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AUGUST, 1968 | 75¢

PF Reporter®

PHOTOFACT

the magazine of electronic servicing

IN THIS ISSUE:

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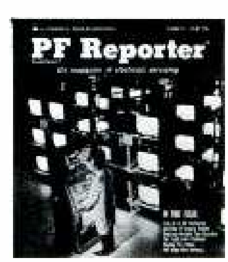
VOLUME 18, No. 8 AUGUST, 1968

CONTENTS

ABOUT THE COVER

Quality control and life testing are two operations essential to maintaining an acceptable degree of reliability in consumer electronic products. Our cover photo this month was taken in a specially equipped laboratory where Zenith color TV picture tubes are subjected to continuous reliability tests. The tubes are operated 10 hours, then cut off two hours in a stepped-up version of home use.



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Know why RCA's color chassis are so easy to service?

Because service men like you helped us design them.

First we got their advice, then we designed the whole assembly for easy servicing. For example, the chassis give you easy access. You don't have to pull out the chassis to get at the high-line voltage connection. Circuits and components on the circuit board are clearly marked so you can easily service them. The tuner assemblies are simplified for your convenience. And, we set up more test points. They're the kind of chassis we think you'd design yourself. Fact is, all our chassis designs are reviewed by a representative group of servicemen. And we appreciate their advice. We think you will, too—every time you service sets by RCA.

RCA

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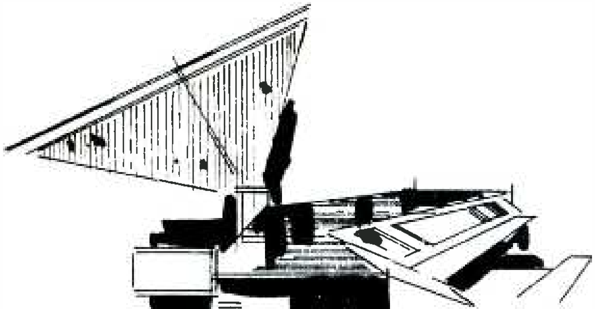


THE ELECTRONIC SCANNER

Labor Costs Included In Warranty

Philco-Ford is offering its dealers full labor costs for the life of warranty under service contracts on consumer electronic products.

Robert O. Fickes, chairman of the board and president, has stated that a service contract on color television will be offered dealers at a cost of $25.95 on each set, with the suggestion from the manufacturer that labor costs be included in the retail price of the product.

Service under this contract would cover labor for the first 90 days of the one-year parts warranty and would cover labor for the full two-year period of the color tube replacement warranty. Labor costs for the full-year parts warranty would be available under a service contract at extra cost.

Similar service contracts will be offered on black-and-white television and console stereo. Labor costs are already included in the warranties covering Philco-Ford's tape recorders, radios and portable phonos.

Westinghouse has also added labor costs to their color warranty. Effective with their 1969 line, Westinghouse will reimburse dealers or service technicians (at retail prices) for 90-day warranty labor on all color receivers.

New Preset Tuning Includes UHF

Zenith Sales Corporation's 1969 line of color television receivers includes sets with an exclusive system of channel selection that brings to UHF the same easy and accurate "click-stop" tuning of VHF. The Ultramatic tuning system is combined with Zenith's automatic fine-tuning control (AFC).

The Ultramatic tuning system lets the viewer automatically select as many as 18 pretuned channels—12 VHF and 6 UHF—with just the touch of a finger at the set or on a remote hand control. The system can be programmed to tune any combination of 6 UHF channels in addition to VHF channels (2 through 13) through a front panel adjustment of the tuner. It can tune adjacent channels on either UHF or VHF frequencies. Also, UHF channels may be preset in any desired sequence in the UHF spectrum. Channels can be changed in two directions rather than one—to the right and to the left—whether the set is manually or remotely controlled. Individual tabs identify each of the six UHF channels; the receiver may be set to skip unused channels.

The Ultramatic tuning system is standard in nine 23″ diagonal screen consoles, five of which are complete with the company's "600" Space Command system of remote tuning.

Plug-In Transistors In Sylvania Color TV

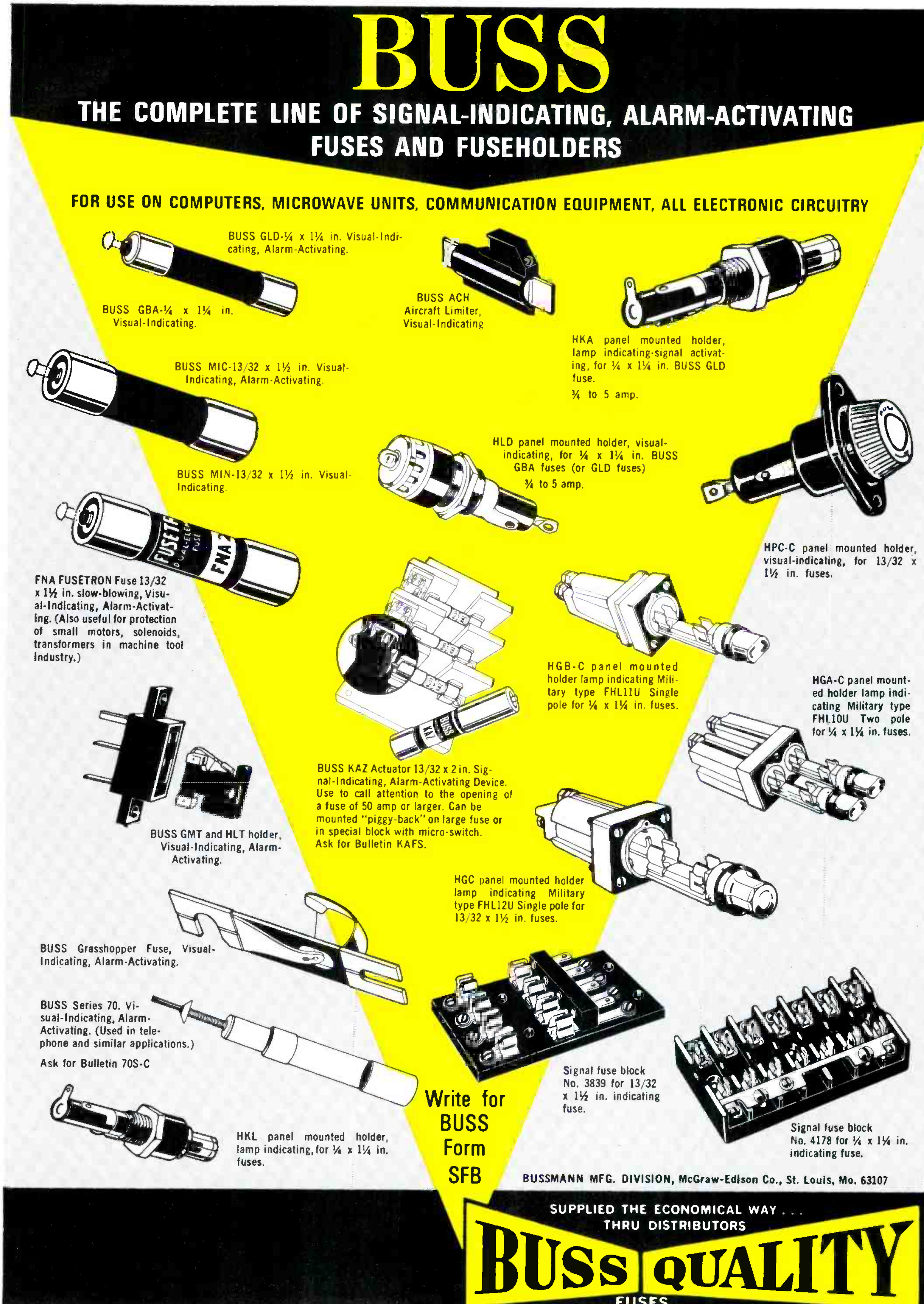
New color TV sets recently introduced by Sylvania Electric Products Inc. feature plug-in transistors for easier servicing. The chassis, which is approximately 66% solid-state, uses the industry's first plug-in transistors. It contains 27 transistors, 23 of which plug-in. In addition, there are 22 diodes, an integrated circuit, and nine receiving tubes, four of which are multi-function devices.

The unique "plugability" concept is carried throughout the entirely new Sylvania chassis. Called the "Gibraltar," the chassis has a plug-in tuner cluster, plug-in deflection yoke, plug-in convergence section, plug-in automatic degaussing section, plug-in speakers, and a plug-in remote control unit.

RCA Introduces '69 Line

RCA has introduced a 1969 line of 39 color television sets that includes a new deluxe series of nine Trans Vista receivers with solid-state chassis and a light-weight portable 18″ color unit.

The new color TV line includes 14 sets with prices ranging from $10 to $50 under similar models intro-



Circle 4 on literature card

duced last June and 22 sets whose price levels have been raised approximately $10 to $105 over comparable models of a year ago. The remaining sets are priced roughly the same as in the 1968 line, although in many cases additional features have been added.

Also introduced were five black-and-white television receivers, all in the 22" diagonal class—two table models and three consoles. They join 12 other monochrome sets introduced as part of the 1969 line last March.

Motorola Expands Warranty

Motorola has announced the adoption of a two-year consumer registered guarantee covering all chassis parts, in addition to the color picture tube, on all 1969 model year Quasar solid-state color television receivers.

At the same time, the consumer products division of Motorola Inc. introduced two Quasar all-transistor color television/radio-phonograph home entertainment theaters from which all tubes have been eliminated except the picture tube. The remainder of the Quasar color TV line is transistorized except for a rectifier tube and picture tube. The two 1969 home entertainment theaters employ a solid-state rectifier.

Motorola recently stepped up to two years, without charge to the consumer, its guarantee on the color picture tube in its Quasar models. The new warranty extends this coverage to include all other parts. The company previously had a one-year guarantee on chassis parts, which remains in effect on its tube chassis color TV receivers.

Andrea Offers Home Service Deal

Frank A. D. Andrea, president of Andrea Radio Corporation, has announced that, effective July 1, 1968, Andrea is offering its dealers 120-day home service on color television receivers, in addition to the present 5-year guarantee on parts, 2 years on the picture tube, and 1 year on receiving tubes.

There will be no increase in the list prices of sets, except that the dealer will continue to pay the present $7.50 charge for the 2-year extension on the picture tube, plus an additional $12.50 for the new 120-day consumer's home service. In the case of the Theatre In The Round, the same charge of $7.50 will apply for the picture tube, plus $32.50 additional for the 120-day home service plan.

All out-of-town dealers will receive the same refund so they can service every Andrea set they sell, providing they are qualified and authorized by Andrea to do so. If not, they will have to engage an independent service company to do the job. The new service plan is not retroactive.

Philco-Ford Expands Training Program

Philco-Ford Corporation has announced the addition of 50 technical training representatives to its field force in a new program designed to sharpen the skills of technicians who service the company's home entertainment products and appliances.

R. Harris Hesketh, general manager of Parts and Service, said the new technical training personnel will be located at service training centers that are being established throughout the United States.

"In the past, we have asked our district service managers and supervisors to handle service technician training along with their other duties," he said. "The new technical training representatives will have full-time responsibility for training."

Philco-Ford has developed an entirely new training approach to insure the continuous availability of highly competent service technicians, Mr. Hesketh said.

"We have made a keen appraisal of the service technician. We have studied his background, his job, his environment and his specific needs. Fortified with this knowledge, we are in a better position to intensify our efforts and to give him the training and backup that will enable him to do a better job."

"This has resulted in the scheduling of more than 600 service training meetings in the first five months of this year—an unprecedented effort in the U.S. industry," Mr. Hesketh said.

Along with the new training program, Philco-Ford is reviewing the diagnostic equipment which the service technician can best use in his business.

"We will have a full range of diagnostic equipment at our Service Training Centers to demonstrate to the service technicians how they can do a faster and better job through the use of proper test methods," Mr. Hesketh stated.

Philco-Ford Parts and Service is working closely with a number of vocational schools in providing educational packages, inviting local school instructors to attend the company's service training meetings, and scheduling meetings at schools.

Dealer and service shop technicians are awarded a Philco Qualified Service Technician Certificate when they avail themselves of the assistance provided by the Service Training Centers, attend local service training meetings, use the Tech Data Library Service and demonstrate their proficiency. The technician is registered at Philco-Ford headquarters and is issued the certificate and a wallet-sized identification card bearing his name and registration number.

Dealers and service-only shops that employ Philco Qualified Service Technicians and meet other requirements are eligible for appointment as Philco Qualified Service Centers.

Galvin Receives TEA Award

Robert W. Galvin, board chairman of Motorola, Inc. has been chosen by the executive committee of Texas Electronics Association (TEA) to be the recipient of TEA's second annual award for outstanding contributions to the electronics industry, according to an announcement from Norris R. Browne, president of the Texas group. This award was presented at the 16th Annual Southwest Electronics Clinic and Fair in Lubbock, Texas on August 2, 1968.

TEA Joins NEA

Norris R. Browne, President of Texas Electronics Association (TEA), announced today that TEA members have voted to join National Electronic Associations (NEA) on a local option basis.

TEA, a state group of local associations formed in 1951, is comprised of retail sales and/or service dealers with executive offices in Fort Worth.

New EIA President

Mark Shepherd, Jr., who in two decades rose from project engineer with Texas Instruments Inc. to president of the Dallas-based firm, today was elected president of the Electronic Industries Association (EIA).

Mr. Shepherd was the unanimous choice of the Board of Directors of the national trade association for electronics manufacturers at elections during EIA's 44th annual convention in Chicago. He succeeds two-term President Robert W. Galvin, chairman of the board and chief executive officer, Motorola, Inc., Chicago.

Long active in EIA affairs, Mr. Shepherd was a member of the association's Board of Directors and vice president representing the Semiconductor Division before his election. Earlier he was chairman of the division.

Yamaha Audio Products Announced

Yamaha International, Inc., well known in the motorcycle, musical instrument and sports equipment markets, has announced their first product offerings in the home entertainment market. The products, which were first shown at the Consumer Electronic Products Show, consist of three music systems and four speaker systems.

Battery Powered Bus

A new electric mini-bus designed for multi-stop service in downtown areas has been unveiled in Philadelphia. The 12-passenger Battronic battery powered bus, built by Battronic Truck Corp. of Boyertown, Pa., demonstrated its capabilities following ceremonies opening the four-day national convention of the Edison Electric Institute. Battronic is a joint venture of ESB Incorporated, the nation's largest battery company, and Boyertown Auto Body Works, custom body maker.

After the unveiling, EEI conventioneers had the opportunity to take demonstration rides in the bus between downtown Philadelphia hotels.

The electronic bus is capable of transporting up to 2000 lbs. of people and cargo at city traffic speeds. According to James F. Norberg, Battronic vice president, the bus provides quite, fume-free, short-route service.

EEI conventioneers were also treated to rides in other electric vehicles. Philadelphia Electric Co., host

of the EEI Convention, demonstrated its new "All Electric Truck," built by Battronic, and its new "All Electric Car" built by Electric Fuel Propulsion Co. of Ferndale, Mich. ESB Incorporated demonstrated a Battronic electric truck it uses to pick up and deliver mail, packages and interoffice communications between three company locations in metropolitan Philadelphia.

Mergers and Expansions

Amphenol Corporation and the **Bunker-Ramo Corporation** have announced that the two firms have been combined into a new company that will operate under the name "The Bunker-Ramo Corporation."

The new firm will rank well up on the list of the 500 largest industrial firms in the United States. Had the companies been combined in 1967, annual revenues would have been in excess of $230 million. Corporate offices will be in the Chicago suburb of Oak Brook, Illinois.

John E. Parker, Chairman of the Board of Bunker-Ramo, will fill that post with the new company. Matthew L. Devine, who had been Chairman of the Board and Chief Executive Officer of Amphenol, becomes President and Chief Executive Officer of the new firm.

Sprague Electric Co., North Adams, Massachusetts, and **Burr-Brown Research Corp.,** Tucson, Arizona, have formed a jointly owned affiliate, Sprague-Tucson, Inc. Sprague-Tucson, Inc. will manufacture operational amplifiers and other functional electronic circuit modules employing both silicon monolithic and thin- and thick-film hybrid circuit technologies.

The **E. F. Johnson Company,** Waseca, Minnesota, manufacturers of citizens-band and business/industrial two-way radio communications equipment and electronic components, has acquired Omnitronix, Inc. of Houston, Texas, for an undisclosed amount of stock. Omnitronix is a specialized electronics company which designs and manufactures instrumentation systems for off-the-shelf delivery as well as special customer requirements. Their product line includes peak readers, power supplies, recorder-testers, telemetry systems and auxiliary equipment for chromatographic analyzers, most of which are applicable to either manual- or computer-type operation.

The **Finney Company** antenna lab facilities and factory production areas are being greatly expanded to meet the demands of increased business. The lab facilities, now completed, provide considerably more area for antenna research and development.

The plant expansion, now under construction and anticipated to be completed in about 30 days, consists of an addition to the existing Bedford, Ohio plant which will add over 50,000 square feet of production area. When complete, the Bedford, Ohio FINCO plant will have a total production area of over 150,000 square feet.

"The FINCO expansion activities," states Mr. L. H. Finneburgh, company president, "reflect our optimism for the future of our industry. In fact we are confident that in no way are we over expanding and in fact believe nearly every square foot of our expanded facilities will be required to meet the demands of the season just ahead." ▲

Scoping for Trouble

The scope is often the only answer to seemingly impossible trouble symptoms.

by Robert Heaton

In routine troubleshooting operations, the service technician observes the raster, picture and sound to determine what portion of a television receiver is defective. Knowing what portion of the receiver produces visible or audible effects, the technician can usually isolate trouble to one or more sections. Most often, a routine procedure is selected to restore the receiver to normal operation for those "common" defects.

Now, let's consider cases of abnormal and/or intermittent troubles. Often, the technician's choice of test equipment and its application can make the difference in the profit or loss column—not to mention prevention of the frustration caused by an "unsolvable" problem.

One example of an uncommon trouble involved us quite deeply with an RCA CTC27 chassis. Our selection of the proper type equipment for testing was the clue to finding the trouble—for here was an instance where ONLY THE SCOPE COULD TELL.

A Logical Technique

After reading the following symptoms, see if you agree with the procedure used to locate the trouble.

Symptoms: Horizontal sync was very critical on fringe signals (slipping out of lock now and then); during reception of local signals, sync was solid. Vertical sync was good at all times. The solution may sound simple at first, but toss in these conditions: three technicians have previously worked on this chassis for this same original trouble, and the problem was intermittent!

Needless to say, several areas—IF, video, sync, AGC, horizontal AFC and horizontal oscillator—had been serviced, and showed visible evidence of being "rebuilt" either partially or completely. Mass replacement of many components had been tried.

Assuming the circuits were restored to normal, we elected to start

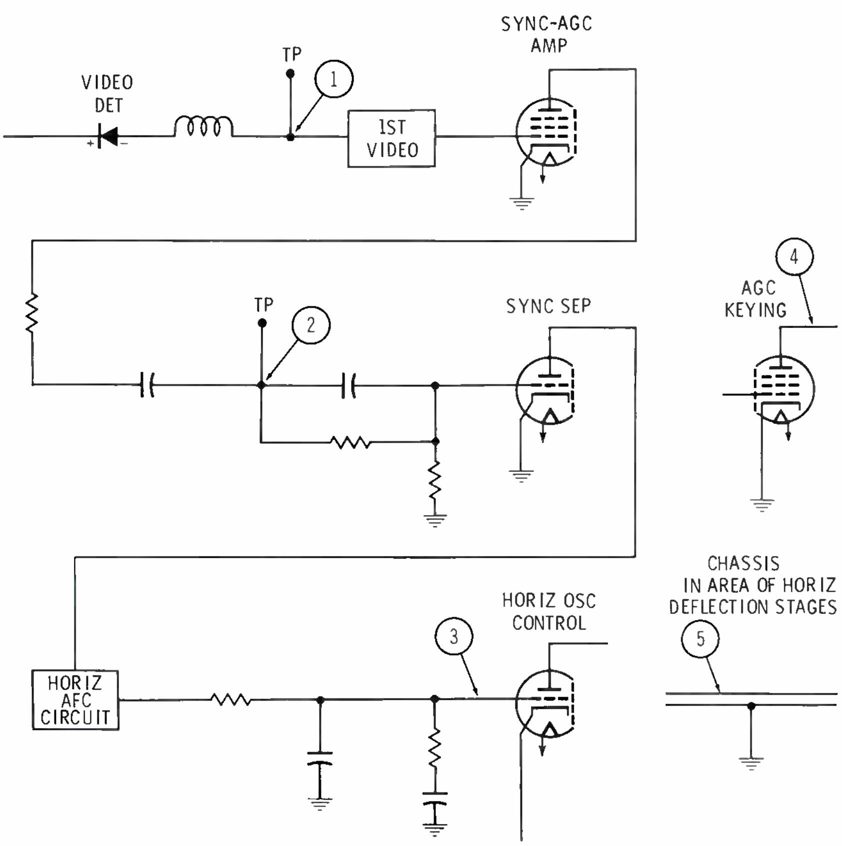
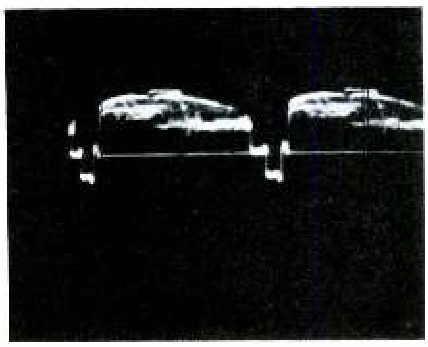


Fig. 1. Radiation pulse was viewed in several circuits and on the chassis.

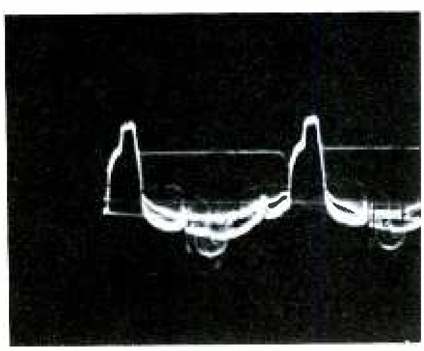
fresh, using the oscilloscope to help find a starting clue. (Incidentally, the circuits previously serviced were found to be normal.) Let's analyze the symptoms before proceeding: video, sound, AFC action, and vertical sync were normal on strong or fringe stations. These indications eliminated the front-end stages as the possible source of the trouble. The main symptom we were looking for was intermittent, critical horizontal sync on fringe signals.

Our Method

Illustrated in Fig. 1 are simplified drawings of the stages with which we were concerned, with the key

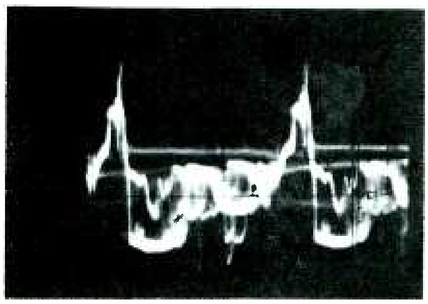


(A) Video detector waveform.

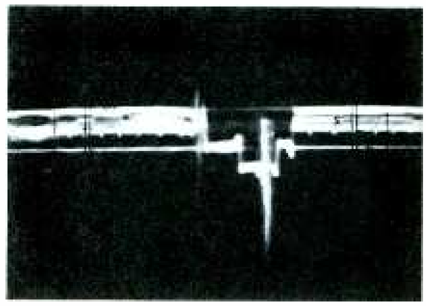


(B) Sync separator waveform.

Fig. 2. Normal waveforms observed when trouble symptom was not present.



(A) Video detector.



(B) Sync separator.

Fig. 3. Spurious signal at horizontal rate appeared in the sync pulse.

points marked. Since sync was effected, the scope was set to produce sweep at a horizontal rate, with the low-capacitance probe connected to the video detector circuit (point 1). The normal waveform in Fig. 2A was viewed on both fringe and local stations. Likewise, the normal signal shown in Fig. 2B was viewed at the grid of the sync separator (test point 2 in Fig. 1).

However, normal signals were expected at this time because the sync was stable and the problem didn't exist. Increasing the line voltage and applying heat to see if the trouble was thermally induced turned out as expected—the sync remained stable.

Next, we decided to leave the scope connected to the sync separator grid, returned the line voltage to normal, and removed the heat lamp. Tuning to a fringe channel, the chassis was left on to "cook" until the problem developed.

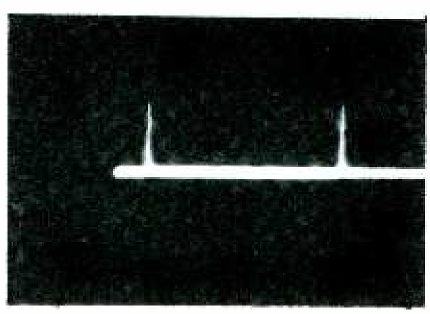
When the trouble appeared, the normal sync separator waveform (Fig. 2B) changed, and a large "spike" was visible during horizontal sync time, as shown in Fig. 3A. The horizontal sync pulse in Fig. 3A measured 30 volts p-p; the "added" spike had an amplitude of approximately 10 to 15 volts. This was the first clue to the trouble; but where was the "spike" coming from, and in what circuit was it entering? Moving the scope to the video detector, we discovered a similar signal at that point. The horizontal gain was increased to expand the trace for a better look at the sync pulse waveform (Fig. 3B). The interference was coming from the front end; most likely, radiation from some circuit was being picked up by the tuner. The pulse was occurring at a horizontal rate; therefore, it must be originating in a horizontal stage. Coupling between circuit components or leads, or insufficient decoupling were possibilities. Intermittently, the spike would stop, and the horizontal sync would remain in lock. The only problem now was to find the source of the radiation.

Radiation of this nature is sometimes difficult to locate. Radiation from a high-voltage rectifier tube is often picked up by the front end and reproduced on the screen in the form of vertical bands of hash. Similarly, radiation caused by a high-voltage arc will sometimes cause random bright spots in the picture or raster. However, these indications were not present in the case under discussion.

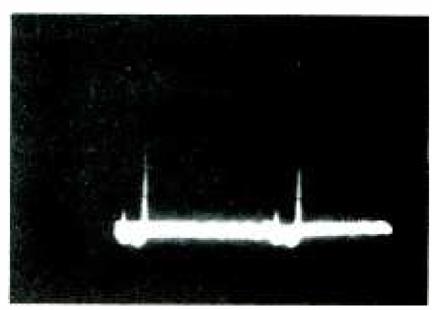
Moving the scope probe from one test point to another finally brought us to Test Point 3 (grid of horizontal AFC tube) where a 50-volt spike was found (shown in Fig. 4A). Here was the point where the unwanted pulse actually caused an upset of the horizontal sync. The pulse was occurring during horizontal retrace time—at exactly the time when station sync occurs.

During reception of fringe signals, sync is weak and AGC has the RF and IF stages operating at maximum gain. Under these conditions, the circuits are most susceptible to internal radiation and/or noise. The oscillator was interpreting the radiation as a sync pulse. Unable to distinguish the difference, the oscillator was "searching," and loss of sync was the result. With a strong sync pulse from a local station, the radiation pulse was effectively overrode, causing no ill effect to the operation of the oscillator.

When the scope probe was applied directly to the chassis in the area of the high-voltage circuits (point 5), the spike shown in Fig. 4B was displayed. Checking several

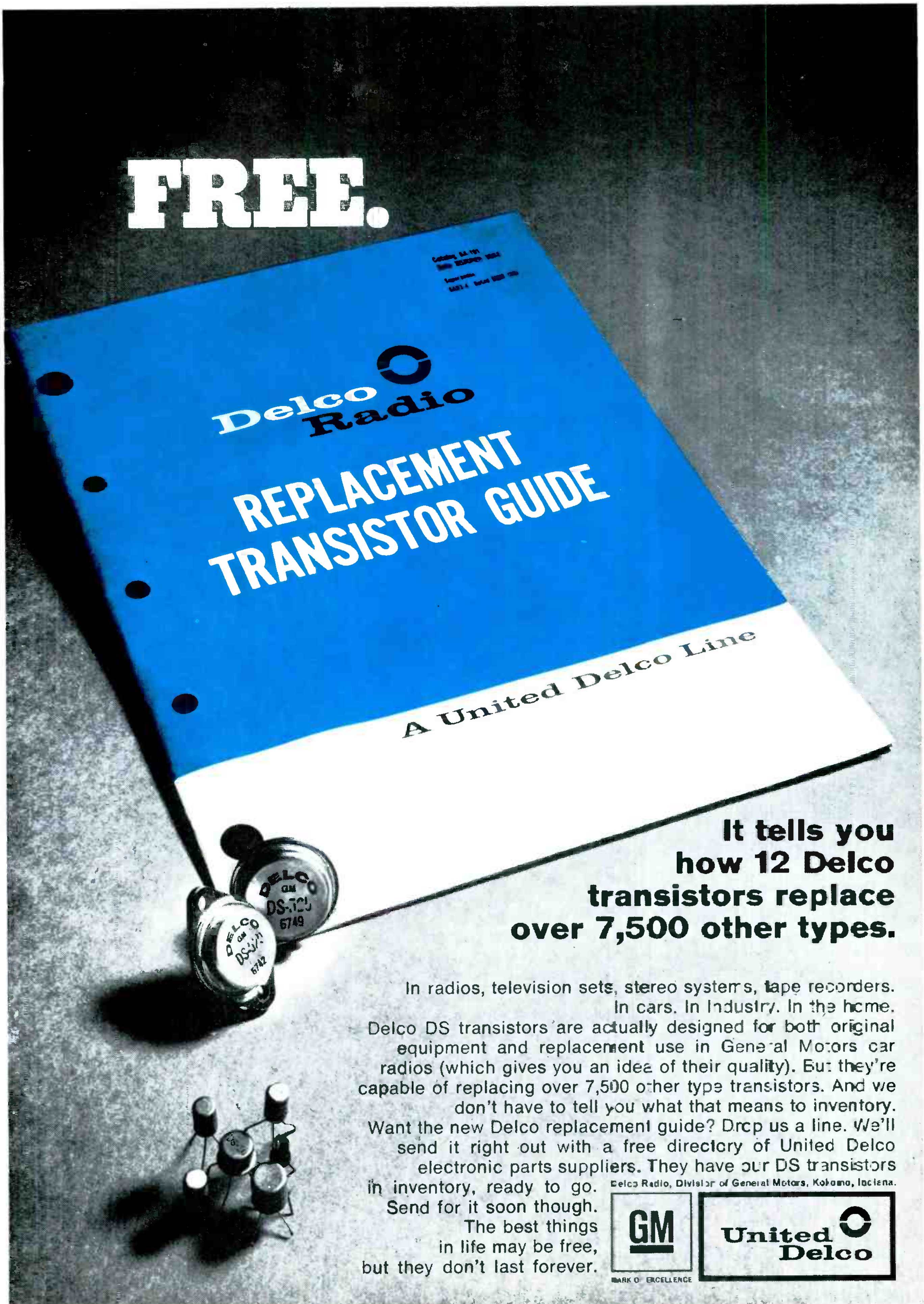


(A) Grid of horizontal AFC.



(B) Spike observed on chassis.

Fig. 4. 50-volt p-p spike occured during horizontal retrace.



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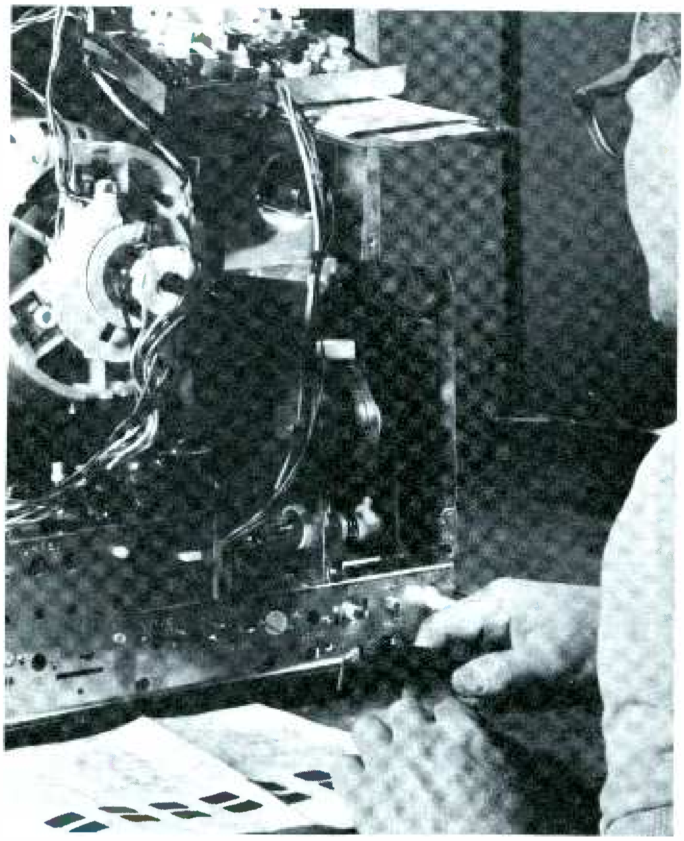
10 Tough Color Problems



An Analysis of uncommon troubles provides tips on "tough dog" servicing methods.

by Homer L. Davidson

The TV technician would have a tiresome and unchallenging career if there never was an intermittent or "tough dog" problem in a color TV chassis. But why do they always come in truck-loads and seem to get tougher each day? Of course, the "tough dog" is usually a weak or intermittent condition that is quite difficult and notoriously hard to locate. Repairing the intermittent condition takes a lot of patience, determination, and sometimes, just plain luck.

To some TV technicians a tough problem may mean one or two hours of hair pulling. While the next technician will take three or four hours. Whatever the time involved, it all adds up to money in the cash register. Time is a service technician's most important tool.

Many different methods are used in locating the toughest TV color problems. There are several ways to test and isolate a "tough dog" circuit. The most practical method used by a particular technician is the most important one. Sometimes the seemingly easiest route may end up to be the longest road travelled.

With the correct test equipment, knowledge, and shop practice, the tough problem becomes a lot easier to locate. Perhaps some of the following "tough dog" examples are routine troubles for some advanced technicians. In any event, let's take a look at how ten particular problems were handled.

The Repeater

An RCA CTC25X color chassis displayed no picture—only a white screen and sound. In fact, there seemed to be several birds within the TV cabinet. A "birdie" sound usually originates from trouble in the tuner or IF stages.

All tubes were tested and substituted in the IF and tuner sections, and still the sound chirped away. The chassis was removed from the cabinet and hooked up to the mock repair bench. Again, the screen was blank except for a white raster.

Quickly, all voltages were checked within the IF stages. The meter indicated 24-volts on the screen grid of the third IF stage. By removing the top metal plate covering the IF sections, a burned decoupling resistor was located. R52 (Fig. 1) was cracked and split wide open. We determined that the 6JC6, third IF tube, had shorted and damaged the 470-ohm resistor. Both the tube and the voltage dropping resistor were replaced.

Within three weeks the customer called and complained of the same trouble. Perhaps another tube had shorted out in the IF section—we hoped. But to our amazement the same 470-ohm resistor was burned and charred.

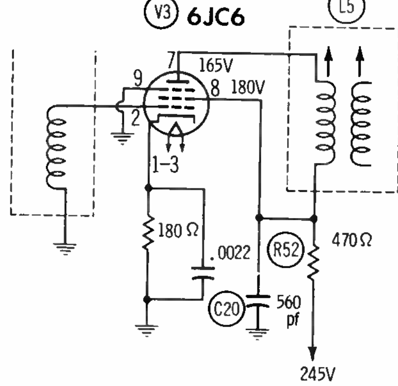


Fig. 1. Resistor R52 overheated.

The chassis was removed, in the home, and another resistor was installed. Taking no chances, C20 was removed and a 1000-volt type soldered in as a replacement. Maybe the 560-pf capacitior was intermittent or leaky, and destroying the decoupling resistor. After touching up the convergence, the receiver was buttoned up and worked perfectly.

About three months, to the day, the customer called again and wondered if we could repair a color TV receiver. The tone of his voice made us begin to wonder—but out we went. Sure enough, old repeater was sitting there burned to a crisp.

For the second time, the chassis was removed and taken to the shop. A quick check of the replaced capacitor and third IF tube tested normal. Another new resistor was installed and the receiver was checked while operating on the service bench for one week.

Perhaps, we should dig a little deeper into the chassis. Was it possible for L5 to have arced over within the transformer can? This was doubtful, but sometimes even a seemingly impossible trouble can develop within a color chassis.

The third IF transformer was removed from printed-circuit board and checked for possible burned or shorted windings. This coil seemed to be good, except one coil connecting lug was bent outward within the metal can. Checking the same position of the mounted coil, a burned arc over point was found along the side of the metal can. Here, was the original trouble—hiding underneath a metal cover. Bending the coil tab inward and wrapping plastic tape around all coil connections cured the repeating condition.

Dim Picture

A weak picture problem (RCA Chassis CTC19A) is shown in Fig. 2. With the contrast and AGC controls fully clockwise, only the outline of a picture could be seen. All video, IF, and RF tubes were checked and substituted—still only a very weak picture.

The color receiver was taken to the shop, chassis removed, and connected to the mock up repair bench. Well, perhaps we were lucky—the same dim picture was there, and at least the condition was not intermittent.

The symptoms indicated that the problem was in the video section; but quick voltage checks did not provide any clues. The scope was employed to trace the signal through the first video amplifier stage.

Perhaps, we had guessed wrong on this one. Tracing the signal through the delay line to test point A, we discovered that the video information was very weak. The signal was obviously being reduced by a defective M9. A resistance check of the delay line proved otherwise. Then, following the video signal with the scope we found the same weak signal at test point B.

Going back to pin 8 of the first video amplifier, the signal appeared quite normal. The defective component had to be R57. The high-wattage resistor had increased to 200K ohms.

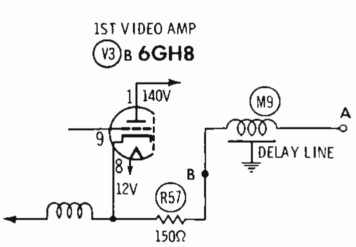


Fig. 2. Increased resistance of R57 produced weak video.

Poor Black and White

An RCA CTC16XL color chassis produced a very poor black-and-white picture with very little color. A defect that causes a poor black-and-white picture on a color receiver can normally be found in the demodulators, or R-Y, G-Y, and B-Y amplifiers. Even one or two weak color guns in the CRT can cause the same condition.

The CRT tester eliminated the possibility of a weak picture tube. The green gun was weaker than the red or blue but could not possibly upset the black-and-white raster.

While we were substituting one of the 6GU7 amplifier tubes, the raster changed from a redish to a purple color. Either a broken printed-circuit board, a poor socket connection, or a defective component was causing the intermittent condition. Pushing and prodding around on the PC board did not provide any clues. However, when pushing down on the G-Y amplifier tube, the intermittent condition would appear.

Voltage checks were made, but all appeared normal. Then, while pushing down on the G-Y amplifier tube, a low voltage reading was found on pin 6 of V21B, the G-Y amplifier (Fig. 3). The normal operating voltage on pin 6 was 120 volts, but now measured 78 volts. Also, the grid voltage on pin 7 dropped from −6 to −2 volts.

Suspecting R183, the plate load resistor, we checked it, but the resistor measured right on the nose at 27K-ohm. The supply voltage measured 405 volts. One thing for sure, 32.7-volts was hiding someplace. With V21B removed from the socket, the plate voltage increased to the total supply voltage.

When one end of the 27K-ohm resistor was prodded, the intermittent condition showed up. Here was

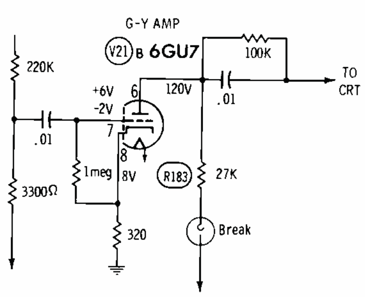


Fig. 3. Poor connection at printed-circuit board terminal.

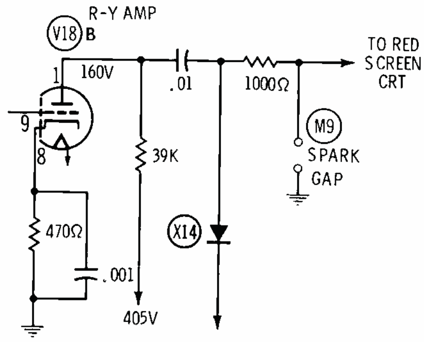


Fig. 4. Shorted silicon diode X14 caused red screen.

a bad soldered connection between the resistor lead and the PC board. The 27K-ohm resistor had a poor tinned lead wire which produced a poor soldered joint at the connection in the printed-circuit board.

Old Red Eye

This happened to be a new 1968 model that was put out on a demonstration loan to a customer. The customer complained that the picture suddenly went completely red; with a completely red screen, both black-and-white and color pictures were objectionable.

When sliding the normal service switch to the service position, the red horizontal line could not be extinguished. Both green and blue screen controls operated normally. In fact, with green and blue screens turned up to match the red horizontal line the black-and-white grey scale was excellent.

Since the color receiver became defective on a Saturday morning, the set was left for the customer to use over the weekend. The color picture was not bad, but could be improved. We noticed when the color receiver was turned off the screen became completely red while fading out.

Monday morning the receiver was placed on the service bench, another tube subsitution was made of the demodulator and-Y amplifier sections. In most color chassis a change in raster is a result of changes within these stages; the CRT was checked out for a possible weak gun.

Going back to the symptom; the red screen control would not change —so the red screen must be causing the trouble. Resistance and voltage checks were made around the red screen control circuit; it checked out normal.

Checking the schematic for possible clues, a silicon diode was noted in the new -Y amplifier stage (See. Fig. 4). All three -Y amplifier stages were identical with a diode in each plate circuit. Then it dawned on me that the trouble could be caused by a shorted silicon diode—

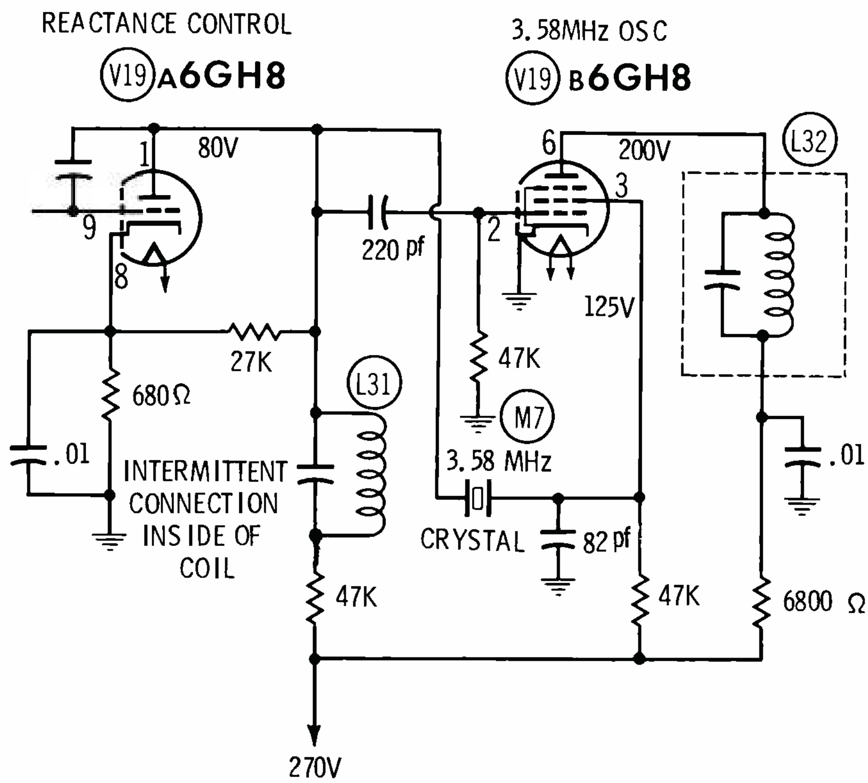


Fig. 5. Deflective coil caused intermittent color.

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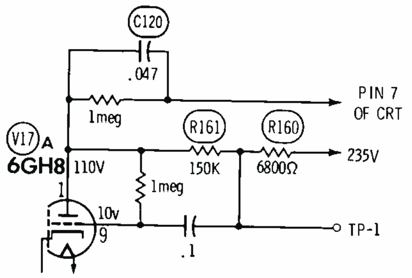


Fig. 6. Loss of green signal.

this should have been a real easy trouble to locate.

The silicon diodes employed in the color difference amplifier plate circuits are small in physical size and ar e100-ua units with a 200-volt rating. Since these small diodes were quite new to us, we substituted the unit with an original part, which placed the color receiver back into operation.

With the blue and green screen controls adjusted to produce a fairly good black-and-white picture, the color flesh tones were not perfect. After the new silicon diode was installed a greater range of flesh tone adjustment was possible with the tint control. These same pulse clamper diodes are found in all RCA 1968 color chassis.

Intermittent Color

An RCA CTC15 color chassis with no color but plenty of color fringing on the black-and-white picture was delivered to the shop. There was sufficient color burst, but no color in the picture. Naturally, the trouble was isolated to the color stages.

When the 3.58-MHz reference oscillator tube was removed from the socket, the screen turned green; this indicated the oscillator section was performing. After the tube was replaced, the color receiver performed perfectly for three days.

The chassis was removed from cabinet and connected to the color mock-up tube. After several hours, the color would intermittently drop out and then return. When test instrument probes were applied to the color circuits the color would come and go.

After several unsuccessful attempts with the scope and VTVM, the intermittent color condition was finally traced to the reactance control stage (Fig. 5). A voltage check revealed (with no color) a −5 volts

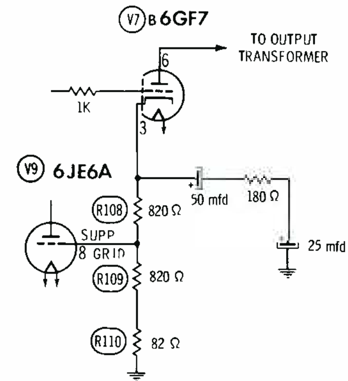


Fig. 7. Resistance values changed with change in temperature.

on pin 1 of the 6GH8 tube. Then the plate voltage bounced back to the normal 80-volts.

With no color on the screen, a quick voltage check revealed 270-volts going into the reactance coil, but nothing coming out. By twisting L31, the intermittent color condition would come and go. Undoubtedly, the coil connection was pulled tight and would break with increased heat or jarring of the chassis.

A small strand of flexible hookup wire was soldered to one end of the broken winding and then loosely wrapped around the coil terminal and soldered. Of course, the whole reactance coil could have been replaced, but this was not necessary.

No Green

This color problem involved an RCA CTC19P chassis that displayed a rather sickly looking b-w raster. By collapsing the screen to a horizontal line with the service switch, a green line could not be obtained with the green screen control turned fully clockwise. A quick test of the green gun in the color CRT proved it was normal. The problem had to be in the G-Y amplifier stage.

Voltage measurements on V17A indicated all voltages were quite close except pin 1, which measured 70 volts. The voltage on pin 1 should measure 110-volts with a normal supply voltage of 235 volts. Both R161 and R160 were checked with an ohmmeter and were found to be within tolerance.

When the G-Y amplifier tube was pulled from the socket, the voltage on pin 1 should have equalled the supply voltage. This was not the case—the voltmeter indicated only 120 volts. A voltage check at both ends of R160 produced higher voltage readings. The loss of 115-volts must be leaking through C120. (Fig. 6).

Removing one lead from the suspect capacitor, a leakage check was made of C120. Sure enough, the .047-mfd capacitor was leaky and caused the green color to be missing.

Vertical Reduced

A tough dog in an RCA CTC25-VA color chassis proved to be a real honey. The color receiver would run for two or three hours, then the picture would pull down one or two

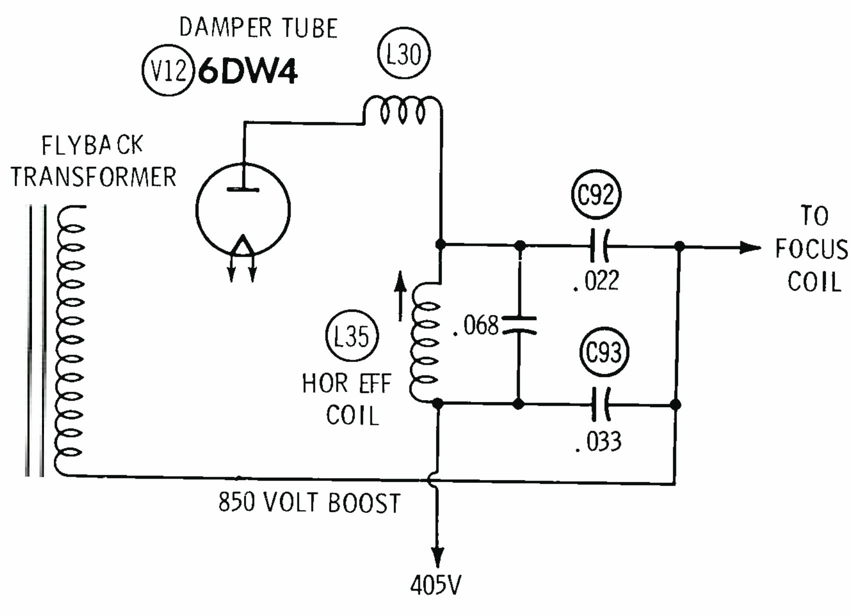


Fig. 8. Shorted C93, resulted in reduction of high voltage.

inches from top of the screen, and sometimes the bottom of the raster would pull up a full inch. During the house call, the 6GF7 vertical tube was replaced, and the screen returned to normal. Both the vertical height and linearity controls were adjusted. Everything was perfect—or so we thought.

Two days later, the picture had pulled down from the top of the screen—just as before. It looked like excessive heat might be involved, so the color receiver was operated for four hours before the second call was made. Replacement of the vertical tube and rotating the adjustments would not fill out the color screen.

The color chassis would perform on the test bench, but when placed in the TV cabinet the trouble symptom would reappear. Checking the vertical section, we discovered that components R108 and R109 appeared to run quite warm (Fig. 7). These two resistors, in conjunction with R110, form the cathode circuit of V7B, and also a snivet suppression circuit for the horizontal-output tube. All three of these resistors were replaced, and the color chassis replaced in the cabinet. The vertical circuit returned to normal.

Red-Hot Dog

This particular RCA CTC24 chassis was accidentally left on all night, resulting in an overheated flyback. After five minutes, the 6JE6, horizontal-output tube became red hot. At first, the flyback transformer was suspected; then several current checks were made.

When the receiver was first turned on, the horizontal output tube current was only 100 ma; this tube normally operates at 220 ma. After three minutes of operation, the current began to rise and increased to 350 ma; the 6JE6 plates were getting red hot. The trouble appeared to be in either the horizontal-output, damper, or flyback circuit.

The cap of the 6BK4 voltage regulator tube was pulled off to eliminate possible trouble in the voltage regulator section. All output voltages were quite low after the receiver operated a few minutes. The 850-volt boost voltage measured only 450 volts.

A voltage measurement of the grid drive voltage on the 6JE6 indicated −45 volts. When the plate cap was removed, the drive voltage jumped to −55 volts, indicating sufficient drive voltage. The screen grid voltage was normal until the plates of the 6JE6 became red hot.

Before attempting to replace the flyback transformer the efficiency coil circuit was checked out. At first, the current reading could be changed by turning the slug into the efficiency coil. Later on, adjustment of the efficiency coil had no effect on the cathode current reading.

Voltage checks were made in the damper circuit (Fig. 8). One end of each bypass capacitor was removed from the circuit and checked for signs of leakage. Capacitor C93 was found to be a dead short. Replacement of the .033-mfd capacitor placed the receiver back in operation. The horizontal-output cathode current and high-voltage adjustments were made before the receiver was returned to the customer.

Out of Focus

The complaint on an RCA CTC24R color chassis was poor brightness and width. At first, the screen

Repairing Portable Tape Recorders

Quick-servicing techniques make repair of these devices a profitable sideline.

by David Held

Have you been avoiding the service and repair of those portable, solid-state tape recorders? If you have been turning down these jobs, perhaps you should reconsider. It is not a difficult job to fix them, and there are some other advantages. For one thing, there are no service calls. People expect to bring them in for service and to pick them up when they are repaired. Also, business begets business, and you may pick up a lot of additional repair jobs on AM-FM receivers, auto radios, portable radios, portable phonographs, etc. It is surprising how quickly these small repair jobs add up to help pay the rent and buy mama that new coat. To add a new twist, perhaps you should ask yourself, "What else needs fixing?"

Initial Tests

When one of these little tape recorders lands on your bench, it is a good procedure to ask its owner what the trouble seems to be. This probably will help you very little (or not at all) in diagnosing the trouble. On the other hand, this opening gambit will endear you to the owner, and it may provide you with some quaint expressions which you can repeat at the next association meeting.

After you have listened sympathetically to a description of all the symptoms, an examination of the power supply is in order. There are three principle power-supply configurations: battery, AC line, or some combination of the two. The battery-operated models may use the same battery (four to six 1-1/2-volt cells) for powering the motor and the amplifier, or they may use separate batteries for each of these functions.

It is surprising how often a dead or weak battery is the cause of tape-recorder troubles. We agree that it is a lot of fun to check all those transistors, passive electronic components, transport components, etc. It makes one feel like a big-time expert to be able to do battle with all these intricate gizmos. Also, it makes one feel very, very stupid when, an hour later, the battery turns out to be the culprit.

If the cells are swelled or corroded, replace them. If not, test them. If you have no battery tester, a 20-ohm-per-volt (that's right, twenty) meter will do. Probably you do not have a meter like this, but it is easy to adapt your shop meter. Simple shunt a resistor across the test leads. A 200-ohm resistor is about right for testing batteries on the 10-volt scale of the meter, a 50-ohm resistor works well on the 2-1/2-volt scale. The value of resistance is not especially critical; the important thing is that you check batteries under load. Another method of checking the batteries is to test them in the recorder with the recorder running. The recorder amplifier will draw about 5 to 10 ma, the motor up to 300 ma.

If the tape transport will run, thread the tape, or insert the cartridge or cassette, and attempt to record. The recorder probably has two speeds, 3 3/4 and 1 7/8 inches per second. Speeds of 15/16 and 7 1/2 ips are available on some recorders, and a very few, particularly the older, higher-priced models, may operate at 15 ips. The higher-priced recorders use a speed-selector mechanism, but the less elaborate ones use a capstan sleeve which doubles the diameter of the capstan.

Insert the microphone plug and actuate the record switch. This

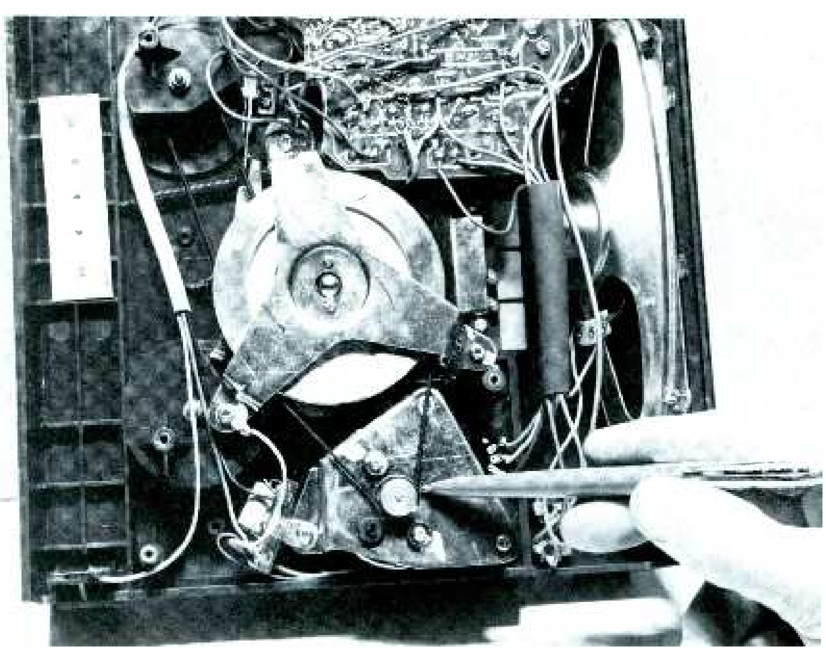


Fig. 1. Mechanical assembly of typical small tape recorder.

switch is usually interlocked to prevent it from being actuated inadvertently. Some microphones are equipped with a switch to start and stop the tape transport. If the transport will not run with the microphone connected, but will run if it is not, suspect this switch.

If the recorder is one of the low-priced models, some flutter, wow, and distortion is to be expected. Therefore, only a rough check of its fidelity is necessary. Simply whistle or hum a few bars of Rachmaninov's Concerto No. 1 (or some other popular ditty) into the microphone and observe the recording indicator. If the indicator does not operate normally, check the microphone. Connect it to your scope and whistle some more. The output will vary, depending on you and the particular make of microphone, but an output from .02 to 0.1 volt is probably normal.

If the recording indicator operates correctly, record for a minute or so and play back the tape. Wow and flutter are caused by improper speed; low output can be caused by a faulty bias oscillator; and no output can be the result of a bad amplifier, if the level indicator is inoperative, or by a bad record-play back switch if the indicator does operate. Other causes of weak or distorted output are poor contact between head and tape, tape which has been inserted with the shiny side adjacent to the head, or a magnetized recording head.

If the recorder retailed for less than about $50.00, this is the moment to introduce the subject of economics to your customer. By now, you probably have spent 10 or 15 minutes on the recorder, and unless you have developed a good diagnosis, or better yet, you have fixed the recorder, you are in danger of losing money on the job. Tell your customer what you think is wrong with the recorder, how much time will be required to repair it, and what materials will be used. Make certain your estimate is high enough to cover the job. It is better to collect a small fee for the service you have performed already than it is to run up a big charge which the customer will not pay willingly. It is easier to collect $3.00 for estimating the job than it is to collect $30.00 for completing the repair of a $39.95 recorder.

Of course, if the tape recorder is one of the more costly models, its greater complexity may require more time for diagnosis of the trouble, but because of the greater value of the machine, you will be able to charge more for the repairs. In any case, be certain that the customer is alerted to the charges he is incurring before you delve too deeply into the recorder.

Mechanical Troubles

Probably the most frequent trouble with tape recorders is incorrect speed. Either the tape speed is too slow or it is not constant. Most tape-speed problems can be repaired by cleaning or replacing the tape-guide assembly, playback/record head, drive belt, and drive wheel. Check for possible slippage due to a worn or cracked drive belt. (Fig. 1). Often, you will find spots of oil on belts or pulley assemblies. Clean all rubber wheels with alcohol or cleaning fluid.

For wow or flutter conditions, check for dry pressure rollers. Remove the drive rollers, clean the bearings, and put a drop of oil on the bearings. Check the bearings of the idler and flywheel assembly for hardened grease. Wash or clean the bearings, and lubricate them. Check for correct tension on all tension springs; be sure that all springs are in place.

In case the fast-forward function is inoperative, check the forward tension spring; it may be disconnected or missing. Be sure the idler-tension spring is in place. Perhaps oil has run onto the take-up idler wheel. Check the supply spindle for drag or a misadjusted brake.

If the tape recorder will not rewind, check for a broken or oily rewind belt. Perhaps oil has leaked onto the motor pully. Also check for a slipping clutch; if necessary, increase the clutch-tension spring.

Check the capstan-drive-idler tension spring if the transport will not function in the play/record position. Check to see that the drive pulley engages, and check for a defective motor. Perhaps there is no voltage being supplied to the motor connections. Pull the motor pulley away from the drive rim, or remove the motor belt to see if the motor will turn. A motor will make a screeching noise if the bearings are dry. A chattering noise indicates worn motor bearings. A drop of oil may remedy the situation; otherwise, the bearings, or the entire motor, will have to be replaced. If the motor shaft is frozen, or will hardly turn, dismantle the motor assembly and wash the bearings before lubricating them.

Slow or erratic speed in the small tape recorders may be caused by a glazed motor-drive pulley. Clean the pulley, and in difficult situations, coat the drive pulley with phono-drive liquid. Wipe off excess dressings that may drip into bearings or onto the rubber drive wheels. Use a pre-recorded test tape to check speed and distortion.

Excessively worn rubber drive rollers also will cause wow or flutter. Replace worn drive rollers and check for possible dry bearings in the rollers. Hardened or gummy lubricants should be washed out and replaced.

Check the large flywheel pulley for signs of oil on its surface. A dirty wheel will cause slippage and slow speed problems. Also, check for dirty or worn pressure pads.

Cleaning and Lubrication

When repairing the tape recorder use a systematic cleaning method. Start at the tape head and clean off excessive tape oxide. Do not use a metalic screwdriver around the play/record head. Clean drive rollers, tape guides, and pressure pads. Check all roller and motor bearings for excessive tape-oxide residue. Clean the tape-guide assembly with alcohol and absorbent cotton.

Next, clean all pulleys, flywheels, rubber drive wheels, and the rubber belt. Remove and wash any sluggish bearings. Be careful not to get cleaning fluid on plastic components.

In many cases, the customer will have attempted to repair a slow-speed problem by oiling every moving object. Excessive oiling has caused more tape-speed problems than it has cured. All of the oil or grease must be removed from friction-drive assemblies.

After all surfaces have been cleaned, lubricate bearings with #20 machine oil. Only a drop or so on each bearing is necessary. Apply a thin film of nonhardening grease to sliding surfaces. Always wipe off excess oil or grease from any surface that has been lubricated.

Electronic Problems

If the recorder will neither record nor play back, isolate the trouble to the head or to the amplifier by setting the recorder to playback and touching a finger to the "hot" lead of the head. If the volume is fully advanced, a hum or rushing noise should come from the speaker. If no sound is heard, suspect either the amplifier, the cable from the head to the amplifier, or the selector switch.

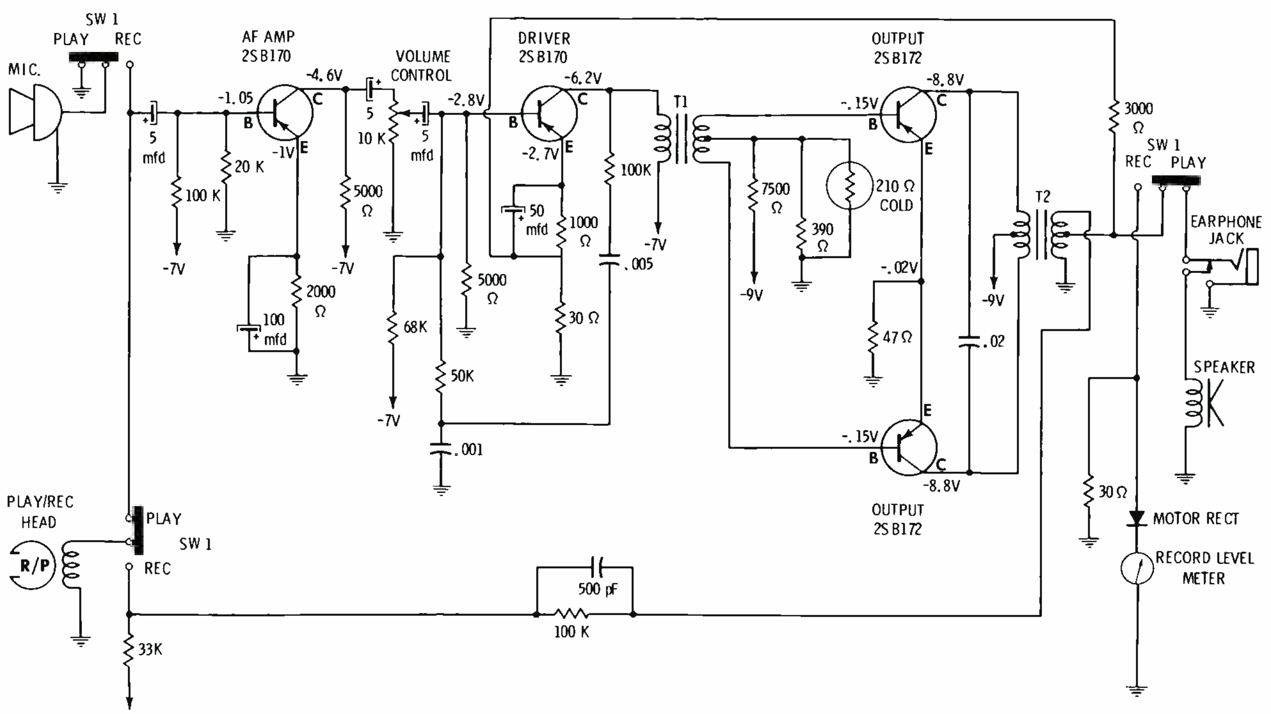


Fig. 2. Schematic diagram of typical low-priced tape recorder.

If sound is produced by the above test, the head is probably faulty. A resistance test of the head should indicate between about 50 and 450 ohms. If you need to know the exact resistance of the head, consult either the manufacturer's data or the appropriate volume of the TR Series of PHOTOFACT data.

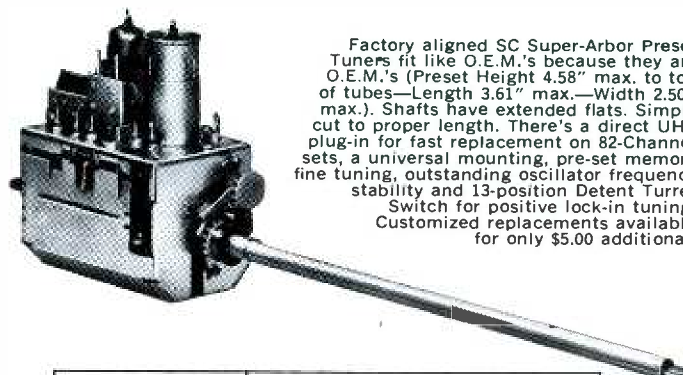
An alternate method of insulating the problem is to connect a scope to the playback head and observe the output from a recorded tape. This output is in the order of millivolts, so a high-gain scope is required.

If the head is good, check the selector switch and the cable from the head; then proceed to the amplifier. Fig. 2 is the schematic diagram of a typical low-priced tape recorder. In the record position, the microphone is switched into the input circuit of the first AF amplifier stage. R1, between the AF amplifier and driver stage, controls the volume. Transformer coupling feeds the push-pull output transistors. The secondary of the output transformer connects to the function switch and then to the recording head. The level meter is connected to the output.

During playback, the head is switched into the input circuit of the first AF amplifier; the speaker and earphone jack are switched to the secondary of the output transformer. On some models, the level meter indicates the condition of self-contained batteries.

The amplifier may be checked by either signal tracing or signal injection, as you prefer. You can use a recorded tape for a signal source and trace the signal towards the speaker, using a scope. Alternatively, a signal source such as a pencil-type harmonic generator may be used to inject a signal at the output. Then work "backwards" towards the head to find the faulty circuit. If you are servicing a stereo recorder, signal from one channel may be used to check the other channel.

If solid-state stages are intermittent, be very careful not to shock an intermittent component into operation. This is especially true if the faulty component is an intermittent transistor or an electrolytic coupling capacitor. Intermittent transistors can be shocked into operation by an injected signal or by an in-circuit transistor tester. Always apply the



injected signal to the collector terminal and then to the base element. Sometimes, when the injected signal is applied to the base element, the transistor will start to function. Remove a suspected transistor and check it with a transistor-beta tester. Sometimes, an intermittent transistor will "fault out" if you apply cold spray mist or heat it with a soldering iron.

Low volume or distortion may be caused by a loss of capacitance in one of the small electrolytic coupling capacitors, or by a change of resistance in a bias or emitter resistor. Distortion also can be caused by the recording tape not being snug against the recording head.

In some small tape recorders, only a PM magnet is used to erase the previous recording. Other models contain a smaller erase head with a fixed DC bias. In the larger models, the bias and erase oscillator supplies a fixed AC voltage to the erase heads.

A defective erase head will produce cross-talk in the next recording. The head may erase only part of the previous recording, or it may be completely inoperative. To check the erase head, record a small segment of new tape. Rewind the tape and set the tape recorder in the record position a second time. With the volume control set to extreme minimum position, let the tape make a second recording pass. Check to see if the first recording has been cleared.

To check the erase head, take a resistance reading of the erase head and check for the presence of an erase voltage. If a PM maget is used as an erase head, be sure the magnet is in contact with the recording tape. Remember that there are two erase heads in stereo models. In case one stereo channel is not erasing, simply switch erase heads to determine whether it is the head or the erase circuit which is defective.

All but the very cheapest recorders use some method of biasing the tape while it is being recorded. In the better recorders, bias is supplied by the bias oscillator, although less expensive recorders use a DC bias current through the recording head. Failure of the bias oscillator will cause the amplitude of the recording to be very low. A recording made with another machine will play back at normal volume.

Service Adjustments

The height and azimuth adjustments should be made after replacing a new playback/record head. To check the height adjustment, load the tape recorder with a 1-kHz test tape. Connect a VTVM or scope to the voice-coil terminals of the speaker. In case the tape recorder is a stereo model, be sure you are on the correct channel. Advance the volume control until the VTVM is at center scale. Then adjust the tape head up and down for a maximum reading on the meter.

For azimuth adjustments, insert a 6-kHz test tape in the recorder. Use a VTVM or scope connected across the voice coil for an indicator. Rock the tape head back and forth with the azimuth-adjustment screws for maximum output.

To check the heads for residual magnetism, connect a VTVM across the speaker voice coil. Turn volume and tone controls fully counter-clockwise and depress the play button. With no tape in the recorder, notice the reading on the VTVM. Load a blank tape and depress the play button. Check the reading on VTVM; if there is a noticeable increase in reading, the head should be demagnetized.

Before demagnetizing the tape head, place a layer of ahdesive tape over it to prevent scratches. It is always best to demagnetize the heads after any tape-recorder repair.

Summary

In order to repair the low-priced recorders at a profit, it is important that you diagnose troubles quickly and accurately. Otherwise, the repair bill may equal or exceed the cost of the recorder. In servicing these small recorders, always look first for obvious problems: bad battery, loose battery connections, tape not threaded properly, "cockpit troubles," oil on pulleys or belts, etc.

As soon as you have developed a "working diagnosis," give the customer an estimate of the repair cost. By using a logical sequence of testing, repairing, and adjusting these small recorders, you can service them at a profit and, at the same time, build up a backlog of potential customers for your other services. ▲

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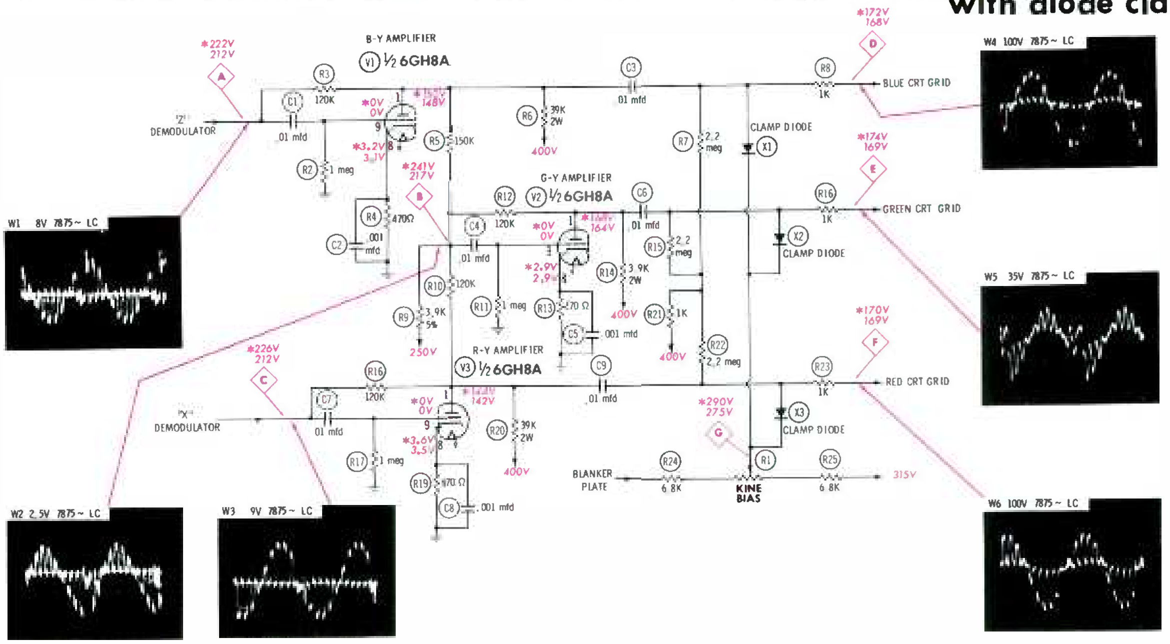


DC VOLTAGES taken with VTVM—no color signal input. *Indicates voltage taken with color-bar input—see "Operating Variations".

WAVEFORMS taken with wide-band scope, TV controls set to produce normal color-bar pattern. LC (low-cap) probe used to obtain all waveforms.

Normal Operation

Major changes in difference amplifier—matrixing circuits of RCA Chassis CTC31 include: common cathode matrixing resistor no longer required, individual cathode resistors used; G-Y signal obtained by sampling portion of output at plates of B-Y and R-Y amplifiers; horizontal retrace blanking now accomplished in video circuits, difference amplifier cathodes no longer pulsed; clamp diodes for DC restoration at picture tube grids allows AC coupling of demodulator, difference amplifier, to CRT grid circuits for more flexible design. AC coupling of stages prevents grids from responding to absolute DC level of either demodulator or amplifier stage. Ideally the CRT grids should respond only to DC content of chroma information, not voltage changes caused by tube drift, etc. Clamp diodes reset operating point of CRT grids to same reference level as demodulators during each horizontal retrace. B-Y circuit functions as follows (G-Y and R-Y similar): B-Y information is coupled through C3 to blue CRT grid; during horizontal trace DC level of grid varies according to B-Y content, right-hand plate of C3 receives current through R7.—DC grid voltage changes; during retrace negative pulse (from blanker plate) is applied to X1 cathode.—X1 conducts returning grid to operating point set by kine bias control; at same time blanker cuts off second bandpass amplifier removing signal from demodulators and setting them to their operating point. Effectively, chroma information, developed in demodulators, is DC coupled to CRT grids. CRT bias operating point is established by varying horizontal pulse amplitude with kine bias control. CRT grids are clamped to blanker plate through control during retrace only.

Operating Variations

A, B, C Points A and C are at same DC potential as respective X and Z demodulator plates. B-Y and R-Y information coupled through coils to block 3.58-MHz signal from difference amplifiers. Only DC variations is slight rise with color signal input. Point B shows similar change.

V1, V2, V3 Three individual amplifiers are similar—use same components and same values—little voltage difference at comparable points and only slight change between no signal and signal conditions.

G DC voltage varies somewhat according to R1 (kine bias control) setting (290V at minimum, 300V at maximum) but primary function is to control blanking pulse amplitude coupled to clamp diodes. Amplitude near 150V p-p at minimum control setting, 100V at maximum.

Waveforms W1, output of Z demodulator (B-Y), varies from zero to about 12V p-p according to color level control setting. This causes W4 (blue CRT grid) amplitude variation of 0 to 140V p-p. Other waveforms show similar variation: W3 (X demodulator output) from 0 to 14V p-p, W6—0 to 130V; W2 (G-Y obtained by sampling V1 and V3 outputs) from 0 to 3V p-p, W5—from 0 to 45V p-p. Amplifier grid waveforms similar to W1, W2, W3—signal at plates similar to W4, W5, W6. Tint control varies content of waveforms—changes phase of individual color signals.

Blue Missing

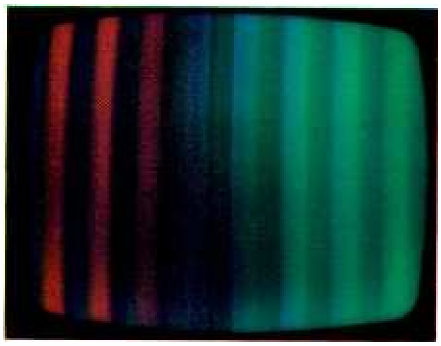
SYMPTOM 1

Red and Green Normal

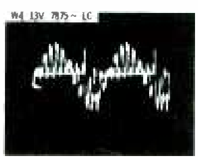
C1 Leaky

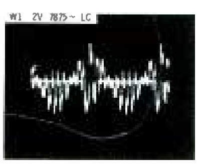
(Coupling Capacitor—.01 mfd)

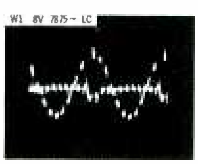
Symptom Analysis



B-W picture OK. Blue missing from color programs—known blue portions of picture now green—normal tint control action missing—flesh tones not "purplish" at one extreme. Generator pattern confirms symptom—red and green OK but blue poor.



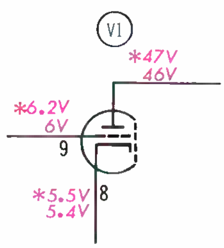




Waveform Analysis

Waveform at D, blue CRT grid, explains loss of blue—amplitude only about 10% of normal 100V p-p—content is poor and amplitude insufficient to drive CRT grid. W1 (B-Y input to difference amplifier stage) with symptom present (second waveform) compared to normal W1 (third waveform). Also shows definite trouble—content poor and amplitude low-normally around 8V p-p, now only 2V. Waveform analysis inconclusive — indicates reason for loss of blue but does not isolate trouble.

Voltage and Component Analysis



Waveform analysis points to demodulator section but DC voltages isolate to difference amplifier stage. V1 voltages give good clue to trouble; grid measures 6.2 V and is positive with respect to cathode (now 5.5V, normal 3.2V). Plate voltage is low— normally near 150V. Relatively high resistance leakage (150K) of C1 upsets V1 bias and causes loss of blue. R4 and R6 can be damaged. Open C1 causes similar symptom but different troubleshooting procedure—W1 normal—V1 voltages normal—but no W4.

Best Bet: VTVM for voltage and resistance measurements.

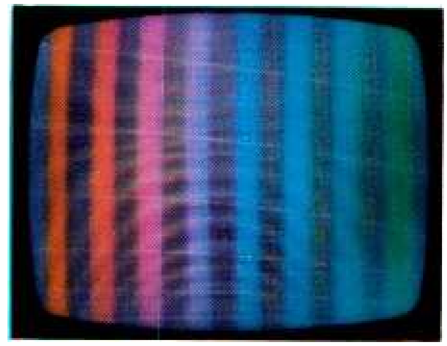
Excessive Brightness

SYMPTOM 2

Both B-W and Color

R24 Increased in Value

(Blanker Network—6.8K)

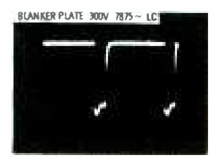


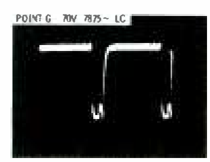
Symptom Analysis

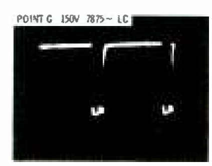
Symptom may be continuing type—screen and kine bias controls require constant adjustment over period of time—some color but little video information at minimum brightness—focus lost (blooming) if control is advanced. Color-bars show but little video signal.

Waveform Analysis

Although not shown, all chroma waveforms are of proper amplitude and content. Blanker plate, source of clamp pulse (first photo), is negative going with normal amplitude of about 300V p-p. Waveform at center-tap of R1 (kine bias control) is only 70V p-p. Normally control varies pulse amplitude from 100V p-p (maximum bias) to 150V p-p (minimum bias). Waveform analysis shows insufficient negative-going horizontal pulse at diode cathodes for sufficient clamper action.







Voltage and Component Analysis

DC about 75V higher than normal at all three CRT grids—with or without signal—DC at point G near normal. Clamp diodes can not conduct during trace (170V at anode, 290V at cathode)—they conduct during retrace when negative going blanker pulse 150V p-p combined with 290V DC level results in 140V potential at cathodes. Pulse amplitude now insufficient —diodes do not reset CRT grids to proper operating point. Grid voltages tend to rise toward 400V source potential through R21, R7, R15, and R22.

Best Bet: VTVM; then scope.

SYMPTOM 3

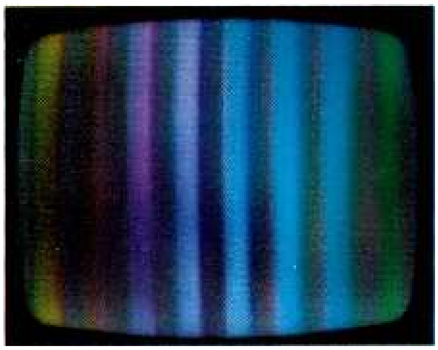
Red Weak

B-W Background Tinted Red

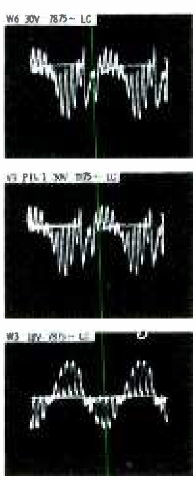
R19 Increased in Value

(Cathode Load—470 ohms)

Symptom Analysis



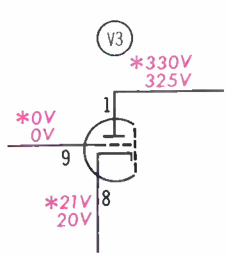
Reds seem much weaker than greens and blues on color programs. Level and tint controls operate but impossible to get proper flesh tones. B&W background is reddish—screen control adjustment corrects—but then red is lost completely on color programs.



Waveform Analysis

W6, at point F (red CRT grid), only 30 volts p-p compared to normal 100V—content is poor. Waveform at V3 plate similar in amplitude and content. W3, X demodulator output or R-Y input to difference amplifier stage, shows good content—amplitude is high, due to increased color level control setting. While not shown, waveform at V3 grid is similar to W3—as it is normally. Waveform analysis isolates trouble to V3 circuitry.

Voltage and Component Analysis



Extremely high plate voltage (normally 144V, now 330V) along with comparatively high cathode potential pretty well isolates trouble. Symptom might be present after replacing defective V3. High resistance cathode load upsets V3 bias—reducing R-Y drive signal at CRT grid. Increased R4 causes loss of blue, R13 loss of green. Extremely high plate voltage allows C9 to charge to higher voltage—X3 clamp diode resets grid to proper operating point but potential rises during trace causing red background on black-and-white picture.

Best Bet: Scope isolates; VTVM locates.

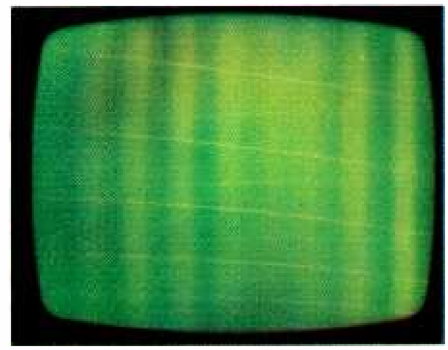
SYMPTOM 4

Green Screen

Both B-W and Color

X2 Open

(Clamp Diode—G-Y)



Symptom Analysis

First symptom may be loss of raster at normal to high brightness control settings—at minimum, screen is green and little out-of-focus. Turning green screen control to minimum produces b-w picture with green background or color program with incorrect colors.

Waveform Analysis

W5, at green CRT grid, shows slightly high amplitude (normal 35V p-p, now 50V) and information appears slightly distorted. Amplitude at input to stage (W2) also slightly high (4V p-p versus 2.5V). Other inputs (W1-W3) and output (W4-W6) also about 40% high. No high amplitude negative going blanking pulse in CRT grid drive waveforms since blanking is accomplished in video circuits instead of difference amplifier cathodes.

Voltage and Component Analysis

Key voltage at green CRT grid—now measures 288 Volts DC—over 100 volts more than normal. Other grids at normal potential. With X2 clamp diode open, green grid is not reset to proper bias point during each horizontal retrace but instead is free to rise towards 400V source voltage potential through R15, R21. Excessive voltage at green CRT grid upsets picture tube circuits as well as video and high voltage sections—resulting in possibility of several different symptoms including loss of raster.

Best Bet: VTVM and component substitution.

Symptom 5

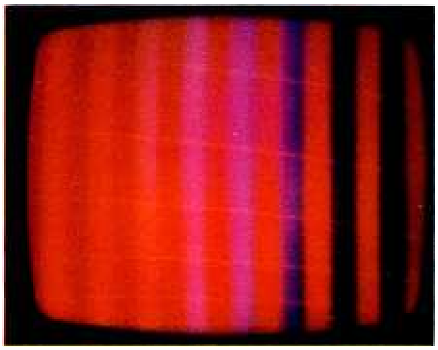
Red Screen

Both B-W and Color

X3 Shorted

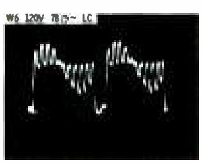
(Clamp Diode—R-Y)

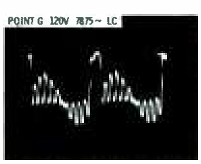
Symptom Analysis



Black-and-white picture with red background obtained by adjusting brightness and contrast controls. Red is predominate color in color programs. Tint control has little effect since red is only color. Color level controls amount of red—other colors hardly noticeable.

Waveform Analysis





W4 (blue CRT grid—shown) and W5 (green—not shown) near normal. Overall amplitude of W6 (red CRT grid) slightly high (120V p-p, normal 100V). Chroma portion near normal 100V but abnormal negative going pulse at horizontal rate increases overall peak-to-peak reading. Logical source of pulses, point G—waveform here very similar to W6—direct coupling between point F (red CRT grid) and G (blanker pulse input to clamp circuits.

Voltage and Component Analysis

D	E	F
*220V	*285V	*208V
218V	270V	202V

All CRT grids measure high—red much higher (285V) than others. Kine bias normally varies grid voltages from above 170V to 220V DC (minimum bias)—should be maintained only high enough for proper color temperature adjustment. With X3 shorted red CRT grid operates at DC level of point G—grid is not reset to proper operating point during each retrace. R-Y chroma signal coupled to X1 and X2 cathodes upsets bias at points D (blue) and E (green). Spark type capacitors protect diodes from CRT arcing.

Best Bet: Scope, then VTVM will solve.

Symptom 6

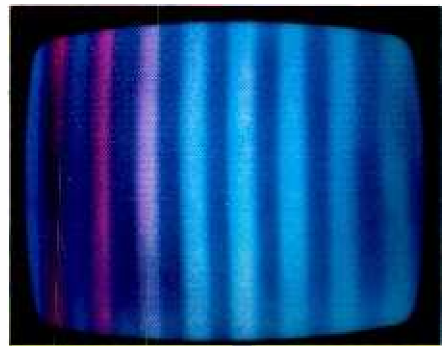
Blue Screen

During Warmup

X1 Leaky

(Clamp Diode—B-Y)

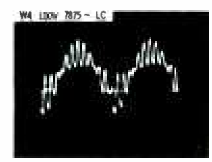
Symptom Analysis

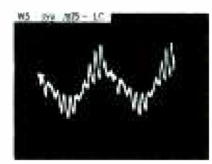


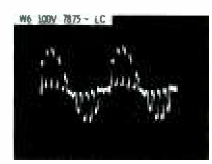
When set is first turned on black-and-white background is blue—predominate color in color picture is blue. As set warms up (15-30 minutes) symptom disappears. Resetting screen controls when set just turned on remedies trouble but then blues lost after warmup.

Waveform Analysis

All CRT grid waveforms appear normal in content and amplitude. Negative going pulse occuring during retrace is observed in W4 (blue grid) if close comparison with normal waveform is made. While not shown, waveform at point G is 10 to 15 volts below normal 150V p-p, hardly reduced enough to cause suspicion. Waveform analysis only confirms what is suspected in symptom analysis—trouble in CRT DC bias network rather than chroma signal circuits.







Voltage and Component Analysis

D	E	F
*215V	*185V	*185V
198V	181V	184V

Key DC voltages are at points D, E, and F (CRT grids)—blue grid about 45V high—others only about 15V. With leaky X1, blue grid bias is held at constant DC level (some portion of voltage at point G) rather than being reset during each retrace. Internal resistance of X1 is rather low (150K) when cold—after warmup resistance returns to near normal—and proper clamp action returns. Clamp diodes are rated 200 piv. @ .3 amps. Working knowledge of circuit quite helpful in troubleshooting intermittents.

Best Bet: VTVM and can of freeze spray.

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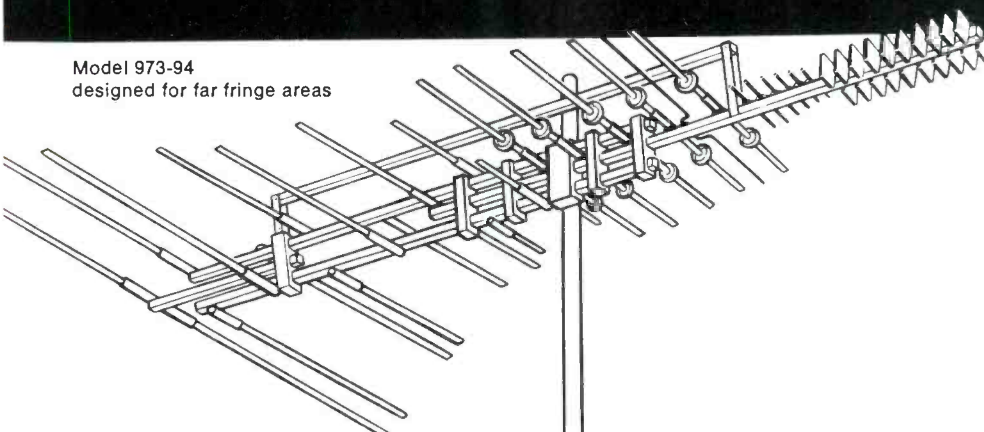

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How Well Are You Equipped?

Up-to-date schematics, technical books and magazines are as necessary to successful servicing as proper test equipment.

by Phillip Kennedy

Are you able to service electronic equipment in an efficient and thorough manner? All electronic service technicians should be able to give an affirmative answer to this question. In recent years, however, this has become increasingly difficult. The widespread use of solid-state and other sophisticated circuitry has, so to speak, separated the men from the boys.

Much of the service industry has, for some time, been concerned with presenting a professional image to the public. But to survive in this business today, a complete professional approach is essential. Just how, you may ask, do we go about accomplishing this? Tossing away the traditional uniform and donning a white shirt and tie is certainly not enough. In this field, or any other professional field, a man's knowledge and his ability to use it makes him a professional.

Most of us in the electronic servicing field today have had some formal training. The day for the television serviceman who "just picked it up" is none too quickly drawing to a close. These people must either equip themselves with the necessary theory and knowledge or find another field of endeavor. It is not enough, however, just to have a good background in electronic theory. Like the athlete who must constantly condition his body, the professional must condition his mind with the knowledge of his field.

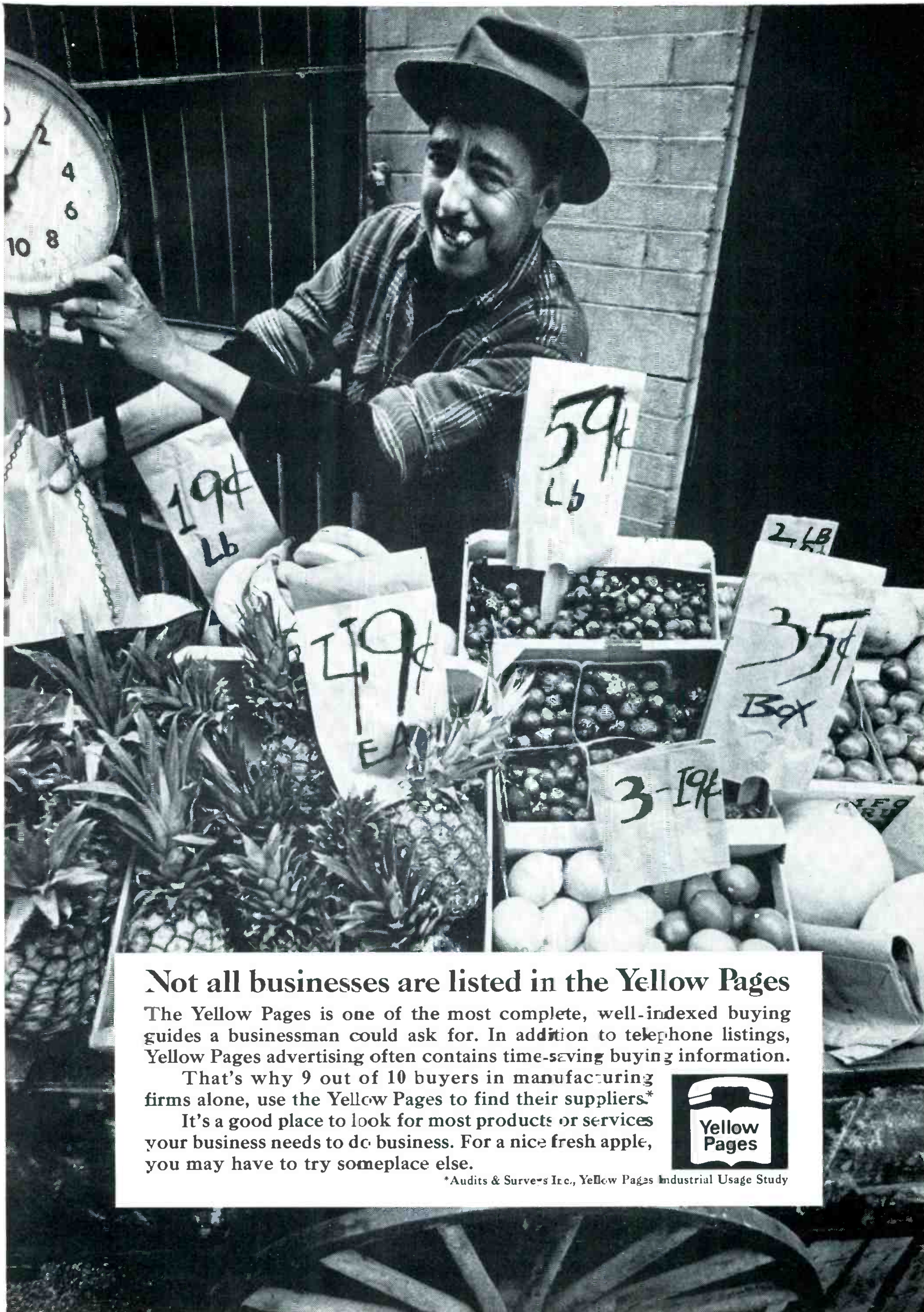
After the technician has completed his formal training, it is up to the individual to continue his education and keep up with the advancements of the industry. Most of us have received our fundamental training from a resident technical school or perhaps through a correspondence school. In either case, this training consisted of a well-planned and programmed course of study. However, to continue our training and keep our technology current, most of us must rely upon the self-study method of training. The subject matter and pace of such a training method will be determined by the needs and ambitions of the individual. In this article we will attempt to help the reader determine the areas where study may be needed and how to obtain the necessary reference material.

As electronic service technicians, we should be able to recognize a symptom of an undesirable condition and associate it with a particular malfunction of a circuit. A good technician may be able to take this approach to a circuit that is familiar to him, but he also may waste a good deal of time on a new circuit that is unfamiliar. Whenever he encounters these new circuits, the technician should attempt to learn the function of the various components of the circuit and the dynamic function of the circuit itself. Sometimes he will be able to accomplish this with a brief study of the schematic. There will be times, however, when this will require research and review of the basic type of circuit involved.

Many technicians, for instance, have difficulty troubleshooting sweep circuits because they really do not have a complete understanding of their operation. Others may have a weak background in the operation of AGC, AFC, sync, chroma, or other circuits. Too often they rely strictly upon the component-substitution method of troubleshooting to locate a defective part. The professional approach would be to take the associated voltage and resistance readings and to observe the pertinent waveforms of the circuits in question. The technician should then assemble this information into a logical pattern and attempt to deduce the source of a particular defect through sound reasoning. Obviously, to do this in a quick and efficient manner, a thorough knowledge of the circuits involved is essential.

A few years ago there were comparatively few circuits in common use in radio and television receivers. But, with the coming of color, solid-state circuitry, and other advancements in technology, there has been a tremendous increase in the variety of circuits now in use. Therefore, the technician will tend to have fewer contacts with any one circuit; instead he will encounter an increasing number of circuit variations designed to perform the same function. It is a difficult, if not impossible, task for most technicians to be completely familiar with each and every circuit they encounter. For this reason it would be impractical to make a complete study of each new circuit as it is introduced. Few, if any of us, could afford the time required for such study. Therefore, the areas of study for the individual technician will be determined by his own requirements in terms of the circuits he encounters.

When we have the need to study or review a specific circuit, we should have a source of reference material conveniently available in which the necessary information can be found. To fulfill this need, the operator of the modern electronic service shop should consider the development of an up-to-date technical library. Such a library or reference center need not be an elaborate or extensive collection of books and texts. It would be preferable to collect your library over a period of time, purchasing various books and periodicals when they are available or would be of benefit. Perhaps you have accumulated a few electronic reference books or the textbooks from some electronic training courses. These books could make a good beginning for your technical library. It is desirable to allocate a specific place in your shop for this



Not all businesses are listed in the Yellow Pages

The Yellow Pages is one of the most complete, well-indexed buying guides a businessman could ask for. In addition to telephone listings, Yellow Pages advertising often contains time-saving buying information.

That's why 9 out of 10 buyers in manufacturing firms alone, use the Yellow Pages to find their suppliers.*

It's a good place to look for most products or services your business needs to do business. For a nice fresh apple, you may have to try someplace else.

*Audits & Surveys Inc., Yellow Pages Industrial Usage Study

Circle 19 on literature card

material and arrange it in such a way that it is readily available.

Presently, the number of books and publications devoted to the electronics field is almost unlimited. There are many books currently available, covering virtually every phase of consumer electronic products and their respective servicing problems. Catalogs, many containing brief outlines and discriptions of the titles offered, are available from the various publishers.

An up-to-date television training manual provides an excellent reference source for any television service shop. Although a training manual might seem too basic to the practicing electronic service technician, such a text should prove invaluable to begining and experienced technicians alike. A current training manual would provide an ideal source for both the review of fundamentals and a study of important new circuits. Also worth consideration are the television service guides, many of which are based on actual experience and case histories. Some of these books are arranged by trouble symptoms and, if relating to television, use photographs of the actual trouble symptom displayed on the screen of the receiver.

There are also training manuals and service guides devoted exclusively to color television. Since color television is definitely here to stay, there are few television technicians who have not expanded their servicing market to include color TV. For those who are currently making the transition from servicing only b-w television to servicing both color and b-w, these texts are particularly useful. They will be especially important to the service technician who has had no opportunity for formal training in color television. Two or three of these books, carefully chosen, will provide a good source of general theory and fundamentals, as well as practical information on setup, troubleshooting, adjustments, case histories, and other information essential to efficient color servicing. Such manuals and guides will also provide discussions of test equipment and test procedures unique to color. Even the experienced color service technician will find these texts a profitable investment.

Although some technicians may think of the transistor television receiver as a retribution for some long-forgotten evil deed, the use of solid-state circuitry has increased rapidly. An attempt to service these receivers without at least an understanding of basic semiconductor theory would be haphazard at best. A book on practical transistor theory should prove very useful if you plan to service transistor T.V. A publication by Howard W. Sams Co. titled *Servicing Transistor TV* is one example of such a book. This text begins with a chapter on the general circuitry of transistor television and then analyzes the receiver section by section providing practical servicing techniques.

Also worth considering are the many specialized books covering various sections of the television receiver. There are texts available to help you understand and service horizontal sweep circuits, tuners, sync circuits, power supplies and every other section of the television receiver. Another worthwhile addition to your shop library would be a radio and TV alignment handbook. Such a book explains how to determine when alignment is necessary, what equipment is needed, and the proper way to hook it up. It will also explain how to follow the alignment procedures outlined in service literature, the purpose for each step and the evaluation of the results.

In addition to the countless books devoted to television servicing, there are numerous others covering the other phases of electronic servicing. These include auto radios, FM multiplex, record players, tape recorders, transistor radios, amplifiers and similar electronic equipment. There are also specialized books on communications equipment, garage door openers, electronic organs and many other electronic devices. There are also several excellent texts on test equipment. The publishers' catalogs will be helpful when planning to purchase a book covering a particular phase of electronics. Although most of these books are available from the publisher, many can also be purchased through your electronic parts distributor. The next time you visit your distributor, look over his display racks of books and reference material. I am sure you will find several books that will help improve your servicing techniques.

Another important source of reference material are the electronic servicing magazines, such as the PF REPORTER you are now reading. These periodicals often provide the most current information on new circuits being introduced by the various manufacturers, as well as articles giving objective and comprehensive discussions of a particular section of a radio or television receiver. These articles, in many cases, will serve to refresh the technicians knowledge of a particular circuit. In addition, these magazines often provide discussions of new servicing techniques and improvement of old ones. Regularly there are articles discussing new test equipment being introduced. The service technician will find many other features in these magazines which should prove interesting and profitable reading. After reading these magazines, it is best to file them in chronological order for future reference. Most magazines annually publish an accumulative index of all articles published to date. This index should be removed from the issue in which it was published and placed in a convenient place to provide a quick reference.

Many radio, television, and component manufacturers publish news letters or service bulletins. The extent and format of this material will vary according to the individual manufacturer. They usually contain information on new products, production changes, or service problems from the field and are available free or on a subscription basis. Schematic services such as Sams PHOTOFACT Folders provide complete service information on nearly all makes and models of TV and radio receivers.

Regardless of what educational and reference material is chosen, it will prove of little value unless it is effectively used. Technical reading material usually requires full concentration and study if the technician expects to get the most benefit from it. If he uses this material objectively, his gain in skill and overall knowledge of his field will be worth many times the effort he puts into it. ▲

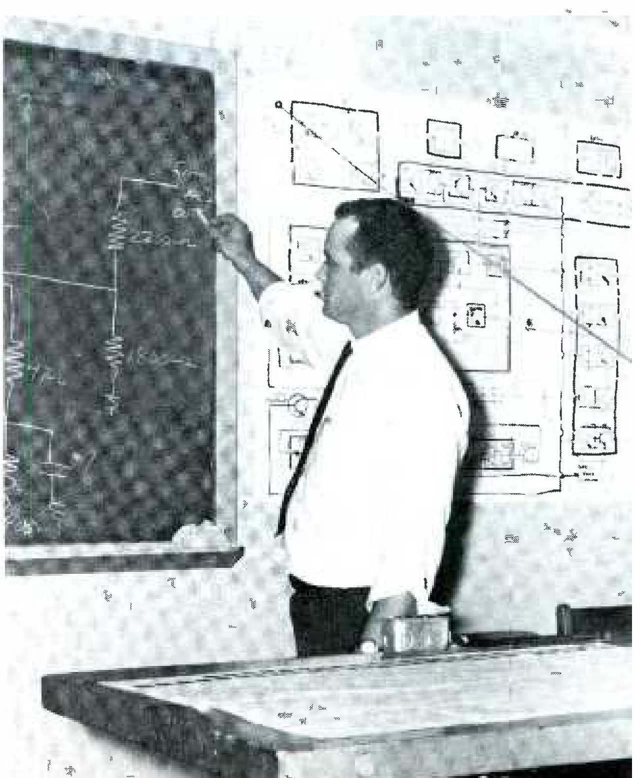
From GI to TV Technician

by Joe A. Groves,
Howard W. Sams member of EIA
Service Committee

Only nine short months ago the Electronic Industries Association Service Technician Development Program (STDP) was presented with an exciting opportunity by the Department of Defense. *Would EIA like to develop a program to teach television servicing to GIs returning to civilian life?* Sure! Here was an ample supply of manpower eager for training in civilian skills. (How many want ads have you seen for a missle technician?) The prime objection of EIA's STDP program would be "To attract, prepare and place young men in careers as service technicians for the purpose of providing reliable service in the consumer electronics industry."

The ground rules were simple: The military would provide the facilities, the manpower and the screening process. Industry would provide the course, the sets, test equipment, tools, parts and the personnel to conduct the training. It would be an 18-week program, 4 hours per day (3 hours duty time, 1 hour free time to be sure of getting interested men and not goldbricks), 5 days per week—90-day wonders with 360 hours of instruction.

Implementing the program was a monumental task; however, results were amazing. The following pictures with related captions were taken during a visit to the class when it had only two weeks to go at the Naval Training Center, Great Lakes, Illinois.



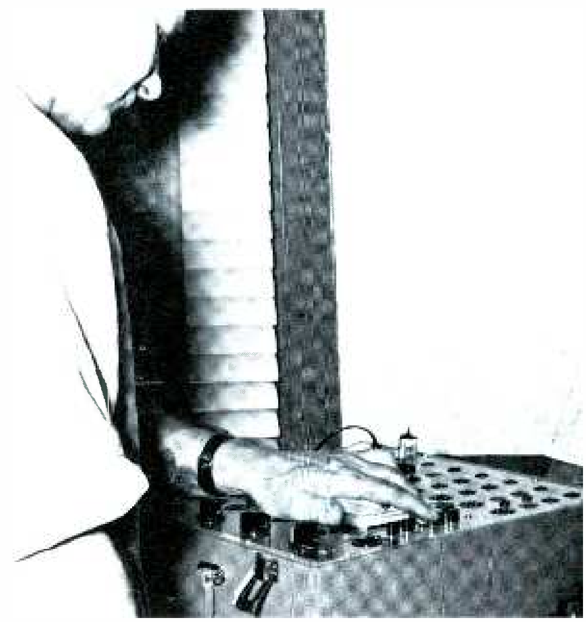
1. R. W. (Dick) Tinnell, STDP Director of Education and Training, developed special course based on concept of "learn by doing with minimum lecture."

2. Start of each session presented ½ hour of practical servicing techniques: Session 1/no-raster, no-video, no-sound. Session 30/tracing circuits in TV chassis. Session 60/defects in transistor video IF stages, etc. Closing ½ hour recaped basic electronics.

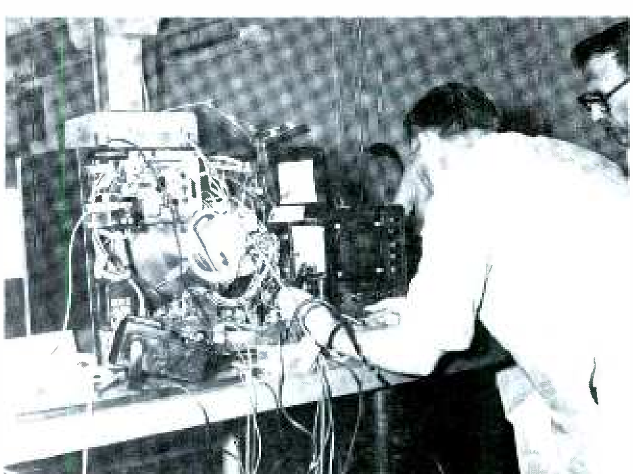
3. Labs started with written diagnosis of every set by every man. Noted items were audio, video, raster and final diagnosis of trouble before making any test instrument check.

4. During visit the men were diagnosing trouble in tubed, hybrid, and all-transistor b-w and color TV sets.

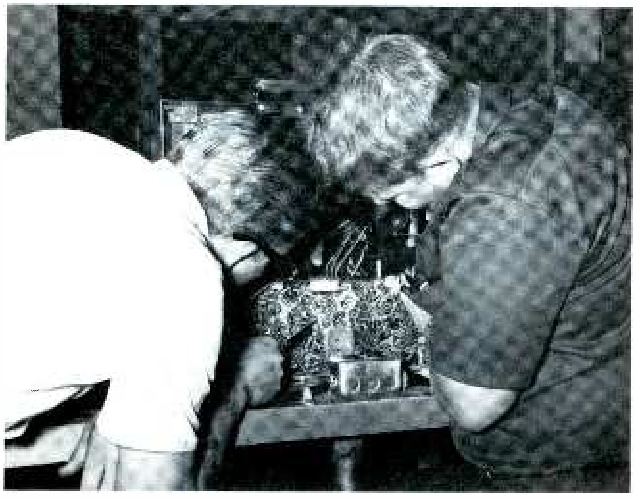
5. After diagnosis came troubleshooting. Thinking process for localizing trouble was apparent as the men studied schematics.



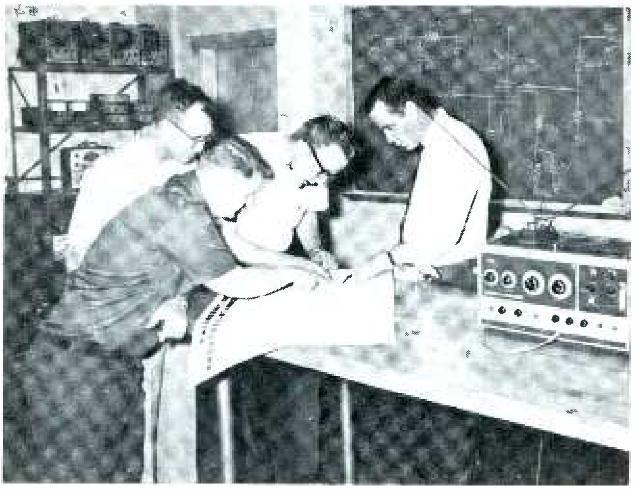
6. The lesson had been learned to test tubes first, or in case of transistors to check for change in collector volts while intermittently shorting base to emitter.



7. When troubles got tougher there was no hesitation in using a color-bar generator and scope to isolate the defect.



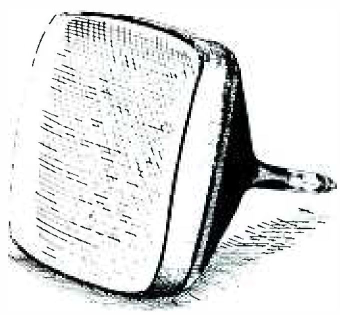
8. Successful troubleshooting resulted in repair of defect, check of sets performance on all channels, and convergence of color sets if needed.



9. Result of good student-to-instructor ratio was individual attention to resolving problems and better explanation of how circuits functioned.

10. Toughest sets for the men to troubleshoot were the miniature solid-state portables—one advantage of total program is exposure to newest sets, test equipment, and streamlined troubleshooting techniques.

11. When all sets were restored to normal operation the men took a break, equipment was bugged again, and process started all over. With pilot program of Project Transition completed, it now spreads to Fort Benjamin Harrison, Indiana and Long Beach Naval Station, California. ▲



Every time a customer buys a color TV set, some manufacturer puts his reputation on the line. He stands back of every component, device and part in that set. And that includes the color picture tube.

RCA plays a big role in building this TV industry confidence. When an RCA color picture tube goes into a color set—regardless of brand—RCA puts its own reputation on the line. Why can RCA do this?

RCA has been building quality color picture tubes in mass production since 1956. That's experience!

RCA makes a greater variety of color picture tubes than any other producer. That's versatility!

RCA has developed more innovations in color picture tubes than any other manufacturer. That's know-how!

RCA has designed color picture tubes as an integral part of a complete, modern television system; in fact without RCA there would be no color television as we know it today. That's technology!

RCA makes color picture tubes that can't be beat for vivid pictures, natural color and reliability. That's performance!

RCA has supplied more color picture tubes than the rest of the tube manufacturers combined. That's acceptance!

Why has the TV set industry used more RCA color picture tubes than all other makes combined?

RCA

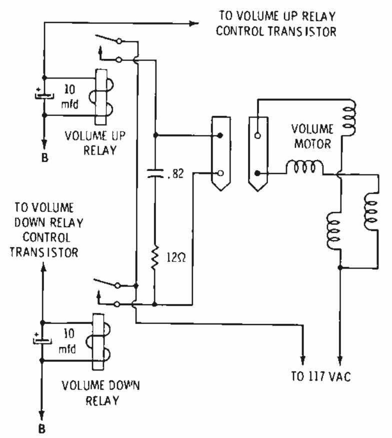


Fig. 2. Reversible AC motor employed to turn the potentiometers.

Fig. 3 shows the circuit of the Admiral S376AN "Sonar" transmitter (Sams PHOTOFACT Folder 942-1A). This is an 8-function type with each function labelled. The basic circuit is a feedback oscillator which operates at 35 kHz. The output frequency is determined by the tuning of the oscillator transformer primary. This is adjusted by A9, the iron core. Notice that this one tunes by adding capacitance across the secondary of the transformer. Most seem to do this.

The oscillator is always tuned to the highest operating frequency. Then, when a given switch button is pushed a small capacitor is added across the circuit bringing the operating frequency lower, to the one desired. In this one these are small fixed capacitors with trimmers across each one. In others they are fixed capacitors with a very close tolerance, generally 1%. The actual frequency separation between channels is from 1.0 to 1.5-kHz.

The Transducer

An innovation used as a transducer or speaker in the transmitter is a very small capacitor microphone with plates made of metallized Mylar. They are set very close for good high-frequency response. Capacitor mikes need a high polarizing voltage for good action. The secondaries of the oscillator transformers are of very high resistance. This means they have a very high voltage step-up ratio in addition to being resonant.

Most will develop voltages up to 600 volts p-p or more. This gives the transducer plates a high voltage to work with. When this high AC voltage is applied to the plates they are alternately attracted and repelled, generating a soundwave.

Magnavox uses a novel idea in their 70404-1 series transmitters. The capacitor microphone is used as a frequency doubler. The signal applied to it is a sinewave. The plates are alternately attracted and repelled on each voltage peak. For example, they are pulled together on the positive half-cycle peak, creating a rarefaction. Then when the signal voltage goes back to zero at the end of this half-cycle the plates will go back to their rest position. This creates a compression. On the negative half-cycle peak, they are again pulled toward each other, creating a rarefaction, then back to zero creating a compression. So for each full cycle of signal there are two full cycles of output signal, as shown in Fig. 4.

The transmitter oscillator operates at one-half the output signal frequency. Thus, for a 40 kHz output the oscillator is working at 20.0 kHz. Other types use the oscillator frequency as the output frequency.

The Remote Receivers

There is a great amount of similarity between the transmitters and the receivers. They use the same basic stages with only minor variations between types. This simplifies things for the service technician.

The input will be a high-gain preamplifier using three or even four transistors. In late model RCA sets this is an integrated circuit. This preamp will feed a tuned coil in the output. This gives the output signal a bandpass response covering only the range of U/S frequencies used. It is designed to have the maximum skirt-selectivity, or the steepest sides, to exclude other signals. In some, this coil will be fixed tuned; in others, an adjustable iron core is used to allow alignment of the circuit to the band-center which is around 41 kHz. Fig. 5 shows the preamplifier stage of the RCA CTP-11A receiver, a 4 stage unit. Fig. 6 shows the same circuit with the IC.

The frequency selection is done in the following stages. Fig. 7 shows

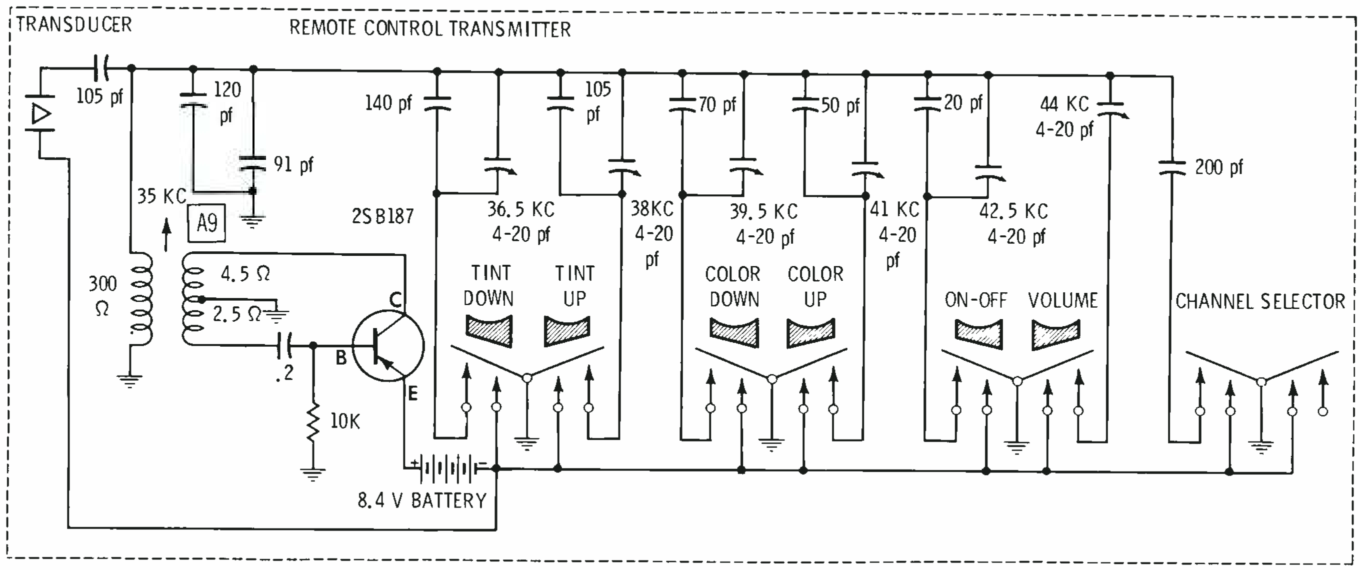


Fig. 3. Transmitter has eight output frequencies.

the relay control stages of the CTP-11D which is basically the same as all others. Each function has it own sharply tuned transformer, relay control transistor and relay.

In this circuit the transformers are tapped coils with one end grounded and the signal fed through 680-pf blocking capacitors. In others, such as the Admiral S376-AN (Sams PHOTOFACT Folder 942-1A), all the transformer primaries are in series with taps. The driver transistor's collector voltage is fed through this circuit. However, the basic function is exactly the same.

When a control signal is received, e.g., for the "Color-Up" function, it is amplified in the preamp and fed into the bandpass amplifier or driver. From this output it goes to the paralleled string of transformers. The color-up signal in this unit is 44.75 kHz. When the signal goes to the string of transformers only the one which is resonant at that frequency will develop any great amount of signal voltage. This appears on the base of the relay control transistor as an AC signal. It is rectified by the base and appears in the collector circuit as a series of pulses. This is smoothed by the electrolytic capacitor connected across the relay coil and develops enough collector current to energize the relay. The relay will start the color control motor running in a clockwise direction raising the color level of the picture. The motor will run as long as the transmitter button is held down or until it reaches the end of travel of the control. Some have slip clutches, others depend on the comparatively low torque of the motor. It can stall for quite a while without damage.

Power Supplies For Receivers

Transmitters are battery powered, but the receivers can be AC powered since they are in the TV cabinet. A

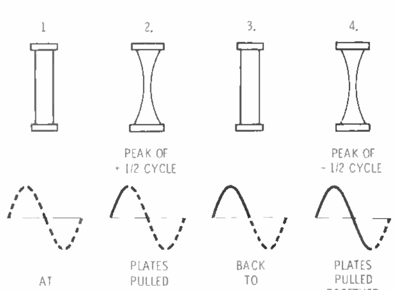


Fig. 4. Plates react on each half-cycle, creating a frequency doubler.

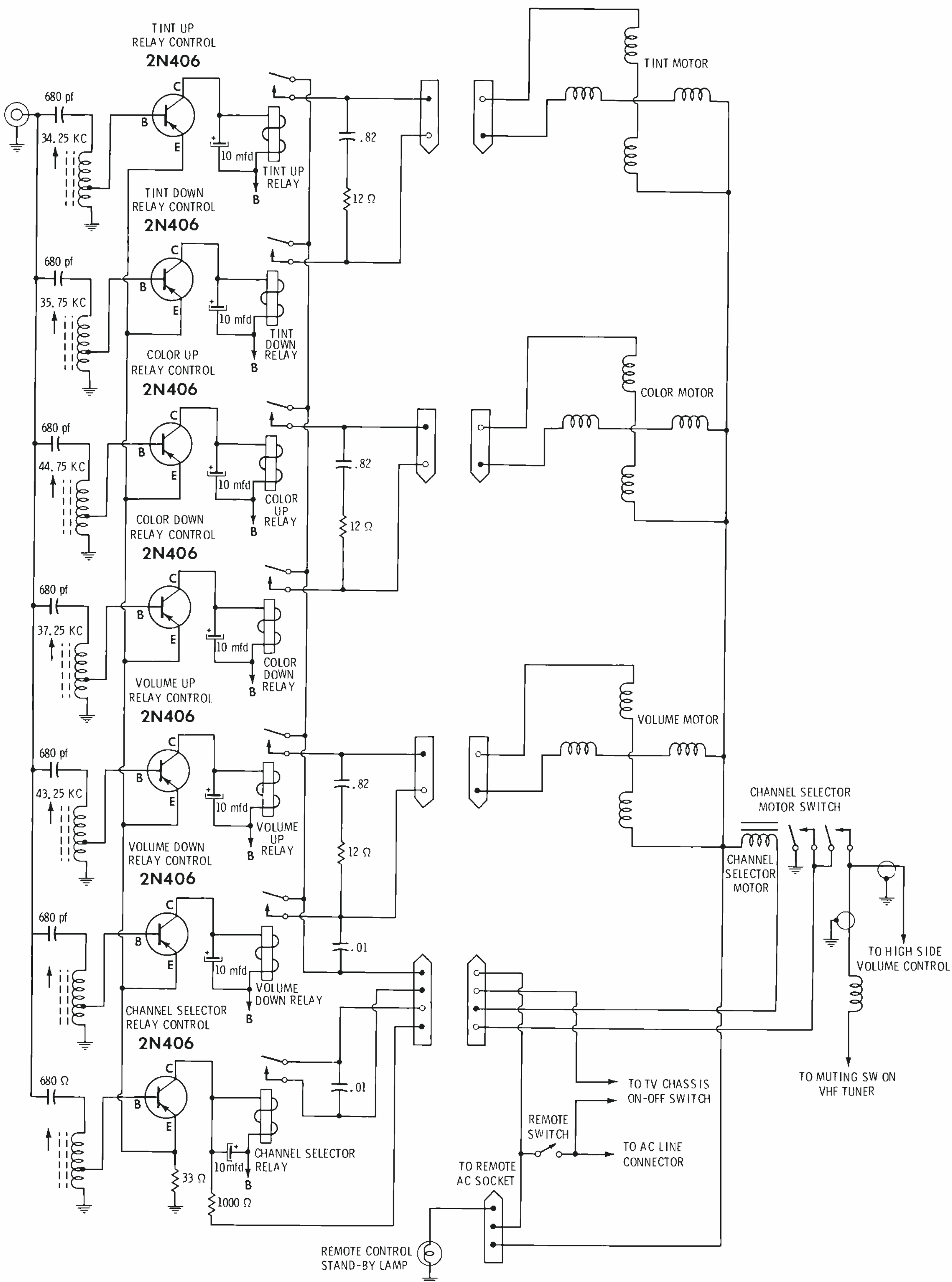


Fig. 7. Sharply tuned transformers select frequency for each function.

the set without the remote or operating the remote receiver on the bench.

Alignment

Like TV sets, these remote control units seldom really need alignment; that is, from circuits actually drifting out of tune. Most of this is screwdriver drift. If a bad capacitor is found in a transmitter do not substitute a capacitor near the right value. These units are special 1% tolerance types and are critical.

By zero beating the audio signal generator against the receiver's own transmitter, any receiver can be realigned or checked. Be sure that the power supply of the receiver, and the transmitter battery, are normal.

The audio signal generator need not go above 20 kHz. Just tune to half the operating frequency and use the second harmonic. Practically all remote receivers will work satisfactorily on this frequency.

If alignment is needed, start with the highest frequency and work downward. Find out what function this frequency controls; then connect the scope, or a VTVM, across the relay which handles that duty. Feed the signal in and tune the transformer for maximum response, either pattern height on the scope or DC voltage on the VTVM. Like IF circuits in radio, a good transformer will show a definite peak. If there is a flat one, no response to tuning adjustments, something is wrong. Signal trace back through the circuit to find where the signal stops.

If only one function of the remote is working, the preamp, bandpass stage and driver transistor, etc., must be all right as these are common to all circuits. Go to the transformer(s) associated with the ones that are not working and check for the presence of input signal on relay control transistors, DC voltages and so on. The transistors can be checked in-circuit for beta with any one of the transistor testers now on the market.

Generally only one unit will be bad, transmitter or receiver, so one can be used as a standard. The transmitter is actually the easiest as an instrument can always be connected across the relay control transistor in the receiver and used to

Circle 24 on literature card

Circle 23 on literature card

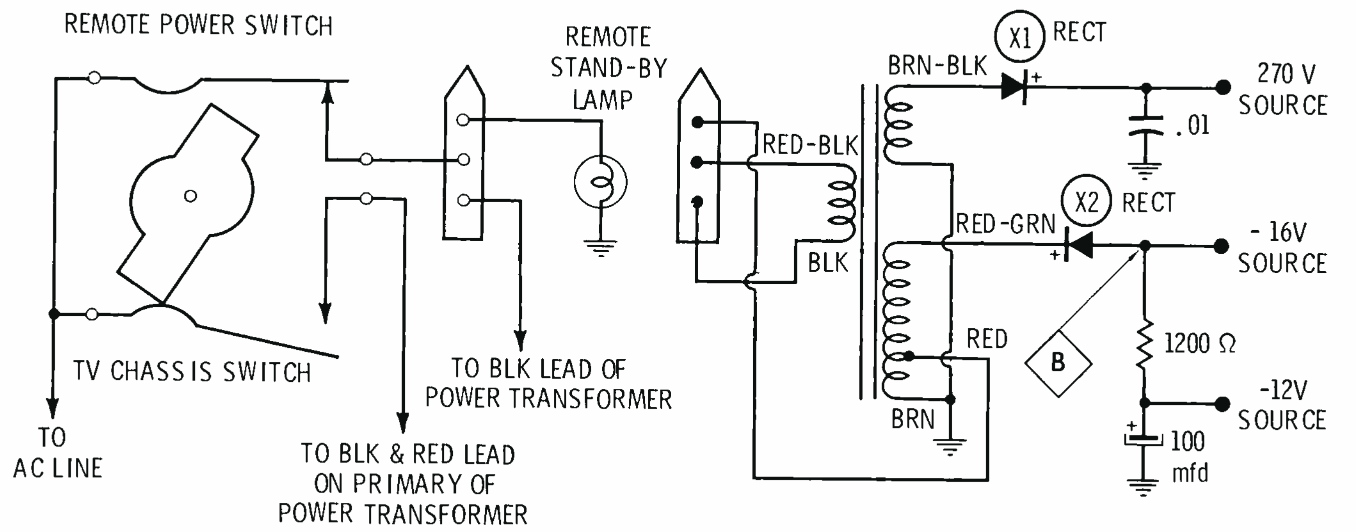


Fig. 8. Power supply provides low voltage for transistors and high voltage for transducer.

detect the transmitter signal, peaking the transmitter by tuning for maximum at that point.

Power Supply Troubles

Power supply troubles will be fairly simple. Look for the universal symptom of nothing working. If this happens, be sure to check the primary AC voltage on the power transformer. It may be going through a plug cable system that is still open somewhere.

Be sure the transmitter battery is not defective. Check the voltage with the transmitter in operation and under full load. Most remote transmitters use mercury batteries which retain their rated voltage level until practically exhausted, then there is a sharp decline in power.

Current measurements will be helpful. Average drain on the one transistor transmitters will be between 30 and 40 ma. Current is drawn only when the transmitter is actually on so battery life should be about one year or more.

Hints And Kinks

Despite every effort to diagnose trouble in remote control units, there may still be one that won't work. Let me point out a few experiences

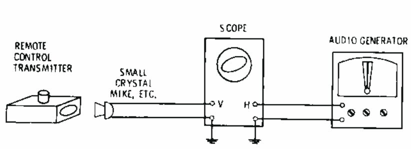


Fig. 9. Single loop on the oscilloscope screen indicates matching frequencies.

that have disclosed the cause of some of these mysterious malfunctions.

First, when working on the receiver, make certain that the shielding cover of the preamplifier is in place or there can be some weird results should the preamplifier go into oscillation. For instance, there are cases of controls going on and off by themselves, of relays chattering and others.

Many receivers work on frequencies which are multiples of the TV horizontal-sweep so a stray signal can be picked up and cause some odd reactions. Some time back I had a remote control b-w TV chassis sitting upside down on the bench. The trouble was in the horizontal oscillator which was off frequency. As I twisted the frequency core in the oscillator coil the chassis suddenly started walking away leaving me astounded. I recovered barely in time to keep it from walking off the bench. The horizontal oscillator had hit a frequency which started the tuning drive motor to run and the chassis happened to be resting on the drive gear.

If there is relay trouble, be careful. *Do not bend contact springs too far.* If a contact is dirty, run a piece of stiff paper between the points. A strip of paper cut from the edge of a postcard is fine. If a contact is badly pitted, smooth it off with crocus cloth, a very fine abrasive, and finish with the paper.

If a dual control binds, check to make sure the rotor is not stuck in the run position so gears and all are turning with the knob. This can be due to an accumulation of dust and lint inside the motor. Blow it out and then check the lubrication. *Do not use an excess of oil* as it will cause the control to accumulate dust and stick again.

If a bell transmitter will not work on one function only, check the rod mounting and the damper. These rods must not touch anything except the normal mounting. If they do, this will change the frequency. If the transmitter has been dropped the rods may be cracked. Be sure of getting the correct rod for replacement by giving all stock numbers and part numbers as well as function to the parts supplier.

Many receivers have sensitivity controls. If there is trouble with false triggering from jingling keys, or random noises, set the control to minimum sensitivity while still getting positive triggering from the transmitter at normal range. In one case of remote trouble a TV set was mysteriously shutting itself off at odd intervals. The technician finally discovered that this happened only when the family dog walked by the set. The license tag on his collar jingled at the exact frequency for that function. Damping the license with a piece of tape stopped the trouble.

In mysterious cases of relay trouble, such as lockup, where a certain relay will close on signal but refuse to open again when the control button is released, check the transistors. A high collector base leakage (Icbo) will upset the bias and cause transistor lockup because the base loses control after it is energized.

Happily, most of the troubles found will be simple ones caused by common defects with which you will eventually become familiar. ▲

PHOTOFACT BULLETIN

PHOTOFACT BULLETIN lists new PHOTOFACT coverage issued during the last month for new TV chassis. This is another way PF REPORTER brings you the very latest facts you need to keep fully informed between regular issues of PHOTOFACT Index Supplements issued in March, June, and September.

Arvin	Chassis 1.25601	970-1
Bradford	BATV-60509/525A/533A/541A/558A	970-2
	CWGE-55384A	967-1
Hitachi	TWA-1800	966-1
Hoffman	Chassis 913-000617, 913-195547	966-2
Packard Bell	CR-424BGE	971-1
	MR-323BGE, MR-325WAL/MOD, MR-523BGE/-525WAL, MSM-202A/ -204A	969-1
Panasonic	TR-238B, TR-903RA	966-3
Philco-Ford	Chassis 18J32	968-1
	Chassis 18JT41, 18LT43	967-2
	Chassis 18L33	971-2
Sears	Chassis 564.80040	968-2
Sony	TV-900U	970-3
Westinghouse	Chassis V-2656-1/ -2	969-2
Zenith	Chassis 20Z1C37	968-3

Production Change Bulletin

General Electric	Chassis DC (Later Version)	969-3
Magnavox	Chassis 48-01-11/ -12/ -22, 48-02-12/ -22	966-4
Motorola	Chassis CTS-/NCTS-/18TS-597	970-4
RCA Victor	BJ262WK, CJ345W. CJ453WK, CJ461LK (Ch. KCS163M/P)	968-4
	Chassis KCS159N/P	966-4
	Chassis KCS160J. KCS160M	967-3
	Chassis KCS164F/K	971-3
Sylvania	Chassis B06-4/ -5	966-4
	Chassis D05-5, D05-10	967-3

analysis of test instruments . . . operation . . . applications

NOTES ON TEST EQUIPMENT

by T. T. JONES

10 MHz Ocilloscope

The instrument shown in Fig. 1 is the Model S54, the first release from the Telequipment line marketed by Tektronix. The Telequipment is designed and manufactured in England, and is intended to fill the gap between service-type instruments and the higher priced scopes such as Tektronix, HP, Analab, etc.

The S54 has a bandwidth of DC to 10 MHz (3dB down), which is wide enough for most commercial equipment servicing. The basic deflection factor is 100 mV/cm, DC coupled, but can be increased to 10 mV/cm, AC coupled, with the bandwidth reduced to 4 MHz.

Among the many other features, the Model S54 has triggered sweep and calibrated time base. The sweep rates extend from 2 seconds per centimeter all the way down to 200 nanoseconds per centimeter, and with uncalibrated horizontal expansion the sweep rate may be as fast as 40 nanoseconds per centimeter —very fast indeed. At that speed, one cycle of a 10-MHz waveform would cover nearly half the screen.

Fig. 2 shows a single bar of a keyed-rainbow signal. The burst is 9 cycles of a 3.56-MHz wave, and covers approximately 6 centimeters of screen. As shown, it is not particularly spectacular, but it must be remembered that the bar represents 1/12 of a horizontal scan line. Translated, the trace shown is 24 times as fast as the normal sweep used in TV servicing, is rock-solid, and is much slower than the scope's capabilities. Actually, the trace could have been expanded so that a single cycle covered the screen.

Fast writing speeds are not the the only impressive feature of the S54. The instrument also performs well at slow speeds, such as TV frame frequency. Fig. 3 shows a scope trace at about 1½ times frame frequency. Again, the trace is rock-solid.

Stopping a video trace at vertical frequency is especially difficult on a service scope. The S54 accomplishes this by use of a unique trigger circuit, shown in Fig. 4.

Fig. 1. New scope shown here has good trigger.[1]

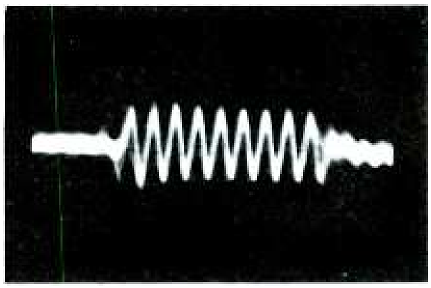


Fig. 2. Single bar of keyed rainbow.

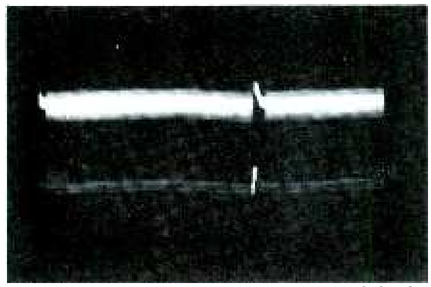


Fig. 3. Trace shows good vertical lock.

With the trigger selector buttons S1A and S1B in the "Normal" position, Q3 and Q4 operate as a Schmitt trigger, with coupling through R31 and C11. The Trigger Sensitivity control adjusts the degree of backlash. The fixed-amplitude, square-wave output from the collector of Q4 is differentiated by C13 and R37, and the resulting bidirectional pulses are applied to X1. The diode clips the negative portion of the output, so that only positive-going pulses are applied to the time-base generator.

So far, we have a more or less conventional Schmitt trigger, such as those used in any number of triggered-sweep scopes. But now comes the unique part, which enables the S54 to so effectively stop a video frame or line.

Depressing the switch button S1B, the TV Line switch, converts Q3 to a sync separator. R27 is switched out of the emitter circuit, and C9 is switched in to bypass the emitter resistor (now R28). Q4 is changed to an inverter stage by the addition of decoupling capacitor C14 across R33. Switching to the TV Frame position makes no change in the Q3 circuit, but R36 is added to the output differentiator, greatly increasing the time constant.

We found in operation, that even with the TV Frame and Line sync buttons, it took some practice to be able to stop a video wave at vertical frequency. The settings of the time-base generator and the Stability control were somewhat critical. However, once the technique was learned, the waveform would jump into place—and stay there.

The trigger circuitry also includes two transistors preceding those shown in Fig. 4. The other two transistors function as a sync amplifier in the triggered and TV modes, and as a free-running oscillator in the auto mode. There are also the usual level controls, polarity switch, etc.

As can be seen in Fig. 4, the Model S54 has made use of solid-state components wherever possible. There are, however, three 13CW4 tubes in the overall circuitry. Two of these are used as input amplifiers in the vertical stages; the other is the input amplifier for the external horizontal input. The design engineers have done all they can to make the Nuvistors look like transistors; the heater voltage is DC, shunt-regulated by a zener-controlled transistor. They should provide long, trouble-free operation, since Nuvistors are basically quite stable, and the heater voltage is controlled. The heater circuit provides initial surge protection.

The Model S54 has all the usual added features, plus one or two which are not so common. Among the latter is a "Probe Test" jack on the front panel. This provides a fast-rising pulse which may be used to adjust a low-capacitance probe to the scope attenuator. Also on the front panel is a 0.5-volt p-p calibration jack. The signal at this jack is produced by clipping a 60-Hz sine wave with a zener diode.

Another unique (at least to us) feature is the Trace Rotation control. This control is located on the rear panel and rotates the entire trace on the longitudinal axis. The rotation is accomplished by controlling a DC voltage applied to a yoke on the neck of the CRT. Though this control is not absolutely necessary, it is quite helpful in aligning the trace wtih the graticule. An alternate method would be to rotate the entire CRT; but, since the S54 uses a rectangular CRT, there would be considerable difficulty designing a mounting system which would allow the CRT to rotate.

We put the S54 through its paces in actual service work and found it was a real pleasure to use. In normal TV and radio servicing we did not begin to utilize all the features the scope has to offer. We can say, therefore, that it is "overqualified" for the job. However, with all the changes taking place in electronics, these features may be necessary next year.

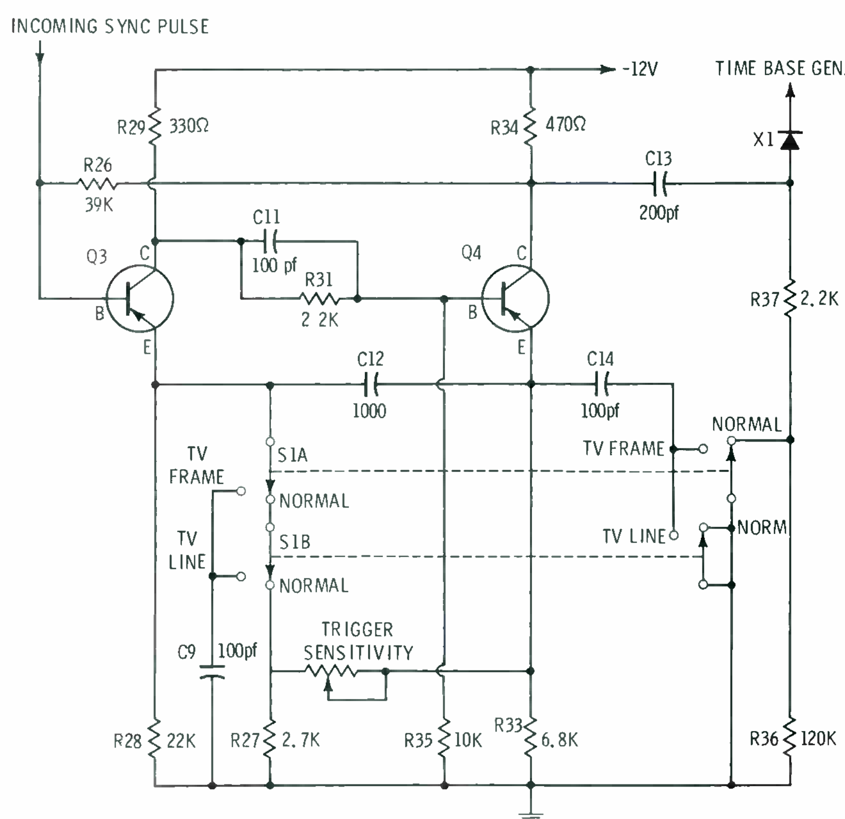


Fig. 4. Partial schematic of trigger stages.

Telequipment Model S54 Specifications

Vertical Amplifier

Bandwidth (3dB down):
DC to 10 MHz at normal gain; DC to 4 MHz at 10× Y gain.

Risetime:
35 ns at normal gain; 90 ns at 10× Y gain.

Deflection factor:
100 mV/cm in a 1-2-5 sequence. Continuously variable between steps. 10× gain switch produces 10 mV/cm maximum sensitivity.

Impedance:
1 megohm shunted by 47 pf.

Accuracy:
±5%

Time Base

Sweep rate:
200 ns/cm to 2 s/cm in a 1-2-5 sequence. Continuously variable to 5 s/cm. Expandable to 40 ns/cm.

Horizontal Amplifier:
DC to 750 kHz, 0.6 V/cm to 3 V/cm, impedance 1 megohm shunted by 30 pf.

Trigger

Automatic:
50 Hz to 1 MHz.

Level:
Any point on the input waveform, 10 Hz to 3 MHz.

HF sync:
Synchronized sweep 1 MHz to 25 MHz.

TV:
Triggers on TV frame or line.

Requirements:
Internal, 2mm deflection; external, 1.5-400 VPP.

Front Panel Connectors

Calibrator:
Line frequency, 0.5 VPP ±2%.

Sawtooth:
1-35 VPP, 30 k ohms load.

Probe Test:
5 VPP.

Size (HWD):
9¼" × 6¾" × 16¼".

Weight:
17 lbs.

Power Requirements:
100-125 V, 200-250 V; 48-440 Hz; 30 watts.

Price:
$350.

Circle 49 on literature card

FET VOM

The voltmeter shown in Fig. 5 is a recent release from Heath, designed to compete with the inexpensive imported VOM's. Though the instrument is probably intended for hobbyists, it is worth taking a look at. We found it to be a very good utility meter. Not good enough for full-time bench service, but a very acceptable second meter.

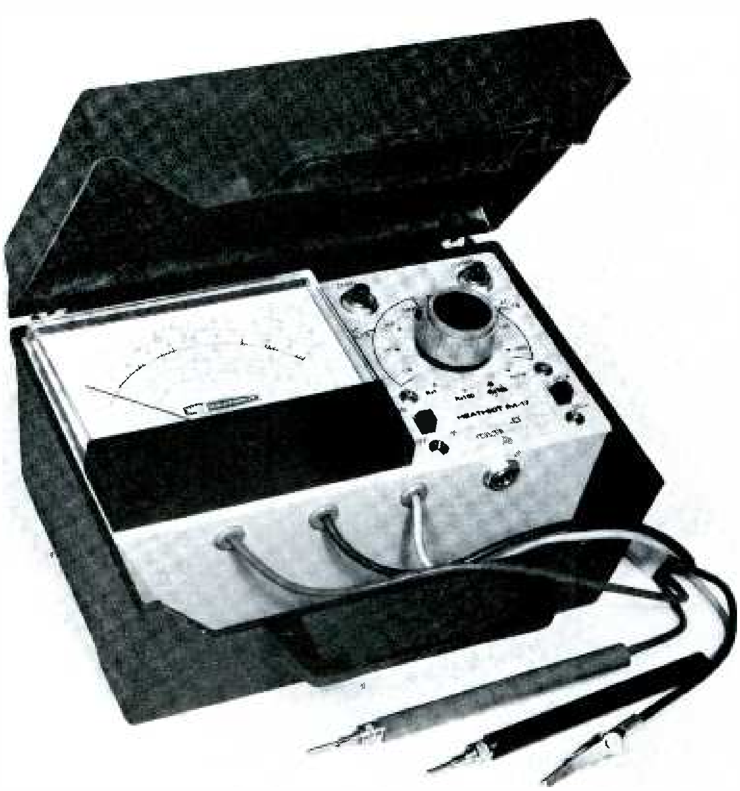


Fig. 5. Heathkit Model IM-17 FET VOM.

The instrument, Model IM-17, has a full 11-megohm input impedance on DC, 1 megohm on AC, pretty good ohm ranges, and it is all solid state, battery powered, and rugged enough to ride in the truck.

The only thing that keeps the Model IM-17 from being a full-fledged bench meter is the wide gap between ranges. For instance, to read line voltage, you have to use the 1000-volt scale. There is no range between 100 volts and 1000 volts. The same is true of the DC and ohms ranges; the range sequence leaves wide gaps. The full story on ranges available is shown in the specifications box.

The IM-17 is a kit, of course, and it went together in a hurry. As soon as it arrived, we unpacked it. It looked interesting, so we decided to try a few assembly steps. The next thing we knew, it was finished. Total assembly time—3 hours.

If you are looking for a second meter for the shop, or a utility meter for occasional use around the house, take a look at the IM-17.

Heath Model IM-17 Specifications

DC Voltmeter

Ranges:
0-1, 10, 100, 1000 V full scale.

Input resistance:
11 megohms.

Accuracy:
±3% full scale.

AC Voltmeter

Ranges:
0-1.2, 10, 100, 1000 V full scale.

Impedance:
1 megohm shunted by 100 pf. (38 pf on 1000 V scale).

Accuracy:
±5% full scale.

Response:
±1 dB 10 Hz- 1 MHz.

Ohmmeter

Ranges:
R × 1, 100, 10K, 1M.

Supply:
1.5 V.

Size (HWD):
4¼" × 8½" × 7¼".

Weight:
2½" lbs.

Price:
$19.95.

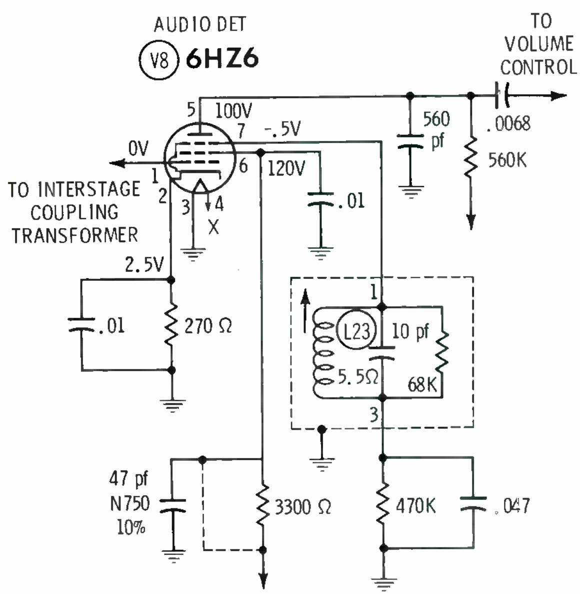
Circle 50 on literature card

ERRATUM

The $18.95 price quoted for Amphenols' Model 865 color-bar generator in the Notes on Test Equipment column in July should have read $189.95 ▲

COLOR COUNTERMEASURES

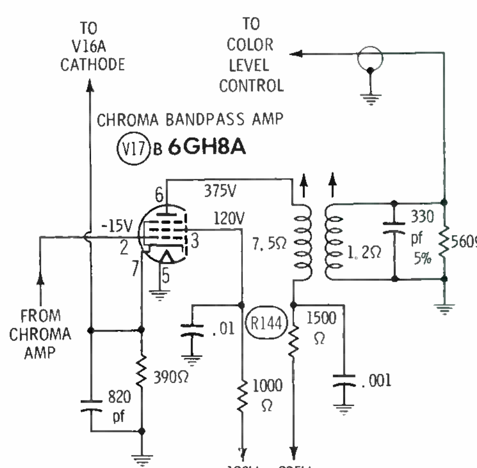
SYMPTOMS AND TIPS FROM ACTUAL SHOP EXPERIENCE



Chassis: RCA CTC17

Symptom: Sound intermittent. Picture not affected.

Tip: Check voltage on pin 7 of V8, audio detector. Possible trouble is defective L32, quadrature coil.



Chassis: RCA CTC19V

Symptoms: Weak Color.

Tip: Plate voltage of chroma bandpass amplifier (V17B) very low. Possible cause is damage to decoupling resistor R144 caused by a shorted tube. Replace R144.

BOOK REVIEW

How To Use Signal Generators: John D. Lenk, John F. Rider Publishing Company, New York, New York, 1967; 120 pages, 9" x 6", soft cover, $3.25.

This book is intended to provide the service technician or student with a better understanding of the variety of applications for which different types of signal generators can be used.

The author has avoided using complicated theory and equations. Illustrations, block diagrams and schematic drawings are used very effectively to illustrate the text. Step-by-step procedures for the testing and calibration of signal generators provide a good reference for experienced technicians.

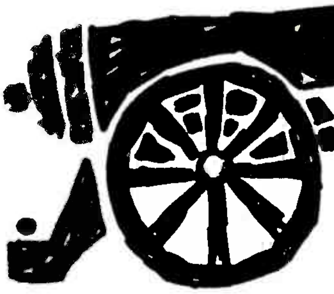
The first two chapters of the text are devoted to the operating principles and functions of the operating controls associated with the five most popular types of signal generators used to service radio, TV, and hi-fi. Also included is a discussion concerning the difference between shop-type and laboratory-type signal generators.

Chapter 3 covers a lot of ground in a very few pages. The author has included in this chapter a step-by-step procedure for the testing and calibration of shop-type signal generators.

The many uses of an RF signal generator or sweep generator for testing an antenna system are explained in chapter 4. This chapter also includes testing procedures such as checking lead-in impedance, checking TVI filters, adjustment of Q bars, and checking the resonant frequency of stubs.

The procedures for using an RF signal generator for alignment and testing of AM radios are provided in chapter 5. The FM stereo generator is covered in chapter 6, along with procedures for using a sweep generator and marker generator to service FM receivers.

Four separate steps using the sweep and marker generator for overall alignment of the television receiver are covered in chapter 7. The uses of a sine-wave or square-wave audio signal generator for servicing the audio section of TV, AM or FM receivers, and hi-fi amplifiers is covered in Chapter 8. ▲



THE TROUBLESHOOTER

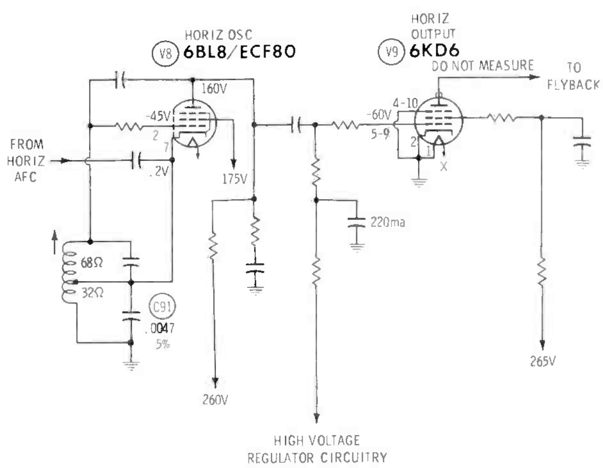
No Pix

The customer complained that she had left the set on while she went shopping, and upon her return, the set had only sound. We pulled the back on the set (a Philco 17MT80, PHOTOFACT Folder 885-2) and found the horizontal-output tube had a hole in the side of the envelope. We replaced the output tube and the horizontal oscillator and fired up the set. The damper plate glowed; so after trying a damper, we pulled the chassis.

On the bench, scope checks showed no horizontal drive. Further checks showed the oscillator was inoperative. We finally pinpointed the trouble to a shorted C91 in the cathode of the horizontal oscillator. It's interesting that the circuit breaker never tripped, even though the horizontal-output tube drew so much power that it melted the glass envelope.

FRANK UNGVARY JR.

Gales Ferry, Conn.



The normal cathode current of the horizontal-output tube is 220 ma. Assuming a 150% overload is sufficient to destroy the tube, this would increase the total current through the circuit breaker from 460 ma. to 570 ma., an increase of less than 30%. Circuit breakers normally are designed to open if the current exceeds 150% of the design value. For further information on the subject, read "The Circuit Breaker is Trying to Tell You Something", PF REPORTER, *February, 1968.*

Intermittent Horizontal

Will you please help me with an intermittent problem? I have come to a dead end. The symptoms are no voltage and normal sound. When the set is first turned on, you may not get a picture. If the picture does come on, it stays on. If it doesn't come on at once, it sometimes comes on after a long delay. The following measurements and conditions were noted during an "off" period:

1. No spark obtained at the cap of the high-voltage rectifier.
2. I removed the cap. but still could not get an arc.
3. The control grid of the horizontal-output tube measured −1.0 volt instead of −30 volts.
4. The voltage on the screen grid of the horizontal-output tube increased from 140 volts to 155 volts.
5. The plate of the 6LT8 increased to 200 volts from 165 volts.
6. The supply voltage measured normal. When the receiver operates normally, all voltages are within tolerance with the exception of the voltage on the grid of the horizontal-output tube. which measures −37 volts instead of −30 volts.

A. M. GATMOST
Independence, Mo.

DC Voltage readings are okay when attempting to isolate a defective component; however, a scope is required in this instance to help isolate the defective stage. You do not mention the drive on the grid of the horizontal-output tube; it should be in the neighborhood of 100 volts p-p. I suggest taking waveform readings, starting at the grid of the horizontal-output stage and working back toward the phase detector. If this particular trouble runs true to form, you will probably probe a check point and shock the circuit into operation. If this happens, you will have to monitor the signal at this point until the symptom returns; however, you will have isolated the trouble to one stage or section.

Drifting Tuner

I have a Symphonic color TV (PHOTOFACT Folder 841-3) that works fine, except the color fades out and you have to reset the fine-tuning control to get it back. You may have to do this several times during a program. I have changed the tubes in the tuner; this seems to help for a short time, but then the same trouble symptom returns again. It acts like a drifting tuner to me. Is there anything you can suggest that will correct this problem?

W. H. MCCAHEN
Mediapolis, Ia.

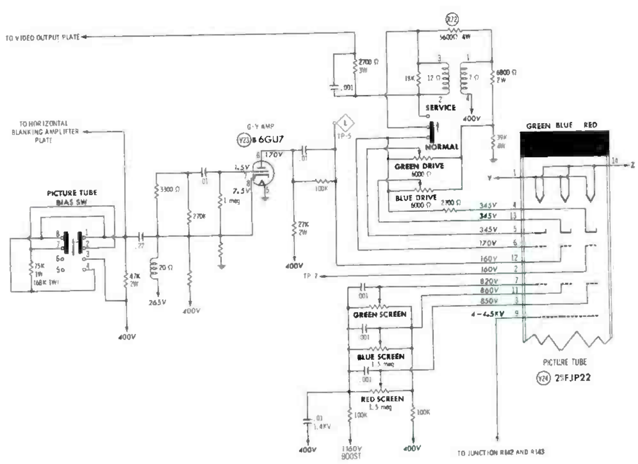
I agree that you have a case of drifting. Check the antenna system for corroded elements; weather-checked, cracked, or bare lead-in; proximity coupling of lead-in to a metal protrusion; etc. Check the May issue of PF REPORTER *for further information on "front end" or antenna problems.*

High Voltage Missing

I would like verification or correction of my diagnosis of a problem I have recently encountered. It concerns a Westinghouse color Chassis V-247323-4. The complaint was loss of picture and raster with an odor that indicated a burning component. The trouble was found to be R72, which was badly charred. There was no apparent reason for it, since all resistance measurements were normal and the video-output tube was not shorted. However, after repair there was no, or very low, high voltage. Following a few minutes warm-up, the high-voltage rectifier plates became cherry red, indicating excessive high-voltage current. Checking and/or substituting the damper, horizontal-output, and high-voltage regulator tubes did not remedy the situation. When the 2nd anode connection was removed from its socket, the high voltage returned to normal. When the 2nd anode was connected and the picture tube socket disconnected, the high voltage again returned to normal. It seems to me there is a breakdown occuring internally within the CRT itself, although there is no audible or visual indications of arcing. Since color television is highly complex and there may be other possible ways that this condition could exist, I would like your opinion on this matter.

JOHN HEINZ, JR.

Cape May Court House, N. J.



Actually, John, a color receiver is a black-and-white receiver with color or chroma circuits added. The same principles apply to a color CRT as applied to a black-and-white CRT; the difference being the addition of two more guns and some physical changes which do add to the possibility that the color CRT will become defective earlier than a b-w CRT. It is a comparatively simple matter to confirm your diagnosis through the use of one of the excellent color CRT checkers available today. However, your difficulty actually appears to be bias. Insufficient bias applied to the picture tube will allow it to conduct excessive current. This excessive conduction will reduce the high-voltage supply since it is a low-current type supply. Check the voltages on the grids and cathodes of the CRT.

Arcing CRT

I have an old Muntz chassis that has trouble I have literally tried for weeks to correct, but to no avail. I hate to give up without first consulting you. The set gives an excellent picture, and the tube is new and checks normal, although I did not install it.

After a very brief warm-up, arcing occurs between the focus magnet and what appears to be the neck of the tube. The picture fades out, of course, when the arcing starts. The waveforms in the vertical and horizontal sections appear normal. Have you any idea what can cause this exasperating trouble? I have read innumerable articles and books, and searched your "speed servicing" for some help, but have never found a word about it.

H. GUSTAFSON

Marinette, Wis.

You would experience difficulty in finding much literature about this trouble, it is man-made. Two things could be causing this:

1. *The man who replaced the CRT could have left out the insulating (fish) paper that was used around the neck of the tube, between the tube and the yoke.*
2. *The replacement CRT has excessive gas or foreign matter causing arc-over and should be replaced.*

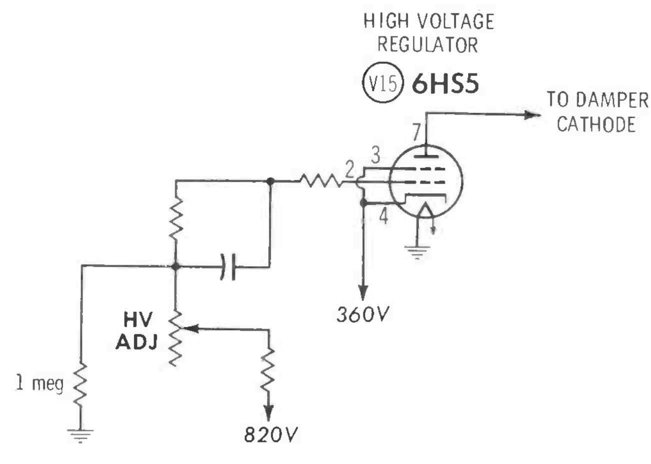
Zenith Tips

Here are two tips on troubles we have found in Zenith Chassis 23XC36:

1. Symptoms include a decrease from the prescribed level of high voltage, with very little change effected by rotating the high-voltage adjust control through its range. High voltage and high-voltage control action returned to normal after replacement of the 1-meg resistor on the high side of the high-voltage adjust control. This resistor tends to increase in value.
2. Symptoms include "streaks" in raster and "flashing lines" in picture. Boost voltage (1200 volts) starts to decrease, picture dims, etc. This trouble requires abnormal settings of red, blue, and green screen controls to compensate for lowered boost. This situation was remedied by replacement of the boost rectifier diode—internal arcing within the rectifier caused the breakdown.

LARRY BOWERS

Opa-locka, Fla.



Thanks Larry, you might save a fellow technician the amount of bench time it took you to troubleshoot the trouble symptoms you have described. The exchanging of such tips and ideas will help everyone save service time and, thus, will increase profits.

66-Meg Troubles

I had an RCA CTC16 (PHOTOFACT Folder 736-4) which had intermittent flashes of light green on the right side of the screen. This would sometimes clear up within a few minutes after turning on the set; other times it would last for hours. The trouble was finally traced to R143, the 66-megohm focus load.

This resistor may be replaced without pulling the chassis. Merely remove the color and tint control knobs, remove the chassis bolts, and slide the chassis back about 4". This procedure requires you to lay on the floor in an awkward position to replace the part, but it sure beats pulling the chassis. Especially if the set has remote control.

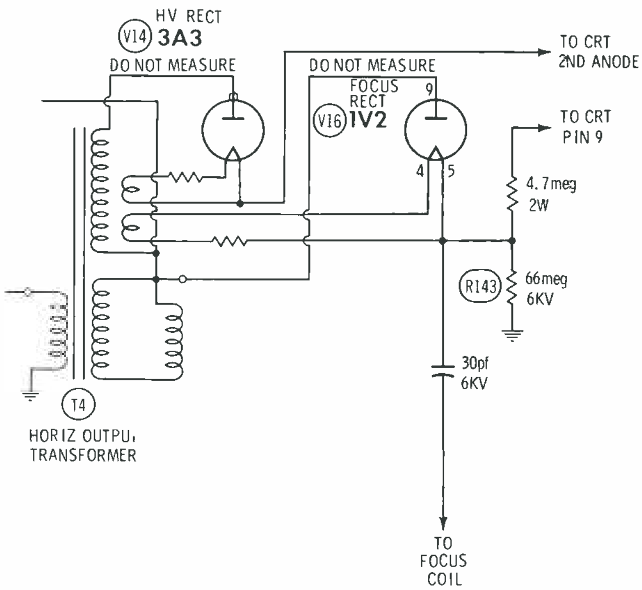
BERNARD SEROTA

Philadelphia, Pa.

I have a Heath GR-180 (PHOTOFACT Folder 882) which worked very well for a year. But finally the set had trouble. It would jump in and out of focus. Close inspection showed that the scan lines would completely disappear. After a lot of fruitless effort, I detected a slight blue glow at the top of the 66-megohm focus load. Replacing this resistor cured the trouble.

WILLARD GOOD

Toledo, Ohio



We have also experienced streaking flashes in the picture, similar to high-voltage arc, and traced it to the focus load. Evidently this resistor can cause a multitude of symptoms, depending on the type of resistor defect, and the particular chassis involved.

Unusual Color Troubles

I have encountered a most unusual fault in several Westinghouse V2655 chassis (PHOTOFACT Folder 920-2). The symptoms are momentary loss of color sync when changing channels, and the killer control affects the tint.

When troubleshooting, we discovered that the output ofthe 3.58-MHz oscillator was greater than usual. Just bringing our hands near the oscillator transformer caused the DC level to change. (The base line of the scope trace moved.)

The trouble was caused by the shield surrounding the oscillator transformer. This shield is a piece of metal formed into a square and spot welded. The welds were broken. Soldering the broken welds top and bottom cured the trouble.

LEONARD HUGHES

Brantford, Ontario

Thanks to you, Mr. Hughes, for sharing this tip with our readers. With the shield broken in the described manner, the capacity and the "Q" of the tuned circuit is greatly changed; thus, the varying of the chroma sync level and frequency ▲

Circle 37 on literature card

Got A TS Tip?

If you've recently run across an unusual trouble symptom and have determined what caused it, why not pass the info on to the other readers of PF REPORTER. You'll not only be saving other service technicians valuable troubleshooting time, you'll also be making a little extra change yourself. Send a thorough description of the trouble symptom and the solution along with a brief discussion of your troubleshooting technique to:

Troubleshooting Tip
PF REPORTER
1014 Wyandotte Street
Kansas City, Missouri 64105

may be grounded. The single unit measures 3½" high by 7½" wide by 8" deep. Price is $55.95. The dual unit measures 3½" high by 15" wide by 8" deep. Price is $111.95.

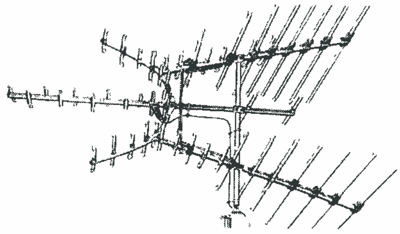
Screwdriver Set
(84)

A set of miniature screwdrivers for the professional serviceman or work-bench enthusiast has been introduced by **Moody Machine Products Co., Inc.** The set consists of six heat-treated screw drivers. Each blade is interchangeable, providing twelve blades ranging from .025" to .100". The screw driver chuck is grooved for blade size identification by touch.

A clear plastic case is included to provide storage when the screwdrivers are not in use. Price of the set is $7.50.

82-Channel Antenna
(85)

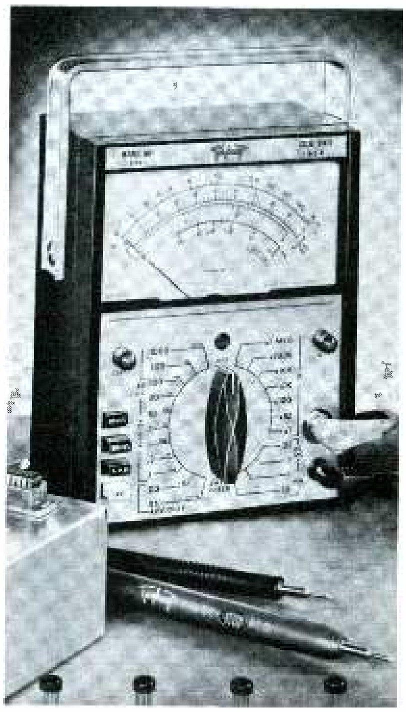
The new antenna shown here features vertical beam phasing on all VHF channels to eliminate signal pickup from above and below the antenna. This feature is intended to reduce interference from such common sources as airplanes and help eliminate ghosts. The **Winegard** antenna also features a UHF screen to



effectively concentrate the signal on the collector element to improve the signal capture area. The UHF reflectors work together to form a magnetic screen with all current fields in phase to produce parabolic reflector efficiency. Another notable feature is the built-in cartridge housing for cartridge amplifiers, which keeps cownlead connections weather-proof. The Model SC-1000 is gold anodized and carries a two-year replacement warranty. Price is $100.00.

VOM
(86)

The new battery operated VOM shown here is introduced by **Triplett**. The new unit employs field-effect transistor (FET) circuitry to provide the instrument with a 11-megohm input impedance on all AC and DC voltage and current ranges. The push-button function switches provide the unit with 52 range selections.



The portable unit has an accuracy of ±2% of full scale on DC and ±3% for AC, with a frequency response on the AC from 50 Hz to 50 kHz. Another interesting feature is the low-power ohms measurement circuit for integrated circuit (IC) applications.

The Model 601 measures 3 3/16" × 5⅛" × 6½" and weighs only 2½ lbs. Price is $125.00.

IC Kit
(87

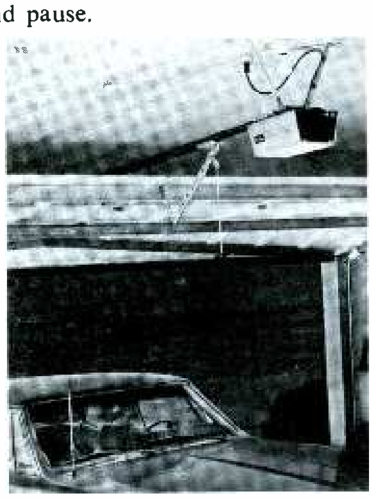
This experimenter kit, introduced by **Motorola** through their HEP program, contains five popular RTL integrated-circuits (IC's). All units are

applicable to many existing and new digital and linear applications. The devices in the kit include two dual 2-input gates, one J-K flip-flop, a dual buffer, and a 4-input gate.

The booklet included with the kit provides a schematic and parts list for eight projects: An ultra high-gain amplifier, sine to square-wave converter, RF signal injector, 4-input mixer, frequency standard, electronic siren, precision tachometer, and an audio signal generator. Uses and features of the circuits included with each schematic provide the user with a good understanding of how IC's can be used in consumer products. The booklet also contains information about the basic IC and how it differs from other solid-state devices, as well as presenting some good service tips. Price of the HEK-1 kit is $3.95.

Garage Door Opener
(88)

The receiver of this new garage door opener is coded to discriminate against any signal disturbance except its own triple combination of signal and pause.



The **Perma-Power** unit is a gear-driven, chain-drive unit with no belts or pulleys exposed. Other features included are: solid-state clutch, computer-logic motor control, automatic garage light control, and instant-stop control.

The Model "Liftmaster 600" is suitable for single- or double-sectioned garage doors. Price is $50.00.

Screwdriver
(89)

This 3-way ratchett screwdriver is reported to have features designed to reduce hand fatigue and speed up the insertion of any screw. Fingertip control provides forward, reverse, and regular combination drives. The blade is made of chrome vandium steel with a nickel chrome finish. Two models of the **Vaco** screwdriver are available: Model 111001 has a ¼"

FREE Catalog and Literature Service

**Check "Index to Advertisers" for additional information.*

ANTENNAS

163. *ANTENNACRAFT*—4-color brochures describing Channel Spanner Series Antennas for UHF, VHF, and FM. Custom Channel Spanner and
164. *FINNEY*—4-color brochure with description and technical details on new Finco Color Spectrum frequency-dependent antennas for UHF-VHF-FM, VHF-FM, and UHF. Form 20-413.
165. *GAVIN INSTRUMENTS* — 6-page folder illustrating the complete outdoor antenna line, converters, and accessories with technical data.
166. *JERROLD*—Form DS-AL-1068, a 4-page, 4-color brochure about the new DYNAROTORTM antenna rotor.
167. *JFD*—New 40-page dealer catalog of TV-FM antennas and accessories.
168. *MOSLEY*—Catalogs on CB, amateur radio, and TV FM antennas.*
169. *RMS ELECTRONICS* — Illustrated specification sheet describes eight "Direction-Finder" UHF, VHF, and FM antennas.*
170. *SOUTH RIVER* — Complete data sheet on universal all-position antenna mount.*
171. *WINEGARD*—Fact-finders on "color-tracker" UHF antennas and a solid-state, 4-set booster-coupler.

AUDIO

172. *ALTEC LANSING*—16-page product catalog, complete with technical information and photographs.
173. *BELL P/A* — Brochure about MOD amplifier series.
174. *ELECTRO-VOICE*—Pocket-size guidebooks for microphones, hi-fi loudspeakers, and hi-fi systems.
175. *STANFORD INT'L.*—Microphone catalog number 5168.
176. *SWITCHCRAFT*—New product bulletin 173 describes 2 new audio adapter connectors.

COMMUNICATIONS

177. *E. F. JOHNSON*—Four 12-page booklets about uses of 2-way radio.
178. *MARK PRODUCTS CO.* — Brochure about the "Mark Invader 23" AM CB transceiver.

COMPONENTS

179. *ALCO*—12-page catalog AS-68, describes complete line of products.*
180. *ASTATIC*—New C-68 cartridge catalog, listing complete line of cartridges with expanded cross-reference guide.
181. *BELDEN*—Catalog 876, a 56-page catalog of the complete Belden line.
182. *BUSSMANN*—Small TV fuse leaflet designed to fit pocket or tool kit, shows list prices of fuses most commonly used in TV sets. Ask for BUSS leaflet TVLP.*
183. *CORNELL-DUBILIER* — New 4-page color-lytic list.*
184. *JENSEN* — Brochure 242, "Hi-Fi Speaker system components," containing a graphic presentation of 2-, 3-, and 4-way Hi-Fi Systems.
185. *LITTELFUSE* — Pocket-sized TV circuit-breaker cross-reference, CBCRP, gives the following information at a glance: manufacturer's part number, price, color or b-w designation, and trip ratings.*
186. *MALLORY*—Bulletin 4-82 describes radial-and axial-lead tantalum capacitors.
187. *MERIT* — Giant wall chart WC-68, listing all popular color transformers.
188. *MILLER*—Catalog 167, a 156-page general catalog with complete cross-reference guide.*
189. *POMONA*—New 1968 catalog. A 44-page listing of the complete line with technical information.
190. *QUAM-NICHOLS* — Catalog No. 67 has information on the entire line.*
191. *SARKES TARZIAN*—New catalog 68-DL-5 describing complete line of rectifiers for replacement applications.*
192. *SONOTONE* — New specification sheet, lists 7 new replacement cartridges.
193. *SPRAGUE*—C-618, a new, complete, general-line catalog.
194. *TEXAS CRYSTALS*—12-page catalog of crystals including engineering data, specifications, and prices.
195. *WORKMAN* — New cross-reference for VDR's and thermistors used in color TV.*

SERVICE AIDS

196. *BLONDER-TONGUE* — New publication, "SOLUTION 1," contains information for servicemen about reception problems.
197. *CASTLE TUNER*—Fast overhaul service on all makes and models of television tuners. Shipping instructions, labels, and tags are also included.
198. *ELECTRONIC CHEMICAL* — Catalog sheet of chemical products.
199. *GC*—Catalog FR69, a 304-page listing for all product divisions.
200. *INJECTORALL*—Catalog of chemicals and tools including new printed-circuit kit.*
201. *TECH SPRAY*—Brochure FB11 describing BLUE STUFF for tuners and catalog FB 10 for chemical products.*

SPECIAL EQUIPMENT

202. *ATR* — Literature about DC-AC inverters up to 6000 watts load.
203. *MUELLER*—8-page catalog describing every clip and insulator in the Mueller line.
204. *PERMA-POWER* — Product sheet on Model D-210 AVR voltage regulator for color TV.*
205. *VECTOR* — Literature about new "Micro-Klip" terminal for use on plugboards.

TECHNICAL PUBLICATIONS

206. *CAPITOL RADIO ENGINEERING INSTITUTE* — Illustrated brochure, "How to Prepare for Tomorrow's Jobs in Electronics," for high-school graduates currently employed in electronics.
207. *CLEVELAND INSTITUTE OF ELECTRONICS*—Free illustrated brochure describing electronics slide rule, four-lesson instruction course and grading service.*
208. *RCA INSTITUTES*—New 1968 career book describes home-study programs and course in television (monochrome and color), communications, transistors, and industrial and automation electronics.*
209. *SAMS, HOWARD W.*—Literature describing popular and informative publications on radio and TV servicing, communication, audio, hi-fi and industrial electronics, including special new 1968 catalog of technical books on every phase of electronics.*

TEST EQUIPMENT

210. *B & K*—Brochures about the B & K, Precision Apparatus, and "Cobra" lines.*
211. *HICKOK*—Specification sheets covering Models CR-35 CRT analyzer, 860 Injecto-Tracer, GC-660 color generator, 677 wide-band scope, and 661 NTSC color-bar generator.
212. *LECTROTECH* — Two-color catalog sheet on new Model V6-B color-bar generator gives all specifications and is fully illustrated.*
213. *SECO*—Operating manual for Model HC8 in-circuit current checker.
214. *SIMPSON* — New 28-page panel meter catalog.
215. *TRIPLETT*—Catalog 53-T with complete line of Triplett test equipment.*

TOOLS

216. *ARROW* — Catalog sheet showing three staplegun tackers designed for fastening wires and cables up to ½" diameter.
217. *CHANNELLOCK* — Brochure describing new curved jaw pliers.
218. *SWING-O-LITE* — Catalog sheet on Models BBM-9 and BB-45 bench lamps.
219. *VACO* — Catalog SD-134 describes new products for electronics industry.
220. *XCELITE*—Bulletin N867 describes hollow-shaft nutdrivers which speed locknut/screw adjustments.*

TUBES AND SEMICONDUCTORS

221. *GENERAL ELECTRIC*—Entertainment semiconductor almanac, ETR-4311C, and picture-tube replacement guide, ETR-702K, are offered.
222. *IR*—Flyer sheet about a new universal replacement transistor (type TR-27) for vertical- and horizontal-output applications.
223. *MOTOROLA* — HEP cross-reference guide lists approximately 12,000 semiconductor types.
224. *RCA*—1D1304, a 12-page brochure on RCA's line of all-new HI-LITE color picture tubes for the replacement market. Explains latest technological advances, such as brightness, Perma-Chrome, and unity current ratios.*

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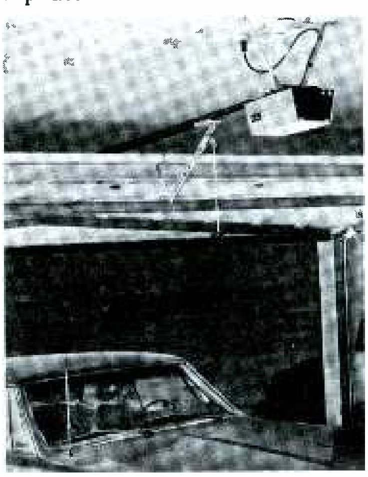

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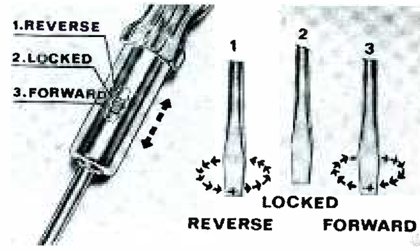


blade with an overall length of 10″, the handle is 1 1/16″ by 4⅛″. Price is $3.00. Model 111002 has a 5/16″ blade with an overall length of 10¼″; the handle is 1 3/16″ × 4⅜″. Price is $3.25.

FM Monitor
(90)

A new FM Communications Monitor that combines the flexibility of modular plug-ins with the ability to make off-the-air measurements of base stations up to 50 miles away has been introduced by **Cushman Electronics.** Called the CE-3, the new instrument gives users a choice of plug-in oscilloscope or meter for deviation display and a choice of three high-sensitivity RF preselector plug-ins—20-80 MHz, 120-180 MHz, and 450-512 MHz—or a broadband RF mixer plug-in for close-in monitoring and in-shop measurements. It also provides built-in frequency and FM-deviation measurement as well as generation capability for the proposed new land-mobile frequencies (between 470-512 MHz) now assigned to UHF TV channels 14-20.

Included is a "dial-in" feature that allows users to "dial-in" any frequency in the FM communications spectrum. Once the frequency is selected, frequency error and FM deviation can be read simultaneously. The whole process takes less than 10 seconds. Frequency accuracy is better than .000075% long term.

The unit uses all solid-state circuits and weighs only 38 lbs. when used with plug-ins. Each unit is factory wired to allow use of accessory meters for display of frequency error and FM deviation several hundred feet from the instrument. Price, less plug-ins, is $3,240.00. ▲

Advertisers' Index

August, 1968

FREE Catalog and Literature Service

**Check "Index to Advertisers" for additional information.*

ANTENNAS

163. *ANTENNACRAFT*—4-color brochures describing Channel Spanner and Custom Channel Spanner Series Antennas for UHF, VHF, and FM.
164. *FINNEY*—4-color brochure with description and technical details on new Finco Color Spectrum frequency-dependent antennas for UHF-VHF-FM, VHF-FM, and UHF. Form 20-413.
165. *GAVIN INSTRUMENTS* — 6-page folder illustrating the complete outdoor antenna line, converters, and accessories with technical data.
166. *JERROLD*—Form DS-AL-1068, a 4-page, 4-color brochure about the new DYNAROTORTM antenna rotor.
167. *JFD*—New 40-page dealer catalog of TV-FM antennas and accessories.
168. *MOSLEY*—Catalogs on CB, amateur radio, and TV FM antennas.*
169. *RMS ELECTRONICS* — Illustrated specification sheet describes eight "Direction-Finder" UHF, VHF, and FM antennas.*
170. *SOUTH RIVER* — Complete data sheet on universal all-position antenna mount.*
171. *WINEGARD*—Fact-finders on "color-tracker" UHF antennas and a solid-state, 4-set booster-coupler.

AUDIO

172. *ALTEC LANSING*—16-page product catalog, complete with technical information and photographs.
173. *BELL P/A* — Brochure about MOD amplifier series.
174. *ELECTRO-VOICE*—Pocket-size guidebooks for microphones, hi-fi loudspeakers, and hi-fi systems.
175. *STANFORD INT'L.*—Microphone catalog number 5168.
176. *SWITCHCRAFT*—New product bulletin 173 describes 2 new audio adapter connectors.

COMMUNICATIONS

177. *E. F. JOHNSON*—Four 12-page booklets about uses of 2-way radio.
178. *MARK PRODUCTS CO.* — Brochure about the "Mark Invader 23" AM CB transceiver.

COMPONENTS

179. *ALCO*—12-page catalog AS-68, describes complete line of products.*
180. *ASTATIC*—New C-68 cartridge catalog, listing complete line of cartridges with expanded cross-reference guide.
181. *BELDEN*—Catalog 876, a 56-page catalog of the complete Belden line.
182. *BUSSMANN*—Small TV fuse leaflet designed to fit pocket or tool kit, shows list prices of fuses most commonly used in TV sets. Ask for BUSS leaflet TVLP.*
183. *CORNELL-DUBILIER* — New 4-page color-lytic list.*
184. *JENSEN* — Brochure 242, "Hi-Fi Speaker system components," containing a graphic presentation of 2-, 3-, and 4-way Hi-Fi Systems.
185. *LITTELFUSE* — Pocket-sized TV circuit-breaker cross-reference, CBCRP, gives the following information at a glance: manufacturer's part number, price, color or b-w designation, and trip ratings.*
186. *MALLORY*—Bulletin 4-82 describes radial-and axial-lead tantalum capacitors.
187. *MERIT* — Giant wall chart WC-68, listing all popular color transformers.
188. *MILLER*—Catalog 167, a 156-page general catalog with complete cross-reference guide.*
189. *POMONA*—New 1968 catalog. A 44-page listing of the complete line with technical information.
190. *QUAM-NICHOLS* — Catalog No. 67 has information on the entire line.*
191. *SARKES TARZIAN*—New catalog 68-DL-5 describing complete line of rectifiers for replacement applications.*
192. *SONOTONE* — New specification sheet, lists 7 new replacement cartridges.
193. *SPRAGUE*—C-618, a new, complete, general-line catalog.
194. *TEXAS CRYSTALS*—12-page catalog of crystals including engineering data, specifications, and prices.
195. *WORKMAN* — New cross-reference for VDR's and thermistors used in color TV.*

SERVICE AIDS

196. *BLONDER-TONGUE* — New publication, "SOLUTION 1," contains information for servicemen about reception problems.
197. *CASTLE TUNER*—Fast overhaul service on all makes and models of television tuners. Shipping instructions, labels, and tags are also included.
198. *ELECTRONIC CHEMICAL* — Catalog sheet of chemical products.
199. *GC*—Catalog FR69, a 304-page listing for all product divisions.
200. *INJECTORALL*—Catalog of chemicals and tools including new printed-circuit kit.*
201. *TECH SPRAY*—Brochure FB11 describing BLUE STUFF for tuners and catalog FB 10 for chemical products.*

SPECIAL EQUIPMENT

202. *ATR* — Literature about DC-AC inverters up to 6000 watts load.
203. *MUELLER*—8-page catalog describing every clip and insulator in the Mueller line.
204. *PERMA-POWER* — Product sheet on Model D-210 AVR voltage regulator for color TV.*
205. *VECTOR* — Literature about new "Micro-Klip" terminal for use on plugboards.

TECHNICAL PUBLICATIONS

206. *CAPITOL RADIO ENGINEERING INSTITUTE* — Illustrated brochure, "How to Prepare for Tomorrow's Jobs in Electronics," for high-school graduates currently employed in electronics.
207. *CLEVELAND INSTITUTE OF ELECTRONICS*—Free illustrated brochure describing electronics slide rule, four-lesson instruction course and grading service.*
208. *RCA INSTITUTES*—New 1968 career book describes home-study programs and course in television (monochrome and color), communications, transistors, and industrial and automation electronics.*
209. *SAMS, HOWARD W.*—Literature describing popular and informative publications on radio and TV servicing, communication, audio, hi-fi and industrial electronics, including special new 1968 catalog of technical books on every phase of electronics.*

TEST EQUIPMENT

210. *B & K*—Brochures about the B & K, Precision Apparatus, and "Cobra" lines.*
211. *HICKOK*—Specification sheets covering Models CR-35 CRT analyzer, 860 Injecto-Tracer, GC-660 color generator, 677 wide-band scope, and 661 NTSC color-bar generator.
212. *LECTROTECH* — Two-color catalog sheet on new Model V6-B color-bar generator gives all specifications and is fully illustrated.*
213. *SECO*—Operating manual for Model HC8 in-circuit current checker.
214. *SIMPSON* — New 28-page panel meter catalog.
215. *TRIPLETT*—Catalog 53-T with complete line of Triplett test equipment.*

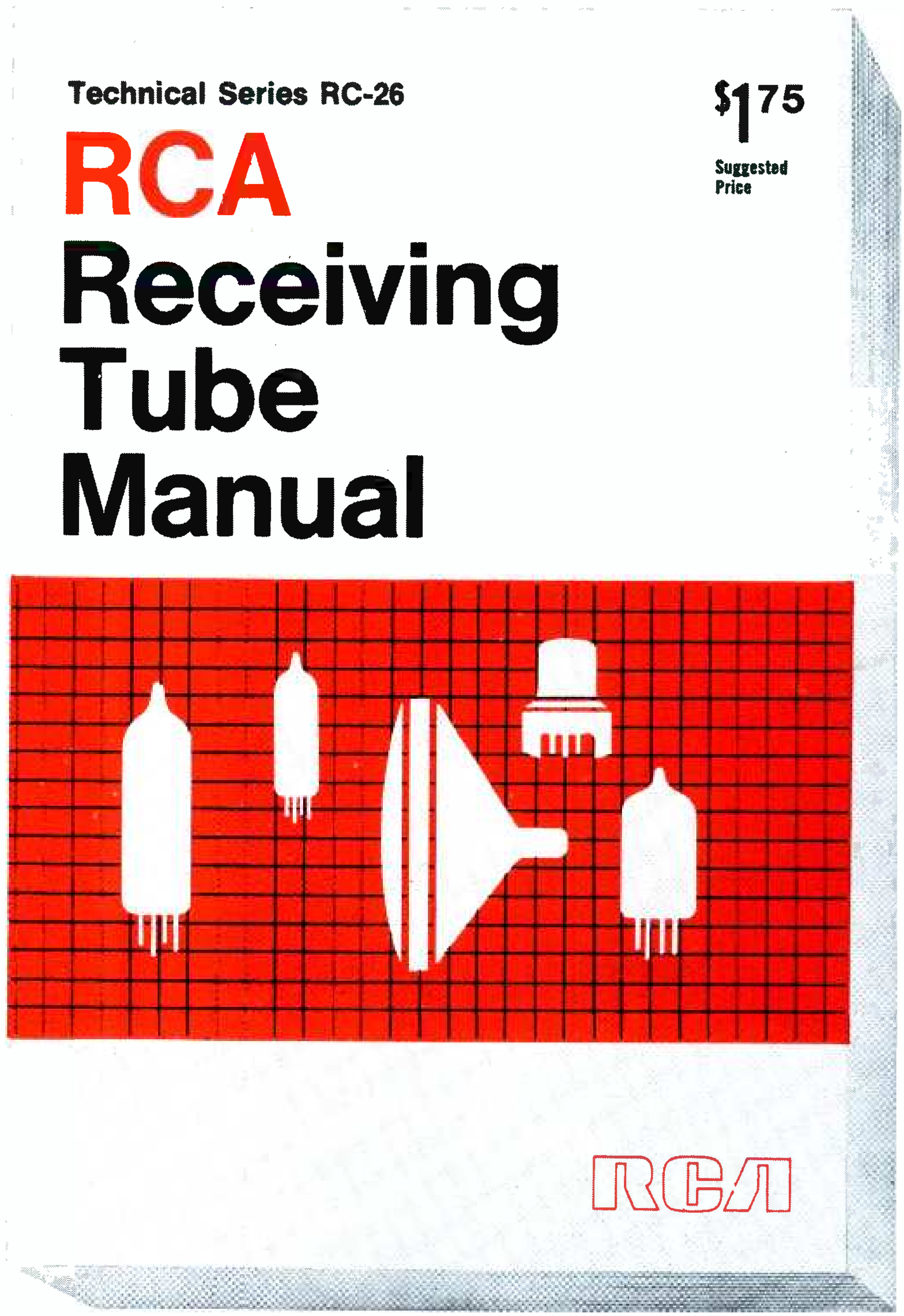
TOOLS

216. *ARROW* — Catalog sheet showing three staplegun tackers designed for fastening wires and cables up to ½" diameter.
217. *CHANNELLOCK* — Brochure describing new curved jaw pliers.
218. *SWING-O-LITE* — Catalog sheet on Models BBM-9 and BB-45 bench lamps.
219. *VACO* — Catalog SD-134 describes new products for electronics industry.
220. *XCELITE*—Bulletin N867 describes hollow-shaft nutdrivers which speed locknut/screw adjustments.*

TUBES AND SEMICONDUCTORS

221. *GENERAL ELECTRIC*—Entertainment semiconductor almanac, ETR-4311C, and picture-tube replacement guide, ETR-702K, are offered.
222. *IR*—Flyer sheet about a new universal replacement transistor (type TR-27) for vertical- and horizontal-output applications.
223. *MOTOROLA* — HEP cross-reference guide lists approximately 12,000 semiconductor types.
224. *RCA*—1D1304, a 12-page brochure on RCA's line of all-new HI-LITE color picture tubes for the replacement market. Explains latest technological advances, such as brightness, Perma-Chrome, and unity current ratios.* ▲

Come and get it!



The RC-26 is the biggest and best receiving tube manual in the industry! Newly revised and updated, it now has 656 pages of vital data... information on the complete RCA line of home-entertainment receiving tubes, color and black-and-white picture tubes, voltage-regulator tubes and voltage-reference tubes... expanded Circuits Section featuring several circuits that illustrate the various stages of a complete color-television receiver ... extremely handy Applications Guide... Technical Data section with comprehensive data and curves for all active RCA receiving tubes.

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Be sure to ask your customers "WHAT ELSE NEEDS FIXING"?

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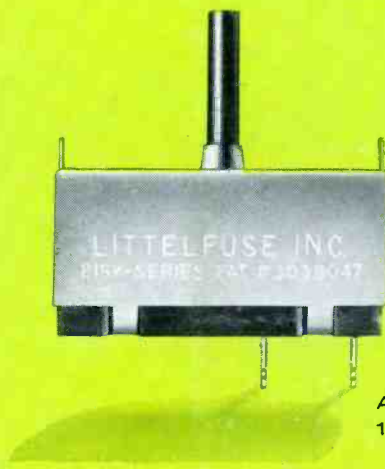
Introducing a Complete Line of Littelfuse Quality Circuit Breakers



Actual Size
$1\frac{3}{4}'' \times 1\frac{3}{16}'' \times \frac{1}{2}''$

Exact replacement from factory to you

Designed for the protection of television receiver circuits, the Littelfuse Manual Reset Circuit Breaker is also ideally suited as a current overload protector for model railroads and power operated toy transformers, hair dryers, small household appliances, home workshop power tools, office machines, small fractional horsepower motors and all types of electronic or electrical control wiring.

LITTELFUSE DES PLAINES, ILLINOIS

Circle 47 on literature card