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# BEAM MONITORING IN THE SWITCHYARD SYSTEM VIA SWIC DETECTORS

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## PURPOSE

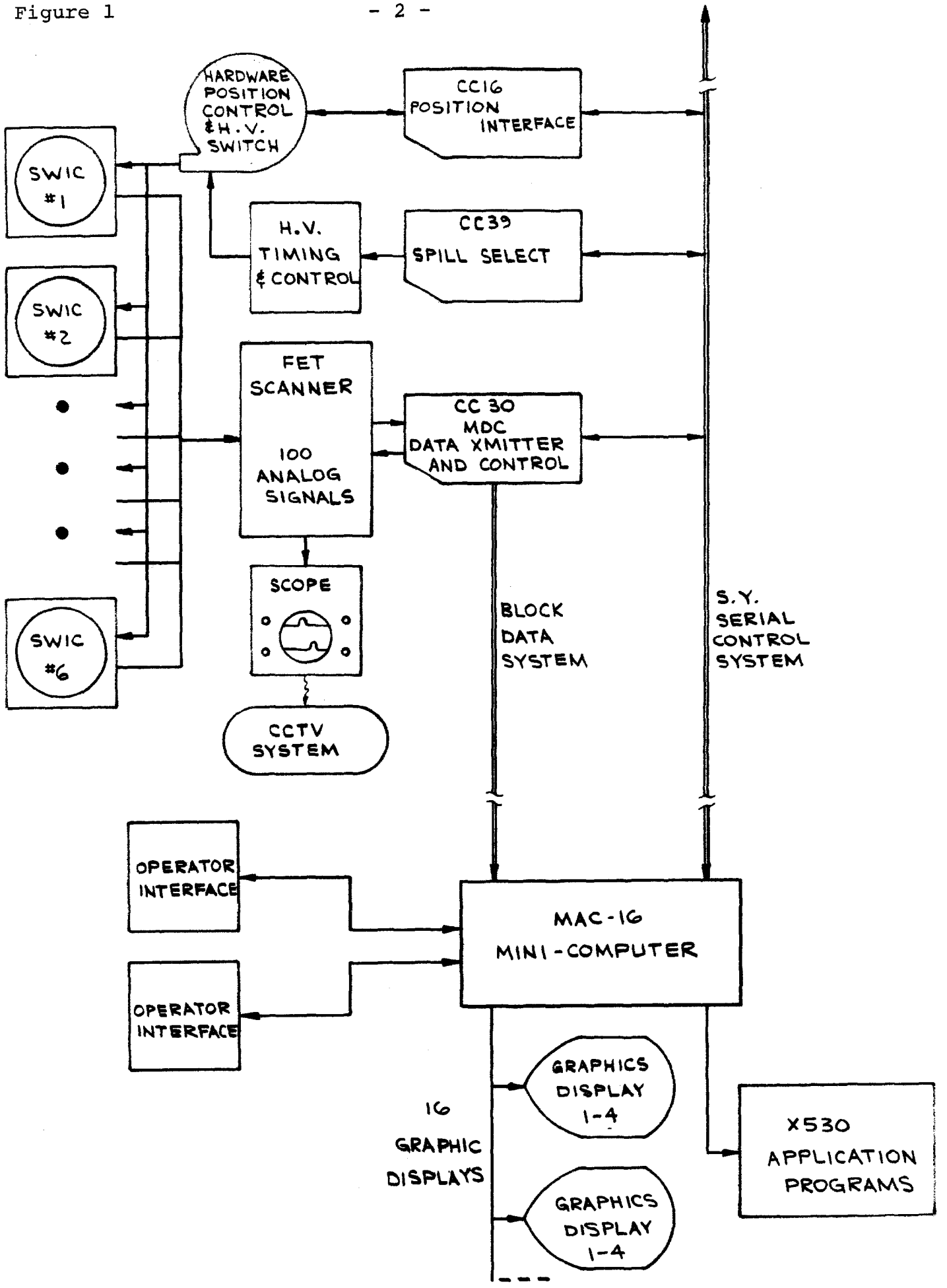
The SWIC (Segmented Wire Ion Chamber)[1] System as presently implemented in the Switchyard/Extraction area provides beam information to operators via an integrated hardware/software system and a functional operator interface. Approximately 40 SWIC detectors located throughout the Switchyard/Extraction Area may be selected to provide 50 vertical and 50 horizontal analog values each. This data may be plotted to physically display horizontal and vertical position, and size. The data is also made available as numeric position, intensity, size values used in beam line tuneup and diagnostic studies. The operator interface provides the source/destination selection of SWIC data as well as specification of optional variables such as gain, etc.

## HARDWARE

The SWIC's are physically located in a special enclosure that allows each SWIC to be moved into the beam path via a positioning interface. Each interface controls the drive motors for up to 6 SWIC detectors as well as provides sense signals to indicate the position of each SWIC. The SWIC's, in order to function, must be provided with a high voltage source. By switching the high voltage in response to timing signals, the beam properties may be sampled during selected periods such as slow spill, fast spill and total spill (see Figure 1).

Figure 1




HARDWARE POSITION CONTROL & H.V. SWITCH
CC16 POSITION INTERFACE
SWIC #1
SWIC #2
SWIC #6
H.V. TIMING & CONTROL
CC39 SPILL SELECT
FET SCANNER
100 ANALOG SIGNALS
CC 30 MDC DATA XMITTER AND CONTROL
SCOPE
CCTV SYSTEM
BLOCK DATA SYSTEM
S.Y. SERIAL CONTROL SYSTEM
OPERATOR INTERFACE
OPERATOR INTERFACE
MAC-16 MINI-COMPUTER
16 GRAPHIC DISPLAYS
GRAPHICS DISPLAY 1-4
GRAPHICS DISPLAY 1-4
X530 APPLICATION PROGRAMS

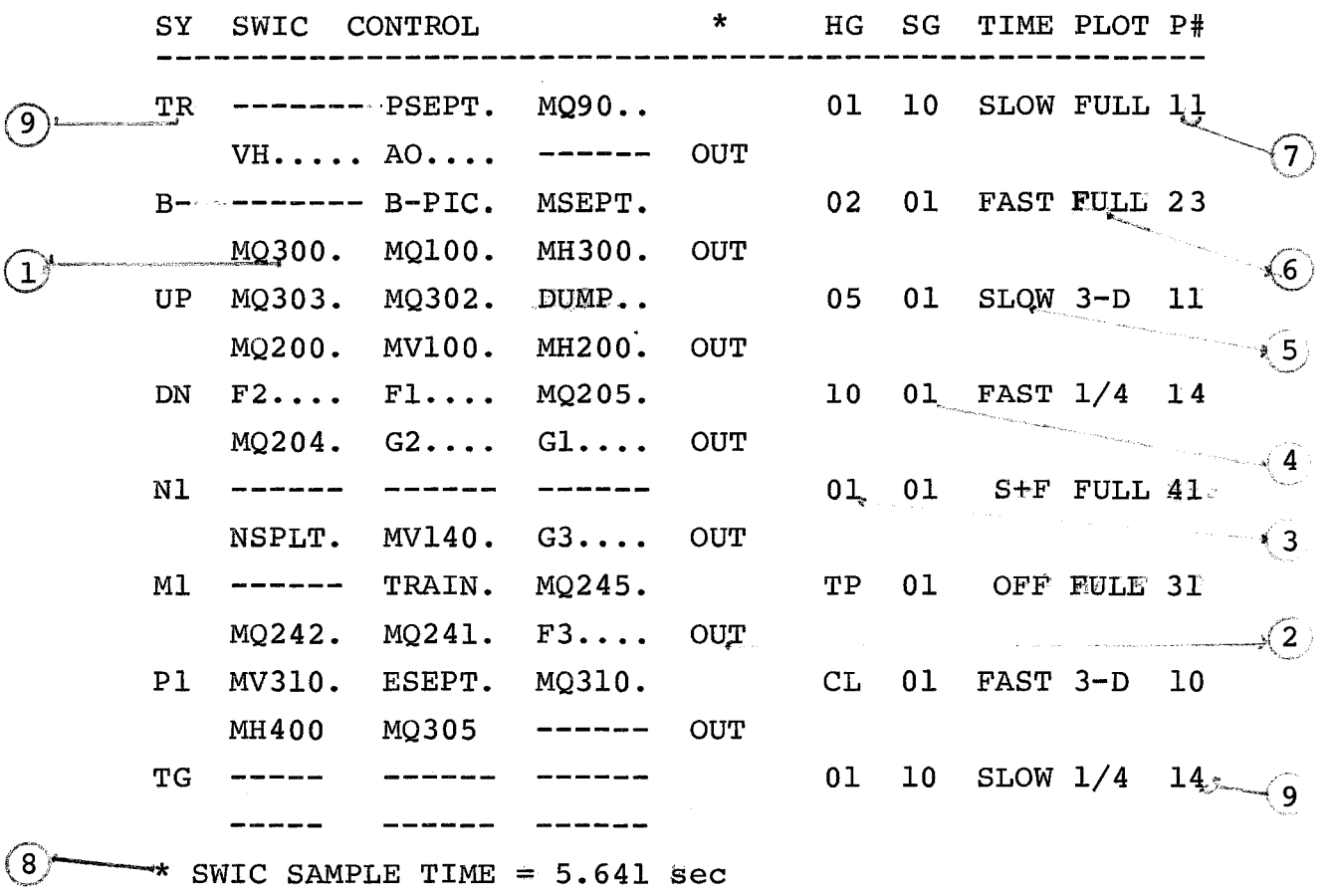
SOFTWARE

There are 8 programs resident in the Switchyard MAC, these programs comprise the SWIC software system. Seven of the programs are fully reentrant tasks running under a multi-programmed operating system having a varying number of tasks. The seventh task is a non-reentrant interrupt driven data collection and plot triggering task. The 8 tasks are:

1. "CIT" - Console Interface Task
2. "PIP" - Plotting Interface Program
3. "DIP" - Data Interface Program
4. "HIM" - Hardware Interface Monitor
5. "SWIMS" - SWIC - MAC to Sigma
6. FULL - Full 2D SWIC Plot with Calculations
7. 1/4 - 2D Short Form SWIC Plot
8. 3D - 3D SWIC Plot

Not included in this list are a large number of system support routines, math routines and graphics I/O support.

CIT is a reentrant task which monitors and updates an operator interface. The operator interface is a CRT, sense switch and cursor positioning combination. CIT monitors the cursor positioning control and moves the cursor accordingly. It also monitors the sense switch which is interpreted as an operator request. The location of the cursor at the moment the sense switch is depressed, determines the operation to be performed. Below is a copy of the text on the CRT and a description of the functions available. In the following descriptions it is assumed that the cursor is positioned as indicated and the sense switch has been depressed.




1. Selection of a SWIC Detector

There are 8 SWIC controllers in the system and a possible 6 SWIC detectors on each controller. When the sense switch is depressed while the cursor is under the name of a SWIC detector the controller is first sent a command to move all 6 SWIC's out of the beam path, followed by a command to move the selected SWIC into the beam path. Once the commands are sent the word "WAIT" is displayed to indicate the operation has been performed. The "WAIT" signal will continue to be displayed until the "HIM" program senses that SWIC movement is occurring or for 10 seconds whichever is shorter. Immediately in front of the SWIC

name is displayed a character to indicate the position of that SWIC. A blank is used to indicate the SWIC is out of the beam path. A question mark "?" is used to indicate the SWIC is either in the "IN" or "OUT" position and a star "*" indicates the SWIC is in the beam path.

2. Clearing All SWIC's (Selecting the NULL SWIC)

This will move all SWIC detectors out of the beam path. The "WAIT" flag and indicators are identical to 1. above.

3. Hardware Gain Selection

Each time the sense switch is depressed, the number displayed will cycle to the next available gain on the scanner. The hardware gain is changed each time you depress the switch. Available gains are "x1", "x2", "x5", and "x10".

4. Software Gain Selection

This works exactly like the hardware gain selection, only the selected gain is applied via software to the raw data entering the computer before any of it is displayed. The combination of hardware/software gains allow a net gain range of "x1" to "x100".

5. Spill Sample Time Select

By switching the high voltage applied to a SWIC in response to preset timing signals you can sample one beam parameter during selected time windows. This allows you to look at "SLOW SPILL", "FAST SPILL" or any other combination. Each depression of the sense switch cycles to another available set of timing signals, displays the name of the spill and sets the hardware accordingly.

6. Plot Type Select

There are 3 different type plots available on the system. You cycle through the selections until the one you want

is displayed. No action other than a record of your selection is performed. When a plot is initiated this information is then used.

7. Graphics Device/Position Selection

Each graphics device is divided into 4 plot positions (1-4) and at present there are 4 graphics storage scopes on the system (1-4). The most significant digit selects the terminal and the LSD selects the position of the plot on that terminal, i.e., "12" means terminal 1, position 2 and "43" means terminal 4, position 3. In order to make selection simpler you may cycle each digit independently.

8. SWIC Sample Time

This displays the time from reset at which the SWIC data is transferred to the computer and is for information only as it is not a controlled variable, but a fixed time in relation to the end of flattop.

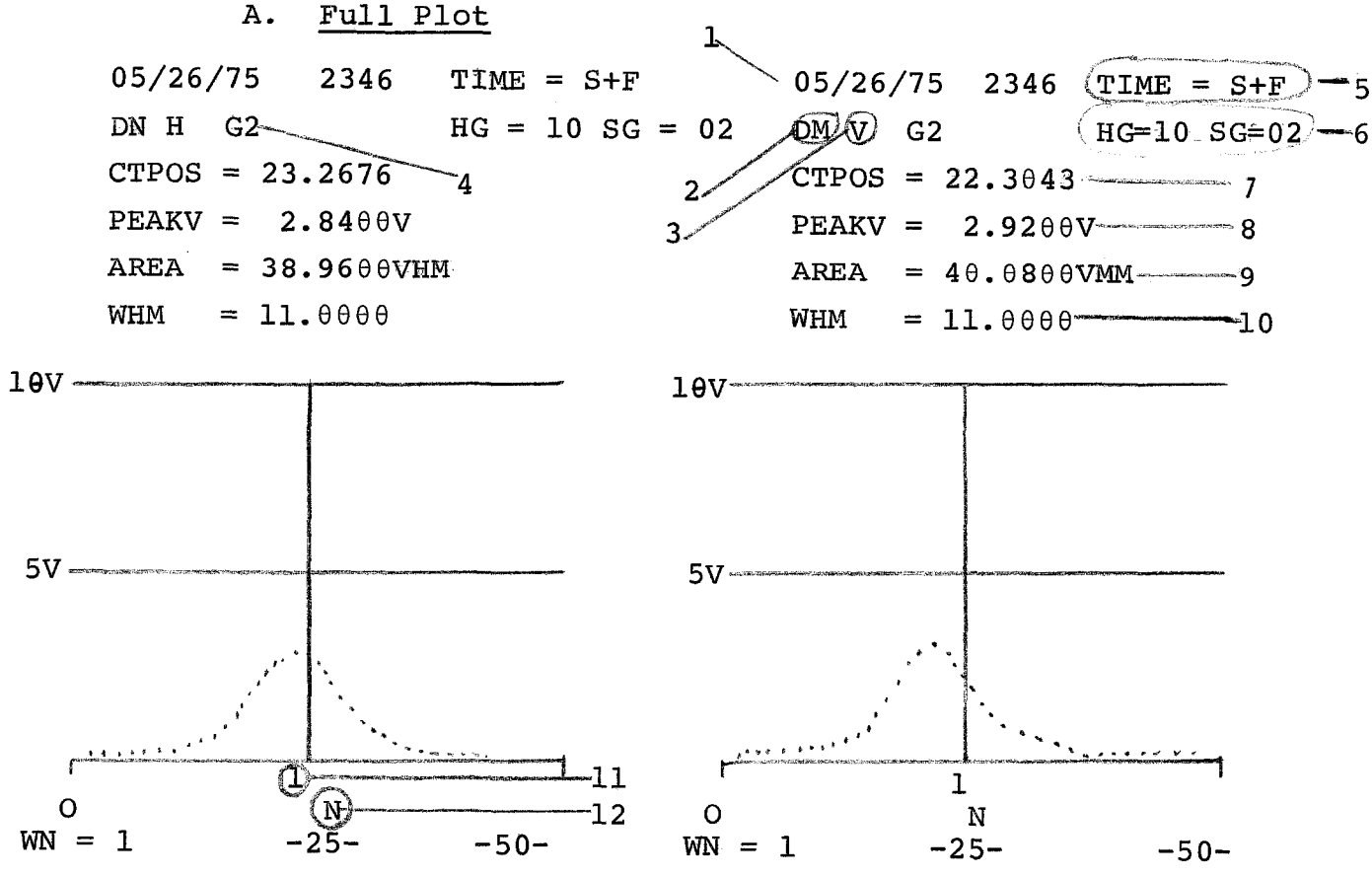
9. Starting a Plot

By depressing the sense switch while the cursor is positioned in the first two or last two columns of the display a plot will be started for the SWIC on the line the cursor is positioned. The CIT gathers basic information needed about the data source and starts a new task called the "plotting interface program 'PIP'". PIP stops interfering plots already running, checks the validity of the new plot request and if valid, requests buffers from a pool of available memory, fetches the data destination device, position, and scale factors, etc. Once the necessary setup is completed the PIP will start the free-running plot task with the appropriate format, and the "PIP" then "STOPS" and becomes inactive until another plot request. Each plot task queues data request with "DIP" and once DIP has received the SWIC data it passes it to the plot program which

in turn proceeds to plot that data.

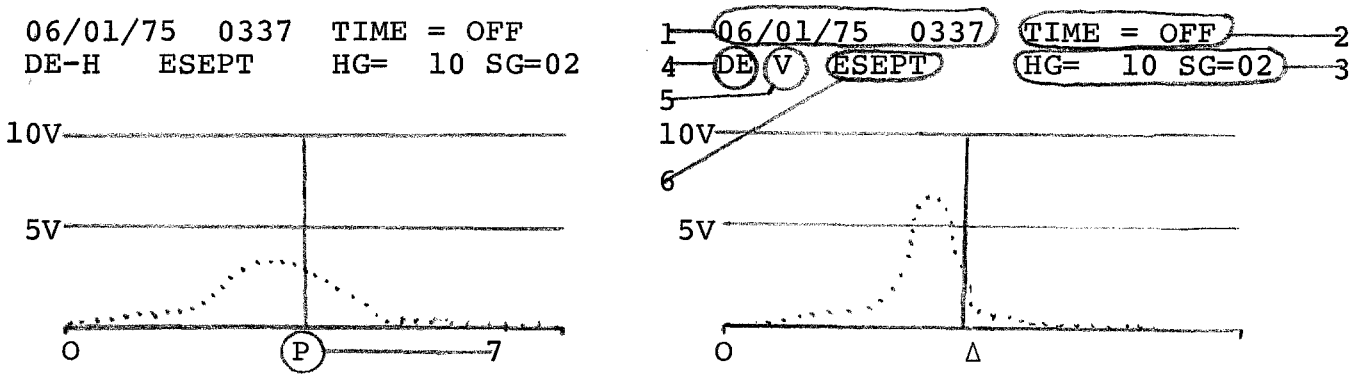
GRAPHICS

A. Full Plot



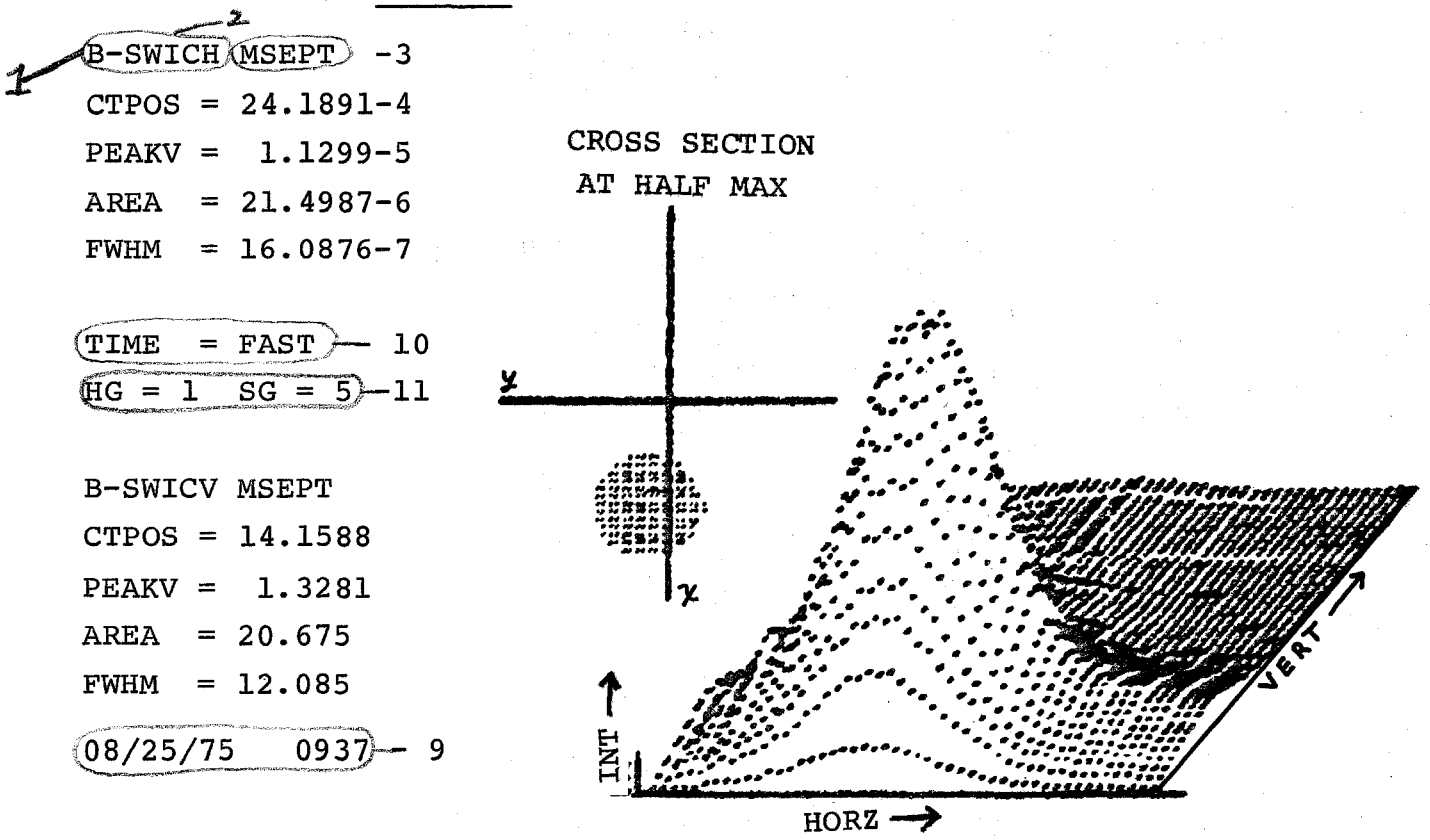

1. Date and Time Data Collected
2. SWIC Controller Name
3. Horizontal/Vertical Data Indicator
4. SWIC Detector Name
5. Spill Time Selected
6. Hardware and Software Gain Applied to Data
7. Centroid Position of Beam
8. Calculated Theoretical Peak Value
9. Sum of Data in One Axis (Intensity)
10. Full Width at Half Maximum
11. Centroid Position Indicator
12. Nominal Centroid Position

B. 1/4 Screen Plot




1. Date and Time Data Collected
2. Spill Time
3. Hardware/Software Gain
4. SWIC Controller Name
5. Horizontal Indicator
6. SWIC Detector Name
7. Nominal Centroid Position

C. 3D Plot



1. SWIC Controller Name
2. Horizontal/Vertical Data Indicator
3. SWIC Detector Name
4. Centroid Position
5. Calculated Theoretical Peak
6. Sum of Data in One Axis (Intensity)
7. Full Width of Beam at HALF-MAX
8. HALF-MAX Cross Section Plot
9. Date and Time Data Collected
10. Spill Time
11. Hardware/Software Gain

## DATA TRANSFER TO X530

### Purpose:

To provide a method of obtaining SWIC data from the Switchyard MAC for use by the X530.

### Usage:

A. The X530 transmits to the MAC a buffer of information containing the SWIC data wanted, sequence, and conditions.

B. The MAC program using (A) information, reads and assembles the data and makes it available to the X530. The MAC does all sequencing, manipulation of SWIC hardware, status monitoring, error checking and data reduction.

C. The X530 monitors a flag and upon completion by the MAC, reads a buffer containing requested information.

### Limitations and Capabilities:

A. A maximum of 32 readings may be requested. This may include multiple readings of 1 SWIC.

B. A maximum of 4 SWIC's may be read in any one machine cycle.

C. A maximum of 7 different min/max condition vlaues may be specified, such as SEM readings or SWIC values, i.e., peak, area, volts, etc.

D. A maximum number of machine cycles may be specified for the entire program.

E. A maximum number of machine cycles may be specified for correct status to be returned. Also, an ignore/abort condition may be specified for a status timeout.

F. A maximum of 16 controllers may be specified.

G. The gain of the hardware may be specified.

H. This program has priority over the graphics being done by the MAC. However, does not preclude graphics from controllers not being referenced by this program.

I. This program may not be in use by more than one console.

J. For each SWIC the following data is returned:

| | | | |
|---|---|---|---|
| 1. | Peak Value | H and V | 16 bits |
| 2. | Area | H and V | 16 bits |
| 3. | Centroid Position | H and V | 8 bits |
| 4. | Full Width at Half-Max | H and V | 8 bits |

K. A maximum number of machine cycles may be specified as part of "C" above as well as an ignore/abort condition.

Reference

1. F. Hornstra, Jr. and J. R. Simanton; A Multichannel Integrator and Scanner for Wire Plane Beam Profile Displays, Nuclear Instruments and Methods, Volume 77 (1969) No. 2.