A Modified Composite Video Signal Generator for the Gamma 11 Computing System

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Many nuclear medicine departments use the Gamma 11 computing system for image processing. In many cases, clinicians would like to display or record these images on equipment that has been designed for use with standard closed-circuit television or broadcast-type composite video signals. Unfortunately, the signals provided by the Gamma 11 differ from these standard signals in a number of important ways. The circuitry presented here converts the computer's output signals into a composite waveform that will properly drive virtually all equipment designed for closed-circuit television or standard broadcast-type applications.

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Many nuclear medicine departments are currently using the Gamma 11 computer system* to process their clinical images. Often practitioners would like to display the output pictures on standard closed-circuit television (CCTV), or broadcast-type monitors, that they have available. Some may want to record the images on a video tape recorder or a multi-imaging system. This usually presents a problem, since the computer does not have a composite video output signal. Instead the picture's video waveform and synchronization pulses are provided as separate output signals.

In addition, the signals* obtained depart somewhat from the standard ones used by the CCTV and broadcast industries. A comparison of important standards is given in Table 1. The computer provides a 256-line noninterlaced picture. Each vertical field contains 273 horizontal lines, of which 256 are active and 17 occur during the vertical retrace period. The cathode-ray tube is blanked during the retrace. A complete picture is produced during each vertical field, which occurs 60 times per sec.

In standard closed-circuit television, the vertical field rate is also 60 per sec, but each field contains 262.5 horizontal lines. Of these, 243 lines are active and 19.5 occur during vertical retrace. It takes two successive vertical fields to display all of the picture information in an interlaced manner. Such systems are referred to as "525/60 interlaced 2:1" indicating that each complete frame contains 525 lines that are displayed using two successive fields occurring at a 60-cps rate. In this case a complete picture is generated 30 times a second.

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Standard broadcast systems also use a 2:1 interlaced system with 525 lines/frame. The field rate is slightly below 60 (59.94) per sec and there are 243 active lines per field.

The horizontal line rate for the Gamma 11 output is 16,380 lines per sec, compared with 15,750 for CCTV and 15,734 for broadcast systems. This produces horizontal line times of 61.05, 63.50, and 63.56 μsec, respectively.

The horizontal and vertical synchronization pulses provided by the Gamma 11 are also nonstandard. CCTV and broadcast television systems use vertical synchronization pulses that last for approximately three horizontal lines. That of the Gamma 11 is two lines long. The CCTV and broadcast horizontal synchronization pulses last for 4.75 μsec, and each is followed by a 4.45 μsec black level "back porch." The Gamma 11 signal consists of a 9-μsec synchronization pulse with no back porch reference level.

Most monitors are designed for use with industry standard input signals, but can be made to operate at the Gamma 11 rate by merely adjusting the horizontal hold and/or the horizontal frequency controls. To obtain a composite video signal that such monitors can use, the computer's "Green" video and synchronization signals must be combined. A number of relatively complicated schemes for doing this have been developed (*1*). It turns out, however, that a satisfactory composite video signal can often be obtained by merely summing the video and synchronizing signals through the use of a pair of ten-cent resistors (*2*).

Unfortunately, some peripheral equipment will not operate using the summation composite signal because its horizontal synchronization pulses cover the entire 9-μsec horizontal retrace interval. Such equipment (e.g., the Dunn Model 627 TLC Multi-Image Camera) requires horizontal synchronization pulses that have a length in the vicinity of the 4.75-μsec television-industry standard. Each pulse should be followed by a black level "back porch" of

TABLE 1. TELEVISION SIGNAL STANDARDS

	Broadcast industry NTSC	Closed-circuit television EIA 525/60 interlaced 2:1	DEC GAMMA 11
Interlacing ratio	2:1	2:1	None
Vertical fields per second	59.94	60	60
Horizontal lines per second	15,734.26	15,750	16,380
Horizontal lines per field	262.5	262.5	273
Active lines per field	243 ± 1	243 ± 1	256
Active lines in a complete image	486 ± 2	486 ± 2	256
Vertical synchronization pulse length (μsec)	191	150 ± 50	122
Vertical blanking length (msec)	1.25 ± 0.08	1.25 ± 0.1	1.05
Horizontal synchronization pulse length (μsec)	4.75 ± 0.5	4.75 ± 0.5	9
Horizontal blanking length (μsec)	10.5	11.0 ± 0.5	9.5

~4.45 μsec, which is a reference to which the circuitry clamps the video waveform. This clamping prevents a shift in the system's black level as the picture information changes. If the back porch is not present, the system will clamp on the left-hand edge of each horizontal line. When this region contains video data, the system clamps to something other than black level, and the result is intolerable bright streaking of the display. The circuitry described here was developed to eliminate this problem.

The circuit shown in Fig. 1 converts the Gamma 11 synchronization signal into a nearly standard waveform. It also combines the modified synchronization signal with the video waveform to produce a composite video signal that is usable with virtually any display, recording, or multi-imaging system. The circuit's input and output waveforms are shown in Fig. 2.

The gates obtained from devices Z1, Z2A, and Z2B should be adjusted to 4.75, 11, and 172 μsec, respectively. This produces horizontal synchronization pulses that are 4.75 μsec long and are followed by a 4.25-μsec back porch. The vertical synchronization pulses last for three horizontal periods.

The output signals are produced by low-impedance integrated circuits that are capable of driving long cables and several peripheral devices. The input signals are the normal computer "Synchronization" and "Green" color output waveforms, which are obtained from the DEC A011 Video Analog and Synch. Output board. The "Green" output is used because in the monochrome mode it carries the complete video waveform.

The circuitry may be placed anywhere in the data-processing system. If it is constructed on a DEC W998 Blank Module Board, it may be plugged into the computer backplane. In this way the computer's dc power supplies are utilized and no additional voltage sources are required.

In addition to monochrome applications, some practitioners may want to combine the computer red, green, and blue color signals with the synchronization waveform to produce a single NTSC composite color signal. Such a signal could then be recorded on a color recorder or displayed on NTSC-type color monitors. Instruments capable of making such a conversion are known as Color Video Encoders and are available from several manufacturers. Many of these encoders, however, will not operate properly with the Gamma 11's nonstandard synchronization signal as an input.

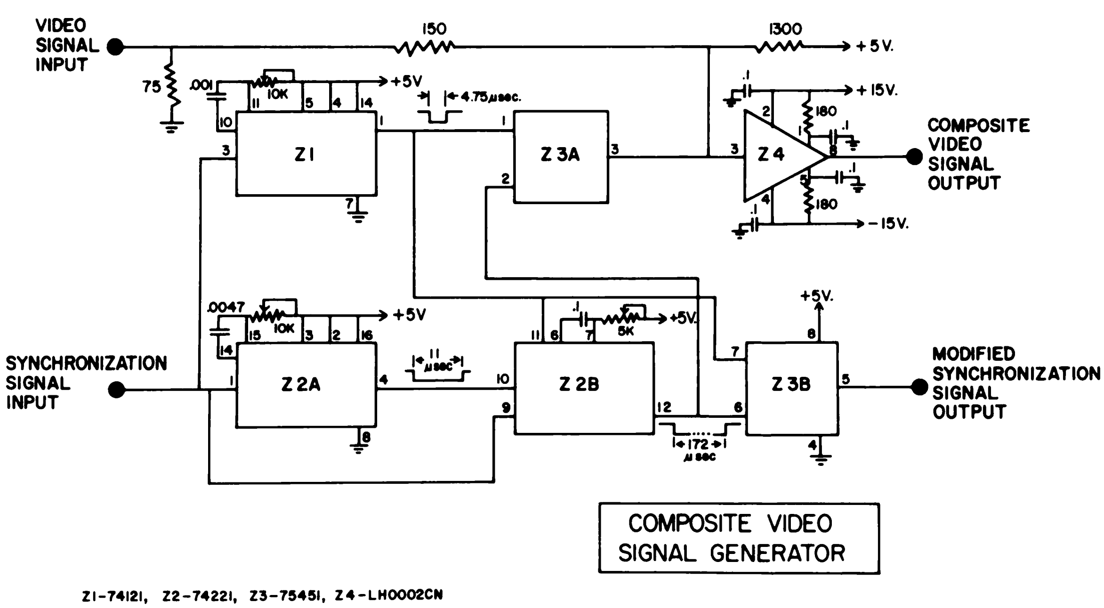

FIG. 1. Circuit diagram.

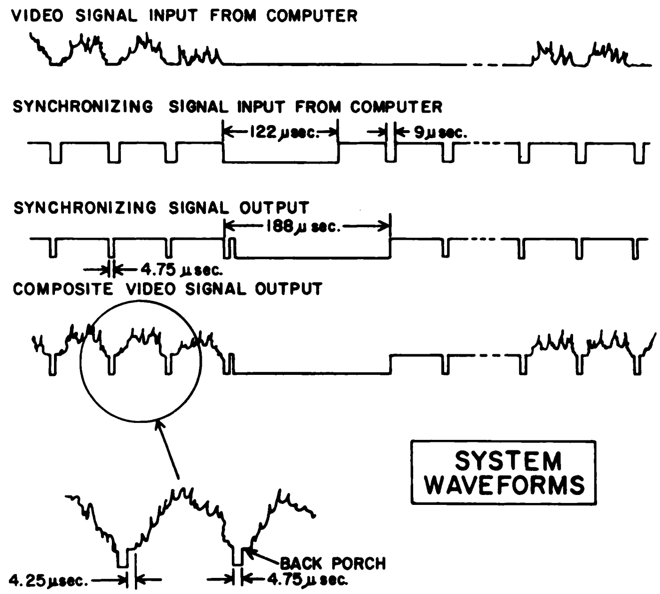

FIG. 2. System input and output waveforms.

In most cases this problem can be eliminated through the use of the modified synchronization signal described above.

Although the circuitry presented here was designed for use with the Gamma 11 computer, the inclusion of adjustable time delay gates makes it usable with other systems that provide nonstandard video synchronization signals.

We note that equipment capable of converting from nonstandard to standard video is commercially available, but it is either very expensive or difficult to find. The component cost for the circuit described here, including the DEC W998 board, was $35.00.

FOOTNOTES

* Gamma 11, Digital Equipment Corp., Maynard, MA.

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