



Automatic Color-Locking Systems

As advancing technology expands our ability to transmit color television programs over long distances, it is natural that those responsible for producing news, sports and public service programs should make increasing use of live material from far-flung locations to assemble these programs. This tendency creates special problems for television engineers. In order to allow production personnel to use the usual special effects such as fades, superimpositions, wipes and mattes, which are necessary if the resulting program is to be artistically pleasing, each source must appear at the Central Control location locked in color phase and raster phase. Conventional locking systems are of no practical use over long distances.

This problem is of such current national and international interest that three papers on the subject were submitted for presentation at the Society's 105th Conference in Miami Beach. A paper on this topic was presented earlier at the 104th Conference in Washington, D.C. In view of the fact that the four authors, who are among the foremost technical experts on this topic were to be at the 105th Conference, it was decided to present a panel discussion on the subject, "Automatic Color-Locking Systems." These papers and the discussion represent important contributions toward the solution of these problems. — RICHARD W. RODGERS, Moderator

Color Picture Source Synchronization by the Natlock System

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Equipment has been developed to synchronize color television sources so that they can be mixed and split-screened together at a central point. The system, which can work with any number of sources, controls the timing and phase of each source by error signals coded as audio tones which are generated by comparison equipment at the mixing point and carried by telephone bandwidth circuits. Part of the system, which was developed primarily for remote sources mounted in vehicles, is also being used within a studio complex in London to perform color-subcarrier phasing. The lock-up times of the various arrangements and the final accuracy required are discussed.

COLOR TELEVISION BROADCASTING involves techniques developed by physicists and electronic engineers in many fields. Some problems, such as accurate color analysis, camera-tube registration, color encoding and long-line transmission are as difficult as we expected, but in addition there is the surprising problem of synchronization requiring accuracy of time measurement of the order of 1 ns (10^{-9} s) and oscillator

stability of better than 1 part in 10^8 . Synchronization of picture sources is necessary when it is required to cross-fade, wipe, superimpose or split-screen two sources. The process involves making the synchronizing pulses of the television waveforms of the sources coincident in time at the same place. Naturally account must be taken of the velocity of propagation of the signals and the remote one must be generated earlier to allow for the additional length of its path to the mixing point.

Monochrome Synchronization

Traditional methods of monochrome synchronization in studio complexes use timing pulses generated centrally and distributed to the various sources. Appropriate delays made up of cable- and lumped-delay networks equalize the transmission times over different routes

so as to make synchronous any group of sources at any mixing point. The extension of this system for color requires additional pulses conveying information about the position and length of the color burst and, in the 625/50 PAL system, the sense of the V-axis switching process. The color subcarrier itself must also be distributed to the color source encoders.

Synchronization of Remote Sources

Where remote sources are involved monochrome practice has been to alter the timing of the local timing waveform generator to conform to the incoming video signals before mixing takes place. This synchronization process, which is known as "genlock" (the local generator is locked to the incoming video signal), has a number of disadvantages. The first is the obvious one, that only one source can be synchronized at a time. To deal sequentially with a number of sources, the director must change from the remote picture to a local one to allow time for the genlock equipment to lock to the new source, before he attempts to mix to it. Naturally, from a production point of view, this period should be as short as possible, but the shorter it is, the greater is the disturbance to the local waveforms during the locking process. Although pictures from purely electronic equipment

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