ABSTRACT

The Genlock–A New Tool for Better TV Programming

By John H. Roe

RECENTLY, the need for more and better techniques in video programming has become more and more apparent, particularly as picture quality has improved, thus focusing attention on ideas for adding some of the finer touches. One of the gaps in the present programming structure arises from the lack of synchronization between two distinct program sources which may supply successive parts of a program. The field-frequency pulses may be phased together by manual adjustment and they will stay so as long as the same power source is the reference for both generators, but there is no such simple solution to the problem of phasing the line-frequency pulses.

Lack of tight lock-in between two such systems results in several programming limitations. For example, when the program line is switched from one system to the other, the receivers have to adjust themselves to the new synchronizing signal. The horizontal (line-frequency) scanning changes very quickly in most cases, but the vertical (field-frequency) scanning circuits have much more inertia and do not respond quickly. The usual result is, therefore, that the picture on a receiver will "roll over," much to the annoyance of the viewer.

Another limitation is the impossibility of using lap-dissolves and superpositions involving pictures from two unrelated television pickup systems. The increasing use of lap-dissolves and superpositions in studio programs makes it seem more and more desirable to provide means to produce the same effects at all times regardless of the sources of the signals to be treated. To make them possible, the synchronizing signal generators must be locked together tightly, field for field and line for line, just as though the whole system were operating on one generator instead of two.

The most direct solution to this problem is to provide means for locking the local synchronizing signal generator, as a slave, to the remote generator, as a master. Once the equipment for this control of the local generator is functioning, the remote signals may be treated as local signals in any of the common types of switching transitions and superpositions, thus making it possible to go back and forth from one source to the other without concern as to the point of origination.

Foreseeing the need and the demand for simple, automatic and foolproof means for tying two television pickup systems together, RCA engineers have developed a device called the Genlock, which accomplishes the desired lock-in automatically without any manual phasing adjustment whatever.

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The Genlock

The Genlock is a unit which combines two separate circuits which serve to provide control signals to the line-frequency and field-frequency sections, respectively, of the local synchronizing signal generator.

The first consists of an automatic frequency-control discriminator which derives a varying d-c error signal from the comparison of the horizontal driving signal (from the local synchronizing signal generator) with the separated synchronizing signal derived from the remote picture signal. This latter synchronizing signal must be separated from the composite picture signal in some other equipment such as the RCA TA-5C stabilizing amplifier. No separator circuit is provided in the Genlock. The error signal is applied to the reactance tube in the local synchronizing signal generator, thus directly controlling the frequency and phase of the master oscillator. The control is rigid, allowing no perceptible horizontal drift or instability between the two pictures.

The second circuit compares the synchronizing signals, one from the local synchronizing signal generator and the other from the synchronizing signal separator operating on the remote picture signal, and from this comparison derives an error signal in the form of a positive pulse recurring at field frequency. As long as the two field-frequency signals are out of phase, the pulse exists, but as soon as they become coincident, the error pulse ceases to exist. The error signal is applied to the 7:1 counter circuit in the local synchronizing signal generator (RCA TG–1A or TG–10A) in such a way as to cause it to miscount. As long as the error signal continues to recur, the local field frequency drifts at an accelerated pace causing the two signals to approach in phase. At the instance of coincidence the error signal disappears and the counter circuit begins to operate normally. Thereafter the two signals remain in phase as long as the Genlock continues to function.

The operation of the line-frequency control circuit is quite rapid so that lock-in of the horizontal scanning circuits appears to be almost instantaneous. The field-frequency control circuit, however, requires a variable amount of time to assume full control depending on the initial phase difference between the two signals. Phase shift brought about by the control occurs at a definite rate of three scanning lines per field. The maximum time required to achieve control is about 1.46 sec.

The Genlock never requires more than one field to bring the field-frequency pulses into phase. The reason is that when it causes the counter in the synchronizing signal generator to miscount, it is possible, under the proper conditions, to bring about a conversion of an "even" to an "odd" field, or vice versa.

The question may arise as to what happens if by some mischance the even field in one system is brought into coincidence with the odd field of the other system. The answer is that nothing serious takes place. The tops and bottoms of the two pictures are slightly displaced under such conditions.

From a practical point of view, it is not important to have exact coincidence of the top and bottom lines, respectively, in the two picture signals. Any lack of coincidence means simply that the edges of the two vertical blanking signals are slightly separated in time, and therefore, in space, on the picture tube. This results in a shift up or down, of the top and bottom of the raster at the time of switching by an amount proportional to the discrepancy. If the discrepancy is, for example, only one or two half-line intervals, the shift is almost imperceptible.

tible. In the average receiver it is hidden behind the mask and is not visible at all.

Thus it may be seen that the Genlock is entirely automatic in operation, and requires only the proper information in the form of suitable signals to bring about a solid "marriage" of the two synchronizing signal systems. The only control necessary is a switch for disconnecting the normal frequency reference standard and at the same time connecting the output of the Genlock to the proper circuits in the local synchronizing signal generator.

System Considerations

Two methods of using the Genlock in a television station are suggested. In the first case, where only one synchronizing signal generator is available at the studio, the connections between it and the Genlock are made through a switch. In the second case, where an additional or standby synchronizing signal generator is available at the studio, the Genlock is used to control the standby generator, and the system is transferred to Genlock operation by switching from one generator to the other. This is the preferable method because it permits previewing of Genlock operation before the system is transferred.

In either case, because a transfer in or out of Genlock operation causes a transient disturbance in the operation of deflection circuits in receivers, it is desirable to make the transfer with the video output of the station faded down to black.

Inasmuch as the Genlock makes the local station dependent on a signal source which is remote and beyond the control of local operators, it is interesting to know what happens when the remote signal fails. The Genlock is so designed that, when the remote signal is lost, the local synchronizing signal generator continues to operate quite normally at a rate which is very close to that existing under Genlock control. In other words, the synchronizing signal generator becomes free-running, depending only on the stability of its master oscillator. When the remote signal is restored, the Genlock regains control in the same way as when initially put into operation.

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