RCA
Plain Talk
and Technical Tips

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Workshop Training—CTC 38

RCA Consumer Electronics distributors are now presenting a new Workshop Program entitled, "Servicing the CTC 38 Color Chassis." This workshop is another in a continuing series that RCA has designed to aid the service industry in keeping abreast with the latest color television technology.

Contents of the program include a flipchart that illustrates servicing procedures for isolating problems within the chroma amplifier section, color sync stages, and the ACC/color killer circuitry. Special emphasis is placed on analyzing the operation of the new solid-state **balanced diode demodulator** circuit used in the hybrid CTC 38 chassis.

The flipchart is designed to present servicing approaches as applied to an actual chassis, including the use of an oscilloscope for waveform analysis. Sweep alignment and sweep waveforms as a troubleshooting technique are discussed in the flips pertaining to the IF amplifier section. In this portion of the program, a signal-tracing technique examines the operation of the **transistorized** three-stage IF. The instructor actually demonstrates the alignment technique used with the CTC 38 chassis. AGC operation is frequently mis-understood by service technicians, thus, a portion of the program is devoted to analyzing the system in the CTC 38. AGC in this chassis is also hybrid, using a tube type keyer stage similar to that found in other RCA chassis; transistor circuitry is used to translate the keyer voltage into a control current for the IF amplifier transistors.

The CTC 38 workshop program should prove extremely beneficial to any technician servicing color receivers. Although the specific service techniques demonstrated in the workshop are intended for the CTC 38, they are also applicable (with modifications) to other chassis.

Complete information on how to enroll in this and future RCA Technical Training Programs is available at RCA Consumer Electronics Distributors.

A Servicing Aid

Beginning with the 1969 Product line, all RCA color television chassis will feature bottom road mapped circuit-boards. This new technique should greatly facilitate servicing operations. As illustrated in the photograph below, all component locations and test points are clearly called out on the circuit board copperside.

This year's color television circuit-boards will continue to use "solder resist" coating, introduced in last year's product line. Component identification and road mapping on the top side of the board will continue as a further facility to efficient servicing.

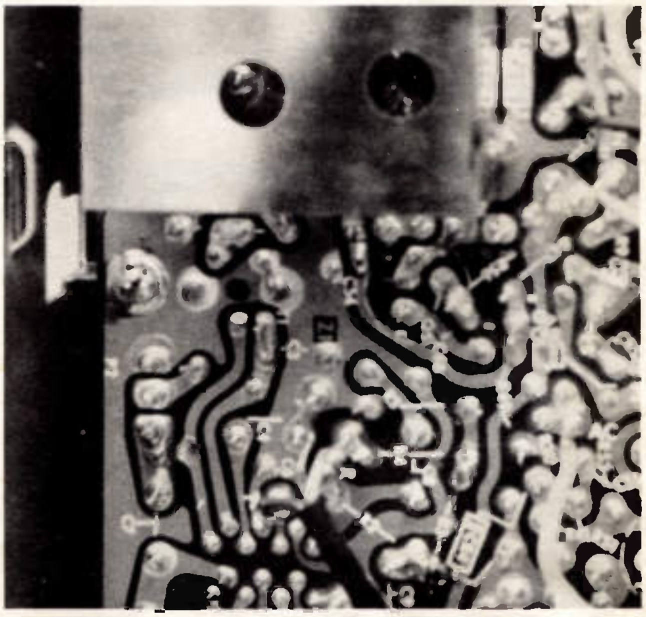

Figure 1—Bottom Road mapped Circuit-board

A monthly publication for the service industry prepared by RCA Sales Corporation

New Solid-State Color Bar Generator

The new WR-502A "Chro-Bar" is a solid state portable (battery operated) color bar generator that generates all the necessary patterns for efficient color television servicing. Patterns include color bars, dots, cross hatch, vertical lines, horizontal lines, and a blank raster. Optimum stability is assured by providing crystal control of the sound carriers, pattern, RF output, and color subcarrier frequencies.

The "Chro-Bar" also features slide switches for shorting out the control grids of the color picture tube, permitting the red, blue, or green guns to be killed as required for convergence and purity adjustments. Test leads are provided for connection to the picture tube grid leads.

The color-bar pattern of this new generator provides 10 bars (keyed rainbow) spaced at 30° intervals. This pattern is useful for checking color phase, matrixing circuits and adjusting AFPC (automatic frequency phase control). As a further asset, narrow brightness pulses are added at the edges of each color bar to facilitate checking the "fit" or registration of the brightness and color signals.

This compact piece of service equipment, weighing only four pounds, is housed in a rugged aluminum case.

Figure 2—"Chro-Bar" Generator

AGC Trouble Shooting

Absence of snow in the TV raster and no "rushing" sound from the speaker may indicate I-F, AGC, or video circuit malfunctions. If snow and noise are observed off-channel but no on-channel, this condition indicates that there is probably excessive AGC, which has reduced the gain of the RF amplifier and I-F stages. A further check can be made by disconnecting the antenna when on-channel to see if a snowy picture can be obtained.

When AGC trouble is suspected, one isolation technique is to clamp the AGC line with an appropriate DC voltage by connecting a battery (or bias supply) to obtain a bias of about −1.5 volts for the RF, and −3 to 4.5 volts for the IF. Obtaining a picture indicates that the AGC section is at fault. (Transistor chassis will require a somewhat different approach. The CTC 38 workshop program demonstrates an excellent approach for AGC tests on these chassis.)

The AGC keyer requires two inputs for proper operation—a keying pulse from the horizontal output stage and composite video. Therefore the first troubleshooting step is to use an oscilloscope to check the keying pulse from the horizontal output transformer, and also the composite video signal at the input of the AGC keyer. Finally measure DC voltages and resistance of components to locate the fault in the keyer circuit.

If tests reveal that the trouble is not in the AGC circuit, the tuner, I-F, and video stages are the remaining possibilities. Use an oscilloscope to check for a signal at the video detector. Presence of video at this point indicates that the IF amplifiers and video-detector stage are functioning—further checks in the video stages should locate the trouble.

If no signal is present at the output of the video detector, the trouble is probably in the I-F stages or tuner. Signal tracing can be used to isolate the stage causing trouble. This is best accomplished by providing an input signal (either a local-channel broadcast signal or an amplitude-modulated RF test signal) to the antenna terminals. Then, using a detector probe and oscilloscope, start at the grid of the first IF stage and scope all grids and plates of the succeeding I-F stages; a signal increasing in amplitude should be observed through each succeeding stage.

When the defective stage is located, make DC voltage and resistance checks to find the defective component.

The MOS Field-Effect Transistor

The KRK 142 tuner (used with RCA's new solid-state CTC 40 color chassis) features an RF amplifier stage using a special type dual-gate MOS-FET transistor. To those not acquainted with this terminology, the MOS-FET is a Metal Oxide Semiconductor-Field Effect Transistor. Because a solid-state device of this type has not been previously used in RCA television chassis, it would be well to acquaint the reader with some interesting facts about this new transistor.

The MOS-FET combines the advantages of solid-state devices (small size, low power consumption, and mechanical ruggedness) with a very high input resistance and linear overall transfer characteristics that closely resemble those of a pentode vacuum tube. In many respects an MOS-FET is similar to a conventional transistor. A big difference, however, is that the MOS-FET controls electron flow by the action of an electrostatic field. This implies that the signal input need not supply current, as is necessary in the case of driving the base of a transistor.

The input element of the MOS-FET consists of a metal control electrode (gate) that acts as one plate of a capacitor—the other plate consists of the semiconductor material. A charge applied to the gate electrode produces an equal but opposite charge in the semiconductor layer (channel) located directly beneath the gate. This charge in the channel area controls conduction between two additional electrodes known as the source and drain, which are applied to the opposite ends of the channel. Figure 4 illustrates that the gate electrode of a MOS-FET is comprised of a metallic contact separated from the semiconductor channel by an **extremely thin** layer of silicon oxide which acts as an insulator (capacitor dielectric). In the depletion type device illustrated, a negative charge applied to the insulated gate electrode will deplete the source-to-drain channel of electrons. When a positive charge is applied to the gate electrode conductivity will increase, resulting in increased electron flow. Because the source-drain current is controlled entirely by varying the electrostatic charge on the gate control electrode, no current is required to bias the input of the device. Therefore, the MOS-FET has an extremely high input resistance.

The manufacturing processes used to produce MOS transistors are similar to those used for high speed silicon switching transistors. Production starts with a lightly doped wafer of P type silicon material. After a polishing operation, the wafer is oxidized in a furnace and photo-lithographic techniques are used to etch away the oxide coating, exposing bare silicon in the source and drain regions of each of the multitude of transistors that are being formed on the wafer. The source and drain regions are next formed by diffusing an N type material such as phosphorus into the wafer.

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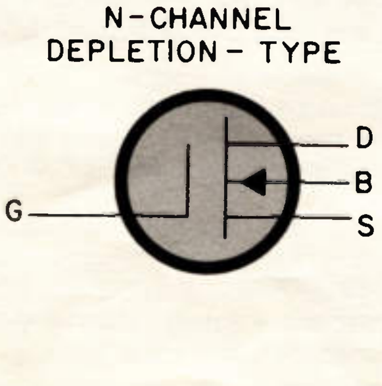

Figure 3—Schematic Symbol for MOS Transistor (G-Gate, D-Drain, B-Active Bulk, S-Source)

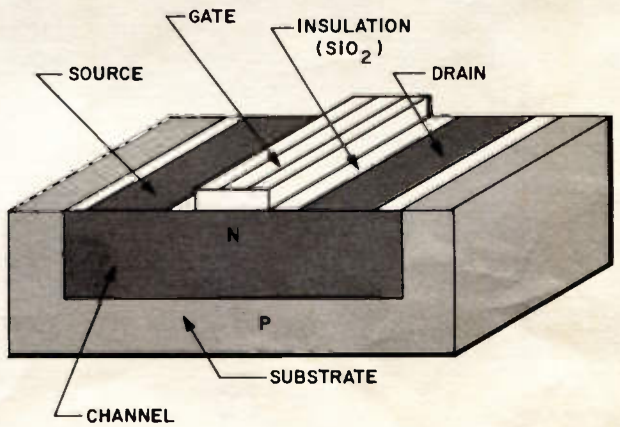

Figure 4—Structure of an N-Channel Depletion Type MOS Field-Effect Transistor

Video Waveforms

An oscilloscope can be of great value to a technician if he uses it to advantage in observing waveforms. The process of signal tracing by waveform is of great value in speeding up television receiver service; it provides a means of quickly determining the operating condition of the most complex circuitry.

The most informative waveform encountered in television service work is the composite video signal waveform consisting of the video information, the blanking pedestals and the sync pulses. If a technician learns to recognize discrepancies in this waveform he can quickly check the performance of many of the circuits within the receiver.

The measurement of the peak-to-peak voltages of these waveforms further reveals the condition of the circuitry; this information is normally supplied in related service information.

To attain reliable information from the observations of composite video waveforms, always use a low-capacity probe and a good oscilloscope. This will assure observation of waveforms as they actually exist in the circuitry. Learn to analyze video waveforms; they can often serve to reveal obscure troubles and save you a great deal of valuable time.

Observation of the horizontal blanking and sync pulse waveform alone can reveal a wealth of information:

Clipping or limiting caused by malfunctioning circuitry can be detected at a glance, as illustrated in Figures 5B and 5C. Sync pulses should normally be approximately 25% of the overall signal level.

In many instances, distortion of the horizontal blanking and sync pulse can reveal malfunctioning circuitry affecting the frequency response within the video section of a receiver. Figure 5D illustrates the rounding effect of the horizontal blanking and sync pulse caused by a loss of high frequencies and indicates a loss of picture detail. Figure 5E shows the effect of excessive high-frequency response on the horizontal blanking and sync pulse which results in fine vertical black-and-white striations following a sharp change in picture shading. The horizontal blanking and sync pulse takes the form shown in Figure 5F when subjected to a loss of low-frequencies. This would show up on the kinescope of the receiver as a change in shading of large picture areas and a general smear of picture detail.

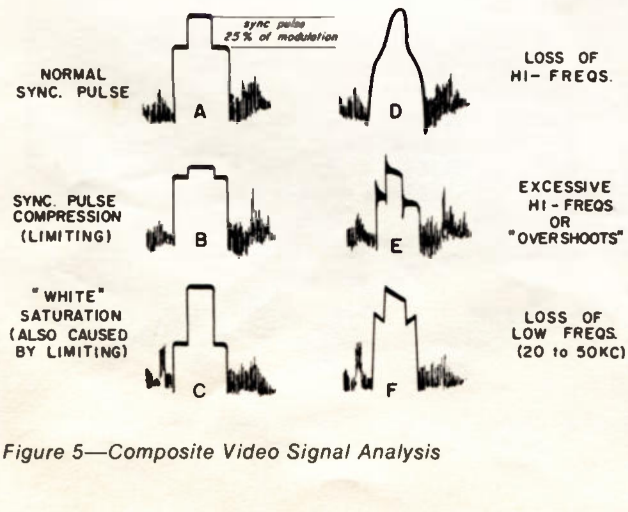

Figure 5—Composite Video Signal Analysis

Another Servicing Aid

Pro or Con? The real "pro" keeps up to date with official information on RCA Consumer Electronics Products. RCA Technical Publications prepares service data on all RCA Consumer Electronics Products from the latest and most accurate engineering and parts information. It is therefore advantageous for the service technician to avail himself with the latest factory information. Servicing time is reduced and replacement parts procurement is greatly simplified when factory service data is used. So be good to yourself and subscribe to RCA Service Data. Subscriptions are now available through your local RCA Consumer Electronics distributor.

MOS-FET

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This diffusion operation forms a bridge (channel) between the source and drain electrodes.

The wafer is again oxidized to cover the bare silicon regions, and a second photo-etching step removes the oxide overlaying the contact regions. In the next step, metal is evaporated over the entire wafer and another photo-etching step removes all metal not needed to produce ohmic contacts to the source, drain, and gate electrodes. Finally, the many MOS-FET's on the wafer are mechanically separated and mounted on individual headers, connection wires are bounded to the metalized regions and each unit is hermetically sealed in its case.

A future discussion will explore the technical aspects of the new MOS-FET device and specifically its application in the new RCA KRK 142 VHF television tuner.

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