

- [54] **OSCILLOSCOPE SYSTEM FOR ACQUIRING, PROCESSING, AND DISPLAYING INFORMATION**
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**Related U.S. Application Data**

- [63] Continuation of Ser. No. 736,677, Oct. 28, 1976, abandoned, which is a continuation of Ser. No. 631,345, Nov. 12, 1975, abandoned, which is a continuation of Ser. No. 321,876, Jan. 8, 1973, abandoned.
- [51] Int. Cl.<sup>2</sup> ..... **G06F 3/05; G01R 13/20; G06F 5/00; G06F 13/00**
- [52] U.S. Cl. .... **364/900; 324/121 R; 340/745; 315/367; 315/379; 340/347 SH; 340/347 R**
- [58] Field of Search ... **364/200 MS File, 900 MS File, 364/521, 487; 315/365, 366, 367, 379; 346/110 R, 33 C, 33 WL; 324/77 R, 77 B, 78 E, 121 R, 77 A; 367/68, 69, 71; 340/347, 721, 722, 723, 736, 745, 747; 328/104, 154; 307/243**

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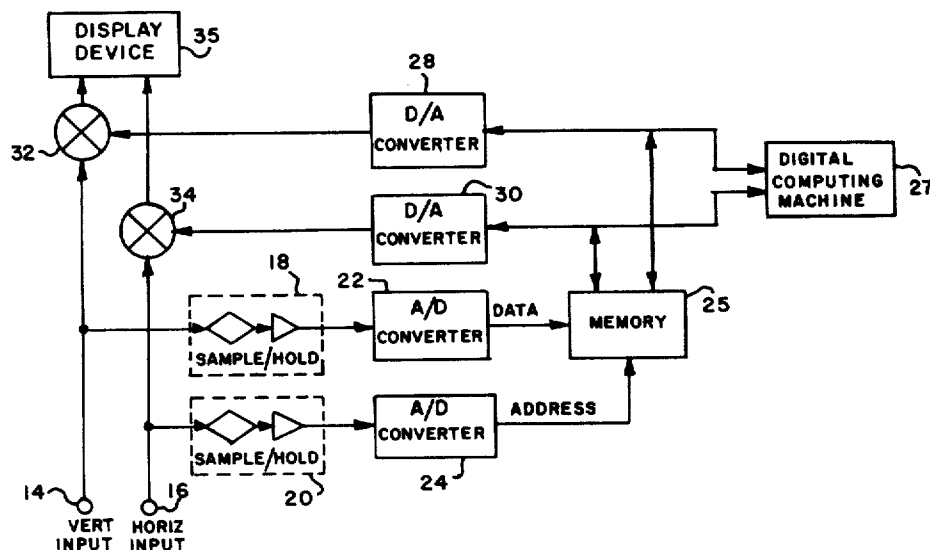
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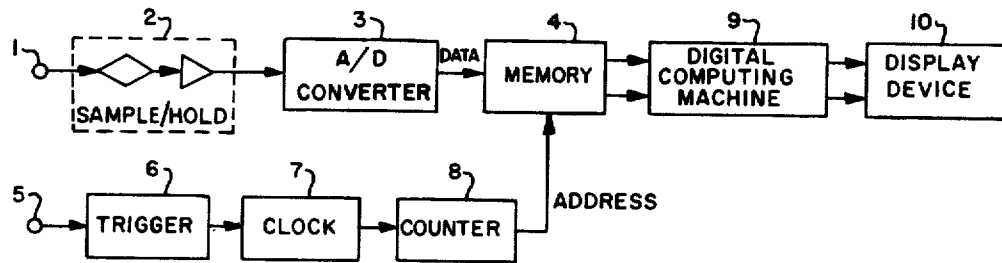
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[57] **ABSTRACT**

A general-purpose oscilloscope system is disclosed wherein waveforms acquired by the vertical and horizontal preamplifier channels can be displayed immediately, or they can be digitized and stored in a memory from where they can be recalled, reconstituted in their analog form and displayed at a later time. The processing system permits simultaneous display of instantaneous and processed waveforms, and includes facilities for processing associated z-axis signals and readout data as well. Access to peripheral equipment, such as a computer or the like, permits the digitized waveforms to be mathematically manipulated and returned to the memory in the processing system for ultimate display. The oscilloscope system can be assembled in a modular manner, whereby the processing unit becomes an integral part of the instrument, or the system can be assembled as a general-purpose oscilloscope without the processing unit, allowing a user to add the processing capability to his system at a later time.

**4 Claims, 5 Drawing Figures**





PRIOR ART

Fig-1

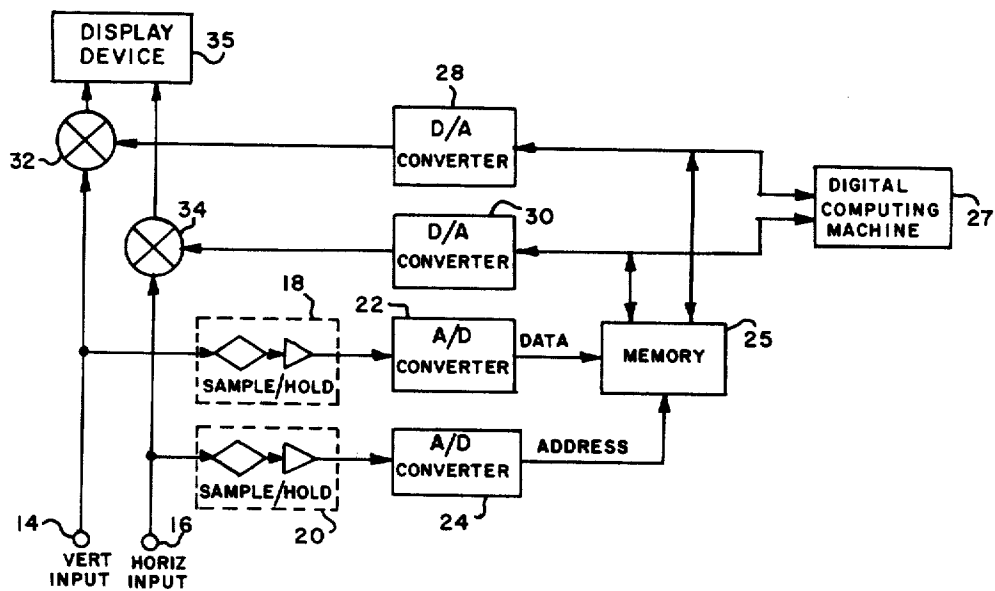


Fig-2

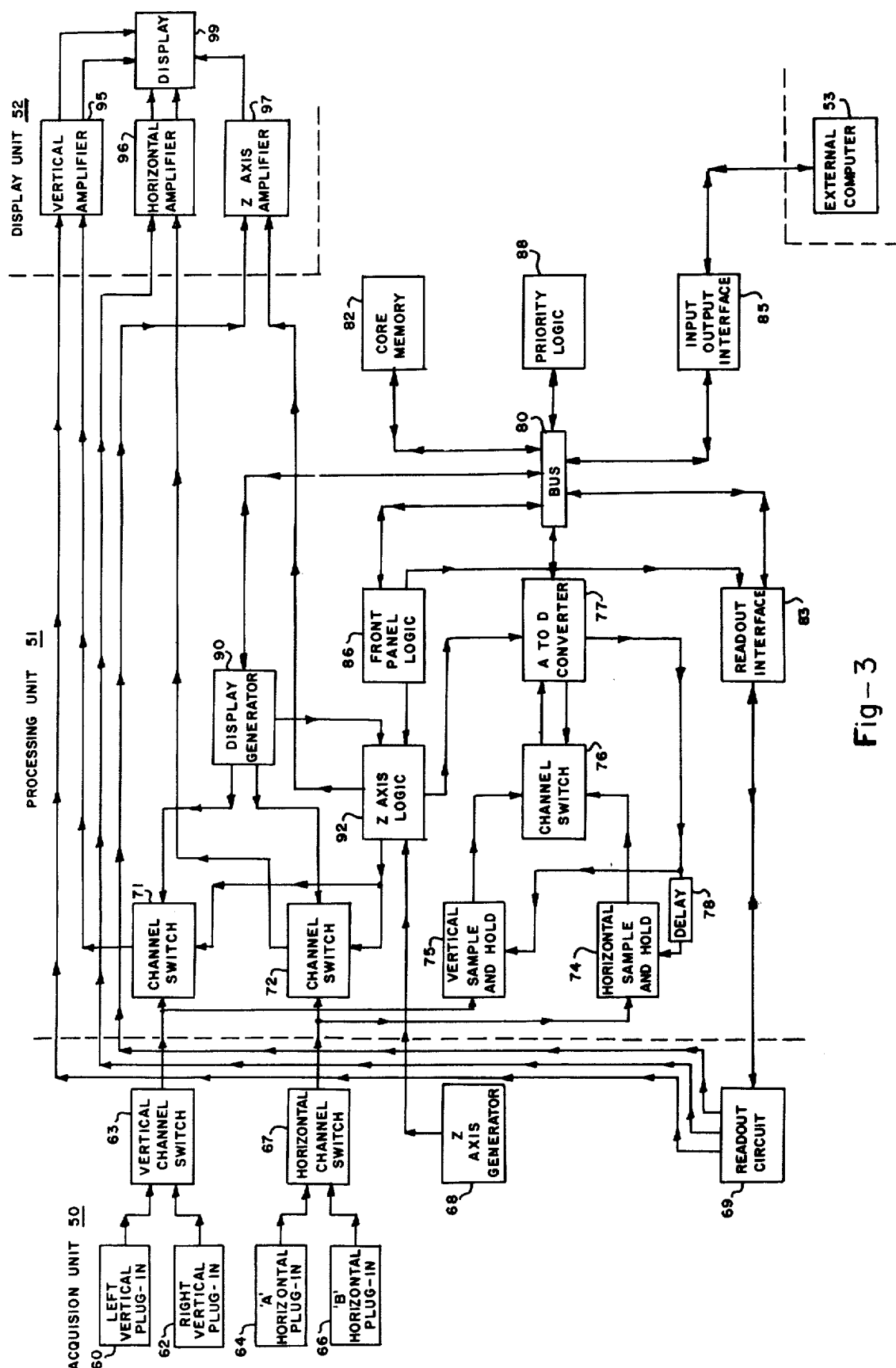


Fig. 3

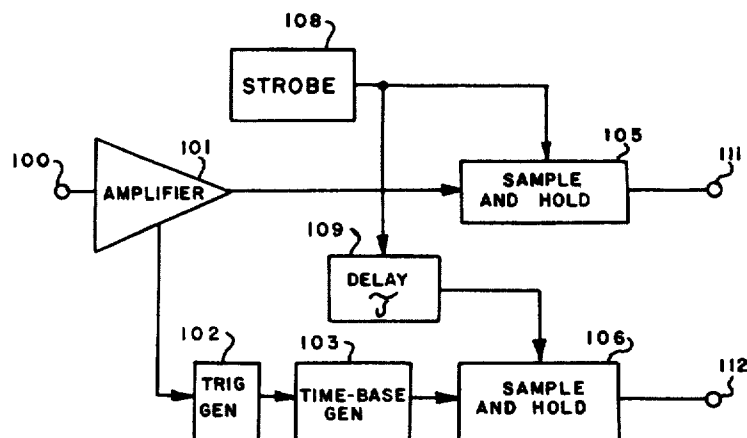


Fig-4

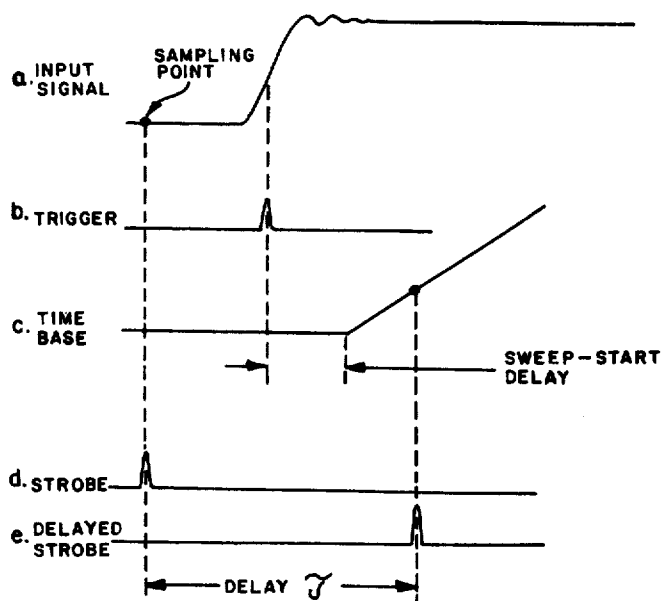


Fig-5

## OSCILLOSCOPE SYSTEM FOR ACQUIRING, PROCESSING, AND DISPLAYING INFORMATION

This is a continuation of Ser. No. 736,677, filed Oct. 28, 1976, now abandoned which is a continuation of Ser. No. 631,345, filed Nov. 12, 1975, now abandoned which is a continuation of Ser. No. 321,876, filed Jan. 8, 1973, now abandoned.

### BACKGROUND OF THE INVENTION

Many attempts have been made to retain and analyze waveform data associated with display systems, such as oscilloscopes and the like. The development of the storage cathode ray tube permitted waveforms to be displayed on an oscilloscope screen for extended periods of time; however, this system lacked versatility. A "split-screen" technique increased the capability by permitting two waveforms to be viewed simultaneously in any combination of stored and non-stored operating modes. To analyze these waveforms, or to perform any mathematical functions thereon, it was necessary for the operator to simulate the waveforms on paper and mentally calculate the desired results. For example, to obtain an electrical power curve from voltage and current waveforms, the tedious operation of point-by-point multiplication of the corresponding points on the voltage and current waveforms was performed, from which the points of the power waveform could be obtained. A major disadvantage of storage cathode-ray tubes for waveform analysis is that information stored thereon can be held for only a limited time. If a particular waveform was needed beyond the storage time limit, it became necessary to photograph such waveform or provide a facsimile.

One form of waveform processing was developed which was capable of categorizing waveform information on one axis only, usually the vertical axis. This system digitized the information and stored it in a memory bank, such as a core memory or a memory register. This information was then available to the display system on a recall basis to provide a refreshed display. However, this system also had its limitations, and one major disadvantage was its extremely narrow bandwidth capability. The system was locked to a timing signal or clock signal which was compatible to a computer and the single-axis information was processed at that rate. Because of slow sweep speeds required to display such processed information, it was impractical to simultaneously view real-time signals which were generally occurring at higher frequencies. While two or more such single-axis signals could be processed in this manner, which could include manipulation by a computer or the like, another serious disadvantage to previous systems was that due to differences in sweep timing and linearity, etc. the identical initial conditions could not be repeated, rendering the accuracy of such processed waveforms questionable and unreliable.

### SUMMARY OF THE INVENTION

According to the present invention, information corresponding to each major axis of a Cartesian-coordinate system display, for example, vertical, horizontal, and z axes, can be categorized simultaneously. Such simultaneous categorization permits wide bandwidth operation, overcoming a previous major disadvantage. In addition to waveform information, this system has the

capability of categorizing associated alpha-numeric data related thereto. A unique sampling circuit, which employs a delayed horizontal sampling strobe to remove the need for the conventional vertical delay line and its compensation, takes samples of vertical and horizontal waveforms; such samples are then digitized by conventional A/D converters and then stored in precise coordinate relationship in a memory device. The present invention is capable of storing several such waveforms and associated alpha-numeric data. These waveforms and data can be recalled for display as desired, or sent to a compatible computer via a direct interface for further processing, such as storage or mathematical operations thereon, and then returned to the system of the present invention for ultimate display. For example, a signal generated in the time domain can be displayed in the frequency domain using a Fast Fourier Transform technique.

It is therefore one object of the present invention to acquire, process, and display wide bandwidth information corresponding to at least two major axes of a Cartesian coordinate system.

It is another object of the present invention to display both instantaneous signals and processed signal information simultaneously on the same cathode-ray tube.

It is a further object of the present invention to match real-time characteristics of the signal by categorizing both vertical and horizontal information.

It is yet another object of the present invention to provide a sampling system capable of sampling both vertical and horizontal signals to provide information corresponding to a coordinate point, without delaying the vertical signal or using a horizontal pretriggering scheme.

It is yet a further object of the present invention to store and display alpha-numeric data corresponding to stored waveforms.

It is still another object of the present invention to provide a flexible display system in which waveforms and related data can be processed by a computer prior to display.

Other objects and attainments of the present invention will become apparent to those skilled in the art upon a reading of the following detailed description when taken in conjunction with the drawings in which there are shown and described illustrative embodiments of the invention. It is to be understood, however, that these embodiments are not intended to be exhaustive nor limiting to the invention.

### DRAWINGS

FIG. 1 shows a block diagram of a waveform processing system according to the prior art;

FIG. 2 shows a general block diagram of the waveform processing and display system according to the present invention;

FIG. 3 shows a detailed block diagram of the present invention;

FIG. 4 shows a block diagram of the sampling system according to the present invention; and

FIG. 5 shows a waveform ladder diagram illustrating the strobe timing of the sampling system of FIG. 4.

### DETAILED DESCRIPTION

Referring to FIG. 1, a block diagram of the prior art is shown wherein a real-time signal corresponding to a single display axis is applied to input terminal 1. Block 2 is a conventional sample and hold circuit which takes



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