

POUGHKEEPSIE  
Department 539  
South Road Laboratory  
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7000 Operating Techniques Memo No. 3

SUBJECT: Specifications for an On-Line Pictorial  
Display Device Suitable for 7000S

1. Introduction

As outlined in earlier memoranda, the provision of an adequate on-line pictorial display device for 7000 systems would reduce the volume of printing required and materially increase the usefulness of the system in many applications. The primary purpose of such a device would be to communicate intermediate and final results to the problem sponsor, for his assimilation and to permit him to interact with the computer while it solves his problem.

This memorandum will discuss the ideal specifications of a device intended for this purpose. Some relaxations of these specifications are, of course, acceptable.

2. Visual Properties

A satisfactory display device must furnish output that can readily be seen. This simple and fundamental requirement is the biggest stumbling block present technology faces.

2.1 Brightness and Contrast

The displayed image must be easily viewed in a normally lighted computer room. This implies an ambient light level adequate for reading, writing, and other close work. The displayed image must stand out clearly against such visual noise as stray background illumination and reflections from the display device, including glare.

2.2 Persistence

The displayed image should remain visible until the succeeding image is ready to be displayed. This can satisfactorily be accomplished by an electronic image locking device, such as a storage tube, or by a tube whose persistence is controllable and long enough to permit a new, complete image to be generated before the old one disappears.

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### 2.3 Size

The image should be sufficiently large to be viewed by one to ten people at a distance of not less than three nor more than fifteen feet. Wall-size images are not needed.

### 2.4 Photographability

The image should be readily photographable by ordinary Polaroid cameras.

### 2.5 Intensity Modulation

It should be possible to display point images with at least two different intensities. It would be desirable to have four or at most eight intensity levels..

### 2.6 Wave-Length Modulation

→ It would be desirable to be able to display point images in different colors. Four discrete colors would be quite valuable; more than sixteen are probably of little value.

## 3. Informational Properties

A display device is an information transducer. The amount and type of information it can display constitute the second fundamental set of characteristics.

### 3.1 Capacity

A pictorial display should have a minimum of 1000 points in each dimension. A side of 2000 points is desirable. More than 4000 points on a side is probably unnecessary. Thus a raster should contain at least  $10^6$  points, preferably  $4 \cdot 10^6$  points, but not more than  $16 \cdot 10^6$  points.

### 3.2 Accuracy

Plotting should be accurate to within one half the distance between points. I. e., a point should fall sufficiently precisely so that it will not fall in the tolerance region of its neighbors.

### 3.3 Resolution

A plotted point should be sufficiently diffuse that a line composed of every possible point has no discernable bright and dark areas. A plotted point should be sufficiently sharp that two points whose coordinates differ by four units should be distinguishable as independent points.

### 3.4 Plotting Speed

Ideally, a display device should be able to plot images rapidly enough to give animation. If each point requires 32 bits of information, the data rate of an exchange channel is such as to furnish information for 15,000 points per second. The display device thus should be able to plot a point each 60 usec. If a Swift tape channel were used, four times this data rate could be delivered. A plotting rate of 15,000 points per second would give 15 frames per second of 1000 points per frame. This is quite reasonable.

### 3.5 Character Plotting Ability

It would be desirable to be able to plot any of 64 or 128 characters at each plotting point. This gives a much higher data rate when any significant amount of character information is to be plotted. This is by no means necessary if the plotting speed is sufficiently high.

### 3.6 Stability

The long term stability of the displayed image should be such that no point drifts more than one unit away from its nominal position. This is necessary to permit the use of transparent overlays containing fixed pictorial information. Again, this is a means of increasing the effective data rate of the output system.

## 4. Other Properties

### 4.1 Cost

An on-line display device for 7000 systems should be priced not over \$2000 per month.

#### 4.2 Logical Organization

The display device should accept information in eight-bit bytes, using four bytes for each point plotted. It should be compatible with transistorized circuits and have the same level of reliability. Plotting should be asynchronous up to the maximum data rate. The device should be organized so that it can be operated off-line from a tape furnishing eight-bit bytes at a rate which does not exceed the data rate. No light gun or other computer input device is needed as part of the display.

#### 4.3 Permanent Plots

It is desirable, but of secondary importance, to get permanent copies of some displayed images. For most purposes, a polaroid photograph of the display is quite adequate.



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