

Four-Channel VIDEO INTEGRATOR

Much current work with closed-circuit television is centered around its use as a means of remotely monitoring several activities that are often carried on simultaneously and in different locations. Some of these are traffic observation on highways and airports, management of employee programs, and telemetering of missile controls. The inherent disadvantage of current closed-circuit television monitoring, however, is that one cathode ray tube can display only one video signal (picture) at a time without the use of very expensive and complex commercial special-effects equipment.

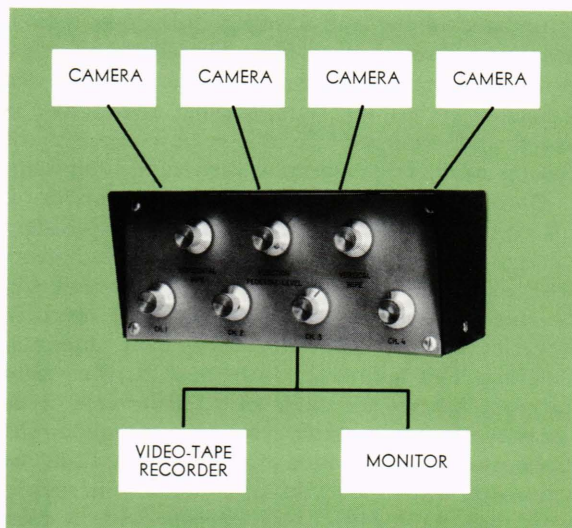
This inadequacy led to the development at APL of a simple, inexpensive, and compact system for combining electronically four separate video signals and displaying them simultaneously on a single cathode ray tube. This device, called the four-channel video integrator, was developed by H. D. Flagle for use in weapon system radar test at APL.

The completely transistorized integrator utilizes 15 transistors and has a characteristic bandpass in excess of 8 mc—more than adequate for our

present needs. (The Ampex video-tape recorder in the system has, by comparison, a 3-mc bandpass.) Four-channel switching is accomplished by a combination of diodes driven by transistorized switching circuits. The overall gain of the device is unity, so additional video amplifiers may be added when necessary. Four separate controls permit independent adjustment of the signal-brightness level of each quadrant. Local synchronization can be added to a noncomposite video signal if it is desired. The integrator can also be used as a variable electronic switch to wipe (fade in and out) from one camera to another.

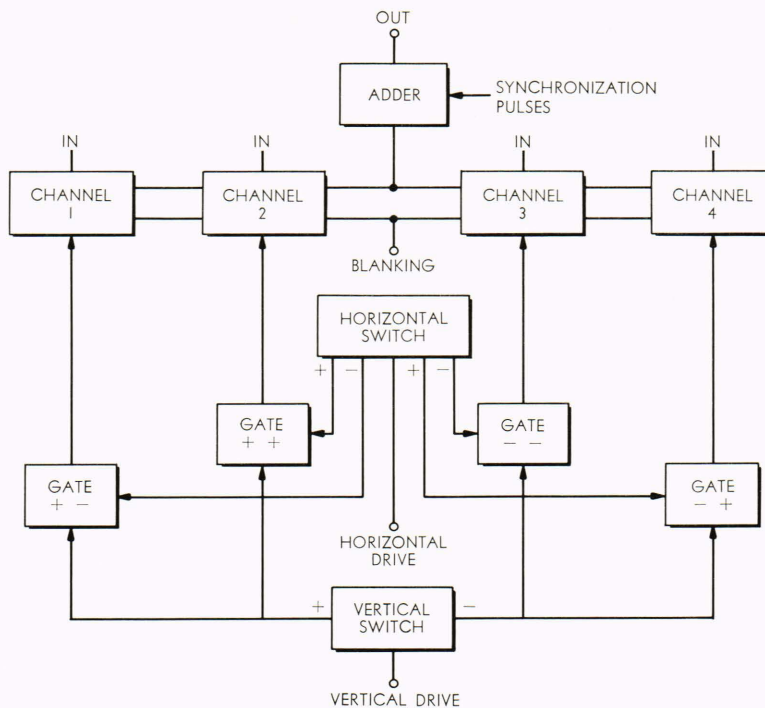
Four independent video signals are supplied to the input terminals of the integrator which, in turn, samples each of the presentations sequentially. The latter are then recombined to form a complete picture containing four quadrants, each of which is one of the four input signals. The switching operates in the following manner. Input No. 1 is electronically switched on for one-half the horizontal scanning time (31.7 μ sec), and input No. 2 for the next 31.7 μ sec. This process continues for 8333 μ sec or half the vertical scanning time. At this time, inputs No. 3 and 4 are substituted for inputs No. 1 and 2 and treated in the same fashion for the second half of the vertical scanning time (8333 μ sec). This results in a final picture divided into four quadrants, each adjustable in height and width. When synchronization and blanking are added to this noncomposite video, it will appear as a standard EIA* signal suitable for recording on the Ampex 1000 recorder.

Another feature of the integrator is that by means of a function switch several combinations of the different video channels may be displayed on the single cathode ray tube. Any one signal may be displayed in one quadrant or it may be expanded to occupy two quadrants (one-half the screen) vertically or horizontally. In one case (channel 2), the picture may be expanded to three quadrants. Corner inserts of test data and notations may also be added to the video display.



Graphic diagram of the system for combining four video signals on one monitor screen by means of the four-channel video integrator.

* Electronics Industries Association.



Circuit diagram of the all-transistor four-channel video integrator.

Performance Characteristics

In the development of this video integrator, several characteristics and features were determined to be essential and were therefore incorporated in the design under discussion. These were:

1. Stable switching to minimize line jitter and drift;
2. Controls for each channel to compensate for unequal brightness levels of different cameras;
3. A flat bandpass to 8 mc for each channel to ensure maximum resolution;
4. Provision for adding EIA synchronization pulses or other pulses necessary to form a specialized form of composite video signal;
5. Adequate isolation between channels to eliminate cross-talk;
6. Minimum degradation of picture quality by added noise;
7. Minimum size and complexity; and
8. A self-contained, regulated power supply.

Conclusions

The device described has met the design requirement of electronically combining four independent video signals into a single, clear, four-quadrant presentation. It has been used successfully with the Ampex video tape recorder to make permanent records of radar tracking instrumentation data; standard instrumentation recorders do not meet the bandpass requirements which, in some cases extend to 100 mc. Kinescope tape recordings make later frame-by-frame photographic analysis of data possible.

The successful use of this integrator in APL research and development programs suggests its adaptation for many other applications. Among these are the following: special effects—generally for closed-circuit TV, small TV stations, and portable field operations; four-way split-screen monitoring for hospitals, banks, air terminals, schools, etc.; observation of four independent or simultaneous operations on one monitor—for example, missile checkout operations, atomic reactions, and radioactive experiments; and coverage of 360° from cameras mounted in a mobile robot, as, for example, in lunar exploration.