A HOWARD W. SAMS PUBLICATION

November, 1968/75c

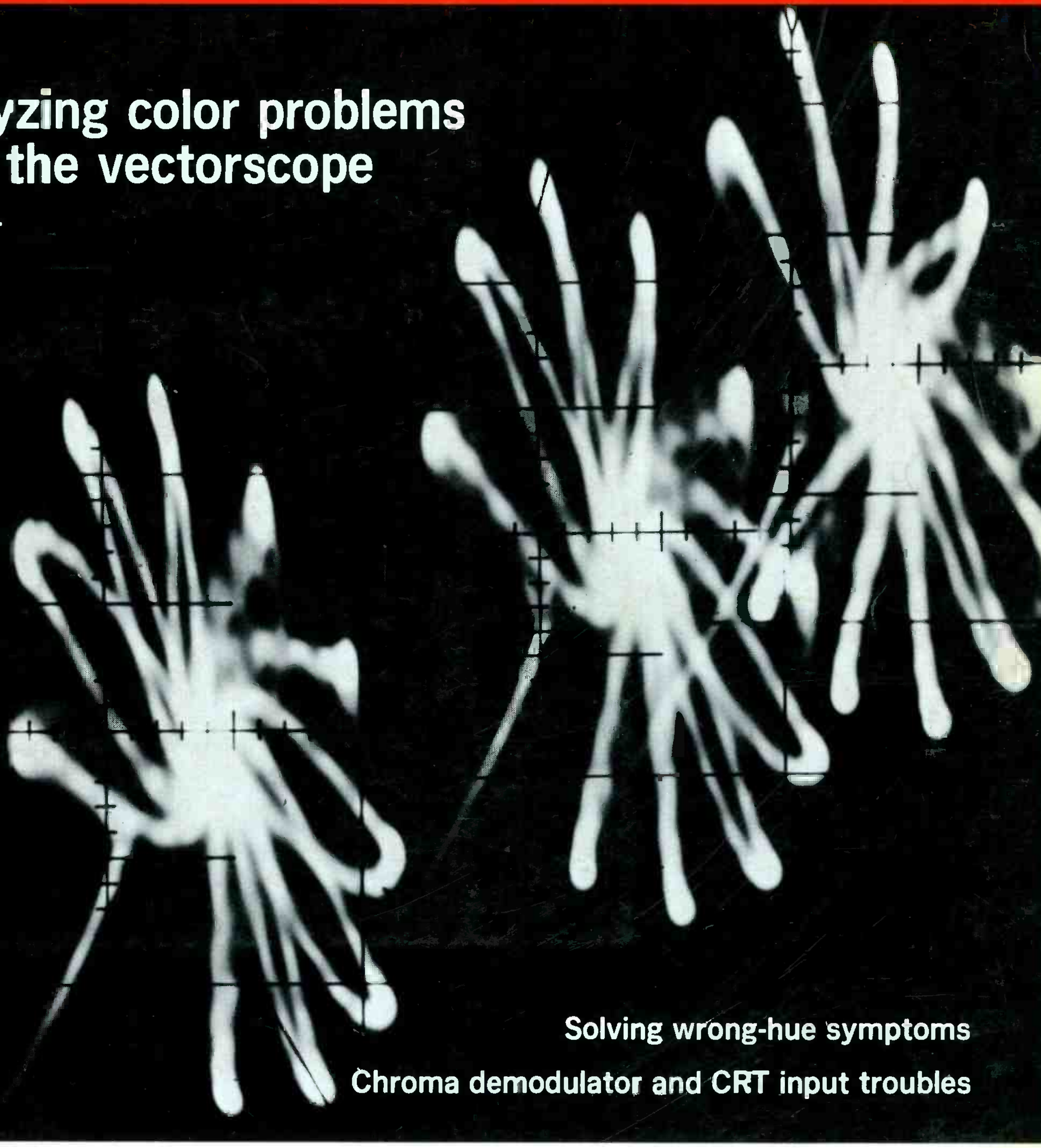
PF Reporter®

PHOTOFACT

the magazine of electronic servicing

Analyzing color problems with the vectorscope

Page 14



Solving wrong-hue symptoms

Chroma demodulator and CRT input troubles

Circle 1 on literature card

November, 1968

PF Reporter®
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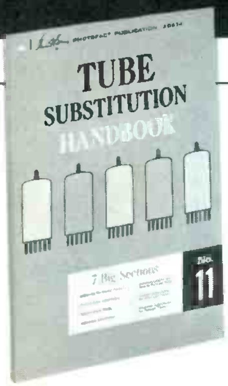
Tube Substitution Supplement

This Supplement has been designed to provide you with the latest up-to-date information on new tubes. The format allows maximum use during a house call or at the bench.



REMOVE THIS
SUPPLEMENT FROM

PF Reporter®

and put it in
the back of your

TUBE SUBSTITUTION HANDBOOK

direct substitutes

Included are the older tubes that will substitute directly for the new tubes. This information supplements the sections in the Tube Substitution Handbook for American Receiving Tubes and Picture Tubes.

basing diagrams

The basing diagram for each new tube will help you in the servicing of new receivers when service literature is not available.

typical characteristics

The typical, or average, characteristics of each new tube can be of great help when troubleshooting new circuits.

easy reference

The direct substitution list will be cumulative each month. Thus, only the latest edition need be carried in the Tube Substitution Handbook.

Direct Substitutions

To Replace	Use
3CU3	3AW3
3CV3	*
3CX3	*
6AH9	*
6AK9	*
6CA11	*
6CT3	*
6JE6C	*
6JR6	*
6JS6B	6JS6 6JS6A
6LF6	*
6LG6	*
6LH6A	6LH6
6LQ6	*
6LR6	*
6ML8	*
6MN8	*
8AC10	*
11CA11	*
11LT8	*
13JZ8	*
16AK9	*
16LU8	*
17BW3	19CG3
17CT3	*
17JR6	*
21LG6	*
22JR6	*
24BF11	*
24JZ8	*
24LQ6	*
35LR6	*
36KD6	*
53HK7	*
9VP4	*
10ARP4	*
11UP4	11RP4
12BUP4B	12BUP4 12BUP4A
12CNP4A	*
12CVP4	*
12CWP4	*
12DCP22	*
13DP4	*
15KP22	*

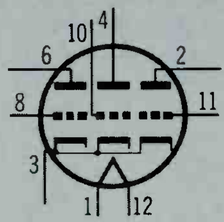
To Replace	Use
15LP22	*
15NP22	*
15RP22	*
15SP22	*
16CSP22	*
16CWP4	*
16CXP4	*
16CYP22	*
19FRP4	*
19GHP4	19DUP4 19EAP4 19ENP4 19ENP4A
19GSP22	*
19GYP22	*
19HBP22	*
19HGP4	*
20ABP4	20RP4 20YP4 20ZP4
20RP4	20ABP4 20YP4 20BP4
20SP4	*
20TP4	*
20WP4	*
20XP4	*
20YP4	20ABP4 20RP4 20ZP4
20ZP4	20ABP4 20RP4 20YP4
21GAP4	21GAP4A
21GAP4A	21GAP4
21GTP4	*
22SP22	*
23GHP4	*
23HMP4	*
23JEP4	23HGP4
23JFP4	*
23JGP4	*
25ABP22	*
25AJP22	*
25AKP22	*

* No substitution at present time.

Eleventh edition of Tube Substitution Handbook now available at your distributor.

General Specifications

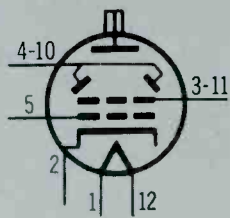
6MN8



12HU

Chroma Matrix Amplifier
Fil.—6.3V @ 0.9A
E_P = 125V
E_G = −1V
I_P = 11 ma
G_m = 9000 µmhos
M_u = 50

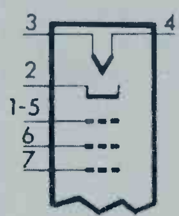
35LR6



12FY

Horizontal-Output Amplifier
Fil.—35.0V @ 0.45A (11 sec)
E_P = 175V
E_{SG} = 110V
E_G = −20V
I_P = 140 ma
I_{SG} = 2.4 ma
G_m = 16,000 µmhos

10ARP4

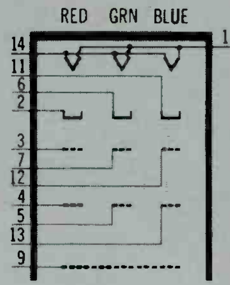


7GR

Protection—Banded
Deflection—90°
Filament—6.3V @ 0.3A
Grid 2—140V
Neck Diameter—0.840"

12DCP22

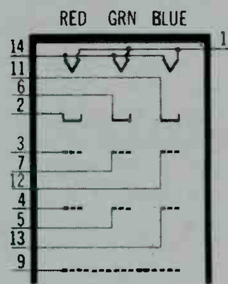
Protection—Banded
Deflection—89°
Filament—6.3V @ 0.9A
Grid 2—390V



14BH

16CYP22

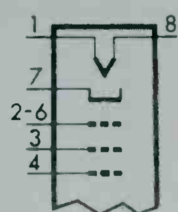
Protection—Banded
Deflection—90°
Filament—6.3V @ 0.9A
Grid 2—300V



14BH

23JFP4

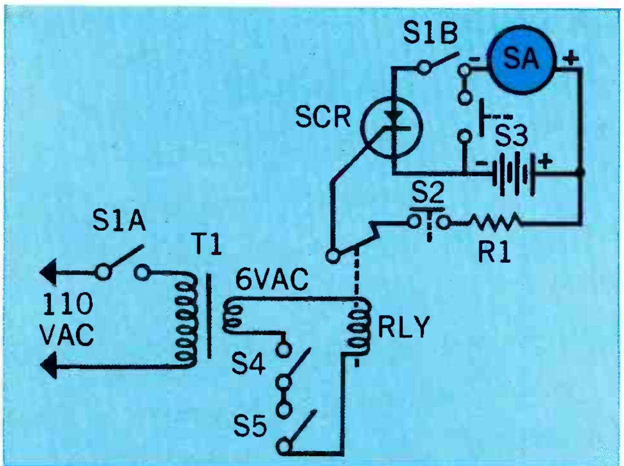
Protection—Tension Band
Deflection—110°
Filament—6.3V @ 0.315A
Grid 2—50V

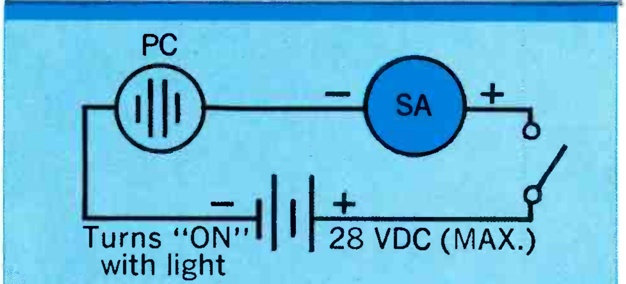


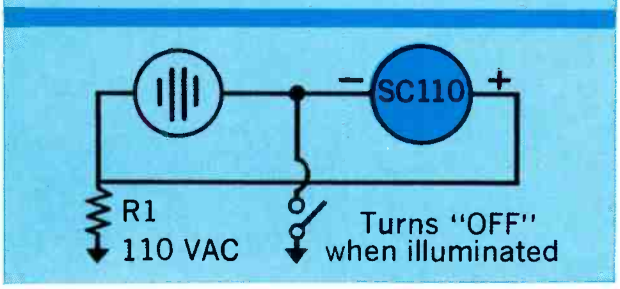
8HR

MALLORY **Tips for Technicians**

Low-drain Sonalert® signal has dozens of uses







Most audible signals take considerable power to operate. But here's a *different* one . . . the Sonalert . . . that is completely solid state and works on a few milliamps. And because of this characteristic, it can be used in signalling, warning and testing arrangements that would otherwise be impractical, complicated or costly.

Here's an intrusion alarm circuit using the Sonalert (SA in the diagram). Switches S4 and S5 are control line contacts in a low-voltage AC circuit . . . which, when opened, will cause the relay contacts to open, gate the SCR and the Sonalert will immediately sound off. S4 and S5 can be door or window contacts, for example. This is a "fail safe" circuit. The Sonalert is powered by a battery (a 9-volt Mercury Duracell® battery TR-146X is ideal). Any loss of AC power will sound the alarm. S2 is an "arming" switch, and S3 lets you test battery condition.

By using fusible links in the S4 and S5 positions, you can convert this to a fire alarm.

In conjunction with photo cells, Sonalert can be arranged to do all sorts of tricks. Its drain is so low that it can be coupled directly to low-cost cadmium sulfide cells. Two simple circuits are illustrated; one turns the Sonalert on when illuminated, the other turns the Sonalert on when light goes off.

Other uses? Sonalert works great as a continuity checker, code practice oscillator, swimming pool splash alarm. In your automobile it can be hooked up as a water temperature or oil pressure signal, or as a "headlights on" alarm. We've published a booklet that describes how to make many different circuits. Ask your Mallory Distributor for a copy of Folder 9-406, or write to Mallory Distributor Products Company, a division of P. R. Mallory & Co. Inc., Indianapolis, Indiana 46206.

®Duracell is a registered trademark of P. R. Mallory & Co. Inc.

DON'T FORGET TO ASK 'EM—*"What else needs fixing?"*

Circle 3 on literature card

November, 1968 • Volume 18, No. 11

PF Reporter

PHOTOFACT

the magazine of electronic servicing

in this issue...

ABOUT THE COVER

Ten-petal vectorscope patterns, such as those displayed on this month's cover, can provide valuable information for aligning and troubleshooting chroma circuits.

DEPARTMENTS

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Robert E. Hertel, Publisher

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OVERHAUL $9.75 • REPLACEMENT TUNERS . . . $10.45

Nine-seventy-five buys you a complete tuner overhaul—including parts (except tubes or transistors)—and *absolutely no hidden charges.* All makes, color or black and white. UV combos only $15.

Guaranteed means a full *12-month* warranty against defective workmanship and parts failure due to normal usage. That's 9 months to a year better than others. And it's backed up by the only tuner repair service authorized and supervised by the world's largest tuner manufacturer—Sarkes Tarzian, Inc.

Four conveniently located service centers assure speedy in-and-out service. All tuners thoroughly cleaned, inside and out . . . needed repairs made . . . all channels aligned to factory specs, then rushed back to you. They look—and perform—like new.

Prefer a universal replacement? Sarkes Tarzian will give you a universal replacement for only $10.45. This price is the same for all models. The tuner is a new tuner designed and built specifically by Sarkes Tarzian for this purpose. It has memory fine tuning—UHF plug-in for 82 channel sets—universal mounting—hi-gain—lo-noise.

ORDER TUNERS BY PART NUMBER, AS FOLLOWS:

Part #	Intermediate Frequency	AF Amp Tube	Osc. Mixer Tube	Heater
MFT-1	41.25 mc Sound 45.75 mc Video	6GK5	6LJ8	Parallel 6.3V
MFT-2	41.25 mc Sound 45.75 mc Video	3GK5	5LJ8	Series 450 MA
MFT-3	41.25 mc Sound 45.75 mc Video	2GK5	5CG8	Series 600 MA

Prefer a customized replacement tuner? The price will be $18.25. Send us the original tuner for comparison purposes, also TV make, chassis and model numbers.

SEND ORDERS FOR UNIVERSAL AND CUSTOMIZED REPLACEMENT TUNERS TO OUR OFFICE IN INDIANAPOLIS.

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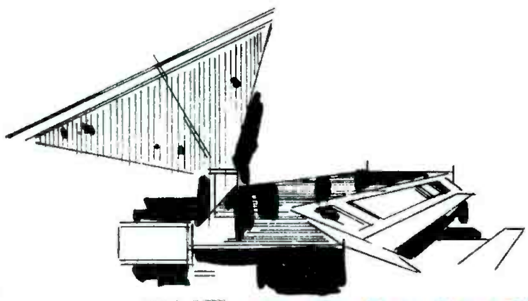
(Home Office)
EAST .... 547-49 TONNELE AVE., Jersey City, New Jersey .... TEL: 201-792-3730
SOUTH-EAST .... 938 GORDON ST., S. W., Atlanta, Georgia .... TEL: 404-758-2232
WEST .... SARKES TARZIAN, Inc. *TUNER SERVICE DIVISION*
10654 MAGNOLIA BLVD., North Hollywood, California .... TEL: 213-769-2720

WATCH FOR NEW CENTERS UNDER DEVELOPMENT

Circle 4 on literature card



THE ELECTRONIC SCANNER

NATESA Director Voices Opinions at Convention

Independent service shops are in danger of being phased out. This ominous warning was voiced by Frank Moch, Executive Director of the National Alliance of Television and Electronic Service Associations, in his keynote address to members attending NATESA's 1968 convention held in Chicago, August 22 through 25.

Commenting on the possible effects on the servicing industry of extended warranties and factory operated service centers, Mr. Moch stated that the facts on hand indicate that after 40 years, with factories relying on independents to do the servicing, set sales have zoomed, but ". . . suddenly independents have gone out of style and are scheduled for phasing out. Most of you, at this moment, are in the enviable position where you have far more than enough business. Don't be deluded. Phasing out would, of necessity, be a gradual transistion of a year or so as factories became geared. Some factories, I am sure, have no intention to deprive you of the right to compete, and will resist, but don't forget that none 'had a gun to their heads' on the extended warranty gambit either."

Mr. Moch continued on the subject of extended warranties and where they are leading by commenting that the factories deprive every service technician who is not part of the captive service or warranty system of ". . . the right to compete for the sale of a replacement of a worn out color picture tube and simultaneously assure the sale on a prebilled basis, to the factory."

He went on to state that only the captive service company or a few warranty agencies can compete for the right to service the sets, and the fees paid such warranty agencies have never been paid to them directly. He added ". . . these agencies have always been used to develop patterns for the factory, for which no compensation is paid.

"Extended warranties do unfairly bar competition by well qualified service people for periods of two, three and even eight years. Can independents survive being isolated from all new color sets for such periods? They could if parts for older sets were readily available and at a cost that wouldn't make service cost prohibitive compared to alleged advertised cost of a replacement set. Do not discount that this total owner control by these extended warranties presents a great propagandizing opportunity that we must expect will be used."

Refering to the Defense Department's "Project Transistion" program (Scanner, April, 1968), conducted in cooperation with the Electronic Industries Association's Service Technician Development Program, Mr. Moch made the following statements: "It just might produce all of 200 'factory style' experts to fill today's shortage of 10,000 technicians.

"So few men at so great an expense could hardly be the real goal. More likely, these are merely pilot operations meant to guide individual set producers to create men for their own operations. . . . No independent operator could possibly use these minimally trained men, especially at the wage rates guaranteed them by the government and the trainer. There is only one logical answer—these are merely 'robots,' trained to service by rote from a 'spec book' prepared by a knowledgeable technician and working on one single model. Replacement men will roll off the 'training assembly line' fast enough to fill drop out and other vacancies.

"If the independent operator can't use this man, the factory can. Today, (of) the few set producers that survived, each has a heavy concentration of sets in each of its market areas. Factory operations are being based near traffic arteries for easy access. Those alongside of expressways will permit traveling substantial distances, because when the 'robot' gets there quickly he has eight or more calls within a few minutes of each other."

To put his comments in the proper perspective, Mr. Moch said, "My comments, I hope, will be interpreted by industry in the spirit in which I make them." He went on to say that his comments are not intended as a declaration of war, but as a plea to recognize a very basic fact: that independent service, by virtue of its great and varied contributions to making home electronics one of the top American industries in a life time, has earned a position of equality and proper survival."

Mr. Moch concludes, "I am certain that you, as I, have recently had a good reason to wonder about the intelligence quotient and morality of the overall industry. I am sure you, as I, have wondered whether being in this industry is worth the effort, costs, etc."

Jobless To Be Trained As TV Technicians

Radio Corporation of America will train 400 of the Nation's hard-core jobless in four cities as television technicians.

In a ceremony in Washington, D. C., RCA Service Company president, Edgar H. Griffiths, and assistant secretary of Labor and Manpower administrator, Stanley H. Ruttenberg, signed a $2.5 million training contract. The 400 will be trained at RCA Service Company facilities in Camden, Newark, Chicago and Los Angeles.

A substantial portion of the program's cost will be assumed by RCA. This will include administrative staff and attendant costs, training center facilities, and all office, classroom and laboratory equipment. RCA anticipates spending about $1 million over and above the government's investment.

Griffiths expects that RCA's "Four Cities Program" will "help alleviate one of the most acute problems in the electronics industry—a shortage of from 50,000 to 75,000 technically trained service people."

The program calls for the training of 80 persons each in Camden and Newark and 120 each in Chicago and Los Angeles.

The training period will last 18 months, during which time the trainees will earn $1.80 to $2.00 per hour.

After training, qualified graduates can progress through stages to $3.45 an hour.

New Warranty and Service Concept Offered by Broadmoor

Broadmoor Industries, Ltd., marketers of portable and table model radios, clock-radios and portable monochrome and color television sets, has announced a new warranty program effective September 1.

Previously all Broadmoor radios and clock-radios have been covered by a one-year, over-the-counter warranty. The consumer has the option of returning the set to the dealer, or to Broadmoor, for warranty exchange. It will be retained as the standard warranty. In addition, however, under the new program, the purchaser has the option of requesting a "Lifetime Service Plan," which covers parts and labor on factory defects for as long as the customer owns the set. Fees to the consumer are on a sliding scale basis: AM radios, $3.95; AM clock-radios and AM-FM radios, $4.95; AM-FM clock-radios and multiband sets, $5.95. Defective sets, under the new Lifetime Service Plan, must be sent to Broadmoor for repair. The only charges will be for postage and handling. There will be no charge for parts or labor, unless the set has been damaged, abused or serviced by unauthorized personnel. Cabinets, decorative items, telescoping antennas and batteries, are excluded from the warranty.

On Broadmoor monochrome TV, the standard warranty has been 90 days on parts, one year on picture tube. Under the new program, this standard warranty now will include labor on parts replaced within the

90 days. Also, the purchaser now has the option of requesting an extended warranty, "One Year Parts and Labor Carry-In Plan," upon payment of a $5.95 one-time fee. This extends the warranty to cover parts and labor (including the picture tube) for one full year. The "Carry-In" provision merely means the consumer must bring the set to an authorized Broadmoor TV service station, or else send it to Broadmoor, prepaid.

On color TV, a field which Broadmoor only recently entered with the introduction of Model 6916 15″ portable at the Consumer Electronics Show, the warranty is one year on parts and two years on the color picture tube.

The mechanics of the new warranty program are very simple. All the dealer does is explain the warranty program to the consumer, who fills out the necessary cards and sends them to Broadmoor along with appropriate remittance for the optional extended warranty plans. Broadmoor registers the warranty and in the case of standard warranties, returns only the cards to the consumer. When the purchaser has chosen an extended warranty plan, Broadmoor also sends him a self-adhesive sticker containing all the necessary information to verify that the set is under an extended warranty.

In the case of the standard radio warranty, the Broadmoor dealer is not obligated to perform the "over-the-counter" exchange, during the one year life of the warranty. He can ask the consumer to return the set to Broadmoor; a new set is then sent to the consumer, who pays the postage and handling charge. If the dealer makes the exchange, there is no such charge.

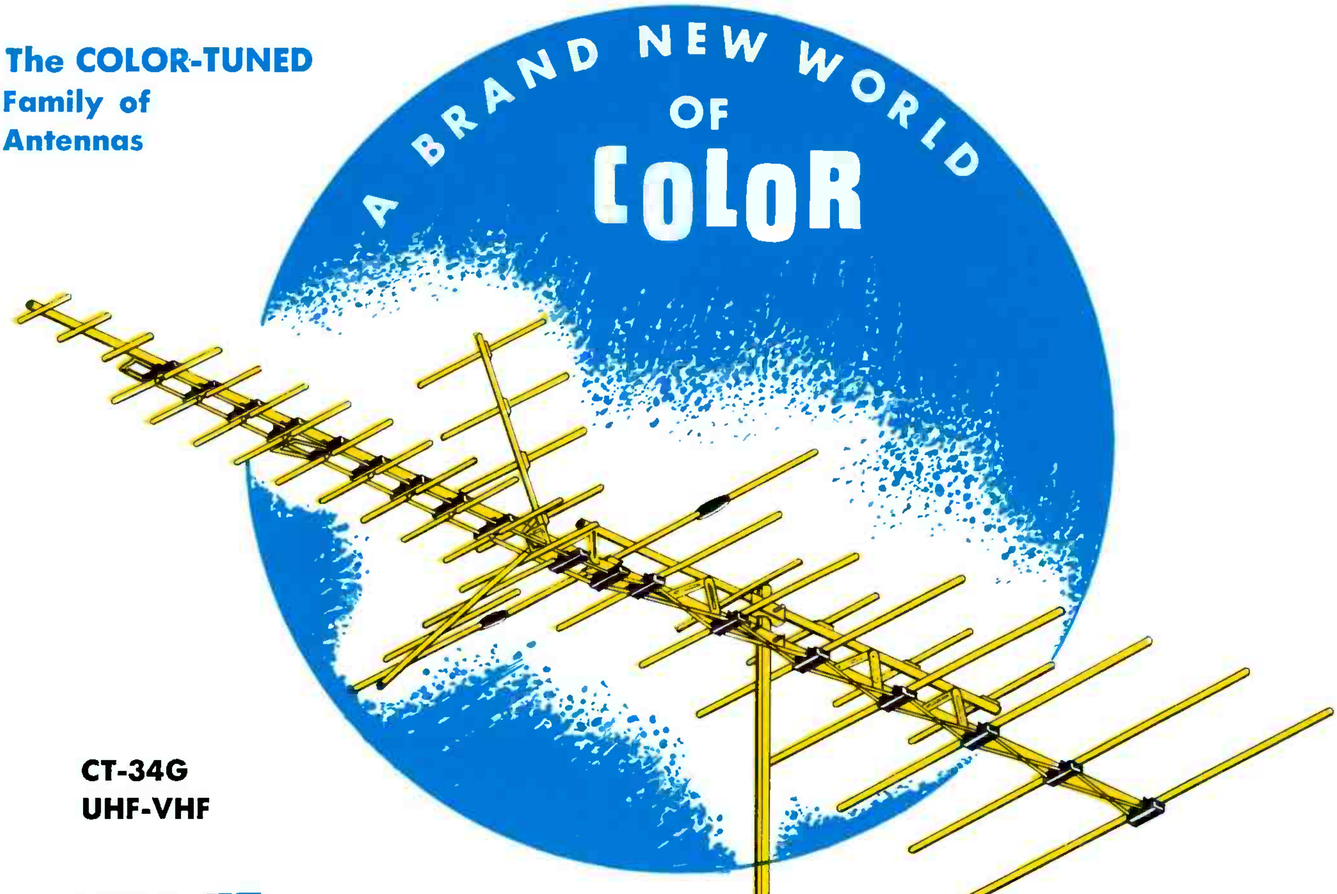
At the same time, a new Service Supervisor, Dan Sporer, has been appointed. Sporer will be responsible for the quality of service work, both in the field and at the factory here in Des Plaines, Illinois.

According to Ted Collins, Broadmoor vice president, the new extended warranty program is being offered at a time when many manufacturers are adding responsibility for extended warranties to their dealers. "Our studies show," he said, "that dealers prefer not to handle warranty service problems. We agree with this trend. We feel the manufacturer should assume his share of the responsibility for extended warranty service for two reasons: (1) It assures the consumer of uniform application of the warranty plans; (2) If there are design or production problems, it is only right that the producer 'pay the Piper' for his mistakes."

Broadmoor's goal for authorized TV service stations is 500. Collins commented that their drive is meeting with success because it is based upon practical business principles. Before they approach a service agency, they evaluate the quality of their work. If it meets Broadmoor's standards, they agree to pay the service agency their standard rate. "In this way," said Collins, "the service agency makes a legitimate profit on service work performed for Broadmoor. Broadmoor radios are not serviced in the field. The reason for this, according

REVOLUTIONARY NEW FIRST FROM KAY-TOWNES

The COLOR-TUNED Family of Antennas



CT-34G
UHF-VHF

IT'S "COLOR-TUNED"

AN ENTIRELY NEW CONCEPT IN ANTENNA DESIGN!

Most conventional UHF-VHF combination antennas use the "pass through" coupling system. The VHF signals pass through the UHF antenna, acting as a section of the transmission line. The presence of the UHF elements attached to this transmission line results in a line mismatch at various VHF frequencies with the standing waves being detrimental to color reception.

NOW—RECEIVE TRUE COLOR AS IT IS TRANSMITTED!

Kay-Townes new "Color-Tuned" concept obsoletes the old "pass through" system. The high gain, nine driven element UHF antenna is coupled to the VHF portion in a manner that actually tunes the VHF section. The antenna features a double stub UHF trap to assure 100% isolation, resulting in a no-loss coupling of the two systems to a single transmission line. A corner reflector doubles as a high gain UHF reflector and a broad, high band, high gain director on VHF channels 7-13 and reduces the space loop losses in both bands.

KAY-TOWNES ANTENNA COMPANY
Box 593 Rome, Ga. 30162

Circle 7 on literature card

to Collins, is that most service agencies prefer not to service portable radios. It presents a tremendous parts stocking problem, and it usually is not profitable. Therefore, Broadmoor asks their service agencies to service TV sets only.

An advantage to service agencies of the new extended warranty service program on TV, is the warranty sticker which the consumer receives. All the serviceman has to do to determine whether or not a set is in warranty, is to check for the warranty sticker on the set.

Collins revealed that a preliminary test mailing to Broadmoor set owners indicates that up to 50 percent will select the optional extended warranty plans.

Microfilm Service Data System

A microfilm system which instantly locates technical information on all home entertainment products ever produced by Sylvania has been placed in operation by Sylvania Entertainment Products, an operating group of the company.

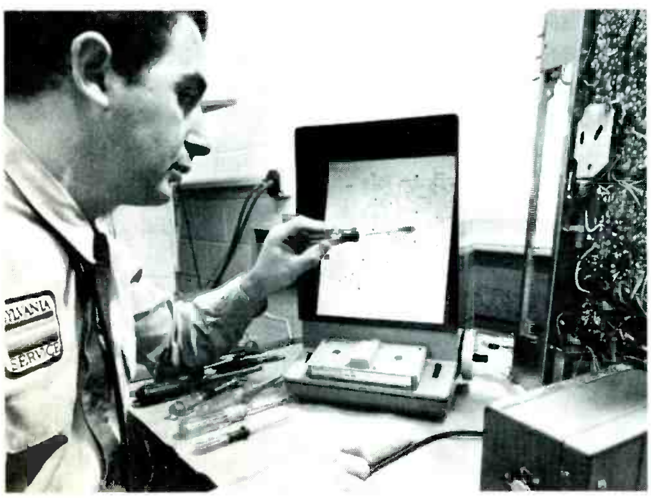
The service, which is being made available to Sylvania distributors, dealers and servicing contractors on a lease basis, consists of two reel-to-reel microfilm cartridges and a desk top reader unit which projects the material on an 8"x10½" screen. The service is designed as a supplement to Sylvania's regular printed service literature which is published as new products are introduced.

The microfilm library would be updated periodically at no additional charge to subscribers.

At present all Sylvania service data is contained on one and a half scaled cartridges, the equivalent of approximately 6,000 printed sheets. There is room for an additional 2,000 sheets of literature on the second cartridge, enough for about two more years of normal service literature before a third cartridge has to be added to the system.

According to Sylvania, it is impossible to place the cartridges incorrectly on the reader, and a technician can manually advance the film at about 200 frames per second.

Printed indexes are provided with each cartridge and an index also is contained on each reel. The reader unit, which operates on normal household current, weighs 11 pounds and is fully portable. It has three simple controls: an on-off switch, a focusing lever, and a film advance-reverse knob.



Sharp Two-Year CRT Warranty

A two year picture tube warranty on all current Sharp color television models has been announced by Sharp Electronics Corporation.

The Sharp color TV line presently consists of an 18-inch table model, a 14-inch portable, and a 12-inch portable. The new picture tube warranty goes into effect immediately.

All Sharp color models carry a one year warranty on all other parts, and the 12-inch and 14-inch portables include a 90 day carry-in service policy at no additional cost.

RCA Tops Three Billion in Tube Production

On September 12th of this year RCA marked a new milestone in electronics—production of its three billionth receiving tube—on the same site purchased in 1881 by Thomas A. Edison for the manufacture of incandescent lamps.

RCA acquired the Harrison plant in 1930 and began making tubes for its early "Radiola" radio sets. The three billion tubes represent almost one-third of all the receiving tubes produced by the industry.

"The receiving tube has enriched the lives of people throughout the world, making possible such things as commercial radio broadcasting, television, talking pictures, high-fidelity phonographs, and computers," according to John B. Farese, executive vice president, RCA Electronic Components.

Noting that receiving tubes today are meeting severe competition from transistors and other solid-state devices, Mr. Farese said "tubes will continue to be widely used because of their low-cost, high reliability and efficient performance." He said RCA alone markets more than 1,000 different types of receiving tubes which are used for the amplification, detection and oscillation of radio signals.

Mr. Farese predicted that over the next five years industry sales of receiving tubes would approximate 1.4 billion units.

RCA's milestone receiving tube is a type widely used in both the 1969 model color and black-and-white television sets. It is designated as the RCA 6GH8A type.

The three billion receiving tubes made by RCA represents enough units to equip 150 million color television sets, each of which has an average of 20 tubes. Approximately 90 per cent of the color television sets produced this year and 1969 will use receiving tubes, the executive stated.

In manufacturing three billion receiving tubes, Mr. Farese added, RCA consumed 187,000 tons of glass, 544,000 miles of tungsten wire, and 2,600 tons of mica. If laid end-to-end, the tubes would stretch approximately 140,000 miles.

New Company Formed to Manufacture TV Components In Latin America

The formation of a new company, Sylvania of Puerto Rico, Incorporated, which will manufacture television set components and accessories for distribution throughout Latin America, has been announced by General Telephone & Electronics International Incorporated.

The new company was organized to supply components and complete TV "kits" for companies which manufacture Sylvania sets in Costa Rica, Jamaica, Trinidad and Tobago, Venezuela, Colombia, and Peru.

The new company also will manufacture TV sets for sale in Puerto Rico.

Occupational Outlook Report on Servicing Industry

According to an occupational outlook report published by the Bureau of Labor Statistics, U.S. Department of Labor, about 125,000 television and radio service technicians were estimated to be employed in early 1967, of whom about a third were self-employed. About three-fourths of all service technicians worked in service shops or in stores that sell and service television receivers, radios, and other electronic products. Most of the remaining service technicians were employed by government agencies and manufacturers, including manufacturers that operated their own service branches.

The report states that information obtained from proprietors of independent service shops and manufacturers who operate service centers located in major metropolitan areas indicates that, in early 1967, many service technicians in entry jobs had straight-time weekly earnings ranging from about $70 to $100 and many experienced service technicians had weekly earnings ranging from $110 to $180.

The report also states that employment of television and radio service technicians is expected to increase rapidly throughout the 1970's. Although technological improvements will continue to reduce servicing requirements in the years ahead, new developments and consumer acceptance and use of new electronic products, such as video tape recorders, will increase employment opportunities for those technicians who have theoretical as well as practical knowledge of electronic circuits and know how to use the latest test equipment.

Oregon Association Joins NEA

President Rod Gregg, Oregon Television Service Association, has announced that the membership of OTSA voted to join the National Electronic Associations, Inc. This action took place at the fall convention of OTSA, September 21 through 22 at Eugene, Oregon.

Oregon's joining NEA closely follows similar membership gains made by substantial groups moving into NEA in the past few months, from the Texas Electronics Association, the California State Electronics Association and the Nebraska Electronic Service Association.

The Oregon Association took the occasion of their convention to present Mr. Al Lamer, CET, with his Certified Electronic Technician certificate, the first in the state. Also, thirty technicians sat for the CET test session that was monitored by two of NEA's vice presidents; Mr. Colin Gregory, of McMinnville, Oregon and Mr. Emmett Mefford, CET, Fontana, California.

Plans Revealed for 1969 NEW Show

Milton Friedberg, President of Antenna Specialists, Cleveland, Ohio, has been elected president of Electronic Industry Show Corporation, and will preside over the planning and operation of the 1969 NEW Electronics Show, to be held at the Sahara Hotel Convention Center in Las Vegas, Nevada, May 21 to 23, 1969. The annual trade show for electronics distributors is expected to be one of the largest conventions ever held in the world entertainment capital. ▲

Letters to the editor

AGC Operation Explained

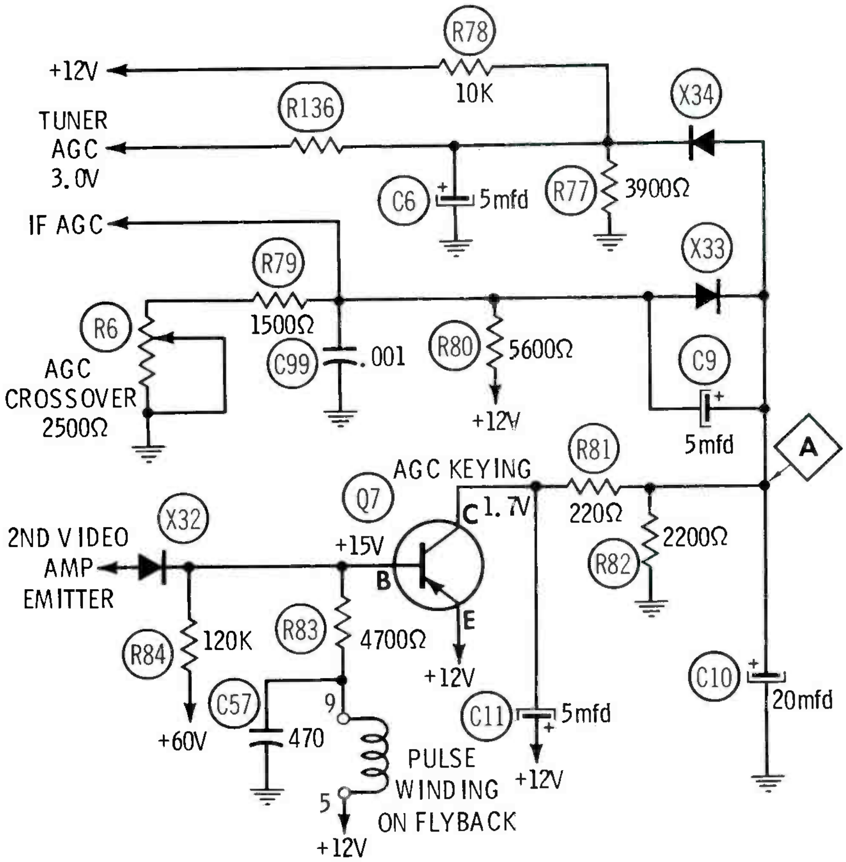
I am writing concerning an article in your June, 1968 PF Reporter. The article in question is found on page fifty and is entitled "Transistorized AGC" by Jack Darr.

I found myself faced with a lack of understanding of "positive going" AGC on NPN transistors. I must say that Mr. Darr's article has been a great help.

However, I would like to point out one small "fly in the ointment". In the column titled "What are all those diodes for?", Mr. Darr's analysis of the function of X33 does not conform with Westinghouse's nomenclature for this diode (AGC Decoupling).

Mr. Darr states, in essence, that X33 will not conduct until the applied AGC voltage "goes above" a preset level determined by the setting of R6. (Mr. Darr might do well to heed his own advice, given earlier in the article, to avoid the use of such terms as "goes above").

May I correct the above statement by saying that diode X33 conducts at all times, except when the collector of Q7 biases the cathode of X33 more positive than the voltage level on the anode, which is preset by R6. Futhermore, conduction through X33 takes place as follows: from ground through R80 to the positive 12-volt source. I might also mention that when no positive AGC voltage is being applied to the cathode of X33, the current flowing through X33 from ground is one of the major factors determining the amount of forward bias on the base-emitter junction of the 2nd video IF transmitter. As the AGC transmitter Q7 begins to conduct, its collector becomes increasingly positive. This action causes the conduction through X33 to decrease, thus causing current



flow through R80 to decrease. This raises the positive potential at the junction of R80 and X33, in turn increasing the "positive going" bias on the 2nd video IF transistor. This of course decreases the overall gain of the IF strip.

When the conduction through the AGC transistor Q7, increases due to an increased video signal, the collector of Q7 becomes more positive. When this positive potential, which is applied through R81 to the cathode of X33, becomes more positive than the preset voltage on the anode of X33, then, and only then, the phenomenon of "decoupling" takes place. This means that any further increase in positive potential on the cathode of X33 will no longer have any effect on the anode of X33, hence no further effect on the AGC bias of the IF strip.

Shortly before this point is reached, and as soon as a positive potential of three volts or more appears at point A, X34 begins to conduct and decreases the gain of the NPN RF amplifier transistor, which, along with the oscillator and mixer transistors, the PHOTOFACT Folder has mistakenly shown as PNP transistors.

In the column preceeding the one I have discussed, Mr. Darr states that there is no external voltage supply at the collector of Q7. I'm afraid that in this case there is a small, fixed, positive voltage coming through R80 and X33 to the collector of Q7, approximately 1.7 volts.

By the way, could you give me a logical explanation for the function of X32 in this same "Monster".

In all seriousness, I do appreciate your fine publication. It is the biggest and the best help there is to the serviceman, if he will take the time to read and understand it.

I feel sure that you won't publish this letter, but I would be interested in an answer as soon as possible. I am a subscriber to everything that Howard Sams publishes.

Neil V. Asselin
Lexington, Mich.

Mr. Asselin, your analysis of the operation of this AGC system is absolutely correct. To further clarify the operation of this system, it should be pointed out that even with low levels of signal input, approximately 2 volts of positive AGC voltage is applied to the video IF's. As the input signal strength increases, the collector current of Q7 increases, making the voltage at both the anode and cathode of X33 more positive. When the voltages at the anode and cathode of X33 become equal (a condition dependent upon the setting of R6) the diode ceases to conduct. Although increased conduction of Q7 will further increase (make more positive) the voltage at the cathode of X33, the anode voltage of this diode will remain at a maximum level of approximately +3 volts. Thus, the IF AGC voltage will vary between +2 and +3 volts, depending on the strength of the incoming signal.

The RF AGC diode, X34, has on its cathode a fixed reverse bias of approximately +3 volts. This bias is produced by the flow of current from ground, through R77 and R78 to the 12-volt source. With X33 cut off, any further increase in the collector current of Q7 increases the positive voltage at point A and, consequently, at the anode of X34. When this voltage exceeds, or overcomes, the fixed reverse bias on the cathode of X34, the diode conducts and effectively offers zero resistance to the positive potential at its anode. Thus, any further increase in the positive voltage (above 3 volts) at point A will be applied directly through X34 to the AGC terminals of the tuner.

Diode X32 provides the "keying" function for transistor Q7. There are two signals applied to X32: A negative-going composite video signal from the 2nd video amplifier is applied to the anode and effectively reverse biases the diode. A negative-going pulse from the horizontal-output transformer is applied to the cathode of X32 to overcome the reverse bias of the anode. When the horizontal pulse is present on its cathode, X32 conducts, passing the video signal and forward biasing Q7 into conduction. Thus, the keying action.

Thank you for pointing out the error in Mr. Darr's article and those in the PHOTOFACT Folder. Although we strive to eliminate all technical inaccuracies, occasionally one does slip by. When it does, we appreciate having it brought to our attention, as you have done in this case.

Better Grease

We note that in the article, "Rotators—Selecting, Installing, Servicing" in your May issue, that Dow Corning 7 compound is recommended as a lubricant for antenna gears and bearings.

A better choice for this application would be Dow Corning 33 grease, which was developed specifically for this type of application. Dow Corning 7 compound was developed as a release agent, and is not recommended for use as a lubricant for gears, although it may work satisfactorily if the gears are lightly loaded.

Philip K. Blumer
Publicity Specialist
Dow Corning Corp.

Modular Designs

In the June issue an article titled "Transistors: A Report on the State of the Art" stated that the plug-in circuit board employed in TV sets in use by Motorola was the only major use of this concept, and I wish to correct the statement if I might. Setchell-Carlson has been using this concept in their TV receivers for a number of years. I have been familiar with their products since about 1958 and I know that their TV sets have used this concept almost entirely since that time and possibly longer.

W. E. Applegarth
Applegarth Service & Supply
Steele City, Nebraska

Mr. Applegarth, you are right. Setchell-Carlson has employed a modular type chassis design for a number of years, although it isn't completely solid-state as is Motorola's. Setchell-Carlson calls their design "unit-ized." ▲

According to data compiled and distributed by the Consumer Products Division of the Electronics Industries Association, the following numbers of home entertainment electronic products were in use as of 1967:

Color television	**12,700,000**
B-W television	**81,500,000**
Home radios	**195,000,000**
Auto radios	**73,000,000**
Phonographs	**51,000,000**
Total	**413,200,000**

Analyzing color problems with the Vectorscope

by Stan Prentiss

Another approach to color servicing

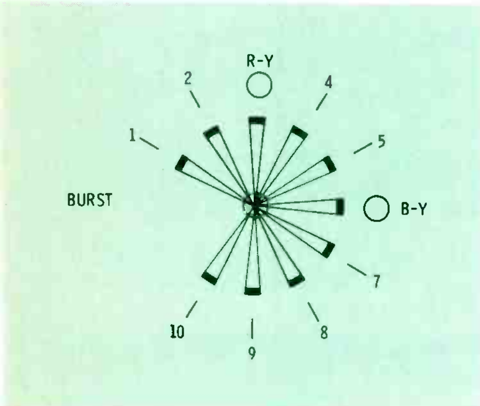


Fig. 1 Typical vectorscope pattern.

Would you believe that a complete AFPC and chroma demodulator alignment could be performed in the home without turning the living room into a service shop?

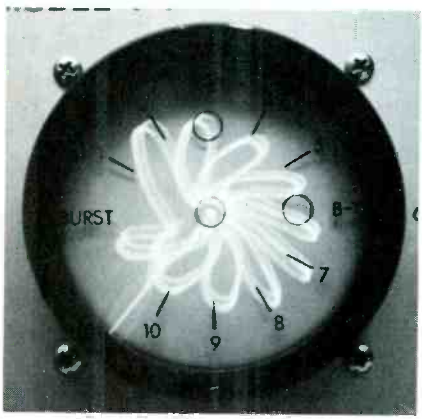


Fig. 2 Pattern obtained with fine tuning of receiver slightly misadjusted.

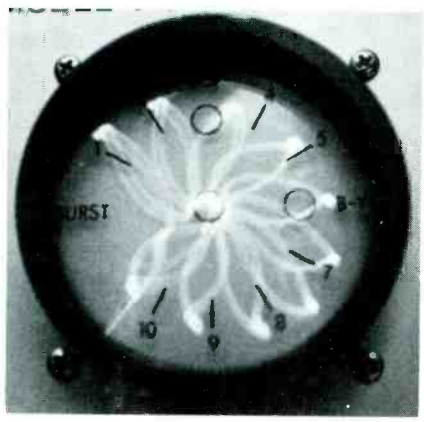


Fig. 3 Saturation of the petal tips caused by gross misadjustment of the fine tuning.

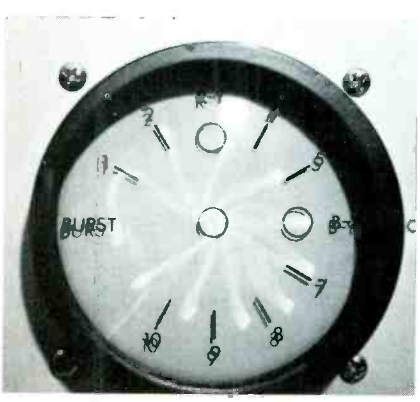


Fig. 4 Pattern observed with tint control rotated completely clockwise.

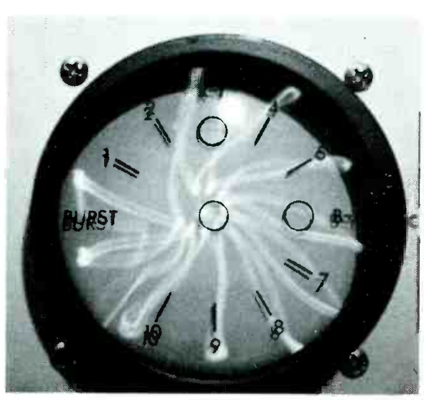


Fig. 5 Full counterclockwise rotation of tint control produced this pattern.

Arrival of the vectorscope on the servicing scene has made such home call procedures possible. The following case history not only adds to the proof that it can be done, it also points up the effectiveness of the vectorscope for troubleshooting chroma circuits. But first, let's examine the pattern displayed by the vectorscope and how it is interpreted.

The Vectorscope Pattern

The 10 chroma bars from a gated-rainbow generator are processed through the circuits of the color receiver and picked off by the vectorscope at the R and B, or R-Y and B-Y, amplifiers to form a circular pattern of daisy petal fingers on the 300° calibrated graticule of the vectorscope, as illustrated in Fig. 1. The R, or R-Y, 3rd bar points almost vertically at 90° and the B, or B-Y, 6th bar extends horizontally at 180° or 180° plus. The various amplitudes, thinness, curvature, position, and presence or absence of these two prinicipal vectors can relate almost anything you might want to know about the condition of the receiver's color circuits.

This instrument can be of tremendous value to the technician and, as we shall soon prove, it can be used just as easily in the home as in the shop.

The Proof

We received a call one day to come and service a relatively new Sylvania, Model 25LC114C, color receiver that reportedly had poor vertical linearity, a yellow haze on

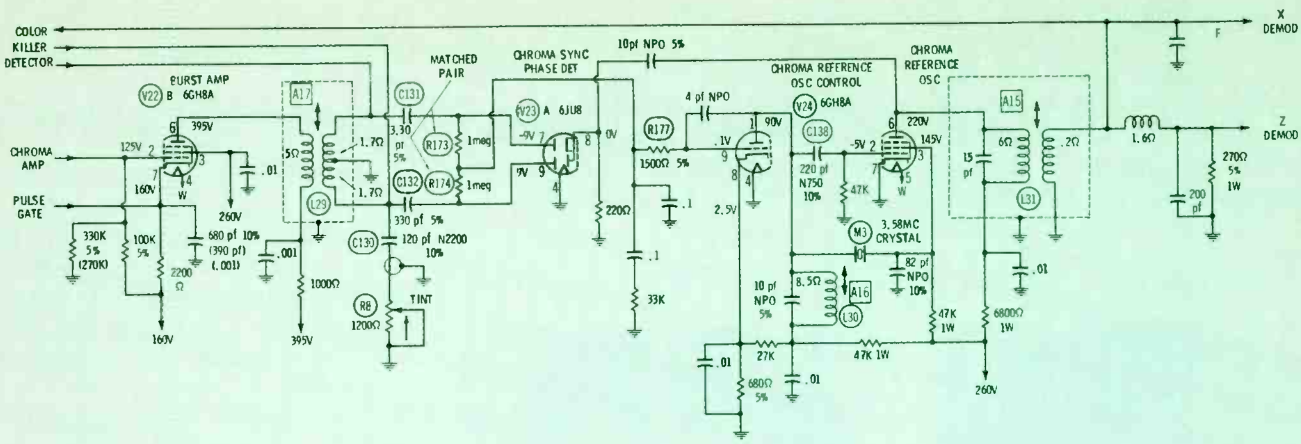


Fig. 6 Partial schematic diagram of chroma circuitry employed in Sylvania DO2 series chassis.

the left side, a high-voltage arc, color fringing on monochrome programs, and inadequate flesh tones during color broadcasts. It sounded like the perfect shop job, but we took along a supply of tubes, a good DC triggered sweep oscilloscope and a vectorscope.

Preliminary checking revealed that the high-voltage arc was caused by a corona leak through the insulated filament winding. We cured this problem with a heavy duty, 30-kilovolt cable.

Next, we checked the tubes. There were four weak ones, including the vertical output tube, which was the cause of the poor vertical linearity. The VHF tuner was also dirty, so it's cover was removed, and the contacts cleaned. A new 6GU7 horizontal blanking and G-Y amplifier eliminated the yellow stripe on the left of the screen. (A decrease in the amplitude of the blanking pulse can cause a greenish-yellow vertical band that can be moved by adjusting the horizontal hold control.) Slight static and dynamic convergence did the rest.

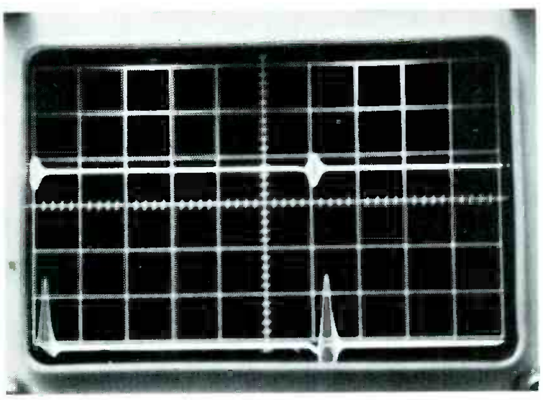


Fig. 7 Double exposure displays both the DC and AC waveform components at the plate of the burst amplifier.

After the set and its new tubes had been allowed to heat for half an hour, a slight adjustment of static and dynamic convergence eliminated the fringing. A final routine check of the high voltage indicated that it was adjusted within the necessary limits for safe levels of X-radiation. Also the screen controls were adjusted for color temperatures that would produce uniform gray-scale tracking over the entire brightness range.

Now came the ultimate test—proper flesh tone, or hue, reproductions. We covered the top of the receiver with a cloth and set up the DC triggered-sweep oscilloscope and a combination vectorscope and color bar generator.

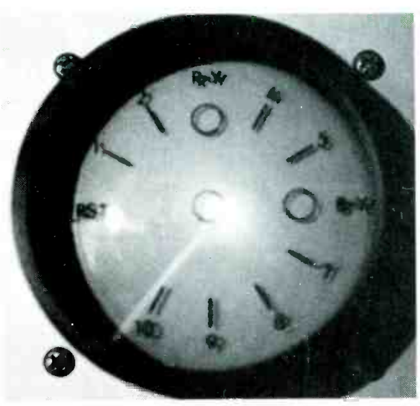


Fig. 8 Pattern displayed with color out of sync.

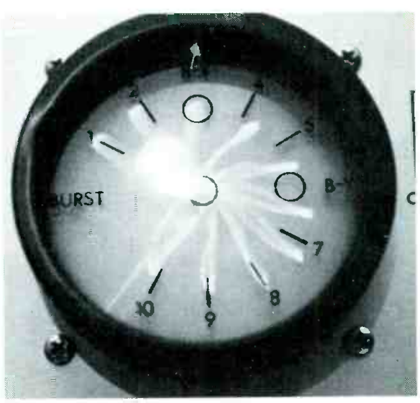


Fig. 9 Pattern showing third petal on the R-Y axis and the sixth petal midway between the B-Y axis and position 7.

The combination vectorscope-color bar generator was connected to the antenna terminals through the RF lead, and to the R-Y and B-Y outputs at the grids of the picture tube (points K and M). Both the receiver and the pattern in Fig. 2 were observed.

The first rule for using a vectorscope is to look at the fine tuning of the TV receiver. If it is misadjusted (for the vectorscope), the pattern will open up into a wide, oval petal display indicating that the local oscillator of the receiver must be readjusted for a relatively fine-line pattern. (Live pictures may require a slight readjustment from this position when the vectorscope is disconnected since the intensity and frequency of the live and instrument-generated signals will differ.) Gross misadjustment of the fine tuning will spread the 10 leaves of the pattern even more and produce what appears to be clusters of saturation at the petal tips (Fig. 3).

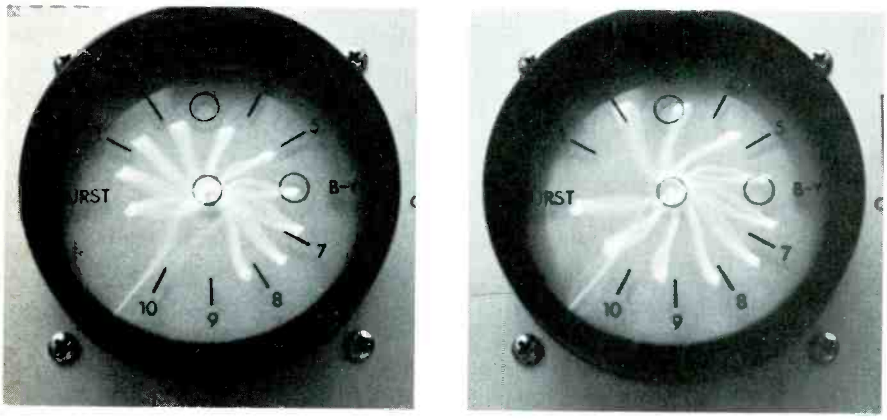


Fig. 10 Effects of rotating the tint control either side of its mid-point setting. **(A)** Tint control clockwise. **(B)** Tint control counterclockwise.

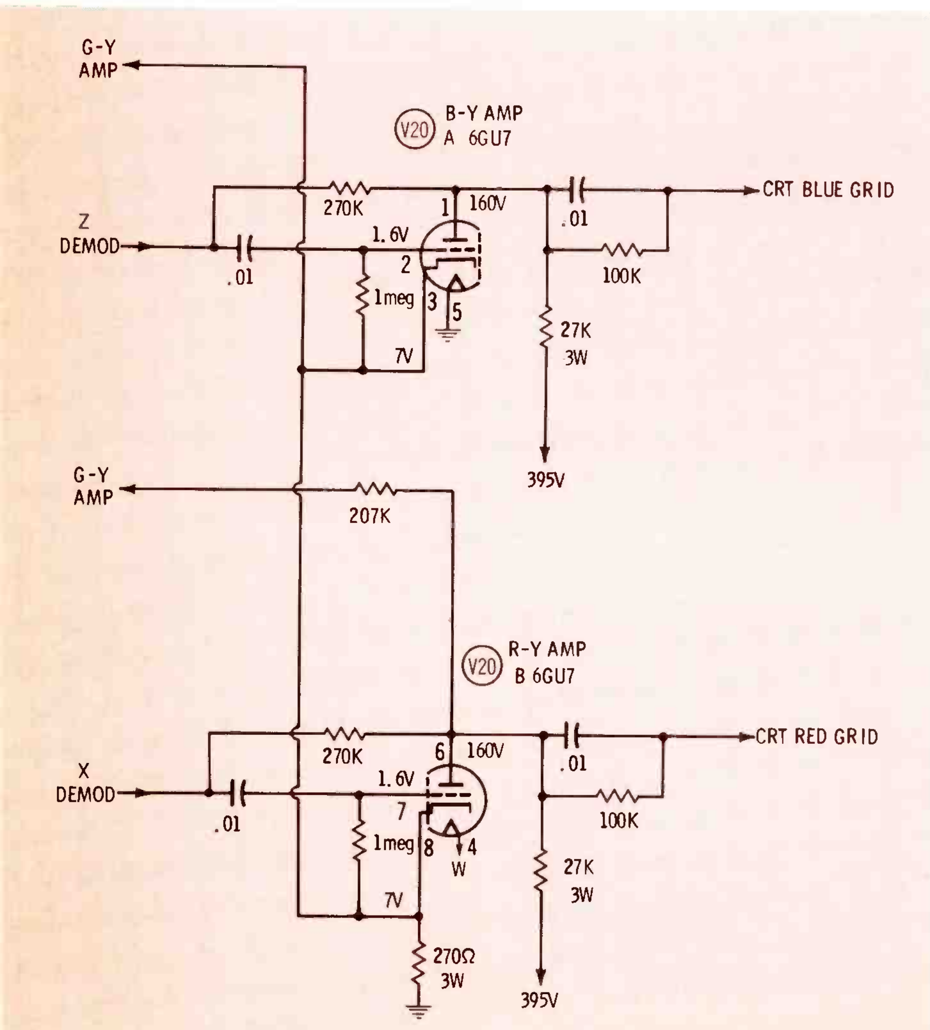


Fig. 11 Partial schematic of color difference amplifiers employed in Sylvania chassis.

Note that the R-Y third bar in both photographs is considerably separated from the vertical axis where, reportedly, it should be to produce "perfect" demodulation.

The next thing we observed was the range of the tint control. (Remember that lack of flesh tones was the principal color complaint.) With the tint control turned fully clockwise, the third vertical bar was only a few degrees to the right of the R-Y vector (Fig. 4). When the tint control was rotated fully counter clockwise, the pattern spread enormously and the third bar wound up almost along the O burst axis (Fig. 5). This was wrong since the receiver manufacturer's literature specifies that the tint control must move the pattern at least 30° either side of the R-Y axis to provide an acceptable range that will meet all colorcast and receiver reception conditions.

Referring to Fig. 6, note that the tint control is simply a charging and discharging path to ground for C130 (an actual time-constant) that, in turn, is connected to the lower side of the burst amplifier transformer as a sort of AC voltage divider and is used to control the phase of the burst transformer secondary. This helps trim the phase detector as it reacts to the difference between the 3.58-MHz oscillator output and the station-generated burst (color sync) signal so that the DC correction voltage generated across R173 and R174 will correctly tune V24A, the chroma reference oscillator control.

Since the tint control, R8, does affect the operation of the 3.58-MHz oscillator, it would be best to be sure of two things: first, that there is no actual breakdown in the burst amplifier that would make the tuning of A17 worthless and, second, that the 3.58-MHz oscillator should be calibrated so that the color demodulation would be relatively correct since A17 has been properly adjusted.

First, let's look at the first amplifier. The waveform at the plate should be approximately 60 volts peak to peak at a DC level of 385 volts. The actual reading, shown in Fig. 7, was approximately 380 volts at a peak to peak scope adjustment of 100 volts per graticule division, and an AC waveform amplitude of 60 volts p-p as indicated by bothe top and expanded trace (20 volts/div.) on the bottom. This

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photo is a double exposure to show both the DC and AC waveforms in convenient perspective and also to illustrate the way a DC voltage can be evaluated using the bottom line of the graticule as O, or ground, reference. Since all voltages were well within 5 percent of the manufacturer's specifications, there was evidently no trouble in the burst circuit, other than some drift. This was due to aging of the 6GH8 (it checked good on a tube checker) or a slight change in the value of a capacitor or resistor, assuming the receiver had been properly aligned when it left the factory—and it evidently had, considering the following information.

Point J, between R173-R174 and R177 (the isolation resistor in the grid circuit of the chroma reference oscillator control) was grounded so that the 3.58-MHz circuit would be free running, permitting it to be tuned so that its resonant frequency would approximate that of the signal from the generator, thus keeping the color bars in floating sync (absolute sync is not attainable with point J grounded since the oscillator receives no correction voltage through V24A).

With the receiver out of color sync, the signal on the vectorscope looked like a semicircular, whirling pattern (Fig. 8) with complete absence of the prominent 10 color bar fingers usually present. Reactance coil L30 was tuned so the 10 color bars displayed on the TV screen were standing still. When the short at point J was removed, color sync snapped into lock, and the receiver was immediately tested on a color program. If the color bar generator itself isn't accurately calibrated for operation close to 15,750 Hz less than the set subcarrier frequency of 3.579545 Hz, the receiver sync oscillator may fail to lock in on the local programs, and the receiver will not produce the correct color information. An accurate electronic counter can be used to calibrate your color bar oscillator to a frequency of 3.563795 Hz; or you may achieve a coarse calibration by beating the generator signal with the broadcast burst in the color receiver. However, check several stations, as they may vary.

The next step was to actually tune the burst amplifier transformer (A17) so that the tint control would

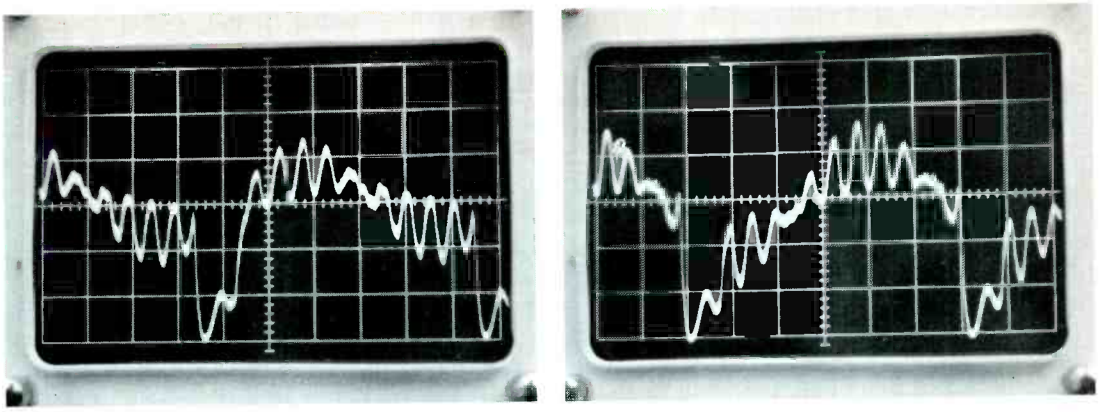

Fig. 12 Conventional displays of the outputs of the R-Y and B-Y amplifiers. **(A)** Sixth bar close to zero reference. **(B)** Third and ninth bars close to zero reference.

have as wide a range as possible from its center setting. There are two methods for accomplishing this adjustment: the vectorscope method and the conventional scope method. We decided to use the vectorscope method first and then check the results with the conventional scope.

The third bar, or petal on the vectorscope was positioned on the R-Y axis (Fig. 9), and A17 adjusted so that rotating the tint control either side of its center setting caused the third bar to move approximately 45 degrees either side of the R-Y axis (Figs. 10A and 10B). The actual effect of the tint control on flesh tones was checked by watching a color program while rotating the tint control. The control had good range and produced acceptable flesh tones, although the center of the tint range did not correspond to the center setting of the control.

Next, the preceding tint range adjustment was checked using a conventional scope. The tint control was set at its mid point of rotation and the scope was connected to the point K (Fig. 11), the output of the R-Y difference amplifier. The burst transformer, A17, was then adjusted so that the 6th bar in the waveform in Fig. 12A was as close as possible to the zero reference line.

The scope input was then switched to point M, the output of the B-Y difference amplifier, and the waveform checked to insure that the third and ninth bars were as close as possible to the zero reference line on the scope, as indicated in Fig. 12B.

With the waveforms in Figs. 12A and 12B present at points K and M, respectively, the burst transformer was assumed to be adjusted for a proper balance between the R-Y and B-Y outputs, thus providing correct tint control range.

The vectorscope was then reconnected to the receiver to again check the positions of the 3rd and 6th bars on the vector pattern. As shown in Fig. 13, the third bar, or petal, was at approximately 85 degrees and the sixth fell slightly beyond the B-Y axis.

Thus, from the vectorscope pattern it was determined that the demodulation angle between the R-Y and B-Y demodulators was approximately 105 degrees (190-85) which corresponded to the demodulation angle prescribed for this receiver by the manufacturer.

As a precaution, the adjustment of the 3.58-MHz oscillator transformer, A15, was checked as follows: The grid of the burst amplifier was grounded and the DC oscillator transformer was then adjusted for maximum negative output while viewing the vectorscope. As it turned out, the transformer was already properly tuned, as evidenced by the following action: As the transformer was adjusted counterclockwise from its original setting, the vector pattern elongated with a slight phase shift to the left. The same action was observed when the control was rotated clockwise. Also, at the maximum negative DC voltage setting, the pattern was null and the scope display did not shift.

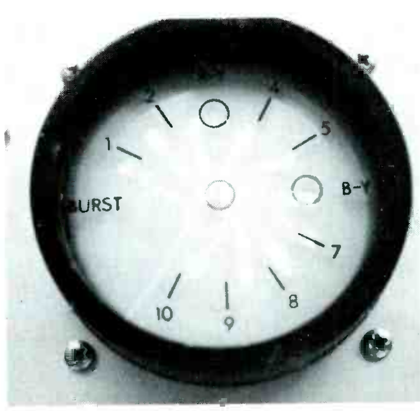

Fig. 13 Pattern indicating a chroma demodulation angle of approximately 105°.

The chroma bandpass amplifier output transformer was checked and found to be properly adjusted since further tuning simply widened or only slightly narrowed the petals of the vector pattern.

Although the job was actually finished in the shop it could have been completed easily in the home if we had not decided to compare the results of the two methods for adjusting the tint-control range.

The preceding case history shows that both the conventional wideband and the vectorscope have wide applications in color TV servicing. The two types of equipment can be used together with one supplementing the other, or they can be used alone. Either approach will be effective as long as the technician understands the limitations and applications of each instrument and can quickly and accurately interpret the waveforms and patterns associated with them. Additional articles on color TV servicing, both with the conventional scope and with the vectorscope, will appear regularly in future issues of PF Reporter. ▲

color

The RCA WT-509A Picture Tube Tester is a precision instrument in the famous RCA tradition. It tests both color and black and white picture tubes for emission quality, interelectrode leakage, and shorted elements. It's all solid-state AND IT'S ONLY $118.00.*

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For a complete catalog of descriptions and specifications for all RCA test equipment see your RCA Test Equipment distributor or write RCA Electronic Components, Commercial Engineering, Department No. K-33WA, Harrison, N.J. 07029.

LOOK TO RCA FOR INSTRUMENTS TO TEST/MEASURE/VIEW/MONITOR/GENERATE

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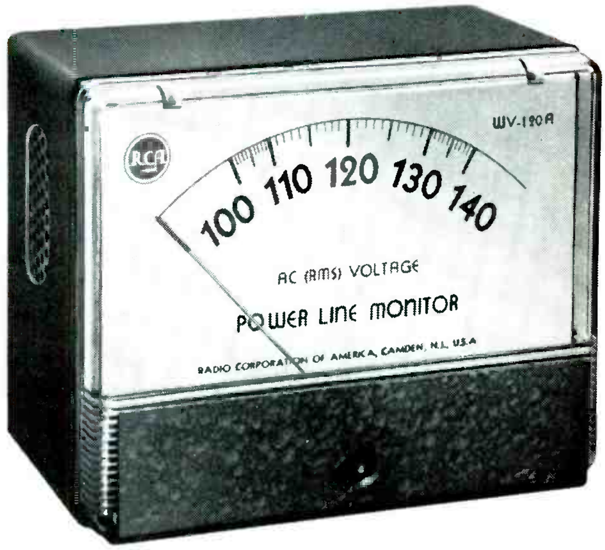
monitor

The RCA WV-503A 240-Volt Power Line Monitor is the big brother of the WV-120A. At a glance, it provides a continuous, accurate indication of the AC line voltage from 200 to 280 volts. Used in conjunction with a variable isolation transformer, it is an invaluable aid in selecting line voltages for TV servicing, test equipment calibration and the operation of electronic equipment that requires a known line voltage supply. ONLY $18.50.*



The RCA WV-120A Power Line Monitor is designed for use by radio-TV repair shops, labs, and industries where it is important to know the power line voltage at all times. Used in conjunction with the RCA WP-26A Isotap isolation transformer on a 50-60 cycle power line, it is an invaluable aid in selecting line voltages for TV servicing, test instrument calibration, and in the operation of electronic equipment that requires a known line voltage supply. AND IT'S ONLY $18.50.*

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Chroma Demodulator and CRT Input Troubles

A look at the common trouble symptoms produced by demodulator and -Y amplifier circuit defects. by Homer L. Davidson

From Demodulator to Picture Tube

The most common trouble symptoms produced by defects in demodulator and -Y amplifier circuits are: missing color or colors, poor black-and-white picture, out of focus and a blooming picture. These same symptoms may appear intermittently; also, more than one trouble may occur in these circuits at the same time.

Generally, defects causing missing colors are found in the demodulator circuits. Poor black-and-white and blooming picture symptoms are usually caused by defects in the R-Y, B-Y and G-Y amplifiers, but don't overlook picture tube and drive circuit defects as the cause for a poor black-and-white picture.

Localizing the Trouble

To quickly localize the trouble, place the normal service switch found on most color receivers in the service position. This will collapse the raster to a thin horizontal line. Next, turn down all three screen controls to minimum. Then, turn up each screen control until a red, blue, or green line appears. If all three colors appear on the CRT screen, the CRT and corresponding circuits are functioning. A weak or missing color indicates a defective CRT or drive circuit.

If one color is missing, change the corresponding demodulator tube. Also, if one or two colors are missing it could be a result of a defect in the -Y amplifier stages. Replace the -Y amplifier tubes for poor b-w gray scale symptoms.

Excessive picture blooming may be traced to the high-voltage regulator or picture tube circuits. The same symptom is produced if the screen grid drive controls are set too high. In the older color receivers, picture blooming is normal when the brightness level is increased toward maximum.

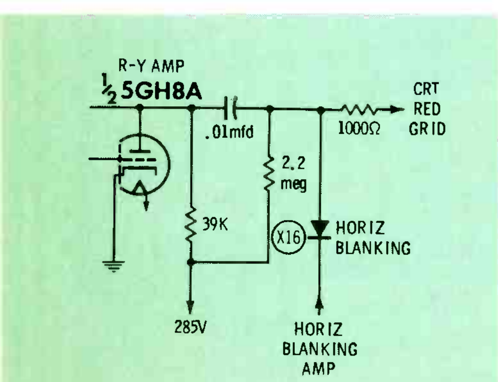


Fig. 1 Diode in plate circuit of RCA color difference amplifier is potential cause of missing color symptom.

Missing Colors

For one or more missing colors, replace the "X" and "Y" demodulator tubes. If this does not cure the trouble, take voltage and resistance readings in the demodulator circuits. A quick scope check on the plate of the demodulator tube will uncover a weak or missing color signal. For accurate scope waveforms always use a dot-bar color generator connected to the receiver antenna terminals.

Defects in the demodulator stages that cause missing color(s) are: defective tubes, open coils, burned resistors, and leaky coupling capacitors. For a weak color condition, check the plate load and cathode resistors. In many cases the demodulator tube will short internally, resulting in burned plate load resistors. Also, check the continuity of all plate coils in the demodulator circuits. Generally, accurate voltage and resistance readings will indicate the defective stage.

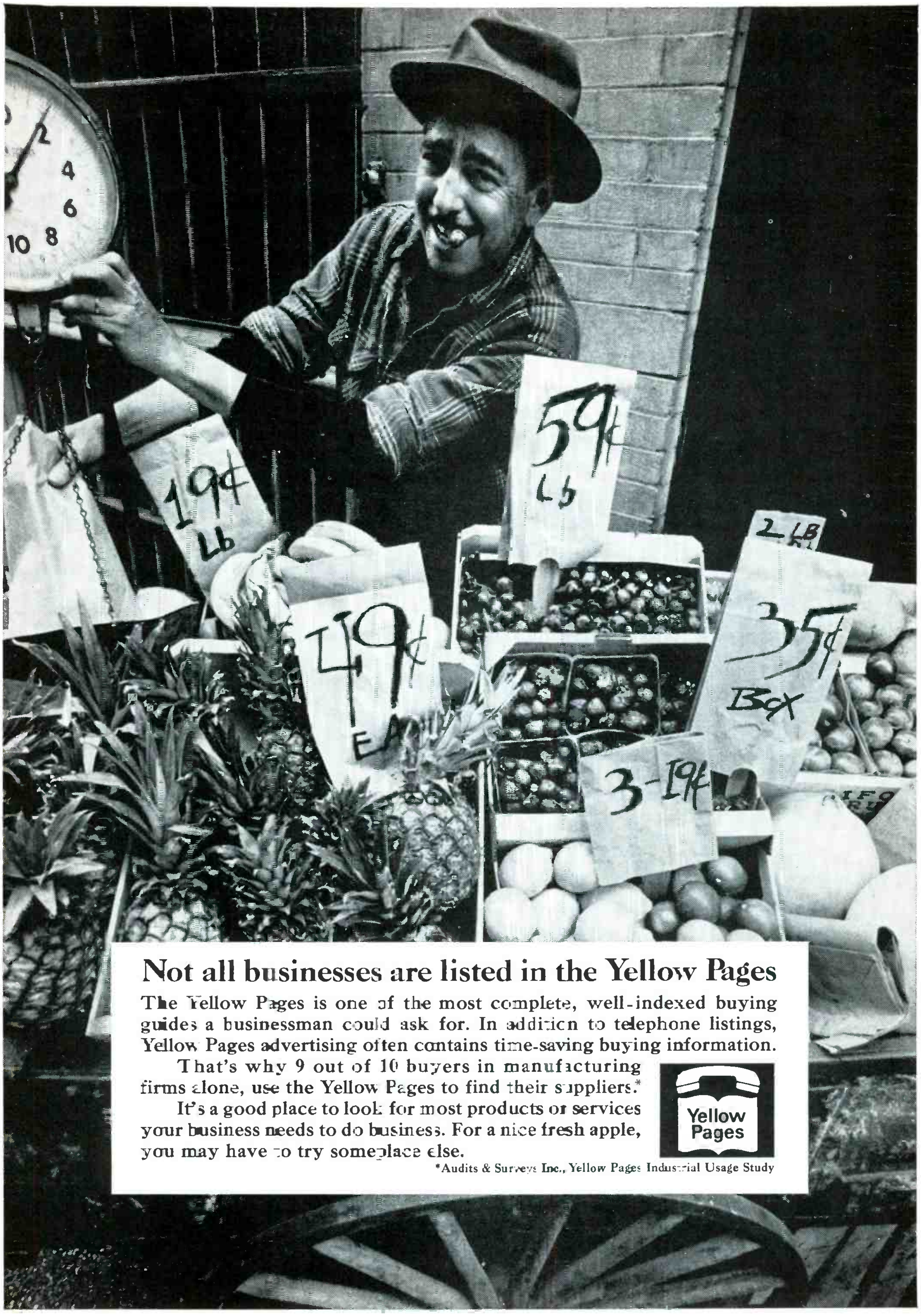
Poor B-W Picture

A poor black-and-white picture is usually caused by a defective -Y amplifier tube or corresponding component. It is also possible to have a defect in the -Y amplifier stages that kills one color. Accurate voltage readings and scope checks will isolate the defective stage.

In the earlier color receivers a poor b-w picture was caused by leaky coupling capacitors between the demodulator and the -Y amplifier grid terminals. These defective coupling capacitors placed a positive voltage on the grid of the -Y amplifier tube, causing excessive current drain. In most cases, the plate load and cathode resistors became burned and changed value. When locating a leaky coupling capacitor in these circuits, replace all three coupling capacitors in the input circuits to the R-Y, B-Y, and G-Y amplifier tubes. This can prevent a possible call back. Most of these capacitors were rated at 400 volts and should be replaced with 1000-volt units.

Don't overlook the possibility of a defective CRT when a good black-and-white picture cannot be obtained. Disconnect the CRT tube socket and check the condition of the CRT with a CRT tester. It is possible that one or two guns will be weak.

Also found in some color receivers is a color fidelity control cir-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cuit. This color fidelity circuit will change the b-w picture to a blue or reddish tint. Always remember to set the color fidelity control in the center of its rotation before attempting to set up the black-and-white raster. This color fidelity control is electrically located in the output of the G-Y and B-Y amplifier circuits.

One advantage of the color fidelity control is that it can be used to compensate for aging of the X, Y and Z circuits which can gradually change the tint of the color picture over a period of time. Also, since no two persons see color alike, the shade or tint of the picture can be tailored to the individual viewers preference.

In some of the 1958 RCA color chassis a pulse set diode is located in the plate circuit of each -Y amplifier (Fig. 1). These diodes can become shorted or open. When one color becomes dominate with a b-w picture, check the pulse diode in the -Y amplifier circuit associated with the predominate color. For instance, if the screen becomes pea green, check the pulse diode in the G-Y amplifier plate circuit. A quick ohmmeter check right on the PC board will determine if the diode is defective. These diodes will normally read 10 ohms in one direction on the low ohm scale. A shorted diode will read less than 10 ohms with the ohmmeter leads reversed. Most of these diodes can be replaced without removing the chassis from the cabinet.

Blooming Picture

Excessive picture blooming is usually caused by improper high-voltage regulation, a defective video or -Y amplifier stage, and defective picture tube input circuits. Blooming is caused by reduced speed of the electron beam in the picture tube.

First, make sure the high voltage is correctly adjusted and properly regulated. With the brightness control set for reduced brightness adjust the high-voltage control for correct ultor voltage. Now insert the current meter in the high-voltage output tube cathode circuit and adjust the horizontal efficiency coil for minimum current reading. A weak high voltage regulator or high-voltage rectifier tube is a likely cause of picture blooming.

After the high-voltage circuits are cleared of possible defects but excessive blooming persists, check the video and picture tube circuits. Any stage that reduces the drive to the CRT can be at fault.

A defective R-Y, G-Y, or B-Y amplifier tube can cause blooming. An open or burned cathode resistor in any -Y amplifier circuit will cause this symptom. Also check for a shorted or leaky coupling capacitor in these stages.

Again, voltage and resistance readings will usually isolate the defect. Also check for increase resistance or burned resistors in the cathode drive circuits of the picture tube. Any change in resistance can produce excessive blooming. When only one color blooms, suspect the bypass capacitors across the corresponding screen control. Setting the screen drive controls too high will also cause blooming.

Poor Focus

Generally, poor focus is caused

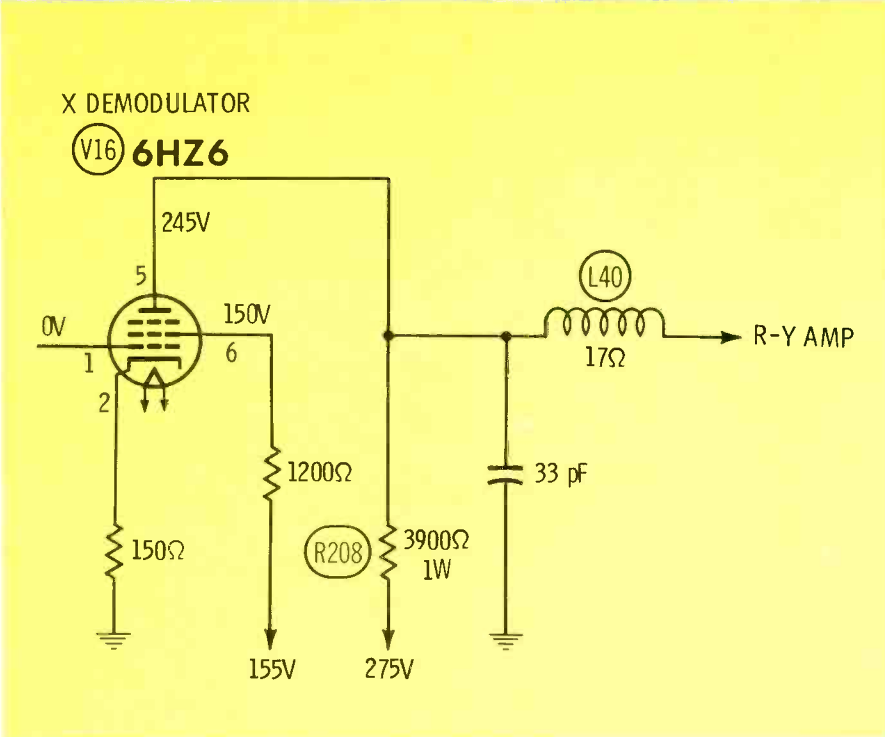


Fig. 2 Poor solder connections at R208 and L40 caused intermittent color in RCA CTC25 color chassis.

by a defect in the high-voltage section, but it is possible to have poor focus conditions with a blooming picture. First, check for correct focus voltage to the CRT. Also check for a corroded focus pin on the CRT tube socket. Improper high voltage will result in lower focus voltage.

If the focus voltage is correct, check the CRT or corresponding circuits. A weak or shorted picture tube will never focus properly.

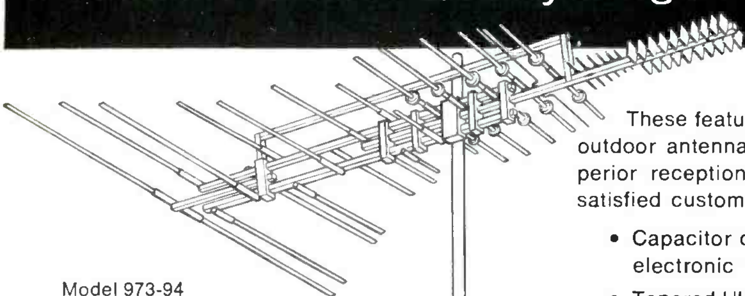
The following paragraphs will analyze actual troubles caused by defects in demodulator and -Y amplifier circuits.

Intermittent Color

The red color was missing from this RCA CTC17 color chassis, and the screen was predominately green with a small tint of blue in the picture. Replacing the "X" demodulator tube did not solve the intermittent condition. The red color would appear and then the raster would shift to a green cast.

The color chassis was pulled and voltage readings were made in the "X" demodulator and R-Y amplifier circuits. After several attempts, the red color disappeared and no voltage could be found on the plate of the demodulator. A poor soldering connection was found on one side of resistor R208 (Fig. 2). The intermittent color condition was eliminated by making a better soldering connection.

In another RCA chassis, CTC25, the same intermittent color condition was located in the same circuit. One leg of coil L40 had an intermittent tinned lead. The coil was removed and soldering paste



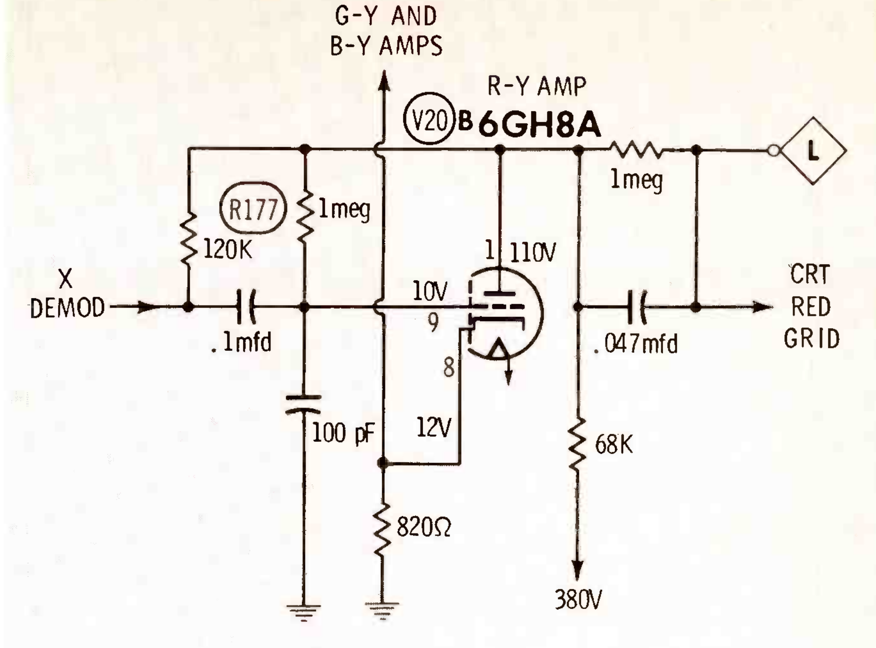


Fig. 3 Poor solder connection at R177 resulted in loss of red color on screen of RCA CTC19 chassis.

applied to make a completely tinned lead. Intermittent color conditions are usually caused by poor PC board connections and intermittent demodulator and -Y amplifier tubes.

An RCA CTC19 chassis would become intermittent, then the screen would turn blue and green without any red in the picture. Tapping the cabinet or chassis would cause the picture to flash on and off. The "X" demodulator tube and R-Y amplifier were replaced, but red was still missing from the color picture.

Quick voltage checks were made at the "X" demodulator stage. By accident, resistor R177 (Fig. 3) was touched and the intermittent condition began again. Probing uncovered the fact that one end of the resistor had a poor soldering connection.

Half and Half

The left side of the picture displayed by an RCA CTC28 chassis was all green and the right side a dark purple color. The trouble was first thought to be a video defect; however, when the R-Y and B-Y amplifier tubes were pulled, the screen went black. The trouble had to be in the G-Y amplifier stage.

Pulling the chassis and making accurate voltage readings isolated the trouble. L706, in one leg of the 270-volt supply line to the G-Y and R-Y amplifiers (Fig. 4), was open.

Since these small inductance coils are completely sealed, it is difficult to find a broken end of the winding to repair. It is usually easier to replace them.

To save valuable service time, suspected peaking and coupling coils can be checked with an ohmmeter from the top of the TV chassis.

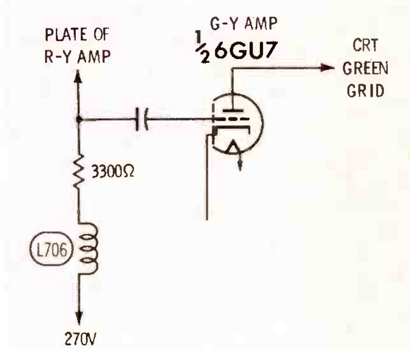


Fig. 4 Open L706 in RCA CTC28 chassis turned left side of screen green and right side dark purple.

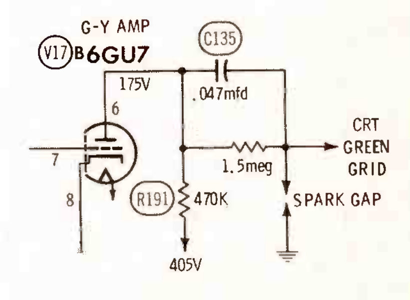


Fig. 5 Leaky C135 caused blooming on screen of RCA CTC25 chassis.

Excessive Blooming

When the brightness control was turned down, the picture on an RCA CTC25 chassis began to bloom. Adjustment of the screen drive controls made no difference. Three months prior to the appearance of this trouble symptom a new CRT had been installed in this color receiver.

We tried to isolate the trouble between the picture tube and -Y amplifier circuits by throwing the service switch. The green horizontal line would not register on the CRT. Since a new picture tube had been installed recently, the trouble was probably in the circuitry of the picture tube.

After taking screen and grid voltages on the CRT, the only telltale voltage reading was on the plate of the G-Y amplifier tube (Fig. 5). The voltage there measured 45 volts less than the normal voltage indicated in the PHOTOFACT folder.

A resistance check of the plate load resistor, R191, indicated that it was normal. The CRT end of capacitor C135 was removed from the PC board and the unit checked for leakage. A DC voltage reading on the disconnected side indicated that the unit was leaking. The original 100-volt type was replaced with a capacitor rated for 600 volts.

Dim Picture

An RCA chassis displayed a dim picture. The customer also complained of white lines flashing across the screen. The lines would appear shortly after the color receiver was switched on and would continue only for a few seconds.

When the 22JP22 picture tube was tapped lightly at the tube socket, the picture would come and go. Testing the CRT on a picture tube tester indicated a short between the heater and cathode elements.

Summary

Missing color is found usually in either the demodulators or -Y amplifier stages. Excessive blooming can develop in the -Y amplifier, high-voltage regulator, CRT or picture tube drive circuits. On color receivers that have a service-normal switch, CRT circuit problems can be isolated by placing the switch in the service position and turning up each screen drive control to determine which color is missing or weak. ▲

Practical Stereo-FM Servicing—Part 1

by Robert G. Middleton

Frequency response tests

Although a stereo-FM or AM-FM stereo chassis is not a simple system, it can be broken down into functional sections as depicted in Fig. 1. Troubleshooting is comparatively easier when a section is completely dead, than when the system "still works but doesn't sound right."

Preliminary clues often can be observed by turning the function switch and listening carefully to the sound output on each function. For example let us consider the following situations:

1. If the AM radio operates satisfactorily, but FM mono is distorted, the FM front end and the FM detector are checked. There is also the possibility of trouble in the FM function of the IF amplifier.

2. If FM-stereo and phono-stereo functions are distorted, the audio sections are suspected first.

3. If the phono-stereo function is normal, but one channel is distorted on FM-stereo, we turn our attention to the multiplex section.

4. If the FM-stereo function is normal, but one channel is distorted on phono-stereo, check the phono cartridge first.

Tube vs. Transistor Circuits

Section malfunction in tube-type or hybrid systems is approached in the same manner as a TV receiver with the tubes being the immediate suspects. However, in an all-transistor system, capacitor defects are suspected at the outset as transistors have a much lower failure rate than tubes. A shorted or leaky capacitor will usually show up during DC voltage measurements, though an open capacitor usually must be pinpointed by scope waveform checks.

With this brief introduction to trouble localization we will now discuss specific trouble symptoms and their causes and cures.

Frequency-Response Characteristics

One of the more elusive causes of a "doesn't-sound-right" complaint is poor frequency response in a defective section. There are several common causes of this symptom:

1. A capacitor or other com-

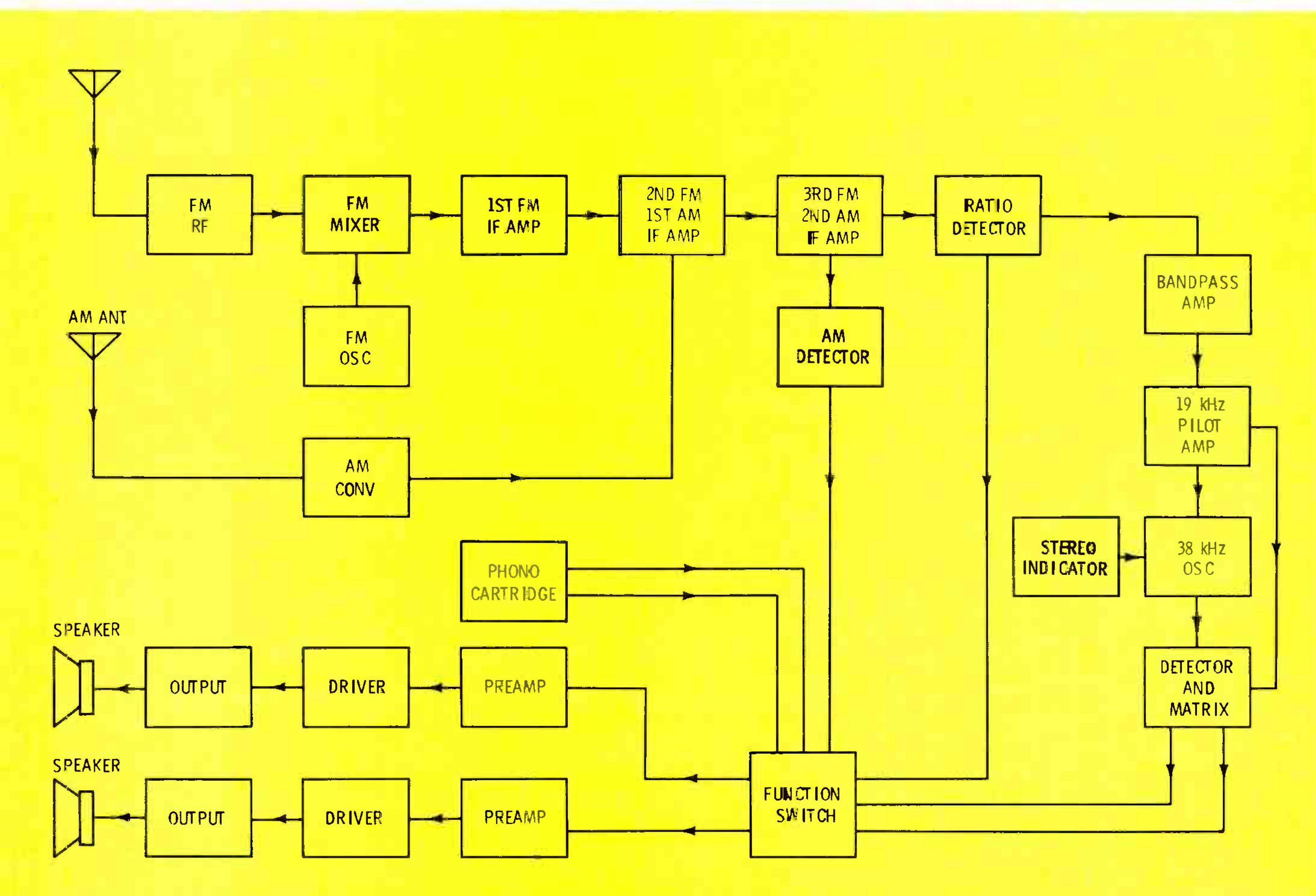


Fig. 1. Block diagram of a typical AM-FM stereo chassis.

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ponent associated with a tuned circuit is defective.

2. Rough handling has caused tuned circuits to resonate off-frequency.

3. Expansion and contraction of components due to thermal cycling has caused frequency shift in a tuned circuit.

4. A do-it-yourselfer has "fiddled" with the alignment adjustments prior to the service call.

5. Previous tube or transistor replacements have changed the total capacitance in one or more tuned circuits, thereby causing tuned circuits to resonate off-frequency.

6. A tuned-circuit component has been replaced previously, and the stage aligned by ear.

Let us consider the normal frequency response for the front end of an FM tuner. Fig. 2 shows the circuit diagram for a typical tuner. The front end consists of the RF amplifier, oscillator, AFC circuit, and the mixer. Each channel has a bandwidth of 150 KHz. Therefore, an ideal frequency response for an FM tuner would have a rectangular shape, as indicated in Fig. 3. The bandwidth indicated for station A would be 150 KHz. However, it is impossible to obtain this ideal frequency response with tuned circuits. Accordingly, we settle for a frequency response similar to the actual response curve shown in Fig. 3.

It might seem that a full 150-KHz bandwidth would not be obtained from the actual curve in Fig. 3; however, the top portion of the curve is effectively sliced off by subsequent limiter action. Therefore, a full 150-KHz bandwidth is obtained, although the peak frequencies span a lesser bandwidth.

It is undesirable to align a front end for excessive bandwidth, because selectivity and gain are sacrificed. On the other hand, it is undesirable to align for decreased bandwidth, because fidelity is sacrificed due to sideband cutting, i.e., if the higher sideband frequencies are attenuated, the higher audio frequencies will be attenuated proportionally.

Note that the AFC and oscillator sections in Fig. 2 have no effect on the shape of the front-end response curve. The front-end response is developed between the antenna-input terminals and the mixer test-point (TP5) by the circuits that include L5, L3 and L4. The oscillator merely injects a beat signal that is 10.7 MHz higher than the center frequency of the front end. Since we are concerned only with the frequency-response characteristics of the front end at this time, details of alignment procedure will be reserved for subsequent discussion.

The IF amplifier includes the circuits from the plate of the mixer tube to the grid of the second limiter tube in Fig. 2. Normally, the IF amplifier has the same frequency-response curve as the front-end except that the skirts are much steeper due to the cascaded tuned circuits consisting of T4, T5, T6 and T7.

The bandwidth of a normal FM IF curve is measured as shown in Fig. 4. The frequency span between the 50 percent maximum amplitude points is normally 200 KHz. Thus, the FM signal with a bandwidth of 150 KHz can be passed by the flat-topped portion of the response curve without sideband cutting.

Note that the flat top of the response curve is due, in part, to limiter action. Therefore, minor peaks and valleys in the IF response prior to the limiter are sliced off, and a flat response is fed to the discriminator. Serious peaks and valleys cannot be removed by limiter action, though, so it is advisable to check the IF frequency response with a signal level that just produces silencing. This will be explained in greater detail later.

The normal frequency response of the FM detector, or discriminator, is shown in Fig. 5. The important characteristics of this S curve are adequate bandwidth (200 KHz in the example shown) and a linear interval between the band limits. If the bandwidth is inadequate, the high-frequency sidebands will be cut. If the frequency response is nonlinear, some audio frequencies will be attenuated and others will be enhanced. The end result of a good alignment job is flat frequency response over the complete audio-frequency range.

Most readers are familiar with pre-emphasis and de-emphasis in FM systems. For the benefit of less experienced technicians, let us note that the high frequencies are emphasized in an FM broadcast signal, but are not emphasized in a test signal obtained from a signal or sweep generator. Therefore, generator tests of frequency response are made between the grid of V9 and test point D in Fig. 2. The de-emphasis network consists of R24, C39 and C40. This is a low-pass filter with a normal frequency response as shown in Fig. 6. The response of the de-emphasis network can be checked with an audio oscillator and an AC VTVM.

FM stereo multiplex configurations, such as shown in Fig. 7, operate from low audio frequencies up to 53 KHz. Therefore, the discriminator must drive the multiplex sec-

Table 1. FM Stereo-Multiplex Adapter Alignment Procedure

FM stereo multiplex alignment using FM stereo signal generator (±.0001% accuracy)

Connect high side of generator to point C, low side to ground.

Generator Frequency	Indicator	Adjust	Remarks
67 KHz	Vert. amp. of scope through a 1 meg to point D; low side to ground.	A19, A20	Adjust for minimum. If whistle or interference is present, readjust A19, A20 to eliminate this condition.
19 KHz	Vert. amp. through 47K to point E; low side to ground.	A21, A22	Adjust for maximum.
19 KHz	Vert. amp. through 47K to point D; low side to ground.	A23	Adjust maximum for 38 KHz response.
Modulated Left Channel	Vert. amp. to point F; low side to ground.	A21, A22, A23	Adjust for minimum.
Modulated Right Channel	Vert. amp. to point G; low side to ground.		Check for minimum. Make compromise adjustments of A21, A22, A23 if necessary.

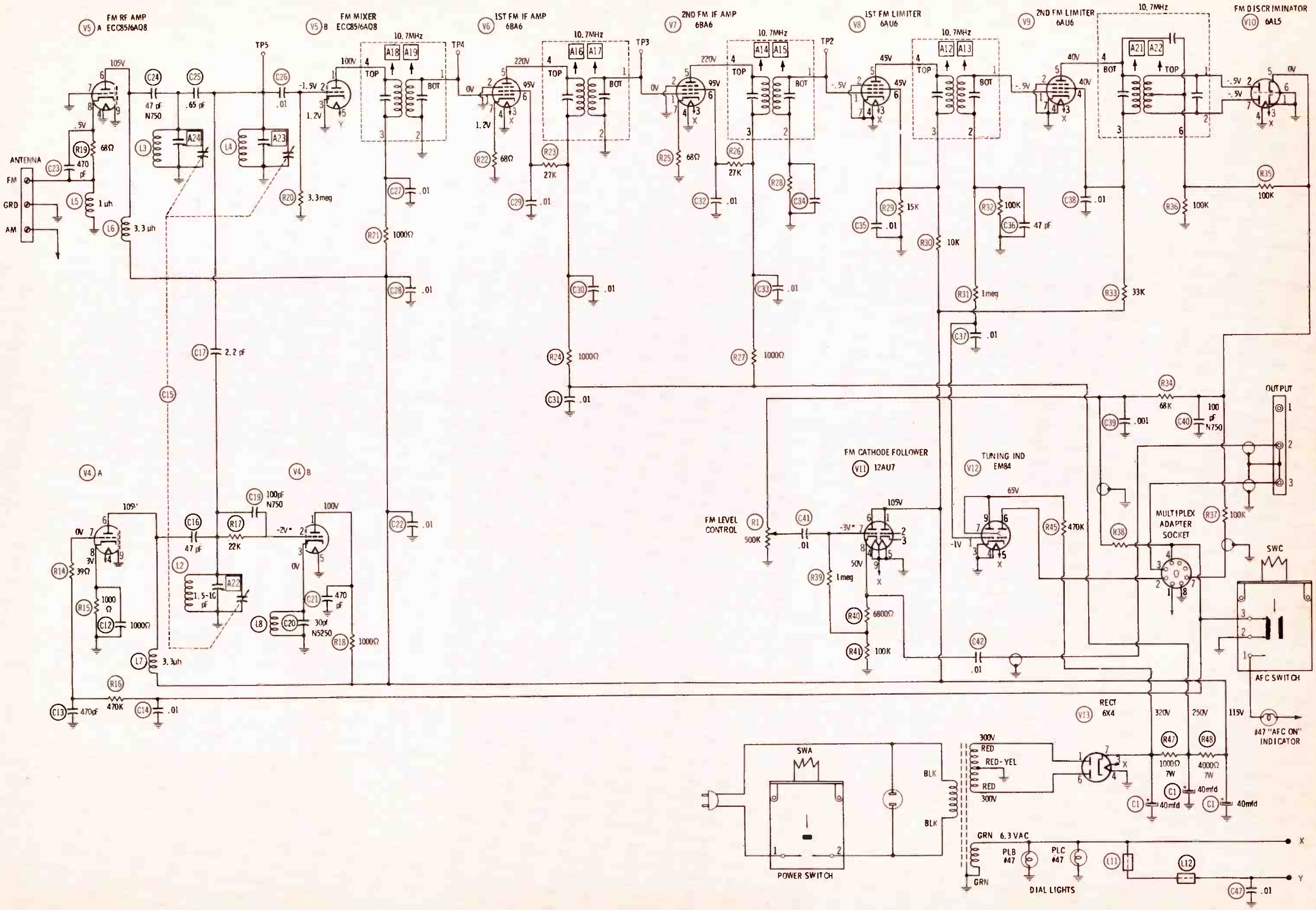

Fig. 2. Complete schematic diagram of a typical tube-type FM tuner.

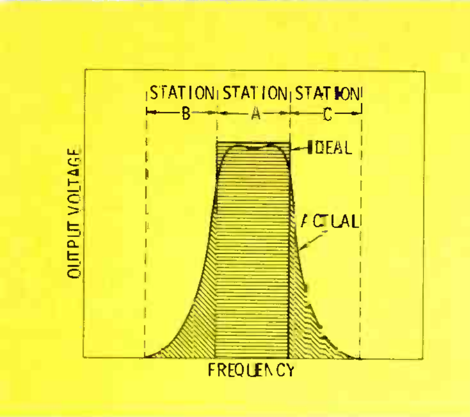

Fig. 3. Frequency-response curve.

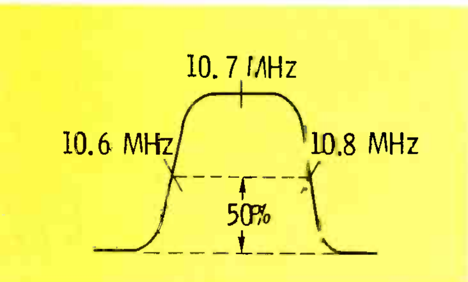

Fig. 4. IF amplifier frequency response.

tion directly, instead of through the de-emphasis network. As in Fig. 2, the output from the discriminator branches into two paths. One path leads through the de-emphasis network; the other through R37 to the multiplex adapter socket.

Fig. 8 shows the frequency spectrum processed by the multiplex adapter. To check the frequency response of the multiplex adapter, a suitable generator such as an FM

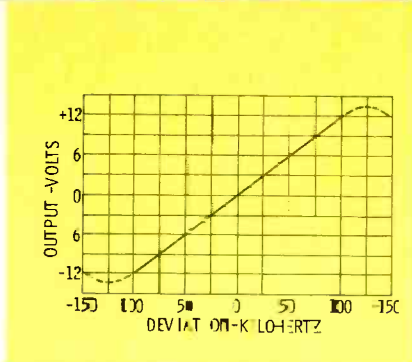

Fig. 5. Discriminator frequency response.

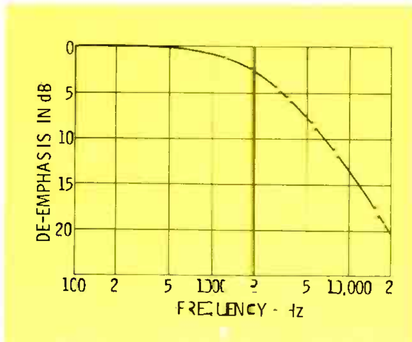

Fig. 6. Standard de-emphasize curve.

stereo multiplex generator or FM stereo signal simulator must be used.

The audio amplifiers are conventional hi-fi units, with an upper frequency response of approximately 20 KHz. Fig. 9 shows the flat audio-frequency response of which the amplifiers are normally capable along with the frequency characteristics of the bass and treble controls. Most shops check audio-frequency response with an audio oscillator and VTVM, though a few employ an audio sweep generator and scope in this test. The chief advantage of an audio sweep test is that the frequency-response pattern can be "sized up" almost at a glance.

Testing Frequency Response

It is a common practice to check the frequency response of stereo-FM systems by sections. Thus, the RF IF sections are checked before the discriminator, etc. An FM test signal is provided by a sweep-frequency generator (or simply sweep generator) and a scope is used as the indicator. As shown in Fig. 10, the FM signal is applied to the input of the tuned circuits, a scope is connected at the output of the tuned circuits, and a frequency-response curve is displayed on the scope screen. For example, the FM RF test signal might be applied at the antenna-input terminals of the FM tuner, and the scope connected at the grid of the limiter tube prior to the discriminator.

We might set the front-end to 100 MHz. In this example the center frequency of the sweep generator would also be set to 100 MHz. The sweep width, or deviation of the sweep generator, is set to a comparatively high value so that the entire response curve and portions of the base line are displayed on the scope screen. The exact bandwidth of the correct response curve should be noted in the receiver service data. It is just as important to align for correct bandwidth as for a properly

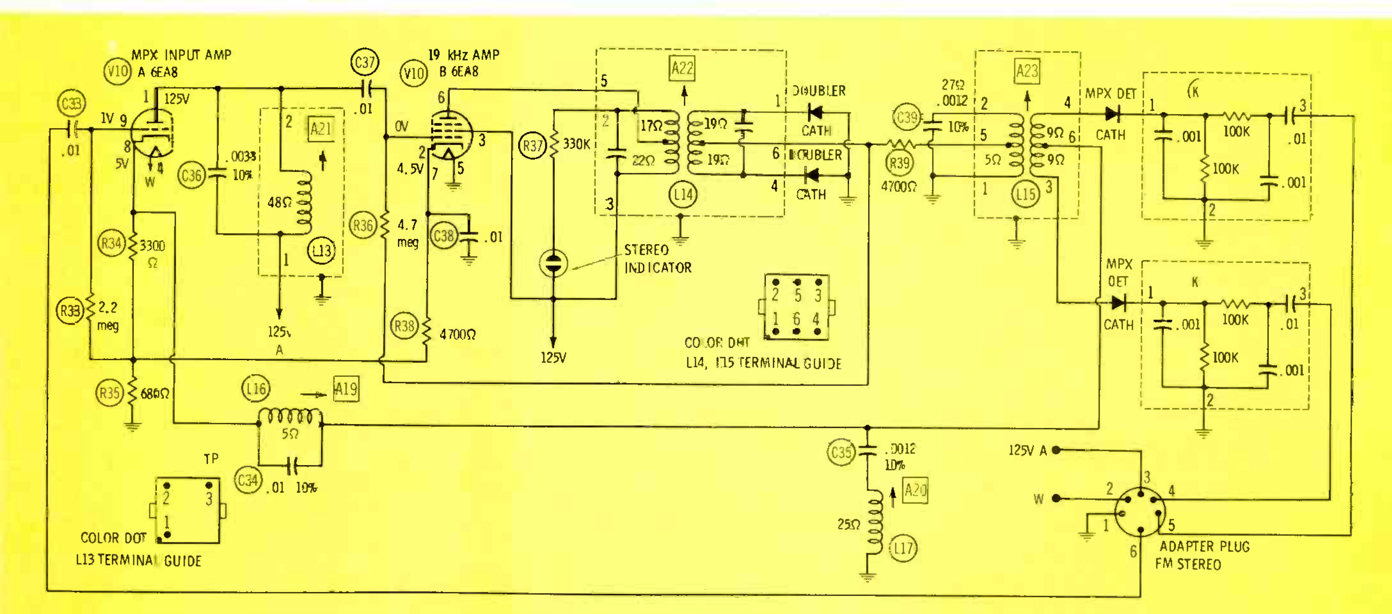

Fig. 7. Envelope-detection multiplex circuit.

shaped curve. A sweep width of approximately 450 KHz is generally used. Fig. 11 illustrates a distorted IF response curve. Compare it with the normal curve shown in Fig. 4.

With reference to Fig. 11, it is necessary to identify the center-frequency point and the frequencies at the 50 percent of maximum points on the curve. This necessitates the use of an accurate marker generator in combination with the sweep generator. (A marker signal is merely a CW signal with a precise frequency. It is marked with the sweep signal and produces a beat frequency that is displayed as a "pip" on the response curve at the marked frequency.) Some sweep generators have a built-in marker generator, if not, a separate marker generator must be used.

Some sweep generators are provided with a crystal holder into which can be plugged a 10.7-MHz (or other frequency) quartz crystal for precise marker indication. For example, if we use quartz crystals to mark the curve shown in Fig. 4, we will require at least two crystals, with frequencies of 10.6 and 10.8 MHz. A crystal with a frequency of 10.7 MHz is also desirable for IF alignment. The foregoing example assumes that the sweep signal is applied at the grid of the mixer tube (V5 in Fig. 2). If the sweep signal is applied at the antenna-input terminals, we then must use RF marker signals. For example, if the center frequency of the sweep is 100 MHz, the bandwidth must be checked with frequencies of 99.9 and 100.1 MHz.

Next, let us consider a test of the discriminator frequency response. An IF sweep signal is applied at the grid of V9 in Fig. 2, and the scope is connected at test point D. A pattern similar to that shown in Fig. 12 is normally displayed on the scope screen (compare it with Fig. 5). A beat marker is easily displayed at either of the band limits (10.6 and 10.8 MHz). However, it is difficult to display a marker at the center frequency (10.7 MHz), particularly when a ratio detector is being aligned. Therefore, many technicians employ a trick of the trade that involves using an amplitude-modulated marker. This causes the response-curve frequency to beat with the modulating frequency, although the marker pip remains in-visible. If the S curve (Fig. 12) is centered on 10.7 MHz, the beat amplitude will pass through minimum as the marker generator is tuned through 10.8 MHz.

Two basic steps are used to test the frequency response of the FM stereo-multiplex adapter. First, the peak and trap frequencies are checked in accordance with the instructions in Table 1. Note that A19 and A20 in Fig. 7 are SCA (subsidiary carrier assignment) traps that are tuned to 67 KHz. L15 is aligned first by peaking it to the subcarrier frequency (38 KHz). However, the optimum adjustments of L15, A21 and A22 are made on the basis of a separation test with stereo signals. This is a specialized test procedure that will be explained in detail in the next article of this series. The procedure is finally verified by checking the frequency-response over the audio-frequency range. Since this verification is tied in with separation characteristics, it also will be covered in the next article.

Frequency-response tests of the audio-amplifier channels in Fig. 1 are commonly made as shown in Fig. 13. The important points to be observed are: (1) provision of a suitable value of power resistor across the output terminals so that the amplifier output circuit is correctly loaded; (2) setting of tone controls for flat response; (3) driving of the amplifier to its maximum rated power output; and (4) spot-checking of the audio-oscillator output to make certain that a constant level of drive is applied over the entire audio-frequency range.

FM Tuner Alignment

Either a signal generator and VTVM may be used, or a sweep-and-marker generator and scope. Let us consider the use of a signal generator. Referring to Fig. 2, proceed as follows:

1. The AFC switch is turned off. If this is not done, the oscillator in the front end will tend to "follow" the test signal, and the bandwidth will seem to be substantially greater than is actually the case.

2. Alignment of the IF amplifier is usually checked first. Turn the FM level control (R1) to maximum and connect the VTVM across the grid-leak resistance of the second limiter tube (V9). This is test point B.

3. A low-level 10.7-MHz CW signal from the signal generator is applied to the grid of the first limiter tube (V8). By setting the generator output below the limiting level, a much sharper peak indication is observed on the VTVM.

4. Slugs A12 and A13 are adjusted to obtain maximum response at 10.7 MHz. Note that the bandwidth is not checked at this time.

5. Align T6 in the same manner. The generator signal is applied to the grid of the second IF tube (V7), with the VTVM connected as before. Thus, T6 is aligned in combination with the response of T7. If the peak indication is broad, reduce the output from the signal generator.

6. Transformers T5 and T4 are peak-aligned in the same way, with the VTVM connected at the grid of V9, as before.

7. The primary of T8 is then peak-aligned. Leave the generator output connected to the grid of the mixer (V5), but move the VTVM connection to the center tap on the secondary of T8. With the generator set for an output below the limiting level, slug A10 is adjusted for maximum indication at 10.7 MHz.

8. To align the secondary of T8, the VTVM connection is moved to test point D, and the VTVM is set for zero-center scale indication. Slug

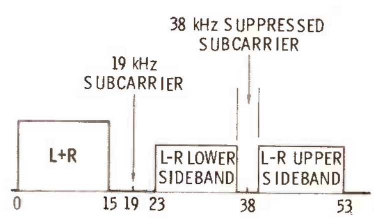

Fig. 8. Frequency spectrum processed by multiplex adapter.

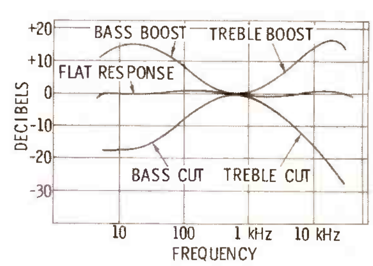

Fig. 9. Response curves for bass and treble tone controls.

The call-back killers...

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A21 is then adjusted for zero indication on the meter. Since A20 and A21 tend to interact, it is advisable to repeat steps 7 and 8.

9. Peak alignment of the IF section is now complete, and we turn next to the RF and oscillator sections in the front end. The signal generator is set up to 108 MHz and its output is applied through a 270-ohm resistor to the FM antenna-input terminals. The VTVM is connected at test point B.

10. With the receiver tuned to 108 MHz, A22 is adjusted for maximum response. This puts the oscillator in rough alignment.

11. Tracking is checked by setting the generator and receiver tuning to 88 MHz. If A22 requires resetting to obtain maximum indication, a compromise adjustment is made.

12. The final peak-alignment procedure concerns the RF section. With the generator and VTVM connected as before, trimmers A23 and A24 are adjusted for maximum indication with the receiver and generator set to 106 MHz. If appreciable adjustment of A23 and A24 is required, it is good practice to repeat steps 10, 11 and 12 because the response is being checked through the IF section.

Peak alignment is ordinarily sufficient. However, when hi-fi response is sought, we must conclude by checking the bandpass of the FM tuner. This is done by leaving the generator and VTVM connected as in Step 12. The generator output is advanced to obtain limiting action (very broad peak indication on the VTVM). Then, the bandwidth is checked with a scope, as shown in Fig. 4. Insufficient bandwidth will cause attenuation of the high audio frequencies and impaired stereo-multiplex action, as will be explained in detail in the next article. Excessive bandwidth is undesirable because selectivity and gain are then sacrificed.

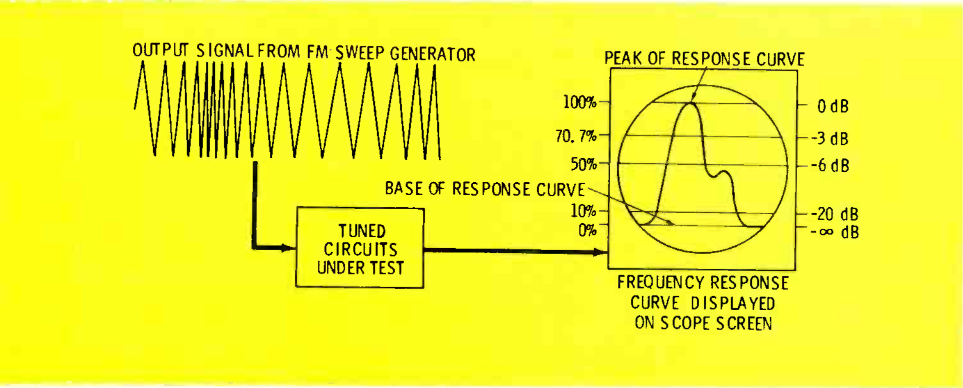


Fig. 10. Basic principle of sweep alignment.

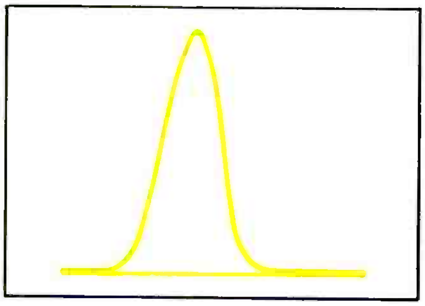


Fig. 11. Distorted IF response curve.

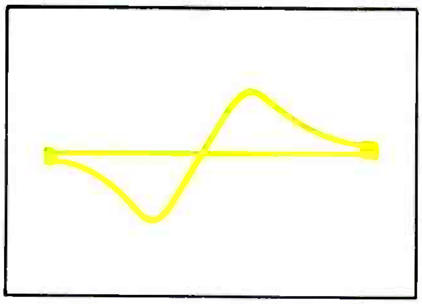


Fig. 12. Discriminator "S" curve.

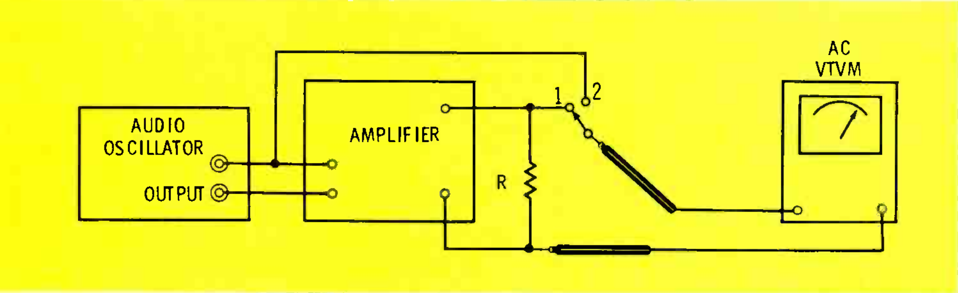


Fig. 13. Equipment setup for testing frequency response of audio amplifier.

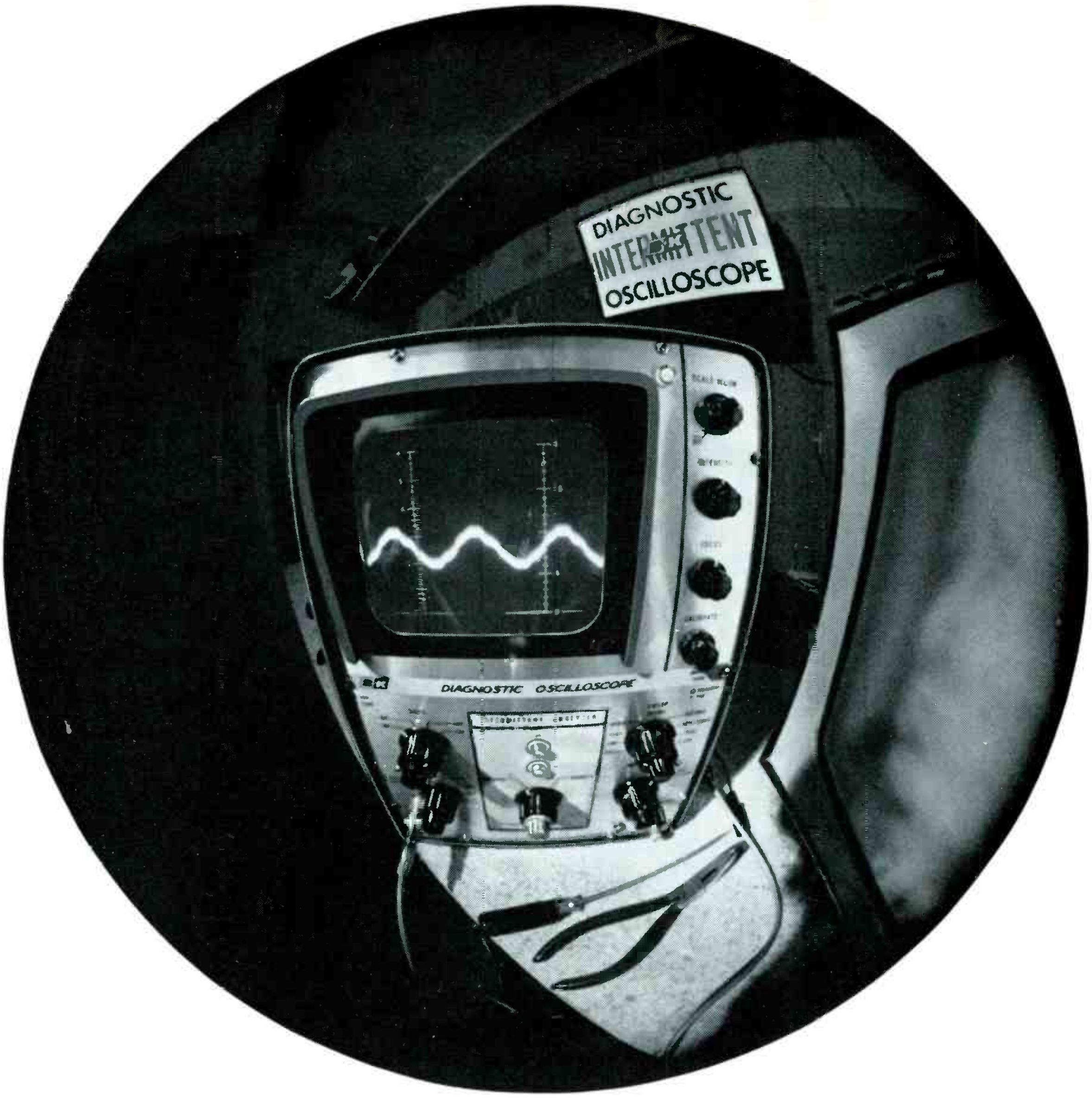
Abnormal Bandwidth

When the over-all response curve indicates incorrect bandwidth even after peak alignment has been attempted, there is probably a defective component in the system. The first step is to localize the defective section. Therefore, we recheck the peak-alignment procedure outlined previously, but we now measure the bandwidth from stage to stage. As we check back from the second limiter, a stage will be encountered at which the incorrect bandwidth suddenly appears. We direct our attention to this stage. Defects in early sections are most troublesome because the inaccuracy is amplified by the following stages.

A common cause of insufficient bandwidth is regeneration. Look for defective screen bypass capacitors, poorly grounded transformer shields and defective plate-decoupling capacitors. Regeneration shows up not only as insufficient bandwidth but also as a change in shape of the response curve at various signal levels. Peaks and valleys in the response curve that are not removed by normal limiter action are usually caused by regeneration. If you place your hand near a tube in a regenerative circuit, the meter indication will change. Stable stages (without regeneration) are practically immune to the effects of hand capacitance.

Excessive bandwidth is commonly caused by leaky capacitors connected across tuned coils. The leakage reduces the circuit Q which, in turn, reduces the stage gain and increases the bandwidth. Suspected capacitors must be disconnected for test since the shunting coil resistance is very low. Shorted turns in a coil have the same effect on circuit action, but this defect is rare.

When transistors are used in an FM tuner, low gain and excessive bandwidth point to collector-junction leakage. It is easy to make in-circuit checks of transistor control action. However, this topic is reserved for treatment in the next issue. ▲



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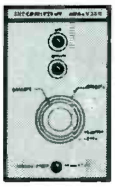

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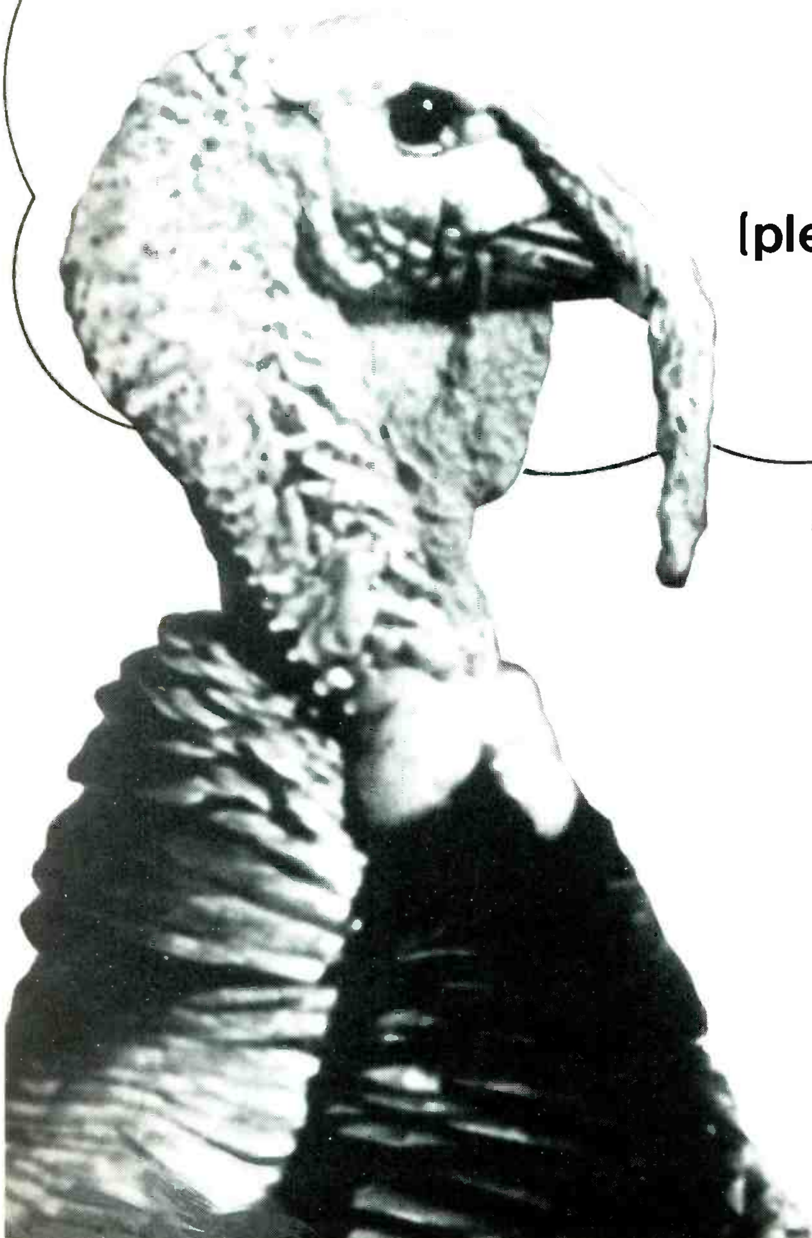

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Beginning with this issue, PF PORTER will provide periodic orts on new training sessions and cialized electronic courses avail- to service technicians and shop ners who are interested in main- ing their knowledge and servic- skill at a level consistent with technological advances of the ctronic industry.

Semiconductor Courses

The Training and Education De- tment of North American Philips mpany, Inc. (Norelco) has an- nced the expansion of its PRAC- ONICS program of electronics truction to include a course in niconductors. Like the first ACTRONICS course, Basic ctricity, full understanding of the rse in semiconductors is achieved ough deductive reasoning based on practical observations.

In each chapter, the method of truction involves a practical ex- iment which serves as an intro- ction to the theory and the math- atics. The student performs the periment, makes and records ob- vations and compares his results th the ideal results given in the t. He then reaches conclusions. ese conclusions may be expressed mathematical and theoretical guage such as laws, theorems, and general statements relating to electrical and electronic phenomena.

With this background, the student is better able to understand the theory because he has actually "re-discovered" the basic principles in his experiment. Completion problems are given at the end of each chapter to test his understanding of the material. There are also experimental problems in circuitry, posed in theoretical terms, which he is required to solve using mathematical formulas. He must then validate his solutions by constructing the circuit and making instrument observations. Thus, the student learns by working from the practical to the theoretical, then from the theoretical back to the practical side of the problem.

The Semiconductors course begins with Basic Operation of the Diode and Transistor and progresses through characteristics, specifications, technology and applications. It consists of two "Practibook" texts and a test set which provides all the necessary power sources, measuring instruments and a variety of components such as capacitors, resistors, diodes, etc.

The same matrix used in the Basic Electricity course is used in the construction of the experimental circuits in semiconductors. It is a transparent matrix specially designed to overlay printed diagrams in the text. In this way, the student learns to recognize essential components visually, in both two and three dimensional contexts, as well as schematically.

The seven-pound, portable, cordless laboratory test set folds to form a compact unit measuring 11″ x 6¾″ x 6″ complete with carrying handles, and is powered by eight 1.5-volt "C" cells. This signal generator-power supply unit also provides a 6-volt unstabilized source; a constant voltage source; and a constant current source. An oscillator produces both sine and square-wave outputs. A multi-range voltmeter/ammeter indicates DC voltage range, AC voltage range and DC current range measurements.

The transparent matrix is equipped with "spiders" containing self-adjusting receptacles which accept both patch cords and mounted components. In practice, the removable matrix will overlay any of the printed diagrams in the "Practibooks". The student constructs the circuit directly on the matrix at the same time as he sees the actual schematic. Each component is precision mounted so that the student can build a reliable circuit.

The matrix and the test set are common to both the Semiconductors and Basic Electricity courses. Progressing from either course to the other involves the purchase of the pertinent "Practibooks" and components only. A classroom demonstrator using the same test set and a large-scale matrix is available.

TV Repair Course

International Correspondence has developed an accelerated program of independent study to teach all practical aspects of color and black-and-white TV repair.

Called TV Servicing/Repair, the course differs from other standard ICS courses in this field by dispensing with electronic theory not necessary for a comprehensive repair knowledge.

The course consists of six hard-cover volumes (936 pages) written by electronics consultant Forest H. Belt, and takes a reader from tube-changing to bench servicing of virtually all TV set disorders—portable and console, tube and transistor, black-and-white and color.

Each volume is indexed and illustrated with line drawings, schematics and close-up photographs—many in full color. Each chapter concludes with a "Check Your Learning" section with answers included so the reader can test his grasp of the subject matter. At the end of the course is a comprehensive examination, which is mailed to ICS for correction. A diploma is awarded after successful completion.

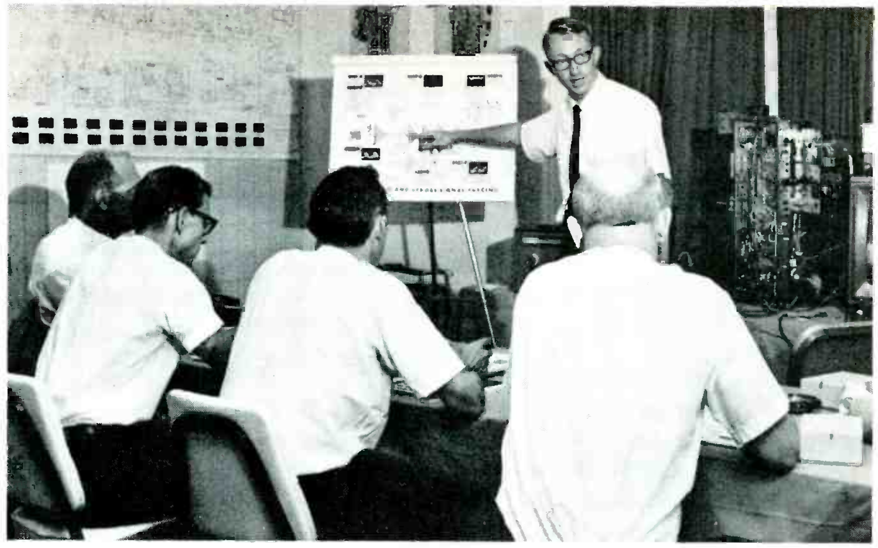
A specially prepared dictionary of TV terms and supplimentary theoretical information, carefully keyed to text material, is included with the course. A portfolio of schematics of major manufacturer's most popular TV models also is available.

This course has been recognized by the National Electronics Association (NEA) as credit towards NEA certification in the Association's apprenticeship program. The price is $99.00.

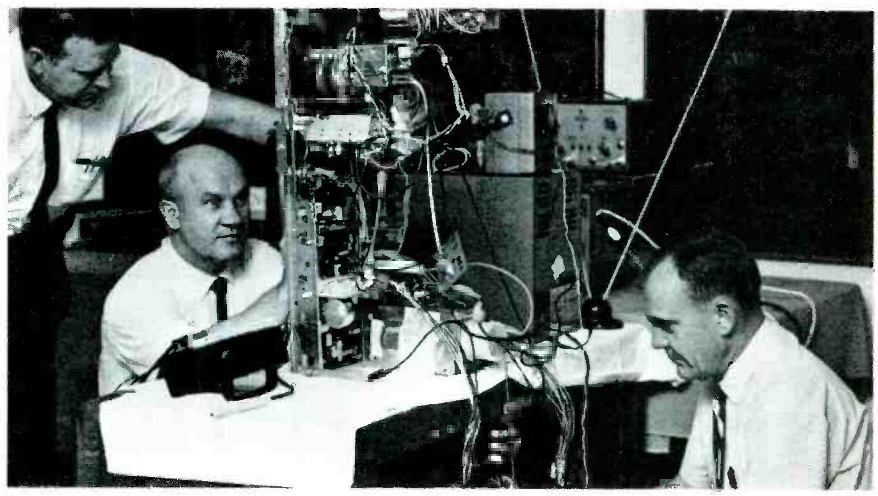
Solid State Color Training

RCA has embarked on an ambitious training program to acquaint service/dealers and technicians with their new CTC40 solid-state color chassis.

Approximately 80 RCA district service representatives recently attended two-day training sessions conducted by the Product Performance-Technical Training Division of RCA at the Marrott Hotel in Indianapolis. Each representative attended one of six two-day sessions held over a period of two weeks. The objective of this kick-off portion of the program was to adequately train each district service manager so that when he returned to his home area he, in turn, could conduct as many two-day training



A member of RCA's Product Performance-Technical Training Division uses a flip chart to explain the circuit operation and servicing procedures associated with the new CTC40 chassis.



The workshop segment of the RCA training program provided district service representatives with practical, first-hand knowledge of the servicing procedures associated with solid-state color chassis.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sessions as needed to provide every interested service/dealer and technician with the technical knowledge necessary to properly service the new solid-state color chassis.

The training sessions were divided into two segments. The first portion was a three-hour slide lecture on circuit theory. The second portion, requiring about one and a half days, was devoted to a workshop training situation in which every technician was given the opportunity to apply the solid-state servicing techniques outlined by the instructor.

Because of the need for individualized instruction during the workshop portion of the program, each class was limited to no more than 12 men.

During the slide lecture each circuit was analyzed in detail using block diagrams, schematics and photos of the actual circuitry as it appears on the circuit board or chassis. Using this method of presentation, the technician is able to relate physical appearances with schematic and block diagram illustrations to increase his understanding and retention of the material.

In the workshop part of the program, the instructor used flip charts to review stage-by-stage circuit operation and introduce proper test procedures. This was followed by a preview of the service problems that are most probable in each circuit, along with the test procedure that will most effectively provide quick and accurate diagnosis of the trouble and its cause.

With the preceding information fresh in their minds, the technicians then moved to the working CTC40 chassis and test equipment to actually perform the test procedures just outlined by the instructor.

Repeated exposure to the operation of the CTC40, together with a practical application of each test procedure provided each district service manager with the in-depth knowledge necessary to conduct effective training sessions in the field.

After successfully completing the two-day training session, each district service representative was awarded a Product Technical Training Certificate of Achievement. The same certificate will be awarded technicians who attend field-training sessions conducted by the district service managers. ▲

SOLVING WRONG-HUE SYMPTOMS

This analysis of circuit operation, trouble symptoms, and troubleshooting techniques will help you quickly pinpoint the causes of improper color. by Carl Babcoke

When the faces on the color TV picture look like green Martians instead of the sunburned Indian hue preferred by most viewers the seemingly natural inclination of many technicians is to adjust the burst transformer until the skin color is natural. Although occasionally a burst phase adjustment seems to clear up the trouble, in most instances such a procedure merely camoflauges the trouble symptom, making the real defect harder to diagnose. After all, a hue adjustment only changes the phase of the 3.58-MHz subcarrier that is applied to the demodulators and many other troubles will also produce wrong-hue symptoms. In the following paragraphs we'll discuss the requirements for proper color production and the techniques needed to uncover defects causing wrong hues.

Good Color From Good B-W

The b-w picture on a color receiver is actually three color pictures—one red, one blue and one green. When all three have the right brightness and contrast ratio and are in good register, the composite picture fools the eye into believing the picture is actually black-and-white. When the desired areas of these three pictures are brightened or darkened by the chroma signal, the b-w picture is changed to full color. Since the color picture is really the b-w picture slightly modified, any defect which keeps the b-w picture from being perfect also degrades the color picture.

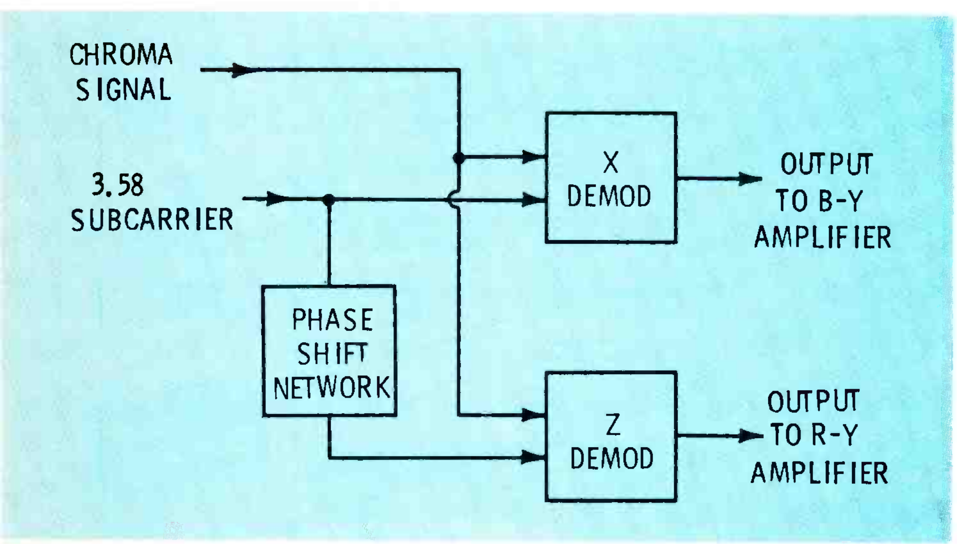


Fig. 1 X and Z demodulators are similar except for phase of 3.58-MHz subcarrier applied to them. Defective components in phase shifting network cause false colors to appear in place of blue.

Set-up adjustments, such as convergence, focus, AGC and brightness-limiter, can greatly improve the quality of both the b-w and color picture. Refer to Howard W. Sams **Color Television Servicing Made Easy,** volumes 1 and 2, for many helpful hints on fast and accurate set-up adjustments.

Of even more importance to natural colors are two other set-up adjustments: purity and screen color. Check the purity by using a gun-killing switch box to look at one screen color at a time. The amount of impurity you see in the red, blue and green fields is the amount of hue error you will see in that area of the color picture. Modern picture tubes, with the phosphor dots large and close together, will show impurities more on color than on b-w pictures. While discussing purity, it should be noted that poor purity can sometimes cause weak color. This is most likely when the impurity causes each color field to be nearly white instead of its intended color. MORAL: always check the purity with this simple test, then correct it, if necessary, before you consider other possible causes of wrong-color symptoms.

The visible balance of red, blue and green in the b-w picture is very critical for true colors. This statement is easily verified on those models which have a "tint" or "color fidelity" control on the front panel to permit the viewer to adjust his own screen color. This screen color control often changes the color rendition as much as the hue (phase) control does. To adjust the screen color on models with this control, set the tint or hue knob to its mid-

point, then proceed to adjust the screen color as usual.

If blue in the b-w picture is weak, the screen color will be greenish-yellow; if green is weak, the picture will be purple. Both of these effects are easy to see. But if red is weak, the screen color will be cyan (blue-green)—and this is not a bad color for a b-w picture. For this reason, you should particularly watch the red when you check or adjust the screen color.

There are two easy tests for sufficient red in the raster. Use the gun-killer switch to turn red off and on several times. Did you notice a definite change? You should be able to tell the difference without any doubt. Now switch rapidly from blue to red to green several times (with a normal b-w picture tuned in). Red and blue should be nearly the same brightness, while green should be somewhat bright. If you have any doubts, better do the whole series of screen color adjustments—using the set-up switch, CRT bias, screen controls and video drive controls—before you check the color picture quality. MORAL: a complete set-up may change a blurred picture with false colors to a good, sharp b-w pictures with true colors during colorcasts.

Wrong Colors From The Picture Tube

Another related problem, which is even harder to recognize, is the color imbalance caused by a weak gun (or guns) in the picture tube. It seems logical to assume that the screen color adjustment step (where the vertical is collapsed and the horizontal line is made white by adjusting the three screen controls) would be a good test to show up a weak gun. This is not true because the beam current required to make this one horizontal line bright enough to be clearly seen is extremely small and often, weak tubes will provide enough current for the line. The true test comes later in the adjustment series, when the picture has normal brightness, contrast and sweep. The almost-black areas of the picture may be gray, showing all three colors to be balanced at low brightness, but the highlights

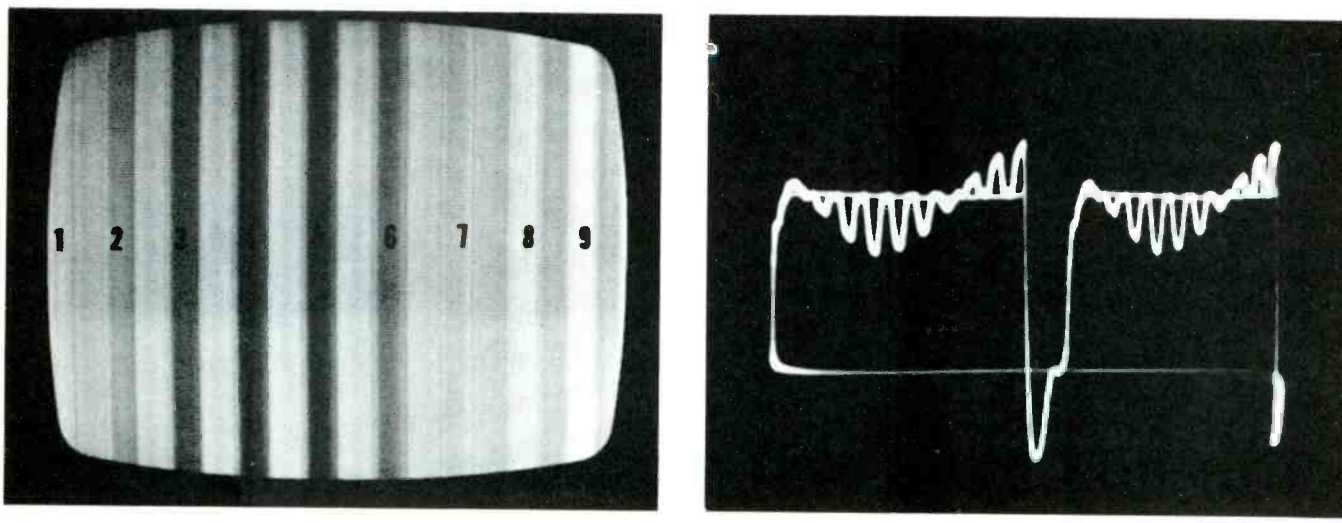


Fig. 2 Green color bar crossovers at bars one and seven as seen on the picture tube and scope screens. **(A)** Color-bar display on picture tube screen. **(B)** Waveform analysis of color bars.

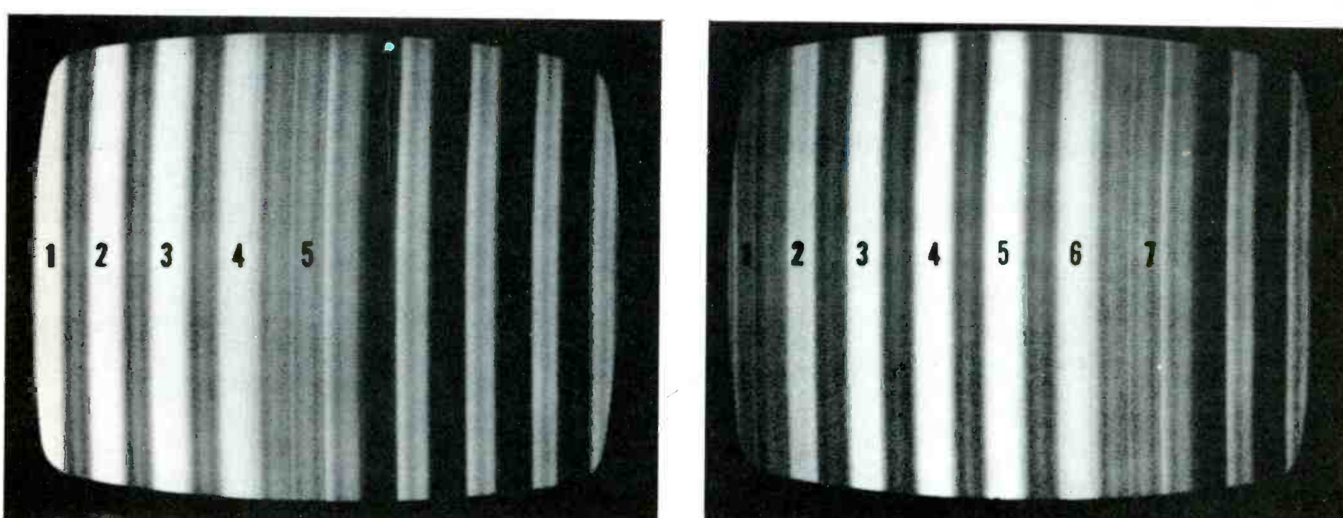


Fig. 3 Adjustment of the hue control must move red crossover from bar five to bar seven or more. **(A)** Crossover at bar five. **(B)** Crossover at bar seven.

will have a tint. Yellow highlights are produced by a weak blue gun; purple highlights by a weak green gun. Again, red is the easy one to overlook, for those cyan highlights look almost normal. Check all three guns if your picture tube emission tester is handy. If not, switch in one color at a time and check the pictures for any signs of highlight compression.

A b-w picture with too much green will also show too much green on a colorcast, and too much blue will make blue dominant on color. One of the obvious indications of insufficient red in the raster is that adjusting the hue control during colorcasts will change skin color from purple to greenish without even producing the normal skin color between these extremes. MORAL: Poor screen color and tracking may fool you into thinking there is a hue or phase problem where none exists.

The Chroma Signals Must Be In Balance

The next important test is for the right amount of red, blue and green chroma signals at the grids of the picture tube. A keyed-rainbow color bar generator is best here. The usual chroma percentages are: blue 100%, red 85% and green 35%. (This ratio varies somewhat according to the designers personal preference, parts tolerances and phosphor efficiencies, but should be close to those listed here.) The chroma voltages can be measured accurately at the picture tube grids with the peak to peak function of a VTVM, provided the receiver does not have horizontal blanking spikes applied at the CRT grids. Otherwise, use a calibrated scope to measure only the chroma portion of the composite waveform.

There is a simpler and faster way that is accurate enough for most cases. Tune in the color-bar pattern with moderate color saturation and with the brightness high enough to see the background between the bars. Turn the brightness control down until one of the three primary color bars disappears. The first to disappear should be green. The red bars should disappear next and finally leave faint blue bars. Any difference from this normal response should prompt a check of the chroma channel to find the defect causing the weak bars.

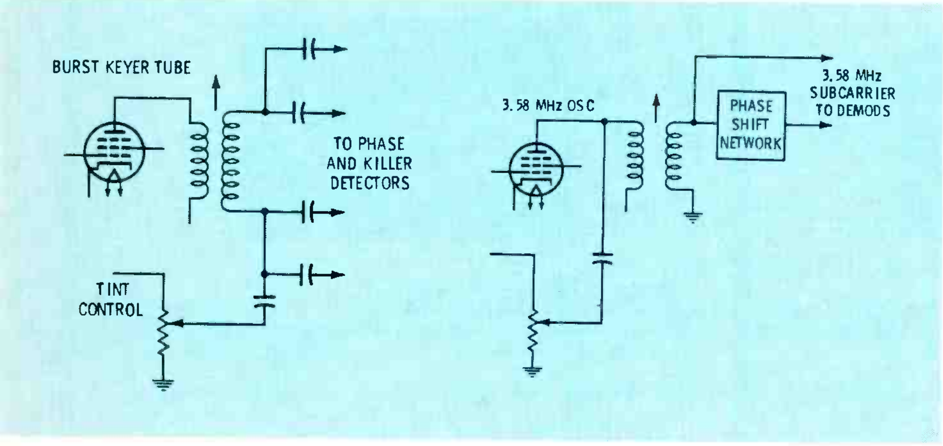


Fig. 4 Two methods for adjusting hue. **(A)** Burst transformer is tuned to change the burst phase, thus changing the phase of the 3.58-MHz oscillator output. **(B)** 3.58-MHz oscillator output transformer is tuned to change the phase applied to the demodulators.

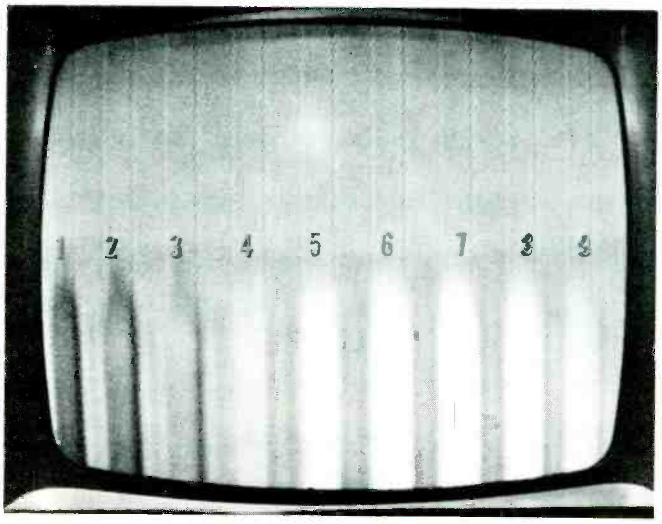


Fig. 5 60-Hz hum in the chroma IF circuit can blank out part of the color, as shown here.

Demodulator Phasing

There must be at least two demodulators, although some models have three, and a few have four. To avoid complications, we'll discuss only the two-demodulator designs.

The demodulators in each make of receiver are very nearly identical, except for the phase relationship of the chroma signal to the 3.58-MHz subcarrier (Fig. 1). In most models the phase of the received chroma signal is the same for both demodulators, while the 3.58-MHz subcarrier phase difference between them may be anything from 75° to 105°, depending on whether they are "X" and "Z" or R-Y and B-Y, and how much tinkering the design engineer has done.

This vital subcarrier phase difference may be determined by the values of the fixed resistors, capacitors and inductances in the phase-shifting network; or the phase may be variable by a tuned circuit, depending on the model. These parts can fail or be burned by external overload, and the resulting wrong phase will cause false colors.

To check demodulator phasing, use the color bar pattern to determine which bars are at crossover (i.e., the same brightness intensity as the background between the bars) by switching in one gun at a time and counting bars from the left side of the screen. If you adjust the hue control to make the brightness of the sixth bar the same as the brightness of the background, the blue crossover should be at 3½ and 9½, and the green at 7½ for a modern receiver. Theory calls for blue at 3 and 9 and green at 7 (as shown in Fig. 2A). Of course, a scope can be used to provide even better accuracy, if you are working at the bench (Fig. 2B). Each bar represents 30° of phase, but don't worry about demodulator phasing unless the crossovers are more than ½ bar wrong.

Hue Control Phasing

Adjustment of the hue control changes the phase to **all** the demodulators **at the same time and the same amount.** With color bars, the entire pattern moves left or right with adjustment of the hue and, on a colorcast, all the colors change the same amount. Figs. 3A and 3B show red bars at bar 5 crossover (bar 2 maximum) and at bar 7 crossover (bar 4 maximum). You will notice the crossovers are much more definite than the maximums.

A hue (phase) control is desirable to give the viewer a choice of color rendition, but the principal use is to allow correction for burst phase errors which are broadcast by the various stations. If you doubt this statement, just tune from one colorcast to another without touching the hue control and notice the wide differences in hue.

Phase errors caused by wrong chroma alignment are usually indicated when the hue control circuit will not change the phase enough

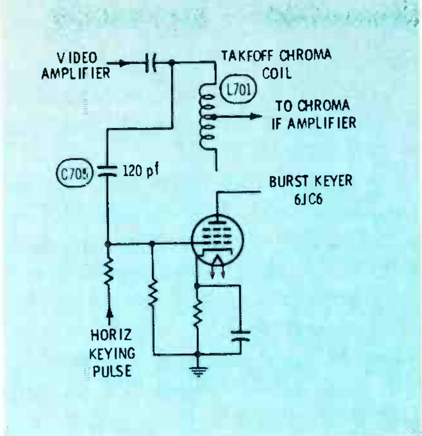


Fig. 6 Open C705 in RCA CTC25X chassis reduced the burst level, producing weak chroma sync and erratic hues.

to permit correct hues, even when accurately adjusted in accordance with the method suggested by the manufacturer. This is particularly possible in those models using direct burst injection into the 3.58-MHz oscillator. Improper IF alignment will indirectly cause wrong phase action also, because the chroma bandpass will be misaligned in an effort to make the overall alignment (including the erroneous IF's) satisfactory. In this case the chroma sidebands are the signal which is most affected by the improper alignment.

Almost all color receivers use one of two general methods of adjusting hue. One way is to change the phase of the burst signal by tuning the

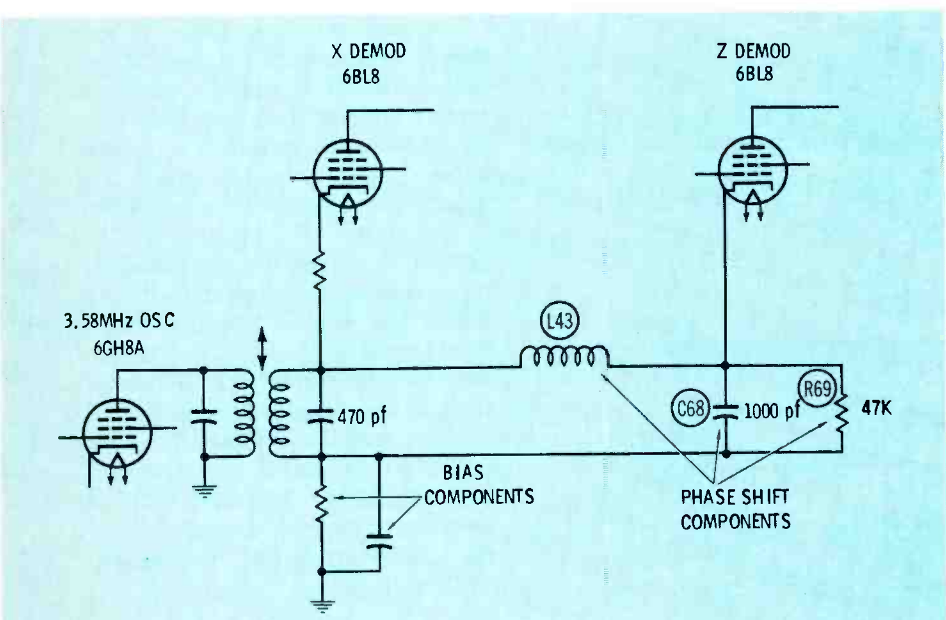


Fig. 7 Shorted turns in L43 of Philco 17QT85A chassis changed the phase of all three colors. The lowered impedance of L43 effectively placed C68 and R69 in parallel with the tuned secondary of the 3.58-MHz oscillator transformer, detuning it. Also, the two demodulators had nearly the same phase.

burst transformer. Other models vary the phase of the 3.58-MHz subcarrier by tuning the oscillator output transformer. See Fig. 4.

One peculiar effect can be noticed in those circuits in which the coil is tuned by a variable resistor in series with the fixed tuning capacitor. The signal level in the tuned circuit changes greatly (25% to 35%) when the variable resistor is adjusted to shift the phase. Also, the signal voltage may be weakened enough to cause sync or color saturation problems if the coil slug is offset too far in a vain attempt to make the circuit tune to good skin color. At the same time, this mistuning will reduce the maximum phase change so that a large adjustment of the hue control will change the hue very little, perhaps only one or two bars.

In many receivers with direct sync injection, such as the RCA CTC19 type, the burst transformer is NOT to be adjusted for correct tint. To do so may weaken the burst enough to cause weak chroma sync. A good method for setting both sync and hue (written in descriptions rather than "C" and "T" numbers to make it more universal) is this one: add a 1 megohm carbon resistor to the outside of the VTVM probe and monitor the 3.58-MHz oscillator grid DC voltage. Adjust the burst transformer for minimum negative voltage when there is NO burst, video or snow coming through the burst amplifier. This can be done by shorting the burst amplifier grid to ground with a short jumper wire. Remove the meter from the oscillator grid and preset the tint control to the center of its range. Bring the oscillator into frequency by adjusting the oscillator grid capacitor while you watch the weak color bars float upright across the screen. Connect the VTVM to the control grid of either demodulator and adjust the oscillator plate transformer slug for maximum negative voltage. Remove the jumper from the burst amplifier grid, and before you remove the meter probe, turn the tint (hue) control from one end to the other and notice the change in meter readings. Readjust the oscillator transformer until the same voltage is obtained at each end of the control, with minimum near the center. This presets the circuit to give maximum phase change, and usually gives correct hue as well. Remove the meter and tune in the color-bar generator very carefully, especially with the fine tuning knob. Now try the hue control to see if the second bar will go from slight purple to slight green or more. If the station broadcasting color is within tolerance, this should give correct hue control action on colorcasts. Touch up the adjustment slightly, if necessary.

Suppose we have gone through this procedure carefully, but the second color bar would not adjust to purple and the faces on colorcasts would adjust from green to normal or very green to slightly green. The most likely cause is poor alignment in the video IF's or chroma IF's and in an extreme case would require a complete alignment of both. If the hue control action is nearly right, try a slight misadjustment of the oscillator transformer. However, it should be noted that excessive deviation from the normal adjustment will cause two other problems: The tint will change very little with adjustment of the hue control, although the color saturation will change. This will shake you up the first time you experience it. The wrong adjustment of the oscillator transformer will weaken the 3.58-MHz subcarrier signal to the demodulators until they become inefficient and reduce the color.

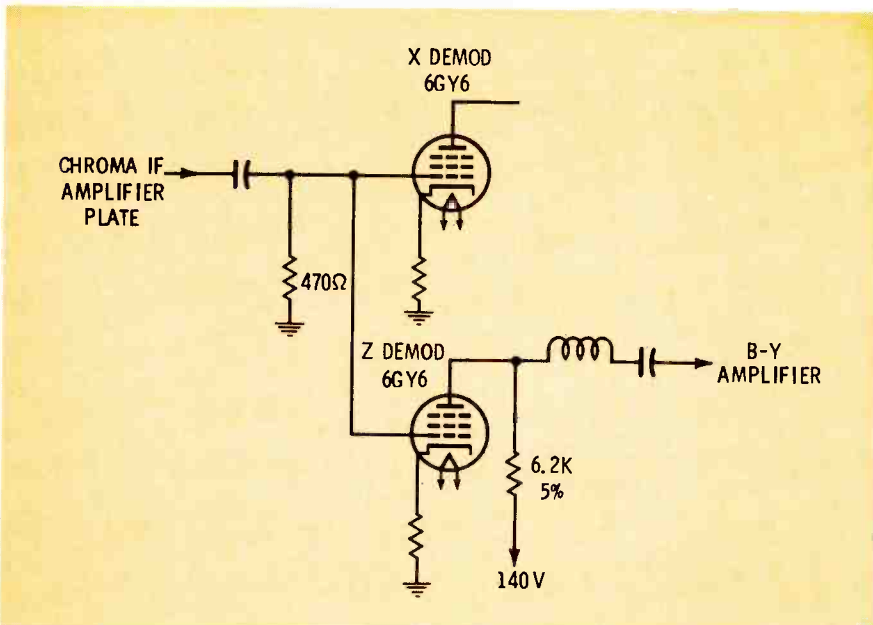


Fig. 8 Shorted Z modulator in Admiral D11 chassis burned the plate load resistor and changed the value of the grid resistor.

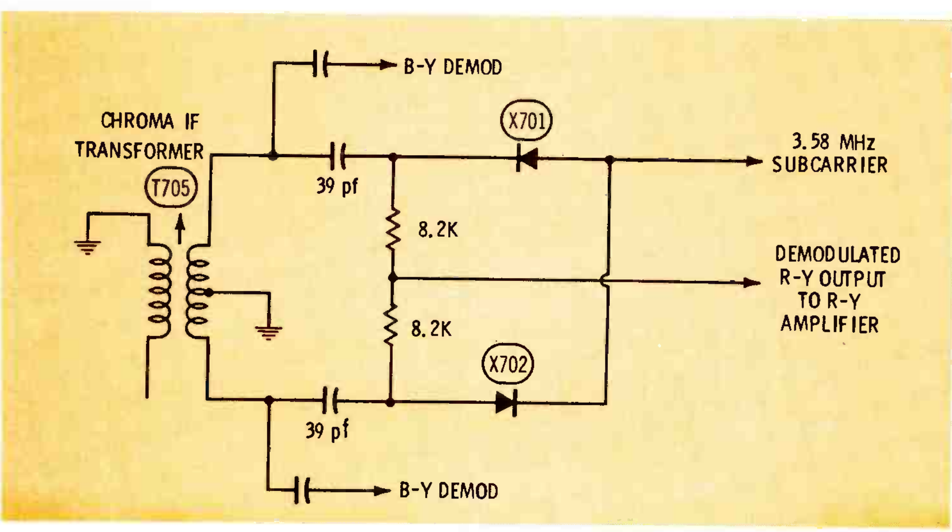


Fig. 9 Open X702 in RCA CTC38 chassis caused wrong R-Y demodulation, producing weak and blurred red hues.

Don't try to produce true colors at the exact center of the hue control. It is sufficient if the color bars travel from 3 to 4 bars when the hue is adjusted, and if the second bar changes from purple to green somewhere in this range.

False Colors From Hum And Shading

Wrong colors from hum and shading are rare but possible. Any hum originating in the tuner or video IF's will be seen only with a station tuned in. Hum in the video stages will be present either on or off channel, and hum from both of these sources will be displayed on the screen in the same manner as similar hum in a b-w receiver.

Hum in the chroma IF's will blank the colors from part of the screen (Fig. 5) or cause weak colors in that same area if the hum is not quite as intense. The main point is that all colors are affected the same way.

Hum in a demodulator or —Y amplifier will show a hum pattern either on or off channel and, in addition, may cause a change in screen color in the hum area.

Hum bars have rounded edges at the top and bottom and will move up or down the picture on broadcasts. Shading is a darkening or brightening at the right or left side, top or bottom, and does not move since it is usually caused by vertical or horizontal sweep voltages getting into the picture.

Case Histories of Wrong Hues

RCA CTC25X Symptoms: Color sync weak, and hue would change with fine tuning on colorcast, or by varying the percentage of burst on the color-bar generator. Since strong color was produced, burst was suspected. All DC voltages on the burst keyer were normal, but low DC was measured on the phase detector diodes, indicating weak burst. The scope showed strong color bars at the chroma take-off coil spike. Diagnosis and cure: C705 open; replaced with 120-pf ceramic capacitor. See Fig. 6.

Philco 17QT85A Symptoms: Intermittent, red interference lines; screen color changes with fine tuning; and vertical stripes of color when a color-bar pattern was viewed. All symptoms very erratic. Color was weak, so scope was used to signal trace the the chroma circuits. Strong bar pattern up to the plate of the second chroma amplifier, but almost no signal on the secondary of the plate transformer. Diagnosis and cure: Open circuit in the ground end of the plate transformer secondary. Found broken wire and repaired to avoid realignment.

Zenith 20K1C36 Symptoms: The tint controls changed flesh tones from bright green to light green, but had less than the usual range. Color sync and other adjustments checked normal, except for the burst transformer. Ohmmeter tests around the transformer and tint control showed too much resistance in the control circuit. Diagnosis and cure: Corrosion on the ground pin of the three prong plug wired to the color and tint controls. Cleaned and tightened socket and plug, then reset the burst transformer.

RCA CTC24 Symptoms: Flesh either too purple or too green. Demodulator phase crossovers of all three colors were normal. Turned brightness control down to check the amplitude of red, blue and green bars. Test showed red bars to be weak. Diagnosis and cure: Weak 6GH8A "X" demodulator and R-Y tube; replaced.

Philco 17QT85A Symptoms: All hues wrong; outside man reported green bars were on the left, blue in the middle and red on the right. Scope showed the demodulator crossovers to be wrong, with blue the worst of all. Checked components in the phase shifting circuit; all seemed normal except the resistance of the coil was low. Diagnosis and cure: Shorted turns in L43; replaced and verified normal performance. See Fig. 7.

RCA CTC28 Symptoms: B-w screen color showed some impurity, and hues were wrong. Checked purity and found it to be very poor. Demagnetized with an external degaussing coil and purity became normal. Three days later made a call-back for the same symptoms. Brought chassis to the shop and found the purity remained good if the test jig degaussing coil was left disconnected. Scope showed the waveform across the degaussing coil to be unsymmetrical and more 60 Hz than 120 Hz. Diagnosis and cure: Power supply silicon rectifier found open in wiring at the rectifier.

Admiral D11 Symptoms: Flesh tones fair, other colors false. Confetti on a blank channel was too pink. Tried color bars and found green and red normal but, weak blue. Diagnosis and cure: Weak "Z" demodulator was suspected since screen color had not changed. New tube did not help much, but scope still showed weak output from the "Z" demodulator. Ohmmeter indicated 500 ohms for the 6.2K-ohm plate resistor; also, the 470-ohm grid resistor had changed in value. Diagnosis and cure: The "Z" demodulator had shorted and burned the resistors. Replaced the burned resistors and the shorted "Z" demodulator tube. See Fig. 8.

RCA CTC38 Symptoms: Colors smeared and slightly false. Switched in one screen color at a time using color-bar pattern. Blue bars normal, green bars fair, and red bars smeared and weak. With all three colors switched on, the background between the bars on the left was greenish. The scope showed the output of the R-Y demodulator diodes to have a curve in the center base line. Diagnosis and cure: Defects in R-Y demodulator; ohmmeter showed X702 to be open. Schematic diagram is in Fig. 9.

Zenith 20Y1C50 Symptoms: Tint control produced purple flesh tones. Color sync and tint adjustments checked normal. T12, the 3.58-MHz injection transformer, would not adjust correctly. When the R-Y core was turned in the direction to give maximum positive, DC voltage at the cathode of the AFC phase detector, the reading nose-dived indicating that the oscillator had quit. Voltage and ohmmeter tests showed nothing wrong, except the primary of T12 measured about 50% high. Diagnosis and cure: An unknown defect in T12, the injection transformer. Replaced it, then adjusted R-Y core for maximum voltage at the cathode of the AFC phase defector. The B-Y core was then adjusted for minimum. Checked crossovers and color hues.

RCA, almost any chassis Symptoms: Weak vertical color stripes behind the regular color picture. The stripes varied with color control setting. This chassis had just been returned from the shop where it checked normal. Diagnosis and cure: Something must have changed during the delivery. Visual inspection showed the center lug of the color control had been bent so that it shorted to the chassis.

Summary

A satisfactory color picture is the sum total of all these factors:

1. A good b-w picture foundation, including purity, convergence, screen color and tracking, brightness and contrast, focus, picture size and locking.
2. Sufficient color gain and bandwidth, with freedom from beat and interference patterns.
3. The correct ratio of red, blue and green chroma signals at the picture tube grids (85%, 100% and 35%).
4. The right demodulator phasing to give correct crossovers.
5. Sufficient range in hue control to produce natural skin color.

A deficiency in any of these five requirements will result in false colors and an unsatisfactory color picture. ▲

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

NOTES ON TEST EQUIPMENT

by ELLSWORTH LADYMAN

Transistor Testers

The term "transistor tester" is somewhat misleading, as the instrument should be capable of testing a variety of solid-state devices such as FET's, zeners, scr's, etc. Most transistor testers available today are capable of performing tests on all solid-state devices and can perform these tests both in and out of circuit. In-circuit tests are a must if you have to remove the component from the board or chassis. You might just as well test by substitution. However, we are all aware of the inherent disadvantages associated with removing solid-state devices from a printed circuit board unnecessarily. Transistors are subject to damage from soldering iron heat. Tips of irons can develop a comparatively high AC potential, and the magnetic field around a soldering iron tip has the tendency to pull printed wiring off the board. These are just a few of the problems.

There are many transistor testers on the market today of which many are separate and individual units. Also, most tube checkers are designed to perform tests on both tubes and transistors. In the next few pages we are going to attempt a brief outline of transistor tester circuit operation, instrument calibration and maintenance, then, introduce some new models of various manufacturers.

Transistor Parameters

It is extremely difficult to conduct a test that would tell you how a device would perform in a given circuit. A tube checker alone can not tell you how a tube would perform when used as an RF amp, or converter. A transistor tester would be hard put to tell you that a specific transistor will work as an FM RF amp, or as an IF amp or perhaps a vertical oscillator.

The transistor tester can tell you how close the device comes to measuring up to its original specifications. This is done by a measurement of the semiconductor parameters. You then compare the results of the test against the original parameters in the manufacturers specification sheet and judge the excellence of the device accordingly.

A typical, moderate price, type tester designed for the service technician will perform measurements of the following parameters.

ICBO—the collector cutoff current.

AC Beta—small-signal current transfer ratio at a given frequency.

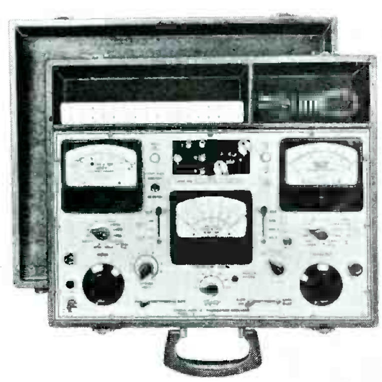
DC Beta—DC current transfer ratio.

ICEO, ICES, ICER } collector leakage currents.

VCE (Sat.)—Collector saturation voltage.

AC input impedance—at a given point of operations.

The transistor tester is going to become a very necessary part of test equipment inventory. With the advent of the all solid-state TV color chassis, more and more hybrid instruments in the home entertainment field and the widespread use of scr's, FET's and zeners in conventional circuits, the transistor tester will become a prerequisite.



Triplett Model 3490-A Transistor Tester.

Triplett Model 3490-A

Triplett Electrical Instrument Co. Bluffton, Ohio, recently introduced an extremely functional and sophisticated instrument. It is called a transistor analyzer and is designed to perform test procedures required by service technicians, lab technicians, quality control departments, schools, etc. It is an all solid-state device and is designed to test both small-signal and power transistors. It is also capable of performing

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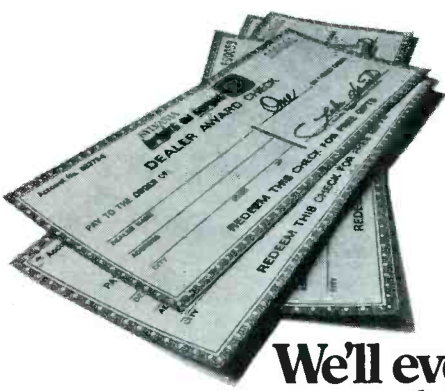

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GENERAL TELEPHONE & ELECTRONICS

Circle 39 on literature card

tests on diodes, rectifiers, zener diodes, scr's and FET's.

The instrument package contains a 30-page instruction book to help the purchaser become fully acquainted with the wide range of application possible with the Model 3490-A. It is possible to plot the complete transistor characteristic curves for a specific transistor by taking single readings but flexible enough to allow the setting up of the conventional parameter checks. The actual set-up procedure is simple. The instrument's internal circuitry contains three separate power supplies and the large 4½-inch meters are easy to read from the distance and in the angle a service technician sometimes finds himself.

The Model 3490-A, Type 2, transistor analyzer incorporates continuous current and voltage controls in its internal circuitry. Three separate 4½-inch meters are used to read static and dynamic values such as emitter current, base current, input voltage, collector voltage, etc. DC Beta, AC Beta @ 1 KHz, leakage current, alpha, saturation voltage, input current to 3 amperes, variable tetrode voltages and floating potential are some of the parameters tester or analyzed by this instrument.

A unique feature of Model 3490-A is the true AC beta test. In this procedure a small signal (5 microamperes) is applied to the base of the solid-state device under test on the 150 beta range. On the 600 range the operator can go down to 1¼ microamperes. The multi-range ammeter allows continuous monitoring of the collector current on any one of the eleven overlapping ranges. The circuit is designed to handle over 1,000 volt-amps of collector power. The collector voltage range is from zero to 120 volts.

Control knobs appear to be rugged enough to withstand the beating they will receive with shop use and are located for convenient and speedy operation. The collector control is a variable transformer controlling primary energy to the collector supply. The input control is a vitreous power potentiometer used for varying the secondary AC voltage to the input supply. Each control has a large knob for convenient adjustment.

Test sockets supplied with the Model 3490 accomodate in-line, circular, square, and power transistor basing designs. The power transistor socket (JEDEC outline TO-3) is built into a solid copper-bar heat sink, with binding posts that permit adapting other power transistor base designs to the heat sink.

Tripl
Sp

3490-A

Input Curren
(emitter or ba

0-100-300 ua
0-1-3-10-30 ua
0-0.1-0.3-0.1-1-3

Collector Current

0-300 ma
0-1-3-10-30 ua
0-0.1-0.3-1-3-10-30 amps

ICEO, ICO, ICBO

0-6 ua, 0-600 ua
0-60 ua, 0-6 ua

Collector Voltage

0-120V, 0-60V, 30V,
0-12V, 0-6V, 0-3V, 0-1.2V

Emitter or Base Voltage

0-12V, 0-1.2V

Tetrode

0-10V (calibrated control)

Dimensions

18 13/16" x 15 7/16" x 8"

Shipping Weight

30 lbs.

Price

$441.00 Consumer Net

Manufactured by

Triplett Electrical Inst. Co.
Bluffton, Ohio 45817
Phone 419/358-5015

Amphenol Model 830 "Transistor Commander"

Specifications

Dimensions

9¼" x 5¾" x 6⅜"

Weight

3 lbs.

Price

$79.95 Retail

Manufactured by

Amphenol Corp.
2875 S. 25th St.
Broadview, Illinois 60153
312/CO 1-2020

Amphenol Model 830 "Transistor Commander"

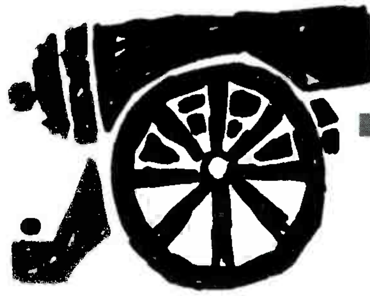
The Amphenol Corporation has introduced a compact moderately priced transistor analyzer that doubles as a DC voltmeter. Named the "Transistor Commander" the instrument lends itself easily to the small shop operating on a comparatively small test equipment budget.

The unit features simple operation with a large (approximately 4") meter with color coded scales to simplify readings. The Model 830 is capable of combining semiconductor checks and measurement of supply voltages to 100V DC. It functions as a diode analyzer and is capable of measuring both forward and reverse currents. Operation is such that both in-circuit and out of circuit checks can be performed.

Some of the features and capabilities of the Transistor Commander are as follows:

1. Checks both high- and low-power NPN and PNP transistors in-circuit for DC beta characteristics.
2. Checks both high and low power NPN and PNP transistors out of circuit for DC beta, ICBO and ICEO leakage.
3. Checks diodes and rectifiers in-circuit for opens, shorts, and ability to rectify.
4. Checks diodes out of circuit for forward and reverse currents.
5. Has color coded meter scales for beta range, collector current, leakage, etc. For example, in NPN/PNP testing:
   a. Beta (hfe) range 1 thru 100 ± 5 percent accuracy.
   b. Adjustable collector current (IC) range 0-10 ma.
   c. Collector base leakage (ICBO) range 0-5000 ua.
   d. Collector emitter leakage (ICEO) range of 0-5000 ua.
6. During the testing of diodes, the diode under test is protected from accidental damage by a 10 ma limiting circuit. A function or selector switch permits "forward to reverse" measurements without removing the diode from the analyzer circuit. ▲

Amphenol Model 830



THE TROUBLESHOOTER

Color Receiver Alignment

I feel the need to equip my shop with a good alignment set-up. Recently, we have become aware of more and more sets requiring extensive alignment procedures. I have looked through literature that we have and cannot decide by myself. Could you please recommend such a set-up? Maybe not the most expensive, but I would like the most reliable.

FLETCHER SWEZEY

Miami, Fla.

It is not our practice to recommend any specific manufacturers equipment. Instruction requirements, however, are listed in each Photofact publication for all adjustment and procedures. The equipment used on the test benches by the Photofact analysis technicians is by no means laboratory equipment. It is the same equipment you find covered under "Notes on Test Equipment" each month in PF Reporter and includes such names as Triplett, Sencore, RCA, Dynascan, Hickok, Precision, Heath, Eico, Lectrotech, etc.

MATV "Tough Dog"

I have a "tough dog" MATV distribution problem and I would appreciate any suggestions from you that could assist me in running down the trouble. Background information is as follows:

1. *There are three separate buildings.*
2. *72-ohm coax is used throughout.*
3. *Separate antennas are used for each of the three available channels, 4, 7 and 13.*
4. *Individual amplifiers are used for each channel.*
5. *All rooms are equipped with like TV receivers, approximately 1 year old.*
6. *Channel 4 is local, Channel 7 approximately 25 miles away and Channel 13 is approximately 60 miles away.*
7. *All wall receptacles are identical.*

The problem: Channels 4 and 7 are very good while Channel 13 is weak and snowy. This is true only when the receivers are plugged into the wall receptacle. By unplugging the receiver from the wall receptable and touching the center of the phono-type plug to ground (distribution feed line or receiver chassis) channel 13 becomes very good.

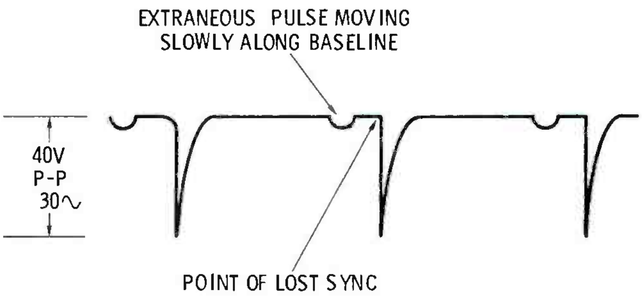
CHARLES B. AYCOCK

Charlotte, N.C.

Several possibilities exist that could be causing this problem. One possibility is that you simply do not have enough signal strength in Channel 13. Channel 13, at a much higher frequency, coupled with the added distance to the tower, just might require more boost than Channels 4 and 7. Another point to check is mismatch. The length of the drop between receptacle and receiver becomes more important at lower levels of signal strength and higher frequencies. You could try connecting directly from the wall receptacle to the receiver antenna terminals. Be sure that all terminations are proper. The signal strength of Channel 13 should be checked with a field-strength meter and compared to the strengths of Channels 4 and 7. Also, make point-to-point checks along the distribution line to rule out any sudden drop in signal strength.

A Real Baffler

Here is a "toughie" I ran into in troubleshooting a General Electric 14T010. Approximately every 20 seconds the picture would roll a few frames, then lock in solid. Following normal troubleshooting procedures, I substituted new tubes in the vertical oscillator, vertical output and sync separator stages, but this had no effect. I then made a voltage check of the previously mentioned stages checking the plate, screen, grid and cathode of each. All voltages measured within tolerance. Since all other circuits in the receiver seemed to be functioning normally, I was puzzled. I connected my scope and viewed the vertical sync. The waveform displayed normal sync separation and amplification. However, it also displayed an extraneous pulse that would move slowly along the base line and coincide with the sync pulse, causing the picture to roll.



The problem now was to determine the origin of this pulse. I established it's frequency as being 60 Hz which immediately pointed to the power supply as the source of the trouble. A filter capacitor was found to be defective, having decreased in value approximately 30 percent, hence the unwanted ripple.

This chassis utilizes a half-wave rectifier power supply that depends greatly on the capacitance of the filter to eliminate the 60-Hz ripple. The defective filter caused excessive ripple, which when added to the sync pulse resulted in a decrease in amplitude of the sync pulse, and periodic loss of vertical sync.

Normally, symptoms of this type are indicated or accompanied with a hum in the audio and/or video. This receiver demonstrates again that a set service procedure almost always results in less bench time per job.

Nicholas Congo

Huntington, New York

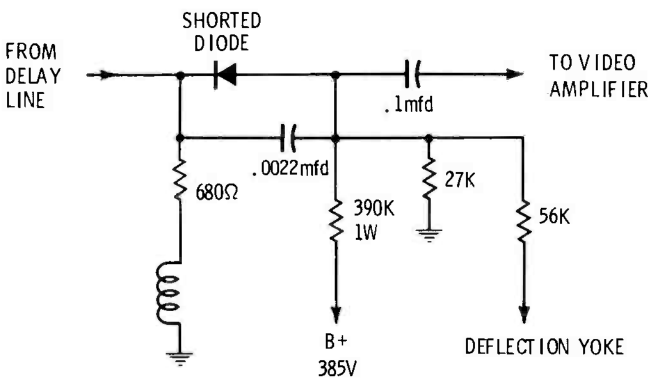
Thanks for the tip. Your problem and the method used certainly is a point in favor of following a set servicing procedure for all jobs. Following false indications invariably result in lost time and money.

Horizontal Shift

An RCA CTC 20C developed a horizontal shift in the raster, and, as the set warmed up, the blanking bar became visible on the right of the screen. When a check of the voltages around the video amplifier and cathode follower sections indicated there was something wrong with the bias on both tubes in these circuits, it was decided the trouble was forward of the cathode follower. Further investigation, however, revealed that the problem actually was caused by a shorted diode located between the cathode follower and the video amplifier. This diode is mounted on the underside of the chassis between the color circuitry board and the horizontal output section.

J. B. AHERN

Vallejo, Calif.

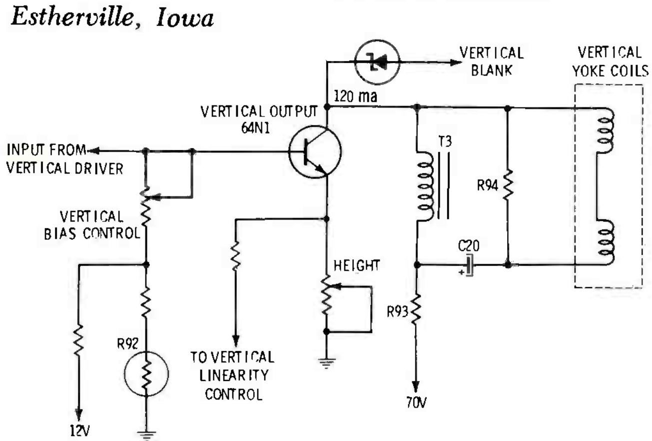


Solid-State Chassis, Vertical Trouble

I have a Magnavox Chassis T908CA with vertical trouble. I can't adjust the controls to fill the screen vertically. The vertical linearity control has plenty of range; however, the height control is at maximum. I have checked all transistors and capacitors in the circuit. The waveforms are all okay both in shape and amplitude with the exception of the waveform at the collector of 64N1, the vertical output transistor. I have set the bias for 120 ma across R93. The collector DC voltage is okay, only the output waveform is slightly decreased in amplitude. I suspect the yoke.

M. S. BREYFOGLE

Estherville, Iowa

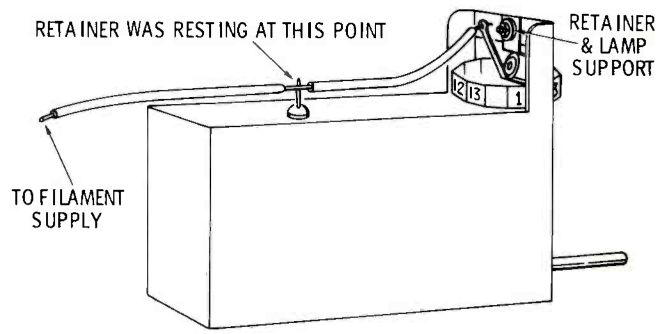


It is quite possible the yoke is defective, and loading the circuit somewhat due to an impedance mismatch. I would suggest, before replacing the yoke, that a thorough check of the following components be made: thermistor (R92), vertical output choke (T3), electrolytic capacitor C20 and resistor R94.

Disappearing Raster

An RCA CTC 12 was long overdue for a convergence job, and preparatory degaussing led to an unusual symptom. The raster disappeared when the degaussing coil was passed over the right hand side of the metal cabinet. When the coil was withdrawn the raster returned.

After pulling the tuner from the cabinet, the cause of the mysterious problem was discovered. Dangling from the pilot lamp lead was a metal wire retainer which had evidently slid down the lead it was intended to support. This retainer normally holds the pilot lamp lead clear of the tuner indicator drum assembly.



In this particular case the degaussing coil was causing the retainer to vibrate so that it came in contact with the ground. The retainer had been resting on an uninsulated portion of the lead next to the tuner tie point, resulting in a shorted filament supply.

J. B. AHERN

Vellejo, Calif.

Not Enough Width

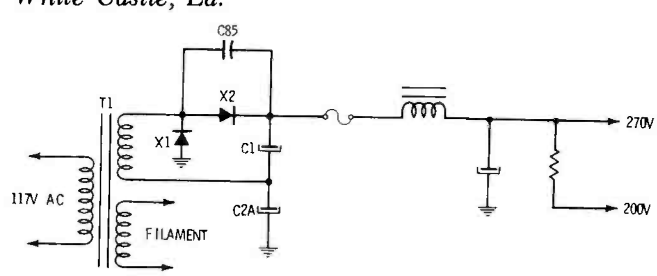
We have an RCA Model 233B605 in for repair. The symptoms are: insufficient width, and wavy and bowed raster edges with an intermittent vertical roll. We have made the following measurements:

1. *Ohmmeter reading at pin 2 of V11 (6GW6) is 0 ohms.*
2. *Ohmmeter reading at pin 3 of V11 (6GW6) is infinite.*
3. *Ohmmeter reading at pin 4 of V9 (6EM7) is 1.1 megohms.*
4. *Voltmeter reading at 270 volt source is 130 volts.*
5. *Voltmeter reading at pin 2 of V12 (6AY3) is 130 volts.*

What is our trouble? We replaced rectifiers X1 and X2 without results.

J. A. TANOOS

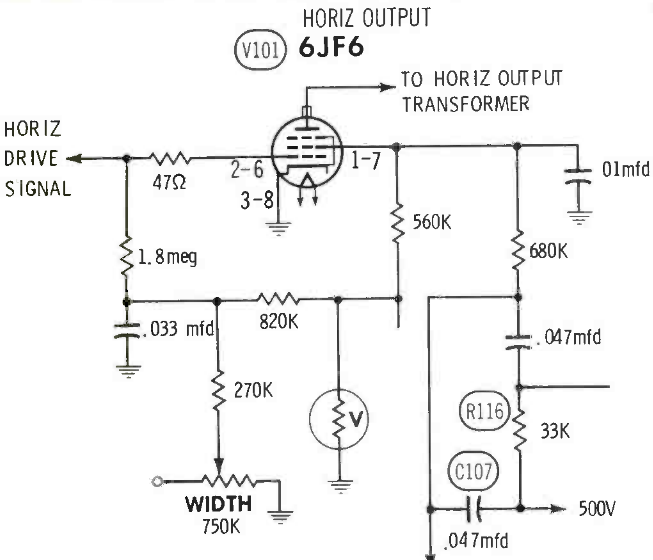
White Castle, La.



It would seem that your trouble is probably in the power supply. The measurement of 130 volts at the 270 volt source indicates that you are not getting the "doubling" action of the circuit. I would replace electrolytic capacitors C1 and C2. It is possible that you have multiple problems; however, I am inclined to think that repairing the power supply will take care of the wavy raster and the intermittent vertical roll.

Sound, But No Picture

An RCA KCS 159A chassis produced sound, but the raster remained black on all channels. All tubes were checked and found to be satisfactory. The horizontal output tube was checked for signs of an overload, but there was no evidence of such. The voltage on the cathode of the CRT was also normal.



When preliminary tests failed to disclose the cause of the trouble, the chassis was removed from the cabinet and further tests were made to determine the cause for the loss of high voltage. A visual check finally uncovered the fact that R116 had been exposed to an overload. Further checking uncovered a defective C107 as the cause of the trouble.

B. H. Serota

Philadelphia, Pa.

RCA CTC4A "Repeated H.O.T. Failure"

I am having difficulty in tracking down the trouble in an RCA CTC4A chassis. This is a high-voltage problem which results in failure of the horizontal output tube. The horizontal output tube gets "red hot" and the horizontal centering control overheats. DC voltage readings at the terminals of the horizontal output and damper tube are normal or within tolerance. Could this defect originate in the 380-volt source? The high voltage and receiver operates normally for approximately a half hour, then the screen of the CRT progressively darkens until the raster disappears. As the horizontal output tube begins to overheat, B+ voltage starts to decrease. I have replaced the horizontal output tube, the high-voltage rectifier and the high-voltage regulator tubes.

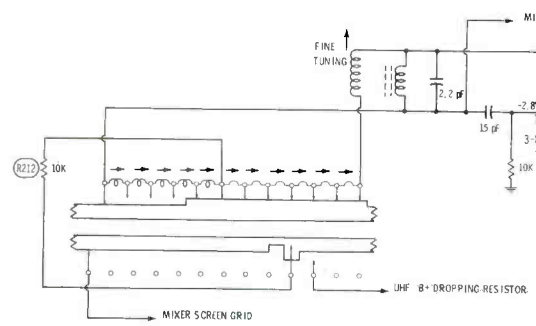
J. A. Marciniak

Minneapolis, Minn.

One basic cause of a horizontal output tube overheating (drawing too much current) is insufficient drive voltage. If, when you scope the drive signal at the horizontal output grid you find you have sufficient drive (125V p-p) and the waveshape is not distorted and all miscellaneous adjustments including high voltage adjustment, high voltage performance check, etc., have been made; I would suggest you follow the Production Change Bulletin for the CTC4A chassis issued in Sams Photofact Folder 385-5. This is a rather lengthy procedure and too involved for a letter.

High Channels Inoperative

A Sears 562.10080 chassis first displayed what appeared to be Christmas Treeing. After the horizontal frequency coil was adjusted, the picture returned to normal and operated for a whole day with no apparent trouble symptoms. However, the following morning when the set was checked out prior to delivery, channels 10 and 13 (local active channels) failed to operate. The other local active station, channel 3, operated normally.



During preliminary troubleshooting it was discovered that adjustment of the AGC control produced a picture on both high channels. The AGC, RF, and mixer circuits were checked, but no defect could be found. However, troubleshooting the oscillator circuit revealed that R212 had increased to 30 megohms. Replacement of this resistor and adjustment of the horizontal frequency coil and the AGC pot restored the set to normal operation.

FRANK BRANDENBURG

Norfolk, Va.

No Vertical Sync

I have an RCA Chassis CTC11A. The trouble is "no vertical sync." The picture floats up and down, and the vertical hold control has no effect. All DC voltages are normal and within tolerance. All components on the vertical board have been checked. The brightness control seems to affect the rolling as it is rotated through its entire range.

J. LIVELY

Jacksboro, Tenn.

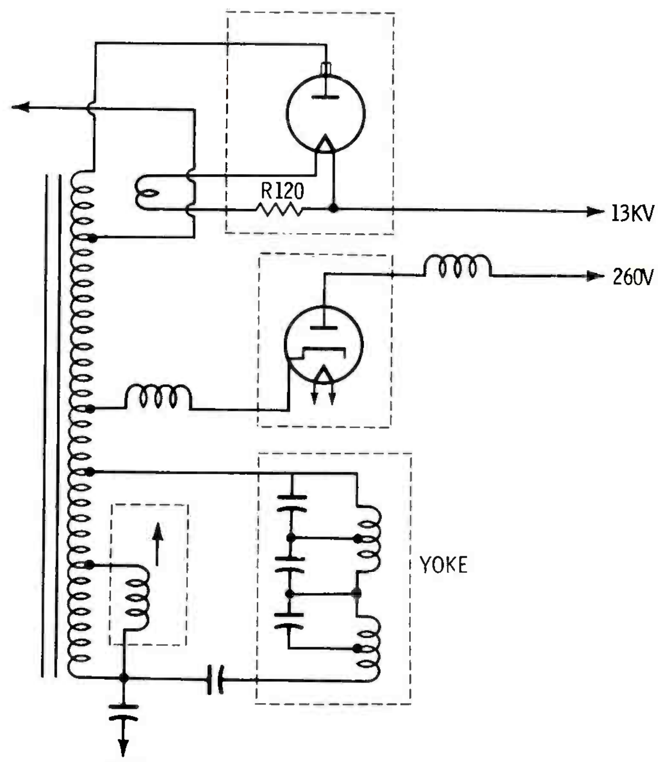
Vertical circuits are perhaps one of the most exacting circuits in a TV chassis. This fact alone helps in their servicing. A certain set of voltage values must be attained if the circuit is going to function as designed. You must have vertical sync pulses of sufficient amplitude to trigger the oscillator. The operating (DC voltages) potentials must be applied to the tube. An oscilloscope is a prerequisite. You must observe the waveforms, both the shape and amplitude present in the circuit. The only advice I have to offer is: Scope these waveforms; check the voltages and attempt to isolate the defect to a stage. This could be the sync separator or vertical oscillator. Then, make "point-to-point" checks to isolate the defective component.

High Volts—Low

I would appreciate some assistance in the repair of an RCA Model 21PD8115. The symptom is one of no raster, low high voltage. Boost voltage measures 300 volts and high voltage checks out at 4500 volts. I have, of course, tried all tubes. DC voltages on the horizontal output tube are within tolerance. With a VOM I made continuity checks and checked capacitors in the damper and high-voltage circuits. I disconnected the horizontal windings of the yoke and boost went up to 700 volts, but the high-voltage remained at 4500 volts. Again, using my VOM, I checked the DC resistance of the yoke windings and the capacitors in associated circuitry. Everything checked okay. I hesitate to replace the yoke, but why does the yoke load down the circuit and why doesn't the high voltage increase with the increase in boost voltage?

F. ARDOLINO

Brooklyn, N. Y.



Let's take your problems one by one. The first is the choice of test equipment. The VOM is a very functional and useful piece of equipment, but it serves your best interest in locating the defective component only *after* you have isolated the problem to a specific circuit or stage. Waveform checks around the circuit are far more useful in locating stage defects than continuity or VOM checks of a capacitor. A VOM, at best, can prove only that a capacitor is a capacitor and does NOT tell you whether its doing the job in waveshaping functions.

You state that all voltages on the horizontal output stage are normal. Does that mean that the peak-to-peak

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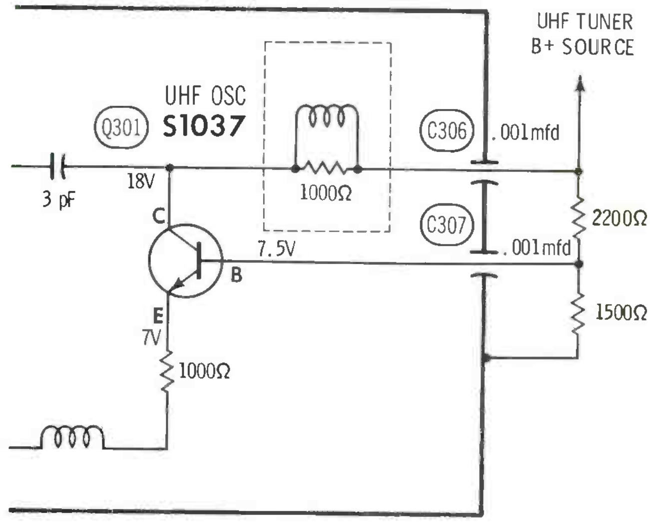
Circle 46 on literature card

drive signal is normal, both in shape and amplitude; or do you mean that all DC voltages are within tolerance? The yoke loads down a portion of the horizontal output circuit because it is the load for that circuit. The horizontal output circuit of a typical receiver has various loads. AGC, AFC reference voltage, high-voltage rectifier, yoke, etc., are a few of the loads. Removing any of these can cause an upswing in voltage output.

If the drive voltage at the grid of the horizontal output tube is 80 volts peak to peak, and all other voltages are normal, I would expect the horizontal output transformer to be defective.

UHF Tuner Trouble

I have recently encountered trouble symptoms of snow or a complete loss of sound and picture with an RCA color chassis employing the KRK 120 UHF tuner. In each case the trouble has been traced to the oscillator transistor, which became temperature sensitive and drifted.



To speed troubleshooting time and prevent unnecessary removal of the tuner, I measured the voltages at C306 and C307. The chart shown here indicates the normal and abnormal voltages. It should be remembered, however, that these voltages will not be present at the two check points unless the channel selector is rotated to the UHF position.

Condition	C306 Voltage	C307 Voltage
Normal	18	7.5
Internal Short	8-9	9
Open base-emitter or Collector	25% increase	10% increase

B. H. Serota

Philadelphia, Pa.

Psychedelic Color?

I turned on my color TV to watch the evening news and was confronted with a psychedlic display of random color over the entire screen on both color and b-w programs.

An hour later I was still trying to determine the cause when the solution hit me. During a thunderstorm earlier in the day, lightning had struck nearby. Degaussing the screen cured the trouble.

Andrew Skvarcek

Orange City, Fla.

▲

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. PHOTOFACT Folders can be obtained from your local parts distributor.

AMC

3C422A, 3C426A,
3C428A 993-1

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Coming in the December issue . . .

Analysis of RCA's Solid-State Color

Lightning Protection for Transistor Amps

Solving Stereo Separation Problems

Color CRT or Chassis Defect

A Proper Approach to Tuner Repair

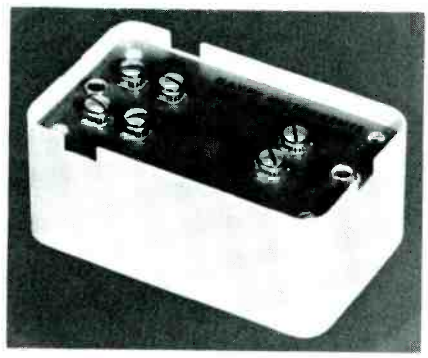
plus the regular departments packed with other practical servicing information

Product Report

For further information on any of the following items, circle the associated number on the reader service card.

UHF Coupler
(65)

A new 2-set UHF coupler has been announced by **Gavin, Inc.** Designated Model C-200, the new unit is designed for use with Gavin Gold Crest UHF antennas.

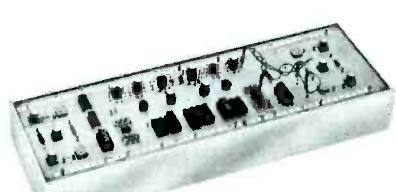


According to the manufacturer the unit utilizes matched ferrites to provide low loss, high isolation and match over the entire UHF spectrum. The splitting loss is less than 4.5 dB at all UHF frequencies and the VSWR is better than 1.5 to 1. Isolation between sets is at least 25 dB.

The unit is shipped complete with mounting screws and lists for $3.75.

Integrated Circuit Kit
(66)

A new integrated circuit kit by **Vector Co.,** provides a means of inter-connecting configurations of integrated circuits for experimentation. Called the 29X Kit, its mounting surface is of pre-punched Micro-Vectorbord and is supported by 2″ Vector Aluminum Frame-Loc Rails. The .042-inch diameter holes on 1/10-inch grid spacing allow high or low density mounting of discrete components.



Wiring of component leads may be done with polyurethane coated wire (solderable through the insulation) or "Daisy Chain" patchcords, both included, which connect directly to the wire wrap tabs or round pins. Flat bus strip is also supplied.

Dual-in-line packages fasten directly to the breadboard with tails extending through the holes, or may be plugged into the D.I.P. sockets.

Kits are priced in the $50 to $60 range, depending upon quantities.

Shut-off Device
(67)

An automatic high fidelity system shut-down control is being marketed by **Saxton, Inc.**

"Hi-Fi Sentinel" (Cat. No. MM-33) plugs into connectors located under the record changer. When the phonograph shuts off, the Sentinel automatically shuts down the entire hi-fi system. The unit may be used with Garrard, BSR, Dual and other changers that employ amp lock connectors. Manual or automatic control is governed by a slide switch. It also serves as a convenience outlet for auxiliary hi-fi equipment. The price is $6.10.

Scope Cart
(68)

A new scope dolly, Model LOW-8, is being introduced by **Waber Electronics, Inc.** The top shelf of this new unit can be adjusted to three positions and the bottom shelf offers additional capacity. Both shelves are constructed of ¾″ plywood laminated with a heavy ribbed Koroseal facing and edged with heavy metal. The framework is of 1″ square tubing.

The unit is equipped with an outlet box with three outlets. Prewired and ready for use, the outlet box

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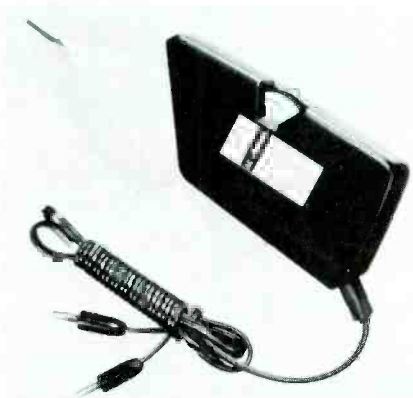
Circle 50 on literature card

features an on-off switch, a pilot light and a panel-mounted fuse, and is rated at 15 amperes, 130 volts continuous duty.

The unit is 34″ x 19″ x 31″ and has rubber tired casters 3″ in diameter. It is priced at $79.50.

Adapter for Current Measurement
(69)

A new, versatile Model 150 Amp-Clamp is now being marketed by **Simpson Electric Company.** The unit may be used with any VOM having a 5,000 ohms per volt AC range of 0-2.5 or 0-3. The range selector in the handle permits readings in six ranges from 0-5 up to 0-250 AC amperes when used with a 0-2.5 AC volt scale. When used with a 0-3 volt scale, six ranges from 0.6 up to 0-300 AC amperes are available. Banana type plugs connect the Model 150 to the VOM and the instrument is instantly ready for AC current measurement. A conversion chart built into the handle next to the selector switch helps prevent miscalculation. The Amp-Clamp is priced at $30.00.



Fluorocarbon Spray
(70)

A new aerosol has been introduced by Industrial Supply Division, **Sprayon Products, Inc.** Designated Sprayon No. 2005 Fluorocarbon Dry Lubricant it contains no silicones or solvents to contaminate or build up on parts—no need to clean

before coating or bonding. It is described as a good corrosion-inhibitor and is reported in use in the electronics, aerospace, computer, instrument and molding industries. The price is $18.00 per case.

Hand Tool
(71)

A tool called the Plierench has been marketed by **Vaco Products Company.** A complete workshop in one tool, the Plierench can be used as a socket wrench, monkey wrench, open-end wrench, and a pipe wrench.

The tool can be purchased in two sizes. The No. 86060 model is 7″ long and lists at $6.25. The No. 86070 model, 8½″ long, lists at $7.95. Each is equipped with a standard jaw and comes in a self-closing, transparent plastic pouch.

Also available are three accessory jaws which fit the 8½″ model. No. 86072 is a standard pipe jaw priced at $1.75. No. 86074, a large pipe jaw, lists at $1.75 and the Giant Internal-External Jaw No. 86073 lists at $2.00. The 8½″ Plierench and the three accessory jaws, packaged as a kit in a blue plastic pouch, are priced at $13.50. ▲

Circle 58 on literature card

Circle 52 on literature card

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I certify that the statements made by me above are correct. (Signature of editor, publisher, business manager, or owner).

ROBERT E. HERTEL

Book Review

Transistor Fundamentals: Howard W. Sams, Indianapolis, Indiana, 1968; four volumes in slipcase, 5½" x 8½", each volume $4.50 or $15.95 for complete series.

This comprehensive, 4-volume work, covers the basics of transistor technology from Ohm's law to digital circuits.

The introductory volume in this series is **Basic Semiconductors and Circuit Principles,** by Robert S. Brite (Training & Retraining, Inc.). This book is a carefully programmed introduction to semiconductors and basic electrical circuits. It begins with a brief description of transistors and later devotes an entire chapter to a detailed explanation of transistor principles. Sandwiched between these chapters are explanations of voltage, current and resistance, and the all-important Laws of Ohm and Kirchhoff.

Volume 2 is **Basic Transistor Circuits,** by Charles A. Pike (Training & Retraining, Inc.). This volume describes transistors and how they are used in semiconductor circuits. Simple circuits, such as found in amplifiers and oscillators, help show how the basic operations are applied. Recent semiconductor developments are discussed later in the text.

Electronic Equipment Circuits, by Martin Gersten (Training & Retraining, Inc.) is the third volume in the series. This book covers circuits used in audio, radio and television equipment. The reader is given a basic explanation of block and schematic diagrams and operating principles of input and output devices such as microphones and speakers. Numerous "X-Ray" illustrations highlight the descriptions of these devices. Also discussed are the uses of the oscilloscope, radio-frequency and audio generators and the voltmeter. Throughout, the reader will learn to recognize trouble symptoms and to use logical troubleshooting methods to narrow down troubles to specific circuits or stages.

Volume 4 is **Digital and Special Circuits,** by Reginald H. Peniston and Louis Schweitzer (Training & Retraining, Inc.). This volume describes how transistorized digital circuits operate. The binary number system is explained so that application of this system in digital circuits can be understood. The text gives a general background of the various digital circuits so that as new, more refined circuits are developed, the same pinciples can be applied. Once these circuits are understood, their application in computers, test equipment and tracking and sensing equipment can be easily mastered.

Got A Troubleshooting 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
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November, 1968

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COMPONENTS

102. *Javex Electronics*—Catalog #269 lists electronic and electrical components including 75 and 300 ohm TV terminations, connectors, jacks, plugs and switches suited for AC, AF, RF, MATV and CATV.
103. *Ohmite Mfg. Co.*—Catalog 750 describes features of Ohmite SSA solid state relays such as inherent contact isolation and universal operating voltage range. Electrical and mechanical specifications are included.
104. *Signal Transformer Co., Inc.*—Catalog #55 describes miniaturized regulating transformers down to 6 watts in rating. Complete circuits are specified.
105. *U.S. Capacitor Corp.*—USCC General Purpose Ceramic Capacitors catalog gives physical drawings, specifications, test procedures and complete ordering information for radial and axial lead units.

MISCELLANEOUS

106. *Heath Company*—116-page 1969 Heathkit catalog describes over 300 electronic kits including stereo/hi-fi components, ham radio equipment, test, service and lab equipment and photographic aids.*

SERVICE AIDS

107. *New York Accessories Supply Co.*—16-page catalog features an assortment of uniforms and work clothes.

SPECIAL EQUIPMENT

108. *3M Company*—42-page Producers Manual is a complete how-to-do-it guide for television videotape production.
109. *Microtran Co.*—DC to DC Converter Technical Application Bulletin discusses converter applications, types of converter circuits, frequencies of operation and types of transformer construction.

TECHNICAL PUBLICATIONS

110. *Sams, Howard W.*—Literature describes 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.*

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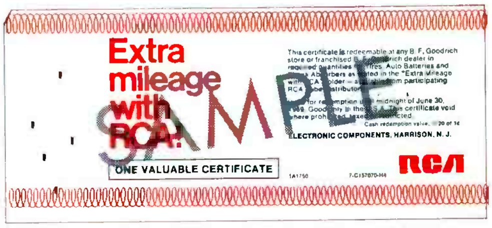

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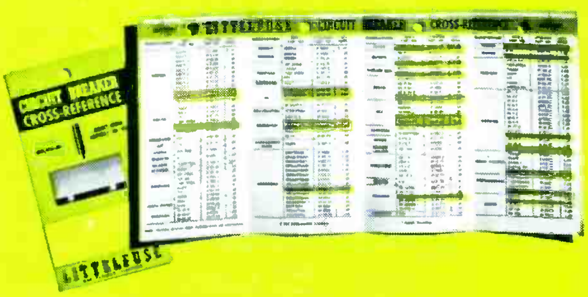

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