RADIO AND TELEVISION

Service News

A PUBLICATION OF THE RCA TUBE DIVISION

The RCA "Silverama Song" TV commercial is a "natural" to pre-sell your customers on the benefits of RCA Silverama Super-Aluminized Picture Tubes and to direct local business prospects to you for fast, dependable service on all makes and models of TV receivers in need of picture tube replacements. Look for this famous commercial. It's coming your way soon on such top NBC-TV programs as "Producers' Showcase," "The Perry Como Show," and "The Saturday Color Carnival." (See story beginning on page 3 of this issue.)

NOVEMBER
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ELECTRONIC AIR CONDITIONER, ELECTRONIC LIGHT AMPLIFIER, HOME 'HEAR-SEE' TAPE PLAYER PRESENTED TO GENERAL SARNOFF TO MARK HIS GOLDEN ANNIVERSARY OF SERVICE IN RADIO AND TV

Three major developments in electronics requested five years ago by Brig. General David Sarnoff, Chairman of the Board of the Radio Corporation of America—an electronic air conditioner with no moving parts, a magnetic tape recording system for television, and an electronic amplifier of light—were presented and demonstrated to him in Princeton, N. J., on October 1st by RCA scientists as gifts to mark his 50th anniversary of service in the fields of radio, television, and electronics.

The new developments, and several unique applications of them, include:

- A room cooled or heated by electronic panels, operating in complete silence and with no moving parts. Also a noiseless electronic refrigerator with no moving parts.
- A home "hear-see" magnetic tape player which reproduces television programs through standard television receivers.
- An electronic amplifier of light which amplifies by up to 1,000 times the brightness of projected light; and an application of it in the form of an amplifying fluoroscope for industrial X-ray use.

General Sarnoff made his request in September, 1951, and expressed his hope that the new devices would be invented by the time of his 50th anniversary in radio, television, and electronics.

Three years later, the RCA scientists produced and publicly demonstrated the first of these devices—a magnetic

Brig. General David Sarnoff
Chairman of the Board
Radio Corporation of America

tape recording system for color and black-and-white television. Designed for broadcast use, this system was later installed at the studios of the National Broadcasting Company, where it has since undergone extensive field tests preparatory to commercial use. It was used in May, 1955, in transmitting the first long-distance tape-recorded color television program, sent over a closed circuit from New York to St. Paul, Minnesota.

Next, the RCA scientists produced and demonstrated publicly a small refrigerator operating by purely electronic means. A little later, they produced and demonstrated an electronic light amplifier panel capable of increasing the brightness of projected light.

On October 1st of this year, the RCA scientists showed that they have made further progress and are bringing these inventions nearer to the market and the home:

- The principles employed in the television tape recording system have been applied in development of a home television sight-and-sound tape player;
- An electronic room air conditioning system and a new, larger electronic refrigerator have been developed from the earlier small refrigerator;
- From the original light amplifier, the scientists have developed a new amplifier capable of increasing by 1,000 times the brightness of projected light, and have also devised a practical application for such a system in industrial X-ray functions.

The presentation to General Sarnoff on October 1st in Princeton at RCA's David Sarnoff Research Center was made by Dr. E. W. Engstrom, Senior Executive Vice-President of RCA, who said:

"The RCA Laboratories organization is especially proud to present you, General Sarnoff, with this fulfillment of your request of five years ago. It is most fitting that these evidences of truly remarkable progress in electronics should be disclosed at this time—on the fiftieth anniversary of one whose faith in electronic science has been unlimited, and whose encouragement of research has been responsible for so many outstanding achievements in radio, television, and electronics."

In his acceptance of the new developments, General Sarnoff paid tribute to the pioneering work of RCA scientists and engineers, saying:

"My request of five years ago was not made lightly, but in full awareness of the ingenuity, vision, and persistence which characterize the research people of RCA. These radical developments represent modern science at its best, concentrating its formidable talents upon the constructive task of providing a wealth of devices and techniques for man's well-being. It is most gratifying to me that all these new developments are related to peacetime use."

RADIO AND TELEVISION
Service News
A PUBLICATION OF THE RCA TUBE DIVISION

RCA RADIO & TELEVISION SERVICE NEWS is published in the interest of dealers and service technicians. It is written to assist them in providing better service, and to foster the growth of their business by supplying them with information on the latest trouble-shooting and sales promotion techniques, sales and service aids, together with invaluable data on RCA tubes, transistors, batteries, parts, and test equipment.

NOVEMBER 1956

RCA RADIO & TELEVISION SERVICE NEWS is a bi-monthly publication of the RCA Tube Division, Harrison, New Jersey.

Harvey Slovik
Editor

Robert Leedy
Technical Editor

Vol. 21, No. 4

RCA Publishes 1957 Edition of Reference Book

The recently published 1957 edition of the RCA Reference Book—the most popular publication of its kind in the electronics industry—is now being made available to radio and TV service technicians by RCA distributors. Have you received your copy? If not, better check your local RCA distributor right away, for the number of copies printed is limited—and they are going fast.

Completely revised from cover to cover, the handy new pocket-size Reference Book will provide you with the latest data on RCA tubes, parts, test equipment, transistors, and semiconductor diodes. In addition, the 1957 edition features a week-at-a-glance type of diary, 16 pages of full-color up-to-the-minute maps of the world, and a personal-data record chart.

Win bigger picture-tube profits

Join the RCA Silverama CRUSADE FOR PROFITS

Your RCA Silverama distributor now stands ready to help you capitalize on the hardest-hitting advertising and sales promotion campaign ever to be launched on picture tubes. It's the new RCA "Crusade for Profits" program that's sure to stimulate your sales of the industry's top picture tube line—RCA Silverama.

Just like the Knight in Silver Armor shown above, you too should toot your horn about your pride in servicing TV receivers with RCA Silverama Super-Aluminized Picture Tubes. You can do so with ease by taking full advantage of the 1956 "Crusade for Profits," for which the Knight is your vanguard. This winning campaign is geared to steer consumers to local dealers and technicians who use RCA's dependable Silverama picture tubes to put new "life" in TV sets.

Most certain to prove an extremely effective business builder for you, the "Crusade for Profits" program features a wide variety of dynamic new business aids backed by a well-planned schedule of impressive advertisements in leading national consumer magazines—LIFE, THE SATURDAY EVENING POST, and TV GUIDE, as well as dramatic commercials on popular network radio and television shows. In addition, this power-packed promotion drive will have even more "punch" when service-dealers place RCA's specially-prepared local newspaper ads and radio and TV spot announcements.

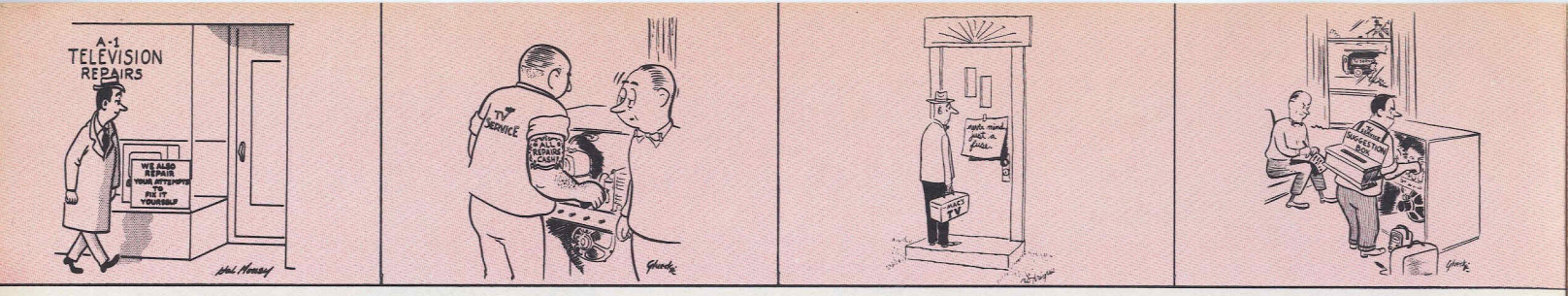
• • •

Ask your RCA distributor today how you may obtain the following new Silverama sales promotion aids:

(1) Silverama Display Kit (Form 4F938)

Key item in this kit is an eye-catching window and in-store display masterpiece that spotlights the TV service technician identified in all RCA Silverama

(Continued on next page)



Cartoons such as the ones shown above add zest to RCA's new consumer-aimed booklet, "TV Life on the Brighter Side" (Form 4F937), which plays up your fast, dependable service with RCA Silverama Super-Aluminized Picture Tubes.

Crusade for Profits With RCA Silverama

(Continued from preceding page)

advertisements in LIFE, TV GUIDE, and THE SATURDAY EVENING POST. Incorporating a flasher unit to demand immediate attention, the brilliantly colored display with its bold, snappy copy points up the importance of the TV service technician in making Silverama replacements. The size of the new display is just right, too—not too large, not too small. Indeed, this easy-to-set-up display builds the status of the TV service technician without monopolizing valuable display space.

Also included in each Silverama Display Kit are two new Silverama window streamers, a new Silverama decal, and a copy of the up-to-date Silverama Replacement Chart.

When posted on your store front, the snappy new Silverama streamers are extremely effective in "stopping" passers-by. The new Silverama decal is a "stopper," also. Easily applied on your door, window, or service truck, it stands out like a brilliant coat of arms, calling attention to your use of RCA Silverama picture tubes in all makes and models of TV receivers.

The revised Silverama Replacement Chart lists the 26 Silverama types from which you may choose replacements for over 115 types of picture tubes. It tells at a glance what Silverama replacements to use, no matter what make of TV set is being serviced. So be sure to post a copy of the handy wall chart near your service bench for ready reference.

(2) Silverama Store-Front Banner (Form 4F929)

Here is a giant, weatherproof Silverama banner that will raise your battle standard above the crowd where it can command attention from all quarters. The banner is 8 inches by 26 inches and includes eyelets and cord for hanging across your store front or wherever you want to focus mass attention on your shop.

(3) "TV Joe" Service-Dealer Bank (Form 4F936)

Every one of your customers or prospects will welcome this jolly ambassador of good will. A unique repeat business builder, "TV Joe" is as useful as his smile is pleasant and his appearance merry. He's a modern version of the "silent salesman."

As a novelty giveaway, "TV Joe" can lend a helping hand in building your store traffic and reputation. Bearing a three-line imprint of your name, address, and phone number, together with the familiar RCA chevron, this appealing bank will remain within the consumer household, a constant reminder of whom to call for television set repairs.

(4) New Consumer Booklet (Form 4F937)

The humorous new "TV Life on the Brighter Side" booklet is another good consumer-aimed item which will build your business. Perfect as an over-the-counter giveaway, as an envelope stuffer, and as a direct-mail piece, this booklet—full of chuckles about the events of everyday living—carries a very palatable sales message about your fast, dependable service with RCA Silverama replacement picture tubes. Top-quality Silverama features are clearly shown. And there is a prominent space for your name, address, and phone number.

(5) Direct Mail Postcards (Forms 3F933-A, -B, -C, -D, -E, and -F)

The six new Silverama direct mail pieces, printed on standard 2¢ government postcards, have a twofold function: They tell a mighty important story in direct, simple language. And they provide a strong tie-in with RCA Silverama ads in LIFE, THE SATURDAY EVENING POST, and TV GUIDE magazines. Your periodic mailings of these two-color postcards will certainly alert your service prospects to the fact that you use Silverama tubes.

(6) Radio and TV Commercials

RCA has specially prepared for your local placement two snappy 20-second television slide commercials (Forms 4F935-A and -B) and a transcription of dramatic 15-, 30-, and 60-second radio commercials (Form 4F934). These Silverama commercials are "open end," allowing time for identification of your service shop.

Song stylist Vaughn Monroe is featured in these commercials, selling Silverama picture tubes and your service. This gives your sales message the added impetus of a nationally-popular personality and a solid tie-in with RCA's national advertising campaign.

(7) New Silverama Ad Mats (Forms 4F932A-P)

Repetition has long been recognized as one of the keynotes of sound advertising. And RCA's new, small and medium-sized ad mats enable the service-dealer to economically repeat his sales message to thousands of newspaper readers. Each ad contains space for dealer name and phone number. All are ready for immediate use by newspapers serving local market areas—so see your RCA Silverama distributor on this right away. He will help you make out a final selection from a proof sheet.

RCA Color-Television Picture Tubes Operate for 5,000 to 10,000 Hours Under Extended Life Tests at Lancaster, Pa., Plant

Color-television picture tubes, undergoing life tests at the RCA Tube Division plant in Lancaster, Pa., are showing long life and high dependability of performance, according to C. Price Smith, the Division's Manager of Engineering, Color Tube Operations Department.

In an extended life test of several tubes selected at random from the production lines, one of the tubes has already operated for more than 10,000 hours under conditions similar to those encountered in home use, Mr. Smith said. This performance is the equivalent of seven years of normal use. The tubes still produce good color pictures, comparable to images from new tubes operating in nearby receivers. Several others already have been operating for over 5,000 hours with excellent performance.

"The RCA Tube Division," Mr. Smith said, "has gone to great lengths to insure the highest quality of tubes by instituting numerous quality-control tests and employing the best electrical design materials."

New RCA Test Equipment

FOR RAPID AND ACCURATE SERVICING OF AUDIO, RADIO, AND TV CIRCUITS

Six new "service-designed" test instruments were recently added to the famous RCA line of test equipment for rapid and accurate servicing of audio, radio, and black-and-white or color TV circuits. Now available from your RCA distributor, the new test instruments are the WA-44B Audio Signal Generator; the WR-61B Color-Bar Generator; the WR-70A RF/IF/VF Marker Adder; the WG-295B Video MultiMarker; the WG-304A RF Modulator; and the WG-307A TV Bias Supply.

The WA-44B Audio Signal Generator has many uses in radio and TV servicing. With a range of 11 to 100,000 cps in four bands and with output up to 15 volts, it is excellent for measuring intermodulation distortion and frequency response in amplifiers, input/output impedances of amplifiers, frequency response of tone controls and phonograph equalizers, resonant frequencies of loudspeakers, speed of recorder/reproducer mechanisms, values of unknown inductances or capacitances, and many other important characteristics.

The ultra-modern WA-44B offers a combination of top electrical performance and low cost. Specifications are as follows: output flat within 1 db over the entire frequency range of the instrument; total harmonic distortion 2% or less from 30 to 15,000 cps; and frequency stability within ± 3% under all normal operating conditions.

The WA-44B will give long, trouble-free performance, and is styled in a modernistic, compact, easy-to-carry case. It will speed servicing of any equipment utilizing audio signals.

The WR-61B Color-Bar Generator is designed for checking overall operation of color-TV receivers and for adjusting color-phasing and matrixing circuits. This compact, light-weight test instrument generates signals for producing 10 different color bars simultaneously (without switching), including those corresponding to the R-Y, B-Y, G-Y, I and Q signals. The bars are accurately spaced at 30-degree phase intervals.

The output signal, crystal controlled on channel 3, consists of an unmodulated sound carrier, a picture carrier modulated by a color subcarrier, and horizontal synchronizing pulses at 15,750 cps. The picture carrier, color subcarrier, sound carrier, and bar frequencies, and the horizontal sync pulses are crystal controlled for accuracy and stability.

A separate video output (either positive or negative) is available at a front-panel terminal for trouble-shooting color receivers. RF output is approximately 0.01 volt p-p across a balanced 300-ohm load; video output at the HI terminal is approximately 8 volts p-p across 4700 ohms.

A front-panel switch on the WR-61B permits removal of the sound carrier

(Continued on page 11)

Sizeable Receiving Tube Order Placed as Part of Inventory-Expansion Program

The Leo J. Meyberg Company, RCA distributor headquartered in San Francisco, recently placed its largest order to date for RCA entertainment-type receiving tubes. This sizeable order is part of a current inventory-expansion program at the Leo J. Meyberg Company which, like other RCA distributing firms across the nation, is constantly striving to avoid out-of-stock situations so as to make sure dealers and service technicians receive speedy and efficient service on tube requests.

According to E. J. Schmidt, manager of Leo J. Meyberg's Electronic Parts Division, the reasoning behind his company's inventory-expansion program is as follows:

"With the increasing demands upon the service-dealer's time by expanding markets and competition, it is most necessary that the supplier provide a 100% order fill program, especially in the receiving and picture tube field, in order to eliminate wasted time in searching for needed items. This action is indicative of our desire to fulfill this obligation as well as to create closer supplier-dealer relations so necessary in present-day business."

P. L. Henry, vice-president and general sales manager of the Leo J. Meyberg Company, added that his firm "enjoys an enviable reputation with the dealers we service. We desire to maintain and enhance this reputation by affording our dealers ready availability of any supplies they may need at the time they need them."

G. F. Anderson (second from left), manager of the RCA Tube Division's Los Angeles warehouse, is shown here handing to E. J. Schmidt, manager of the Electronic Parts Division of the Leo J. Meyberg Company, the invoice for the exceptionally large RCA receiving tube order recently placed by the RCA distributing firm as part of its inventory-expansion program. Showing their approval are W. W. Lessing (extreme left), RCA Tube Division salesman, and P. L. Henry, vice-president and general sales manager of the Leo J. Meyberg Company.

Some Problems Associated with Television

BY L. P. THOMAS
TV Receiver Division

To the average television viewer it may not be immediately apparent that the television receiver must be capable of presenting a clear picture over a rather extreme range of signal strength. Signal strengths may vary from channel to channel, especially in areas where there are both local stations with transmitters nearby and fringe area stations with transmitters many miles distant.

Television signals may also fade in or out from time to time, being better at night or perhaps during the winter season. Passing airplanes may also cause a rapid change in signal level, which must be controlled in order to present a picture of uniform intensity. This constantly changing signal level, whether rapid or "long-term," must be held constant by some electrical circuit if television viewing is to be enjoyed without having the viewer constantly compensating or adjusting for the differences in signal strength. Automatic Gain Control (agc) is a circuit that performs this function automatically, and is generally used in receivers throughout the United States.

Early Problems with Manual Control

The most dramatic impression of what agc accomplishes can be gained by looking at a receiver that has manual gain control. Remember the famous "630" chassis? The contrast control changed the bias on if and rf stages manually. Everything was fine until an airplane flew overhead, or the user changed stations. The reflections from an airplane alternately increased and decreased the signal level at the receiver. The scene then wavered from side to side, with the background level alternately going white and black.

Switching from one television station to another with manual gain control also posed a problem. If channel 6 happened to be a considerably stronger rf signal than channel 3, the kinescope probably would be black, with possible sound buzz and drifting white bars, when tuning in channel 6. The situation required a bias change in the receiver to accommodate the stronger signal. The bias was adjusted by the contrast control, as mentioned previously. Tuning back to the weaker signal level on channel 3 resulted in a picture so low in contrast that the television program was barely perceptible. Decreasing the bias on the receiver solved this problem.

The early agc circuits required the use of a negative power supply in the receiver and were costly, although they solved the problem of switching from weak to strong signals fairly well. These circuits worked so long as the signal level didn't change too rapidly. Rapid variations in signal level such as those caused by airplanes were still a problem. Some of today's low-cost agc circuits still may have annoying characteristics in modern television receivers. For example, interference from an electric mixer, or electric shaver in the vicinity or on the same power line may cause the kinescope to become white. The agc circuit in this case has just "set up" on noise pulses and since the receiver is biased off, the video information is lost.

A Brief Review of Television System

Figure 1A shows a transmitted television signal waveform in which the tips of sync represent the peak power of the transmitter, and are held constant in amplitude at the transmitter. It is these tips of sync that the agc system (except the "average" type) maintains constant with varying signal levels in the television receiver, since the agc voltage should not change with amplitude modulation. Figure 1B shows conventional modulation as used in commercial broadcasting. The differences should be carefully noted.

The transmitted signal is amplified by the rf stage, Figure 2, and then converted to the if by the oscillator and mixer. Most present-day receivers use three if stages, with the first two controlled by agc bias. The rf stage, which largely determines the signal-to-noise ratio of the receiver, is also controlled by agc bias.

The second detector recovers the video information from the picture if carrier. The video signal is amplified by the video amplifier section and applied to the kinescope. The sound and sync signals are also taken from the video amplifier. In Figure 2, the agc amplifier is fed from the video section.

In the design of a television receiver, the agc, video amplifier, and sync circuits must be designed as a unit in conjunction with rf and if characteristics. Many other problems enter into the design of agc circuits, including such factors as high-voltage regulation and B+ variations with signal level or fine tuning. This article will concentrate only on the design requirements of the agc as such and not discuss at length, or at all, many of the other related factors that must be taken into account in the design of a practical agc circuit.

'End-Result' Requirements for AGC

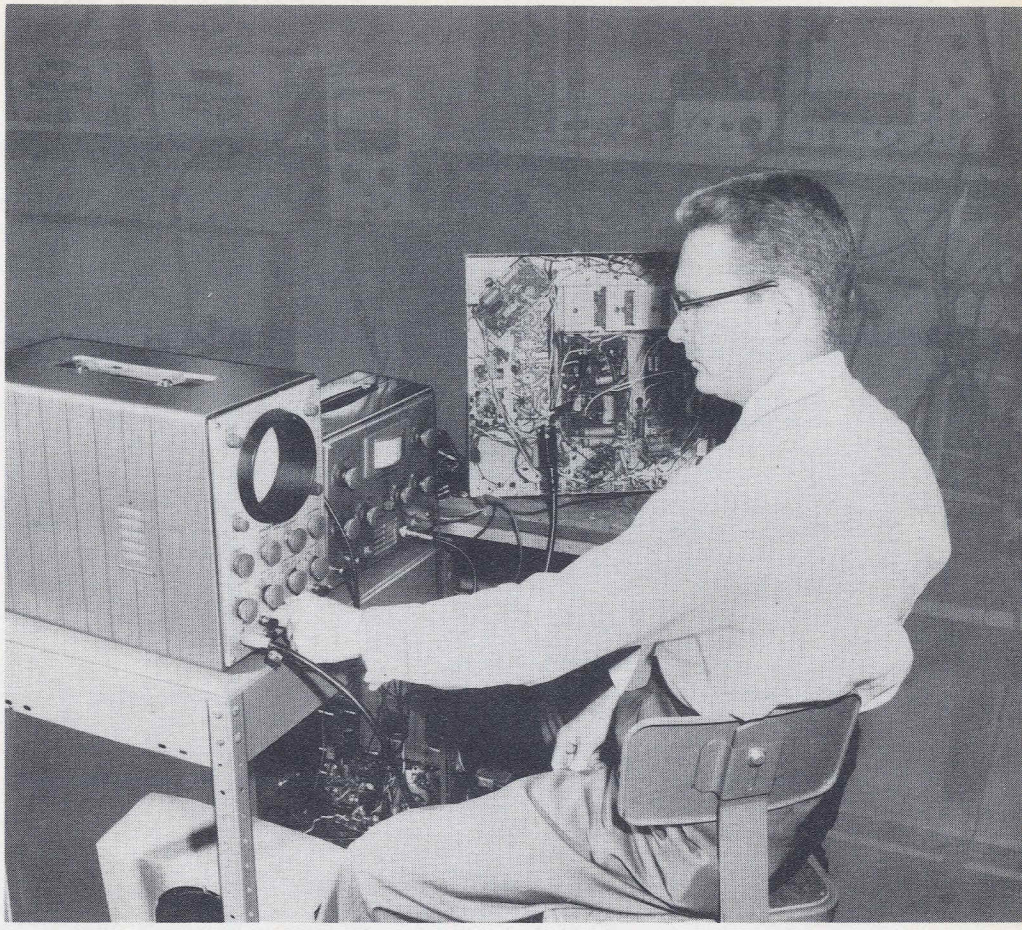
First of all, an agc circuit should keep the output of the second detector essentially constant with wide variations in signal levels. For example, a good system maintains an essentially constant second-detector output for approximately 50 microvolts to 100,000 microvolts of receiver rf signal input. In this respect, the agc circuit can be considered a dc amplifier, with adequate gain to accomplish the above purpose. The agc circuit should not limit the maximum gain of the receiver. The lower limit to which a good agc system can hold the second detector output constant is largely determined by the overall gain of the receiver. The strongest signal the receiver can handle is limited by the overload or cross modulation that can occur in the rf or if sections of the receiver.

In addition to being able to handle wide variations in signal level, rapid variations in signal level must also be considered, such as those caused by reflections from airplanes. This requires consideration of the time constant of the agc system. If the time constant is too long, the receiver cannot follow rapid variations in signal level due to airplane interference, and the picture flutters in amplitude. If the time constant is too short, noise immunity will be poor and some components of vertical sync may introduce a ripple voltage in the received picture.

If some types of gated agc are used, ripple voltage will appear in agc due to scene changes because the gating pulse changes with scene. If a picture is half black, the high voltage and the gating pulse (which is derived from the receiver's horizontal deflection circuits) are high during the black portion of the picture since the kinescope is not drawing beam current. The gating pulse will be lower during a white portion of a picture. The variation in gating pulse causes an unwanted ripple in the agc. A form of feedback circuitry may be used to cancel this ripple voltage.

Feedback circuitry may also be used to cancel the vertical sync component in pulsed agc circuits. Such circuits can be made to function so well that no agc

AGC Circuits



The author shown evaluating the performance of a printed-wiring version of an agc system.

filtering would be required at all except for noise immunity considerations. There is a certain minimum capacitance required on if bias source points to prevent impulse noise pulses (which can cause grid current in if tubes) from "setting up" the if bias and causing white flashing in the picture. In addition to the time-constant effects, the dc grid impedance of tubes in agc must be kept low to prevent grid current transients (such as caused by switching from weak to strong signals) from blocking the receiver.

The agc threshold control changes the bias on the agc-amplifier grid, which affects the overall gain of the receiver on strong signals. The ratio of rf to if agc bias is determined by circuit constants. The ratio of rf to if bias, and the agc threshold control are two distinct circuit functions. This will become clear as each of the circuits is discussed.

When a strong signal is imposed on the receiver (for example, 50,000 microvolts) and when the rf bias is too low, there may be if overload or cross modulation. Overload can cause a washed out picture, sound buzz, or picture bending. Cross modulation can cause interference between the sound and picture carrier of a given station or even cause a "wind-shield wiper" effect from another television station. When a color signal is received, the cross modulation problem is more noticeable due to the presence of the color sub-carrier.

Too high an rf bias under some conditions may also cause cross modulation, depending on the distribution of signal on the grids of the rf amplifier. Too high an rf bias in medium signal strengths (1,000 microvolts, for example), will cause a picture to have excessive snow at the medium signal level. The above discussion indicates that the rf bias can neither be too high nor too low for any given input signal imposed on the antenna.

The rf bias at any signal level is largely determined by resistor divider circuits, delay voltage applied to the rf tube, and the characteristics of the tubes controlled by agc bias voltage—assuming a correctly aligned receiver with normal parts. The largest production variable that affects rf gain is variation in tube cutoff.

The rf bias *versus* microvolt input is plotted in Figure 3. If the developed rf bias exceeds curve A in Figure 3, there will be excessive snow in the picture at the input signal level where the curve is exceeded. If the developed rf bias is less than curve B, Figure 3, the set will be in overload or will cross modulate.

Curve A is strictly a function of the tuner. It is, in a sense, a plot of the signal-to-noise ratio for high levels *versus* bias. A sharp-cutoff rf stage, for example, would lower curve A for all strong signal values of input (Figure 4).

Curve B, Figure 3, is largely a function of the if section of the receiver. In general, the last if stage on agc bias overloads first. If the second if stage were sharp-cutoff its acceptance would be lower, therefore curve B, Figure 3, would rise, or shift toward lower signal levels. On the other hand, if the rf stage were remote-cutoff, allowing still more signal than normal to be applied to the if section, curve B would rise still further. This condition is illustrated graphically in Figure 5.

The effect of sharp-cutoff if tubes, in conjunction with a remote-cutoff rf tube is illustrated in Figure 5. The same lettering applies to Figures 3, 4, 5 and 6. Figure 6 is Figure 4 and 5 superimposed to illustrate how the limits change with tubes.

The tubes in agc not only determine the limit curves A and B but also effect the developed rf bias, with all other factors remaining fixed. Assume the limit curves A and B as well as the developed rf bias curve as shown in Figure 3. If the nominal-cutoff if tubes of Figure 3 were replaced with remote-cutoff if tubes, the bias required at each signal level would be greater. This means the negative voltage on the plate of the agc tube is greater at all signal levels. Therefore, the rf bias is greater at each signal level.

These figures illustrate that comparing two receivers or similar agc systems without knowing the tube characteristics is futile.

Figure 3 will be called the design-center curve. Now let us look at the factors other than tubes that affect the developed rf bias curve. Tubes determine the limit curves A and B as illustrated in Figures 3, 4, 5 and 6. Resistors and a delay voltage are used to center the developed rf bias (Figure 3) with nominal tubes between curves A and B. The circuit is shown in Figure 7. The delay voltage is

$$E_d = \frac{E_1 (R_2 + R_3 + R_4)}{R_1 + R_2 + R_3 + R_4}$$

The agc tube must develop sufficient negative voltage to overcome this posi-

(Continued on page 9)

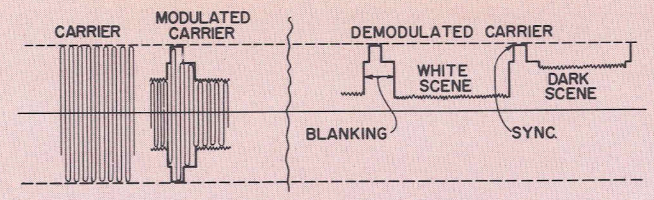


FIG. 1A TELEVISION MODULATION

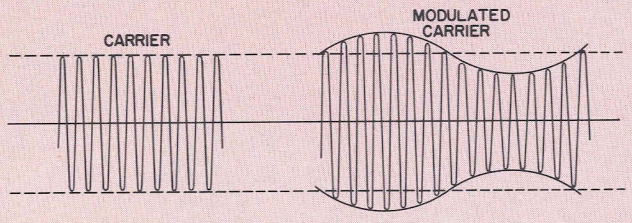


FIG. 1B AM MODULATION

Figure 1: Television and AM-broadcast modulation envelopes.

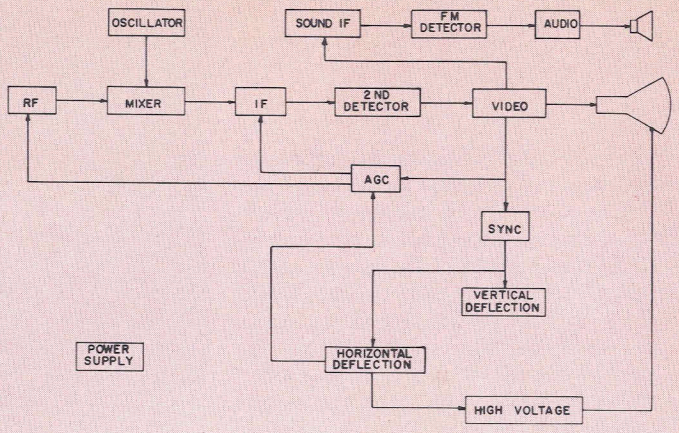


Figure 2: Television receiver block diagram.

Ⓐ THRESHOLD BIAS OF SNOW.
ANY DEVELOPED RF BIAS HIGHER THAN Ⓐ WILL GIVE SNOW IN THE PICTURE.

Ⓑ THRESHOLD BIAS OF OVERLOAD.
ANY DEVELOPED RF BIAS LOWER THAN Ⓑ WILL CAUSE OVERLOAD.

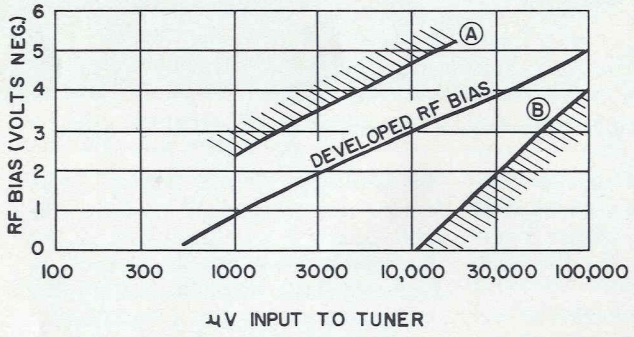


Figure 3: RF bias limits vs. signal level with nominal-cutoff if and rf tubes.

Ⓐ THRESHOLD BIAS OF SNOW.
Ⓑ THRESHOLD BIAS OF OVERLOAD.

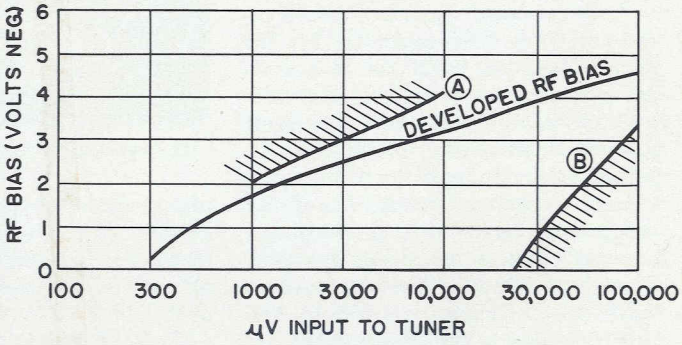


Figure 4: Effect of sharp-cutoff rf tube and remote-cutoff if tubes on (1) rf bias limits and on (2) developed rf bias curve.

Ⓐ THRESHOLD BIAS OF SNOW.
Ⓑ THRESHOLD BIAS OF OVERLOAD.

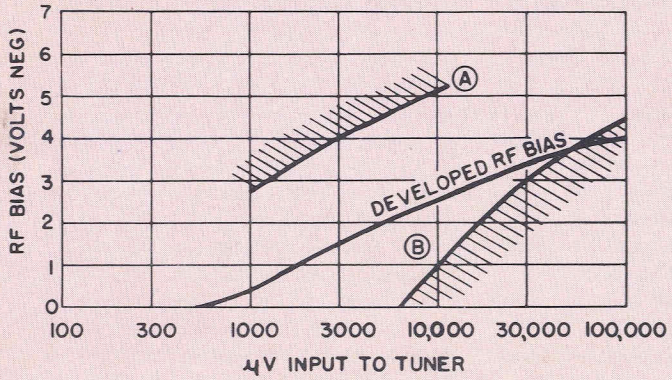


Figure 5: Effect of remote-cutoff rf tube and sharp-cutoff if tubes on (1) rf bias limits and on (2) developed rf bias curve.

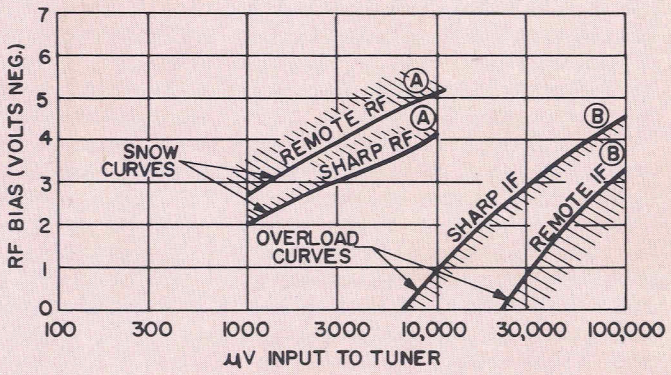


Figure 6: Overall effect of tubes on rf bias limits.

(Continued from page 7)

tive voltage before any bias is applied to the rf stage. V_1 is a diode clamp used to prevent positive voltage from being applied to the rf stage. Any variation in E_1, R_1, R_2, R_3 or R_4 will shift the developed rf bias curve in Figure 3. The resistors meet 5% tolerances, and the variations due to these components or E_1 are generally not as serious as tube variations.

AGC Systems

AGC systems can be divided into three rather broad categories: average, pulsed, and gated. The latter two are generally referred to as amplified agc and may use either a triode or pentode.

Average AGC

The average agc system is simply a filter with a long time constant utilizing a voltage from the second detector (see Figure 8). The average system tends to keep constant the dc output of the second detector. Consequently, scene variations that affect the dc component of the video signal cause the level of the sync tips to vary at the second detector output. In addition, the second detector output varies with the signal level, which means that it is desirable to control the acceptance of the first video stage with the contrast control.

This system generally uses a pentode rf stage with the if and rf bias tied together. The cutoff of the rf stage must accordingly be adjusted to go along with the if bias requirements. When a "totem" type of rf stage (two triodes in series across the B supply) is used with an average agc, normally an rf bias control is provided in the form of a local distance switch or potentiometer. There are other versions of this circuit which use an "assist voltage" from the sync separator grid.

Pulsed AGC

This system (Figure 9) uses a tube to develop a dc voltage proportional to the height of the tips of sync, which is applied to the grid of a tube whose plate is pulsed at the horizontal scanning rate.

R_1C_1 is tailored to give a voltage proportional to the tips of horizontal sync; thus, the cathode of V_1 acts as a peak detector. V_1 conducts only on sync tips and horizontal sync can also be taken from the plate of V_1. The dc voltage developed on the cathode by R_1C_1 is applied to the grid of V_2 to give amplified agc on the plate of V_2.

The high positive pulse on the plate of V_2 causes a great number of electrons to collect on the plate, and thus as the tube current increases, so does the negative voltage on the plate. If the signal level tries to increase (represented by tips of sync as shown in Figure 1), the voltage across R_1C_1 becomes more positive, decreasing the bias on the grid of V_2, thus increasing the plate current and the negative voltage on the plate of V_2, which increases rf/if bias to hold video signal level constant.

The divider circuit shown in Figure 7 would be connected to the plate of V_2 (Figure 9) to control the rf bias as already illustrated.

The pulse system is not dependent on the horizontal circuit of a receiver being synchronized with the transmitted sync pulses. If the time constant of R_1C_1 (Figure 9) is too long, noise immunity of the agc system will be poor. If the time constant is too short, the cathode circuit of V_1 (Figure 9) will not function as a peak detector.

Gated AGC

This system is called a gated system because the agc tube conducts normally when the plate gating pulse, derived from the horizontal deflection system of the receiver, and the transmitted horizontal sync pulses are coincident (see Figure 10). Thus, the tube does not conduct on noise pulses that occur at any time between horizontal gating pulses. There are ways to prevent the agc system from "blocking out" when the set is out of sync horizontally with either a triode or pentode gated agc. The agc tube normally conducts only on sync pulses, thus developing a voltage proportional to sync tips. The tips of sync represent the peak carrier output of the TV transmitter. It should be obvious then, that when the receiver is out of sync horizontally, the gating pulse (derived from the receiver's horizontal scanning system) and the transmitted sync pulses are no longer coincident. This requires some special design techniques to prevent the agc bias from decreasing to such a level as to cause the set to overload and block when the receiver is out of sync horizontally.

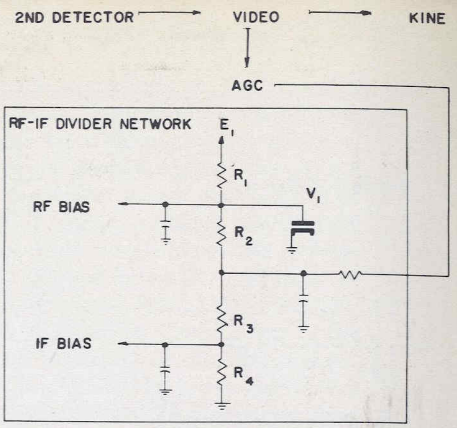


Figure 7: Circuit that determines rf-if bias ratio.

Gated agc provides amplified agc voltage at a reasonable cost as well as having excellent noise immunity and airplane-flutter characteristics.

In order to eliminate some components, both gated and pulse systems are dc coupled to the second detector.

One example of an unusual problem that arose during the design of a triode-gated agc circuit for a television receiver occurred when the writer was observing a western movie on the developmental receiver, and indicates how agc circuits get involved with other portions of the TV receiver.

The triode-gated agc circuit was carefully designed for adequate gain, airplane flutter, noise immunity, and rf bias tracking (see Figure 3). The circuit was given the usual checks with a signal generator modulated with the familiar indian-head test pattern. Additional checks were made with on-the-air daytime programming on the local television stations. The circuit appeared to have excellent performance. During a casual observation, however, the hero of the 6:00 pm western movie rode across the kinescope on his white horse in the dead of night. With this circuit he also rode through the agc!

This phenomenon may be explained as follows: the triode agc circuit was gated by a pulse from the horizontal scanning circuit. Amplitude of the gating impulse is a function of kinescope beam current, since beam current represents a load on the horizontal

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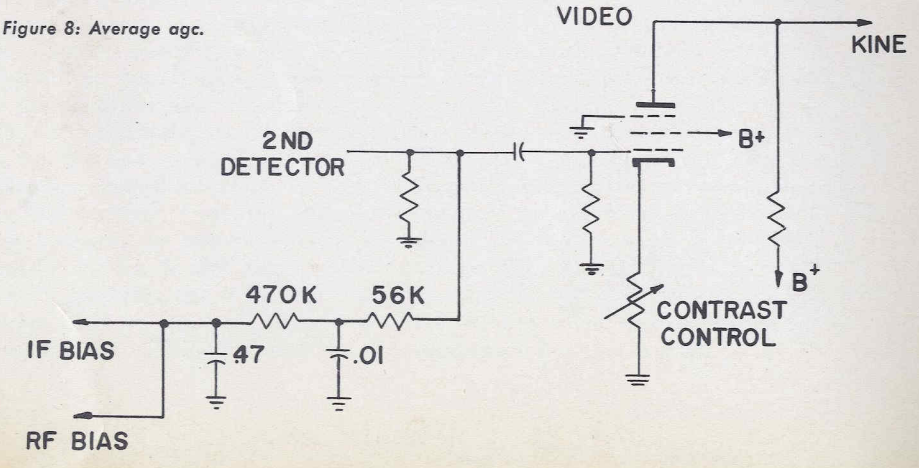
Figure 8: Average agc.



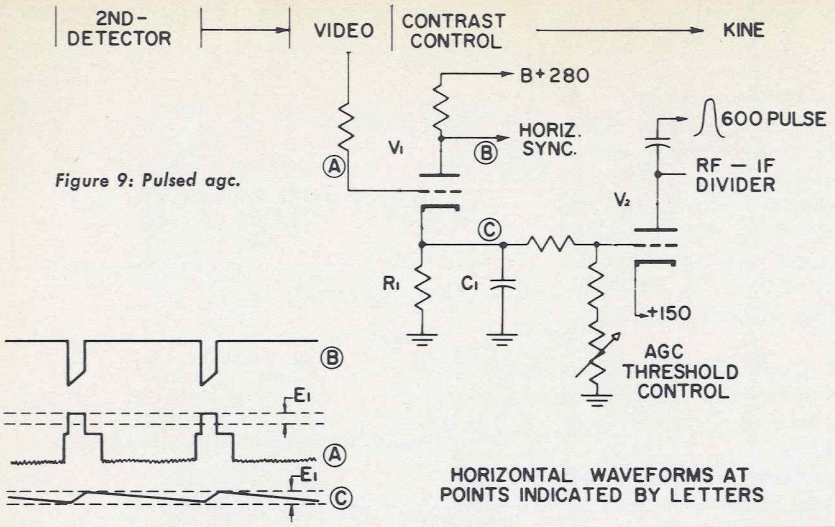


Figure 9: Pulsed agc.

(Continued from preceding page)

scanning system. The western-movie scene was a sharply contrasting one; the cowboy's horse drew appreciable beam current, while the black background drew none. The scene therefore caused a fluctuation of the gating pulse as the horse galloped across the screen. It is generally known that the output of a triode varies as a function of plate voltage. The triode agc tube hence produced a fluctuating agc bias to the rf/if stages.

The average televised scene or test pattern has a fairly constant average video level, which explains why this condition did not present itself earlier.

The solution was found, fortunately, without increasing the cost of the receiver: it is known that a ripple voltage, which is a function of scene variations, is present in the "B-boost" supply originating in the horizontal circuit. By returning one of the filter capacitors in the plate of the agc tube to "B-boost," the ripple in agc caused by the cowboy scene was cancelled.

AGC Threshold Control

In either the pulsed or gated system, the agc threshold control is adjusted to operate the second-detector output level just under the point (threshold) at which sync would be clipped in the first video stage.

Figure 11A shows the second detector output in the presence of electrical interference. Figure 11B shows the acceptance of the first video. Figure 11C shows the result of correct agc bias, too little agc bias, and too much agc bias.

Too little agc bias causes the second detector output to exceed the acceptance of the first video, and consequently clip sync. This may cause buzzing in the sound and bending in the picture.

Excessive agc bias will cause the second detector output to be low. This will result in weak contrast, and poor noise immunity. The poor noise immunity results because the impulse noise voltage far exceeds the sync signal, which tends to bias the sync separator too high. Figure 11 illustrates the importance of the correct setting of the agc threshold adjustment.

Conclusion

We have discussed several of the problems affecting agc circuits as well as the necessity for properly adjusting the agc threshold control. Working with the design of practical agc circuits requires a thorough knowledge of most all of the circuits found in a television receiver.

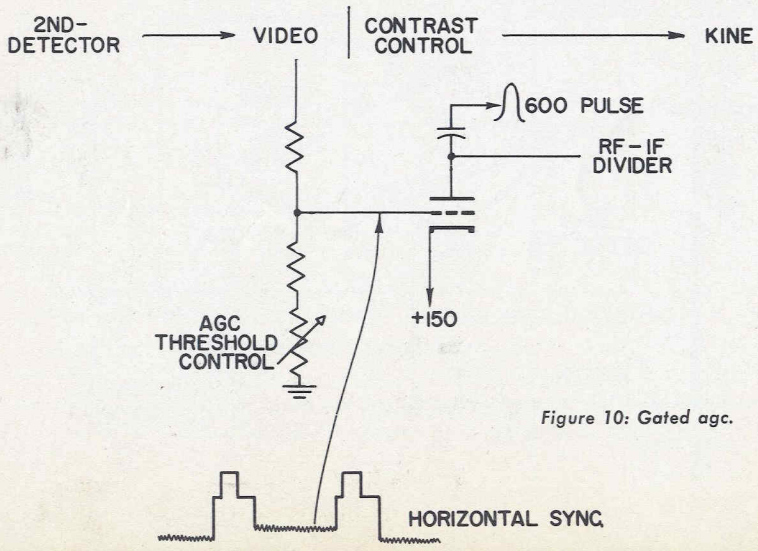
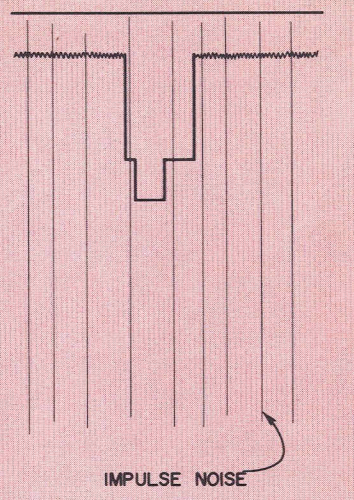
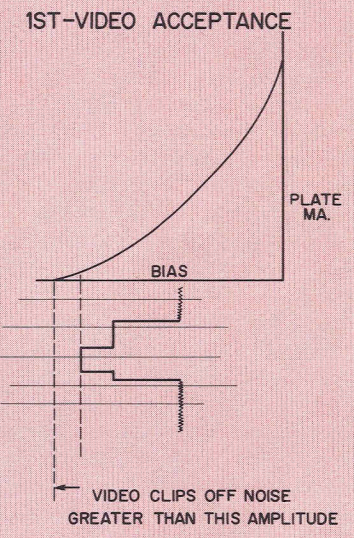
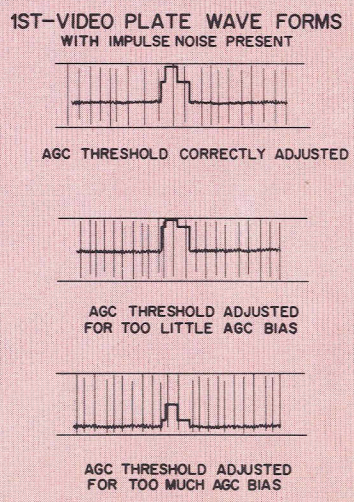


Figure 10: Gated agc.







Figures 11A (top), 11B (middle), 11C (bottom): Effects of agc threshold adjustment (see text).

NEW RCA TEST EQUIPMENT

(Continued from page 5)

from the output signal. This feature provides quick identification of sound interference in the bar pattern. The sound carrier is provided to insure precise tuning of the receiver, and to check sound rejection and beat interference between the color sub-carrier and the sound carrier.

Luminance signals are provided at the edges of the color bars to check registration of the luminance and chrominance signals.

Special circuitry in the WR-61B enables front-panel adjustment of the output signal in two ways. The amplitudes of the color-burst and subcarrier signals are made adjustable to facilitate checking of color sync-lock action. Another front-panel control permits addition or removal of special 189-Kc pedestals in the output signal. When pedestals are applied, color-subcarrier signals are superimposed on top of the pedestals. Pedestals, also adjustable in amplitude, serve as luminance-channel signals to facilitate checking of dynamic balance between color channels.

A built-in rectifier circuit, for use with an external *VoltOhmyst®*, facilitates measurement and adjustment of sync and subcarrier amplitudes.

The WR-61B is supplied with a shielded rf-output cable for connection to balanced 300-ohm inputs, and a shielded video cable for connection to 75-ohm video circuits. This portable color-bar generator measures 10″ x 13½″ x 7½″. Weight: 13 lbs.

The WR-70A RF/IF/VF Marker Adder offers a rapid method of injecting frequency markers for accurately aligning black-and-white or color TV receivers. The WR-70A produces narrow, distinct, high amplitude-markers for use with conventional test equipment in the sweep-frequency alignment of rf, if, and video stages.

Four coaxial cables are supplied for connection to a sweep generator, to a marker generator, and to an oscilloscope. Used in this set-up, the WR-70A offers these important advantages:

(1) Front-panel control provides instant choice of one of four different marker shapes best suited to response curve being observed.

(2) Eliminates distortion of marker or of the sweep curve by the marker because the marker is added to the sweep-response signal after the sweep signal is taken out of the receiver. The marker signal does not enter rf, if, or vf channels of the receiver.

(3) Marker "suckout" by receiver circuits is eliminated—traps aligned simply and precisely.

(4) Provides very high-Q markers—high amplitude, narrow width.

(5) Front-panel control of marker shape, amplitude and polarity; sweep-trace amplitude and polarity greatly simplify black-and-white or color TV alignment.

(6) Electron-tube regulator circuit for all B+ voltages provides steady trace display on oscilloscope.

The WG-295B Video MultiMarker is an absorption-type marker device especially designed for sweep alignment and trouble-shooting of color-TV receivers. The MultiMarker connects directly to the if/vf output connector of a WR-59-series VHF sweep generator and provides seven simultaneous reference markers on a sweep response curve at factory-set video-range frequencies.

Two new frequencies are available on this Video MultiMarker because the alignment procedure for new color sets requires additional markers at 4.1 Mc and 3.0 Mc for checking video- and bandpass-amplifier response curves. These markers are in addition to the markers at 0.5 Mc, 1.5 Mc, 2.5 Mc, 3.58 Mc, and 4.5 Mc supplied by the WG-295A. These frequencies check the "Q" and "I" filters, bandpass filter, color subcarrier circuitry, and the sound trap of the color-TV receiver.

A time-saving feature of the new WG-295B is the seven "touch terminals"—one for each marker—located on top of the MultiMarker case. When one or more of the terminals is touched, corresponding markers on the sweep trace will disappear. These markers are narrow and distinct and appear on the video response curve as "suckout" or absorption-type pips which point downward from the top of the sweep trace. Thus, the trace is not obscured by overloading, and spurious markers are eliminated.

A coaxial cable approximately 15 inches long provides connection to a sweep generator. To save servicing time, a switch has been added to the WG-295B to permit shorting out the unit during if amplifier alignment.

The WG-304A RF Modulator offers—for the first time—a simplified method of checking overall frequency response of a TV receiver *from the antenna input terminal to the picture tube.* Primarily for use in the alignment of color-TV receivers, the WG-304A may also be used in checking overall response of black-and-white receivers.

Used with a signal generator and a video sweep generator, the WG-304A provides an rf-output signal which is amplitude modulated by the signal from the video sweep generator. The rf-output signal includes the picture carrier and two sidebands whose widths depend upon the excursion of the sweep signal from the video generator. The output signal is fed to the antenna terminals of the TV receiver. When the WG-304A is connected to a color-TV receiver, the frequency characteristics of the tuner, picture-if amplifiers, video amplifiers, bandpass amplifier, and color-signal demodulators may be checked by means of an oscilloscope.

In conventional TV alignment, an rf sweep generator is used to check response of the rf and if amplifiers, and a video-frequency sweep generator is used to check response of the video amplifiers. However, with this method, effects of the second-detector load circuit—which may change overall response of the receiver—cannot be observed on either the rf-, if-, or video-response curves. The new RCA WR-304A RF Modulator now permits the observation of true overall frequency response of a TV receiver—including the effect of the second-detector load circuit.

The RCA WG-304A is housed in an aluminum case measuring 1⅝″ H x 4″ W x 2⅛″ D. Two coaxial cables are attached to the case and are fitted with microphone-type connectors for direct connection to other test instruments. A separate shielded cable, fitted with a microphone-type connector at one end and three insulated clip leads at the other end, is supplied for connecting the output of the WG-304A to the antenna terminals and chassis of the TV receiver. A suitable resistance-matching pad is built into the rf-output cable.

The RCA WG-307A TV Bias Supply is used in servicing and aligning color and black-and-white TV receivers. It will provide three separate output voltages, adjustable from 0 to −15 volts for application in the rf, if, and agc bias circuits of TV receivers. A fourth output voltage, −100 volts, is provided for use in the burst-keyer grid circuit of color-TV receivers during alignment tests of the chrominance circuitry.

These output voltages are available from four different binding posts on top of the unit. Special binding post jacks permit multi-type test lead use. Separate potentiometers provide adjustment for the three 0 to −15-volt outputs.

The WG-307A utilizes a power transformer and operates from a 117-volt/60-cps power source. Power consumption is less than 5 watts.

It's a fact...

9 of the 12 top-selling replacement TV tubes are original RCA designs.* Manufacturers of TV sets have given RCA tube-type leadership by using RCA-designed tubes in their equipment. Experience has shown these manufacturers that RCA-designed tubes are tops in performance. Service dealers know, too, that the company which knows how to design tubes knows how to build them BEST. So follow the lead of smart service technicians everywhere—say "RCA brand, only" on *all* your tube orders and get tubes that are tops in quality and performance.

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