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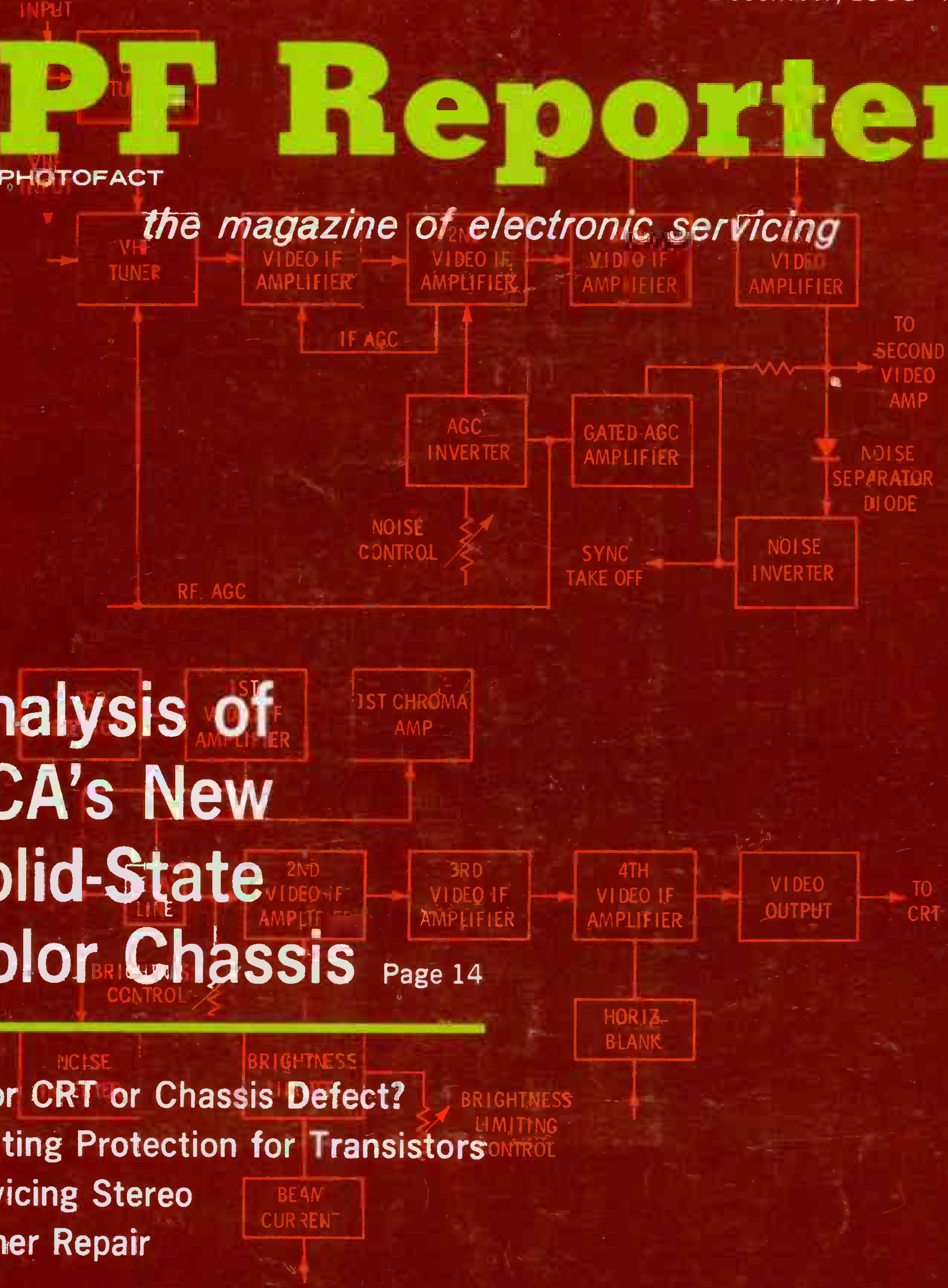
December, 1968 75c

PF Reporter®

PHOTOFACT

the magazine of electronic servicing



Analysis of RCA's New Solid-State Color Chassis

Page 14

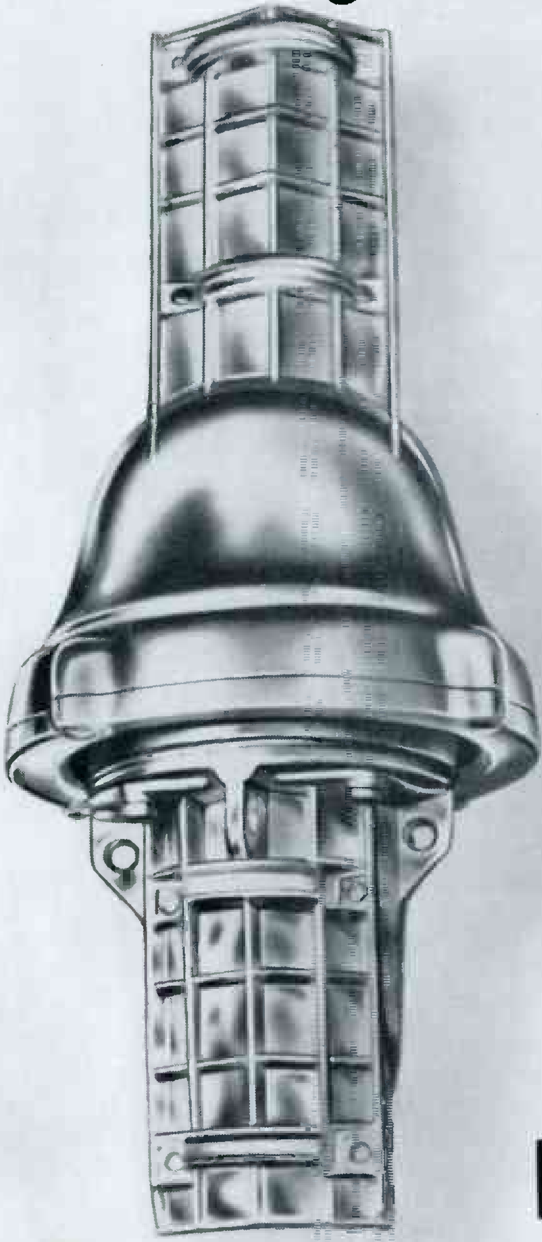
Color CRT or Chassis Defect?

Lighting Protection for Transistors

Servicing Stereo

Turner Repair

Never ask a lightweight rotor to do a heavyweight's job.



Selling your customer a lightweight rotor when he has a large antenna array just doesn't make sense. Especially since you can offer him an alternative: the heavy-duty "Bell Series" rotor, from CDE.

Available in both automatic and manual forms, this rotor is designed specifically for large, heavy antenna arrays... designed specifically for unmatched fringe-area reception... designed to give your customers the finest color TV reception possible. In fact, this is the *only* heavy-duty rotor available.

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CDE CORNELL-DUBILIER

Circle 1 on literature card

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ANNOUNCING: The new B&K Sweep/Marker Generator. Does for TV sets what no other instrument or instruments can do. It makes alignment of color as well as black & white TV sets simpler, easier than ever.

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See it soon at your B&K distributor or write us for advance information on the product that makes TV alignment procedures of old a fearless operation: simple, fast, accurate. The new Sweep/Marker Generator, Model 415.

B&K

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Where electronic innovation is a way of life.

New B&K Sweep/Marker Generator.

Circle 2 on literature card

December, 1968 • Volume 18, No. 12

PF Reporter

PHOTOFACT

the magazine of electronic servicing

in this issue...

ABOUT THE COVER

The block diagrams on this month's cover illustrate the circuitry discussed in the first installment of a three-part series on RCA's new CTC40 solid-state color chassis.

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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.

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WATCH FOR NEW CENTERS UNDER DEVELOPMENT

Circle 3 on literature card

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.*

The RCA WR-64B Color-Bar/Dot/Crosshatch Generator has for years been the finest instrument of its type. Exceptionally stable, portable, it's a precision instrument designed for use in the laboratory and factory as well as for servicing on-the-bench and in-the-home. AND IT'S ONLY $129.00.*

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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. L-33WA Harrison, N.J. 07029.

RCA

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

Circle 4 on literature card

THE ELECTRONIC SCANNER

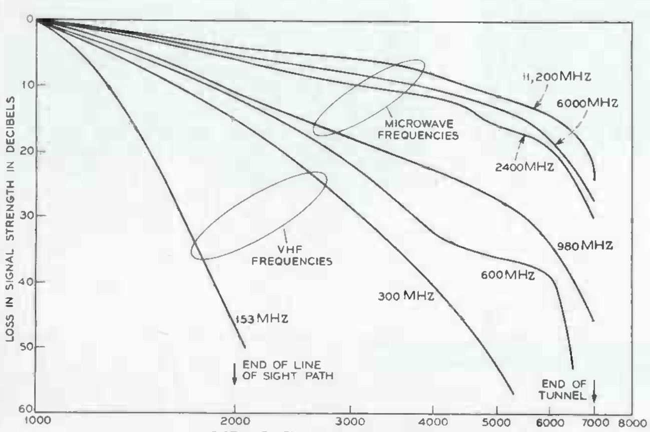
Microwave Tests In Tunnels Favorable

Experiments conducted recently by scientists at Bell Telephone Laboratories, in cooperation with engineers of the Port of New York Authority, indicate that microwave signals are guided by tunnel walls, unlike VHF signals, which either are absorbed by, or pass through, the walls into the surrounding environment. The results of these experiments tentatively indicate that microwaves provide clearer, more dependable communications in enclosed environments, such as tunnels.

The tests were made in an empty tube of the Lincoln Tunnel, using a fixed transmitting unit and a mobile receiving station operating at approximately 11,200 MHz. The transmitter was stationed near the mouth of the tunnel at the New Jersey side, with the antenna beamed toward the tunnel entrance. The receiving vehicle then drove through the tunnel, picking up the transmitted signals.

The level of the signal did not drop appreciably until the receiver was 2000 feet from the transmitter, and the drop was only a few dB compared to the greater than 30 dB per 1000 feet VHF signal loss in the tunnels. In fact, for most of the length of the tunnel, the received signal strength was 6 dB higher than if the vehicles were the same distance apart in free space.

The receiving antennas for the experiment were quarter wavelength monopoles above a ground plane.



Transmitting antennas were directional with the beam aimed into the tunnel. Signal amplitude was logarithmically detected with a 100-KHz bandwidth receiver, having a usable dynamic range greater than 60 dB. The detected signal was analog recorded on magnetic tape as the receiving vehicle traveled into the tunnel.

Tests were made at several frequencies: 153, 300, 600, 980, 2400, 6000 and 11,215 MHz. For any given distance between transmitter and receiver, the higher the frequency the better the reception. To date, however, no simple theory seems to explain the interrelationship between distance, frequency and loss rate shown in the accompanying illustration.

Similar tests made in the tunnel with other vehicles present show more fading at the receiving end, but the fading is not severe enough to obscure communications.

Service Association Honors Distributors

Service managers of television and test equipment distributors and parts managers of distributor and supply houses were honored at the September meeting of the Oklahoma Television and Electronic Service Association (TESA), an affiliate of the National Alliance of Television and Electronic Service Associations (NATESA).

Seventeen service and parts managers were presented with honorary membership in TESA.

—The Antenna, Oklahoma TESA

Results of Impromptu Price Survey

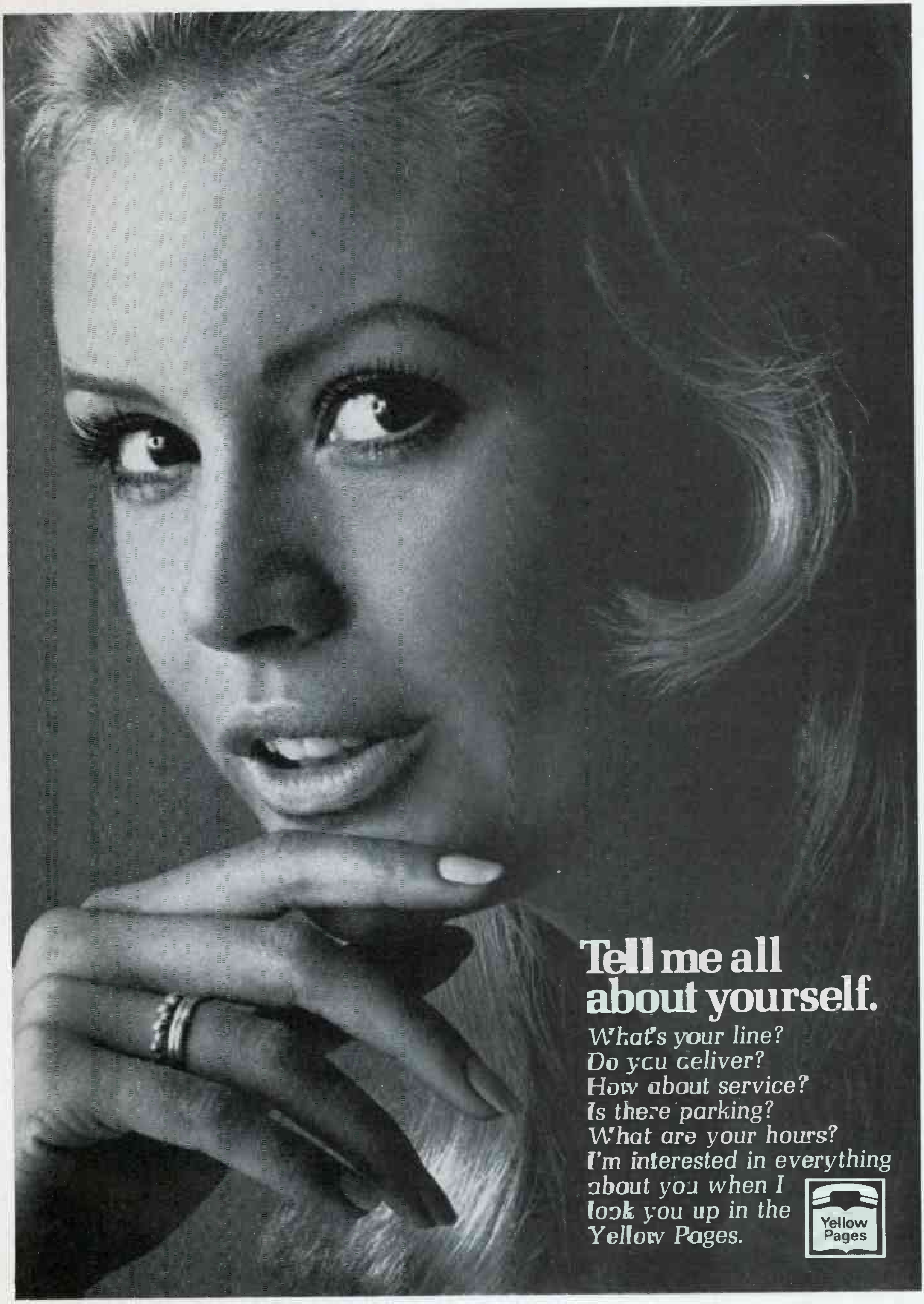
Many members of Michigan's Television Service Association (TSA), an affiliate of the National Electronic Associations, have raised their service prices. This fact was brought out in an impromptu pricing survey conducted during a general meeting of that association in early September.

According to a report in TSA News, the official voice of that association, many members were charging around fifteen dollars an hour for service time. Representative figures for 30-minute home service calls were $14.95 for color and $11.95 for b-w. Warranty dealers who were handling color contracts for other dealers mentioned figures up to $25.00 for a ninety-day service policy.

The major reason for the increases in service pricing, according to a consensus of those members present, hinged on inflation, which the service dealers could not resist but were forced to follow. One dealer, who had raised his service rates before the meeting and was watching closely the effects of his price increase, reported that, although his business declined ten percent (which he could not definitely attribute to his price increase), he did receive a twenty percent increase in profits which he could definitely attribute to his increase in service charges.

New Director of NEA Technician Certification

The National Electronic Associations, Inc. (NEA) has announced the appointment of Mr. Leon F. Howland, C. E. T., as Director of NEA's Certified Electronic Technician Program for 1968-69. Mr. Howland was recently elected National Secretary of NEA and has been a member of the association's Certification


Tell me all about yourself.
What's your line?
Do you deliver?
How about service?
Is there parking?
What are your hours?
I'm interested in everything about you when I look you up in the Yellow Pages.
Yellow Pages

Committee since its inception three years ago. He also is serving as Chairman of the Indiana Radio-Television Service Examiners Board. Mr. Howland succeeds Howard L. Bonar, C.E.T., of Marshalltown, Iowa, who has been NEA's Certification Director throughout 1968. Mr. Bonar remains Chairman of NEA'S Promotion and Publicity Certification Subcommittee.

Special Norelco Warranty

North American Philips Company, Inc. has announced a special service warranty on their fall line of Norelco radios. The warranty provides free repair or replacement of all defective parts reported within one year of the original purchase date, and free labor for replacements during the first 90 days of use.

Instant Replacement Offered By JFD

An "instant replacement guarantee" on home TV amplifiers and preamplifiers has been announced by the Consumer Division of JFD Electronics. The guarantee calls for JFD distributors to replace instantly out of stock Snow Plow Preamplifiers and Program Center Amplifiers that fail to operate satisfactorily. According to Mr. Edward Finkel, JFD executive vice president, the new instant replacement guarantee assures dealers that they will not have to wait for repair on any of the home amplifiers in his company's line. The only requirements for instant replacement are that the purchaser be dissatisfied, that the case be unopened, and that the warranty card be mailed to JFD within ten days of the initial purchase.

Manager Appointed For Sylvania Training Center

The appointment of John A. Sheeran to the newly-created position of manager of Sylvania Entertainment Products' Training Center has been announced.

Ray D. Dennis, manager of Quality Control and Field Service of Sylvania Entertainment Products, an operating group of Sylvania Electric Products, Inc., said Mr. Sheeran will supervise and coordinate all division training of service technicians and trouble-shooting staffs in cooperation with the Sylvania National Service Managers Organization and the Parts Service Organization.

Grundig Opens Larger Facilities in West

New office, warehouse and service facilities for the West Coast have been opened by Grundig Electronic Sales, Inc., the U.S. sales branch for Grundig radios, high-fidelity components and tape recorders. Tripling the capacity of Grundig's previous West Coast installations, the new headquarters is located at 4225 West Jefferson Blvd., Los Angeles, California.

World's Smallest Hi-Fi Radio

Clairtone Electronics Corporation has introduced what is reportedly the world's smallest high-fidelity transistor radio. The unit measures 1½" x 1¾" and weighs only 1 oz. According to Clairtone, the sound quality is equal to a radio employing a 12" speaker and will play up to 200 hours before the batteries must be replaced.

Letters to the editor

Virginia Electronics Association Takes Stand on Warranties

Reproduced here in its entirety is a letter written by Mr. W. S. Harrison, president, Virginia Electronics Association, an affiliate of the National Alliance of Television and Electronic Service Associations (NATESA). Copies of this letter have been circulated by Mr. Harrison to:

1. All major electronic components manufacturers
2. Mr. Charles D. Mahoffie, Jr., U. S. Department of Justice
3. Miss Betty Furness, Special Assistant to the President on Consumer Affairs
4. Mr. Frank J. Moch, Executive Director, NATESA
5. National Better Business Bureau
6. Electronic Industries Association
7. Affected governmental agencies.

Because of the controversial nature of this letter, PF REPORTER invites written comment on the subject from our readers and all other interested parties.

We wish to take exception to the trend that began as a ripple in the ocean with a single manufacturer and has continued to grow and pick up momentum until now it is large enough to predict that, at its present growth ratio, it will eventually sweep like a tidal wave over the independent servicing profession, sending even the biggest to the bottom and, in the process, wreak havoc on the unwary consumer.

The name of the game is "extended warranties" and already its misuse is showing up in analysis figures of practically every independent TV and electronics setup, but particularly in small, strictly servicing organizations that form the backbone of independent service.

It's true that the Mr. Big Manufacturer who "guarantees" his product longer than anybody else has a sales advantage over competition—until competition joins him or until a competitor "out-guarantees" him. But we wonder (and shudder at the answers we come up with) just how far this lie is going to be carried.

The term we use is lie (i.e., untruth; deliberate falsehood), because there is no other word that will suffice, unless you prefer the word cheat.

With your extended warranties you are telling people that the sets you build now are built better, with longer lasting parts, are less complex and easier to service, and will be retained in family possession much longer than their predecessors. This is not only untrue, it is intended to be untrue.

Quite understandably, all manufacturers deny the implementation of planned obsolescence, which, de-

spite your denials, is obvious to everyone but the fantastically gullible. You cannot deny that compactness, price-meeting (or beating), and the inventions of modern technology have made present day sets more time-consuming to repair and keep repaired at a time when, at least partly due to your own raiding of the field, technicians, and the chances of obtaining them, are critically scarce. Additionally, resistance to anything resembling a universal replacement part is not only skyrocketing the costs of stocking even so-called quick-turnover parts, but it is helping to insure that the customer will have to endure a lengthy wait for repairs that he feels should not have been necessary to begin with.

When you tell the customer, or even imply that someone is going to supply parts and/or labor to keep his equipment purchases in working order for a definite or indefinite period of time at absolutely no cost to him, this is the biggest lie of all, which cheats not only the consumer, but the honest manufacturer/seller and the eventual servicer as well.

The uneducated and unwary consumer is the only one who believes you are giving him a "free" warranty because of a superior product. You do not bother to tell him that you have calculated the probable expense of furnishing parts, including your handling costs plus a reasonable profit on the transaction, and added the cost of this "insurance policy" to what would otherwise be the lower selling price of the unit. Whether you also include the cost of an insurance policy to cover what mediocre wages you think a dealer should be paid for upholding your reputation or whether you leave this particular scheme to the seller is immaterial. The effect is to make the consumer a captive customer of the factory, the factory's selling agent, or the factory's appointed servicing agency, and all of this at the direct expense of the purchaser. The customer is relieved of the advantage of choice in seeking the best possible service, as he must accept the will of the manufacturer and the whims of their representatives in order to receive the benefits of a "free" warranty that he paid for.

If the customer should decide to

go to an independent for service, one of the distasteful alternatives open to the servicer is to accept the fact that not only will he be cheated of the sale of a part, the profits from which he must rely on to help finance increasing parts inventory, technical information, and ever-changing and modern test equipment, but he must also incur the added cost of paperwork, returning and procuring the parts. The other option is to try to explain why the owner must pay a percentage and handling charges on an item he has every right to expect should be free, and also attempt to smooth the fact that it may take days or weeks or even longer to affect this warranty exchange.

More frequently than not, the customer is left with the impression that the technician is incapable or corrupt, or both, and this only tends to hurt everyone in the industry, even including you in the long run, Mr. Manufacturer.

What are you going to do, Mr. Manufacturer, when we are forced to close our doors, as some already have, and are no longer around to try to explain to and satisfy your customer? Do you really want captive service? Do you really want to resort to equipping and stocking and trying to find help for countless service stations where you have to meet, face-to-face, the people to whom you sold those "electronic marvels of perfected perpetuality" and try to explain to them yourselves exactly why they don't work?

And what will then happen to the buying public if this monopolistic eventuality should occur?

Inasmuch as we are firmly convinced by the facts of many years of experienced and qualified field work that any warranty in excess of the standard and proven ninety days is merely a sales gimmick designed to cover up shoddy manufacturing practices or to create a prolonged captive customer with the consumer's own funds, we must go on record as being emphatically opposed to any stated or implied warranty in excess of this period of ninety days which does not offer the consumer freedom of choice and which does not pay promptly to the professional, licensed servicer chosen by the product owner, the servicer's regular and normal labor rate for locating and replacing any defective part or parts plus a realistic fee to compensate for the handling and/or return of said part or parts.

This, naturally, still would not create a "free" warranty, but it would be a fair warranty to the consumer, and would be one that the servicer, your competition, and your own conscience could live with.

Of course, when you discover just how much you'll have to increase your prices for your "built-to-last-forever" electronic equipment to cover your three, five or ten-year warranty, you just might decide to forsake extended warranties altogether and leave the routine maintenance of your products to the professional servicing technicians and the free enterprise system which served you and the pubso well for so many years in the past.

W. S. Harrison, *President*
VIRGINIA ELECTRONICS ASSOCIATION OF TIDEWATER, INC.

DC Component In Waveforms

Following is a letter that was directed to one of our contributing authors, Stan Prentiss. We are including it in this column because we feel the question asked in the letter and Mr. Prentiss' answer will be of interest to the other readers of PF REPORTER.

Dear Mr. Prentiss:

I just finished reading your article titled "Sync Is Simple . . . Almost" in the September issue of PF Reporter.

May I complement you on a well written article. I appreciated your oscilloscope photos that accompanied the article. However, there was one or two things that puzzled me and I would appreciate your setting me straight.

I always understood that the DC voltage of an AC signal was equal to the voltage (DC) at that pin. In other words, if the AC signal was 22 volts p-p at the plate of a sync separator, and the DC plate voltage was 45 volts, then the DC level was 45 volts. In your article the amplitude of the waveform in Fig. 5 was 22 volts and was hanging at a DC level of 60 volts at the plate of the sync separator. In your diagram of this sync separator, the *plate voltage is marked 45 volts. In several other instances the DC level does not correspond with the DC voltage at that pin.*

I thank you very much in advance for your explanation of this matter.

M. Blair
Elmhurst, N.Y.

First, in some of the older receivers the DC supply voltage was not always exactly 260 volts as the schematic predicted. You'll have to watch this carefully on any receiver. The variance can be easily 10 to 20 percent. I don't remember if this particular one had changed or not. Secondly, some of these voltages have been measured with a 20,000 ohms-per-volt VOM that can load, and so decrease, the B+ readings slightly, particularly where the B+ voltages aren't stiff, that is, there's insufficient current to permit additional loading. But the final reason is—and it's applicable in this instance—that B+ voltages at certain stages change with the introduction of the AC signal.

I always troubleshoot a monochrome receiver with a signal from the air. You will note a rise in video IF, video amplifier, and sync output DC levels since the incoming AC is making them conduct harder. This is the operating principle of the color amplifiers in Zenith receivers, for instance, and the way the DC bias is overcome on the 2nd color amplifier.

Consequently, in all black-and-white servicing in my articles the B+ voltages may be a little higher than those indicated on the schematic, which are measured with a VTVM under completely quiescent conditions (that of no incoming signal). My DC measurements are done with an oscilloscope because it's easier to illustrate and there's less loading due to the 1 megohm impedance of the scope itself and an additional 13 to 16 megohms of series resistance in the low-capacitance probe.

Stan Prentiss

Selecting Antenna Lead-In

I am interested in resolving just one problem. Is it advisable to use a shielded or coaxial cable in preference to unshielded flat twin-lead for color television?

As a subscriber to your magazine, I remember reading an excellent article that pictured the effects of antenna lead-in on color television. Could you direct me to the issue that this article appeared in, or a similar article?

I would appreciate an objective answer that takes into consideration the latest developments in antenna lead-in and the variables associated with it, such as location. I would appreciate it if your answer included recommendations that would apply in the vast majority of average installations.

Mel Hambleton
Audio-Visual Director
Lyons Township High School and Junior College
La Grange, Illinois

The many variables that you have mentioned make it impossible to determine exactly what comprises an "average" antenna installation. Thus, I cannot offer any recommendations that will be truly valid, even for a category of antenna installations.

Six basic types of antenna lead-ins are currently available:

1. 300-ohm flat twinlead
2. 300-ohm oval twinlead
3. 300-ohm round, foam-filled twinlead
4. 300-ohm jacketed twinlead
5. 300-ohm shielded twinlead
6. 75-ohm coaxial lead-in

Each type has definite advantages and disadvantages in terms of signal attenuation, durability, susceptibility to interferring signals, standing waves, impedance matching, ease of installation and costs. The effects of all of these characteristics must be weighed against the factors peculiar to a given installation.

For instance, the relative higher signal loses inherent in a 300-ohm shielded lead-in and 75-ohm coaxial cable are usually of no consequence in areas having a high signal level. Conversely, the lower inherent signal losses of an unshielded 300-ohm twinlead can make it particularly suitable for fringe-area reception of UHF signals.

An article titled "Facts About Antenna Lead-In" in the March, 1968 issue of PF Reporter provides a comprehensive analysis of the characteristics of each type of antenna lead-in. ▲

A look at RCA's solid-state color Part 1

An analysis of RCA's CTC40, from tuner input to video output. by Ellsworth Ladyman

The new all solid-state (except CRT and high-voltage rectifier) RCA Chassis CTC40 introduced this year features many new circuits that will demand some new inovations in servicing procedures.

The VHF tuner, KRK-142, utilizes an MOS field-effect transistor in the RF amplifier circuit. The mixer stage is comprised of a conventional cascade-type circuit. The automatic fine-tuning system is a newly designed integrated circuit comprised of a discriminator/amplifier; however, the circuit functions in the same manner as the AFT circuit operation of the CTC30 chassis.

The sound section also utilizes an integrated circuit. This IC includes the IF amplifier, demodulator, preamplifier and an audio driver stage.

There are three stages of IF amplification, the first and second stages being under AGC control. A noise inverter circuit is coupled to both a gated AGC amplifier and a two-stage sync separator circuit.

Five stages of video amplification are provided, and the video section features advanced video peaking and automatic brightness limiting.

The chroma section utilizes two stages of amplification and a bandpass amplifier to feed three separate chroma demodulators, one for each primary color difference signal.

Demodulated color signals (R-Y, B-Y and G-Y) are amplified by individual driver and output stages and then applied to the CRT control grids.

A diode clamp-type circuit is used to restore the DC level. This circuit action is similar to the one employed in the RCA CTC38.

The automatic chroma control uses a closed loop type circuit to control the gain of the first chroma amplifier. Color sync AFPC is accomplished in approximately the same manner. A closed loop circuit utilizes the properties of a varactor frequency controlling diode and a separate 3.58-MHz CW amplifier.

Vertical sweep is accomplished by a modified Miller system controlled by electronic switching. The horizontal oscillator is a blocking oscillator with automatic frequency control provided by a diode phase comparison circuit.

The horizontal output circuitry is quite different and unique. Silicon controlled rectifiers are used in the deflection system to provide sweep and retrace functions. The circuit also provides the energy to satisfy high-voltage requirements.

The KRK-142 VHF Tuner

RF Amplifier

A dual-gate MOS field-effect transistor is used in this stage. Operation of this device (shown in Fig. 1) is as follows: A dual-gate FET functions in much the same manner as two vacuum tubes connected in a cascade configuration. Internal feedback capacitance, which tends to cause amplifier instability (oscillations), is defeated by the relatively low input impedance of the driven portion of the FET. Because of this characteristic of the FET, neutralization is not necessary at VHF frequencies. RF gain control is accomplished by reverse biasing of gate G2. This reverse gain-control voltage reduces the amplifier gain by reducing the drain current of both sections of the FET. Since this control voltage (reverse bias) is derived in combination with the chassis circuitry, it actually forms the RF AGC.

Circuit Operation (Fig. 2)

Signal from a 300-ohm antenna input is applied to an impedance-matching circuit on the cabinet back to match the 75-ohm input impedance of the receiver. This signal is fed to gate G1 of the FET through the high-pass filter network and the RF tuned circuitry. The RF AGC voltage is applied to gate G2 of the FET. This voltage may range from —5.0 volts on a very strong signal to a 6.7 volts on an extremely weak signal. The bias for gate G1 is comprised of a portion of the AGC voltage applied through resistor R1 and the voltage developed across the source resistor, R2. In this circuit the source and gate G1 voltages will coincide or vary with applied AGC, minimizing input capacitance variations. Printed inductances are utilized to couple the RF amplifier output signal to the mixer input circuit.

Mixer (Fig. 3)

The mixer stage is also connected in a cascade configuration, using two transistors. Transistor A operates in a common-emitter circuit and its output drives a common-base amplifier. As with the FET RF amplifier, the principal advantage to this type of circuit is its inherent stability.

The base bias network for transistor A is comprised of resistors R1, R2, R3 and R4. This bias voltage is maintained at a value designed to allow the most efficient mixing action. Transistor B base bias is derived from a biasing network composed of resistors R2, R3 and R4.

The output, or resultant IF signal, is coupled from the mixer by a circuit configuration called "low-side C." The IF output signal is developed across capacitor C1. This capacitor is connected from coil L1 of the tuned output circuit (L1 and C2) to ground. From this circuit configuration comes the term low-side C. This coupling arrangement tends to minimize the amount of oscillator energy that might be coupled into the IF circuit. At oscillator frequencies coil L1 acts as an RF choke and greatly reduces the amount of oscillator energy developed across C1.

Oscillator (Fig. 4)

The local oscillator is basically a

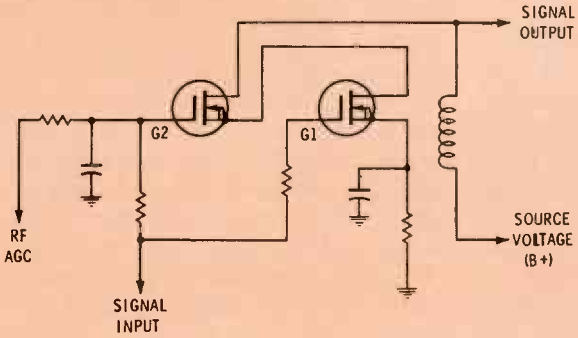


Fig. 1 Circuit diagram illustrating the basic operation of the dual-gate MOS FET employed in RF amplifier.

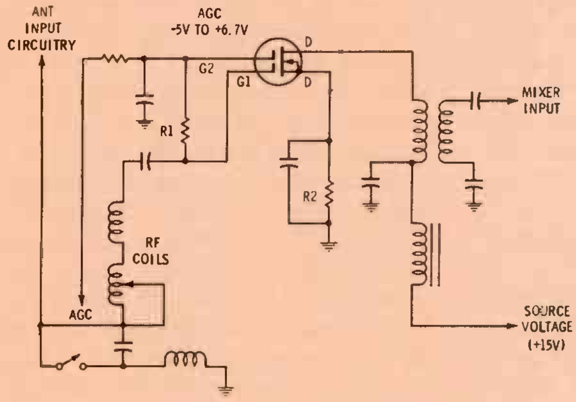


Fig. 2 Simplified schematic of RF amplifier employed in CTC40 chassis.

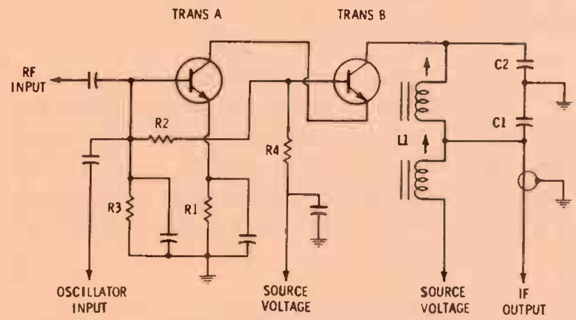


Fig. 3 Mixer stage employing two transistors in cascade arrangement.

Colpitts-type arrangement. Energy at the selected frequency of the oscillators is developed across the tank circuit. The inductance of the tank is composed of L1 (channel 13 adjustment) and the oscillator coil, which changes for each channel selected. The capacitance of the tank is supplied primarily by capacitor C1 and the AFT transistor. Oscillation is sustained by a capacitive voltage divider made up of the transistor internal capacitance existing between the emitter and collector (CCE) and the emitter and base (CEB). Capacitor C2 couples the oscillator transistor output to the tank circuit.

Automatic fine tuning is provided by transistor Q2. The internal capacitance of this transistor varies in proportion to the AFT control voltage applied to its collector and base terminals. This transistor then controls a portion of the oscillator tuning capacitance and, thus, the frequency output of the oscillator.

The KRK-132 UHF Tuner

The UHF tuner used in the CTC 40 chassis is a KRK-132 and has been used previously with several other RCA chassis. It contains no physical or electrical changes from those originally used.

Video IF Circuits

The CTC40 IF section contains three common-emitter amplifier stages (see Fig. 5) capable of supplying a maximum of 80 dB gain to frequencies within the limits of the IF bandpass. This IF bandpass is established through the proper tuning of eight tuned circuits located within the IF system. Alignment of these circuits is very similar to the alignment process of similar RCA circuits employed in tube-type receiver chassis.

Gain in the first and second IF stages is under AGC control and it is possible to reduce the overall gain of the IF section up to 70 dB under very strong signal conditions.

Link Coupling (Fig. 6)

The IF signal contained in the output of the mixer stage is link-coupled to the first IF amplifier. The link coupling circuit used in the CTC40 chassis is very similar to other recent RCA color chassis. The circuit is basically a double-tuned, or overcoupled, network consisting of the mixer collector coil, coupling capacitor, the first IF base transformer and two trap circuits with their associated capacitors. The link coupling components are essential in obtaining a good IF response curve. It is necessary that they be aligned and adjusted exactly. The correct curve is shown in Fig. 7. The manufacturer's specifications or other accurate service data should be consulted for the correct procedures to obtain this response.

First and Second Video IF Amplifiers

The first and second video IF amplifiers are identical. Both are common-emitter types employing identical input and output circuits.

The input coupling circuit to the base of each amplifier consists of a series resistance/capacitance combination. This coupling circuit provides DC blocking and highly efficient impedance transfer. Their output signals are developed identically across single-tuned circuits.

Bias for the first and second IF amplifiers is obtained as follows: The second IF amplifier receives base bias voltage from the output of the AGC inverter stage. This identical voltage (less the small drop across the second IF amplifier base-emitter junction) is applied to the first IF amplifier. In this manner both the first and second IF stages receive almost identical AGC control voltages. The emitters of both the first and second IF amplifiers are returned to ground through a 450-ohm, 7-watt wirewound resistor. The positive temperature coefficient properties of this resistor function to vary the bias on both transistors and compensate for long-term temperature-related gain changes. The emitters of both stages are bypassed by a capacitor.

Third Video IF Amplifier (Fig. 8)

The third video IF amplifier is a common-emitter configuration whose output is applied to the video detector, AFT, and sound circuits. The base bias is derived from a voltage network comprised of resistors R1 and R2. The source voltage for this network is taken from the collector resistor (R3) of the third IF amplifier transistor. DC negative feedback is obtained from this arrangement, which improves bias stability. Emitter bias is obtained, or determined, by resistor R4. This resistance is AC bypassed by capacitor C1. Due to the high gain (40 dB) of the third IF stage, neutralization is a necessity, and it is provided by feedback capacitor C2.

The overall frequency response, which is determined by the efficiency of the link circuit, the interstage tuned circuits and the third IF amplifier output, is illustrated in Fig. 8. Again, please refer to the manufacturer's data sheet or PHOTOFACT for information relating to alignment procedures.

Video Detector

The video detector circuit (Fig. 9) does not differ greatly from the circuits previously used in tube-type chassis. Harmonics of both the detected carriers and difference frequency signals are bypassed by C1. The 4.5-MHz difference frequency developed by mixing the picture and sound carriers is removed by a 4.5-MHz bridged-T trap composed of coil L1, capacitor C2 and resistor R1. L2 and L3 decrease harmonics developed by detector functions. The DC component of the detected video signal is retained by using the average DC level produced by the detector as the major portion of the first video amplifier base bias. The detected video signal is applied across the detector load impedance comprised of resistor R2 and peaking coil L4. This voltage is series-added to the comparatively small second detector pre-bias voltage derived from the 15-volt supply by a resistive divider network made up of resistors R3, R4 and R5. This voltage sets the initial bias level for the first video amplifier, and also provides a constant emitter bias for the gated AGC amplifier.

AGC

The purpose of any type of AGC is to maintain a constant video detector output level over a wide range of input RF signal levels. The changes or variations in video signal amplitudes are translated into DC

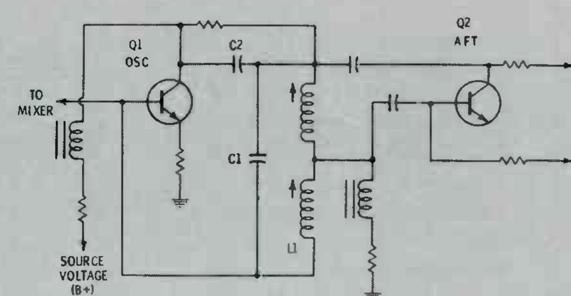


Fig. 4 Local oscillator and AFT circuitry employed in KRK-142 VHF tuner.

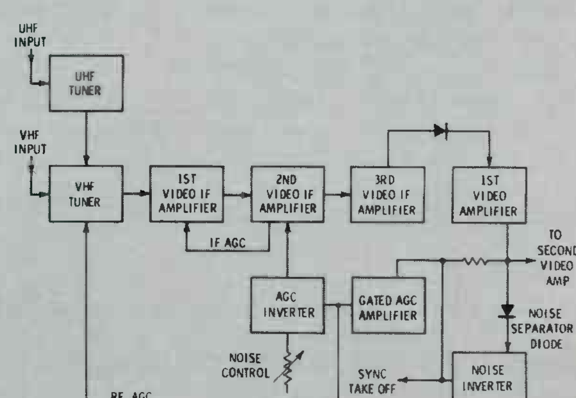


Fig. 5 Block diagram of tuner and video IF circuits employed in CTC-40 chassis.

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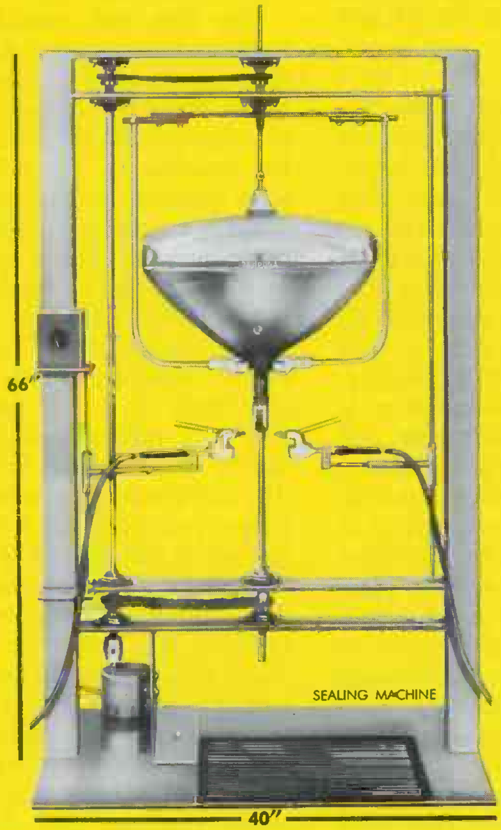

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voltages which are used to control the gain of the RF amplifier and the first and second IF amplifiers. in the CTC-40 chassis.

Video information from the first video amplifier is fed to the gated AGC amplifier to produce an output DC voltage that is proportional to the sync tip amplitude. This AGC output is filtered and applied simultaneously to the RF AGC clamp circuitry and the IF AGC inverter.

The RF AGC clamp circuit sets the requirements of the AGC voltage variations that can be applied to the RF amplifier. The RF amplifier operates under reverse AGC control. A more negative voltage (reverse bias) results in gain reduction, and a more positive voltage (less reverse bias) results in increased gain.

An AGC inverter stage is required for the first and second video IF stages to satisfy their requirements for forward AGC control voltage. The AGC inverter base bias is made variable by the noise control, to establish the proper proportions of AGC voltage applied to the RF and IF stages.

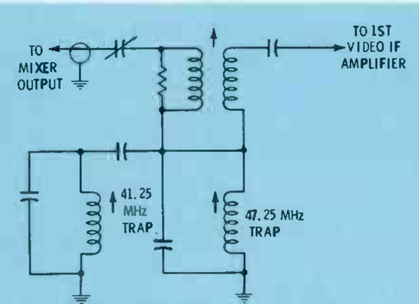

Fig. 6 Doubletuned link coupling is used between mixer output and video IF input.

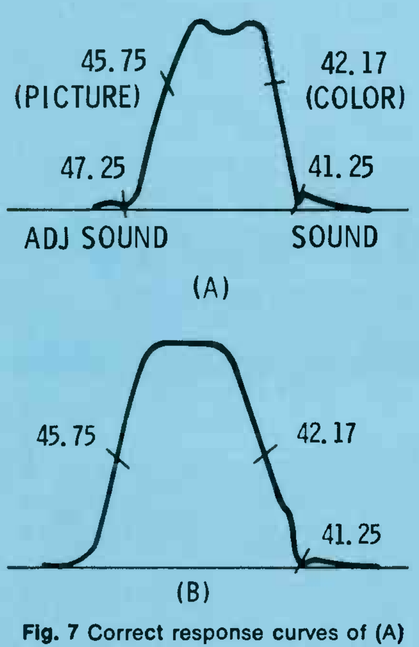

Fig. 7 Correct response curves of (A) link coupling circuit and (B) overall video IF circuit.

Gated AGC Circuit Operation (Fig. 10)

A video signal which contains positive-going sync pulses is fed to the gated AGC amplifier base. (This signal level is proportional to the picture carrier strength.) The gated AGC amplifier is designed to conduct only during sync pulse time by the positive-going keying pulses coupled to the collector through capacitor C1. These pulses occur at the horizontal frequency rate and key the transistor simultaneously with the horizontal sync pulses contained in the video signal applied to the base. The bias on the transistor is such that the base-emitter junction can become forward biased only during the positive peaks of the sync pulses. This circuit keeps spurious noise to a minimum.

During conduction time, electron current flow is from the emitter to the collector, leaving a negative charge on capacitor C1. This negative charge becomes the AGC voltage and its value is directly proportional to the amount of amplifier conduction; and the amount of amplifier conduction is directly proportional to the peak positive amplitude of incoming sync pulses. The RC network, composed of R1 and C2, improves the overall stability of the circuit.

Service Switch

It is necessary to provide a blank raster to aid in picture tube setup. A positive voltage is applied to the AGC amplifier by operation of the service switch. When the service switch is actuated, a 30-volt potential (normally dropped across resistor R2) forward biases diode X1 and appears on the base of the AGC amplifier. This potential is sufficient to saturate the AGC amplifier and, consequently, produces a high negative AGC voltage. This voltage, in turn cuts off the RF amplifier, and the first and second video IF amplifiers. All video information is removed from the CRT, and a blank raster results. Diode X2, in the collector circuit of the AGC amplifier, prevents the developed negative AGC voltage from discharging back through the collector-base junction between keying pulses.

AGC Inverter (Fig. 11)

The first and second video IF stages require forward AGC control voltages; therefore, it is necessary to invert the AGC output before application to the IF circuits. This is the function of the AGC inverter stage illustrated schematically in Fig. 11. It is a common-emitter DC amplifier designed for a gain of approximately 0.15. Fractional gain is necessary to reduce the large voltage range of the AGC amplifier to within the bias base control limits of the IF amplifiers. The AGC inverter base bias voltage can be varied by the noise control. The noise control is used to set the proper proportions of AGC voltages applied to the RF and IF amplifiers throughout the AGC control range. The control is used basically to establish the point at which the AGC voltage starts reduction of RF amplifier gain, or, if you prefer, sets the RF AGC delay point. Changing the bias on the AGC inverter stage by changing the noise control setting varies the bias and the gain of the first and second video IF amplifiers. The gain of these two amplifiers sets the video signal level applied to the gated AGC amplifier, whose output determines the RF AGC voltage. The noise control should be adjusted while observing a noise-free signal and rotating the noise control in the opposite direction until the snow is gone.

Noise Inverter (Fig. 12)

The purpose of a noise inverter circuit is to prevent any spurious noise pulses that might be present in the video signal from interferring with the smooth operation of the AGC amplifier or upsetting the sync separator. The noise inverter minimizes the effects of any noise pulses by inverting and, thereby, cancelling the pulses before they are applied to the AGC and sync circuits.

The circuit operation of the noise inverter is as follows: A reverse bias is fed to the cathode of X1 from the constant source potential available at the emitter of the gated AGC amplifier. This potential sets the conduction threshold for the diode. Diode X1 conducts only during the

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interval of positive-going pulses. These pulses forward bias the diode and are applied to the base of the noise inverter through diode X1 and capacitor C1. The noise inverter transistor does NOT have a DC forward bias; therefore, conduction will occur only when an incoming positive pulse exceeds the base-emitter barrier junction potential of 0.6 volt. The positive-going sync pulses fed through diode X1 and capacitor C1 are only at approximately 0.2 to 0.3 volt amplitude and are insufficient to cause conduction. Only noise pulses in excess of 0.6 volt will trigger the noise inverter into conduction. When the noise inverter does conduct, the noise pulses that triggered the stage into conduction appear amplified and inverted in the collector circuit and cancel the noise pulses coupled to the collector from the first video IF amplifier. Resistor R1 is connected in series with diode X1 to limit the peak conduction rate. This is required to reduce charging of capacitor C1. If this capacitor is allowed to charge excessively, noise inverter action would be blocked until the capacitor discharged to its initial level.

Sync Separator (Fig. 13)

The sync pulses present at the collector of the noise inverter are applied to the sync separator amplifier base. The output of the sync separator amplifier is of the correct polarity and amplitude to drive the sync separator.

The sync separator is a PNP common-emitter switch which is triggered into conduction by the negative-going sync pulses applied to the base through capacitor C1. Discharge path for coupling capacitor C1 is through resistor R1. The output of the sync separator is made up of positive-going sync pulses which are developed across a voltage divider network and applied to both horizontal and vertical deflection systems. The noise immunity features of the sync separator are enhanced during horizontal sync time through the use of .01-pf capacitor C1, which provides coupling between the stages. Capacitors C2 and C3 provide filtering for high video and chroma components of the incoming signal.

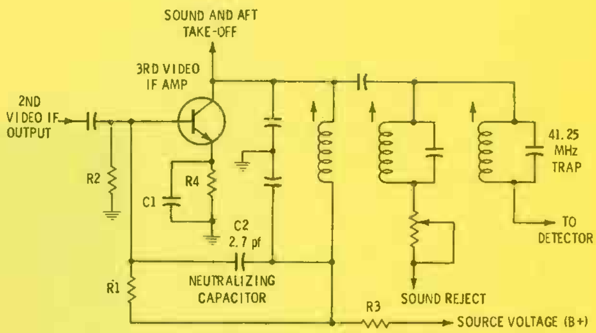

Fig. 8 Third video IF amplifier employed in CTC40 chassis.

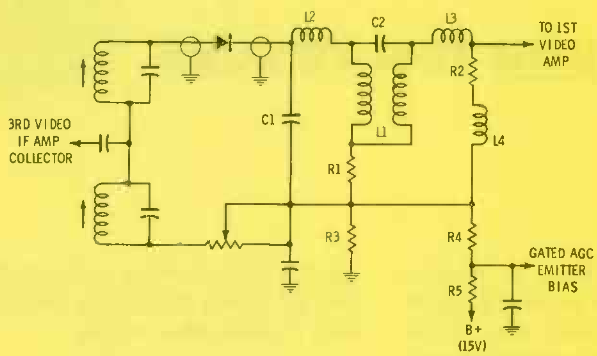

Fig. 9 Video detector circuit of CTC40 is similar to the design employed in previous tube-type chassis.

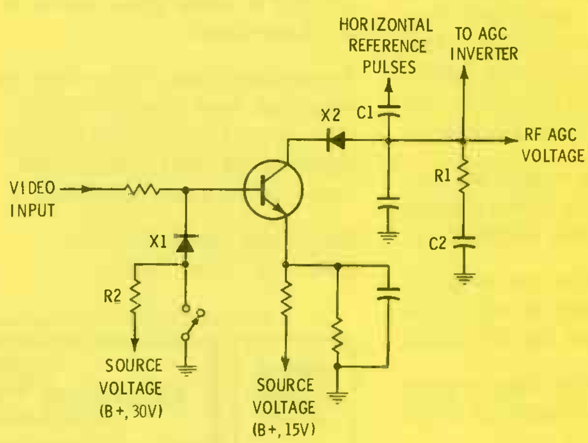

Fig. 10 Gated AGC system is keyed on by positive-going sync pulses applied to base and collector.

Video Amplifier Section (Fig. 14)

First Video Amplifier

The output of the video detector is effectively in series with the base bias of the first video amplifier. Base bias is developed by a voltage divider network. The first video amplifier is connected in an emitter-follower configuration. This circuit features a high input impedance to match the inherently high output impedance of the detector circuit. Output of the emitter-follower is developed across a 1000-ohm resistor in the emitter circuit. Additional circuit loading results from coupling to the following stages: The output circuit of the first video amplifier is connected to the first chroma circuit, the second video amplifier, the sync separator amplifier, the noise inverter and the AGC gate.

Delay Line

The signal output of the first video amplifier is coupled to the delay line. The delay line must be properly terminated to prevent ringing, faulty color registration, etc. The CTC40 delay line has a characteristic terminal impedance (input and output) of 680 ohms at video frequencies. A 560-ohm resistor, in combination with the first video amplifier output impedance, provides the delay line with the proper 680-ohm input terminal impedance.

The output terminal of the delay line is applied to the second video

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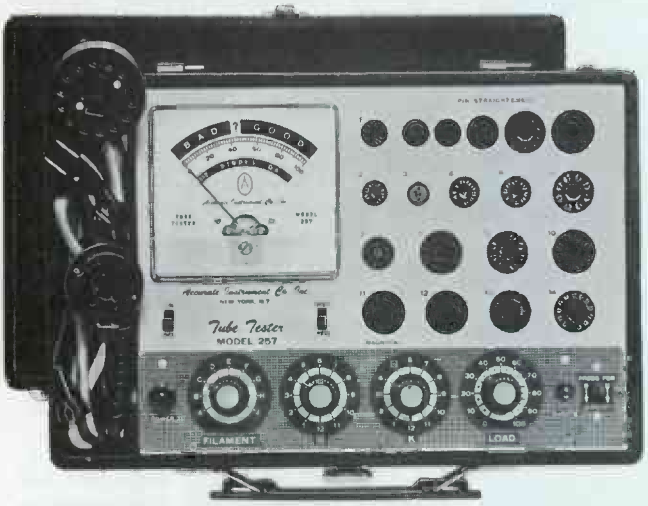

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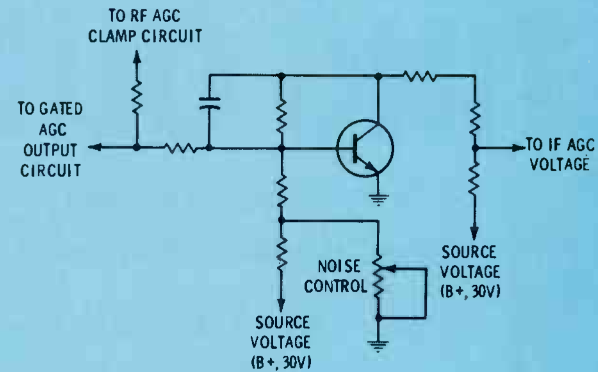


Fig. 11 AGC inverter provides forward AGC control of the 1st and 2nd video IF stages.

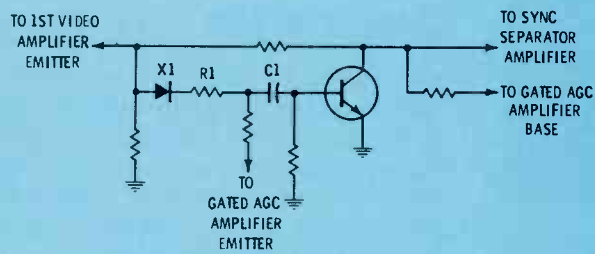


Fig. 12 Noise inverter prevents spurious noise signals from upsetting AGC and sync operation.

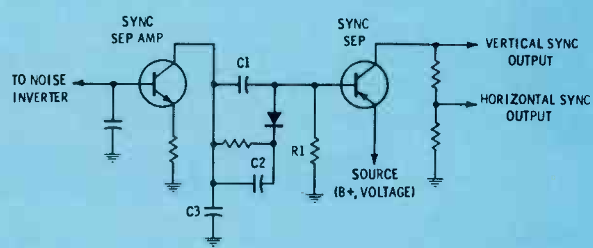


Fig. 13 Two-stage sync separator supplies positive-going sync pulses to horizontal and vertical sync circuits.

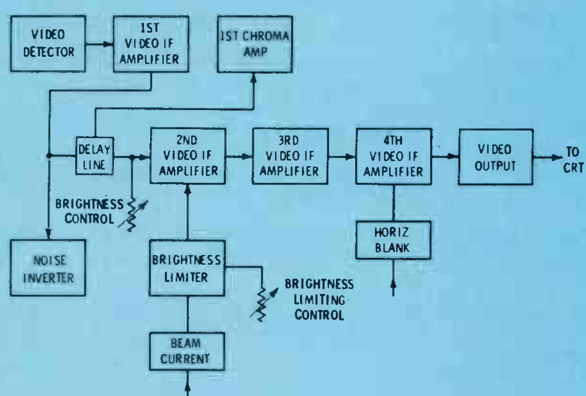


Fig. 14 Block diagram of video amplifier section employed in CTC-40 chassis.

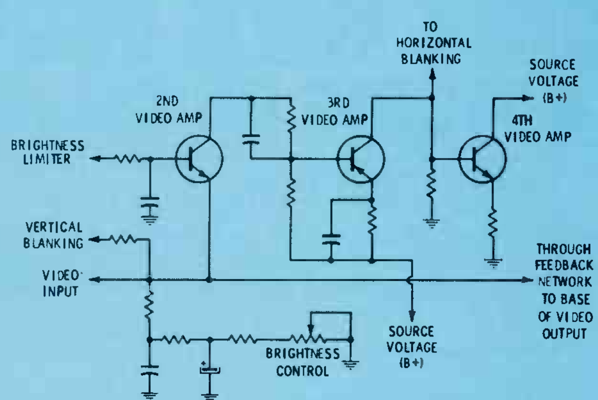


Fig. 15 Simplified schematic of the 2nd, 3rd and 4th video amplifier stages.

amplifier through a 680-ohm resistor. The second video amplifier stage is designed to exhibit an AC input impedance of zero ohms. Therefore, the output of the delay line is effectively coupled to AC ground through a resistor to properly satisfy termination impedance requirements.

Second, Third and Fourth Video Amplifiers

The simplified circuit configuration illustrated in Fig. 15 points up the relationship of the second, third and fourth video amplifiers. From a functional standpoint their operation is so similar that a brief discussion of the operation of each will suffice.

Second Video Amplifier

The second video amplifier utilizes a common-base configuration and is designed for an input impedance of zero ohms. This is accomplished through the use of a 10-mfd bypass capacitor. The stage functions as a power amplifier. Any fluctuations in the DC output of the first video amplifier are amplified throughout the range of video frequencies. This stage provides proper impedance matching between the delay line output and the third video amplifier input. Positive-going pulses at the vertical frequency rate are fed to the emitter to provide vertical retrace blanking.

The operating point of the second video amplifier varies with the setting of the brightness control. Any change in the brightness control results in a change of the operating point by changing the forward bias current. The lower the resistance of the brightness control, the greater the forward bias current. The result is a larger average current flow through the second video amplifier load resistance. This current flow is translated by the remaining video amplifiers as a reduction in CRT cathode bias and, consequently, an increase in brightness.

Third Video Amplifier

The third video amplifier employs a PNP transistor in a common-base configuration. The video signal is fed to the base through a 1000-ohm resistor. This resistance provides proper loading for the second video amplifier and impedance matching between the second and third video amplifiers. It also functions to prevent saturation of the third video amplifier in the event the second video amplifier develops a collector-emitter or emitter-ground short circuit. The output signal is developed across an 1800-ohm load resistor and direct coupled to the base of the fourth video amplifier.

Fourth Video Amplifier

The fourth video amplifier is connected as an emitter-follower. The output of the stage is developed across an 1800-ohm resistor and is direct coupled to the base of the video output transistor. Positive bias voltage applied to the collector is decoupled from the chassis 30-volts supply source by a filter network comprised of a 10-ohm resistor and an .01-pf capacitor. This decoupling network prevents feedback loops that could cause low-frequency smear, etc. Horizontal pulses, which occur simultaneously with the horizontal retrace interval, are fed to the base to accomplish horizontal retrace blanking. This circuit operation is as follows: Horizontal pulses originating at the high-voltage transformer are applied through a clamp transistor to an isolation diode. The isolation diode is reverse biased during scan time by a positive DC voltage developed at the collector of the clamp transistor. During this interval the blanking circuit is isolated from the fourth video amplifier to prevent loss of high-frequency components.

The negative-going horizontal pulses, fed to the isolation diode during retrace intervals, overcome the diode reverse bias and permit it to conduct. These negative-going pulses are present at the base of the fourth video amplifier and are of sufficient amplitude to affect cutoff. These pulses are applied to the CRT through the video output stage. This action causes picture tube cutoff, or a dark screen, during horizontal retrace time.

Brightness Limiter

A brightness limiter circuit is employed in the CTC40 chassis to hold the CRT beam current within proper limits. The drive potential of the horizontal deflection system is such that, with a high, non-limited brightness control adjustment, it is very possible to exceed the current capabilities of the CRT.

Brightness limiting action of the CTC40 functions to reduce the forward base bias voltage on the second video amplifier when the preset limit of CRT beam current is attained. The preset limit is 1600 micro-amperes (1.6 ma). Circuit action is as follows: The high-voltage transformer secondary winding is returned to B+ through the brightness limiter control. Therefore, all beam current drawn by the CRT must pass through the brightness limiter control. Connected between the low side of the brightness limiter control and ground is the brightness limiter transistor. The fixed base bias for this stage makes the voltage across it comparatively independent of the current through it, as long as it is conducting. This action is much like that of a zener diode; the zener voltage being determined by the resistive divider network in the limiter base circuit.

The current through the brightness limiter control has two parallel paths: one through the brightness limiter transistor, and the other through the CRT. If the brightness control is adjusted in such a manner that the CRT is cut off, the only path for current flow is through the brightness limiter control and the brightness limiter transistor. When the CRT is cut off, this current will be 1.6 ma, the desired CRT beam current limit. Should the brightness control be adjusted so that the CRT starts drawing current, part of the current will flow through the CRT and the remainder through the limiter circuitry, the total current flow remaining at 1.6 ma.

The constant voltage applied to the emitter of brightness limiter supplies a regulated bias voltage of approximately four volts to the base of the second video amplifier throughout the range of the brightness limiting system.

When the brightness control is set to the point where the CRT draws the total preset current of 1.6 ma, all of the current flowing through the brightness limiter control is beam current. Therefore, there is no current available to sustain conduction of the brightness limiter transistor. This results in a loss of the constant voltage applied to the base of the second video amplifier. If more current is demanded by the CRT, the voltage on the emitter of the brightness limiter transistor decreases, reducing the forward bias voltage on the second video amplifier. This action results in a decrease of average conduction in the second video amplifier, and a decrease in brightness and CRT beam current, holding beam current within the preset 1.6 ma limit.

Video Output (Fig. 16)

The video output circuitry is reminiscent of previously employed tube-type configurations. It consists of a common emitter amplifier whose input is DC coupled to the emitter of the fourth video IF amplifier, and whose output is DC coupled to the CRT.

The contrast control is used to vary the value of the series emitter resistance. The contrast control is AC bypassed by a 30-pf capacitor. This circuit action (varying the AC bypass of the contrast control) effectively controls AC degeneration with the end result of effective gain, or contrast, control.

Further control of the stage is provided by capacitor C1, which functions to reduce high-frequency degeneration and prevent changes in high-frequency response (peaking) at different contrast control settings. Inductance and capacitance components form a 3.58-MHz trap which functions to reduce the effects of interference resulting from the mixing of chroma signals and high-frequency video signals.

Output loading of the video output stage presents a familiar circuit configuration. Identical circuits have been employed in several previous RCA chassis.

Next month: analysis of the chroma, sound and automatic fine tuning circuits employed in the CTC40 chassis. ▲

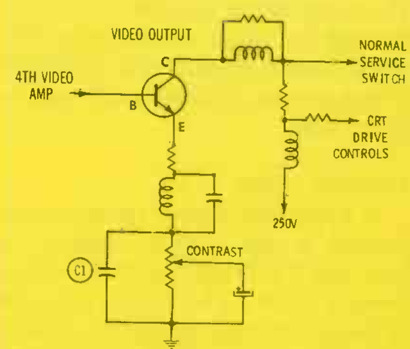


Fig. 16 DC coupling is employed in the input and output of the video output stage.

Circle 17 on literature card

Solving stereo separation problems

Practical stereo-FM servicing, Part 2

by Robert G. Middleton

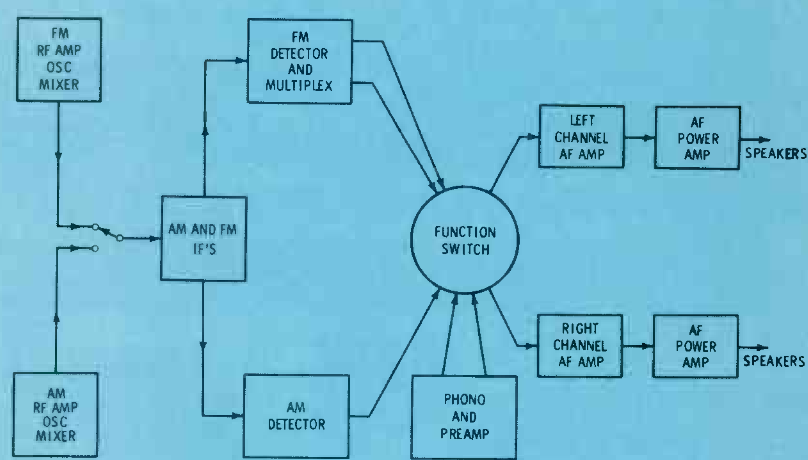
A block diagram of an FM stereo multiplex receiving system is shown in Fig. 1. In part 1 of this series we discussed the circuitry up to the FM detector. In this article we will cover dynamic testing of multiplex adapters and defects causing poor separation. However, to provide a clearer understanding of stereo channel separation we first will review the generation of the FM stereo signal.

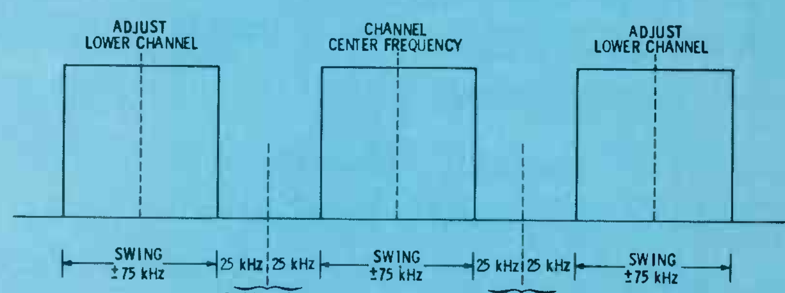
Producing the FM Stereo Signal

Basically, an FM-stereo signal consists of two different audio-frequency signals that occupy the same FM channel. These separate audio signals provide stereophonic sound reproduction. The individual audio signals are identified as "left" (L) and "right" (R). In conventional programming, this pair of audio signals originates from a pair of microphones at a sound studio, as depicted in Fig. 2A. The audio signal from the L microphone differs from that of the R microphone. Therefore, the stereo signal consists of two audio waveforms that vary independently in frequency and amplitude. At the receiver, the L and R signals are fed to separate speakers. These speakers are separated to simulate the placement of the transmitting microphones.

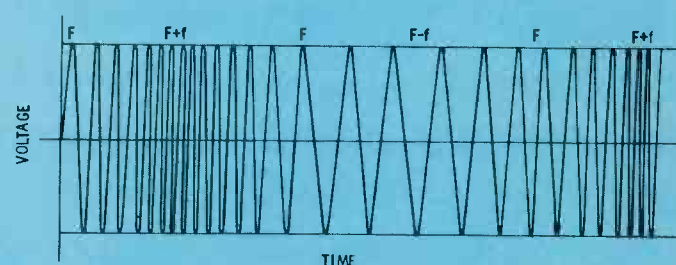
Fig. 2B shows the FM channel allocations. In monophonic transmission, the carrier (center frequency of a channel) is frequency-modulated as depicted in Fig. 2C. A swing of ±75 KHz represents FM sidebands that occupy the entire channel. In turn, the question arises concerning how one channel can be used to transmit two signals without mutual interference. If high fidelity were not required, an FM channel could be divided into two equal parts for transmission of the L and R signals on individual carriers. However, since high-fidelity transmission is a basic requirement, a method must be employed that permits each signal to occupy the entire channel bandwidth.

To transmit both the L and R signals at high fidelity in a single channel requires multiplex transmission. This is a technique which permits satisfactory separation of





(B) Frequency spectrum



(C) Frequency-modulated carrier

the L and R signals at the receiver. Note also that the system specified by the FCC is a compatible system. In other words, to a conventional FM receiver (monophonic receiver) the multiplex signal "looks like" an ordinary FM signal. But to a stereo-multiplex receiver, the multiplex signal "looks like" separate L and R signals.

A stereo-multiplex system starts with the conventional monaural audio signal, which is produced as the sum of L and R signals. That is, two microphones are employed as the equivalent of a single microphone. When the L and R signals are mixed, as shown in Fig. 3, the mono (L+R) signal is produced. This L+R signal is frequency-modulated on the RF carrier, and the result is the same as if a single microphone were used. Furthermore, to an ordinary FM receiver, only a mono signal is being transmitted —actually, as explained next, additional information to which on ordinary FM receiver is unresponsive is also being transmitted.

To explain this additional transmitted information, let us consider the effect of adding a 38-KHz carrier as depicted in Fig. 4. Both the L+R signal and the 38-KHz carrier are frequency-modulated on the RF carrier. However, only the L+R signal can be reproduced at the FM receiver. That is, the 38-KHz carrier is out of the range of audibility. Next, if amplitude modulation is impressed on the 38-KHz carrier, this modulated signal will be inaudible on an ordinary FM receiver. With reference to Fig. 5, the L+R signal is frequency-modulated on the RF carrier as before. In addition, an audio signal, A2, is amplitude-modulated on the 38-KHz carrier; this AM carrier subsequently modulates the RF carrier in combination with the L+R signal.

Fig. 1 Block diagram of AM/FM stereo multiplex receiving system.

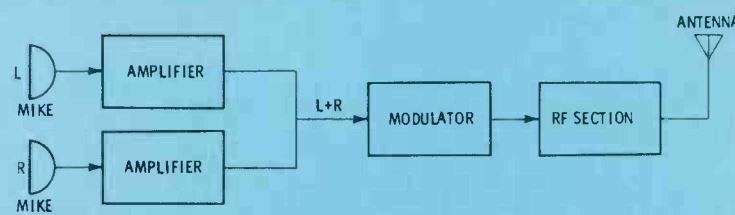
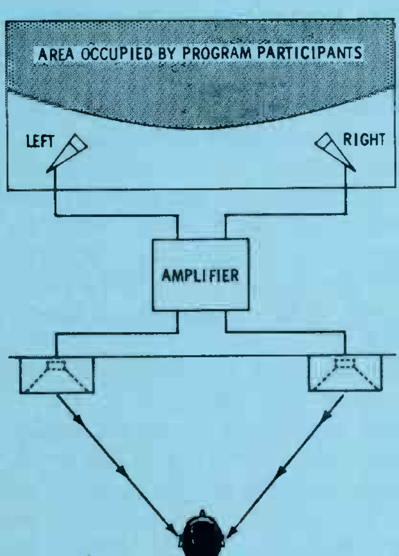
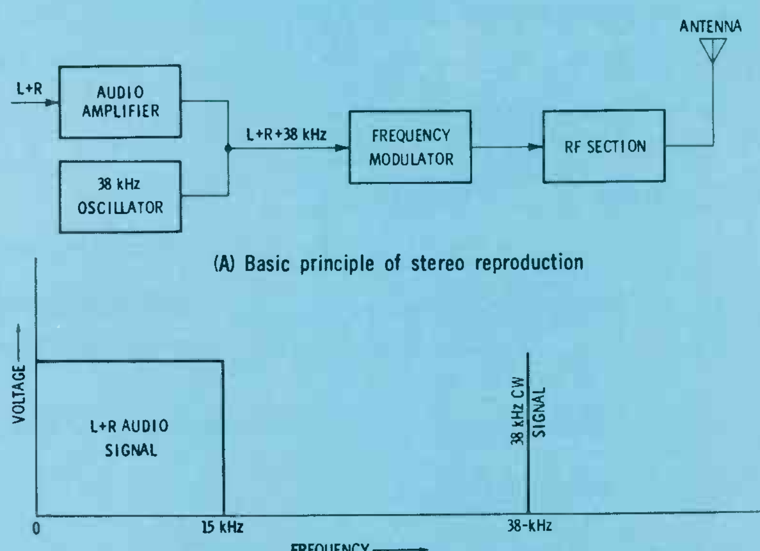


Fig. 3 L and R signals are mixed to produce monaural signal.



(A) Block diagram

Fig. 2 Basic concept and characteristics of FM stereo system.



(A) Basic principle of stereo reproduction

(B) FM channel specifications

Fig. 4 L+R and 38-KHz signals frequency modulated on RF carrier.

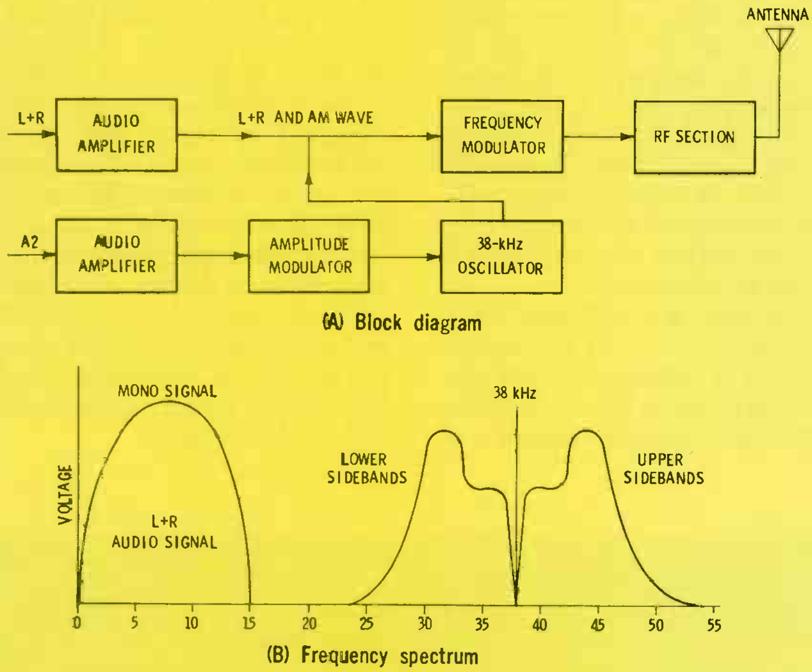


Fig. 5 Amplitude-modulated 38-KHz subcarrier combined with L and R signals.

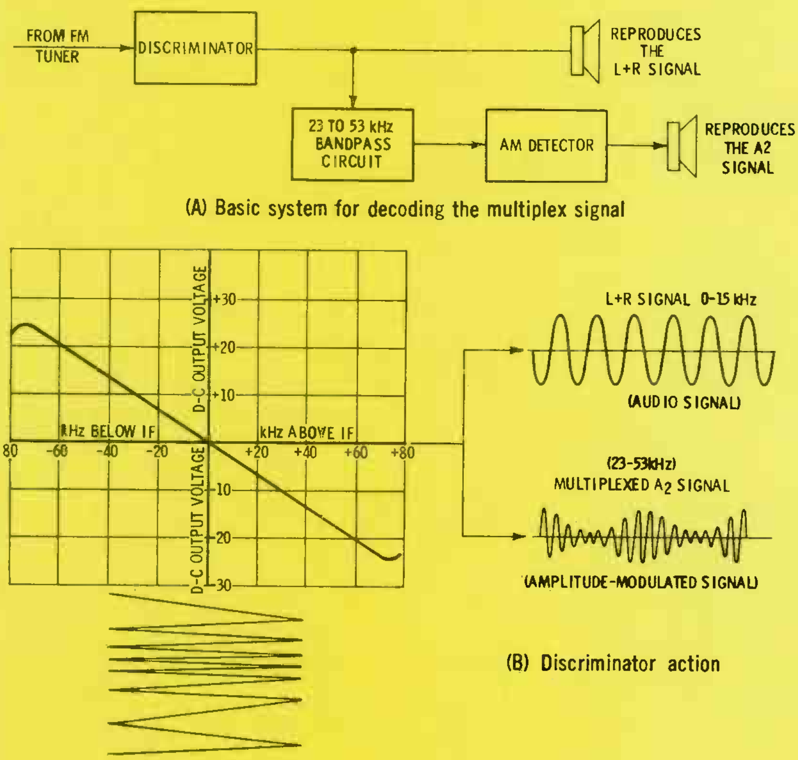


Fig. 6 Method for reproducing the multiplexed signal.

Fig. 5B shows the frequency spectrum of the modulating waveforms. The L+R signal has frequencies up to 15 KHz. On the other hand, the amplitude-modulated 38-KHz carrier has frequencies in the range from 23 KHz to 53 KHz. Note that after this frequency spectrum is frequency-modulated on the RF carrier and then processed through the discriminator of an ordinary FM receiver, the frequency spectrum is recovered in its original form, as depicted in Fig. 5B. Of course, only the L+R signal can be made audible. That is, the frequencies from 23 KHz to 53 KHz are said to be "encoded" in the radiated FM signal.

Now, let us see how the encoded signal can be recovered and made audible at the FM receiver. Fig. 6A shows a bandpass filter with response from 23 KHz, to 53 KHz, driven by the discriminator and followed by an AM detector and a speaker. It is evident that the bandpass filter picks out the AM signal, which is then demodulated by the AM detector. The demodulated (audio-frequency) wave envelope is then fed to a speaker which reproduces an audible signal. This is the A2 signal shown in Fig. 5. Note that the output from the discriminator in Fig. 5B is a mixture of the L+R and the A2-AM signal. Thus, the bandpass filter provides separation of the signals.

The foregoing example illustrates the basic principle of multiplex operation. However, the simple arrangement that we have analyzed must be elaborated somewhat to actually transmit R and L signals, and to obtain the R signal from one speaker and the L signal from the other. This requires the development of an L—R signal with a phase inverter at the transmitter, as shown in Fig. 7.

By inverting the polarity of the R signal and adding it to the L signal, we obtain an L—R signal. Thus we have both L+R and L—R signals available at this point. Note that if L+R is added to L—R, we can obtain 2L (the L signal with the R signal cancelled or separated). Again, if L—R is subtracted from L+R, we can obtain 2R (the R signal with the L signal cancelled or separated).

Addition or subtraction is accomplished in mixers, with associated in-

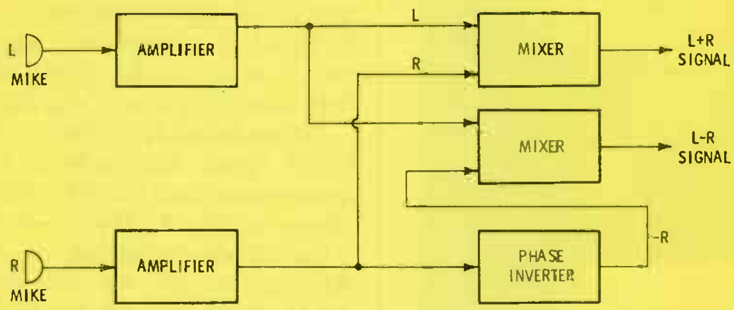


Fig. 7 Developing the L+R and L-R signals.

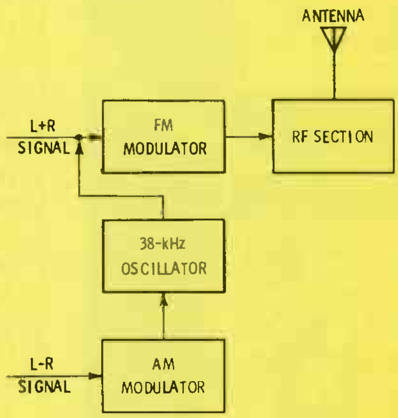


Fig. 8 Generation of the composite stereo signal at the transmitter.

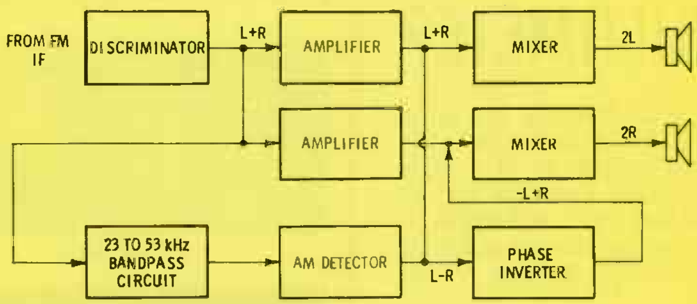


Fig. 9 Block diagram of multiplex adapter illustrates method used to obtain stereo reproduction.

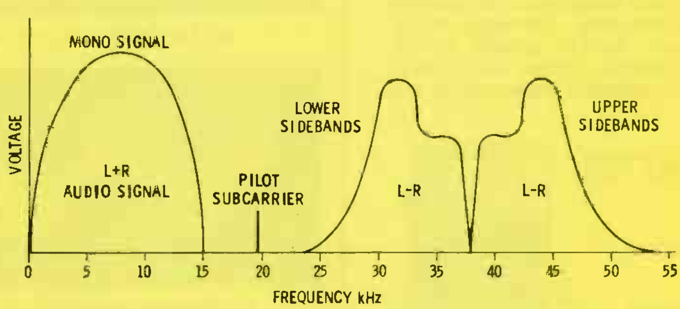


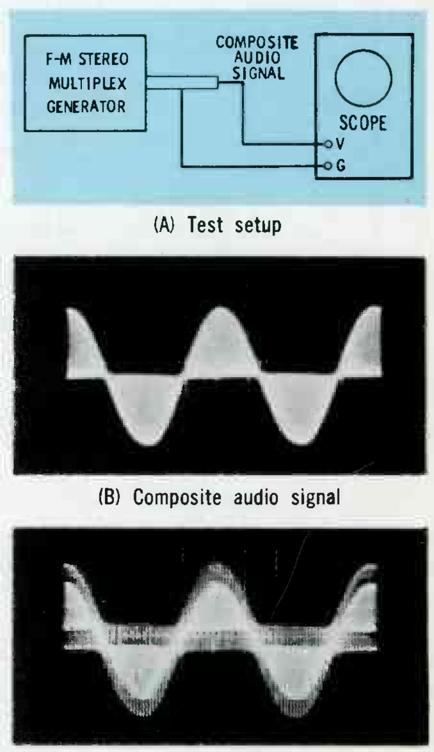
Fig. 10 Composite stereo signal showing 19-KHz pilot subcarrier in empty portion of spectrum.

verters. After the R and L signals have been separated from the L+R and L—R signals, we can feed the R signal to one speaker, and feed the L signal to the other speaker, thus obtaining stereo reproduction.

At the transmitter, the L+R and L—R signals are employed to frequency-modulate the RF carrier as shown in Fig. 8. The L—R signal is amplitude-modulated on a 38-KHz carrier, and the resulting signal is mixed with the L+R signal. In turn, the mixed signals frequency-modulate the RF carrier.

The frequency spectrum of the modulating signal is the same as shown in Fig. 5B, wherein the upper and lower sidebands flanking the 38-KHz carrier are produced by the L—R signal. At the receiver, this same frequency spectrum appears at the output of the discriminator.

To obtain stereo reproduction, the L—R signal is separated by means of a 23- to 53-KHz bandpass filter, amplitude-demodulated, and further processed in a phase inverter and a pair of mixers, as shown in Fig. 9. The addition of L+R and L—R produces a 2L signal. Subtraction of L—R from L+R (the same as adding L+R and —L+R) produces a 2R signal. Thereby,



(A) Test setup

(B) Composite audio signal

(C) Composite audio with 19-KHz pilot subcarrier superimposed

Fig. 11 Output check of multiplex generator.

stereo reproduction is obtained from the speakers.

In theory, the 38-KHz carrier (technically termed the subcarrier) could be transmitted. However, in practice, it is preferable to suppress the subcarrier at the transmitter, to permit transmitting the upper and lower sidebands of the L—R signal at a higher level and, thereby, improve the signal-to-noise ratio. In turn, the 38-KHz subcarrier must be reinserted at the receiver. This is accomplished by mixing a locally generated subcarrier with the L—R sidebands. Note that reinsertion must be accomplished not only at the exact frequency of 38 KHz, but also in correct phase, in order to obtain high-fidelity reproduction.

To permit precise reinsertion, a 19-KHz pilot subcarrier is transmitted for receiver synchronization. Fig. 10 shows how the 19-KHz pilot subcarrier is transmitted in an empty portion of the spectrum between the L+R signal and the lower sideband of the L—R signal. Interference is thereby avoided and good separation is facilitated at the receiver. Note that the 38-KHz subcarrier is generated at the transmitter, but is trapped out before it is broadcast. A 19-KHz pilot-subcarrier oscillator is locked to the 38-KHz subcarrier signal, thereby maintaining precise phase and frequency relations.

At the receiver, a tuned circuit picks out the pilot subcarrier and feeds it to a doubler, thereby developing the 38-KHz subcarrier. This subcarrier is then reinserted by mixing it with the L—R sidebands. The end result is the same as if the 38-KHz subcarrier had been transmitted with the L—R sidebands.

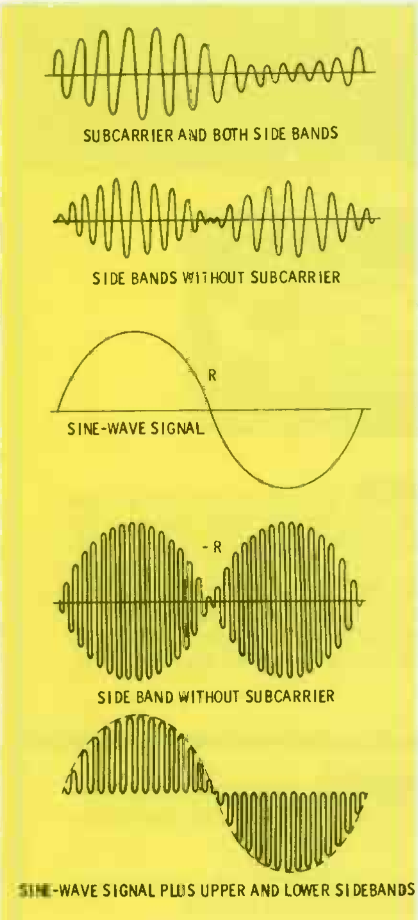
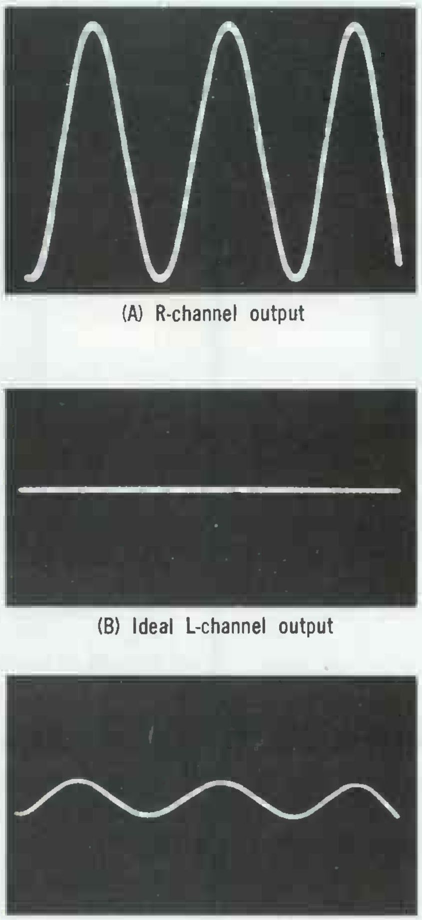


Fig. 12 Waveforms obtained at discriminator.



(A) R-channel output

(B) Ideal L-channel output

(C) Normal L-channel output

Fig. 14 Waveforms observed during separation test.

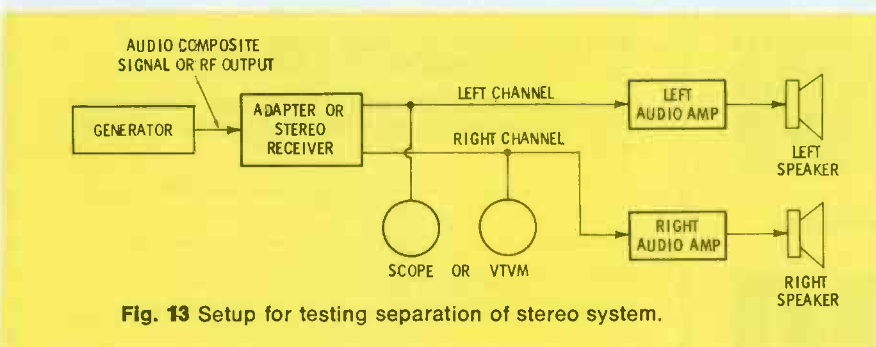


Fig. 13 Setup for testing separation of stereo system.

Dynamic Tests of Multiplex Adapters

A stereo-multiplex generator is required for dynamically testing of stereo-multiplex circuits. Such a generator supplies an L+R signal, an L—R signal, and a 19-KHz pilot subcarrier. A 1-KHz audio tone signal is employed to generate the L+R and L—R signals. Most generators provide a choice of modulated-RF (FM) signal output, or unmodulated signals. The unmodulated (composite audio) output is used when a multiplex adapter is tested directly.

A composite audio signal consisting of a multiplexed L+R sine wave and the 19-KHz pilot subcarrier appears on a scope screen as illustrated in Fig. 11. Technicians are often puzzled concerning the waveshape of the composite audio signal. Therefore, the following points should be observed with reference to Fig. 12:

1. The waveshape of the subcarrier and its sidebands are the same as an ordinary amplitude-modulated signal.

2. When the subcarrier is suppressed, the envelope of the waveform has twice its original frequency.

3. The generator L+R (or L—R) signal is produced by modulating a 38-KHz signal with a 1-KHz sine wave and then suppressing the 38-KHz signal.

4. The end result of the generator action is the waveform illustrated in Fig. 11B. Insertion of the 19-KHz pilot subcarrier results in the waveform illustrated in Fig. 11C.

The most basic test of a multiplex adapter is its ability to separate L+R and L—R signals. Fig. 13 shows the test setup. To test the multiplex adapter by itself, the audio composite signal is applied to the adapter input terminals. Either a scope or an AC VTVM can be used as the indicator. In theory, when an R-channel signal is applied, we would observe full output from the R terminal, and zero output from the L terminal, as shown in Fig. 14A and B. However, in practice, we usually observe more or less output from the L channel, as shown in Fig. 14C. Similarly, when an L-channel signal is applied, there is, ideally, zero output from the R terminal of the adapter.

A stereo multiplex generator provides a test signal with practically complete separation, unless the generator is defective. Our concern is with how many decibels of separation are provided by the multiplex adapter. A high-quality multiplex adapter will provide approximately 30 dB of separation in normal operation. It is generally considered that a separation of 10 dB is barely tolerable. 30 dB corresponds to a voltage ratio of more than 30 between L and R channels. On the other hand, 10 dB corresponds to a voltage ratio of approximately 3 between L and R channels.

Defects That Cause Poor Separation

The circuitry of a tube-type stereo adapter is shown in Fig. 15. The composite stereo signal is amplified by V1A and then fed to the grid of phase-inverter V2A. V2B operates as a mixer for the two outputs from V2A after sampling by the ring demodulator consisting of X3 through X6.

If V2 is not defective, check the other tubes as a matter of course. Next to tubes, capacitors are the prime suspects. Therefore, a systematic approach requires checking C8, C11, C9, C10 and C15. If all capacitors check normal, the next step is to test (or replace) the diodes in the ring demodulator. Therefore, we turn our attention to X3, X4, X5 and X6. Note also that poor separation can be caused by a defective diode in the frequency-doubling section that changes the 19-KHz pilot subcarrier into a 38-KHz subcarrier. Thus, if the ring demodulator is not defective, check X1 and X2.

Resistors are not likely to cause trouble; however, off-value resistors are occasionally responsible for poor separation. R33 is vulnerable because a shorted tube can cause the resistor to overheat and change value. Similarly, R34 can change value due to overload. If this resistor increases substantially in value, V2B is biased incorrectly and does not operate as a linear mixer; in turn, separation is affected. The setting of R31 determines the amount of L—R signal that is applied to mixer V2B and, consequently, affects separation. If R31 is not defective, suspect R35 as the cause of poor separation.

Alignment of the multiplex adapter is checked last, because this is the least likely cause of poor separation (unless a do-it-yourselfer enters the picture). Alignment of the adapter in Fig. 15 is comparatively simple: T2 is peaked at 19 KHz, and T3 at 19KHz. T4 is peaked at 38 KHz.

To align T2, inject an unmodulated 19-KHz signal at the grid of the preceding tube, V1, and connect an AC VTVM at the plate of V4. Adjust the slug in T2 for maximum indication. The test signal can be obtained from a multiplex generator, or from an accurate, conventional signal generator.

To align T3, inject a 19-KHz signal at the grid of the preceding tube, V1, and connect an AC VTVM at the plate of V4. Adjust the slug in T2 for maximum indication. The test signal can be obtained from a multiplex generator, or from an accurate, conventional signal generator.

To align T3, inject a 19-KHz signal at the grid of V4 and connect an AC VTVM to the plate of V5A. Adjust the slug in T3 for maximum indication.

Finally, to align T4, inject a 38-KHz signal at the grid of V5A, and connect an AC VTVM at the junction of X5 and X6. Adjust the slug in T4 for maximum indication. If alignment corrects a poor-separation symptom, it is good practice to try to improve the separation by compromise adjustment of the slug in T4. If a slightly different setting of T4 is required on an L-signal test, compared with that of an R-signal test, use a compromise setting for optimum separation in both tests.

Conclusion

Poor stereo separation can be the result of poor alignment in the front end or in the IF amplifier. Poor discriminator alignment can also cause impaired separation. Therefore, if a multiplex adapter shows good separation on an audio composite signal, troubleshoot the preceding receiver sections to localize a symptom of poor system separation. The necessity for good alignmment in an FM stereo-multiplex system cannot be overemphasized.

After separation has been verified (or restored satisfactorily), check for good balance and negligible crosstalk. These tests are made on the audio amplifiers. Since this is a rather extensive topic, explanation of test procedures will be reserved for the next article. ▲

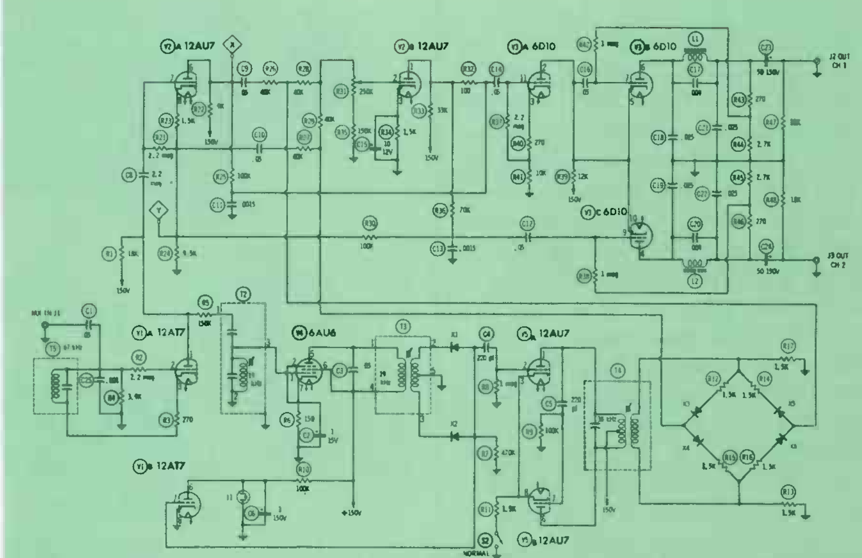


Fig. 15 Schematic of a typical tube-type stereo adapter.

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A proper approach to TUNER REPAIR

Where, when and how to service tuner defects

By Jack Darr

The quick, efficient, and economical services offered by TV tuner repair and replacement companies have almost eliminated the need for service shops to perform tuner repair. However, there are instances when time and economics demand that service shops perform bench servicing of the tuner. Although such instances are becoming more rare, when the need arises the technician must be able to accomplish efficient diagnosis and repair.

In any event, whether the tuner is repaired in the shop or sent to a tuner repair company, the technician must be able to isolate the trouble to either the tuner or the chassis.

Tuner or Chassis?

Signal substitution is probably the quickest and most accurate method for isolating the cause of a trouble symptom to either the tuner or chassis. Simply feed the tuner IF output of a known good receiver through a coupling capacitor into the IF input of the defective receiver. If a normal picture appears on the screen of the defective receiver, the trouble has been isolated to the tuner of that receiver. CAUTION: Do not use an AC/DC or line-connected chassis as the test receiver unless you carefully check and eliminate any AC potential that exists between the two chassis.

Tuner Removal

When the defect has been isolated to the tuner, there is the problem of removing it. Although extremely helpful, it is not necessary to have a test jig with available source, AGC voltages, etc. Most late-model sets have the tuner mounted separately on the front of the cabinet. These tuners can be removed and pulled out through the rear of the cabinet, in many instances without removing the chassis. In console-type cabinets, color chassis, etc., you can fabricate a set of extension cables. Only three to five wires plus a length of coaxial are required to connect most tuners. The IF cable and leads can be extended without excessive harmful effects. The only effect resulting from this extension would be on the IF response curve, and this is not of primary concern when tuner trouble is indicated. The primary concern is whether the tuner will produce an IF output, and it will, using the extension cables up to a distance of ten feet.

Signal Substitution

It is a simple procedure to isolate the defect to a single stage or circuit. There are only three stages: RF amplifier, mixer and oscillator (See Fig. 1). Since each stage performs a specific function, signal substitution is easy. Use the shop antenna as a signal generator, or source. Connect one side of the lead-in to ground, attach a clip-lead to the other side and attach a two-inch length of stiff wire to the free end of the clip-lead. Slip a length of spaghetti over the clip and partially over the stiff wire to form a handle or probe. Now, touch the probe (end of the stiff wire) to the mixer grid. (Use a test adaptor to facilitate accessibility to the tube pins.) If you are working on a transistor-type tuner, touch the probe to the mixer-base test point. If the CRT indication proves the mixer stage is functioning, move the probe to the RF input point; if the RF amplifier is functioning properly the CRT should show an improvement over the indication obtained with the signal injected at the mixer input.

Next, move the probe to the antenna input. There should be no gain, and also no significant loss.

Remember when making signal substitution or signal-tracing tests that you are not looking for an excellent picture on the CRT, but a change or a difference in the signal level. This change could be gain or loss of signal strength. Experiment on several tuners. Get to know what to expect from a normal tuner when you touch the probe to the specific test points.

Oscillator Stage

When the trouble symptoms are snowy raster and no picture, the oscillator stage is a prime suspect. The easy, obvious checks should be made first: Replace the tube or check the transistor. On tube-type tuners check the oscillator injection voltage at the mixer grid test point with a VTVM or FET meter. (Do NOT use a VOM). This voltage should be approximately —1.5 to —3.5 volts. When servicing transistor-type tuners use a VTVM or FET meter to check voltages on the base of the oscillator. They should average around —1 to —2 volts. (Always refer to the schematic of the equipment under repair for actual

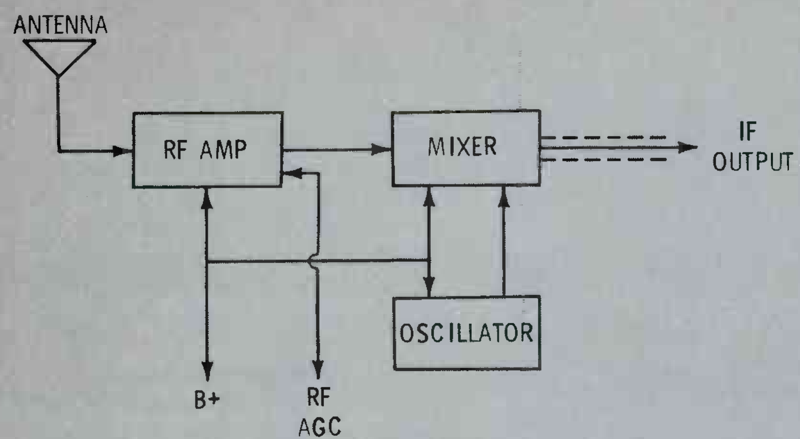

Fig. 1 Block diagram of typical VHF tuner.

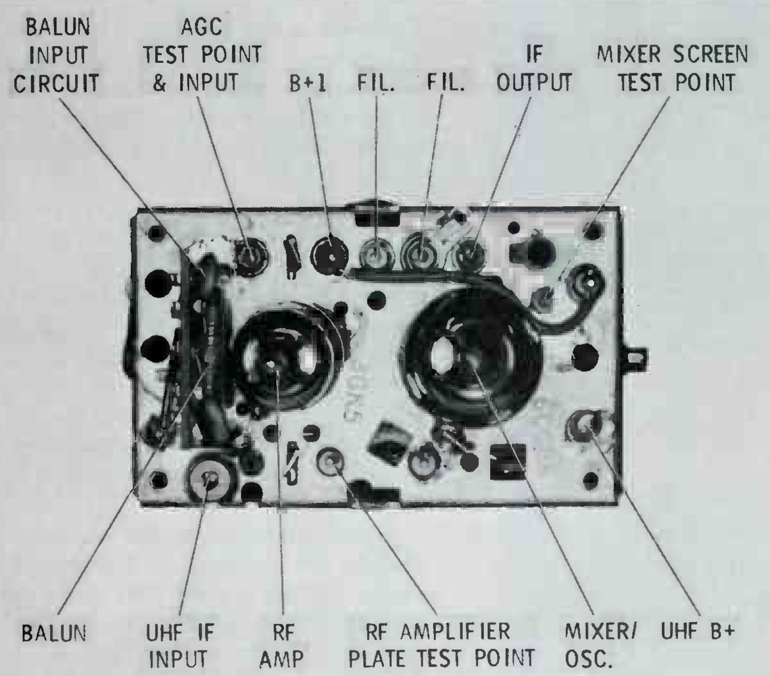

Fig 2 Top view of typical VHF tuner, showing common test points.

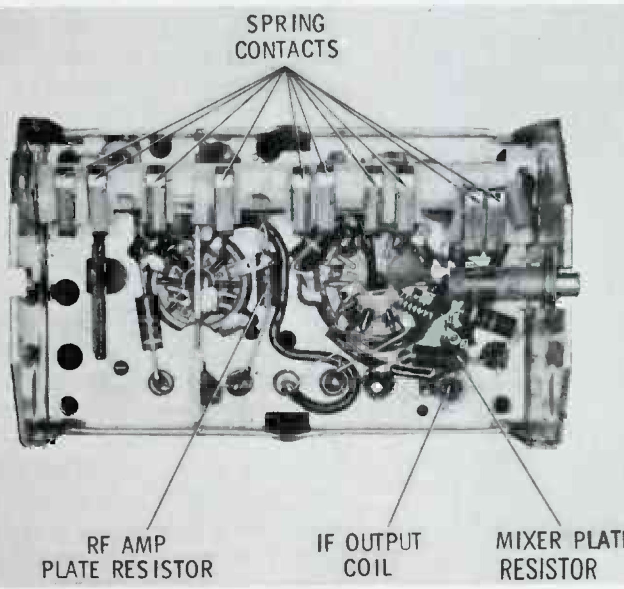

Fig. 3 Common sources of trouble are pointed out in this bottom view of VHF tuner with turret removed.

voltage readings).

Oscillator trouble will affect all channels if the oscillator stage is not functioning at all. However, an oscillator tube or transistor can be defective in such a manner as to affect only one band of frequencies, usually the high-band or channels 8 through 13, and in rare cases, only the low-band or channels 2 through 6.

Tube-Type Tuner (Figs. 2 and 3)

When the defective stage has been isolated, either through signal substitution or signal tracing, further checks must be made to isolate the defective component. If, for instance, a shorted tube has been uncovered and replaced, the chances are excellent that the plate load resistor of that tube has been damaged. Replacing the tube without replacing the load resistor will normally result in faulty or erratic tuner operation. This resistor can be checked without removing the tuner cover by using an ohmmeter to measure the resistance between the plate pin of the tube and the B+ terminal. (See the schematic of the tuner under repair for proper resistance readings.) In most cases this circuit will include a feed-through type capacitor, some chokes with near-zero resistance and the load resistor. The coils will not affect the resistance readings. If the value of the resistor varies more than 10 percent from the value indicated on the schematic or if the pointer of the meter acts erratic during the measurement, make a visual inspection of the resistor and check for evidence of overheating. In any case, it should be replaced.

Transistor-Type Tuner (Figs. 4 and 5)

The same basic procedures used in checking tube circuits will suffice for transistor stages: signal tracing, voltage measurements, resistance readings, etc. There could be some problems with the diode effect of the transistor junctions during resistance measurements. When making resistance checks, always reverse the ohmmeter probes each time to be sure of your readings.

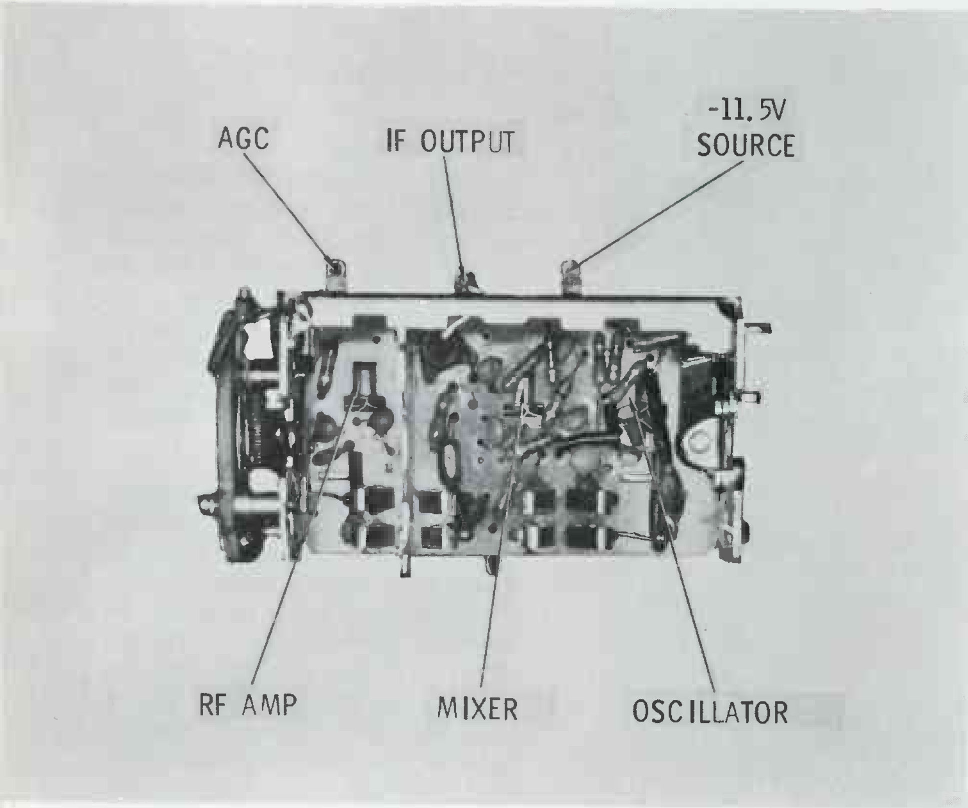

Fig. 4 Component side of typical solid-state VHF tuner with common test points indicated.

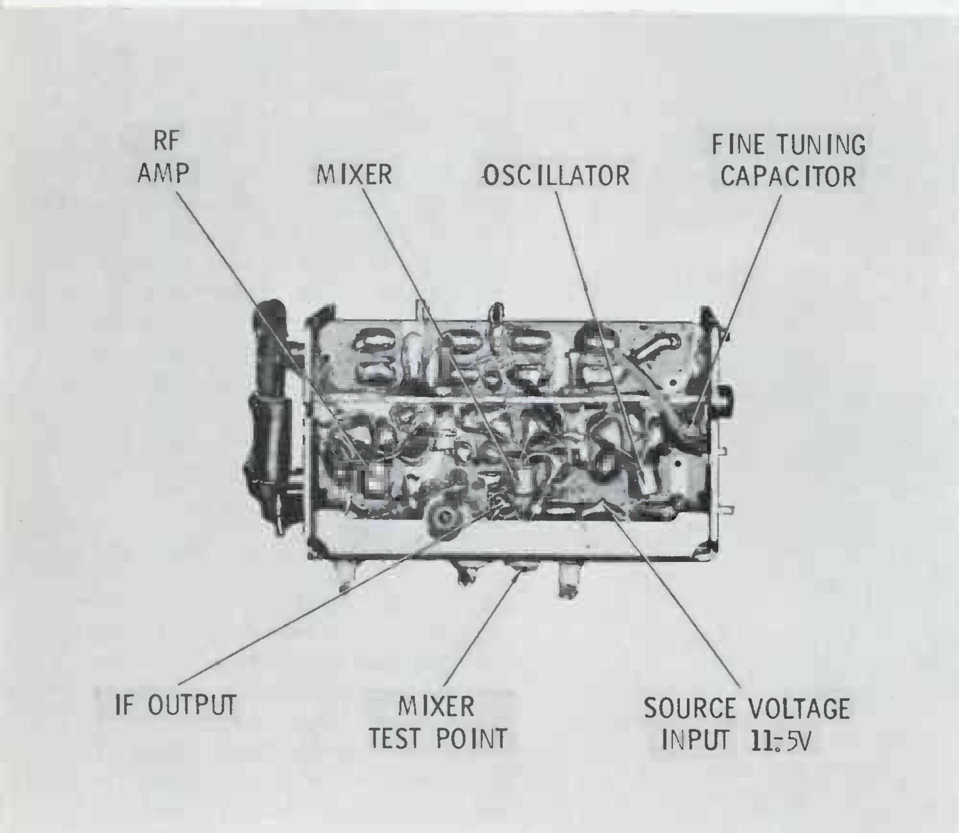

Fig. 5 Additional test points are indicated in this bottom view of circuit board employed in a solid-state VHF tuner.

In transistor tuners that have the transistors mounted on top it is advisable to lift one element connection to make resistance readings. When making voltage checks throughout the circuit always use a blocking capacitor in series with the meter. This is necessary to avoid upsetting the transistor bias circuits.

RF Amplifier Stage

One of the most common signs of tuner problems is snow (noise) in the picture. The tuner is receiving and passing the signal, but the signal is obviously weak. In some cases snow can be caused by the IF's. These cases are rare but you should be certain. Follow the procedure outlined for signal substitution and eliminate the IF's as possible trouble sources before proceeding with tuner repair.

In the vast majority of cases snow originates in the RF amplifier/balun circuitry. The noise that is displayed as snow on the CRT does not come from the antenna but is actually generated in the RF amplifier stage by either the transistor or tube. When the incoming signal is amplified to the proper level, it overrides the snow and a snow-free picture is displayed.

Signal injection is an excellent method for isolating the cause of a snowy picture. Two methods of evaluating the effects of injecting signals at different test points in the tuner can be used. One method is to observe the CRT and check for an increase or decrease in the snowy conditions as you move the probe from point to point. Another method is to connect the scope across the video detector output and lock in two frames of video. Check the amplitude or the variation in amplitude of the video waveform as you move the probe from test point to test point.

First, inject a signal (using the shop antenna as previously described) to the mixer grid or the mixer base, as the case may be, and observe the output on either the receiver CRT or scope. Next, move the probe to the RF input and observe the output indication. (There should be a substantial increase in gain.) Now move the probe to the antenna terminals. The output indicator (CRT of receiver or scope) should show very little, if any, gain.

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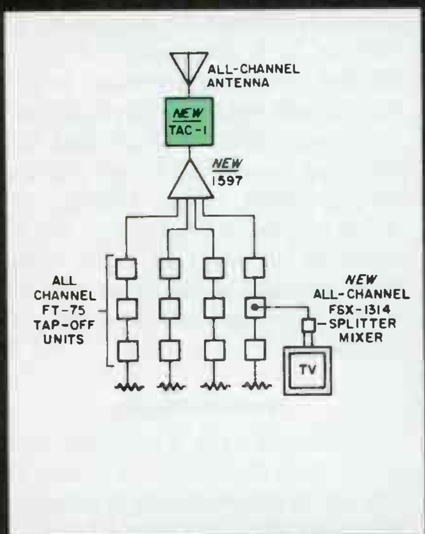

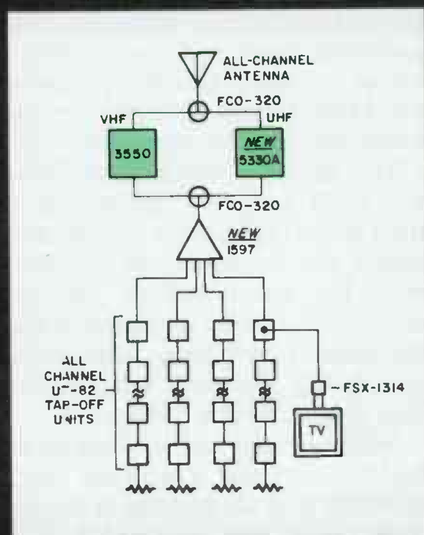

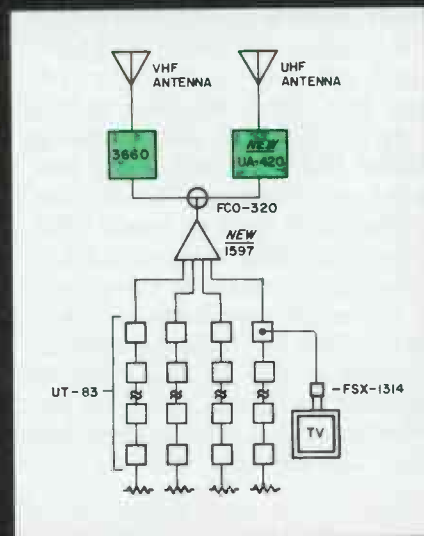

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However, if a significant loss is observed, a defect in the coupling circuit or balun coil, is indicated.

Balun Coil (Fig. 6)

The balun coil is a prime source of trouble and is capable of exhibiting all types of trouble symptoms. It is made of extremely fine wire and is particularly susceptible to lightning strikes. Should lightning strike anywhere in the immediate vicinity, there is an excellent chance of the balun coil being damaged. Should one side of the balun become open, there will be a picture on the CRT, but it will be snowy. Another indication, and it is a misleading symptom, will be the loss of either high or low bands. This symptom normally indicates a defective oscillator stage. The signal tracing procedure previously described will eliminate the oscillator stage as a suspect in this instance, and an ohmmeter check will isolate the defective balun coil. The antenna terminals will normally exhibit a very low resistance to ground (from either terminal) if the balun is directly connected to the antenna terminals (see Fig. 6A). In some line-connected chassis, the RC networks (resembling ceramic capacitors) are connected in series from the antenna terminals to the balun input (see Fig. 6B). These are necessary on line-connected chassis to keep AC voltages off the antenna terminals (for shock protection). In these RC networks, resistance values are comparatively large, and capacitance values are small. Continuity tests of the balun should be made on the balun side of these networks.

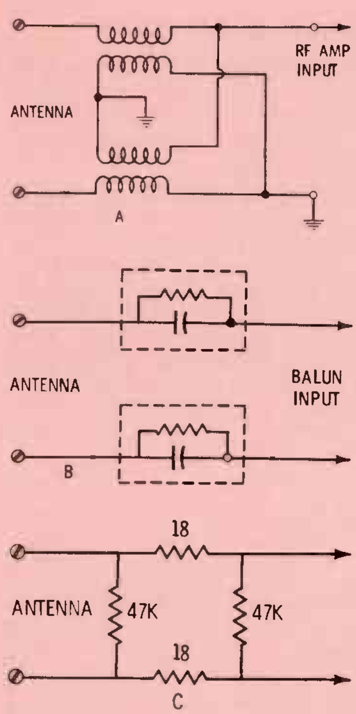

Fig. 6 Typical input circuits employed in VHF tuners. Above, A, Standard balun coil connections. Center, B, RC networks isolate antenna input terminals in line-connected chassis. Below, C, 1-dB pad used in some Zenith tuners.

In a number of Zenith color chassis, 1 dB pads are inserted on a fibre board between the antenna terminals and the balun coil (see Fig. 6C). The series resistors are 18-ohm units. Should lightning reach the antenna terminals, these resistors usually disappear entirely, but they save the balun coil.

When a balun coil is found to be defective, replace it with an exact duplicate if at all possible, if for no other reason than to avoid further problems. If it is impossible to duplicate the original, use a balun that is electrically similar. The function is the same, but the time involved in fabricating a new mounting can sometimes defeat the entire purpose of servicing tuners in the shop, which is to save you and your customer time and money.

Mixer Stage

A blank screen, white raster, and an occasional squeal from the speaker are symptoms often caused by the tuner. These symptoms could be the result of a defect anywhere from the video output stage to the mixer; therefore, it is advisable to use signal substitution to localize the defect to a specific section before suspecting the tuner.

When this defect is localized to the tuner, the trouble is usually in the mixer stage. A defective RF stage normally leaks enough broadcast signal to produce an indication on the CRT screen. There is always the possibility of RF AGC trouble, which often cuts off the mixer entirely. Usually AGC is applied only to the RF stage, but check the schematic for other applications.

AGC voltages can be eliminated as a suspected trouble source by simply shorting the RF AGC terminal to ground. This will set the RF AGC voltage at zero and remove any effect the AGC voltage might have had on the operation of the mixer.

Some chassis designs have delayed AGC voltage applied to the tuner through a filter network from a high B+ source. The voltage at this B+ point is on the order of 175 to 250 volts. A large value of resistance is used in the filter network, normally around 22 megohms. This resistor is a common source of trouble. It is fairly critical in value and should always be replaced when resistance checks indicate that it has deviated more than 10 percent from the specified value. Failure or a value change in this resistor can also result in an upset IF AGC voltage by coupling too much or too little positive voltage back into the AGC circuitry.

Intermittents

All tuners have a tendency to become intermittent. This is due mainly to the switching arrangement necessary for rapid channel changes. Contacts become dirty, pitted, and corroded, causing symptoms such as streaking and flashing in the picture, numerous adjustments of the channel selector when changing channels, picture and sound are best when selector is seemingly not indexed, etc. Such trouble symptoms normally can be eliminated by careful cleaning of the switch wiper contacts. Use a good tuner cleaner, spraying the contacts thoroughly and wiping dry with a lint-free cloth, then lubricating lightly.

CAUTION: Some color chassis show evidence of detuning when the tuner is sprayed with some types of tuner cleaner. The detuning effects disappear, in most cases, when the cleaner dries. Be sure to wipe all excess cleaning fluid from the tuner components.

Should the intermittent condition be impossible to eliminate through cleaning, the trouble is probably broken or bent contacts. In many cases this can be repaired by using a strong magnifying glass and a pair of tweezers. However, the time involved is prohibitive and it would be best to send it to a tuner repair station at this point.

Snowy Picture

Figs. 7A and 7B are illustrations

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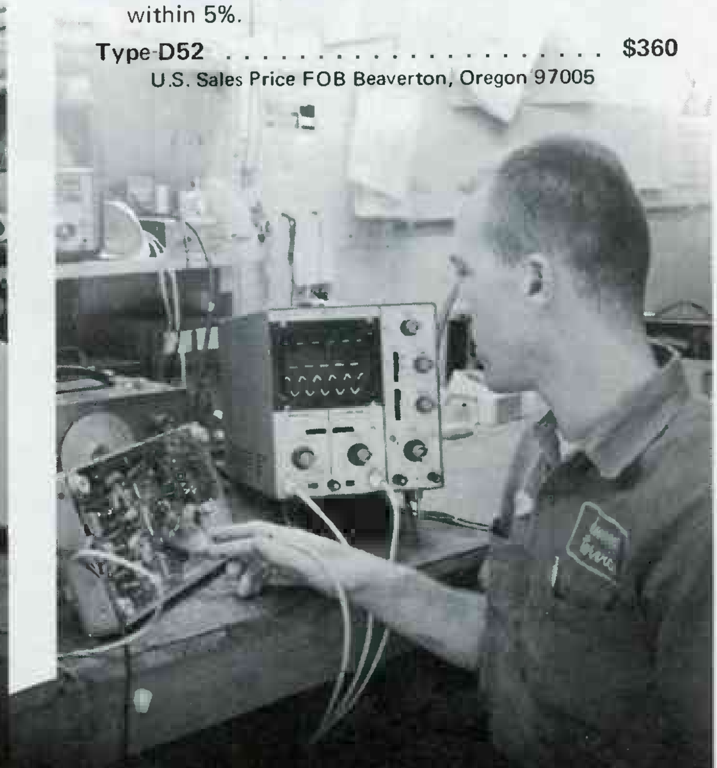

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of snowy picture symptoms. Fig. 7A exhibits heavy snow and is indicative of a weak signal, a defective balun, a weak RF amplifier tube or a noisy RF amplifier transistor. A somewhat better picture is illustrated in Fig. 7B. Light snow is visible and usually is indicative of a defective balun, weak RF amplifier tube or a leaky RF amplifier transistor. In several transistor-type tuners, improper adjustment of the AGC control can result in a snowy picture. This can be checked by rotating the AGC control through its range while observing the results on the CRT.

Picture Pulling—Distortion—Partial Blanking

These symptoms usually are attributed to a bad heater-to-cathode short in the mixer or RF amplifier. Usually it will be the RF amplifier. The 60-Hz voltage of the heater is applied to the cathode and blanks the CRT screen during one-half the vertical sweep. A similar symptom can occur in a transistor chassis. This is usually caused by a power supply defect that allows a 60-Hz ripple voltage on the DC supply, or source, lines. This is usually caused by a defective diode in a full-wave rectifier, or an open filter capacitor in a half-wave rectifier. This trouble can be detected by scoping the DC supply lines, checking excessive ripple. If the ripple voltage is not of sufficient magnitude to cause the symptom indicated in Fig. 8, it can cause pulling and weaving of the picture. If this symptom is caused by a slight 60-Hz ripple, the edges of the raster will be straight, but the picture will weave or pull.

Separation of Sound and Picture

This symptom can be caused by one of two faults: tuner misalignment, or insufficient signal strength. Either defect has the same end result, a flattening of the RF response curve. Misalignment is not usually accompanied by snow, therefore, if snow is evident on the CRT in conjunction with separation of sound and picture, a weak tube or malfunctioning circuit is probably the cause. If the misalignment is severe enough, it will produce a snow-free picture with no sound, or sound with no picture. The cure requires realignment of the tuner. For best results follow the manufacturer's or Photofact alignment instructions.

Ringing, Ghosts and Smear

The symptom illustrated in Fig. 9 is usually the result of tuner misalignment. The IF output coil is often used to peak the response curve at or near the picture carrier. Consequently, any misadjustment at this point can cause trouble. This can be detected by checking the response curve of the tuner. This will show where picture and sound carriers are located.

Fig. 7 Snow in picture is common indication of tuner trouble. Above, A, Heavy snow caused by weak RF tube or defective balun. Below, B, Medium snow resulting from slightly weak RF tube, noisy transistor, or AGC trouble.

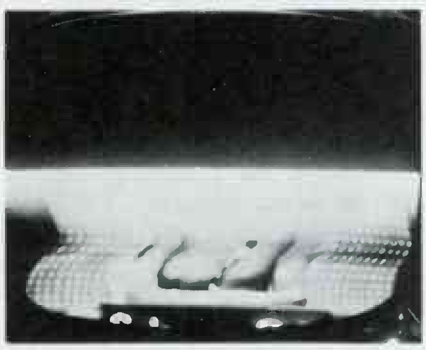


Fig. 8 Bending and partial blanking caused by heater-to-cathode short in RF tube.

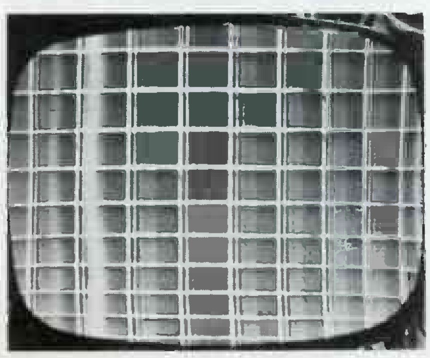


Fig. 9 Severe ringing caused by misalignment of tuner IF output coil.

CAUTION: Effects identical to those just described can be the result of misadjustment of the fine-tuning control. Be certain this is not the case.

Fine-Tuning and Oscillator Adjustments

Some late-model chassis utilize a small coil with a moveable core for fine-tuning functions. This is adjusted by a cam arrangement. In some versions this core and its shaft will break, leaving the core either jammed or pushed all the way out of the fine-tuning coil. This usually results in a job for the tuner repair companies.

General Service Procedures

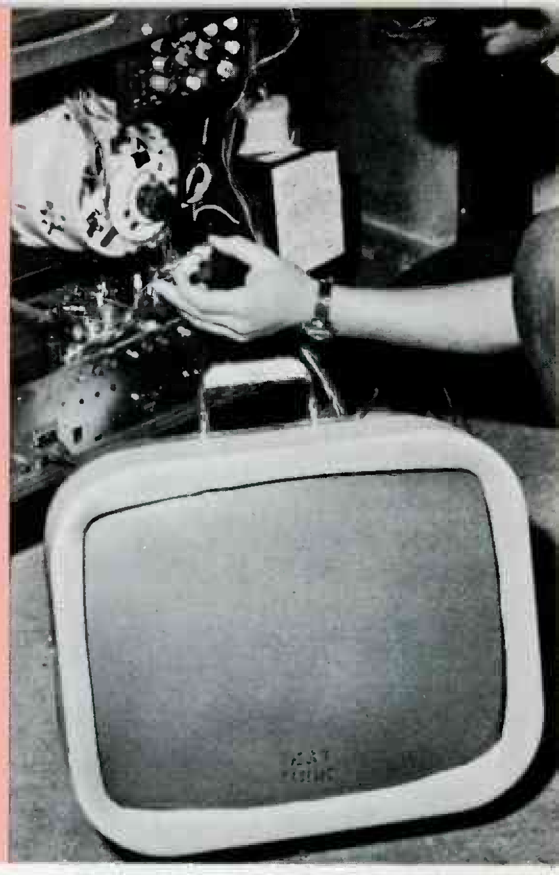
Check the grounding of the IF coax cable. Be sure the shield is firmly grounded. Tuners employing a phono-type plug should be checked very carefully to insure proper grounding. An improper ground can result in such symptoms as ringing, oscillations and smear.

The less you probe around inside the cover, the better. When making voltage measurements, use a test-adaptor; this will allow easy access to the tube pins and prevent undue probing around the tube pin terminals and associated circuitry.

Make full use of external test points (see Figs. 2 and 4) for AGC, B+ and IF-output measurements. When replacing components be very sure that the exact replacement is used. Physical size and electrical specifications are extremely critical. Dressing of leads must also duplicate the original lead dress. Do not bend or twist lugs on the switch. Overheating when soldering may cause damage to other components. Any pushing or bending of components will result in some degree of misalignment.

Tuner troubles may not be as difficult to diagnose or repair as you may have expected. However, if you feel it would be more economical for both you and the customer to send it to a repair service company, do not hesitate to do so. ▲

Color CRT or Chassis Defect?



Methods for isolating trouble symptoms to either the CRT or chassis.

by Homer L. Davidson

A color picture tube that displays a dim black-and-white raster that will not focus could be defective. However, it also is possible that the trouble symptoms are the result of a defect within the circuitry on the chassis. Thus, the service technician must determine which is the source of the trouble symptom—picture tube or chassis defect. This article will discuss the methods used to answer this question, along with examples of common CRT defects.

Substitution

There are three basic methods for isolating the cause of a trouble symptom to either the picture tube or chassis. Of the three, substitution of the receiver's picture tube with that of a color test jig is probably the easiest and most accurate.

The color test jig is a special color CRT equipped with its own deflection yoke, convergence circuitry, and cable and socket assembly that permits it to be substituted for the picture tube in the receiver. Thus, if the test jig screen does not display the same trouble symptom evident on the CRT of the receiver, it logically can be assumed that the CRT is defective.

Although most color test jigs currently available from manufacturers are designed for testing that particular manufacturer's chassis, most can be adapted to test other makes of color chassis. In most cases, this requires changing the CRT base socket, or the use of a socket adapter. The application of one manufacturer's portable color test jig is shown in Fig. 1, although, as previously pointed out, other manufacturers design and market similar units.

If you do not have a color test jig, or one is not immediately available at the time you need it, the following methods can be used to isolate a defective color picture tube. Of course, the exact sequence and tests will depend on the trouble symptoms.

Testing Color CRT with CRT Tester

To correctly test a color picture tube with a CRT tester, each gun should be checked separately. Start with the red gun, since it is usually the weakest. This is especially true for the older, round CRT's.

First, rotate the function switch of the tube tester to the "cutoff" position. Using the G2 control, check the cutoff characteristic. If the correct cutoff indication cannot be obtained, the emission is weak and the CRT should be replaced. Next, adjust the G2 control to the "wide open" position and rotate the function switch to the emission position. If the reading falls within the green area on the meter, the emission of the red gun is good. Record the actual reading.

Perform the preceding emission test on the green and blue CRT guns and record the meter readings. If the emission tests of all three guns produced an indication within the green area of the meter, compare the actual readings that were recorded. If the highest reading is no more than 1½ times the lowest reading, the emission characteristics of the CRT can be considered to be good. For example, if the red gun reads 650, the green gun 750 and the blue gun 800, multiply 650 by 1½. The result will be 975. The highest reading obtained, 800, is less than 975, indicating that the emission ratio between the strongest and weakest gun is satisfactory.

Most color CRT testers also provide a means for detecting leakage and shorts. Such defects are usually indicated by a neon bulb. Lightly tap the tube neck when testing for shorts. A faint glow signals a short.

Emission Test for Isolating Cause of Changing Gray Scale

Gun	First reading	Five-minute reading	75% of 5-minute reading
Blue	700	800	637
Red	550	850	600
Green	800	800	600

Substituting the receivers picture tube, convergence circuits and deflection yoke with a color test jig is the easiest and most accurate method for determining whether the picture tube or chassis is at fault.

Using a self-contained probe to check the high voltage.

Step-by-Step Isolation Procedure

The first step in any servicing procedure is to analyze the trouble symptom(s). This is particularly true when the color picture tube is a possible source of the trouble. The technician must determine if the trouble symptom indicates misaligned convergence, poor purity, insufficient brightness, improper focusing, missing color, etc. Once the exact nature of the symptom has been determined, the proper troubleshooting sequence can be followed to isolate the defect.

Low Brightness

This symptom is usually caused by insufficient high voltage, a gassy CRT or low CRT emission. If the high voltage is normal, check the picture tube with a CRT tester.

Missing Color

A fool-proof method for determining which color is missing is to place the normal-service switch in the service position and rotate all three screen drive controls counterclockwise. Then turn the screen controls up one at a time. If one color fails to produce a horizontal line on the CRT, either the drive circuit or the CRT gun associated with the missing color is defective. A quick emission test of the CRT gun will isolate the trouble to either the CRT or drive circuit. Occassionally, the cause of a missing color symptom can be traced to an open filament in the gun associated with that color. A visual check of the CRT filaments will confirm this condition.

No raster

Missing or insufficient high voltage or open filaments are the most common causes of this symptom. First, make a visual check of the filaments. If they are not lit, gently twist the CRT socket. Poor contacts on the CRT base pins of the picture tube socket may be the cause. If the filaments light up when the CRT socket is twisted, check the heater pins. Resolder the heater base pins and/or install a new CRT socket.

Flashes or White Lines in the Picture

This symptom is usually an indication of an intermittent gun. Gently tap the neck of the CRT. If a gun is intermittent the picture will flash off and on and will often return to normal operation. In any event, the CRT should be replaced.

Poor Black-and-White Picture

When one or two CRT guns become weak, it is almost impossible to obtain correct gray scale tracking no matter how much the CRT bias and screen controls are adjusted. A CRT tester will confirm the cause of this trouble symptom.

Changing Gray-Scale

If the black-and-white gray-scale tracking changes after the CRT has warmed up, suspect a defective CRT or —Y amplifier circuit. If two —Y amplifier tubes are used, replace both. Let the color chassis cool, then check the b-w raster. Don't tear into the —Y amplifier circuits until the CRT is checked out.

The CRT may have one or two guns that take longer to warm up resulting in a changing black-and-white raster. It is best to take an emission reading of each CRT gun. Record the three different readings. Take another reading after the CRT has operated for five minutes.

The readings obtained at this time must be in the green area of the meter scale, and the highest reading should be no more than 1½ times the lowest reading as explained earlier. The meter readings obtained in the first test should be at least 75 percent of the reading obtained for the same gun after it has operated for five minutes. (See example in Table 1.)

If the picture tube checks normal, suspect a defective —Y amplifier circuit as the source of the trouble. Monitor the voltages in each —Y amplifier circuit. Changing the plate or grid voltages will pinpoint the trouble.

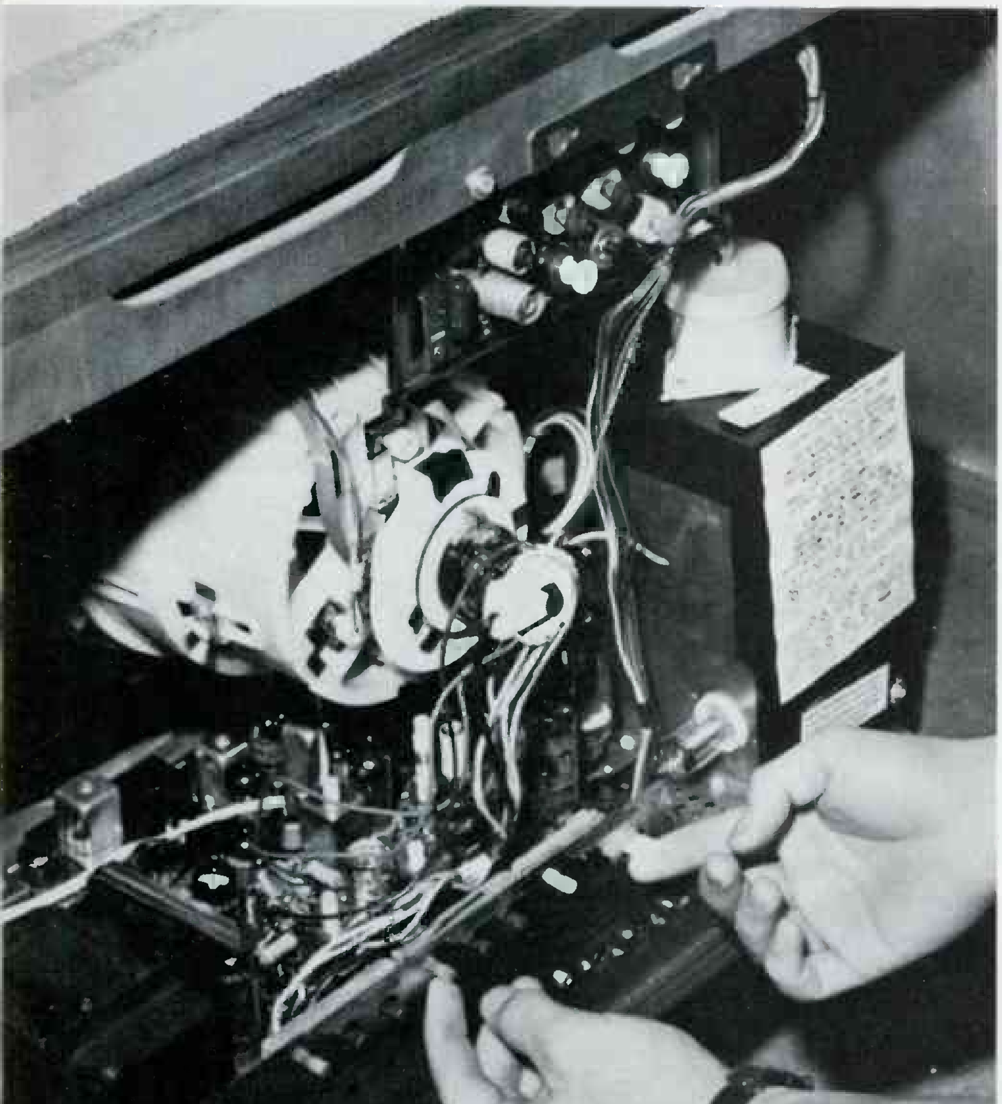
Poor Focus

Suspect insufficient focus voltage or a defective CRT if the raster lines will not focus properly. Check for correct focus voltage at the focus pin on the picture tube socket. First, see if the focus control will change the focus on the face of the picture tube. Does the focus voltage change when the focus control is rotated? If not, the trouble is either in the high-voltage power supply or the focus circuit.

The proper range of the focus voltage is from 4.5 to 5 KV. If the focus voltage is exceptionally low, check and adjust the high-voltage circuit. Improper high voltage will result in poor focus voltage. These two functions go hand in hand. Suspect the focus tube or diode.

Also, check the focus pin on the CRT. These pins can become corroded. Sometimes the focus wire or base pin will pull out of the CRT base or socket.

If correct focus voltage is found on the focus pin of the picture tube, but the picture is out of focus, replace the CRT. A bad CRT will have dull raster lines; the raster lines may change when the focus control is rotated, but they will not focus properly.



Placing the normal-service switch in the service position and turning up the screen controls one at a time is an easy method for determining which color is missing or weak.

Changing Purity

The purity of a defective CRT may change after several months or within hours. Movement of the shadow mask within the CRT is a possibility. First, make sure a strong magnetic source, such as a vacuum sweeper, is not causing the purity to change. Then, check the degaussing coil circuit.

To check the degaussing circuit, place an external degaussing coil in front of the TV screen. Hold the degaussing coil stationary and switch it off. Notice the smeared designs on the color picture tube. Now turn the receiver off and let it cool for fifteen minutes. Switch the receiver on and if the degaussing circuit is performing, all traces of impurities should be eliminated.

A Motorola color receiver displayed a greenish cast. The picture tube was degaussed with an external degaussing coil. A proper black-and-white picture was restored after a little adjustment of the screen controls. This color receiver did not have a built-in degaussing circuit and the purity had been upset when the lady of the house vacuumed the rug in the vicinity of the set.

A new Admiral color TV displayed purity problems after operating normally for two months. On the second service call the color receiver was removed to the shop. The degausing coil circuit was checked and found functioning normally.

The receiver was externally degaussed and the convergence readjusted. The set was cooked for two days. About noon of the third day, poor purity was noted in the top corners of the TV screen. A new picture tube solved the changing purity problem.

Another case of changing purity occurred in an RCA CTC16 chassis. The purity would change every time the receiver was turned off. Each time you started to set up purity, the "red ball" would be at the left side of the screen. A portable CRT test jig was harnessed to the color chassis and proved that the trouble was in the color CRT.

Brown Dots on Screen

This symptom occurred in sets using early 23" color picture tubes. Several dots would appear on the glass screen as a result of the color

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beads popping off the screen surface. These dots appeared brownish in color, about the size of a fly speck. The only solution was to replace the CRT.

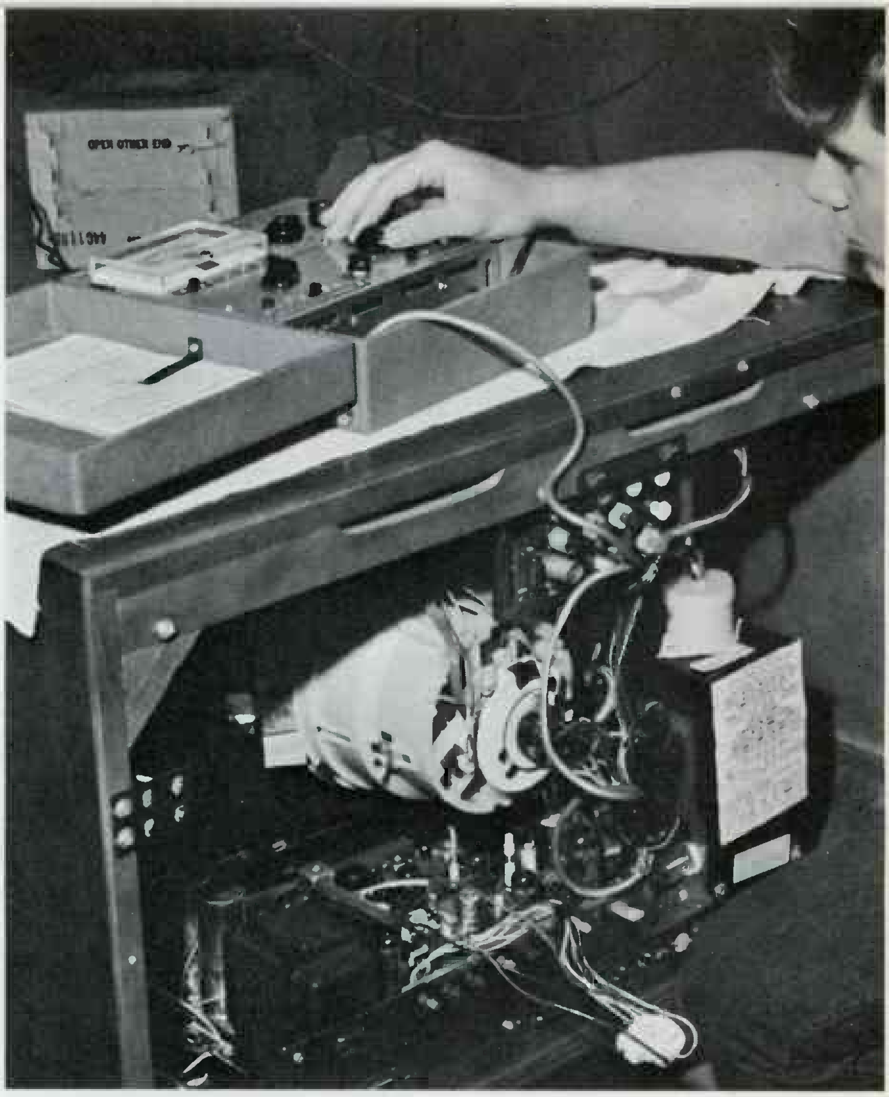
A 23" Admiral color receiver was only three months old when two specks appeared on the screen. The picture tube was checked, but the cause of the trouble was not known at that time. The customer was told to watch for additional specks on the screen. After six months, an additional fifteen brown dots appeared and the CRT was replaced.

Raster Dead, CRT Good

Originally, an RCA CTC15 chassis had poor focus problems. In fact, the core of the focus coil was frozen and could not be turned. Replacement of the focus coil restored proper focus.

The back cover was being replaced when the CRT went black. The high voltage checked normal. The CRT was tested, but checked normal.

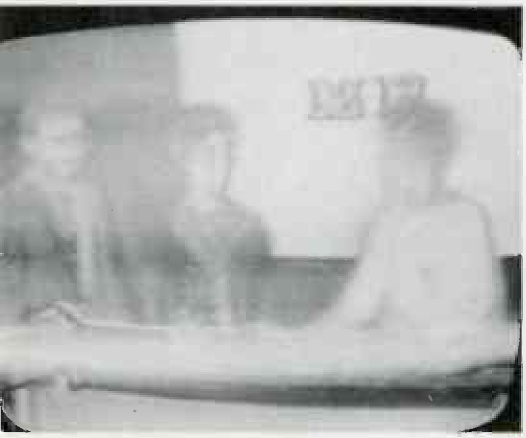
The video tube was removed for testing, and when it was replaced in the socket the raster returned. The trouble appeared to be a defective socket or loose components underneath the chassis. When the killer amplifier was tapped, the brightness would come and go. The tube tester uncovered a short between the grid and the cathode of the killer amplifier.



The CRT tester uncovers weak, shorted or leaky picture tubes that produce such symptoms as insufficient brightness, missing color, poor gray-scale tracking and changing gray-scale.

Poor Convergence

A Zenith 23XC26 chassis with a new CRT exhibited poor convergence. The red and green dots were bowed vertically at the top and bottom of the screen, and were spaced about one inch apart. The cause of the trouble was determined to be either a defective CRT or convergence board.



Example of trouble symptom displayed by a defective color CRT. Smeared and improperly focused picture was caused by a shorted picture tube.

A loose harness or convergence board was suspected. All wires were inspected and seemed okay. Further checking revealed that someone had mounted the convergence yoke backwards.

Always suspect a weak color tube when a good black-and-white picture cannot be obtained. One or two guns probably have weak emission. If all three guns are weak, a color tube brightner will sometimes help. But never install a color tube brightner when only one gun is weak. The CRT tube brightner will raise the level of all three guns an equal amount; thus the original weak gun will still be weak in relation to the other two. It is better to rejuvenate the weak gun. (Never rejuvenate or place a CRT brightner on a color picture tube that is under warranty.)

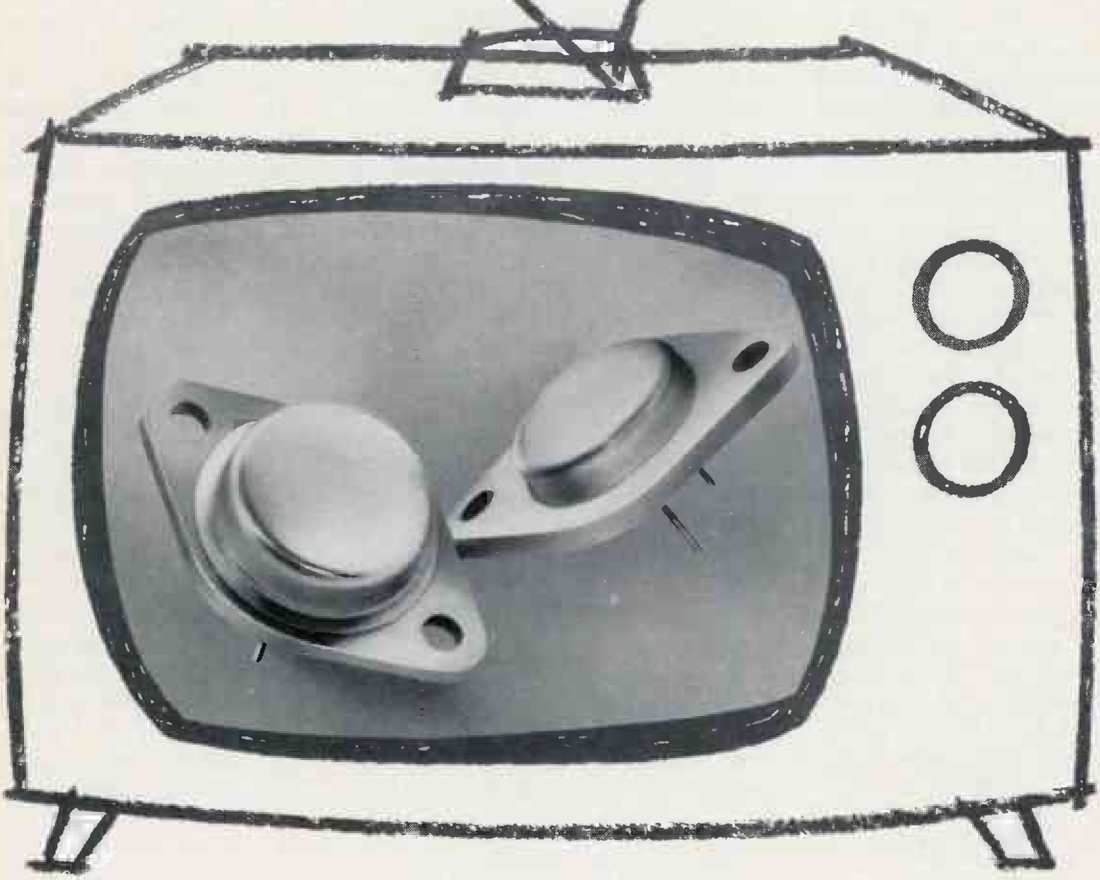
A poor black-and-white picture was displayed by an RCA CTC19 chassis. The raster lines would not focus properly. At first, a defective —Y amplifier was suspected, but the trouble turned out to be a weak green gun in the CRT.

Summary

First carefully analyze the trouble symptoms displayed on the screen of the receiver. Check the high voltage reading for weak or no brightness symptoms. Use the service-normal switch and screen drive controls to check for a missing color or weak gun, or test the CRT on a good CRT tester. If the trouble symptom is poor focus, check for correct focus voltage at the base pin of the CRT.

Use a CRT test jig to check out intermittent picture and purity problems. Make sure the trouble is not in the TV chassis before pulling the CRT. ▲

Two New SK Devices Simplify Servicing of TV Deflection Circuits



More than a dozen solid-state TV sets—RCA and others—can use these two new RCA SK-Series transistors—specifically designed for replacement use in deflection circuits.

The RCA SK3034 is for replacement use in horizontal driver and in vertical-deflection-output circuits; the SK3035 is for replacement use in horizontal-deflection-output circuits.

Both units are germanium p-n-p devices in hermetically-sealed TO-3 packages, and are for use in domestic and imported TV sets with anode voltages to 18 KV and with picture tubes having deflection angles up to 114°.

Add both to your stock of RCA "Top-Of-The-Line" SK-Series replacement transistors. See your RCA Distributor today about your supply of RCA SK-Series replacements . . . 33 individual units that can replace approximately 11,800 solid-state devices.

RCA Electronic Components, Harrison, N. J. 07029.

Circle 30 on literature card

Now available . . . a comprehensive and accurate source of solid-state replacement information! It's RCA's Solid-State "Top-of-the-Line" Replacement Guide, SPG-202F. Cross-referencing RCA SK-Series Transistors, Silicon Rectifiers, and Integrated Circuits, the Guide provides replacements for nearly 12,000 solid-state devices —including U.S. industry standard EIA types, foreign types, and types identified only by device-manufacturers' or equipment manufacturers' parts numbers. SPG-202F is available through your RCA Distributor. Ask him about it. Today.

**Ask your participating RCA Distributor for details.*

RCA

Lightning Protection for Transistor Amplifiers

An analysis of how lightning causes failures and how to compensate for it.

By Dale L. Hemmie

Lightning has been a problem since the first transistor was designed into a television amplifier. Each time a thunder and lightning storm rolls into an area a number of transistor amplifiers fail. Mast mounted pre-amplifiers, back-of-the-set amplifiers, booster-couplers and distribution amplifiers have all been "burned out" by lightning.

In some cases a direct hit by lightning is the cause of failure. But, in the majority of cases the transistors are destroyed simply by a bolt striking in the vicinity of the amplifier. A great deal of research has been done in an effort to understand and overcome this problem but with only limited success to date. Efforts to solve the problem were hampered by the fact that it was not known exactly how lightning was entering the circuit and destroying the transistor.

Many theories have been presented and circuit modifications incorporated to support the theories but with little success. However, recent breakthroughs in the analysis of the problem offer solutions which will substantially reduce the failure rate.

The analysis can be divided into two parts: first, the lightning bolts and its transistor destroying component; second, the transistor, its weakness, and how to compensate for it.

Referring to Fig. 1, it can be seen that, although, the primary power dissipated by a lightning bolt is DC, a number of random pulses are generated. The crackling fingers of a lightning flash produce short duration pulses which have many of the characteristics of RF. The pulses, although diminishing in amplitude as they go up in frequency, extend well into the UHF TV band. The highest failure rate occurs in the VHF TV band, channels 2 through 13, due to the higher amplitude pulses generated at these frequencies.

The main lightning bolt can generate up to 1 billion volts with current levels as high as 500,000 amperes. Pulses that fall in the TV range can be very powerful and radiate a considerable distance from the point of the flash. It is these radiated pulses that are the most frequent cause of transistor failure. The amplifier input bandpass circuit, which allows TV signals to enter, also passes lightning-generated RF pulses that fall within the frequency range of TV signals.

Transistors have come a long way as RF amplifiers. Gain has been raised, noise figures lowered, and cross-modulation characteristics improved, but their ability to handle high-amplitude pulses has suffered. The geometry of high frequency transistors has been reduced for improved small signal operation, but in the process they have become more susceptible to damage from high-amplitude pulses.

The point of failure is the emitter-to-base junction. The reason for the failure is the relatively low value of voltage required to break the junction down. Typical small signal transistors available today have an emitter-to-base reverse breakdown voltage rating of from two to five volts. This means that a negative going pulse, of five volts or greater, fed into the base of a common-emitter circuit will, in most cases, destroy the transistor.

In a typical NPN common-emitter circuit the emitter is approximately .8 volt more negative, in respect to chassis ground, than the base (see Fig. 2). When the base suddenly becomes negative (with respect to the emitter) by a voltage

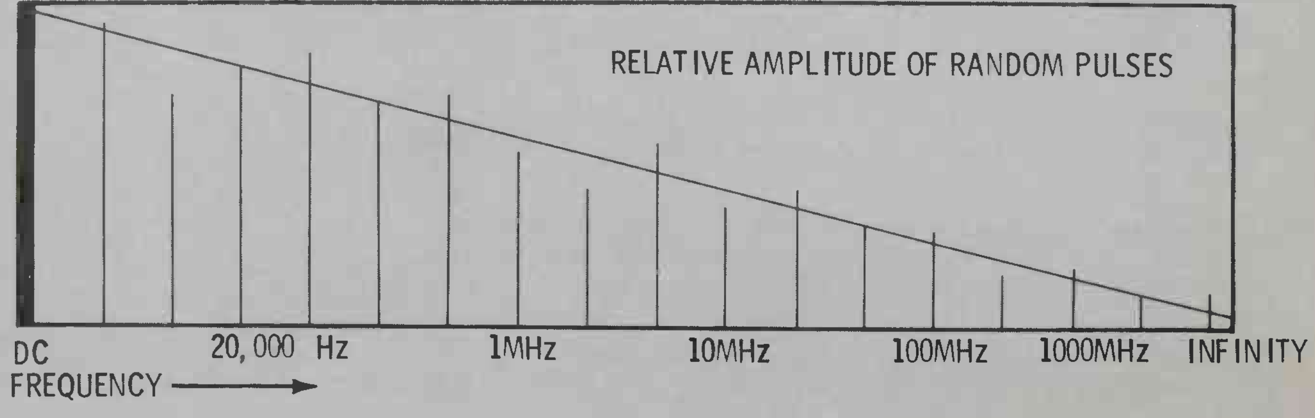


Fig. 1—Graphic representation of energy dissipated by a typical lightning bolt.

Coming in January, 1969:

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When the first PHOTOFACT Folder Set appeared in May, 1946, we made this pledge to the radio servicemen of America:

"PHOTOFACT will provide complete, accurate, uniform service data, and present that data on a current and continuing basis, to keep up with the production of the industry."

We have kept that pledge. We covered all of the post-war AC-DC, AM-FM, Auto Radio, and Phonograph models. With the appearance of the first black-and-white TV, we were there with exclusive PHOTOFACT TV coverage. We kept pace as the industry introduced new types of products and poured them out in thousands of models: Automatic Record Changers, High-Fidelity Instruments and Components, Tape Recorders, Stereo Instruments, Transistor Radios, Color TV, Citizens Band Radios—right down to the introduction in 1968 of PHOTOFACT coverage of Home Cartridge Tape Players.

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We have kept *that* pledge. PHOTOFACT introduced full photo coverage of all chassis views, keyed to the famous Standard Notation Schematic, with its wealth of vital information; disassembly instructions (including auto radio removal): tube location charts; troubleshooting charts; a superior alignment system; terminal identification; dial cord stringing; field servicing notes; alternate tuner data; complete replacement parts lists; exploded views for record changers and tape recorders; actual waveform photographs on the TV schematics, and a host of other invaluable features. With the appearance of printed circuitry, PHOTOFACT introduced CircuiTrace® for fast tracing of printed boards. Forthcoming PHOTOFACT Folders will feature techniques for rapid servicing of such new developments as the "Quasar" circuit TV models.

In January, 1969, PHOTOFACT Set No. 1002 will appear. It is eloquent testimony to the continuous loyalty of thousands of electronic servicemen, and solid proof of the ability of PHOTOFACT to boost their earnings day-in and day-out through faster, better repairs.

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The Service-Minded Organization with the Service Technician in Mind

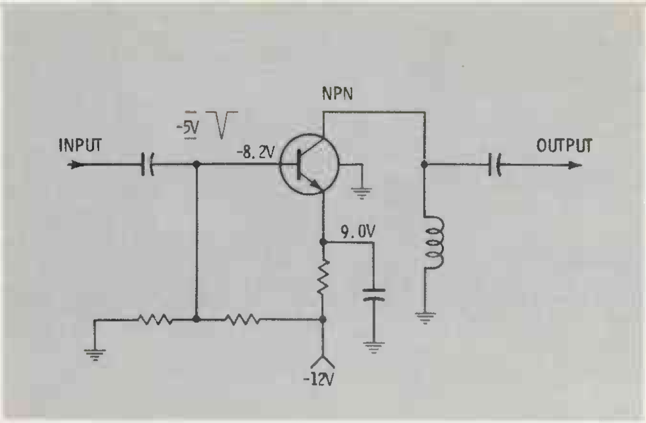


Fig. 2—Input circuit of typical transistor amplifier employs an NPN transistor with the emitter .8 volt more negative than the base.

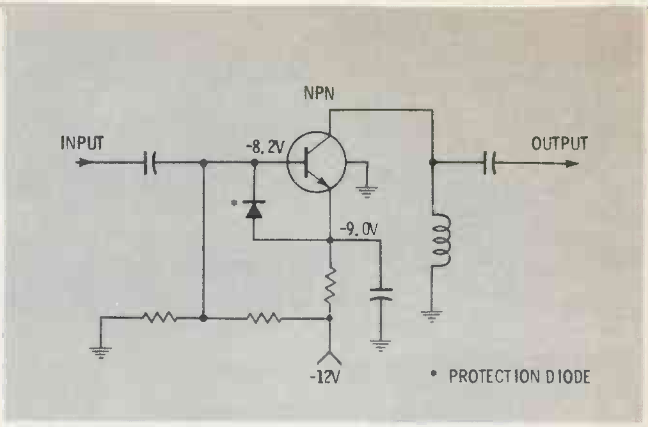


Fig. 3—Fast-recovery diodes bypass high-level lightning-generated negative pulses around base-emitter junction of transistor.

greater than the rated capability of the junction, the junction shorts and the transistor is dead. This is what happens when a lightning-originated pulse of high negative amplitude reaches a transistor.

To prevent lightning-created pulses from destroying the transistor, lab and field tests have isolated the cause of the problem and produced core effective lightning protection.

One method of lightning protection uses an ultra-fast recovery diode in the input circuit of the amplifier. The electrical location of the diode can be seen in Fig. 3. The cathode of the diode is connected to the base lead of the transistor and the anode to the emitter lead. These connections are reversed for a PNP transistor.

With the diode connected in this manner, the transistor biasing maintains the diode in a reversed-biased condition and prevents the diode from loading the circuit during normal operation of the amplifier. However, when a high-level negative pulse appears across the base-to-emitter junction, the diode quickly conducts and bypasses the pulse around the junction, preventing transistor burn-out.

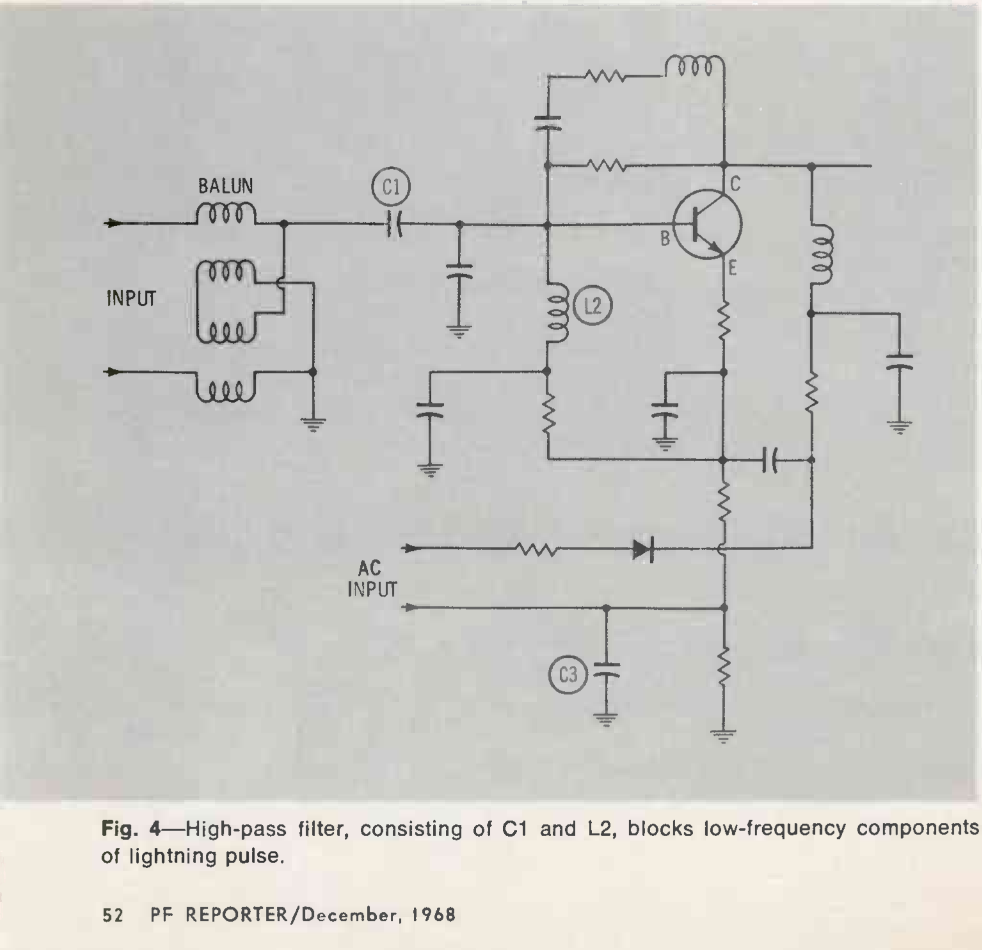


Fig. 4—High-pass filter, consisting of C1 and L2, blocks low-frequency components of lightning pulse.

Another method of lightning protection is illustrated in Fig. 4. This method is designed to take advantage of the fact that the major portion of the energy generated by lightning is concentrated in the lower ranges of the frequency spectrum, as shown in Fig. 1.

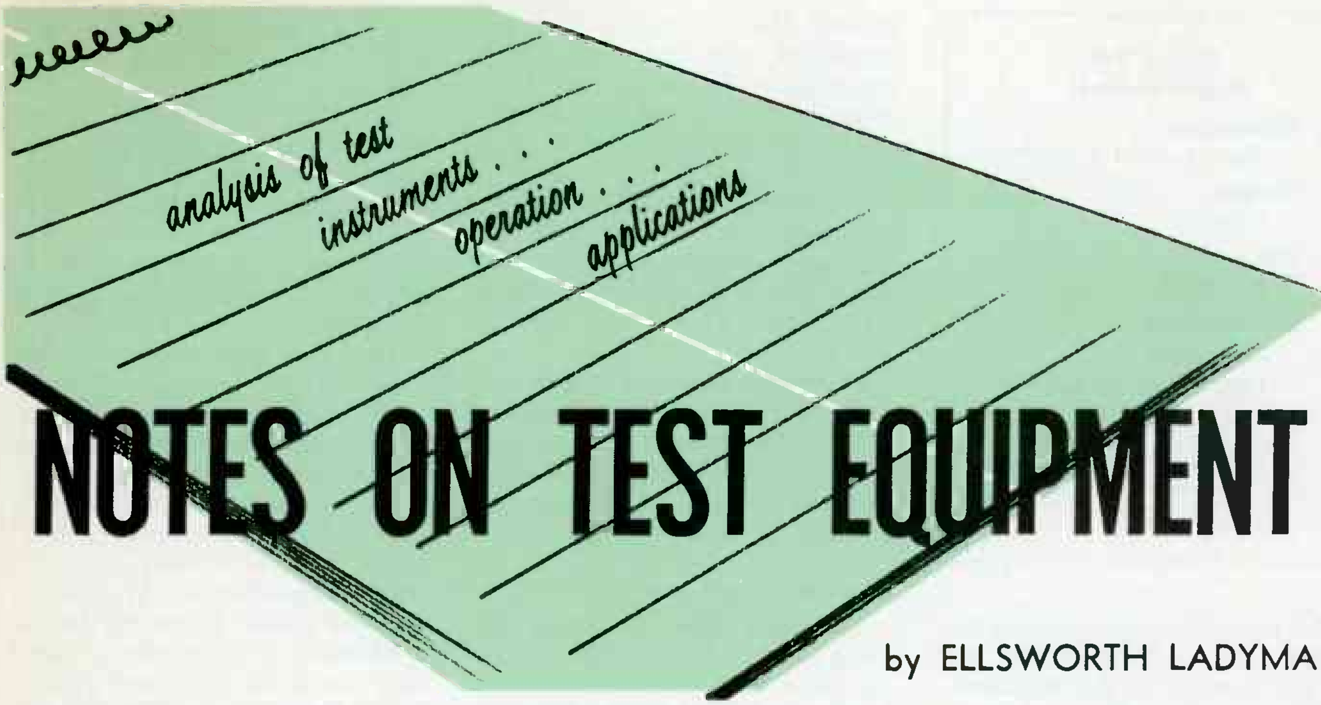
This system is intended to provide lightning protection in the following manner:

1. Isolation of the transistor from the bulk of the lightning energy. This is accomplished by C1 and L2, which form a high-pass filter network that blocks the lightning energy concentrated in the lower frequencies.

2. Bypassing the lightning energy around the transistor circuit. The balun performs this function by providing a low-impedance path to chassis ground at the input.

3. Supplying a path for the lightning energy to return to an earth ground. This is accomplished by capacitor C3, which returns the lightning energy to the AC line which, in turn, passes the energy on to ground. The AC line was chosen as the return path because of the lack of a true ground at many installations using transistor amplifiers.

In summation, it is the radiated pulse component of lightning flashes which causes the majority of TV amplifier transistor failures. In such cases transistor destruction is due to the low reverse voltage required to short the base-to-emitter junction. Bypassing the lightning-generated pulses around the base-emitter junction of the input transistor to ground greatly reduces the possibility of transistor destruction resulting from nearby lightning strikes. ▲



NOTES ON TEST EQUIPMENT

by ELLSWORTH LADYMAN

Lectrotech, Inc. has introduced two new instruments to their test equipment line that will enable the service technician to perform more complete color TV servicing in the home, and a faster service job on the bench. The Model V-5 vectorscope indicator is a small, compact instrument, rugged enough to withstand daily service calls and lightweight enough to be carried easily. This unit can be used in conjunction with any standard color-bar generator and permits a service technician to perform several functions quickly and easily. Some of the functions that can be used in the home are:

Reactance coil adjustments

Injection or demodulator transformer adjustments for any required demodulator angle

Efficiency checks of the bandpass amplifier alignment

Accurate adjustment of the burst transformer to electrically center the tint control

Comparative gain checks of the R-Y and B-Y amplifiers.

Without the use of a vectorscope and color-bar generator, the preceding operations could not be performed in a practical manner in the home because of the cumbersome test equipment requirements.

The Model V-7 color generator and vectorscope combination lends itself in an even more efficient manner to both home service calls and bench work. It contains both a vectorscope and a color generator combined in a single case, simplifying both hook-up procedures and transportation.

Lectrotech Model V-5 Vectorscope Indicator

The Model V-5 vectorscope indicator is a relatively simple instrument (see Fig. 1), but when used in conjunction with any standard color-bar generator it is an extremely valuable tool for servicing color.

The controls are located on the front of the cabinet (see Fig. 2) and are self explanatory. Only four controls are required: focus, for the fine trace adjustments; vertical and hori-

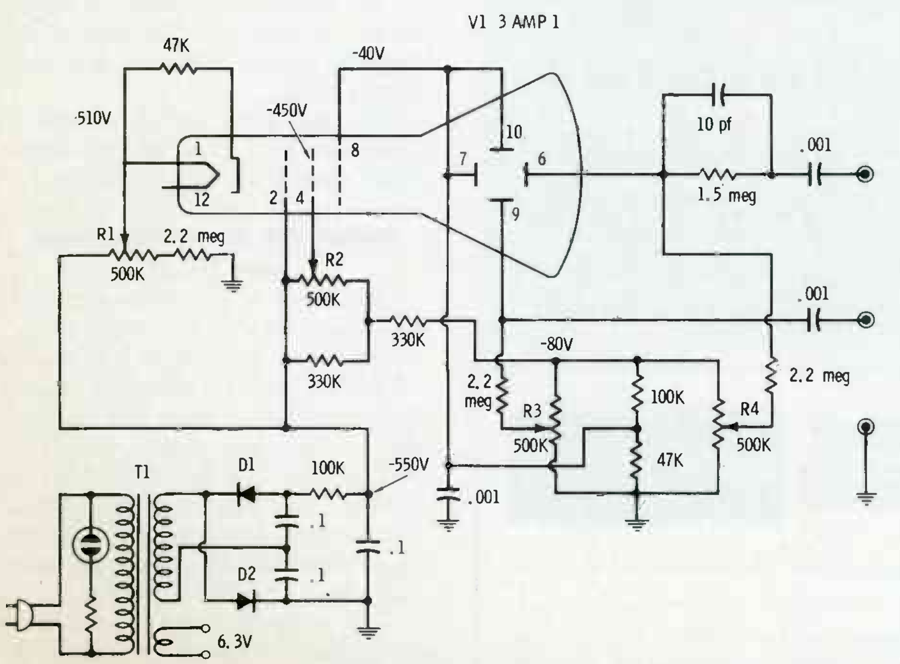


Fig. 1 Schematic of Model V-5 vectorscope indicator.

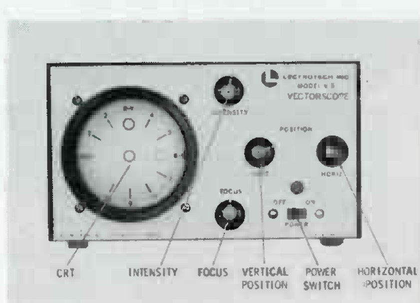


Fig. 2 Model V-5 vectorscope indicator with callouts.

Model V-5 Specifications

Dimensions
7⅜" x 4¼" x 7⅝"
Weight
5 lbs.
Price
$79.50
Manufacturer
Lectrotech Inc.
1221 West Devon Ave.
Chicago, Illinois 60626
312/764-7005

zontal positioning, for centering the pattern; and intensity control, for the adjustment of the brightness. (Best focus is attained at lower brightness levels).

Input cables are from the rear of the cabinet. Connection to the color receiver CRT is simple: Connect the red lead from the unit to the red CRT control grid, the blue lead to the blue CRT control grid and the black lead to the receiver chassis ground. The red and blue leads are terminated with lead-piercing alligator clips. Be certain that the prong in the lead-piercing alligator clip makes contact with the CRT grid wires.

A free copy of "Color TV Servicing with a Vectorscope" by Wayne Lemons is included with the V-5, along with a detailed instruction manual.

Lectrotech Model V-7 Color Generator and Vectorscope

The combination color generator and vectorscope indicator is one of the most unique test instruments available to service technicians.

Front Panel Controls (see Fig. 4)

The power switch is a three position switch: off—standby—on. In the stand-by position the filament voltage is applied to the tubes in the hybrid circuit, but B+ voltage is not applied. In the on position, both B+ and filament voltages are applied. The pilot light glows only in the on position.

The pattern switch could be called a function switch. It is a rotary type wafer switch with the following positions: cross-hatch, dots, vertical lines, horizontal lines and color bars.

The video level, or gain control, varies the video output from a minimum of zero volts to a maximum of two volts peak-to-peak.

The video polarity control is used to change video sync polarity to produce either positive or negative going pulses.

The color level control sets the color level in the composite video signal and is calibrated at minimum, normal or maximum. Normal position represents 100% modulation.

The horizontal line adjustment is used to adjust the number of horizontal lines. In a fully counterclockwise position, no horizontal lines are visible. When the control is advanced in the clockwise direction, horizontal lines will appear, and at the maximum clockwise position, there will be three or four lines.

The intensity control is used to vary or adjust the brightness of the pattern displayed on the vectorscope.

CAUTION: Adjustment of the intensity control will affect the focus adjustment.

The focus control is used to obtain the clearest and most distinct pattern display possible.

The vertical position control is used to move the pattern display vertically on the CRT, allowing the center of the pattern to be positioned centrally on the graticules.

The horizontal position is similar to the vertical position control except the pattern will move in a horizontal plane.

The gun killer switch is used to deactivate the guns of the color CRT during set-up procedures.

Model V-7 Circuit Operation (see Fig. 5)

The heart of the instrument is a frequency divider, or "timer chain" circuit. This circuit originates a 189-KHz, crystal-controlled signal that is applied to three other stages: the vertical line shaper, the 189-KHz shaper and the 15.75-KHz oscillator. The output of the vertical line shaper functions as a buffer stage between the crystal oscillator and the 31.5-KHz oscillator.

The output signal of the 189-KHz shaper stage synchronizes the 31.5-KHz oscillator by affecting a

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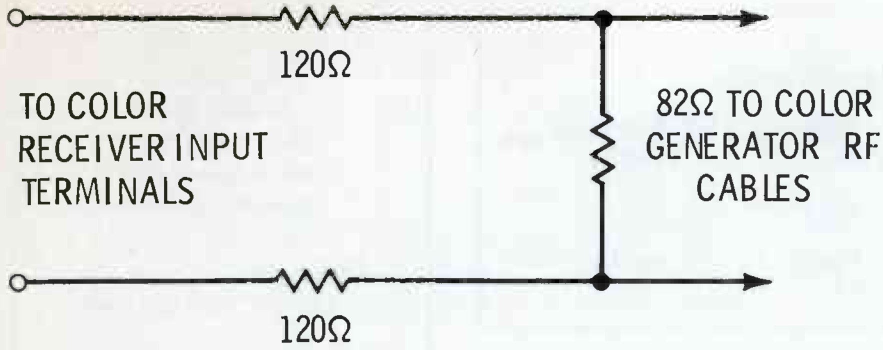

Fig. 3 Schematic of resistor matching pad.

division ratio of six. Dividing the original signal (189 KHz) by six produces a 31.5-KHz signal. This output is then used to lock the 4.5-KHz oscillator in by affecting a division ratio of seven. This output (4.5KHz) is then divided by five to synchronize the 900-Hz oscillator. The 900-Hz output is applied to two stages: one connected in a flip-flop circuit configuration, the other used to synchronize a 60-Hz oscillator. The output of the 60-Hz oscillator is used to provide a sync signal for the sync mixer circuit.

The third output of the 189-KHz oscillator is used to synchronize the 15.75-KHz oscillator by affecting a division ratio of twelve. The output of this oscillator is also fed to the sync mixer and contains a composite sync signal with both vertical and horizontal sync information.

The frequency divider stages—the 31.5-KHz, 4.5-KHz, 900-Hz and 60-Hz oscillators—employ silicon, unijunction, solid-state devices that are relatively immune to fluctuations in temperature. This characteristic greatly enhances the frequency division stability of the stages and renders them relatively independant of external circuit parameters. Source voltages are regulated to assure complete voltage independence.

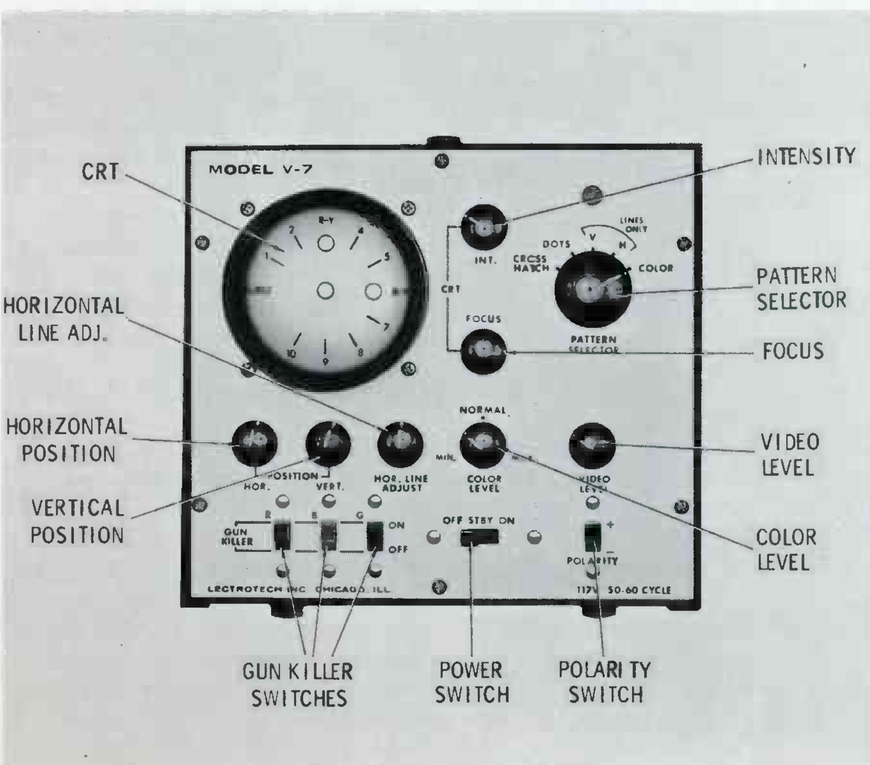

Fig. 4 Model V-7 vectorscope and color generator with callouts.

CRT Control Grid Identification

Control Grids	Rectangular Color CRT	Round Color CRT	GE Portacolor 11SP22
RED	Pin 3	Pin 2	Pin 2
BLUE	Pin 12	Pin 12	Pin 14

900-Hz Flip-Flop

For every signal pulse applied to the base of Q8 (part of the flip-flop circuit formed by Q8 and Q9), a pulse is present at the collector of Q9. This pulse width is made variable by a control (horizontal line adjust) in the base return circuit of Q9. The flip-flop output signal is applied to the pattern selector and represents the horizontal lines function. The 189-KHz output applied to the pattern selector from the vertical line shaper circuit supplies the vertical lines function.

The 3.563-MHz oscillator (V1A) produces the offset subcarrier color signal, and its output is applied to the color keyer stage (Q10). The base of Q10 receives a signal from Q1, the 189-KHz oscillator, which is of sufficient strength to either cut off or saturate the color keyer, depending on the polarity of the signal. When the color keyer is in a saturated condition, the collector is effectively at ground potential. No color information will be contained in the output circuit. When the signal from Q1 is of the proper polarity to affect cutoff, the collector impedance goes to maximum, and the full color signal is developed across a 1000-ohm potentiometer (the color level control). This signal is then applied to the pattern selector switch.

The pattern selector switch selects and applies signal voltages to the various circuits necessary for each function.

Dots are accomplished by means of a diode. This is done by shifting the clipping level to allow video information to pass when the sum of the vertical and horizontal lines is present.

The output of the pattern selector is applied to the modulator which produces a composite video signal (made up of the output of the pattern selector plus the output of the sync mixer circuit).

The RF oscillator output is variable from channel 3 through 5, and the output is taken from the cathode and applied to the diode modulator. The diode modulator output is a fully modulated RF signal at the frequency of channels 3, 4 or 5. The second output of the diode modulator is available from the cable (composite video) at the rear of the cabinet. The output of the calibrate-select switch is applied to the sawtooth generator (V1B) which supplies the necessary sweep signal to the horizontal deflection plates of the vectorscope CRT. The vertical signal for the vertical deflection plates is obtained directly from the CRT control grids of the receiver under test.

The high-voltage power supply delivers 600 volts and is obtained from a voltage doubler. Low voltage (+125 volts) is obtained from a half-wave rectifier. The 125 volts are used for both the tubes and solid-state devices (through a voltage dropping network).

The pilot light indicates that the instrument is on and also provides regulation of the CRT grid-cathode voltages.

A detailed instruction manual is included with the color generator and vectorscope. In addition to complete operating instructions, the manual analyzes keyed rainbow and vector color patterns. Color circuit alignment procedures for major brands of color chassis are also included with the unit. ▲

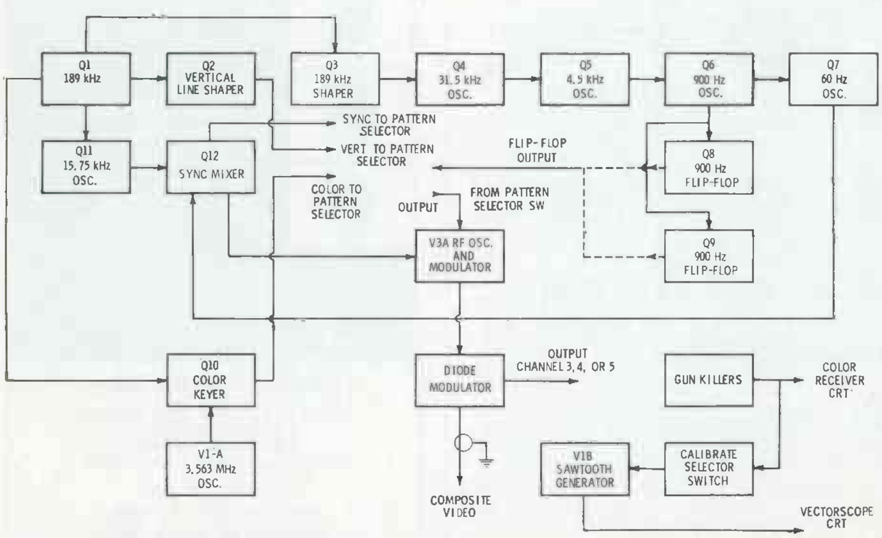

Fig. 5 Block Diagram of color generator section of Model V-7.

Lectrotech Model V-7 Color Generator and Vectorscope Specifications

Dimensions
8¼" x 7½" x 12⅞"

Approx. Weight
13 lbs.

Net Price
$189.50

Manufacturer
Lectrotech Inc.
1221 W. Devon Ave.
Chicago, Illinois 60626
Phone 312/764-7005

What's in a name?

All-Purpose Primer
All-Purpose Silicone Spray
Anti-Rust Wax
Auto Body Under Coater
Automatic Choke Cleaner
Automotive Acrylic Spray
Automotive Trunk Paint
Battery Protector
Belt Dressing
Car Colors
Cleaner and Degreaser
Crystal Clear
Damar Varnish
Decorator Spray Paint
Dulling Spray
Electric Motor Cleaner
Engine Spray Paint
Glowing Fluorescent
  Spray Paint
Heavy Duty Silicone Lubricant
Hide-a-Mark Spray Coat
High Gloss Varnish
High-Heat Spray Paint
Hot Rod Primer
Insulating Varnish
Let-Go Super Penetrant
  and Rust Solvent
Matte Finish
Open Gear Lubricant
Paintable Silicone Mold Release
Pressure-Sensitive Spray Adhesive
Retouch Varnish
Rust Magic® Metal Primer
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Zinc Chromate Primer

Krylon® protective spray coatings and paints are used by more artists, electricians, radio/TV technicians, automotive mechanics and more men in industry than any other brand.

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Color Countermeasures

Symptoms and tips from actual shop experience

Chassis: RCA CTC25AA

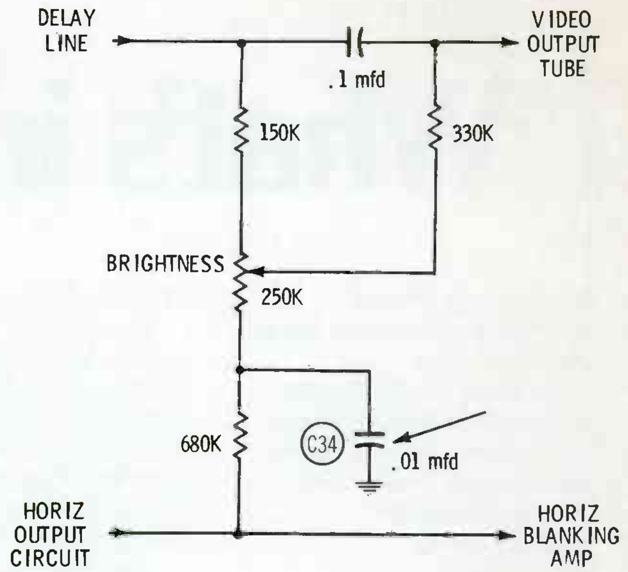
Symptoms: Motor boating in sound.

Tip: If motor boating persists with the volume control turned down, suspect the audio output transistor. High leakage between base and collector is usual defect.

Chassis: RCA CTC9B

Symptoms: Smoke coming out of high-voltage section.

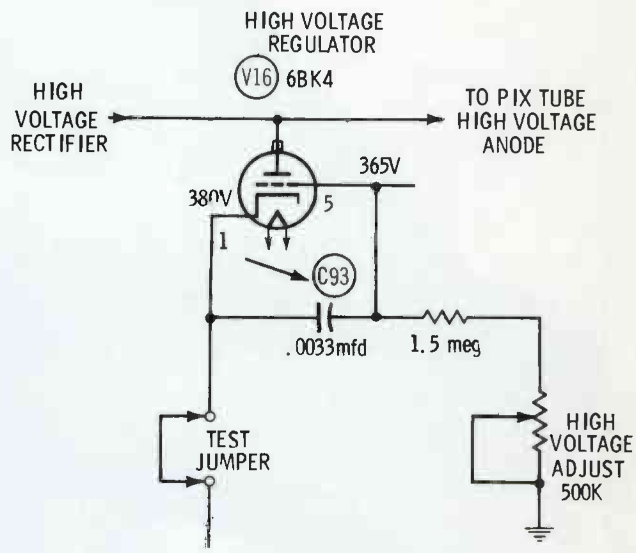
Tip: Suspect arcing in flyback or burned focus control. Also suspect horizontal centering control. If effect of both controls is erratic, replace them.



Chassis: RCA CTC16X

Symptoms: Dark picture.

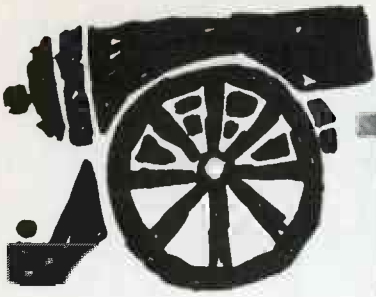
Tip: Check blanker stage for incorrect voltages. Suspect leaky or shorted C34. Also suspect video amplifier tube.



Chassis: RCA CTC11

Symptoms: No picture; no raster; sound normal.

Tip: Very little high voltage present at anode connection of the picture tube. When the regulator tube cap was removed, the high voltage increased to 27K. When measured out of the circuit, C93 had a leakage of 2700 ohms. ▲



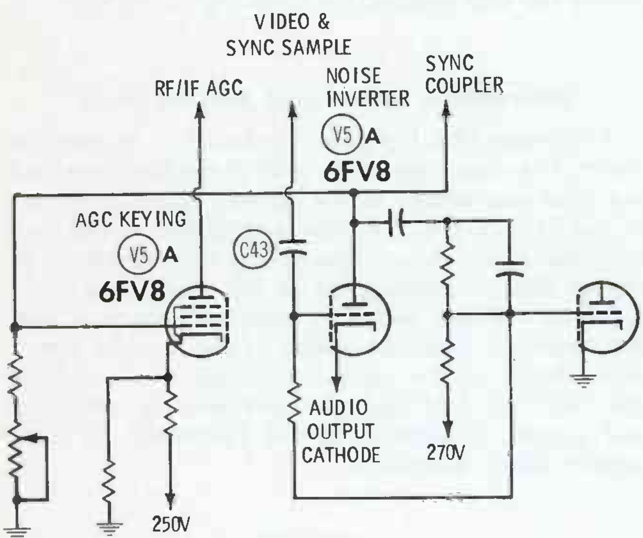
THE TROUBLESHOOTER

AGC, Sync or . . . ?

An Airline TV model GTM-2565A exhibits bending and horizontal and vertical distortion. When capacitor C43 was disconnected from pin # 1 of V5 (6FV8), the picture became normal. It has been operating on the bench without distortion. Please explain why this set works normally with C43 disconnected. Also, include an analysis of the original trouble.

J. L. King

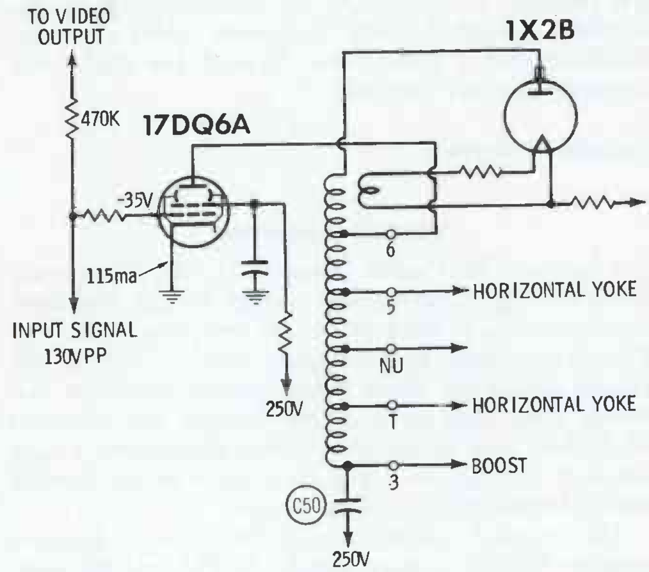
Kaylor, Pa.



By disconnecting capacitor C43 you disabled the noise inverter stage. The purpose of a noise inverter circuit is to prevent or minimize the effect random noise pulses from the video circuit have on the AGC and sync stages. It is quite possible for a receiver to work without the noise inverter, as you have shown. However, you still have the original defect. As for providing an analysis of your original trouble, I would have to have more information, although I would suspect a problem in the AGC or sync circuit.

Repeated Flyback Failure

I have a Westinghouse portable, chassis V2373 (Photofact Folder 392-4). It is my "loaner" and, therefore, is unused for long periods of time. During a span of about four years I have replaced the flyback three times. Each time there were signs of excessive heat, wax melting, etc. I have used a Thordarsen part No. Fly 95 each time.



I wonder if something else is wrong that could be causing this failure. I have made component checks in the horizontal output circuitry but have found nothing wrong. Before I replace the flyback again, I would like to have an opinion on the probable cause and how to correct the overheating and repeated failure.

Joseph T. Lacey

Niagara Falls, N.Y.

There are several points to check; the first is the cathode current in the horizontal output stage. This should be no more than 115 ma. Next is the peak-to-peak drive signal at the grid of the horizontal output stage. It should measure 130 volts p-p. Also check the shape of this waveform. Capacitor C50 could be slightly leaky. Anything in the output circuit that shows signs of deterioration should be replaced. Finally, the problem could be one of just excessive heat. Some of those early portables did an excellent job of retaining heat.

Proper Grounding of PC Boards

We have experienced in our shop a number of hard-to-find intermittents in color chassis employing printed circuits.

The cause in the majority of these cases has been traced to bad connections on the eyelets that ground the foil on the printed-circuit boards. This problem seems to be more prevalent in older color receivers such as RCA's CTC15 and CTC16 chassis.

The solder around the eyelets on the top of the board might appear normal. However, close inspection of the foil on the bottom of the board usually reveals that the foil is not grounded properly.

A prime suspect for such a condition is the ground connection for the heaters of the chroma amplifiers. An improper solder connection at this point will *usually produce hum in the picture, or a blacked-out raster.*

To eliminate the possibility of these intermittent printed-circuit connections, we have adopted a standard practice of resoldering all printed-circuit boards to their mounting posts. Sufficient solder is added to insure that it flows down through the eyelet and properly grounds the foil.

JIM BISKEY

Sheridan, Oregon

Vertical Distortion

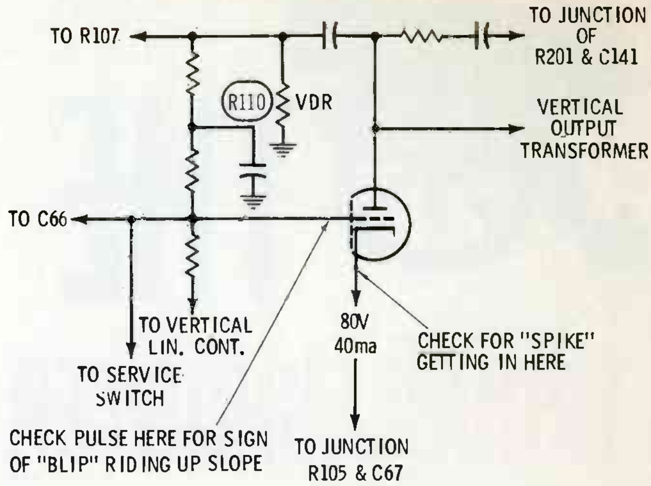
*I have an RCA color chassis CTC16A (*PHOTOFACT *Folder 736-4). I can't obtain enough height, and there is compression at the bottom and stretching at the top. These symptoms become more noticeable as the chassis warms up. There is a horizontal bar about two inches wide that starts at the bottom and proceeds about half way up the raster, then disappears. I have checked or replaced every component in the vertical multivibrator stage with no results.*

The original complaint was "no raster". I found resistor R210 (in power supply) "open" and the horizontal output transformer "shorted" and burned to a crisp.

JOHN ZANATH

Alliquippa, Pa.

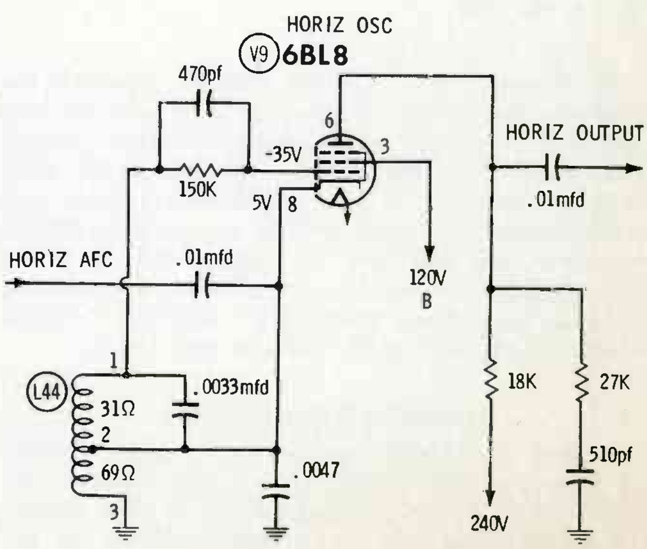
The trouble symptom you describe is indicative of an extraneous pulse getting into the vertical circuit.



I would hesitate to guess where the pulse is originating since the possibilities are unlimited. The only effective method for determining the source of such contamination is by scoping. Start in the power supply. Check for excessive ripple or a "spike". The fact that R210 was "open" suggests that capacitor C2 could be causing your trouble. In this instance, I don't think separately bridging the section will help you. You will have to substitute the can. The voltage dependent resistor, R110, is another prime suspect. Substitution also is the best method for checking the VDR.

Intermittent Raster and Missing Color

A Sylvania D06-1 chassis developed an intermittent raster. The waveform at the grid of the horizontal output tube was similar to the normal waveform shown in the PHOTOFACT Folder, except that it had more of a sine-wave shape. Monitoring this waveform revealed that it disappeared at the same instant the raster went blank, indicating that the horizontal oscillator was the probable source of the trouble. Resistance checks in the oscillator circuit uncovered the fact that coil L44 was open between its center tap and ground. Replacing the coil eliminated the intermittent raster symptom.



An RCA CTC20C chassis would not produce any color. Using a scope and color-bar generator, the signal at the grid of the chroma bandpass amplifier was checked and found to be normal. However, no signal could be found on the screen grids of the X and Z demodulators. Voltage measurements indicated -15 volts on the control grid of the bandpass amplifier. (Normal voltage during colorcast is approximately -.1 volt). It was evident that the color killer was conducting and producing enough bias to cut off the bandpass amplifier. A voltage reading of only -.5 on the control grid of the color killer confirmed this deduction. From all indications, either the 3.58-MHz oscillator was not operating or the burst signal was not reaching the oscillator. A scope check revealed that burst was reaching the cold side of the 3.58-MHz crystal. This left only a chroma-oscillator defect as the source of the trouble. Replacing the 3.58-MHz crystal restored color production.

CHARLES E. RAMBO

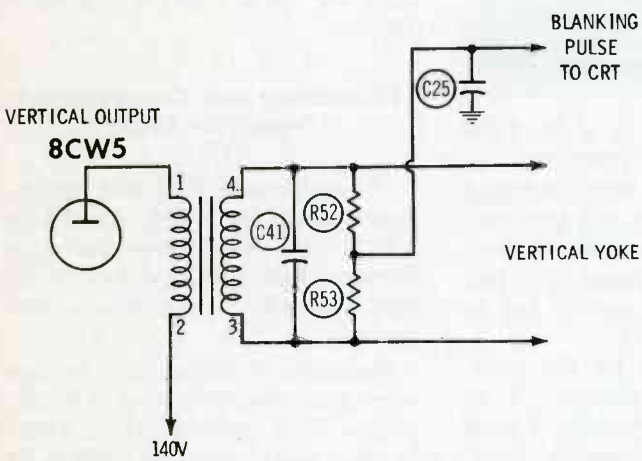
Elkton, Maryland

Retrace Lines

An Emerson Model U1840 displays very pronounced retrace lines. I can eliminate these lines by shorting the junction of R52 and R53 to ground. What do you suggest?

FRANK VZRAK

Desert Hot Springs, Calif.



You have not provided much information. However, here are some suggestions that might help:

1. Check the shape and p-p amplitude of the waveform at terminal #4 of the vertical output transformer.
2. Check the vertical blanking pulse on the picture tube element. It should be as shown in PHOTOFACT Folder 743-2.
3. Check by substitution capacitors C41 and C25.
4. Check the values of R52 and R53 (should be within 10% tolerance).

The principal thing to remember is that you must have a vertical blanking pulse of the proper shape and amplitude applied to the CRT. It is a fairly simple procedure to trace with a scope the signal path of this waveform. Further checks using a VTVM should isolate the defective component. ▲

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 are available through your local parts distributor.

AMBASSADOR
7042 998-1

BRADFORD
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122-733 1002-1

CORONADO
TV2-6618A 1001-1
TV2-6623A, TV2-6625A 1003-1

CURTIS MATHES
Chassis CMC24-AFC-Remote 1002-2

MOTOROLA
Chassis TS-924B/C 1000-2
Chassis 20TS-611A/B, 22TS-611A/B 1004-2

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CT-911 (Ch. CT-1940) 1001-2

PENNCREST
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RCA
Chassis CTC38A/38B/38H/38XP/38XR/38XT/38XU Remote Control Receiver CTP11H, .. 1000-3
Transmitter CRK9A 1000-3A

SEARS
5006 (Ch. 562.10390) 1003-2
5035 (Ch. 562.10460) 1002-3

TRUETONE
HFP1665E-86, HFP1667E-86 . 998-2
TAE4815A-86 (2DC4815) ... 999-2

WARDS AIRLINE
GHJ-17949A, GHJ-17959A ... 998-3

Production Change Bulletin

EMERSON
Chassis 120822, 120835, 120844, 120859, 120871, 120893 1002-4

MAGNAVOX
Chassis T915-01-AA/-02-AA/-02-CA/-02-DA/-03-AA/-04-AA/-04-BA/-04-CA/-04-DA/-05-CA/-05-DA/-06-CA/-06-DA/-07-DA 1003-3
Chassis T920-18-CB thru T920-33-CB, T920-35-CB thru T920-44-CB, T920-46-CB thru T920-49-CB 1002-4

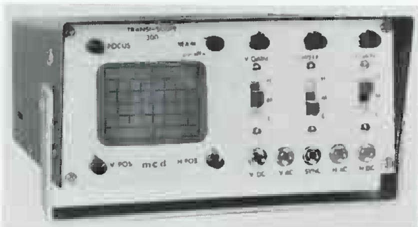
Product Report

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

Portable Oscilloscope
(50)

A new portable solid-state oscilloscope weighing less than 7 lbs. has been developed by **Measurement Control Devices, Inc.** Designated the Model 300, the unit features identical DC vertical and horizontal amplifiers and has a sensitivity of better than 10 mv p-p.

A convenient carrying handle, which doubles as a stand, adds to the portability of the scope. Adapters for full-rack mounting and half-rack mounting are available options.



The display tube is a 3" CRT with a ¼" divided graticule. The housing is aluminum with a brushed aluminum front panel and measures 3½"x7½"x12". Vertical and horizontal amplifier response is 0-100 KHz (—3 db) DC and 10 Hz to 100 KHz (—3 dB) AC.

Attenuation—both for the vertical and horizontal planes—is in three steps of approximately 20 dB plus 25 dB in gain control. Input impedance is 0.5 megohm shunted by 100 pf. The scope sweep is automatically synchronized and repetitive and is continuously adjustable from 10 Hz to 20 KHz in three steps. Power requirements are 115/230V AC, 50-400 Hz, 25 watts. Price is $169.50.

Sine/Square-Wave Generator
(51)

The availability of a new solid-state sine and square-wave generator, Model IG-18 is announced by **Heath.** The generator has a sine-wave ouput range continuously variable from 1 Hz to 100 KHz using one multiplier and two selector switches plus a vernier control. It features eight output voltage ranges from .003 to 10 volts RMS with an external load of 10K ohms or more, and six output ranges from .003 to 1 volt RMS (—62 to +22 dB) using the built-in 600-ohm load or an external 600-ohm load. Sine-wave output has less than 0.1 percent distortion from 10 Hz to 20 Hz.

The square wave section has a frequency range from 5 Hz to 100 KHz at 0.1, 1 and 10 volt (p-p) switch-selected outputs, with a rise time of less than 50 nanoseconds. Sine and square waves are available simultaneously.

The unit is equipped with a dual-primary transformer for 120/240V AC operation and a three-wire line cord for added safety. Price is $67.50.

Field-Effect and Conventional Transistor Tester
(52)

A combination FET and conventional transistor tester, the Model TF151, has been announced by **Sencore, Inc.** The new unit is designed for both in- and out-of-circuit testing.

Selection of either FET or conventional transistor testing is accomplished by a large function switch on the front panel. Rotating the function switch to the left permits

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in- and out-of-circuit testing of conventional transistors, both beta gain and Icbo out-of-circuit leakage. Rotate the function switch to the right and the tester becomes an in- or out-of-circuit tester for field-effect transistors. Each FET is tested for actual transconductance in- or out-of-circuit. Igss leakage is checked out-of-circuit.

Special features include a new low-current test for RF transistors, a higher-current power transistor test, and a special Idss test for FET matching and industrial culling. The new tester will also test "enhancement" FETs.

Included free of charge with the Model TF151 is a new book showing all of the setups and results on over 14,000 transistors and FETs. This book also is available for approximately $10.00 for use with other transistor testers. Price of the Model TF151 is $129.50.

Variable-Voltage Power Supply
(53)

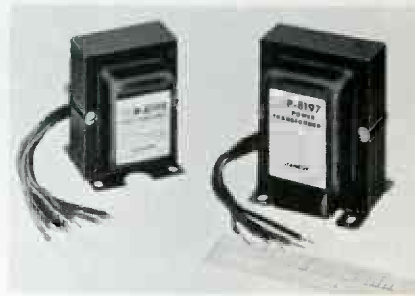
A compact variable-voltage bench power supply has been announced by **Power/Mate Corporation.** Designated the BP-89, the unit has an output of 0 through 34 volts at 0.5 amps. Regulation of the supply is 0.01 percent and ripple is 250 microvolts, or 1 mv p-p. The unit is provided with both short-circuit and overload protection.

The front panel contains a 2-range meter for voltage and current readings, fine and coarse voltage controls, 5-way binding posts, on-off switch and pilot light. The circuitry is all silicon solid-state and utilizes an input differential amplifier to maintain constant voltage over a wide range of temperature variations. Cost of the power supply is $89.00.

Transistor Power Transformers
(54)

Two new Stancor Power Transformers for Transistor Power Supplies have been developed by **Essex Wire Corporation,** Controls Division.

Designed for full-wave bridge or center tap rectifier circuits, the units provide the most popular DC voltage and current ratings for electronic OEM and service replacement. They are 1500 volt (RMS) insulation tested and are shielded to provide increased safety for the user.



The Stancor P-8197 measures 3⅛" x 2½" x 2½" and is rated for 50 CT volts, 1.0 amp; while the Stancor P-8198 measuring 2⅝" x 2 3/16" x 2⅝" is rated for 54 CT volts at .5 amps (secondary No. 1) and 6.3 volts at .5 amp (secondary No. 2). Transformers operate on a primary 117 volts at 60 cycles and are supplied with lead-wire termination.

Both transformers are priced in the $4.00 range.

Audio Test Set
(55)

Designed for audio-system servicing, the model 140 Audio Test Center incorporates an RF/IF/AF signal tracer, tone generator, multi-input amplifier, and scope preamplifier. The **Century General** unit is battery-operated and is designed not to overload or damage transistors. The price is $48.00, complete with probes and six penlite batteries.

Tuner Degresser
(56)

A new tuner cleaner-degresser called Tun-O-Wash from **Chemtronics Inc.** is formulated to penetrate, dissolve and wash away deposits of grease, oil and dirt that build up inside TV tuners.

Scope Cart
(57)

A mobile oscilloscope cart, featuring a multiple power outlet box, has been announced by **Waber Electronics Inc.**

The Waber Model LOW-25 measures 28″ x 32″ x 19″ and features solid steel construction. It sits on 3″ swiveling cushion rubber casters and has adjustable stops to give the unit added versatility.

The outlet box on each scope cart includes a fuse post, switch, pilot light, 3 "U" ground outlets and a 15′ cord set. The outlet box is rated at 15 amps, 130 volts.

The complete unit is priced at $42.50.

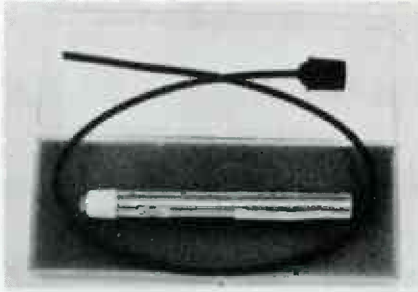
Flashlight
(58)

The availability of a light source, based on the light-directing science of fibre optics that can throw light on difficult places is announced by **Amertest Products Corp.**

The product, trade-marked "Opti-Flex," consists of a penlight, a length of flexible optic cable, or duct, and an adapter. Because the duct can be twisted, or even tied into a knot, without diminishing or distorting the rays of light, it bands light around corners and aims it at specific, hard-to-reach spots, even through holes as small as one-eighth of an inch in diameter.

"Opti-Flex" light is cold and so can be used safely in an explosive atmosphere, with the switch some distance away. Because the duct does not transmit electricity, it can

Circle 40 on literature card



be poked into "live" circuits.

A magnetic hand permits attaching "Opti-Flex" to any metallic object, freeing the user's hand for other work. When not in use, the new light can be carried in the pocket, like a pen, or in its cushioned carrying case. The flashlight itself, which is easily detached from the duct, uses two standard AAA batteries. Price is $4.65.

Oscilloscope/Vectorscope
(59)

A new 5-inch wide-band oscilloscope/vectorscope has been introduced by the **Jackson, Co.** The unit, Model CRO-4, measures amplitude

of waveforms like a VTVM or a VOM.

The oscilloscope includes a vertical amplifier with response up to 5.8 MHz ±3 dB, a sensitivity of 5.8 mv RMS/cm, and rise time of 0.06 microsecond. Acceleration voltage is 1500 volts and horizontal sweep-frequency range is 5 Hz to 500 KHz.

In addition, it is a complete vectorscope with inputs at the front panel and has vectorscope calibration facilities to insure the horizontal/vertical vectorscope pattern proportions. Rear input includes Z-axis modulation and direct access to the deflection plates.

The unit measures 11¼" x 9" x 16", weighs 23 pounds and is priced at $249.95.

Solder Remover
(60)

Solder-Wick, a pretreated, braided copper wire wick is introduced by the **Solder Removal Company.** Residue left on the connection after desoldering is a non-corrosive, electrically non-conductive rosin. Connections can thus be resoldered without cleaning.

The manufacturer claims Solder-Wick requires only one second to desolder a typical electronic connection. Heat build-up in components and PC boards is minimized, reducing the possibility of damage due to flux running into holes. Corrosion in the reworked connection is eliminated.

Solder-Wick is available in two sizes: #40-2-05, for use on miniature and sub-miniature circuits; and #40-3-05, for use on boards where solder deposits are larger. The price per five-foot coil is $1.49 for either size. ▲

Circle 41 on literature card

Book Review

Modern TV Waveform Analysis: Stan Prentiss, TAB Books, Blue Ridge Summit, Pa., 1968; 256 pages, 5½" x 8½", soft cover, $4.95.

The content of this text provides the reader with much more information than is indicated by the title. In addition to a complete and comprehensive analysis of the waveforms present in representative late-model b-w and color TV chassis, this book also provides a thorough description of the operation of every circuit—from tuner input to video output, including noise, sync, AGC, vertical and horizontal deflection, audio, power supply and chroma circuits—both tube and solid-state designs.

Also included along with the operational analysis of each circuit are tips on trouble symptoms and their causes, correct troubleshooting and alignment procedures using the scope, as well as special sections devoted to explanations of basic waveforms and effective solid-state servicing.

Schematic diagrams and photographs of actual waveforms and screen symptoms supplement the written text. Zero reference levels, accurate time bases and true peak to peak voltage values are included in or along with the waveform photographs.

Although written in the TV service technicians language, this book should prove valuable to engineers and other electronic-oriented individuals who need or desire a thorough understanding of present state-of-the-art color and monochrome TV circuits and related servicing procedures.

Advertisers' Index

FREE CATALOG & LITERATURE SERVICE

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100. *ITT*—16-page catalog, CP-2, details the design considerations, conductor selection and properties of dielectric insulating materials. Also included are illustrations of cable constructions and complete attenuation information.

AUDIO

101. *Bell P/A*—6-page short-form catalog describes commercial sound equipment including amplifiers, boosters, tuners, tape players, systems and accessories.
102. *MICHIGAN MAGNETICS*—Brochure describes Spot Check, a system for telling when a tape recorder head is wearing out.*

SPECIAL EQUIPMENT

103. *COHU ELECTRONICS*—Bulletin 8-92 discusses how a computer aids large-scale drafting with closed circuit television.
104. *LEE ELECTRIC*—24-page catalog describes bells, buzzers, transformers, push buttons, etc., with special attention on a new line of burglar alarm components and fire detection devices.

TECHNICAL PUBLICATIONS

105. *INTERNATIONAL CORRESPONDENCE SCHOOLS*—384-page manual explains function operation and objectives of the school. It also lists 266 courses of study offered and synopses of the instruction texts used.
106. *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.*

TEST EQUIPMENT

107. *B & K INSTRUMENTS*—8-page data bulletin describes the model 4712 Frequency Response Tracer.*
108. *COHU ELECTRONICS*—4-page, 2-color technical data sheet, 15-76, covers the model 355 DC Voltage Standard with specifications, instrument features, functional description and typical instrument systems.
109. *LEADER ELECTRONICS*—12-page catalog describes test instruments including oscilloscopes, signal generators, voltmeters and test probes.
110. *MEASUREMENT CONTROL DEVICES*—Bulletin describes the model 100 Transi-Scope DC to 10-MHz oscilloscope.
111. *SIMPSON ELECTRIC*—12-page illustrated catalog, Bulletin 368A, shows a new line of precision industrial instruments.

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