columns paper only.  
Maximum speed: 4800 bauds  
Producer: DEC

LA75 - Dot printer.  
80 columns paper only.

This paper has: 6 pages + 9 figures        annexes.

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A. Mazzari - EP

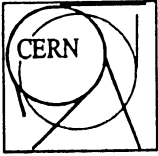
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Title (or ALEPH No.): \_\_\_\_\_

Author(s): \_\_\_\_\_

Date: \_\_\_\_\_ Signature: \_\_\_\_\_



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Maximum speed: 4800 bauds

Producer: DEC

LA75 - Dot printer.

80 columns paper only.

Maximum speed: theoretical: 9600 bauds.

( The test is made with the HSC printer. I can not modify the speed up to 4800 bauds)

Producer: DEC

LN03 - Laser printer.

Emulates the DEC dot printer functionalities (Protocol compatibility)

A4 sheet

Maximum speed: 19200 bauds

Producer: DEC

Note: The LN03 has a small memory (37 Kbytes). This is a problem for graphic printing and TeX printing (and probably for VAX DOCUMENT). But it is possible to add an external memory cartridge (128 kbytes). This printer has been tested with and without additional memory. Without external memory the test image is printed on two sheets.

LN03R - PostScript Laser printer.

A4 sheet

Maximum speed: 57,600 bauds

(Digital recommends using 9600 bauds with a VMS host)

Producer: DEC

LW (I) - PostScript Laser printer.

A4 sheet

Maximum speed: 9600 bauds (to be confirmed)

Producer: Apple

LW II NTX - PostScript Laser printer.

A4 sheet

Maximum speed: 57,600 bauds (Same for LW II NT)

Producer: Apple

## Connection

A printer can be connected on a VAX or on a DECserver. On the VAX station 2000, there are two output ports, up to 19,200 bauds. On the VAX station II or VAX station 3200, there is one output port, up to 38,400 bauds (the use of this port must be verified). The DECserver 200 can transfer data up to 19,200 bauds.

## Printing

There are two methods of printing. The first method is to copy the data directly onto the printer. This is the case when the printer is connected to the station. The second method uses a print symbiont. This is the case when the printer is shared between many users and VAXes. This is always the case for the PostScript printers. The VAX Station software enables the system manager to select one way or the other when a user makes a screen copy.

## Sixel vs PostScript

Using the VWS graphic system, data extracted from the screen are coded in sixel format.

Sixel is a DEC specific format for bit-map images. This format is very short. It was created for the dot-matrix printer. Most of the DEC devices understand this format. A DEC escape sequence initializes the sixel mode and another finishes it. So, it is possible to mix graphics and text.

The PostScript language is a 'de facto' standard for graphics and text printing on a laser printer. It was proposed by Adobe. A PostScript printer can be more powerful than a traditional printer and many manufacturers furnish this type of printer. PostScript is supported by Unix, X/DEC window, VMS, Apple for the MacIntosh and probably many other manufacturers. Many tools at CERN, such as PAW or some GKS, can generate outputs in PostScript.

PostScript is an interpreted language. Sending a PostScript image to a printer loads a program in the computer of this printer and executes it.

PostScript printers were recently introduced on the market, so the software can have some limitations. For example, the size of the bit-map image in PostScript is larger than in sixel.

The next generation of software can be more powerful and the bit-map size can be reduced (See 'Problems & solutions').

A PostScript printer can be very fast. Many of these printers use Motorola 68000 or 68020. In these tests, the measurements show that the limitations are due to the transmission time through the communication line.

For the dot-matrix printers, the data size is small and the limitations are due to the hardware.

### Aspect ratio

The dot printers have rectangular dots. Printing an screen image on dot printers gives an irregular image. To correct this aberration, it is necessary to print two pixels for each point of the image. The option 'aspect ratio' from the main menu of the station enables the user to select one mode or the other. The mode '2 to 1' is used with dot printers. The mode '1 to 1' is used with laser printers.

Using the mode '2 to 1' with a laser printer increases the print time by a factor of 2.

## Measures

The test image is a black and white image, with 456 lines and 1008 pixels per line (The full size of the VAX-Station screen is 1024 x 1024 pixels).

The test uses a captured file, so the time for extracting the data from the screen and building a file is not measured. This time is approximately 30 seconds for the image in this test.

### Aspect ratio 1 to 1

Device	VAX				
	Speed	Time	Processor	Connection	Method
LA50/LA75	4800	3 mn	VS 3200	DECServer	copy
LA100	9600	2 mn 33	8250	direct	copy
LN03R	9600	2 mn	VAX II	direct	print
LN03	19200	0 mn 44	8650	direct	copy
LN03	19200	0 mn 21	8650	direct	copy
+ cartridge					
LW II NTX	9600	2 mn	8700	DECServer	print
LW II NTX	19200	1 mn 20	8700	DECServer	print

### Aspect ratio 2 to 1

Device	VAX				
	Speed	Time	Processor	Connection	Method
LA100	9600	4 mn	8250	direct	copy
LN03R	9600	4 mn	VAX II	direct	print
LW II NTX	9600	4 mn	8700	DECServer	print
LW II NTX	19200	2 mn	8700	DECServer	print

## Printer characteristics

Device	Aspect	Full Screen	Landscape mode	Portrait mode	Scaling capacity	Regular aspect
LA50/LA75	2 to 1	?	?	yes	?	yes
	1 to 1	?	?	yes	?	no
LA100	2 to 1	?	?	yes	?	yes
	1 to 1	?	?	yes	?	no
LN03	1 to 1	?	?	yes	?	yes
DEC symbiont	1 to 1	?	yes	yes	?	yes
LAL symbiont (See at the end)	1 to 1	yes	yes	yes	yes	yes

(?) This symbol means I have not found a method to print in this mode.

## Problems and solutions

The first problem is to select a standard printer type for the group. The second problem is to reduce the transmission time.

If this standard is PostScript, three actions can be made to reduce the transmission time.

### 1. Select the '1-1' aspect ratio

The '2 to 1' seems to be the default. This option is associated with the logical name `UIS$PRINT_ASPECT`. It is set to 'YES' with the option '1-1'. This option is always reset to '2-1' when the option 'Use default settings' is selected.

To correct this feature, it is necessary to have more information on VWS.

### 2. Increase the line speed

It is possible to use a high speed interface (more than 19200), a DEC Server 200 (19200) or a local line (19200).

If we assume a 9600 baud line can send 960 characters per second, the minimum time to transmit the data of a PostScript image is given by the following table

image	aspect	size (blocks)	speed (bauds)	time
PostScript	1-1	230	9600	122 s (2 mn)
			19200	61 s (1 mn)
	2-1	450	9600	240 s (4 mn)
			19200	120 s (2 mn)

These values are compatible with the measurements

### 3. Reduce the size of the data

To reduce the size of data, it is necessary to modify the coding method used to represent the bit-map image. Currently a bit-map image in PostScript is described by a long string coded in hexadecimal. Each group of 4 bits is associated with one ASCII character. So a simple image is as big as a complex image.

It is possible to optimize this coding scheme using repeaters. A repeater is used to say that many successive codes have the same value.

This is possible because a PostScript printer contains a computer, and this computer can be programmed using the PostScript language. Using standard PostScript instructions guarantees these optimizations are portable on any PostScript printer.

The problem is that it is not easy to introduce this new coding scheme in the DEC software.

Another print symbiont exists. It is used at LAL (Orsay). I wrote this software before DEC delivered PostScript printers and software. This software is used in the same way as the one from DEC, i.e, it sends a full bit-map to the printer. It is necessary to make some tests to find the best solution to compact the data and to modify the symbiont to use this solution.

#### Advantages

The LAL symbiont is PostScript printer independent, so it is easy to use it with printers provided by different manufacturers. I have made tests with three types of printer. This solution can correct many problems currently pending between the DEC symbiont and the Apple printers.

#### Disadvantages

- This is a user solution. Long term support could be a problem.
- In the next months, DEC will introduce DEC Window for its stations, so it is possible a screen hard-copy will generate directly a PostScript description of the screen and not just an copy of the bit-map. In this case, the hard-copy can be faster than all current solutions.

## General problems

### Current problems using the DEC print symbiont

- No solution to select character size directly from the PRINT command. It is necessary to insert special escape sequences in the front of the text.
- No solution to print a subset of the file. All the pages are printed.
- No solution to share a DEC server port between two VAXes. This possibility exists for the other DEC printers but not for the PostScript printer.
- Long time between two prints, because all the prologue (a PostScript library) is reloaded before each print.

### Current problem between the DEC print symbiont and the Apple Laser Writer II NTX

- When we print a PostScript program, the print aborts with a PostScript error. The problem does not exist when we use some other way to send the file to the printer.

### General problem between the DEC print symbiont and foreign PostScript printers

- The DEC print symbiont uses special LN03R instructions. So, it is necessary to modify the DEC library before using this software with a foreign printer.

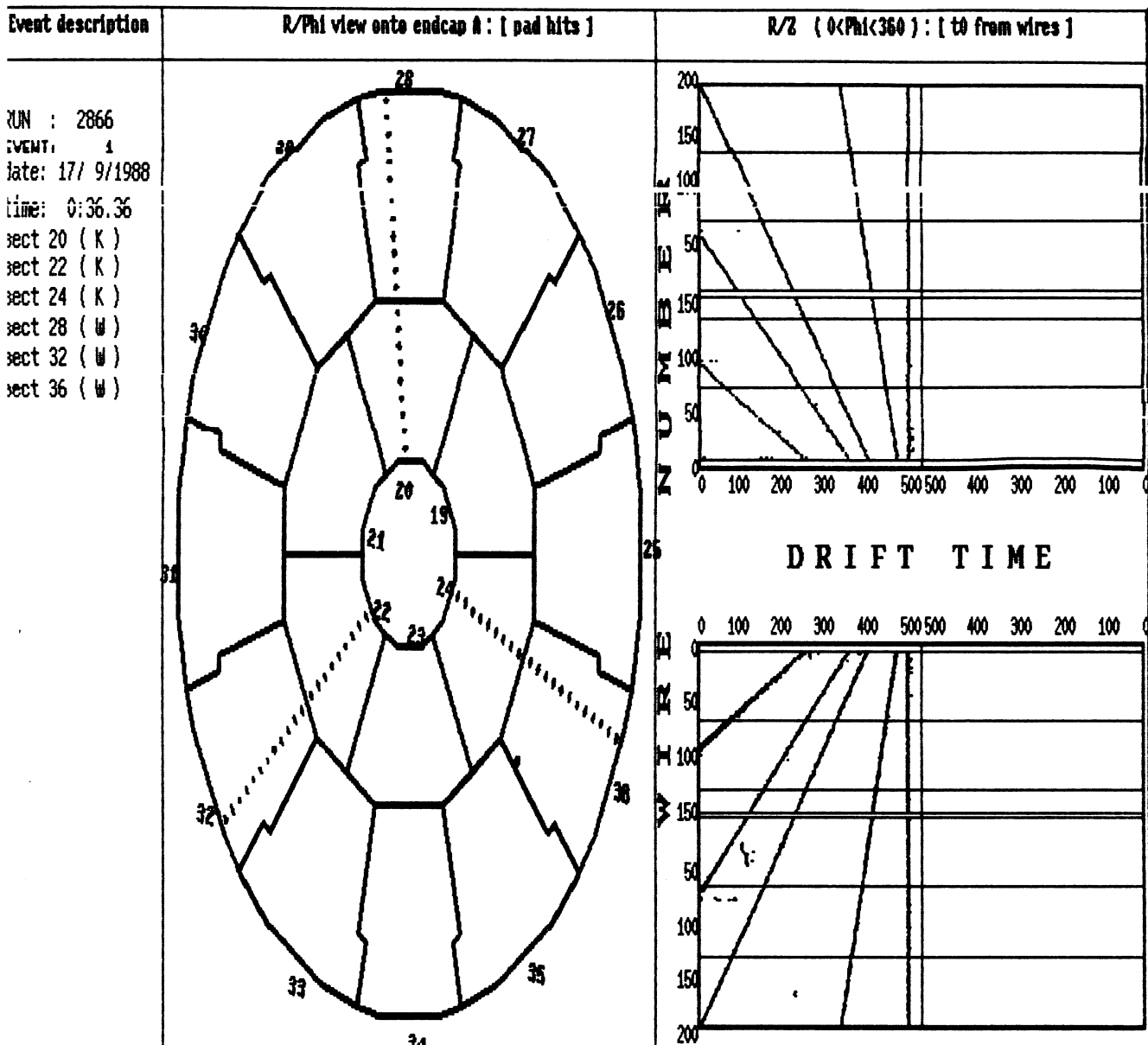
## Optimization

The first tests made to optimize the bit-map representation showed that it is possible to reduce its size from 230 disk blocks to 90. If we look at the time used to transfer these data we find the following results.

Coding	size	line	minimum
	(blocks)	speed (bauds)	time (second)
Full bit map	230	9600	122
		19200	61
Optimized	90	9600	48
		19200	24

Using an optimized print symbiont with the PostScript printers can reduce the bit-map representation and decrease the printing time.

The time needed to compute the full bit-map or the reduced bit-map is approximately the same (10 seconds on a VAX station 3200).

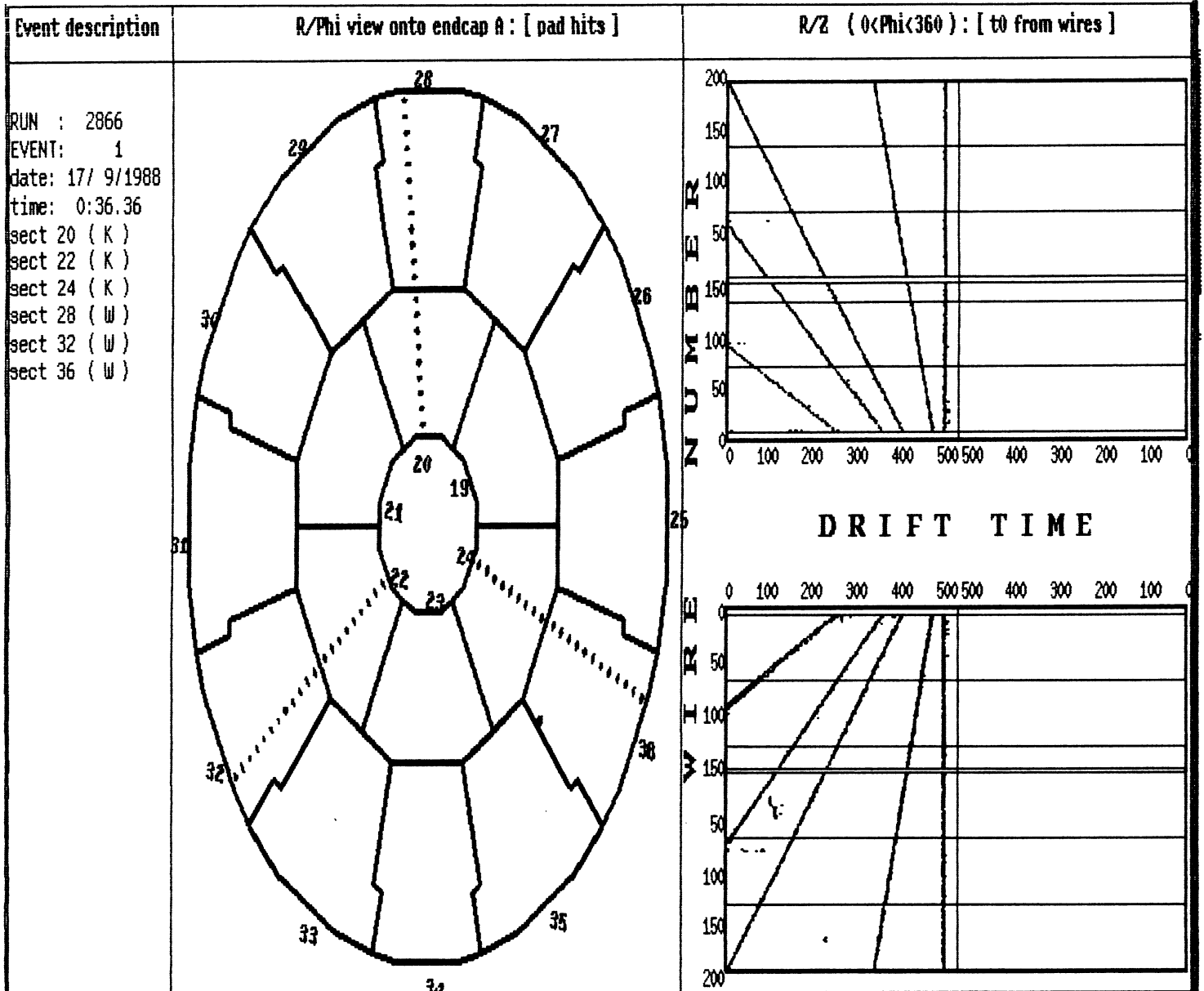


LA 50

ratio 1 to 1



DISK\$GENERAL:CALBERT.DEVELOPPEMENT.PRINTERJTPC...HALF...LASER.SIX;4



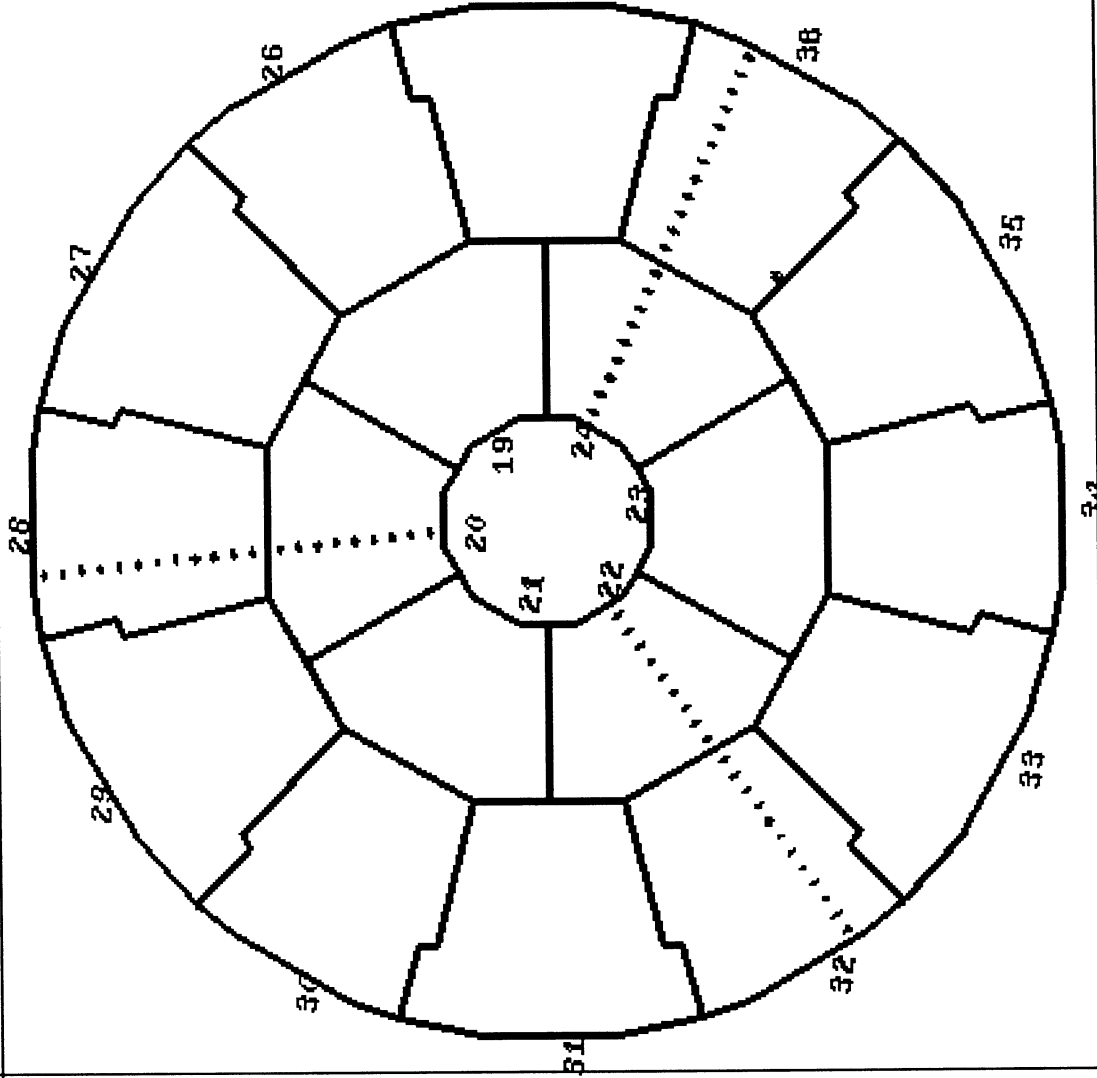
EC#

LA 100 - ratio 1 to 1

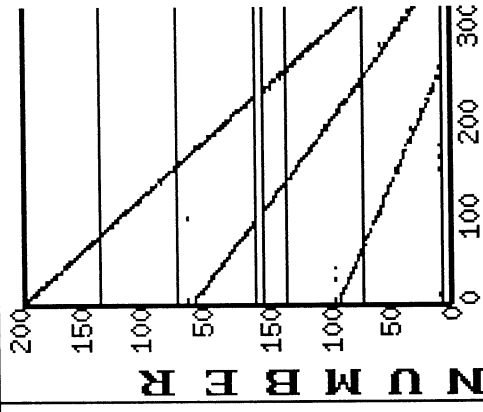
**Event description**

RUN : 2866  
 EVENT: 1  
 date: 17/ 9/1988  
 time: 0:36.36  
 sect 20 ( K )  
 sect 22 ( K )  
 sect 24 ( K )  
 sect 28 ( W )  
 sect 32 ( W )  
 sect 36 ( W )

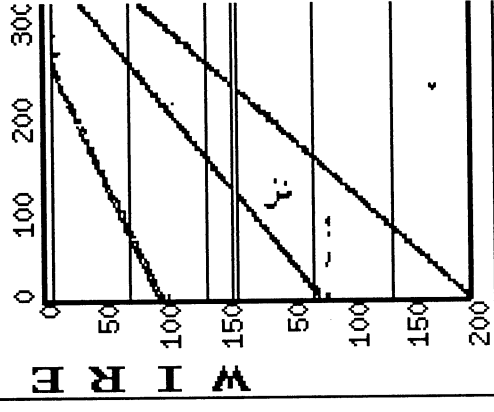
**R/Phi view onto endcap A : [ pad hits ]**



**R/Z ( )**



**DR**



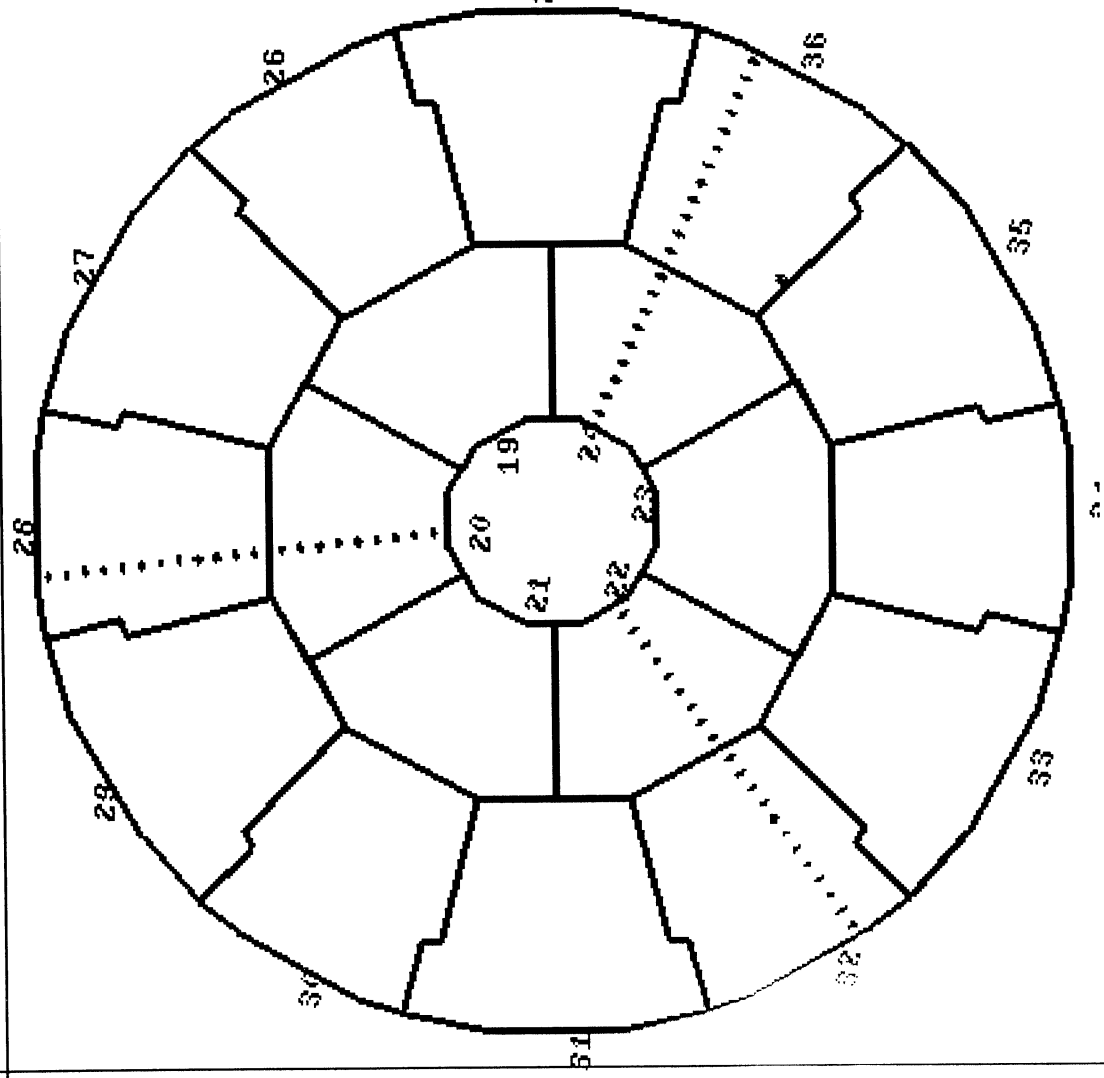
L-NOR or L-W IITX  
 using the DEC print symbiant.  
 ratio 1 to 1

Event description

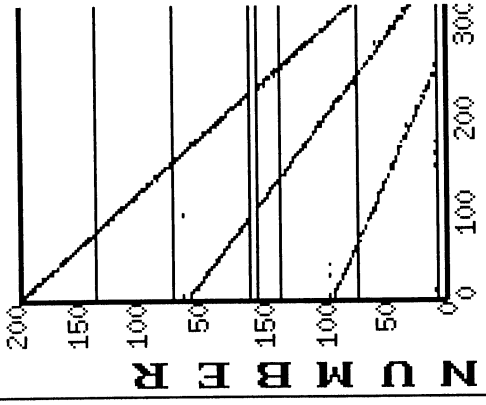
```

RUN : 2866
EVENT: 1
date: 17/ 9/1988
time: 0:36.36
sect 20 ( K )
sect 22 ( K )
sect 24 ( K )
sect 28 ( W )
sect 32 ( W )
sect 36 ( W )
    
```

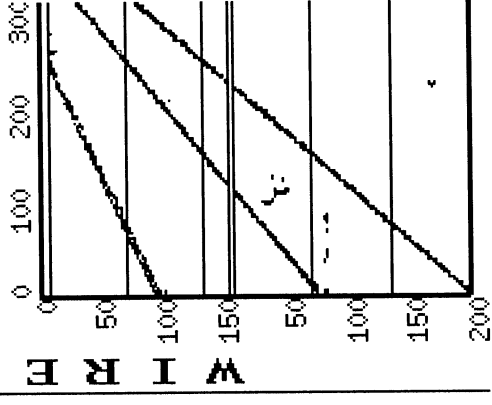
R/Phi view onto endcap A : [ pad hits ]



R/Z ( C



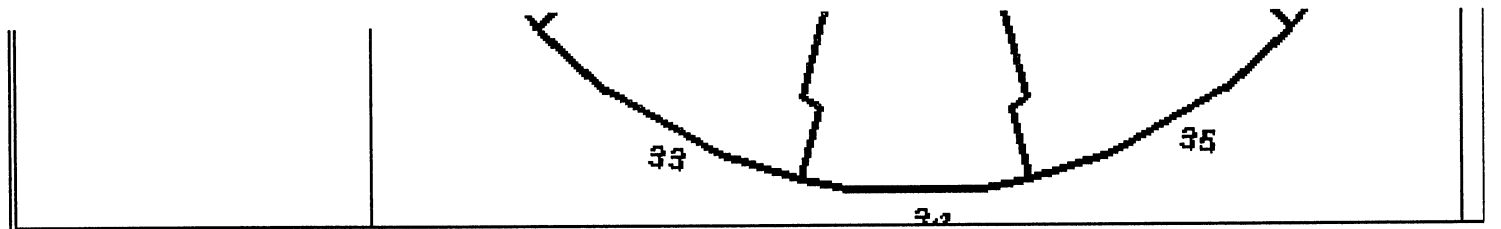
DR



Second test. LHO3R or LWII HTX  
 - DEC printer symbient  
 - ratio 2 to 1

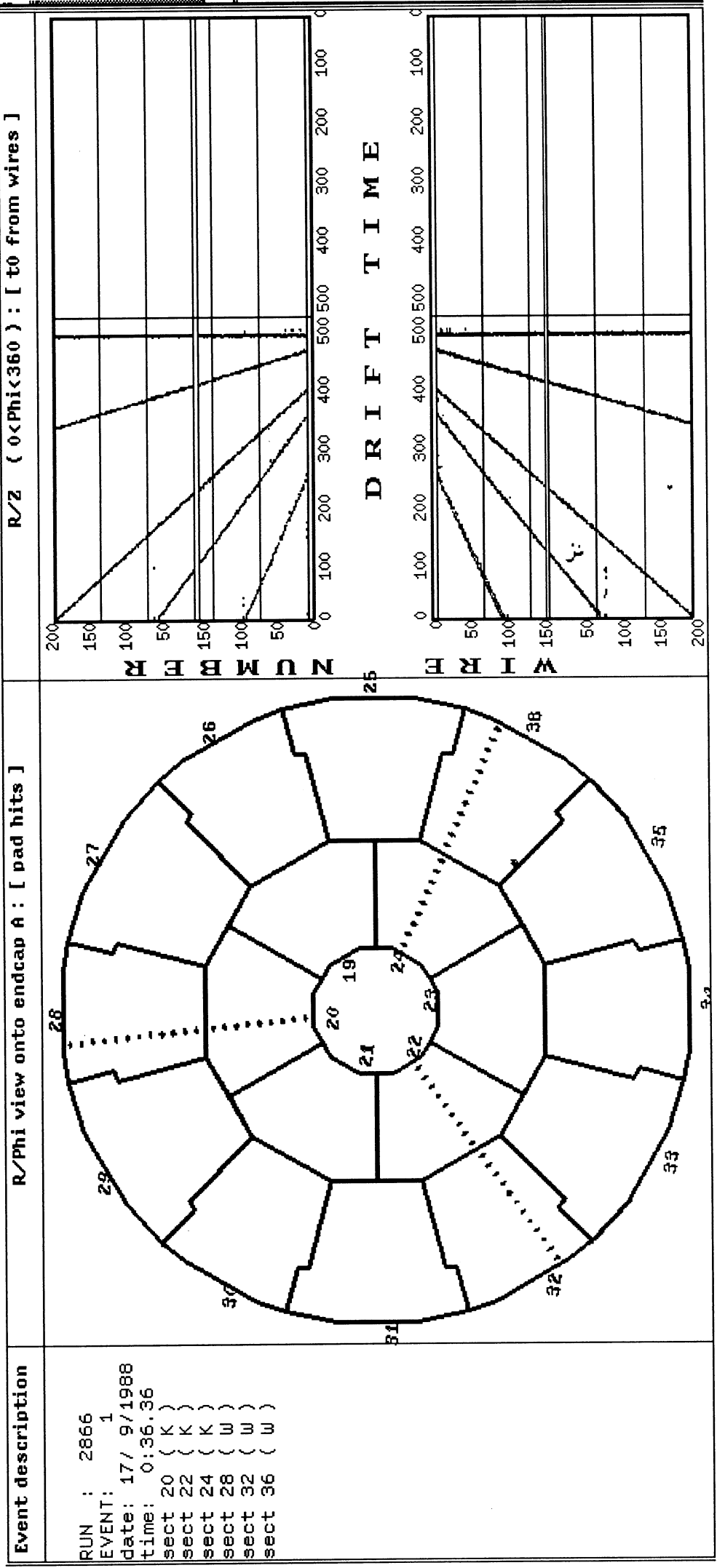
Event description	R/Phi view onto endcap A : [ pad hits ]
RUN : 2866 EVENT: 1 date: 17/ 9/1988 time: 0:36.36 sect 20 ( K ) sect 22 ( K ) sect 24 ( K ) sect 28 ( W ) sect 32 ( W ) sect 36 ( W )	<p style="text-align: right; writing-mode: vertical-rl; transform: rotate(180deg);">W I D E N U M B E R E D</p>

- 19200 bel
- LHO3 (without cartridge memory)
- 8650
- DMF32 (comp. (VM232))
- Time: 43.41 s

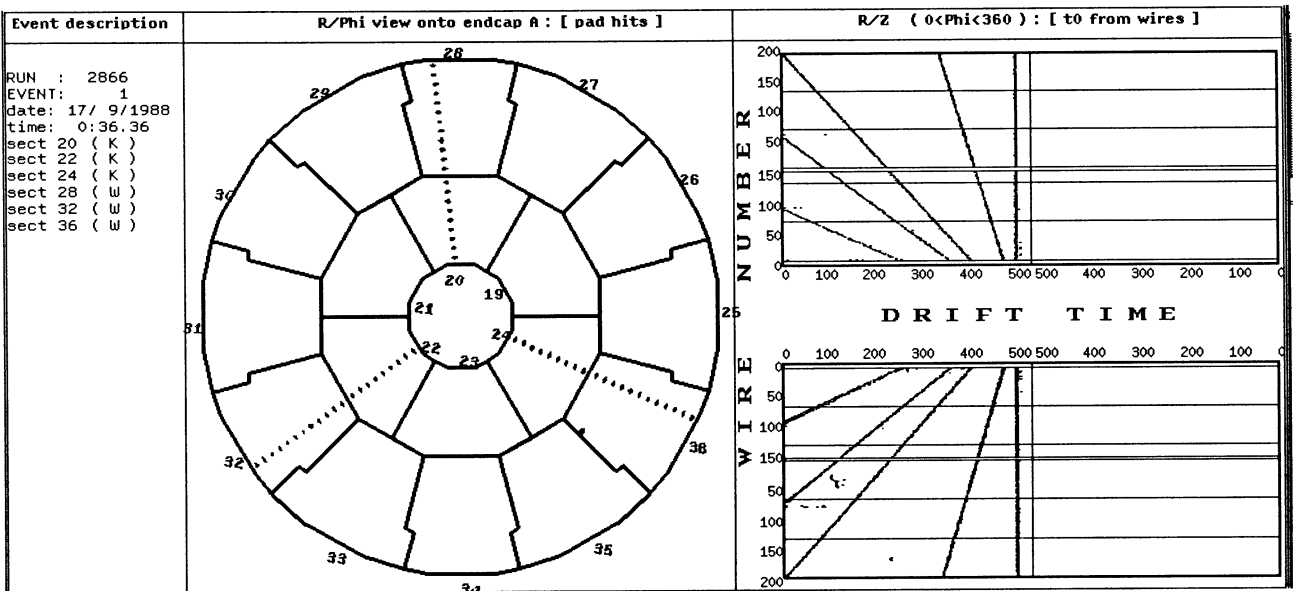


Event description	R/Phi view onto endcap A : [ pad hits ]
RUN : 2866 EVENT: 1 date: 17/ 9/1988 time: 0:36.36 sect 20 ( K ) sect 22 ( K ) sect 24 ( K ) sect 28 ( W ) sect 32 ( W ) sect 36 ( W )	<p style="text-align: right; writing-mode: vertical-rl; transform: rotate(180deg);">NUMERICAL</p>

- 19200 bcd
- LNΦ3 (1 memory cartridge)
- 8650
- DMF32
- Time: 22.4φs



L-W III NTX  
 2 At 8 jmbiant  
 Scale 0.80 in landscape } external convert.  
 on plot and document



LWII RTX

LAL symbiant

scale  $\phi.48$

condensed format } from an external  
 converter, for test.