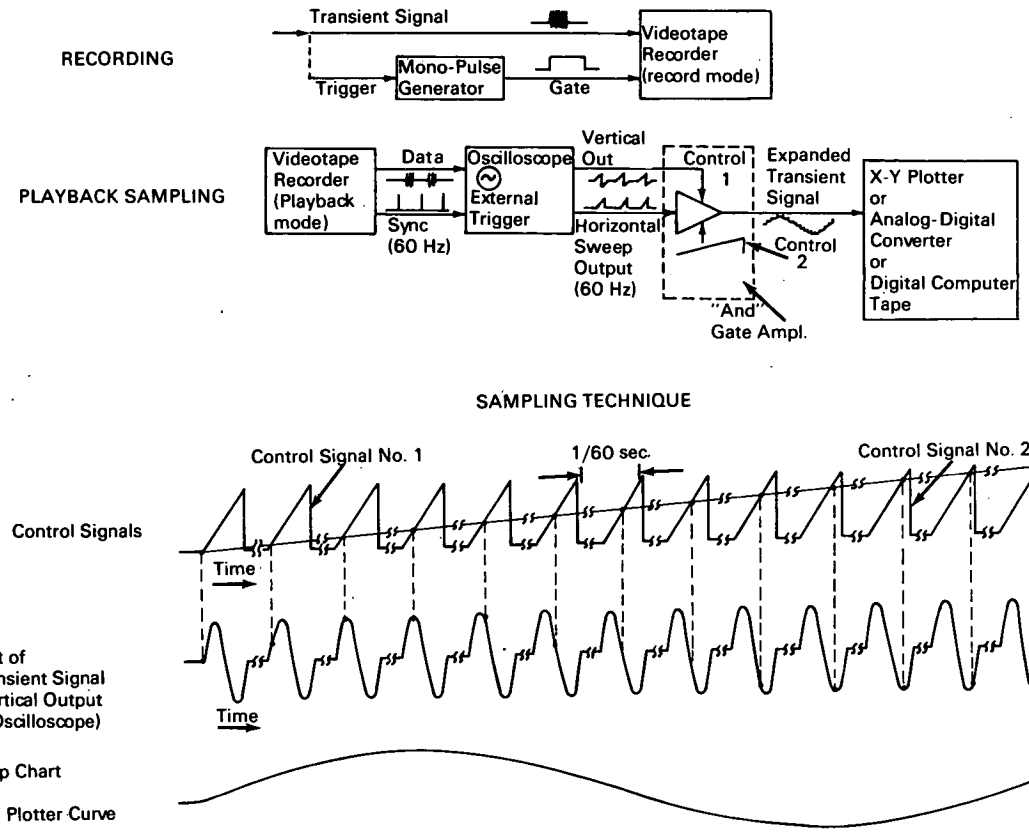
NASA TECH BRIEF

Recording and Time Expansion Technique for High-Speed, Single-Shot Transient Video Signal



The problem:

To record a high-speed, single-shot, transient voltage which lasts several milliseconds and has a 3 MHz information bandwidth. This recording must be printed on an x-y recorder or rerecorded on a digital computer tape for data processing.

The solution:

Record the transient signal on a modified commercial video tape recorder operating in a single-frame (stop-motion) record mode. When operated in the playback mode, the video tape recorder converts the single transient signal to a repetitive signal in

(continued overleaf)

which the original transient is repeated each time the tape heads make one revolution. This repeating signal is used to drive a sample data translator whose function is to slowly produce the original transient in an interval of time (10,000 times or more, longer than the original transient duration) suitable for an x–y plotter or a computer tape recorder.

How it's done:

Commercially available video tape recorders achieve a 3.5 MHz bandwidth by wrapping a slowly-moving magnetic tape in helical fashion around a high-speed, rotating disk containing the video record-playback heads. The video signal is thus recorded in a slanted stripe pattern on the tape. Single-frame (stop-action) playback is achieved by stopping the tape, thus allowing the rotating video heads to scan repetitively over the same tape stripe. Simple modifications permit the recorder to function as a continuous closed-loop recorder with loop lengths of 1/60 second. With the recorder set to operate in the stop-frame playback mode, a single positive square gate pulse slightly less than 1/60 second long, is applied to the video record amplifier to switch the video heads into the record mode. This gate pulse is initiated by either the start of the transient signal itself or by a trigger pulse preceding the transient signal. While the gate pulse is present, the transient signal is recorded on one stripe of the magnetic tape. When the gate pulse ends, the heads revert to the playback mode and the recorded transient signal is played back repetitively 60 times per second.

As shown in the diagram, the playback transient signal is applied to the vertical channel of an oscilloscope whose horizontal sweep is synchronized to the signal via a 60 Hz pulse available from the video tape recorder during playback.

The translation of the transient signal from the video recorder to the strip chart form is accomplished using a simplified sampling technique. The synchronous-sawtooth-horizontal deflection voltage from the oscilloscope is applied to control input 1 of an "AND"-gate amplifier. Another triggered sawtooth voltage of equal amplitude, but with a period hundreds of times longer, is applied to control input 2. The transient signal is connected from the "vertical-output" connector on the oscilloscope chassis to the input of the "AND"-gate amplifier. Whenever the two control signals are of equal amplitude, the transient signal will be coupled through the "AND"-gate amplifier to a strip chart, x–y plotter, or an analog–digital converter.

Since the oscilloscope sweep will be triggered 60 times per second, the transient signal will be sampled at a similar rate. The number of times the transient signal is sampled will depend upon the ratio of the periods of the two sawtooth signals as shown in the diagram. Great time base expansion and resolution of the transient signal may be obtained by using the oscilloscope's delayed-sweep feature and fast rates to display only selected small portions of the entire transient signal on the oscilloscope. Breaking this complete transient translation into a family of sequential frames also eliminates the accumulated jitter.

Notes:

1. Circuit modifications have been designed for Ampex and Sony video recorders to adapt them to this technique. Diagrams for the Sony circuit alterations are available.
2. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Ames Research Center
   Moffett Field, California 94035
   Reference: B67-10139

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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