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# A portable GPIB controller

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Abstract: A Portable PC (Toshiba 3200 SXC) has been equipped with GPIB, and Ethernet interface cards for storage of instrument traces and the control of instruments. A description of the system is given together with an application for a Lecroy 9450 Digital Storage oscilloscope. Here a useful feature of storing rare events to hard disk is described with the possibility of plotting/printing these traces on the network.

## THE PORTABLE GPIB CONTROLLER

The Portable GPIB controller consists of a PC with Ethernet and GPIB interface cards.

The PC is a Toshiba 3200SXC . It is a 386, 20 MHz Labtop, with 120 MB hard disk, 13 MB RAM (fully extended) and colour screen. With 120 MB it is possible to store large amounts of data and the colour screen is useful for applications where displaying of data on the PC screen is needed. It weighs 8 kg.

The Toshiba 3200SXC has internal space for 2 extension cards; one 16 bit (long) and one 8 bit (half). As GPIB interface a National GPIB II/IIA 8 bit card is used.

As mentioned earlier, the Toshiba 3200SXC is also equipped with an Ethernet card. This was mainly done to give the possibility of plotting/printing data traces on a network plotter/printer, either directly or from inside word processors like " WORD ". A Diane installation (including Qemm) has been done and the PC is therefore fully compatible with other PC's at CERN. The system looks as in Figure 1.

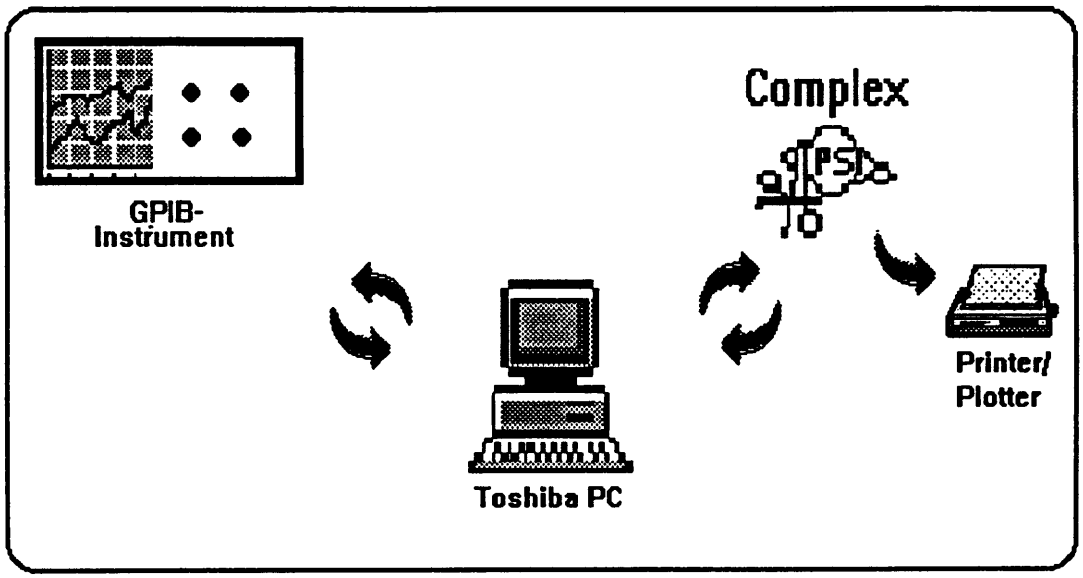


FIGURE 1
The system

## THE LECROY 9450A DIGITAL SAMPLING SCOPE
(or similar)

The 9450A has 2 unique features which makes it ideal for tracking rare events:

1. The Smart trigger
2. The Pass/Fail Mode

### 1. The Smart Trigger

Two levels of triggering are available in the 9450A: the standard trigger, the same as on all other scopes and the smart trigger.

To capture rare phenomena such as glitches and spikes, logic states or missing bits, an oscilloscope must be able to trigger on elusive events. To do, this two important facilities are given:

a) the ability to sense the logic states of the trigger sources, channel 1, channel 2 and external and to trigger on any chosen logic combination;

b) the ability to count a specific number of events with a pre-set counter or alternatively to measure time intervals.

This latter feature can be applied to introduce a post trigger hold off, which can be set as number of events or as a time interval. Hence, following defined starting conditions, the trigger can be given after a pre-set number of events or a pre-set time as well as after pulse widths or pulse separations greater or smaller than pre-defined values.

A block diagram of the smart trigger is shown on Figure 2.

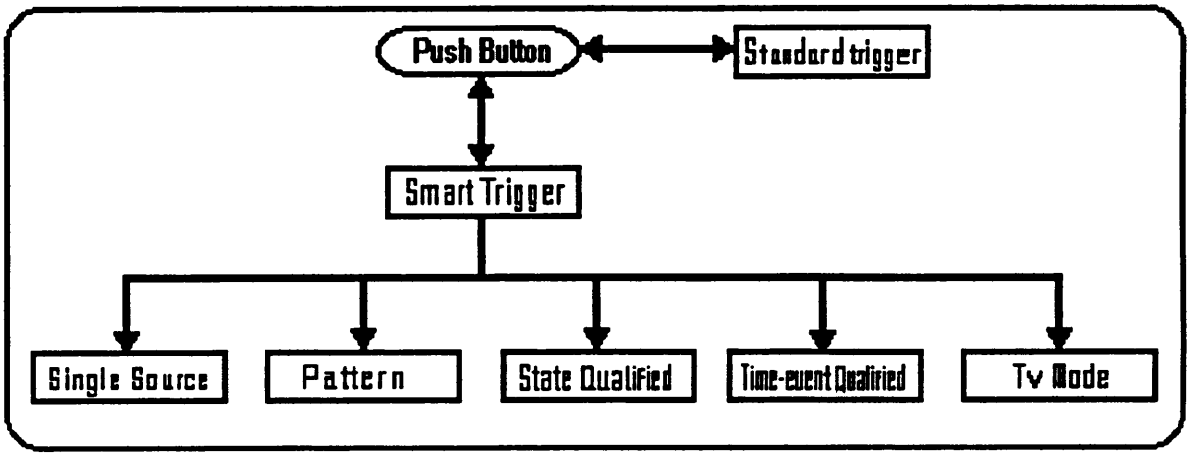


FIGURE 2
The Smart Trigger

Refer to the users manual for further information.

## 2. The Pass Fail Mode

After the scope has received a trigger, either with normal trigger mode or using the smart trigger, it is possible to set up a certain number (up to 4) of " test conditions " on one or several traces.

When the traces fulfil (or fail to fulfil) the conditions, it is possible to select a number of actions (e.g. store the trace to memory, beep etc.).

A picture of the Pass/Fail mode set-up panel is seen in Figure 3.

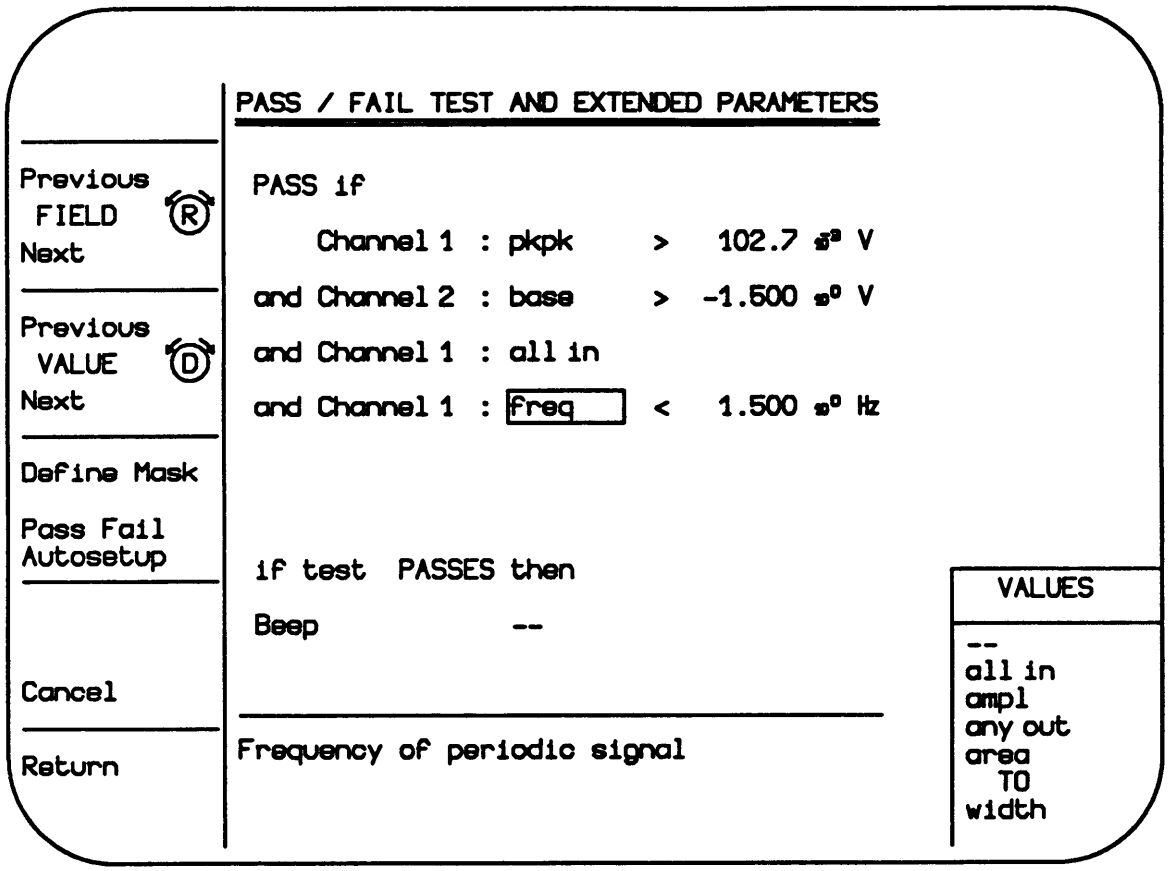


FIGURE 3
The Pass/Fail mode set-up panel

The following sources are available for testing:

| | |
|---|---|
| Channel 1 | |
| Channel 2 | |
| Expand A | Zooming, using Ch1 or Ch2 |
| Expand B | as source. |
| Function E | Traces performing arithmetic like averaging |
| Function F | FFT etc., using Ch1 or Ch2 as source. |

On each source the following tests can be performed:

| | | |
|---|---|---|
| All in | | All points from "Channel" visually within mask in memory C. See Figure 4. |
| Ampl | [ Volts ] | Difference between top and base value. |
| Any out | | All points from "Channel" visually outside mask in memory C. See Figure 4. |
| Area | [ VS ] | Integral of values. |
| Base | [ Volts ] | Nominal baseline of signal. |
| Cycle | | Number of cycles in display. |
| Delay | [ SEC ] | Time between trigger and first edge. |
| Duty | [ % ] | Duty cycle. |
| Fall | [ Sec ] | 90 - 10 % transition time. |
| Freq. | [ Hz ] | Frequency of periodic signal. |
| Maximum | [ Volts ] | Maximum value. |
| Mean | [ Volts ] | Mean (average) of values. |
| Minimum | [ Volts ] | Minimum value. |
| Over - | [ % ] | Overshoot negative. |
| Over + | [ % ] | Overshoot positive. |
| PkPk | [ Volts ] | Difference between max./min. |
| Period | [ Sec ] | Duration of one cycle of periodic signal |
| Rise | [ Sec ] | 10 - 90 % transition time. |
| RMS. | [ Volts ] | RMS. value. |
| Sdev | [ Volts ] | Standard deviation. |
| Top | [ Volts ] | Nominal "top" level of signal. |
| Width | [ Sec ] | Width of pulse (50 % Threshold). |
| - - | | No test condition. |

As seen in Figure 3 it is possible to "And" up to 4 different "tests" on 1 or up to 4 different channels.

It is also possible to store a complete reference image (e.g. from Ch1) and add to that horizontal and vertical tolerances.

An example of this is shown on Figure 4.

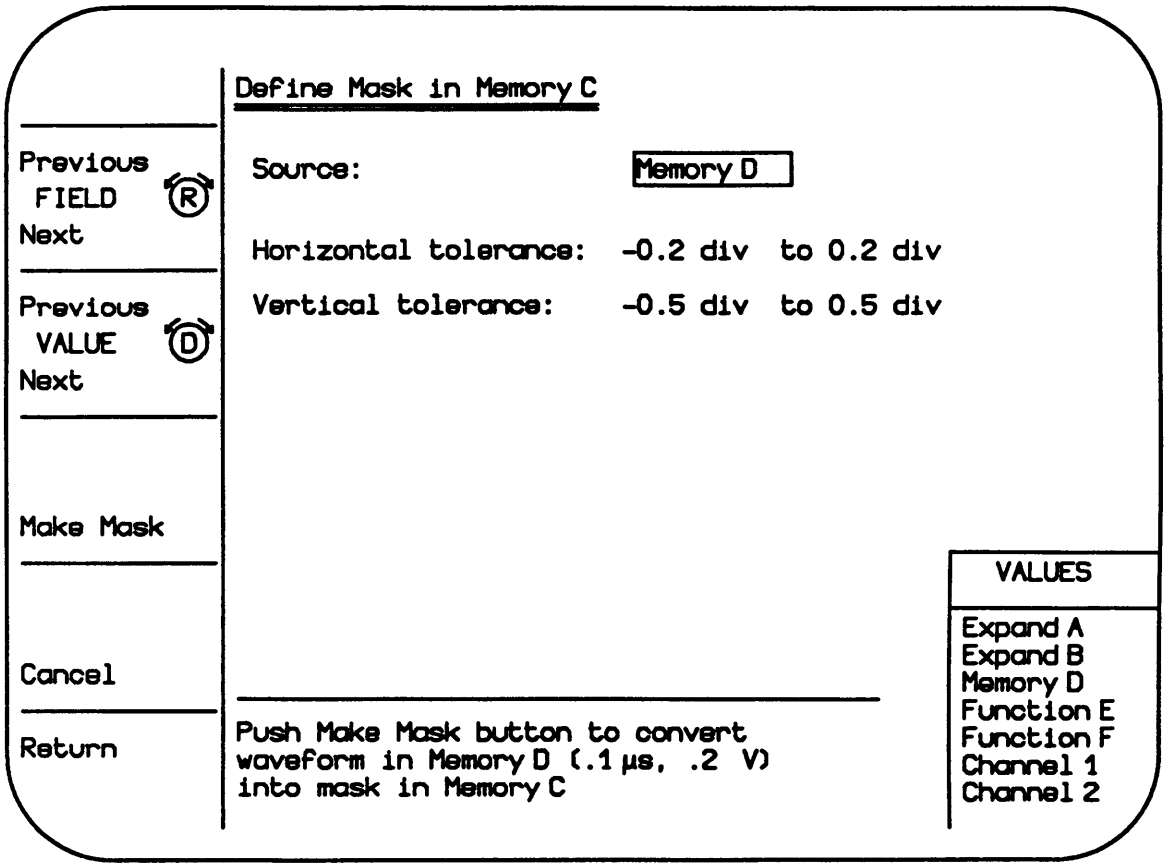


FIGURE 4
The define mask utility

If all of the conditions set (1 - 4) are fulfilled it is possible to program actions to be done. The choices are the followings:

| | |
|---|---|
| - - | Nothing, Not very useful |
| Beep | Beeps for 400 mS |
| Pulse out | Emit 10 µS pulse on Rear panel |
| Store to memory card | Store trace to memory card |
| Store to memory D | Store trace to memory D |
| Screen Dump | Make hard copy of screen |
| Stop | Set trigger mode to" single " |

The Pass/Fail utility is very useful to find/observe rare events e.g. in Accelerators where tracking intermittent events can be very time consuming. With the Smart Trigger and Pass/fail conditioning it is possible to filter the number of captures (triggers), but since 1 trace easily fills 100KB the oscilloscope's own storage capability is much too limited. This is where the portable GPIB controller with appropriated software comes in.

## THE LECROY 9450A APPLICATION PROGRAM

The Lecroy 9450A has internal memory and memory card, but these memories are very limited and to get full profit from the oscilloscope it is necessary to be able to store data on a hard disk.

A program running on a PC with GPIB interface allows storing/reading traces to/from the hard disk both manually or automatically in for example Pass/Fail mode. Here the PC will store a trace each time a trace has fulfilled the Pass/Fail conditions. The program is based on a program developed by Lecroy Inc., but with some modifications. It is written in GWBASIC.

When running the Program the following menu is displayed on the PC screen:

GPIB Remote Control Program for the Lecroy 9450/24/20 and IBM PC

Options available are :

S = Store  R = Recall  C = Command  Q = Query  L = Local  E = Exit

| | |
|---|---|
| REP = | Automatic Repeat Capture |
| PASS = | Automatic Capture in Pass/Fail mode |
| PLAY = | Play Repeat Capture Wave forms |
| D = | Change Device Address |
| SD = | Screen Dump To Disk File |
| SP = | Store Panel Set-up |
| RP = | Store Panel Set-up |

Press ENTER for option explanation and instructions.

Enter Option S, R, C, Q, L, E, D, SP, SD, RP, REP, PASS, PLAY, or O for list.

FIGURE 5
The Lecroy 9450A menu

The program is self explanatory and will prompt for oscilloscope channel, filenames and directory. Here follows an explanation of all the commands.

| | |
|---|---|
| REP = | Automatic storage of traces to hard disk. Each time the scope receives a trigger the trace will be stored to hard disk. The program will ask for the file name and add an incremented index for each storage ( .wav1, .wav2, etc. , etc. ). |
| PASS = | Automatic storage of traces to Hard disk.<br>Here the program surveys if a Pass/Fail condition has occurred and then stores the trace to hard disk. Again the program asks for the filename and adds an incremented index<br>e.g. "filename.wav2". |
| PLAY = | Automatic recall of traces.<br>With this command it is possible to replay the traces stored with "REP" or "PASS" back onto the oscilloscope. The program asks for the filename and will start replaying traces starting with index "wav1". Between each replay the program asks you if you want to continue. |
| S = STORE | Manual storage of trace. The program will prompt you to specify the source trace. Example: C1 allows you to store the wave form on Channel 1. The program will then prompt you for the filename. You may also specify a drive and or a directory if you want to save the wave form on a floppy disk. |
| R = RECALL | Manual recall of trace. The program will prompt you for the target memory MC, MD, ME, or MF then you are prompted for the Filename [drive] [path] [filename]. |
| SD = | Screen dump to disk file. For documentation purposes it is possible to make a hard copy of the oscilloscope screen. See hard copy on page |
| SP = | Store panel set-up. The oscilloscope settings will be stored to disk file. |
| RP = | Recall panel set-up. |
| C = COMMAND | Is any GPIB command listed in the 9450/24/20 manual.<br>Example: TDIV 1MS will change the Time per Division scale to 1 ms. |
| Q = QUERY | You may use the Q command for GPIB Commands that require the DSO to produce an answer. Example: TDIV? would produce a reply from the DSO stating the current Time per Division setting. |

| | |
|---|---|
| D = | Change device address. Default device address is " Dev4 ". GPIB address of instrument. |
| L = LOCAL. | This command will return local control to the DSO until a new command is entered. |
| E = EXIT | Will return you to DOS. |

## PRINTING AND PLOTTING

Single and multipen plotters as well as IBM, HP Quiet jet, Think jet, laser jet and EPSON printers can be used to make hard copies of the display. The Hard copy set-up panel of the 9450A is seen in Figure 5. The supported plotters are : HP 7400 - 7500 series, PHILIPS PM 8151, GRAPHTEC FP and compatible models.

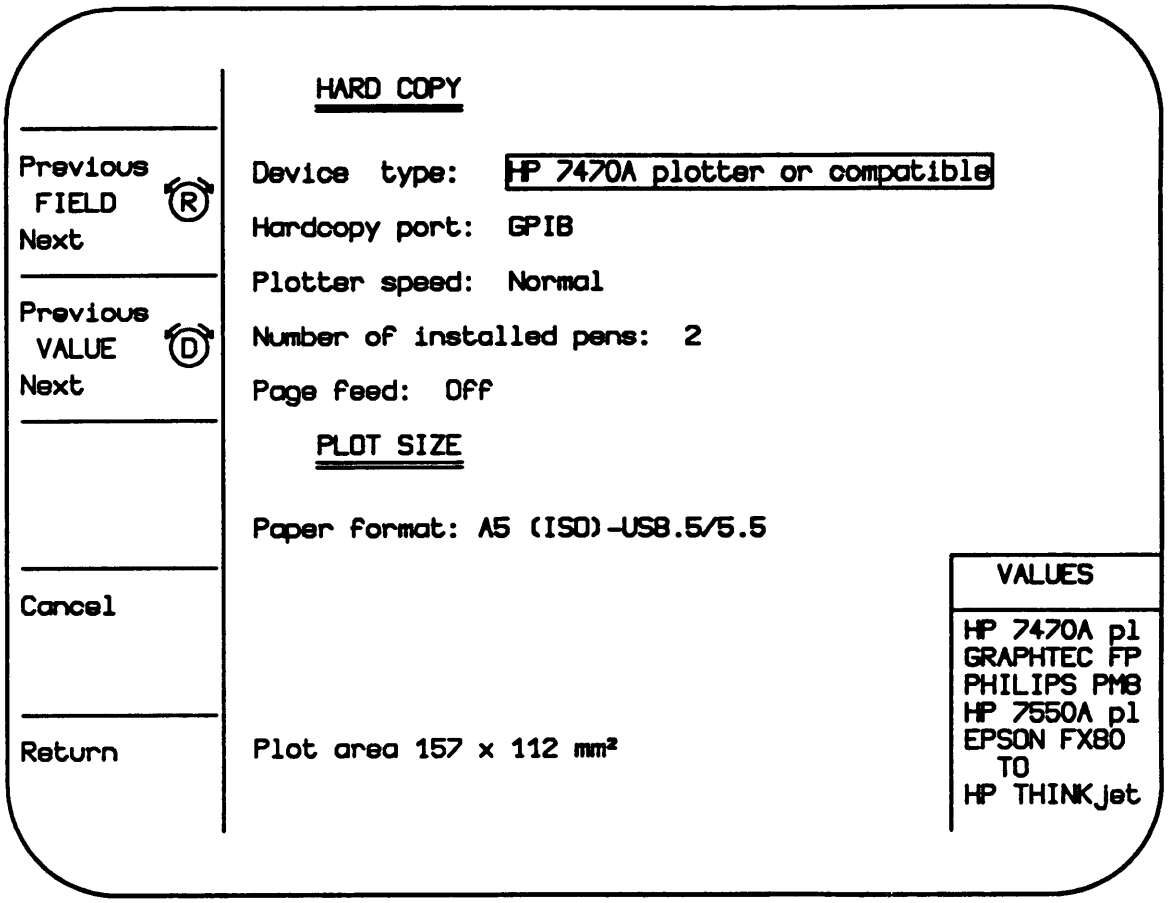


FIGURE 6
The hard copy set-up panel

The best results are obtained by using one of the plotters either directly by using the "send file to network printer" utility under windows or by using a word processor like "WORD" into which it is possible to "insert picture". In both cases it is a HPGL file, produced by the "SD" (screen dump) command, which is used. When using the plotters directly it is normally on LPT3. Word uses postscript on LPT2.

Slightly less good results are obtained by using a laser-printer or similar. Again it is the "SD" command which will generate a hard copy of oscilloscope screen and the "send file to network printer" utility which will send the file to the printer wanted, normally on LPT1.

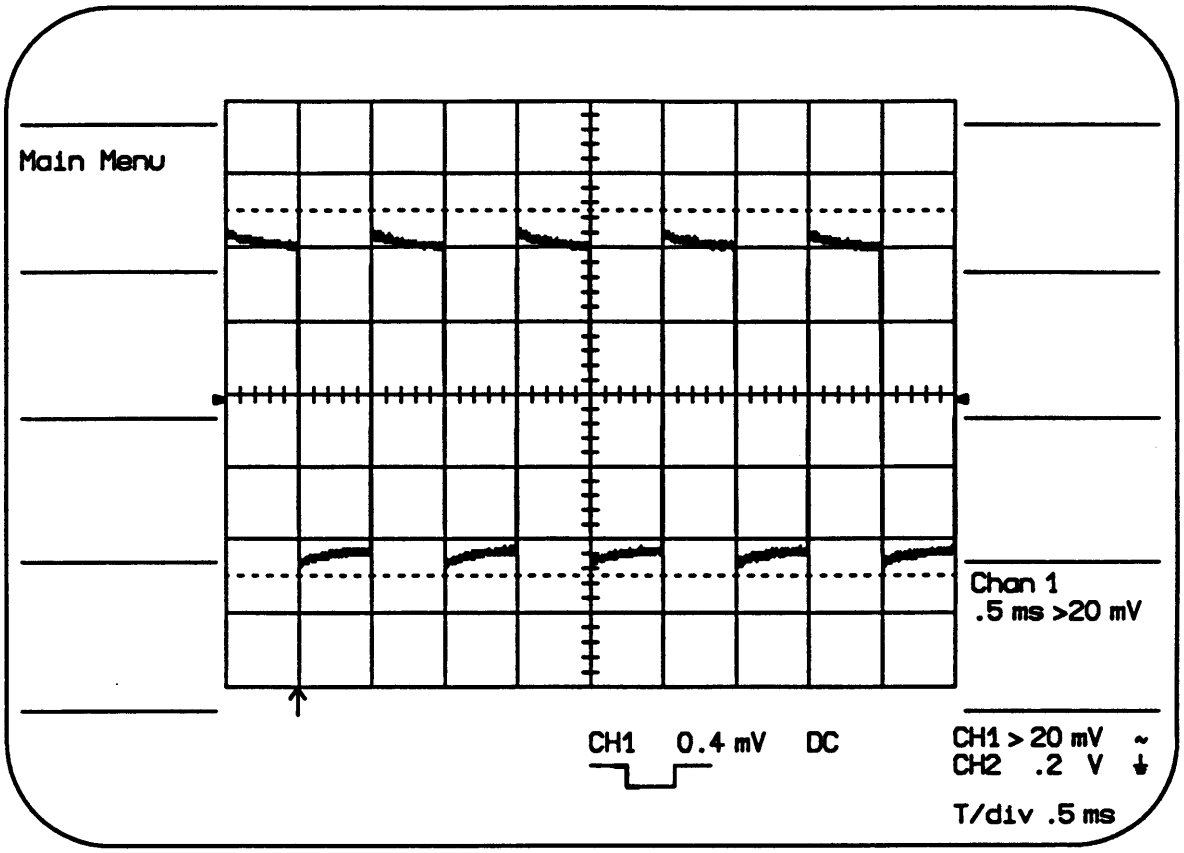


FIGURE 7
Typical hard copy

Remarks: The possibility of storing instrument data onto hard disk is not a new feature, several fixed installations with Camac-GPIB interface and dedicated instruments already exist at CERN. The advantage of this system is the portability. The Toshiba 3200SXC can be connected at any GPIB instrument anywhere at CERN and the data can be sent to any location via Ethernet. Together with the unique Trigger and Pass/Fail modes of the Lecroy 9450A it is also a powerful tool for tracking rare events.

So far we have limited ourselves to storage and recalling of data to/from the instrument with the possibility of printing hard copies on a network printer. The display and manipulation of data on the PC screen is already common and is the future trend.