



Modifying a Horizontal Blocking Oscillator to Provide Increased Driving Voltage for the Scanning Circuit

This Note describes the use of sawtooth-generating circuits of the blocking-oscillator type with modern high-efficiency horizontal-scanning circuits in television receivers employing magnetic-deflection kinescopes. Such scanning circuits require a driving voltage containing a sawtooth component of considerable amplitude. This driving voltage must cut off the horizontal output tube rapidly at the end of each scanning cycle and must keep it cut off during the entire retrace interval. The high peak voltage which appears at the plate of the horizontal output tube during retrace is coupled to the grid through the grid-plate capacitance of the tube. The resulting attenuated pulse at the grid may permit plate-current flow. Since even small currents represent an important energy loss at the high plate voltage, it is usually desirable to assure complete cutoff by adding a negative "peaking" pulse to the sawtooth driving voltage during horizontal retrace.

In order to satisfy these cutoff requirements with conventional discharge-tube sawtooth generators, "series resistance peaking" is commonly used. A resistor in series with the discharge capacitor increases the rapidity of cutoff and causes a negative peaking pulse. In blocking-oscillator discharge circuits of conventional design, however, series resistance peaking is not useful. Since such circuits normally generate a sawtooth with a steep trailing edge, a further increase in rapidity of cutoff is not required. Furthermore, the negative pulse provided by series resistance peaking would not be of sufficient duration to assure cutoff throughout the entire retrace interval. When driving circuits of the blocking-oscillator type are used, most horizontal scanning circuits perform quite well without peaking. Some improvements in circuit efficiency may be obtained, however, by the addition of a peaking pulse of 10% to 20% of the total sawtooth driving voltage. Such a pulse may be obtained by "feedback peaking" if the scanning circuit employs a transformer with a secondary winding connected so that it provides a negative pulse.



Sawtooth Amplitude

An important condition for the proper operation of the scanning circuit is that the sawtooth input be of sufficient amplitude. The driving circuit should be designed with some margin of output amplitude so that the drive may be adjusted to accommodate tube and component variations. The trend in modern scanning circuits is to demand more drive and, therefore, modifications of the well-established horizontal-oscillator circuits are usually necessary.

Fig.1 shows a popular circuit in which a single tube serves as a blocking oscillator and synchronizing control.* This circuit will provide a sawtooth voltage of approximately 60 volts peak to peak. The sawtooth amplitude may be controlled by the capacitive attenuator formed by C_{11} and C_{12} . As the capacitance of C_{12} is increased, the drive is reduced by the change in attenuation and also by a second-order effect caused by a change in the effective value of the discharge capacitance. The discharge capacitance includes the equivalent series capacitance of C_{11} and C_{12} which is in parallel with C_{10} . An increase in the discharge capacitance decreases the amplitude of the sawtooth output, and C_{12} , therefore, will function as a drive control even if the coupling capacitor, C_{11} , is made very large compared to C_{12} . A large coupling capacitor may be desirable in some circuits but it has the accompanying disadvantage of permitting the drive control to have a greater effect upon the horizontal-oscillator frequency.

If it is necessary to increase the sawtooth voltage available from the circuit, one expedient is to use a higher B voltage, if available, such as that obtained by making use of the boost voltage from the horizontal-scanning circuit. Changing the B voltage will necessitate adjustment of the value of R_{11} so that the current through the hold control, R_6 does not change. Any increase in the sawtooth voltage output will also necessitate adjustment of the value of R_2 . R_2 and C_3 form an attenuator and partial integrating circuit through which the sawtooth output is applied to the grid of the control tube and is compared in phase with the sync pulse. If the sawtooth voltage is increased, the attenuation through R_2 and C_3 must be increased to restore the proper amplitude of the voltage at the control-tube input.

Any further increase in sawtooth voltage must be accomplished by changing the time constant of the charging circuit, the most important elements of which are R_{14} and C_{10} . Reducing the value of either of these components will increase the sawtooth amplitude. Reducing the time constant of the charging circuit by reducing the value of C_{10} will increase the frequency of oscillation. Although it would appear that reducing the value of R_{14} would have the same effect, there are compensating effects which actually cause the frequency to decrease slightly. In order to increase the sawtooth amplitude with minimum effect upon frequency, both R_{14} and C_{10} should be reduced in value. Reducing the value of R_{14} , however, tends to increase peak currents in the blocking-oscillator tube, so its value should not be made too small. Another component which may

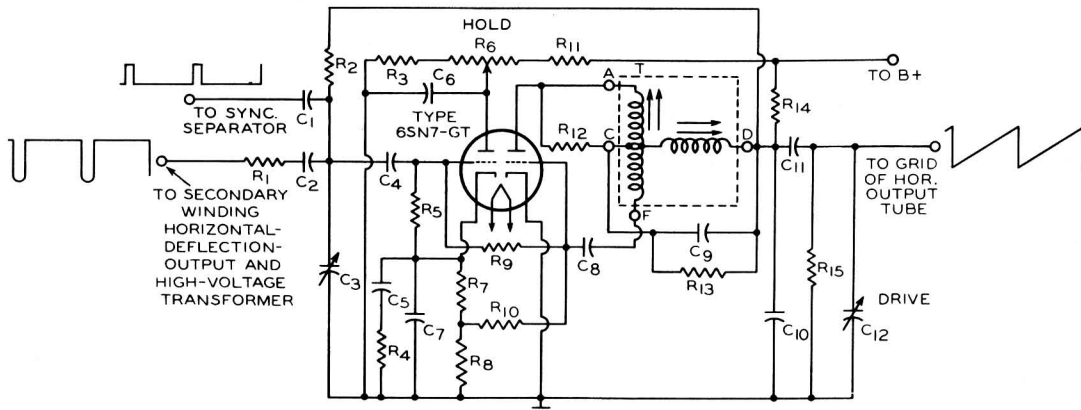
* This circuit, a development of the RCA Home Instruments Department, is known as the "Synchroguide".



be used for frequency adjustment and which has a relatively minor effect on other parts of the circuit is the coupling capacitor C8 to the grid of the blocking oscillator. Increasing the value of C8 decreases the sawtooth frequency. Peak currents in the blocking-oscillator tube are also increased as the value of C8 is increased.

Sawtooth Linearity

For optimum performance and linearity in the scanning circuit some curvature in the waveform of the driving sawtooth is desirable. It may be noted that in many scanning circuits the driving waveform is deliberately altered by imperfect bypassing of the cathode resistor of the horizontal output tube in order to produce frequency-selective degeneration.



Parts List for Original Circuit

- B+ = 350 volts
- C1 C8: 180 μf , mica
- C2: 5 μf , mica
- C3: Horizontal Locking Range Control, 10-160 μf , mica trimmer
- C4: 0.0022 μf , 600 v.
- C5: 0.22 μf , 400 v.
- C6: 0.047 μf , 600 v.
- C7: 0.022 μf , 400 v.
- C9: 0.01 μf , 600 v., oil-filled
- C10: 0.0022 μf , 600 v., oil-filled
- C11: 390 μf , mica
- C12: Horizontal Drive Control, 40-370 μf , mica trimmer
- R1: 0.56 megohm, 0.5 watt
- R2 R7: 0.15 megohm, 0.5 watt
- R3: 68000 ohms, 0.5 watt
- R4 R12: 8200 ohms, 0.5 watt
- R5: 0.82 megohm, 0.5 watt
- R6: Horizontal Hold Control, 50000-ohm potentiometer
- R8: 0.15 megohm, 1.0 watt
- R9: 2.7 megohms, 1.0 watt
- R10: 0.1 megohm, 1.0 watt
- R11 R14: 0.12 megohm, 1.0 watt
- R13: 22000 ohms, 0.5 watt
- R15: 1.0 megohm, 0.5 watt
- T: Horizontal-Oscillator and Sync-Stabilizer Coil, RCA-205R1

Parts List for Modified Circuit

- *B+ = 500 volts
- C1 C8: 180 μf , mica
- *C2: 22 μf , mica
- C3: Horizontal Locking Range Control, 10-160 μf , mica trimmer
- C4: 0.0022 μf , 600 v.
- C5: 0.22 μf , 400 v.
- C6: 0.047 μf , 600 v.
- C7: 0.022 μf , 400 v.
- C9: 0.01 μf , 600 v., oil-filled
- *C10: 0.0018 μf , mica
- *C11: 0.005 μf , paper
- C12: Horizontal Drive Control, 40-370 μf , mica trimmer
- R1: 0.56 megohm, 0.5 watt
- *R2: 0.33 megohm, 0.5 watt
- *R3: 82000 ohms, 0.5 watt
- R4 R12: 8200 ohms, 0.5 watt
- R5: 0.82 megohm, 0.5 watt
- R6: Horizontal Hold Control, 50000-ohm potentiometer
- R7: 0.15 megohm, 0.5 watt
- R8: 0.15 megohm, 1.0 watt
- R9: 2.7 megohms, 1.0 watt
- R10: 0.1 megohm, 1.0 watt
- *R11: 0.24 megohm, 1.0 watt
- R13: 22000 ohms, 0.5 watt
- *R14: 0.1 megohm, 1.0 watt
- R15: 1.0 megohm, 0.5 watt
- T: Horizontal-Oscillator and Sync-Stabilizer Coil, RCA-205R1
- * Modified Circuit Values.

Fig. 1 Horizontal-Blocking-Oscillator Circuit.



Although circuit changes which increase sawtooth amplitude for a given B voltage affect sawtooth linearity, sawtooth linearity is not likely to be a limitation in obtaining the required driving voltage for most scanning-circuit designs.

Sample Circuit Modifications

In order to obtain the sawtooth driving voltage of at least 90 volts peak to peak for a 16GP4 scanning circuit using an RCA-6CD6-G horizontal-output tube and an RCA-218T1 horizontal-output transformer which provides a boosted supply of approximately 500 volts, a simple modification of Fig.1 may be used. The modified components are indicated by an asterisk(*) in the parts list for this figure. Some further improvement in performance may be obtained by adding feedback peaking until the total input signal is increased from 90 volts to 100 volts peak to peak. The addition of further peaking does not appreciably improve circuit performance and excessive peaking is not desirable. Because excessive peaking may cause phase displacement of portions of the picture by its influence upon the horizontal oscillator circuit, it is preferable to apply the peaking directly to the grid of the horizontal-output tube. With this arrangement, the peaking pulse is attenuated through the coupling capacitor before reaching the horizontal oscillator.

Negative Pulse for the Control-Tube Input

A negative pulse is applied to the control-tube input through R1 and C2 to steepen the trailing edge of the sawtooth at the grid of the control tube after its integration through R2 and C3. The values of R1 and C2 in Fig.1 are chosen to provide proper shaping of the voltage at the control-tube input with a negative pulse of approximately 1200 volts. In certain horizontal-scanning circuits, this pulse is obtained from the secondary winding of the horizontal-output transformer which is connected to the deflecting yoke. In direct-drive scanning circuits and circuits employing autotransformers, the pulses at the yoke are positive. With RCA horizontal-deflection-output and high-voltage transformers types 217T1 and 218T1, which are of the autotransformer type, a negative pulse of approximately 250 volts may be obtained from the width-control winding. When this lower-voltage pulse is used, it is necessary to change the attenuation through R1, C2, and C3 by reducing the values of either R1 or C2 or both. Some horizontal-oscillator designs similar to that of Fig.1 are in use which do not require that a pulse be fed back from the horizontal-output circuit.

Precautions

The designer should remember that the circuit described is a complex arrangement in which many circuit functions are interdependent. As circuit modifications become more extensive, it is increasingly important to check carefully the performance of the circuit for such characteristics as pull-in range, hold-in range, stability with tube aging, stability with changes in B voltage, and adequate range of adjustment to allow for tube and component variations.

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