RCA
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Understanding Horizontal-Output Circuits

The complexity and lack of understanding of horizontal deflection circuitry result from the fact that it is comprised of several interdependent circuits. Also, the apparent complexity is increased because the horizontal deflection system provides additional DC voltages and pulses that are necessary for the operation of other circuits within the receiver. Actually, the horizontal deflection and high-voltage system has two basic functions in a color television receiver. The first is to provide 15.7 kHz horizontal yoke current. The second function is to produce high voltage and focus voltage for the color picture tube.

A block diagram (Figure-1) details the essential components of a horizontal-deflection system. These include the Horizontal-Oscillator Stage, Horizontal-Output Stage, and Damper Stage.

Horizontal Oscillator

The function of the horizontal oscillator is to provide grid drive for the horizontal-output stage. The horizontal oscillator is designed so that its output signal may be synchronized with the horizontal scan originally produced at the broadcast station.

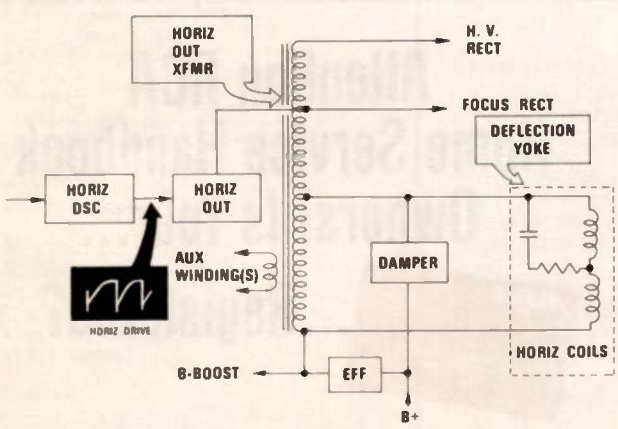

Figure 1—Horizontal Deflection Block Diagram

This is accomplished by comparing the horizontal-oscillator frequency against synchronizing pulses extracted from the video signal. A control voltage derived from this comparison maintains the horizontal oscillator at the correct frequency so that the video information that was transmitted line-by-line is reconstructed on the screen of the picture tube.

The horizontal-output stage uses a beam power pentode tube such as (6JE6, 6LQ6, etc.) which may be thought of as a switch. Conduction of the tube applies a pulse of voltage across the primary of the horizontal-output transformer. This voltage produces a linear increase in current that drives the deflection yoke to scan the right side of the television picture. When the right side scan is completed, horizontal retrace occurs. During this interval the electron beam is rapidly deflected from the right side of the screen to the left. This rapid retrace of the electron beam is not visible on the screen because the horizontal blanking circuit cuts off the picture tube.

At the end of retrace, the damper stage (a diode such as the 6CL3, or a silicon diode) controls the deflection current so that the electron beam produces a linear scan from the left side of the picture to the center. Then the horizontal-output stage conducts again and the cycle repeats.

It is interesting to note that although the B+ voltage (typically about +405 volts) is available, the horizontal-deflection system produces its own volt-

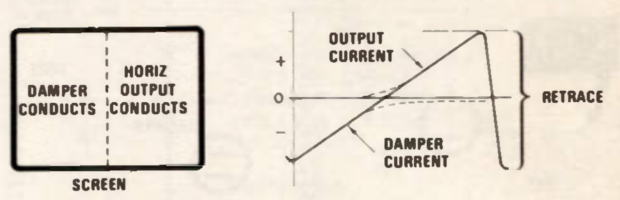

Figure 2—Beam Scan Vs. Yoke Current

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age supply which is known as B-Boost. This voltage is typically about +810 volts. (The reader should assume, for the purpose of explanation, that the horizontal-output circuit operates from the +810 volts B-Boost supply. B-Boost generation will be discussed after the basic operation is explained.)

The remaining block in Figure-1 is the efficiency circuit which functions to improve the efficiency of the horizontal-output circuit by reducing the power dissipation of the horizontal-output tube. Its second function is to provide linearity correction so that the horizontal-yoke current provides good linearity in the reproduced picture. The previously mentioned high-voltage and focus circuits have been omitted from the block diagram because they may be considered as auxiliary circuits, and thus are not essential to the operation of the circuit.

Figure-2 shows graphically that the horizontal-output tube conduction contributes the right side of the picture and the damper contributes the left. The waveform in the illustration depicts the current in the deflection yoke during horizontal scan. When the horizontal-output tube is driven "on," the transformer/yoke current increases in a linear manner from zero to maximum and the electron beam scans from the center to the right side of the screen. The horizontal-output tube is then turned "off" and retrace occurs. During retrace the scanning beam moves rapidly from the right side of the screen through the center to the left side of the screen. At the end of retrace, the damper conducts and provides scan current for the left side of the picture.

Horizontal Outut Stage

Figure-3 describes the conditions related to horizontal-output stage conduction. The instant at which conduction occurs is determined by the time when the leading edge of the horizontal grid-drive waveform exceeds the cut-off bias of −50 volts. The shape of the drive waveform allows the horizontal-output tube to be rapidly driven from cutoff to maximum plate current. Once the tube is biased "on," current withdrawn from the B-Boost/efficiency circuit flows through the primary of the horizontal-output transformer and yoke to produce a yoke current that causes scan from the center to the right side of the screen. During this time interval energy is stored in the magnetic field of the horizontal-output transformer and yoke. As the scan reaches the right edge of the screen, horizontal retrace is initiated when the trailing edge of the grid-drive signal suddenly goes far more negative than the −50 volts DC grid bias. Consequently, the horizontal-output tube is cut off, and the magnetic field of the transformer and yoke suddenly collapses. The collapsing magnetic field causes the transformer/yoke circuit to ring at its self-resonant frequency, producing a yoke current and magnetic field reversal to rapidly drive the electron beam from the right side of the screen to the center. This current flow charges the distributed capacity of the self-resonant transformer/yoke circuit, providing a high positive voltage (flyback pulse) whose maximum value occurs when the yoke current is zero (at the center of the screen). Due to the oscillatory nature of the circuit, the distributed capacity begins to discharge, the yoke current again reverses, and the electron beam is driven to the left side of the screen. At this time, the amplitude of the flyback pulse has dropped sufficiently to allow damper tube conduction. The conducting damper can now produce left side scan as the remaining energy in the transformer/yoke is recovered by the B-Boost/efficiency circuit.

To Be Continued

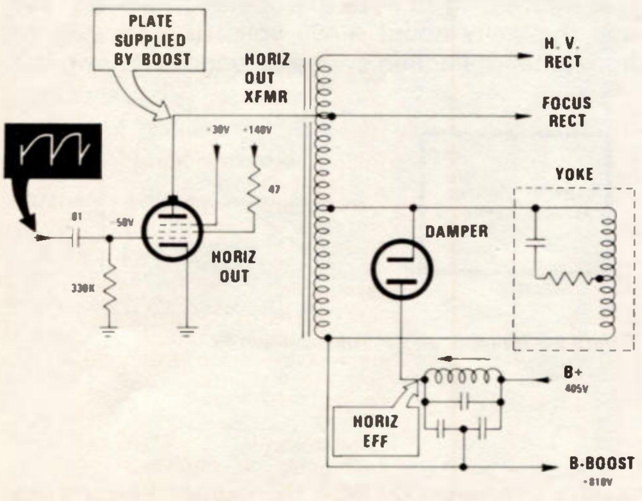

Figure 3—Simplified Horizontal Output Stage

Servicing ■ ■ ■
Test Equipment Repair Stations

Efficient and accurate servicing requires that your test equipment be in good working order. Fortunately for RCA Test Equipment owners, like-new performance is assured when RCA Test Equipment is repaired and recalibrated at the test equipment repair stations listed below.

California

Electronic Service Co.
7732-A Densmore Ave.
Van Nuys, Calif. 91406
Attn: Stuart Oleskar
213-780-3071

Guaranteed Electronics, Inc.
5822 Mission Street
San Francisco, Calif. 94112
Attn: Mr. Bruce
415-334-5900

Otto's Instrument Service
Ontario International Airport
Ontario, Calif. 91761
Attn: Wm. Otto
714-986-6624

Colorado

Insco Company
841 Champa Street
Denver, Colo. 80204
303-255-7665

Clyde N. Still
2630 W. Kiowa
Colorado Springs, Colo. 80904
Attn: Clyde Still
303-633-8404

District of Columbia

Electronic Maintenance
308 Carroll Street
Washington, D.C. 20012
202-882-2333

Georgia

Powell Electronic Service Co.
1250 Virginia Avenue
Atlanta, Georgia 30306
Attn: Arthur Powell
404-872-9688

Idaho

TV Tuner Service
410 Elm Street, No.
Twin Falls, Idaho 83301
Attn: Neils Haslam
208-733-5636

Illinois

B & S Electronics
6326 W. Roosevelt Road
Oak Park, Illinois 60304
Attn: O. J. Staks
313-383-2363

Kansas

Main Electronics Inc.
353 Pattie
Wichita, Kansas 67211
Attn: Dennis Main
316-267-3581

Louisiana

Audio & Instrument Associates
5511 Sussex Street
Shreveport, Louisiana 71108
Attn: E. Nuttall
318-868-9577

Ted Drell Electronics
3341 Ole Miss Drive
Kenner, Louisiana 70062
Attn: Ted Drell III
504-721-3740

Massachusetts

Douglas Instrument Labs.
176 Norfolk Avenue
Boston, Mass. 02119
Attn: Harold Millen
617-445-4836

Michigan

Main Electronics Company
5558 S. Pennsylvania Ave.
Lansing, Mich. 48910
Attn: Gordon D. Main
517-882-5035

Missouri

Kansas City Calibration Lab.
2607 Holmes
Kansas City, Missouri 64108
816-471-2080

Scherrer Instruments
7170 Manchester Avenue
St. Louis, Missouri 63143
314-644-5362

Kermit Shetley Repair
2613 Marvin
Cape Girardeau, Missouri 63701

Nebraska

Electrometrics Company
412 South 11th Street
Lincoln, Nebraska 68508
Attn: Larry Merriman
402-477-3434

New Jersey

Blackwood Electronics
104 E. Hillcrest Avenue
Blackwood, New Jersey 08012

Brownell-Electro Inc.
207 Columbus Avenue
Roselle, New Jersey 07203
Attn: Jack Marsh

New York

A to Z Service Co.
1067 Harlem Road
Buffalo, New York 14225
Attn: Carl Mayer
716-825-6666

Electrical Instrument Service
25 Dock Street
Mount Vernon, N.Y. 10550
Attn: Gerry Frank
914-699-9717

Brownell-Electro Inc.
85 Tenth Avenue
New York, N.Y. 10011
Attn: Joe Grant
212-675-2400

Radio & Electronic Service Co.
401 N. Townsend Street
Syracuse, N.Y. 13203
Attn: Larry De Martino
313-422-5707

North Carolina

Speed Instrument Company
3028 E. Rothgeb Drive
Raleigh, N.C. 27609
Attn: Wm. Speed
919-782-1468

Oregon

Progress Electronics Co. of Oregon
5160 N. Lagoon Avenue
Portland, Oregon 97217
503-285-0581

Pennsylvania

Certified Calibration Labs
2709 N. Broad St.
Phila., Pa. 19132
Attn: Dave Krantz
215-229-7557

Sanders Electronics
6236 Jerome Blvd.
Harrisburg, Pa. 17112
Attn: Irv. Sanders
717-545-3260

Sunshine Scientific Instruments
1810 Grant Avenue
Philadelphia, Pa.
Attn: E. Lansdowne
215-673-5600

Tennessee

Edwin Bohr Electronics
5880 Dayton Blvd.
Chattanooga, Tenn. 37415
Attn: Edwin Bohr
615-877-8207

Texas

Ultra Instrument Laboratory
9995 Monroe Drive
Dallas, Texas 75220
Attn: Steve Huszar
214-357-0297

Whitlock Instrument Repair
1314 North Texas
Odessa, Texas 79760
Attn: Larry L. Ritchie
915-337-3412

Washington

Eicher-Richards Company
2727 N.E. Blakeley Street
Seattle, Washington 98105
Attn: Dick Richards
206-523-7888

Sutherlands Inc.
South Annex—Boeing Field
Seattle, Washington 98108
Attn: Alex McCallum
206-763-2491

Service Hints for Circuit Boards

Avoid unnecessary complications when servicing circuit boards by following the precautions and service hints in this article.

To avoid overheating, do not hold soldering iron on the copper wiring any longer than necessary to melt the solder. It is better to apply heat for two or three short periods during a service operation than for one long interval, because heat can cause the copper wiring pattern to unbond from the board.

When removing components from circuit boards apply a minimum of pressure or pull on the leads to prevent damaging the board. This is important because the adhesive under the copper pattern is thermoplastic and softens with heat. Thus a strong pull on the lead as heat is being applied is very likely to pull the copper from the board before the solder melts sufficiently to free the lead.

Replacement components should be installed so that they are tight against the board before the leads are soldered.

After making repairs on a circuit board, always check for splattered solder and solder bridging over to other conductors.

Never handle an unmounted board carelessly. Although circuit boards have more than ample strength when mounted, they are subject to breakage when unmounted.

Circuit Board Repairs

Tools: A small pencil-type soldering iron; a pair of diagonal pliers; a pair of long-nose pliers; a soldering aid or scribe; a vacuum desoldering tool; and a small knife.

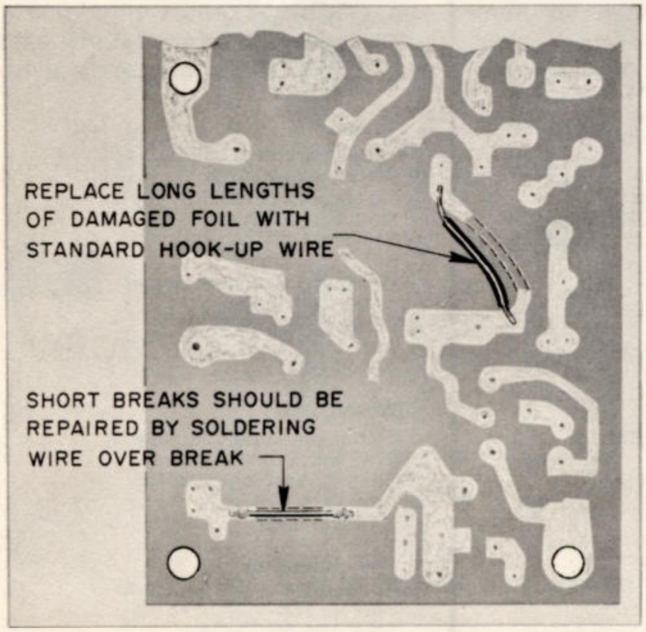

Figure 4—Methods of Repairing Wiring on Circuit Boards

Materials: 60/40 rosin-core solder; alcohol and tinned hook-up wire.

Component Replacement

1. Heat the solder joint on the wiring side and using long-nose pliers pull the lead through the component side—Careful use of a knife will help loosen clinched leads. Multiconnection components such as transformers are easily removed by using the soldering iron to melt the solder at each connection. The melted solder is then removed with the desoldering tool.

2. Heat and clean out the lead hole with the desoldering tool or soldering aid.

3. Form leads on new component and insert leads properly into the circuit board.

4. Re-solder leads using rosin-core solder, and remove excess flux with alcohol. Clip excess lead wire.

Repair of Breaks in Copper Pattern

1. Cut a piece of hook-up wire about ½ inch longer than the break.

2. Tin both ends of the wire.

3. Center the wire over the break along the conductor and hold it with the soldering aid while soldering each end of the wire to the copper circuit.

4. Clean wire with alcohol.

Note: A small break in the copper pattern can normally be found easily by a visual examination of the circuitry. The use of a magnifying glass can be of help in locating small "hair-line" breaks in the wiring. Very small breaks can be repaired by carefully flowing solder over the break or by wire bridging as described above.

Raised Wiring

If the board copper pattern becomes raised from the board, carefully clip off the raised section and replace it with a piece of insulated hook-up wire —connect each end to mechanically-secure tie points.

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