MARCH, 1964 50 CENTS

PF REPORTER

PHOTOFACT

including **Electronic Servicing**

SPECIAL ISSUE:

TEST EQUIPMENT

also

Instruments Simplify Color Tough-Dogs

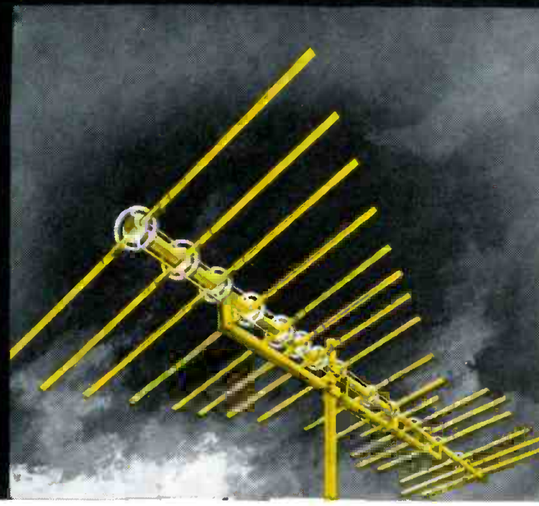
Servicing TV with VTVM

DC Scope for Quick Analysis

Curing Troubles in RF Generators

LIMA, O., SERVICEMEN SWITCH TO JERROLD PARALOG

...they weren't "snowed" by doubletalk!



Time and again, throughout the country, it's happening. Wherever we introduce Paralog antennas and ask servicemen to test their performance against competition, Paralog wins new supporters hands-down.

So it went in the difficult Lima (Ohio) reception area when our distributor, Allied Supply, presented the Paralog line to local servicemen. Shown here are a few of the Lima servicemen, previously dealers for other brands, who are now solidly behind the fabulous new Paralog. AND WHY THE SWITCH? Not because of trumped-up "gain charts" or gobbledegook. Simply because they've found that Paralog sells on its performance in all areas.

Have *you* tried the Jerrold-Taco Paralog side-by-side with its competition? Don't—unless you're ready to join the growing army of Paralog boosters.

RAY MAGER, MONTGOMERY WARD

"Paralog works better than any other VHF antenna ever made. We had 200 calls within two weeks. Some of our customers pull in Cleveland, over 160 miles away, consistently."

RALPH DEPALMA, RADIO HOSPITAL

"We insisted on a side-by-side, in-the-air field-strength-meter test. . . . Results proved Paralog superior. . . . This has been our first big boom in antenna business since the introduction of TV in 1951."

PHILIP NEWLAND, JR., OTIS & CO.

"Our company sold 68% of the color TV in our county in 1962. Obviously we have to use the best antennas, with the best front-to-back rejection. We've switched from Brand C to Paralog."

TOM LAMBERT and FRED ANSEL, VANGUARD ANTENNA SERVICE

"We've been installing antennas for 13 years. When Paralog hit Lima we found it outperformed Brand C, was built better, and we've been using it 100% ever since."

ROGER HEFNER, HEFNER TV

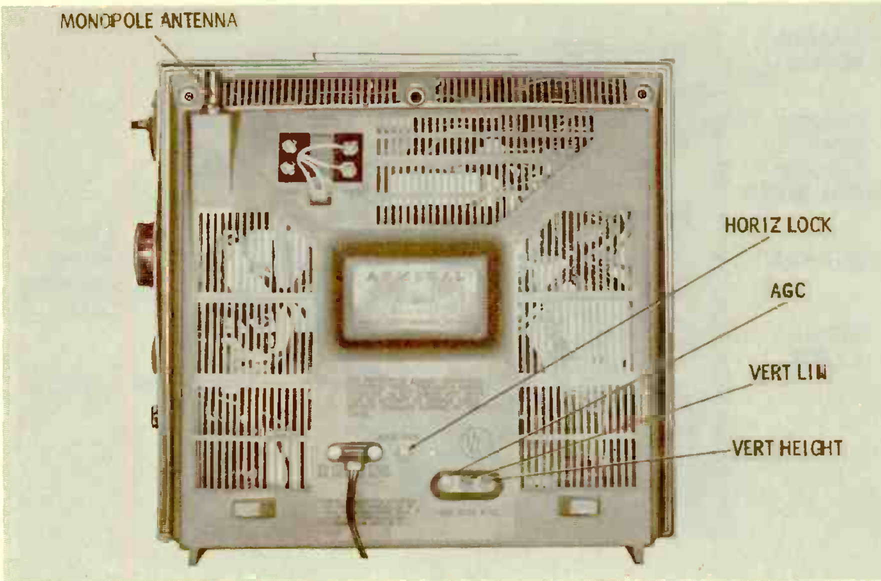
"As a set dealer who has antenna installations done by an independent installer, the only reception product I insist on is Paralog after seeing its performance in the tough Lima area."

For complete information, write Distributor Sales Division, Jerrold Electronics, Philadelphia, Pa. 19132.

JERROLD ELECTRONICS

Circle 1 on literature card

Admiral



Admiral Model UP1112C Chassis C21A10-2C

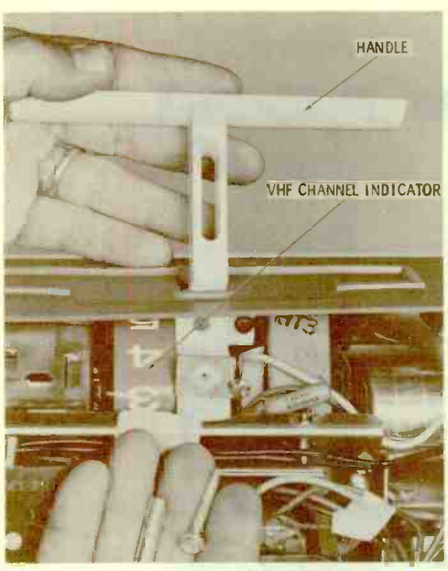
Here is Admiral's newest introduction —an 11" portable equipped with a built-in monopole antenna, earphone, and carrying handle. This compact, lightweight receiver features a 13-position VHF tuner and transistorized UHF tuner. Circuitry in this receiver does not differ greatly from that previously used by Admiral, although dual-purpose compactrons have replaced some of the more conventional tube types to save space. Most of the components are on a horizontally mounted printed board.

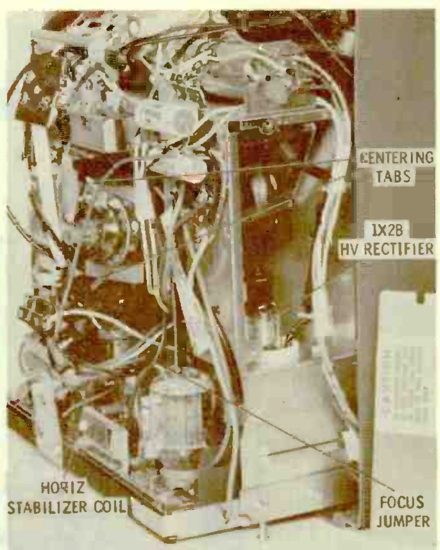
The 6K11 compactron used previously in the AGC keyer-sync separator stage has been replaced by a 6GH8. A two-stage video IF uses a 4BZ6 and 4DK6, and the video output-sound IF amplifier is an 8JV8. The audio detector-output is a 12AL11 compactron. Other compactrons include the 17JZ8 vertical multivibrator-output and 33GY7 horizontal output-damper. The 1X2B high voltage rectifier is not new; but should this tube need to be replaced, you must first slide the chassis partly out of the cabinet. This is accomplished by removing five Phillips screws holding the rear cover, two metal screws located at the bottom of the chassis, the metal screw and sleeve holding the top carrying handle, and one Phillips screw holding the top of the chassis. Disconnect the CRT socket, slip the yoke back, slide the chassis rearward, open the door to the high voltage cage, and the rectifier can be reached.

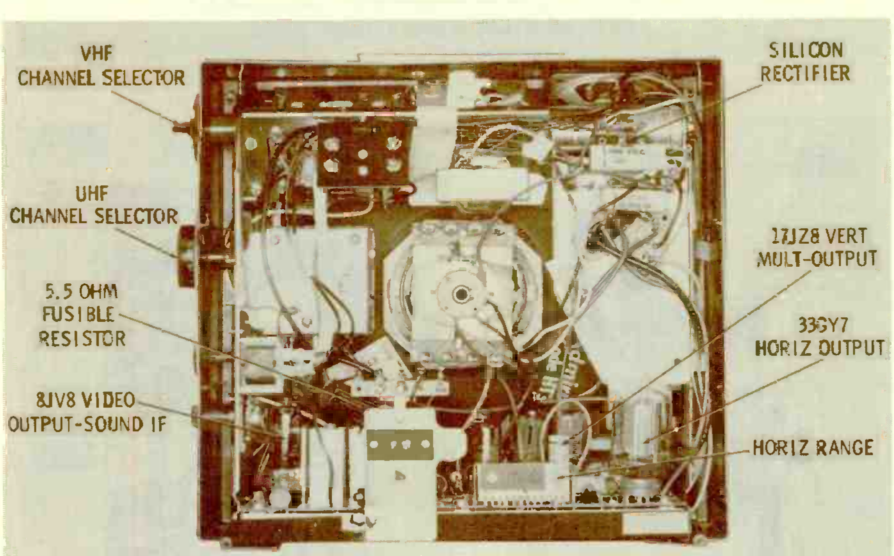
This transformerless chassis uses a 15 ohm, 5 watt resistor in series with the filament string, and the single silicon rectifier developing B+ is protected by a 5.5 ohm fusible resistor.

The UHF tuner uses as its oscillator an NPN transistor, and a 1N82A mixer diode. The video detector, also a germanium diode, is a 1N87A. A common-cathode dual selenium is used in the horizontal AFC circuit.

The VHF tuner has an individual oscillator slug for every channel; each can be reached by removing the channel selector and fine tuning knobs. In VHF-only sets, there are just three oscillator slugs—one covering channels 13-9, one for 9-7, and the third for 6-2.







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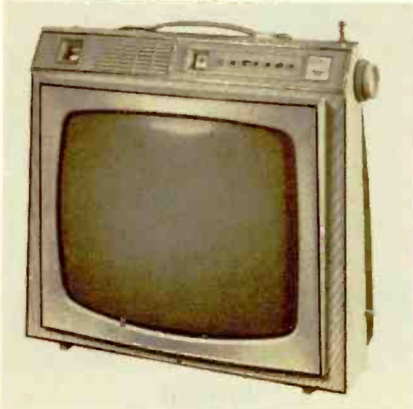


Emerson
Model U1840
Chassis 120673-C

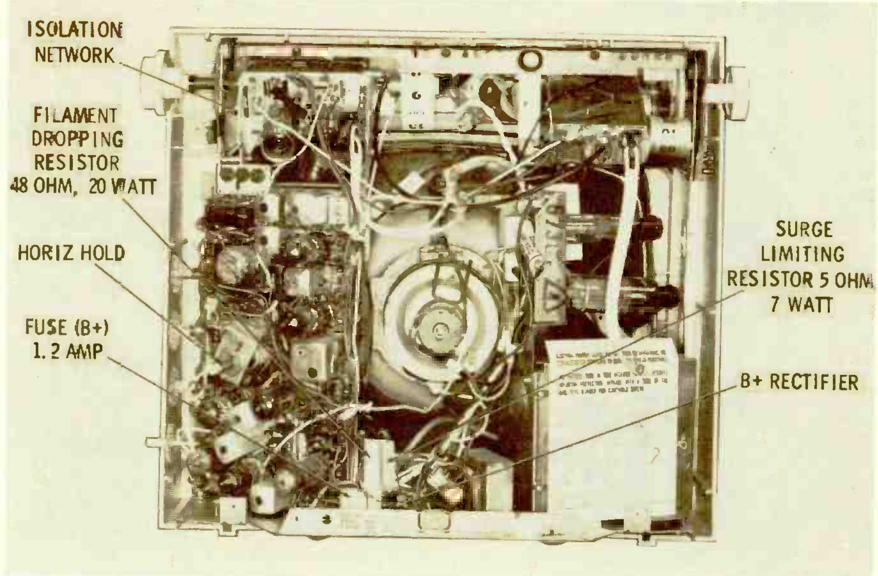
The smallest of all Emerson TV chassis introduced this year is the lightweight 16" portable shown above. This is a completely new set equipped with a built-in monopole antenna and a carrying handle. Pictured here is the VHF-UHF version; however, other versions of the 1840-1841 series, using this same chassis, are not equipped with UHF. If UHF reception is desired, an external UHF converter may be used. The VHF tuner is not adaptable through the use of individual strips.

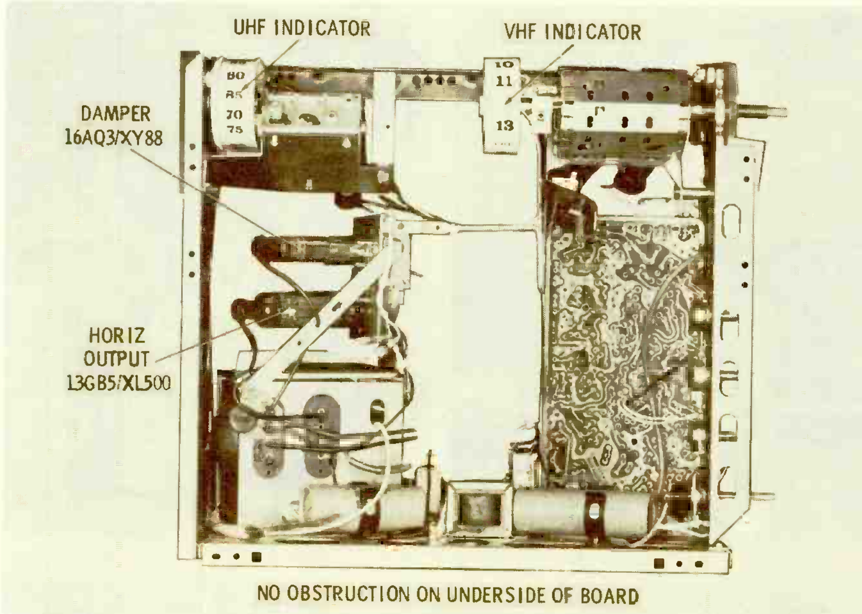
The picture tube is a high-G2, bonded 114° 16ANP4. Numerous other new tubes are also used; among these are the specially designed low B+ types in the sweep output circuits. The horizontal output uses a 13GB5/XL500; an 8CW5/X186 serves as the vertical output; the damper is a 16AQ3/XY88. A compactron 6K11 has three functions—AGC keyer, noise inverter, and sync separator. In some cases a 6Q11 may be used; it is directly interchangeable with the 6K11. A two-stage video IF section is composed of high gain pentodes 3EH7 and 3EJ7 respectively.

The series filament string has a 48 ohm, 20 watt dropping resistor, while protection for the single silicon B+ rectifier is provided by a 5 ohm, 7 watt surge limiting resistor and a 1.2 amp fuse. Other protective devices include a polarized AC input plug, and a 470K resistor and 470 mmf capacitor for isolation between the carrying handle and chassis ground.

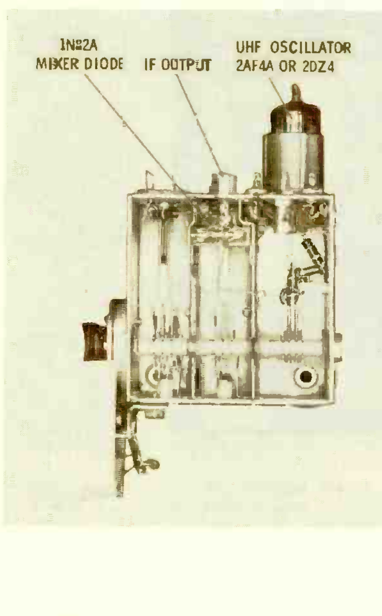
Most of the components are located on the one and only printed board. All tube basings are marked on the board, along with most of the key check points. Located at the top left of the PC board are AGC, vertical linearity, and vertical size controls—all three in one unit. Cathode bias on the AGC keying tube is varied by means of a PICTURE OPTIMIZER control. This control does not vary the video bandwidth in this chassis.

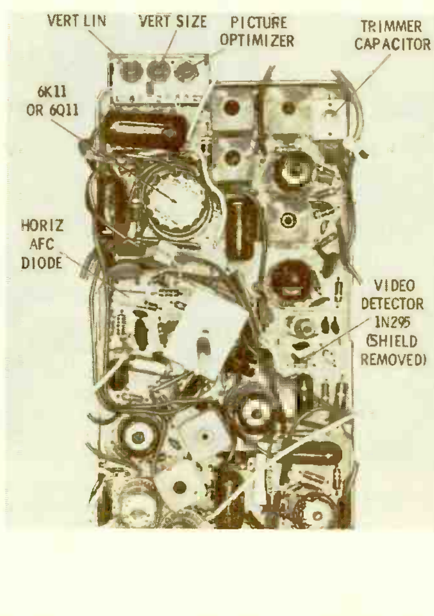
Should replacement of the video detector become necessary, it is a 1N295 crystal diode located beneath the shield covering the last IF transformer. A common-cathode dual selenium diode is used for horizontal AFC.



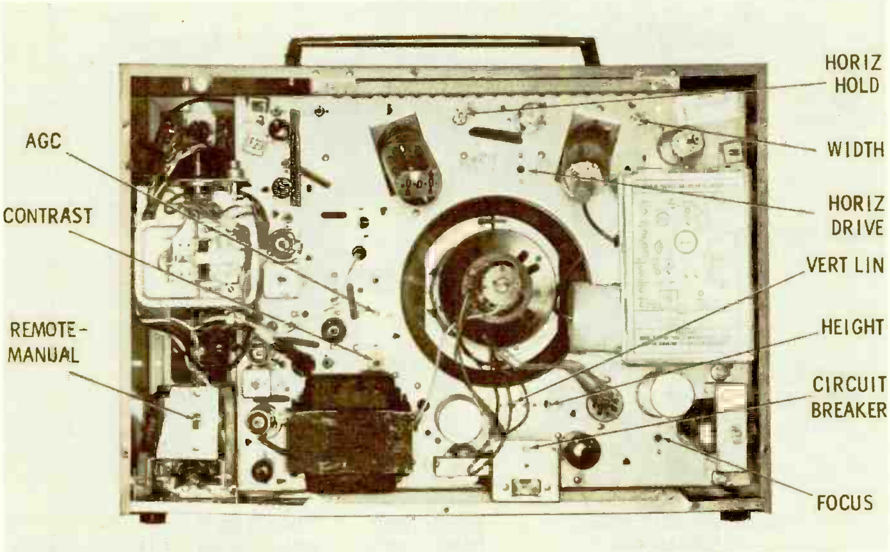


NO OBSTRUCTION ON UNDERSIDE OF BOARD

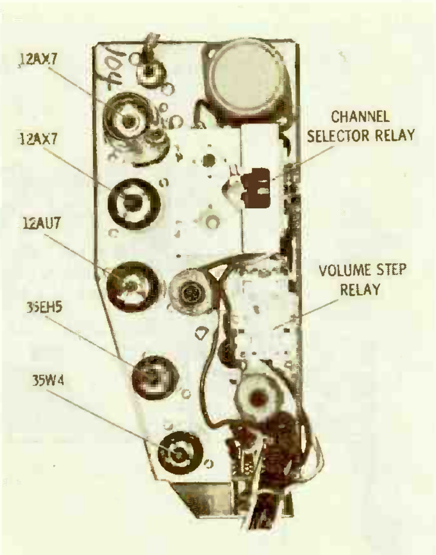


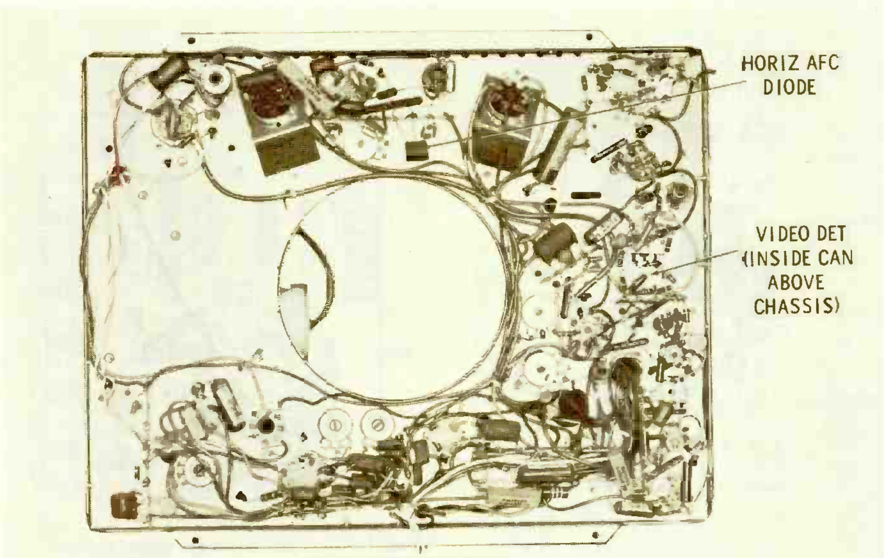


PREVIEWS of new sets — Packard Bell



BOTTOM VIEW REMOTE RECEIVER





HAND WIRED CHASSIS

Packard Bell Model 19T22 Chassis 8814P

Pictured above is Packard Bell's transformer-powered 19" portable, equipped with wireless remote control receiver and transmitter. It has a remote-manual switch (located on the rear apron) to change the mode of operation. The TV chassis and the remote receiver are both hand wired. The remote transmitter uses one small printed board. This chassis is not equipped for UHF reception, but it can be converted by adapter strips. It does come equipped with a built-in monopole antenna, computer dial lights, and an earphone jack.

The VHF tuner has preset fine tuning; each individual oscillator slug is adjusted, via a gear train, when the fine tuning knob is turned.

The 265 volts B+ for the TV chassis is developed from a 5U4GB circuit. B+ for the remote receiver is obtained from a 35W4 rectifier; it develops 150 volts DC. Protection for all circuits in the main chassis and the remote receiver is provided by a circuit breaker in the primary winding of the power transformer.

This chassis does not differ greatly from the ones previously used in comparable '63 models; however, the picture tube has been changed to a 19AYP4. Other tubes found are: 6GK5 RF amplifier, 6CG8A mixer-oscillator, 6BZ6's in the first two IF amplifiers, and the pentode section of a 6EA8 as the third. The other half of the 6EA8 functions as a noise inverter. The audio detector-amplifier is a 6BN8, with a 6AQ5A in the output socket. A 6AW8A is used as the video output-AGC keyer and a second 6EA8 serves as sync separator-sound IF. The vertical stage contains a 6EW7 multivibrator-output, and the horizontal circuit uses a 6CG7 or 6FQ7 as oscillator and a 6DQ6B or 6GW6 for output. The damper is a 6BA3 or 6AY3A, and the high voltage rectifier is a 1G3.

The video detector is a 1N295A germanium diode; it can be reached by removing the clip-on shield covering the third IF transformer. Horizontal AFC is provided by a dual selenium having common cathodes; it's a soldered-in type, located on the underside of the chassis.

Controls adjustable from the front include those for on-off-volume, brightness, and vertical hold.

Zenith
Model T2203J
Chassis 14L30

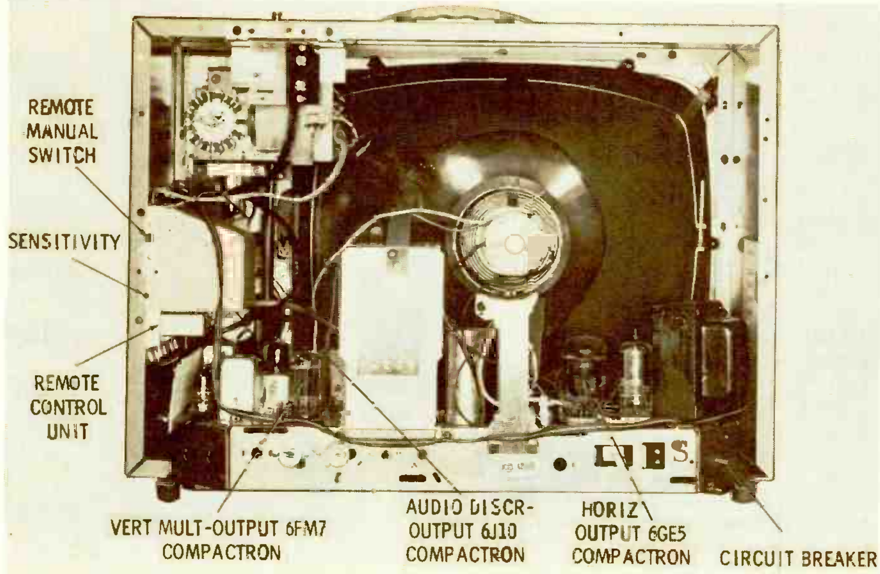
This transformer-powered 19" portable is among the new models introduced by Zenith for 1964. The set pictured here is equipped with a transistorized *Space Command 300* remote control unit. A total of 14 tubes are used in this set, including those in the VHF tuner and the 92°, 19CRP4 picture tube. A decrease in the number of tubes is made possible by the use of multipurpose compactrons; three are used in this chassis, as follows: 6J10 audio discriminator-output (replacing the usual 6BN6-6AQ5 combination). A 6FM7 makes up the vertical multivibrator-output circuit, and a 6GE5 is used in the horizontal output stage.

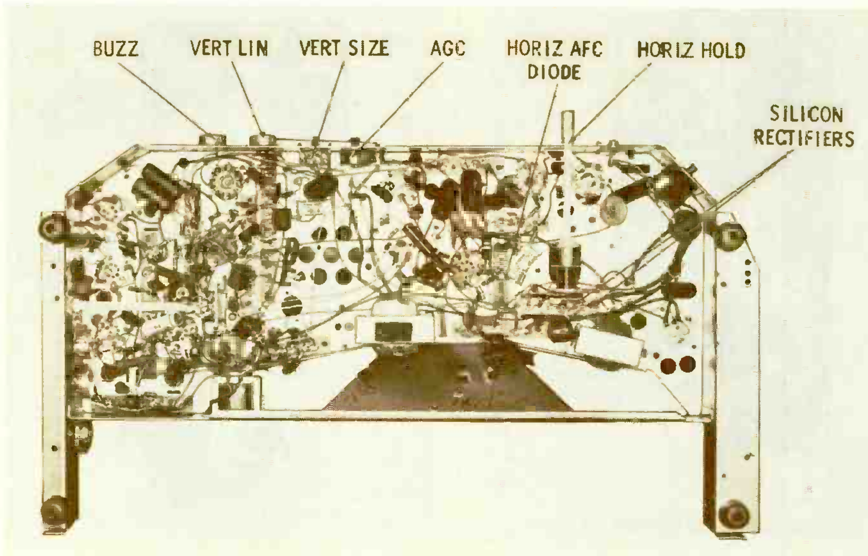
The low voltage rectifier tube used previously has been replaced by two silicon rectifiers, connected as a full-wave voltage doubler with an output of approximately 250 volts DC. Rectifier protection is provided by a circuit breaker located in the primary circuit of the power transformer. A link of No. 25 copper wire protects the parallel filament circuit.

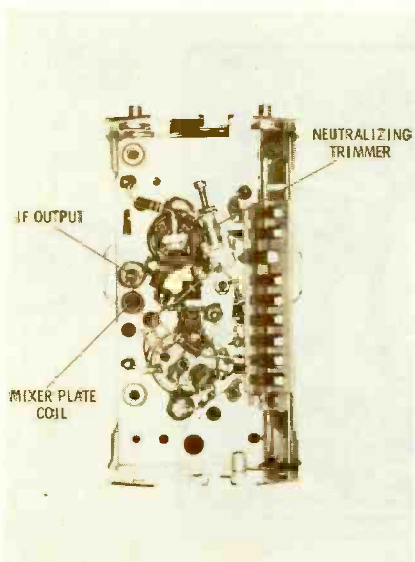
The remote control receiver has its own power supply, using the third silicon rectifier found in this set. Also in this unit, and pointed out in one of the photos, is a .15 amp slow-blow fuse, a remote-manual switch, and a sensitivity control. Proper adjustment of this last control is made by placing the remote transmitter 20 to 25 feet away from the receiver, then depressing either the channel selector or volume button and adjusting the control until the corresponding relay triggers. This remote also features six PNP transistors, all plug-in types.

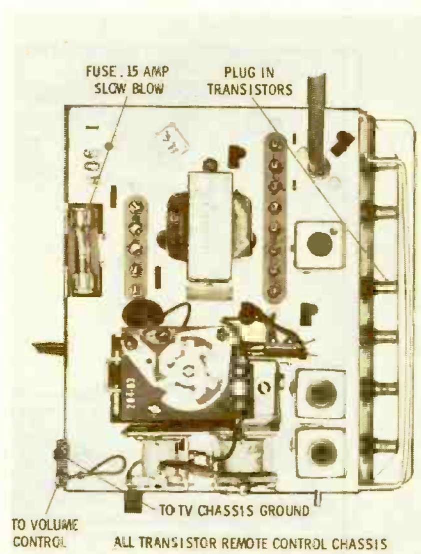
Underneath the chassis is a soldered-in dual diode (common cathode) for horizontal AFC. The three-stage video IF section, composed of 6BZ6's, is followed by a germanium diode video detector. Its location is beneath the shield covering the third IF transformer. The detector load circuit includes a "peak picture" control; adjusting it varies the video frequency response.

The usual *Fringe-lock* control is no longer used; replacing it is a VDR (voltage dependent resistor). This resistor is used in the noise limiter circuit to vary the voltage on the control grid according to the amount of conduction in the video output tube.









ALL TRANSISTOR REMOTE CONTROL CHASSIS

See PHOTOFACT Set 559, Folder 2

See PHOTOFACT Set 559, Folder 2

Mfr: RCA **Chassis No.** KCS 137A

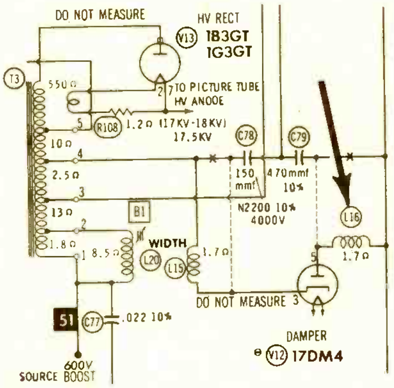
Card No: RCA KCS 137A-1

Section Affected: Raster.

Symptoms: No raster, no boost voltage; sound normal.

Cause: Open choke in damper plate.

What To Do: Replace L16.



Mfr: RCA **Chassis No.** KCS 137A

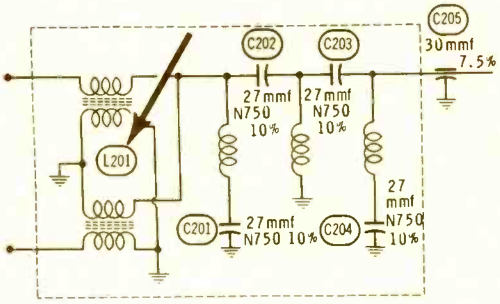
Card No: RCA KCS 137A-2

Section Affected: Pix.

Symptoms: Weak pix with snow on all channels; sound may also be weak. Visual check reveals burnt or charred balun coils.

Cause: Open balun coils in tuner.

What To Do: Replace L201.



Mfr: RCA **Chassis No.** KCS 137A

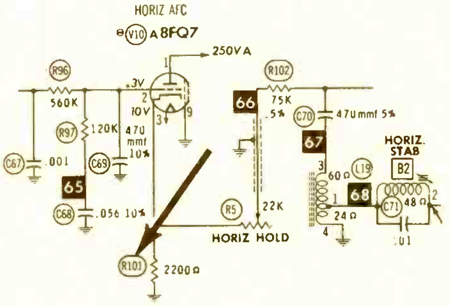
Card No: RCA KCS 137A-3

Section Affected: Sync.

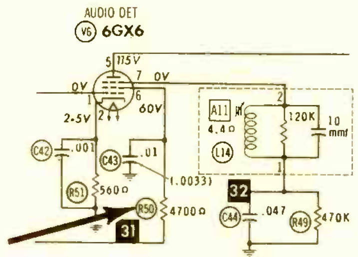
Symptoms: Loss of horizontal sync; unable to correct with hold control.

Cause: Cathode resistor in horizontal AFC stage increased in value.

What To Do: Replace R101 (2.2K).



See PHOTOFACT Set 559, Folder 2



See PHOTOFACT Set 559, Folder 2

Mfr: RCA **Chassis No.** KCS 137A

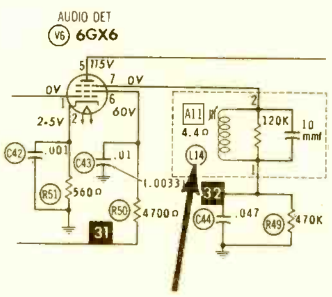
Card No: RCA KCS 137A-4

Section Affected: Sound.

Symptoms: Low volume.

Cause: Resistor in screen grid circuit of audio detector increased in value.

What To Do: Replace R50 (4.7K).



Mfr: RCA **Chassis No.** KCS 137A

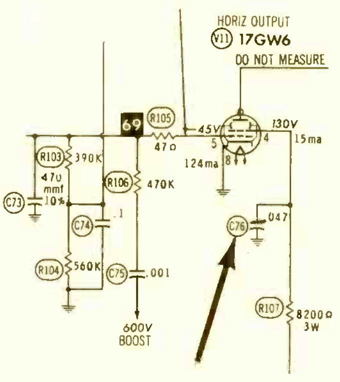
Card No: RCA KCS 137A-5

Section Affected: Sound.

Symptoms: Distorted and/or weak sound. Slug in quadrature coil is frozen.

Cause: Physical and chemical changes in slug and coil housing.

What To Do: Insert Allen wrench in slug, heat Allen wrench with soldering iron, and turn wrench until slug rotates freely. Realign L14.



Mfr: RCA **Chassis No.** KCS 137A

Card No: RCA KCS 137A-6

Section Affected: Raster.

Symptoms: Insufficient width after approximately one hour of operation.

Cause: Leaky capacitor at screen grid of horizontal output.

What To Do: Replace C76 (.047 mfd).

VIDEO SPEED SERVICING

Silvertone

See PHOTOFACT Set 566, Folder 1

Mfr: Silvertone **Chassis No.** 456.51800

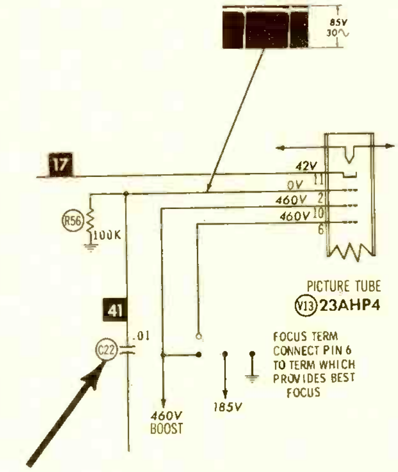
Card No: SI 456.51800-1

Section Affected: Pix.

Symptoms: Brightness remains at maximum; brightness control appears inoperative. High positive voltage on control grid of CRT.

Cause: Leakage in coupling capacitor supplying blanking pulse to grid circuit of picture tube.

What To Do: Replace C22 (.01 mfd).



Mfr: Silvertone **Chassis No.** 456.51800

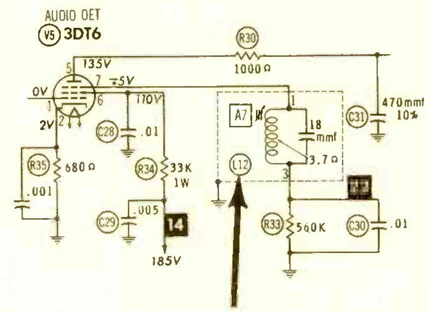
Card No: SI 456.51800-2

Section Affected: Sound.

Symptoms: Buzz in sound.

Cause: Open quadrature coil.

What To Do: Remove L12 from shielding can and resolder pigtails to terminals. After re-installation, adjust slug for minimum buzz.



Mfr: Silvertone **Chassis No.** 456.51800

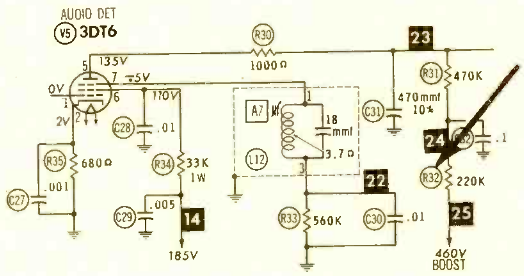
Card No: SI 456.51800-3

Section Affected: Sound.

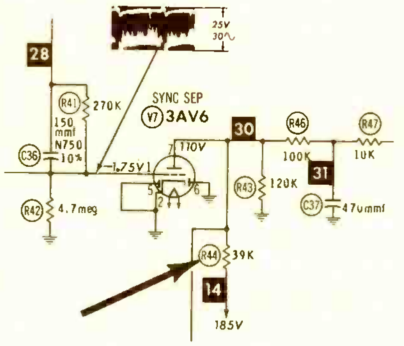
Symptoms: Weak sound. Low voltage at plate (pin 5) of 3DT6 audio detector.

Cause: Plate load resistor increased in value.

What To Do: Replace R32 (220K).



See PHOTOFACT Set 566, Folder 1



See PHOTOFACT Set 566, Folder 1

Mfr: Silvertone **Chassis No.** 456.51800

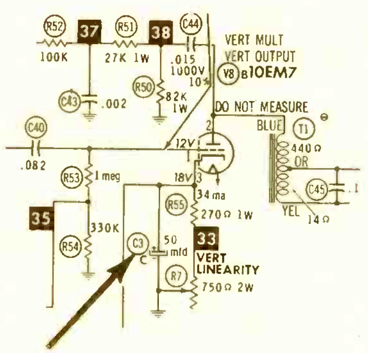
Card No: SI 456.51800-4

Section Affected: Sync.

Symptoms: Poor vertical hold and horizontal tearing. Voltage at plate (pin 7) of sync separator V7 is too high.

Cause: Plate load resistor has overheated and reduced in value.

What To Do: Replace R44 (39K). Check V7 (3AV6).



Mfr: Silvertone **Chassis No.** 456.51800

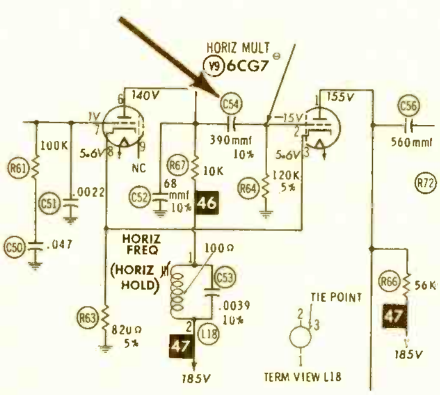
Card No: SI 456.51800-5

Section Affected: Raster.

Symptoms: Poor vertical linearity.

Cause: Open capacitor in cathode circuit of vertical output tube.

What To Do: Replace C3 (20-20-50 mfd—300-300-50V).



Mfr: Silvertone **Chassis No.** 456.51800

Card No: SI 456.51800-6

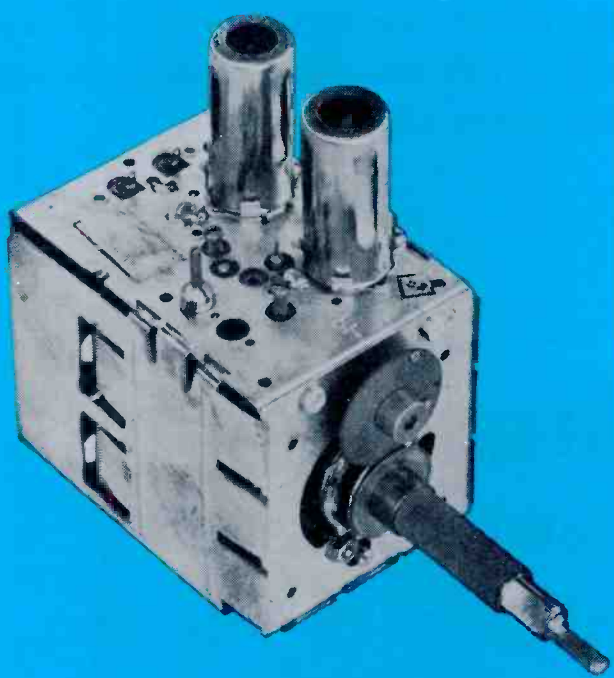
Section Affected: Sync.

Symptoms: Horizontal oscillator drifts during operation. Negative grid voltage on V9 decreases.

Cause: Leaky coupling capacitor at output grid.

What To Do: Replace C54 (390 mmf).

TUNER REPAIRS



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Circle 2 on literature card

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PF REPORTER
including Electronic Servicing

VOLUME 14, No. 3 — *MARCH, 1964*

CONTENTS

SPECIAL TEST EQUIPMENT ISSUE

ABOUT THE COVER

With circuits becoming more complex, and at the same time smaller, test equipment is becoming ever more important. This special issue brings you over 100 pages of the very lastest information to help you select, buy, use, and maintain test equipment.

Letters to the Editor

Dear Editor:

A publication, "Television Interference, Its Cause, Effect, and Cure," has been distributed nationally and internationally for several years by the Washington (D.C.) TVI Committee. Several thousand copies of the latest rerun are still available; I'm enclosing a sample.

Free single copies will be supplied on request to those of your readers who identify their connection (either full or part time) with the television or communications service and maintenance, engineering, or broadcast industry. Each request should be accompanied by a 9" x 12" self-addressed envelope stamped with 20¢ postage to cover first-class return mailing costs. Please direct all requests to Harold R. Richman, Editor, WTVIC TVI Aids, 1110 Lake Boulevard, Annandale, Virginia.

The committee will appreciate any help you can offer in its educational project, which is directed primarily toward the television service technicians.

Harold R. Richman
Associate Advisor
Washington Television
Interference Committee

Annandale, Va.

This meaty publication offers real help in fighting a perennial service problem. And you say it's free . . . are you ready for a deluge of requests?—Ed.

Dear Editor:

After 35 years in radio and television servicing (30 years of that time as owner of my own service business) I recently sold my shop in Virginia. Approaching the age of retirement, I do not expect to return actively to the service field, and am now here in France to give my children a taste of European education.

I wish to compliment your company on the great aid it has been to service technicians, through both your magazine and the Photofact Folders. A complete file of these publications, including *all* copies of the magazine from its inception, was passed on to the new owners of my business. I wish I could have kept them, but the new owners wouldn't let me.

L. H. Covey

Clos Siam Proun
St. Maxime, S/Mer
Var, France

Dear Editor:

I read the comments from various readers about splicing 300 ohm line, and agree that their comments are entirely correct. In my experience, a staggered joint with 2" to 3" overlapping "tongues" of plastic insulation makes a strong splice. The joint can be strengthened even more by putting a layer of tape under the plastic overhang before taping the complete joint.

Nat Wolfson

Bronx, N.Y.

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Shows correct pattern in window viewer for visual guide

2 PATTERN SELECTOR
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3 AUTOMATIC DECONVERGENCE
Simplifies static and dynamic convergence. No digging into set

4 COLOR SELECTOR
Produces each color one at a time for accurate color set-up

5 COLOR GUN KILLER
Automatically enables the technician to actuate any combination of the 3 guns

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Makes alignment extremely simple, without going into the color set

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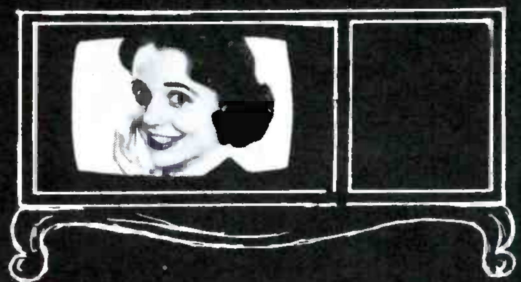

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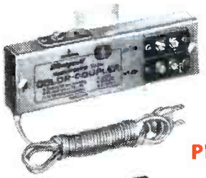

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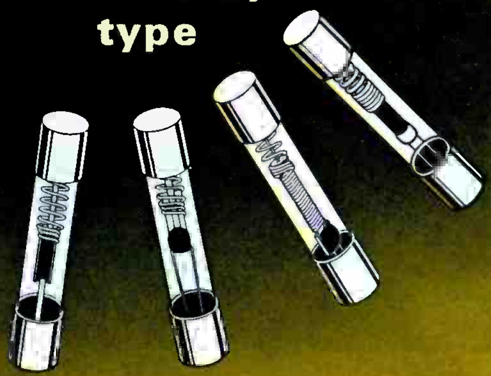


The Troubleshooter

answers your servicing problems

Citizens Band

We have for repair a Capital ND-309 *Personalphone*, for which we are in desperate need of a schematic diagram, parts list, and any other information you might be able to supply. Any help would be greatly appreciated.

W. W. BERTSCH

Cincinnati, Ohio.

The Capital ND-309 is covered in PHOTOFACT *Folder 608-5 and also in the Howard W. Sams "Citizens Band Radio Manual" (Vol. 3). If you are interested in service data on other CB brands, I suggest you visit your local distributor and examine this newly introduced series covering CB equipment. These manuals provide such information as: who may service CB radios, frequency band coverage, test equipment needed, and CB servicing in general.*

Question Time

Please explain or answer the following three questions for me: (1) I've noticed in several of the new 1963 and 1964 color receivers that the IF amplifiers are arranged in a "stacked" B+ configuration; the plate voltage for the first IF is obtained from the cathode circuit of the second. What is the advantage, if any, of this "stacked" system over the conventional system where each IF has its own path to B+? (2) Also, in the new receivers, both color and black-and-white, why do the vertical circuits employ the multivibrator principle, rather than the blocking oscillator design? Is the multivibrator design superior? If so, what added advantage does it offer over the blocking oscillator? Or is the more widespread multivibrator based on economical considerations? (3) In most sets using three IF amplifiers, only the first two stages are controlled by AGC voltage. Why isn't the other stage also controlled? Wouldn't this permit the use of a smaller AGC control voltage on the RF amplifiers, and consequently produce a more snow-free picture? What are the disadvantages of controlling all IF stages? If there are none, why aren't all of them controlled?

MICHAEL KINNEAR

Beaumont, Tex.

(1) The first of your three questions has no easy answer! Stacked IF systems are finding great favor in late-model sets, perhaps because of greater efficiency, easier AGC control (since gain of both stacked tubes is controlled by bias on only the first tube), removal of a fluctuating load from the low B+ line for more constant voltage on this line, or any number of other factors. (2) Your other two questions are somewhat easier to put a finger on. As to the waning popularity of blocking oscillators for vertical sweep, there are several reasons why it would be to a manufacturer's advantage to eliminate the blocking transformer. Besides the reduction in component costs, there is also the benefit of removing a rather heavyweight component and eliminating a major source of electromagnetic radiation. Both the latter factors are important in today's compact printed-circuit construction. (3) One disadvantage to using AGC on a third IF stage stems from the relatively strong signal reaching that stage. If there's considerable bias on the stage, it may be somewhat hard to have linear amplification

when the signal-voltage swings at the grid are on the order of 1 volt (as may be the case in a modern third IF). Many recent designs also use a special tube as a third IF, with a transfer characteristic much different from the AGC-controlled tubes. It is designed to cut off with only a couple of volts bias on the grid, but if operated at low bias, it is capable of three times the amplification of older-type tubes. Incidentally, modern AGC systems generally have enough RF delay that the tuner operates with zero AGC bias most of the time. Signals really have to be strong to develop negative voltage on the RF branch of the AGC system.

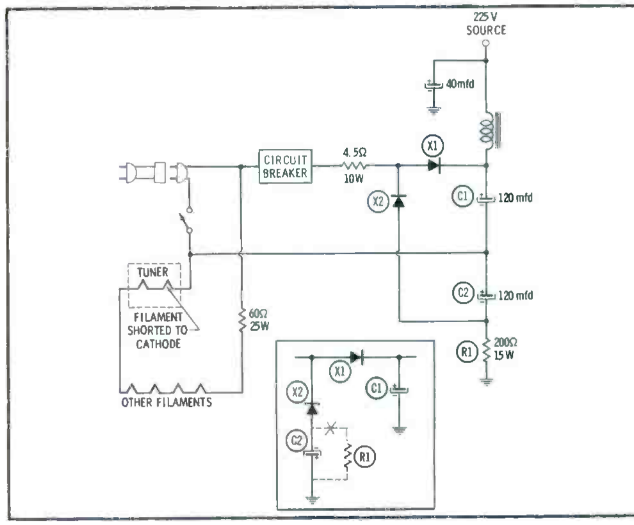
Raster or No Raster

With reference to Mr. Savino's B+ problem in a Silvertone Chassis 528.50180 (*Troubleshooter*, page 94, November, 1963 issue): When the shorted tube is replaced, the technician will be surprised to find he has gone from bad to worse—he probably had a very dim raster with the 140 volts of B+; after he replaces the tuner tube he won't have a raster at all. However, reinserting the old tube restores the dim raster! When an inspection is made, the technician will find the 200 ohm, 15 watt resistor open, because of the added load when one side of the line was grounded.

ARTHUR DOEHNERT

Houston, Tex.

We've shown the schematic for this particular circuit again, and added in the inset a simplified drawing of the rectifier circuit when the tube in the tuner is shorted. This will help you understand exactly what happens. The resistor will burn only if the receiver is left on after the tube shorts. As you'll notice in the inset, the circuit can function as a halfwave rectifier, hence 140 volts of B+ is developed via rectifier X1. This voltage is sufficient in some receivers, to develop enough high voltage to give a raster (in other sets, the high voltage is completely lost). Of course, the width and height will also be affected. Now, what happens to R1 under these conditions? When the short occurs, X1 will conduct during one half of the input cycle, up from ground through R1. The dissipation rating of R1 will be exceeded (almost 50 watts will develop), and after prolonged operation of the set, R1 will burn out. Damage to X2 or C2 is unlikely; the ratings of these components are not exceeded. When R1 does open, X2 and C2 play little part in the circuit. If any of you have trouble of this nature in these chassis, thank reader Doehnert and take this tip for future reference: If the set will not produce a raster after the shorted tube is replaced, the resistor is likely open! ▲



The Electronic Scanner

news of the servicing industry

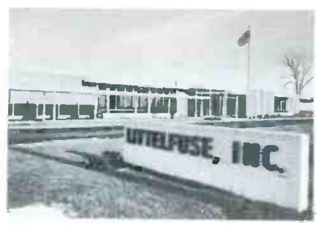
Home Entertainment Center

A modern home entertainment center has been opened by **Sylvania Electric Products Inc.** in New York City to display radio, television, and stereo hi-fi equipment. The 1700-square-foot center is located on the ground floor of the General Telephone Bldg., Third Avenue at 45th St.

UHF TV Openings

The first UHF educational TV station in the Los Angeles area is soon to be constructed by Community Television of Southern California, and WCIU (Ch. 26) has recently became Chicago's first UHF station. These bring the total to approximately 15 UHF stations that are planning 1964 openings. Others are: WIHS-TV (Ch. 38) Boston; WNJE-TV (Ch. 77 ETV) Glen Ridge, N. J.; and WTIU (Ch. 30 ETV) in Bloomington, Indiana.

New Plant Opening



A 125,000-square-foot, air-conditioned manufacturing plant has become the new home of **Littelfuse, Inc.** in Des Plaines, Illinois. The new facility is equipped with modern data processing and the latest production tools for making billions of electronic and electrical circuit protection and control devices. The plant, located at 800 E. Northwest Highway (U.S. Route 14), was opened formally with the raising of the Stars and Stripes by the firm's corporation officers.

Merger

The acquisition of the B & G Woodworking Co. and its 40,000-square-foot manufacturing plant in Windsor, Illinois, has been announced by **Wheaton Industries, Inc.** The new organization, which will be known as the Windsor Products Division of Wheaton Industries, will continue to design and manufacture speaker and hi-fi sound system cabinetry for the parent firm, as well as for contract fabrication.

Colombian CD Network Established

Wayne W. Cawley, president of **Cadre Electronics,** explains the versatility of a modified Model 520—their 5 watt transceiver—to Ernesto Caro, Consul General of the Republic of Colombia. Cadre will supply 1,000 such transceivers and component parts as the first step in establishing the Colombian Civil Defense Network.

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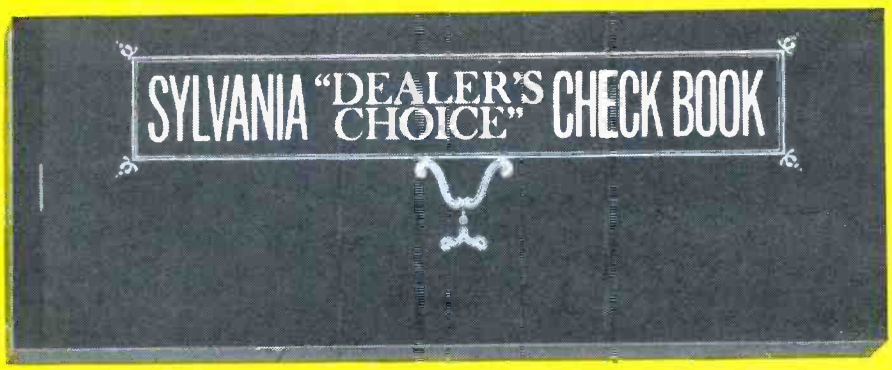

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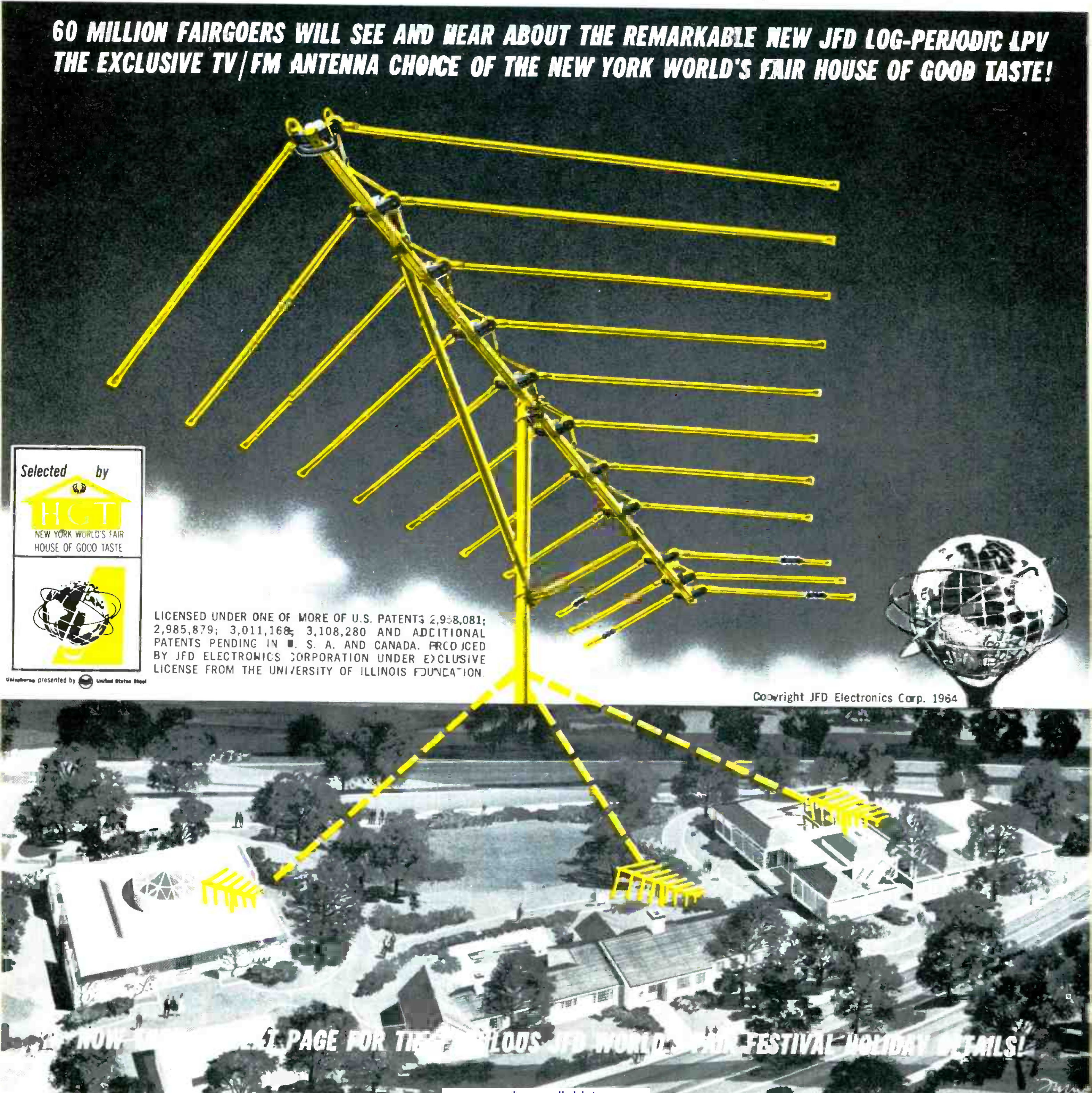
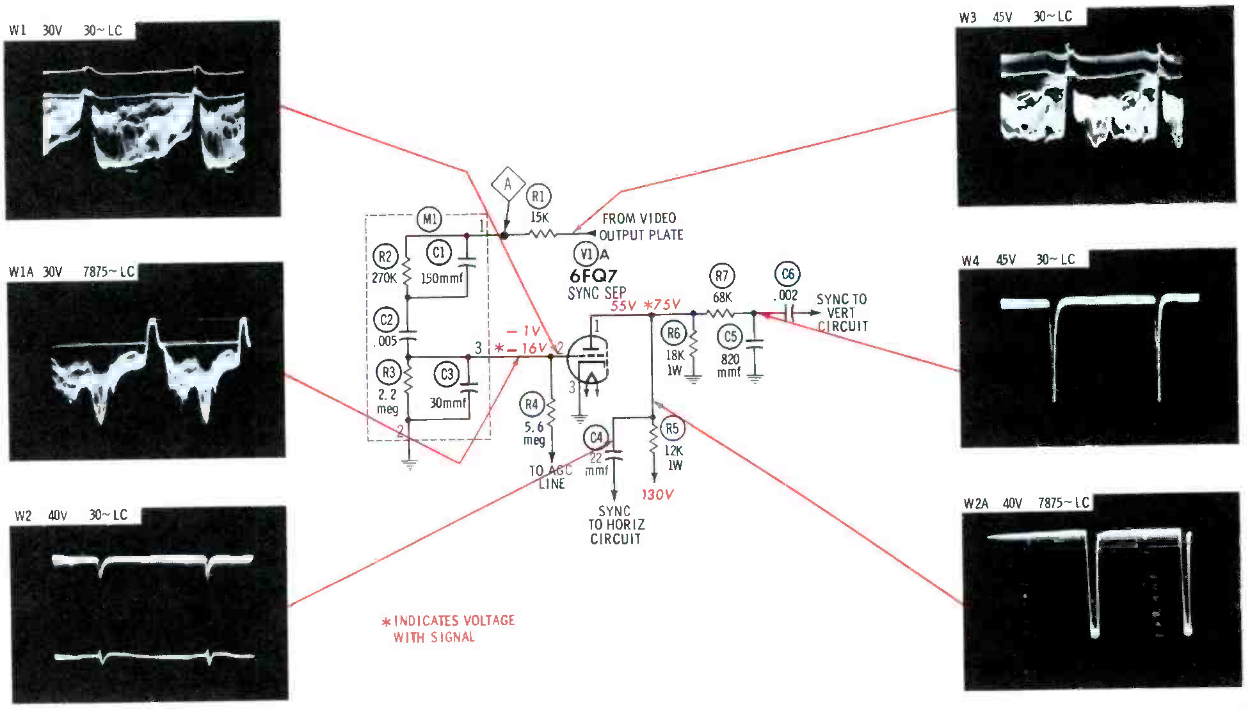


PF REPORTER Symfact™

Sync Separator

Using Single Triode



DC VOLTAGES taken with VTVM, on inactive channel; antenna terminals shorted. *Means voltage varies with signal conditions—see "Operating Variations."

WAVEFORMS taken with wideband scope; controls set for normal contrast (50 volts p-p video to CRT). Low-cap probe (LC) used to obtain all signal waveforms.

Normal Operation

Circuit shown here (from Chassis Series S37, built by Wells Gardner and used in several private-label sets) is typical in receivers having only one stage of sync separation. Not much amplification is imparted by this stage, so plenty of drive is assured by taking high-level composite signal (W3) from plate circuit of video output tube. Video signal is applied to printed component unit M1 (C1, R2, C2, R3, and C3)—a timing network that shapes sync pulses to some extent. Incoming signal (W1) develops high negative grid bias, so V1A can conduct only during positive sync tips. Stage thus operates as clipper, removing all video information below level of sync pedestal. Low plate voltage permits stage to act also as limiter; saturation is easy, and extremely high sync tips (and any accompanying noise pulses) are thus eliminated. Output is pure sync pulses (W2), of constant amplitude, and negative-going because of natural inversion. Horizontal pulses are coupled to AFC circuit by C4. Vertical pulses (W4) are integrated in network R6-R7-C5 and fed to vertical circuit by C6. To develop strong sync signal needed to keep vertical hold from being touchy, integrated signal is fed first to vertical output grid, amplified, and then applied to oscillator via feedback circuit. AGC in this receiver is simple, developed at video detector. High grid-leak bias at pin 2 depends on signal level, so R4 interconnects separator grid and AGC line, to help AGC action. This extra connection to grid circuit doesn't affect separator action.

Operating Variations

PIN 2

With strong signal from local station, and normal setting of contrast control, DC voltage is about –16 volts. When contrast control settings are varied from minimum to maximum, voltage ranges from –8 to –20 volts. Amplitude of W1 also changes in direct relation to contrast setting and input signal strength.

PIN 1

When signal is applied, no-signal 55 volts increases to 75 volts. Rotating contrast control through its range, or changing channels, causes only very slight difference—1 or 2 volts. Likewise, amplitude of waveform W2 (and W4) does not change noticeably with any of the normal operating adjustments. W4 (40 volts) contains sync and also pulse coupled back via C6 from vertical oscillator; 20 volt sync pulse can be viewed by turning vertical hold.

A

Entire sync stage is located on printed circuit board. Connection from R1 to M1 is made via soldered terminal on this board. R1 itself is located near to the video output. Contrast control determines gain of video output tube, so its setting directly affects amplitude of W3 (and W1). On strong local stations, peak-to-peak amplitude of W3 varies from 30 volts minimum to 70 volts maximum, throughout rotation of contrast control.

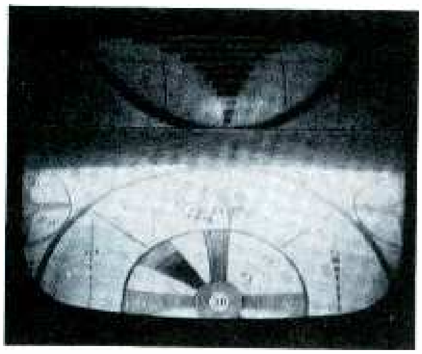
SYMPTOM 1

Intermittent Vertical Roll

Horizontal Critical

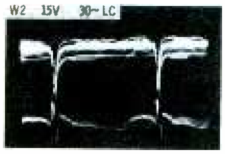
R5 Increased in Value

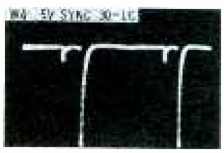
Symptom Analysis



Vertical has slow roll and "floating" tendency; range of hold control is very critical. Unable to get positive locking action with control, indicating sync signal probably isn't controlling oscillator. Changing channels causes temporary loss of horizontal sync.

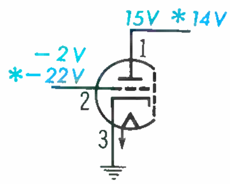
Waveform Analysis





W1 and W3 (not shown) are okay, indicating trouble is in output of V1A. Video contamination in W2, and low 15 volt amplitude, confirms suspicion that vertical sync pulse isn't sufficient to control oscillator; note ragged appearance of horizontal tips between vertical pulses. W2A, although weak, can control horizontal. Adjusting hold control to view sync signal in W4, reveals only 5 volt sync amplitude—would be 20 volts during normal operation.

Voltage and Component Analysis



Pinpointing clue is low 15 volts DC on plate of V1A. Incoming video signal to pin 2 is normal, so grid voltage, with or without signal, remains close to normal. Evidence thus points to trouble in B+ path to plate of separator. In this instance, R5 has increased to approximately 150K; if resistance increases much further, both horizontal and vertical sync will be lost. Low plate voltage reduces gain and shifts normal operating mode of separator. Video passing through stage, because of poor clipping action, only aggravates symptom.

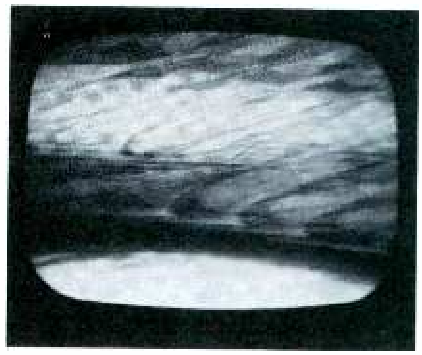
Best Bet:* *Scope isolates; voltage measurements conclusive.

SYMPTOM 2

Loss of Sync

Horizontal and Vertical Affected Equally

Point "A" Open at PC Board

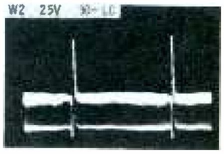


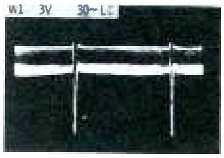
Symptom Analysis

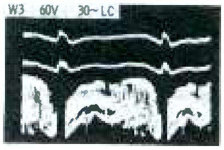
Picture indicates complete loss of vertical and horizontal sync. Both hold controls are operative, and picture can be steadied slightly by careful adjustment. Symptom is present on both strong and weak stations, so AGC is probably okay.

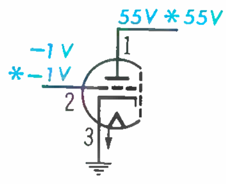
Waveform Analysis

Reduced pulse is present at W2, a good starting point—but it's *positive-going;* must be caused by pickup and feedback from vertical oscillator circuit. Information on base line is stray noise. W1 contains no video information, just very weak inverted waveform from plate of V1A. W3 video signal is normal with above-normal amplitude, suggesting trouble is between this point and grid of V1A. Scope on either side of point A pinpoints fault.









Voltage and Component Analysis

Voltage on plate and grid of V1A doesn't vary at all when signal is applied; likely reason is lack of grid-leak bias normally developed by incoming signal. Normal no-signal voltages on V1A practically rule out trouble in plate components R5-R6 and grid components R3-C3. Twist while changing tubes is all that's necessary to cause open connection (sometimes intermittent) at point A. Video signal at W3 increased in amplitude due to AGC action—negative AGC voltage decreased slightly when *extra* AGC source (through R4) was removed.

Best Bet:* *VTVM gives clues, but scope is conclusive.

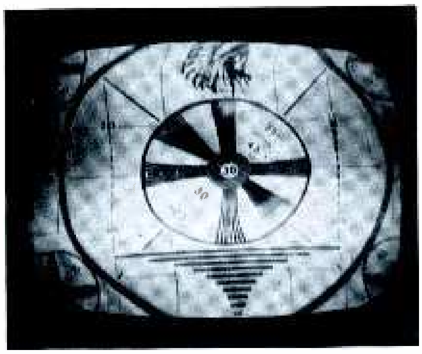
Horizontal Pulling

SYMPTOM 3

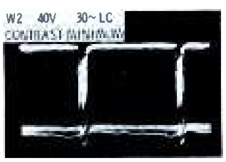
Vertical Sync Critical

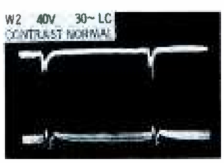
C2 Leaky

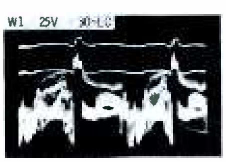
Symptom Analysis



Screen displays familiar pulling at top of picture, with intermittent vertical roll. Contrast control offers clue—in minimum position symptoms are worse; at maximum, condition improves. Trouble in video or AGC isn't likely, since condition affects all stations.



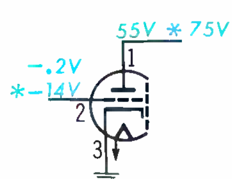




Waveform Analysis

With normal setting of contrast control, amplitude of W2 is okay; but look at video content in sync pulse slot with minimum contrast setting. With contrast at normal, very little video is seen in W2; increased signal fed to grid of V1A lets tube act more like true separator. This accounts for increased symptom as contrast is turned down. Decent looking signal at W1, with 25 volt amplitude, doesn't offer much clue to actual defect present in circuit.

Voltage and Component Analysis



Extremely reduced grid voltage without signal is vague clue to leakage in C2; however, low voltage *with* signal won't attract attention because wide variation is expected anyway. *Dynamic* leakage test of C2 is in order for several reasons: Coupling capacitors at this point are known to be troublesome; waveform checks indicate sync output is contaminated, although operating voltages aren't far from normal; lowered bias on grid of separator is vague clue. Test can be made by slicing printed wiring at terminal 3 of M1.

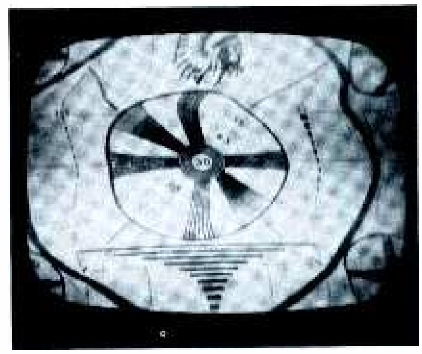
***Best Bet:** Takes VTVM to pinpoint fault.*

Horizontal Bending and Pulling

SYMPTOM 4

Entire Raster Affected

C1 Open

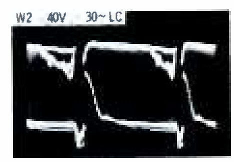


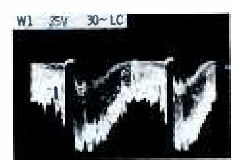
Symptom Analysis

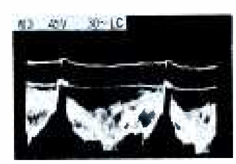
Extreme bending and pulling of picture might indicate hum, video, or distorted sync signal is reaching horizontal oscillator; makes quick check of horizontal sync pulses most logical beginning. Vertical sync is fairly stable. Symptom remains on all stations, weak or strong.

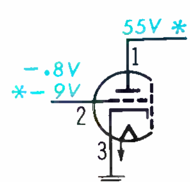
Waveform Analysis

Twisted video signal at W2, almost without sync pulses, clears horizontal circuits of suspicion and directs attention to sync separator. Note also there are practically no sync pulses in W1 at grid of V1A. This clears separator circuit, since fault is obviously farther back toward stage input. Next logical point for tracing with scope is W3. Acceptable video signal at this point pinpoints trouble spot to somewhere between R1 and grid of V1A.









Voltage and Component Analysis

Voltage on plate with or without signal is within normal range. Bias *with* signal offers best voltage clue; although not drastically changed, it is low enough to suggest further checking in grid circuit. However, leaky C2, as in Symptom 3, could be the fault. Actually, scope proves lowered bias on V1A is result of low-amplitude input signal, which has no sync pulses. R2 and C1 are part of timing and coupling network located in M1; with C1 open, sync pulses are greatly attenuated and never reach grid of V1A. Replacement of M1 is necessary.

***Best Bet:** Tracing with scope pinpoints trouble.*

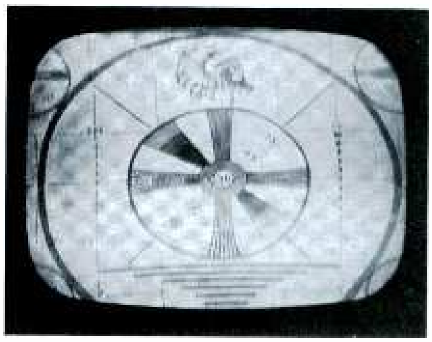
SYMPTOM 5

Vertical Jitter

Horizontal Normal

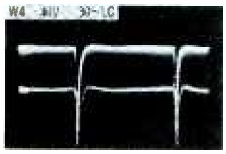
C5 Open

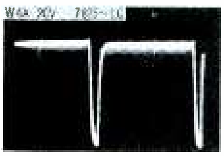
Symptom Analysis



Vertical circuit in this set is normally very stable. Jitter on screen, then, isn't as noticeable here as in some sets. "Nervous" condition comes and goes—picture jitters, then stops. Trouble could be in vertical stage or caused by improper sync triggering oscillator.

Waveform Analysis





W2 (not shown) appears okay, so separator is working normally. W2 is always a good starting point for tracing sync problems in circuit of this type. Amplitude of W4 is okay, but something has been added—note low-amplitude signal riding between vertical sync pulses. W4A, taken at 7875 cps, proves extra signal in W4 is horizontal sync pulses with 20 volt amplitude.

Voltage and Component Analysis

No Voltage Clues

Since W4 appears normal at first glance, and all DC voltages are okay, tendency is to move directly to vertical section. However, with sync stages it's always a good idea to stop and check each waveform very closely. If important clue of contamination in W4 were overlooked, or scope check at this point omitted, much time might be lost hunting for trouble in vertical circuit. C5 is important component to integrator network, and is necessary to keep horizontal pulse from reaching vertical circuit. Horizontal pulse of this amplitude in some receivers might produce a constant vertical jitter, or cause a complete loss of vertical sync.

Best Bet:* *Waveform analysis spots this trouble.

SYMPTOM 6

Loss of Vertical Sync

Horizontal Pulling

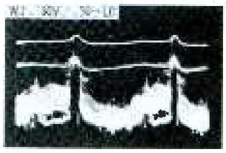
R5 Decreased in Value

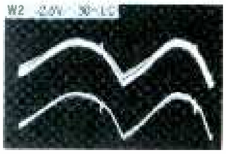
Symptom Analysis

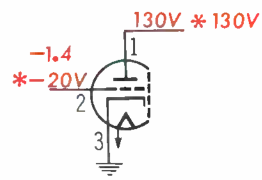
Vertical has slow roll and can't be locked in at all. Hold control is operative—can change direction of roll. Horizontal pulling also appears, and horizontal sync is lost when weak fringe-area signals are tuned in. Horizontal hold control operates, but action is critical.

Waveform Analysis

Good composite video signal and acceptable amplitude of 45 volts in W3 (not shown) rules out trouble in video stages. W1 is normal, so all signal paths to this point must be okay. Odd waveform at W2 indicates video signal on grid of V1A is failing to pass through separator stage. There are no sync pulses in this waveform; only random noise and hum appear.







Voltage and Component Analysis

Best voltage clue to this trouble is extremely high B+ on plate of V1A. Full source voltage is present, and doesn't vary with or without signal. Voltages on grid remain normal, so plate voltage hasn't risen as a result of cutoff bias. B+ for separator is determined primarily by divider network R6-R5. Prolonged operation with R5 at such low resistance (2200 ohms, in this case) would probably damage R6, too. On the other hand, if R6 opens and R5 remains good, sync operation would remain almost normal. The big difference in that case would be apparent in amplitude of W2—it would increase from normal 40 volts to large 75 volt amplitude.

Best Bet:* *Voltage measurements are sufficient.

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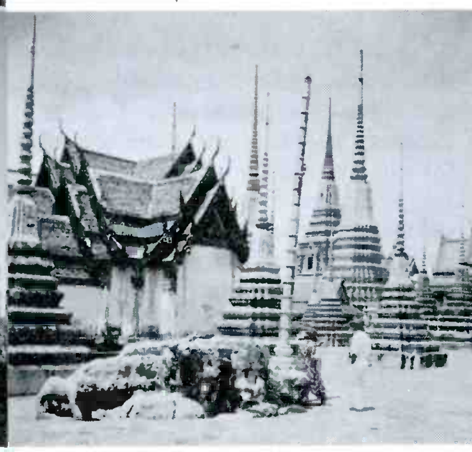

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Servicing TV with VTVM or VOM

The array of test equipment on the servicing bench of most shops is impressive indeed. Fancy dials and chromium-plated lights dress up the many multipurpose instruments which now save the time of the technician and make his job easier.

But in almost every service shop, the instrument that receives constant use is the VOM or VTVM. This is especially true with the old timers who spent years of servicing without a scope or any other modern refinements in test equipment. Veteran technicians will tell you that, when full use is made of it, a VOM or VTVM can handle most TV servicing jobs without any help from its more sophisticated contemporaries. And they are right.

If speed of service is not the most important factor, or if other instruments aren't available (such as on a home service call), the VOM or VTVM can usually solve the problem if used expertly. Let's review a few actual case histories and see how a VTVM (or VOM) can be used to best advantage. We will also see some instances in which a VTVM simply can't provide conclusive evidence of trouble by ordinary methods. And further, we'll discuss means of getting around these drawbacks. One factor you'll discover is that you should be well versed in circuit operation to understand these techniques thoroughly and use them easily.

Raster Okay

In the first case, raster was okay, but video and sound were missing. The most common cause of this, other than tubes, is loss of plate or screen voltage in an IF or the tuner. It is a quick matter to check DC voltages at all these points with the VTVM or VOM, and in about 60% of the cases an incorrect voltage will be found. This should not take more than a few minutes, especially if 7- and 9-pin tube adapters are used to facilitate checking from the top of the chassis. An unusually high voltage indicates that the tube is not conducting, probably because of an open cathode resistor or a high negative bias on the control grid. Low or no voltage means a faulty plate (or screen) resistor or coil, or that bias is too positive.

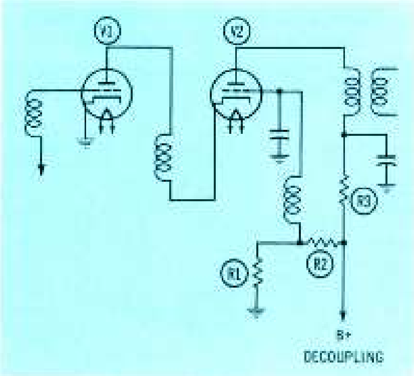

Fig. 1. In cascode circuit, V1 plate voltage will be missing unless tube V2 is operating.

Technicians frequently choose the ohmmeter function of the VTVM (with the set off) to check from cathode to ground rather than measure cathode voltage, because a live tube draws current through the meter and gives a false indication. The ohmmeter gives positive proof of the condition of the cathode resistor or ground connection.

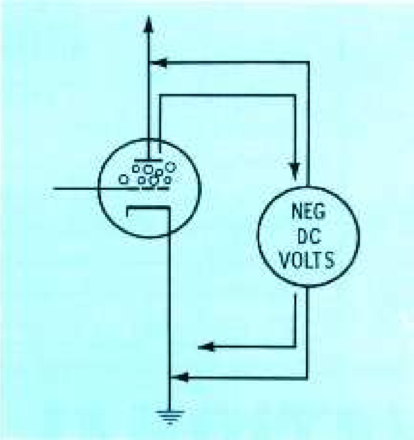

Fig. 2. If B+ path to plate is open, voltage on VTVM may read in the negative direction.

When the tuner is the cause of missing video, open decoupling resistors in the plate circuits of the RF amplifier, mixer, or oscillator can be spotted at once by noting missing plate voltages. It is easy to measure these voltages from the top of the tuner; but it is especially important to do so with a good tube in the socket, so an adapter should be used. Fig. 1 shows the familiar cascode RF amplifier; the voltage on the plate of V1 depends on conduction through V2. If the tube were removed, there would be no voltage between the plate terminal of V1 and ground. This condition will cause much consternation to the technician who mistakenly assumes there is an open in the plate circuit and proceeds to disassemble the tuner.

Another point of confusion awaits the unknowing technician who measures voltage between the grid of V2 and ground. This is supposed to be a positive voltage slightly less than that on the plate of V1 and on the cathode of V2; thus the grid is negative with respect to its cathode. R1 and R2 set the grid voltage.

The operation of the oscillator in the tuner can be checked by measuring the grid-leak bias from the oscillator grid to ground. A VTVM must be used because of its high input resistance; an extra 1 megohm resistor at the end of the probe will help prevent loading the grid circuit and stopping oscillation. The exact voltage value is not important; any negative potential at this point is a good indication of oscillation. An old trick used by many servicemen is to touch the grid terminal with a finger while taking the reading; if

See just how valuable these instruments are for troubleshooting.

by EDWARD F. RICE

the voltage drops, you can be sure the grid-leak bias was resulting from oscillation.

Raster and Sound Good

Loss of video due to an open peaking coil in series with the video amplifier plate can be found quickly with routine voltage checks. Sometimes, when the connection from B+ to plate is open, the meter will read a few volts negative at the plate because of the space charge in the tube (see Fig. 2). Some video amplifiers have screen resistors that must be checked.

AGC Faults

When video overload and unstable sync seems to be worse on stronger channels, or the picture is improved when one side of the antenna lead is removed, an efficient "VTVM" technician replaces the RF, IF, and AGC tubes, and then proceeds to tests that will isolate the faulty section as quickly as possible. With the VTVM connected to the source of AGC voltage, the receiver is switched from an active channel to an inactive one. A reduction in negative AGC voltage indicates that the AGC system is working and the fault must be elsewhere. However, no change in the AGC voltage means the entire AGC system will have to be checked. A positive voltage indicates that B+ may be reaching the AGC line through the coupling between two IF stages, via the delay (or bucking) resistor, or from some other source —unless the set is one of those using "positive" AGC (see June, 1963, *Symfact*).

Interstage coupling leakage can be checked by removing the tuner and IF tubes and opening the ground end of the secondary of the suspected IF transformer. The VTVM, set on a low DC scale, is used to see if there is any slight positive voltage on the secondary. Fig. 3A illustrates the method; Fig. 3B shows how it can be done when capacitive coupling is used. This method works equally well in sets using series filaments because B+ is present even with the tubes removed.

If there is no voltage at all on the AGC line, the entire network can be checked with an ohmmeter for a shorted bypass capacitor. In simple systems, battery bias can be connected to the line as shown in Fig. 4 and the voltage checked at various points throughout the system; it is sometimes most convenient to do this with the receiver turned off.

In sets using keyed AGC, trouble in the stage will be suspected when the application of battery bias to the AGC line (clamping) produces normal operation. The AC function of the VTVM can be used to check for horizontal pulses at the keyed AGC plate. The voltage reading, though not accurate at the horizontal pulse frequency, will indicate the presence of pulses. The pulses should be about 500 volts peak to peak; if the AC scale has rms calibration, it will read about 125 volts.

No keying pulses at the AGC tube leads to an ohmmeter check of the capacitor or resistor leading back to the horizontal section where the pulses originate. If normal keying pulses are present at the AGC stage, the DC voltmeter can be used at the screen and cathode of the keyer tube. One grid is also fed with video information, and its presence can be detected with the AC section of the VTVM.

No Vertical Deflection

The first step in analyzing the vertical stages using only a VTVM

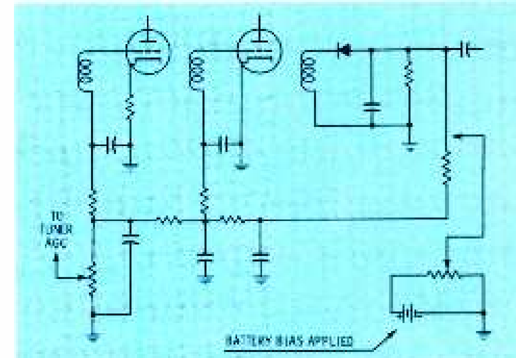

Fig. 4. External bias voltage can be applied to AGC line and test made with the set off.

is to make sure there is drive signal at the grid of the output stage; the AC voltmeter will give indications, but not in peak-to-peak values, because the waveform is not a sine wave. If drive is okay, the trouble is in the output circuit. The AC meter cannot be used directly at the plate of the vertical output tube because the peaks there are very high. It is necessary only to set the voltmeter to a high scale and clip the probe to the insulation of the plate lead. Then decrease the scale setting one step at a time until the presence or absence of the signal is apparent.

If no vertical deflection signal is present on the output plate, but drive signal appears at the grid, it is clear the output stage has failed and not the yoke. DC voltages can be checked, and you can make an ohmmeter check of the cathode circuit.

The ohmmeter will also check the yoke. You can disconnect one vertical yoke lead so separate tests can be made of the transformer secondary and the yoke winding, as shown in Fig. 5.

No drive signal at the grid of the vertical output tube indicates trouble in the oscillator section. If the combination multivibrator-output circuit is used, component checks are usually necessary. A defect in the

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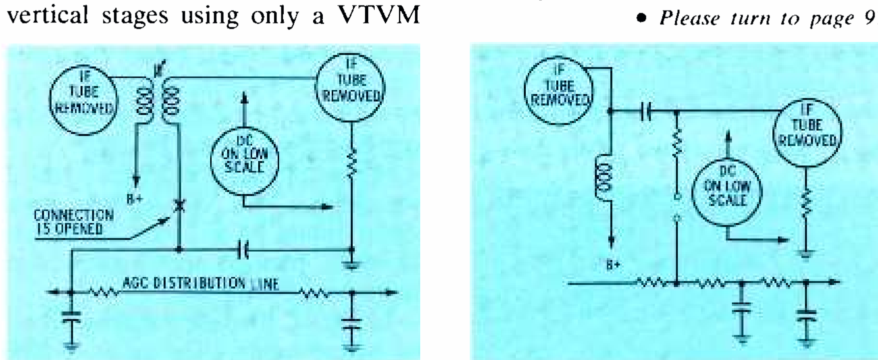

(A) Transformer coupling (B) Capacitive coupling

Fig. 3. Methods to measure interstage leakage.

DC Scope for Quick

by John D. Lenk

Are you planning to buy a new scope? If so, you probably have been reading specification sheets for the host of oscilloscopes available on today's market. If you have read these sheets carefully, you probably have noticed "DC scopes" having a response which is flat from zero frequency to some specified upper limit. Such scopes have DC coupled vertical amplifiers, without coupling capacitors. However, many DC scopes can be used as ordinary AC-coupled units; you merely switch a capacitor in series with the input, to keep out DC voltages.

You may have noticed also that DC scopes are usually priced higher than AC scopes having similar features. Too, since DC scopes require more expensive basic circuitry, they often have extra features that further increase their capabilities—but also the cost. But, are they basically better than AC scopes? The answer to this question is not a simple yes or no; it is difficult to compare AC and DC scopes on a side-by-side basis.

The obvious test would be to compare waveforms on each of two similar scopes—one an AC type and the other DC. Another way to compare is by making the tests with a "combination" scope, one that uses DC-coupled vertical amplifiers but can be switched for an AC (capacitor) input. With such an arrangement, we could observe a given waveform in the DC mode, and then switch to AC to observe any appreciable change in the scope presentation.

We took some photos of waveforms on such a scope, to show the difference in AC and DC patterns. In some cases, the waveforms were doubly exposed on the same print, while in other cases the no-signal trace was exposed to show a voltage reference (zero) point. The scope and camera controls were not touched in the changeover from DC to AC, except when it was necessary to reposition the trace vertically to show the entire presentation. Typical sine waves, sawtooth signals, and square waves were photographed in the AC and DC modes, and here is an analysis of the resulting photographs.

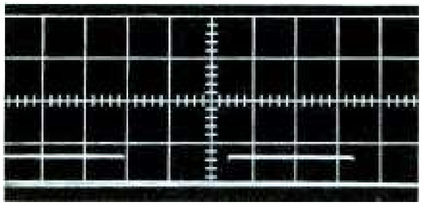

Fig. 1. Scope is switched to AC coupling.

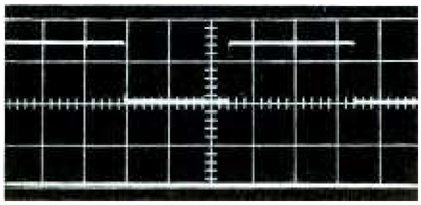

Fig. 2. DC coupling shows a 2 volt DC level.

Simultaneous Measurements

One obvious advantage of a DC scope is that with it the DC level in a circuit can be measured simultaneously with the signal voltage. As an example, assume that you want to measure and study the signal at the input grid of the horizontal output tube, and at the same time measure the DC level at that grid. With a straight AC scope, you must use a meter for the DC level, and then use the scope to check the drive signal. With a DC scope, the trace (showing the signal waveform) will be deflected vertically by an amount corresponding to the DC level.

As an example, in Figs. 1 and 2 we show a 1.5 volt square wave signal riding on a 2 volt DC level. In both photos, the bottom line represents zero volts.

In Fig. 1, the scope was switched to AC coupling. The positive *half* of the square wave appears to be .75 of a division above the zero reference line, indicating that the full square wave is 1.5 volts in amplitude. We could position the complete square wave so its top or bottom lines up with the reference line, and still make an accurate measurement of 1.5 volts. However, we want to show that the square wave starts at zero and goes in both directions.

In Fig. 2, the entire square wave trace has moved up 2 divisions, indicating a 2 volt DC level; but notice that the square wave still covers 1.5 divisions, indicating a 1.5 volt signal. It can also be seen that the peak is 3.5 divisions from the bottom, indicating that positive peaks reach 3.5 volts above zero.

Zero Voltage Reference Line

Another important use for a DC scope is to establish a zero reference point quickly and easily. Assume that you want to measure a sawtooth waveform which has a peak-to-peak amplitude of 25 volts, and which starts from exactly zero volts and rises to 25 volts positive. Both the AC and DC scopes will permit you to measure the 25 volts peak-to-peak value, but the AC scope will not tell you whether the vertical rise starts at zero or at some DC reference

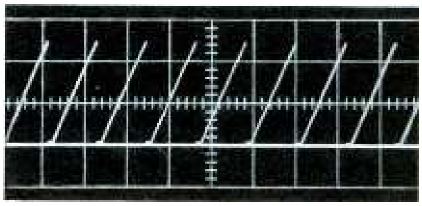

Fig. 3. Entire sweep is above zero reference.

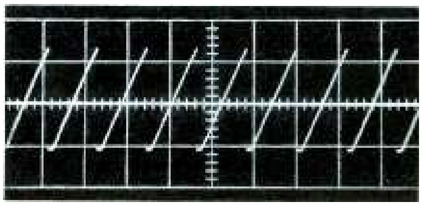

Fig. 4. Sweep centered around zero reference.

Analysis

level; further, it won't tell what the true peak voltage is.

Figs. 3 through 6 show a sawtooth sweep which starts exactly at zero, dwells there for a short time, and then rises to a peak of 25 volts.

In Fig. 3, the DC scope is set for 10 volts deflection for each vertical division, with the zero reference at the second grid from the bottom. The trace starts from the reference line (indicating that it starts at zero volts) and rises 2.5 divisions (indicating that the peak-to-peak value is 25 volts).

In Fig. 4, all settings are the same, except that the scope is set for AC, and the reference line was moved up (with vertical position control) to the center line so the entire waveform could be seen. As before, the trace covers 2.5 vertical divisions to show the 25 volt peak-to-peak value, but there is no indication that it starts from zero. Not knowing just where true zero is, you might assume that zero is at the center (reference) line; this could

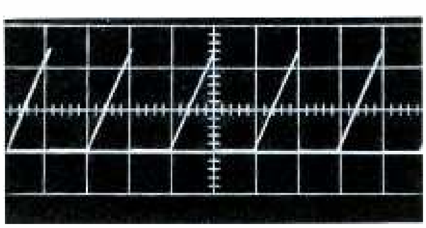

Fig. 5. On DC, trace again starts at zero.

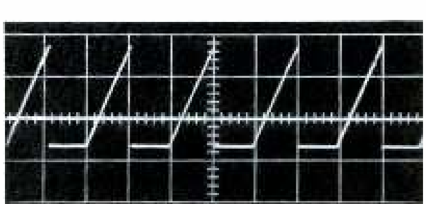

Fig. 6. Trace centered about average voltage.

lead you to also assume (incorrectly) that the sweep starts at 11 volts negative, and rises to 14 volts positive.

Figs. 5 and 6 show what happens with even a slightly different waveshape. In Fig. 5, the scope is returned to DC, the no-signal (zero reference) trace has been returned to the second line from the bottom, and the input signal is a little different in shape—there are now two divisions *between* sawtooths, indicating more "resting" time between sweep cycles. On DC, the trace again starts from the reference line (zero volts), and rises 2.5 divisions (still 25 volts).

In Fig. 6, all conditions are the same except that the scope is again set for AC, and the zero line moved up to the center grid. The signal trace appears the same—2.5 vertical divisions—but there is no dependable zero reference, since the input capacitor blocks DC from the scope.

Compare Fig. 6 with the presentation in Fig. 4, and you will see that the entire signal trace is in a different position. If you were to assume that the center line is *true* zero, the sweep seems to start at about –7 volts, and rise to about +18 volts. The reason for the difference between Figs. 4 and 6 is that, when AC coupling is used, the signal trace will always center itself about the *average* of the waveform voltage. This makes it even more difficult to establish a true zero point with an AC scope, since the trace will reposition itself with changes in waveform shape. In other words, one-half the *effective* voltage of the waveform will always fall above the no-signal trace line, and the other half will fall below. Compare the *areas* bounded by each portion of each waveform, and you can see this effect quite easily.

No Waveform Distortion

Another advantage of a DC scope is its relative freedom from low frequency waveform distortion. This distortion may be observed whenever a waveform of long time duration (low frequency) is displayed on an AC scope. This is caused by the nonlinear charge and discharge rates of capacitors used in the vertical amplifier stage. Of course, there are certain waveforms in which this distortion is not objectionable, and at higher frequencies it is not readily apparent. But in an AC scope, some degree of this distortion always exists, especially at low frequencies, and it can be a problem when faithful reproduction of waveforms is necessary.

In Fig. 7, the scope is set for DC, and a low-frequency (about 5 cps) square wave with a very short "rest" period is being fed to the vertical amplifier. Its amplitude is approximately 30 volts. The trace starts from the reference line (indicating zero volts), remains at zero for a few milliseconds, rises 3 vertical divisions (30 volts), and remains positive for a considerable time.

In Fig. 8, all conditions are the same, except that the scope is set for AC, and the trace is repositioned to show the entire presentation on the screen. Although amplitude and pulse duration can still be measured accurately, there is obvious distortion of the waveform.

This distortion is caused by the coupling capacitor that must be charged and discharged to pass each square wave pulse. If the waveforms were short in duration (a few microseconds) as are high frequency signals, they would use only a short portion of the capacitor charge-discharge curve, and would appear

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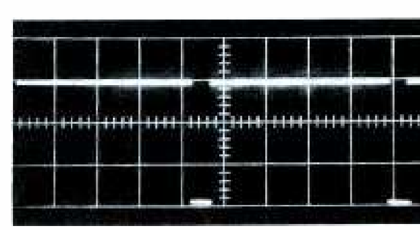


Fig. 7. On DC, a square wave looks square.

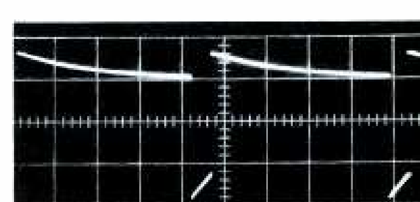
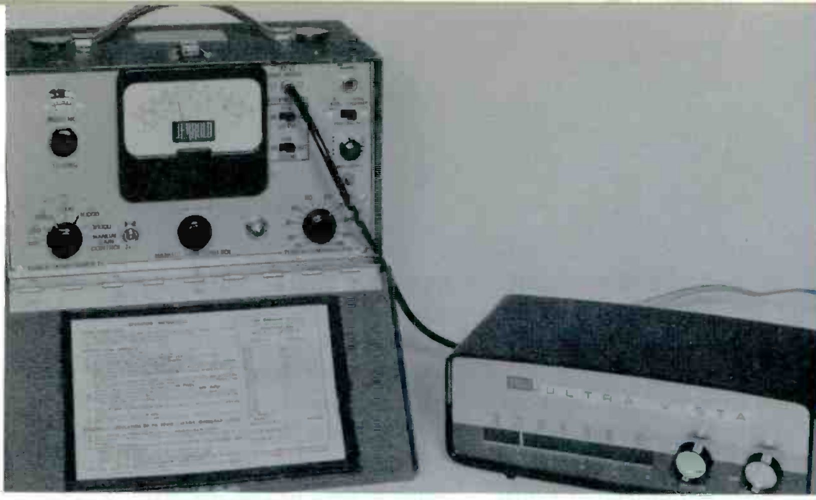
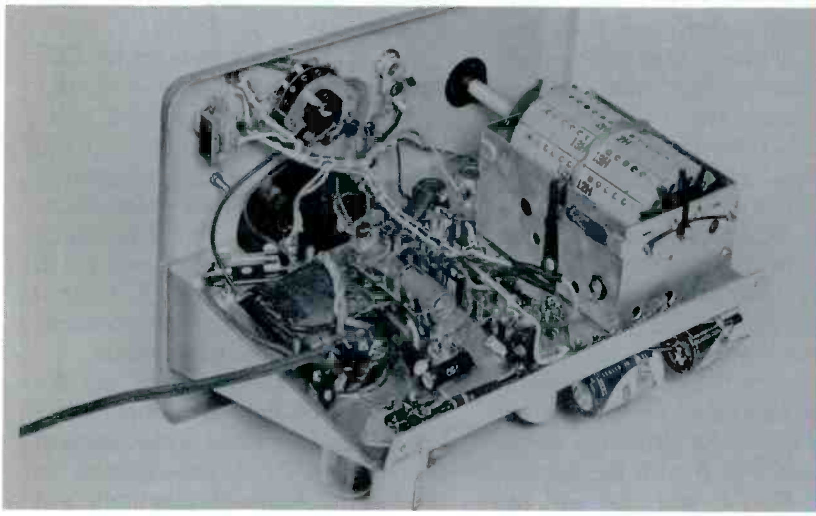


Fig. 8. AC coupling shows obvious distortion.

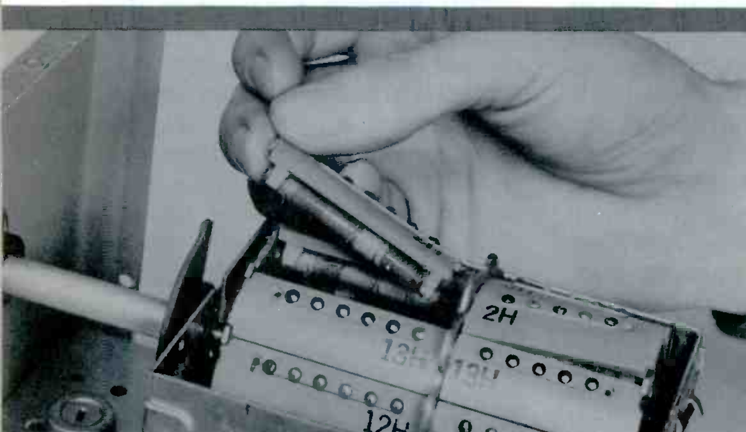


If your VHF FSM isn't easily convertible, connect the UHF antenna to a UHF-to-VHF converter and the converter output to the VHF FSM.

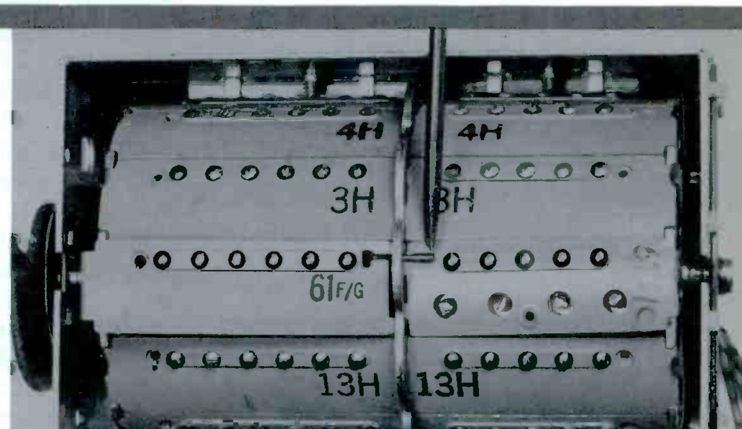


A VHF field-strength meter with a drum tuner that has individual channel strips is easily converted to UHF by installing UHF strips.

converting



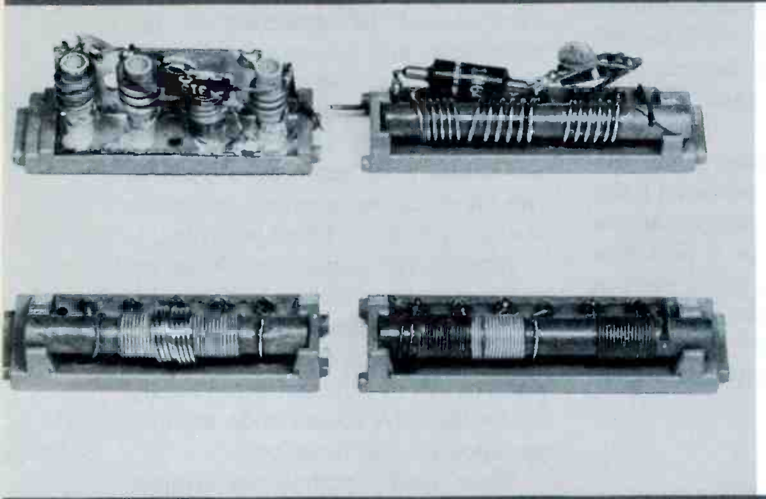
To make room for the UHF strips, remove the coil strips of an unused VHF channel. They are held in place by the tuner spring clips.



Here you see UHF channel strips ready to be snapped in place. A pin fits through a slot in the tuner and connects the two strips.

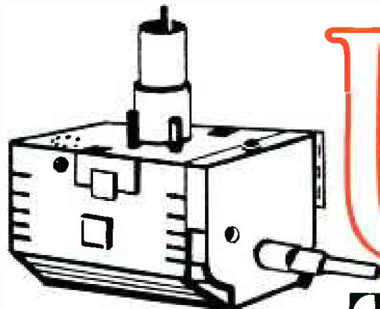
This feature shows how you can equip your shop with a field-strength meter for measuring UHF TV signal strength. By far the least expensive method is to convert your VHF unit to UHF. By so doing, you eliminate the cost of an entirely new instrument, and the converted FSM will work for both VHF and UHF

FSM's for UHF

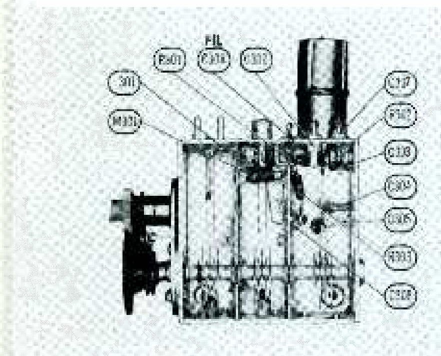


UHF strips (top) contain mixer diode (left), and oscillator frequency multiplier (right). VHF coil strips are shown at the bottom.

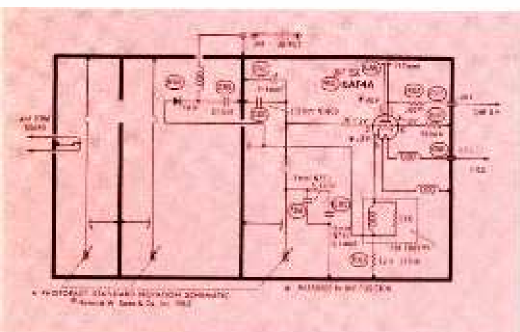
Shown here is a new field-strength meter that measures either VHF or UHF TV channel signals by just a flip of the function switch.



UHF TUNERS



(A) Pictorial view



(B) Schematic

Fig. 1. A three-section tuning capacitor is used for station selection in this UHF tuner.

With the recent announcement that all TV sets produced after April, 1964 must provide for receiving UHF stations, it is expected that UHF stations will soon begin operation in many areas. Quite a few technicians will be servicing UHF tuners and converters for the first time, and UHF frequencies present problems that are different from those most technicians are accustomed to working with.

First, let's get our terms straight. UHF *tuners* convert the UHF signal directly to the IF frequency of the set, and *converters* convert the UHF signal to a VHF signal, usually channel 5 or 6. Converters can be inside the set, or they can be "outboard" in a separate cabinet; tuners are always built in. Of course, one section of the converter is a tuner; only the oscillator frequency differs from set tuners.

Major Designs

Over the years, since UHF was first introduced, many different methods of tuning have been tried with varying amounts of success. Fortunately, in the last four or five years the industry has pretty well settled on two basic tunable designs, plus the use of UHF channel strips. Since strips involve no service problems and are easily replaced, we will discuss the two tuned designs—the capacitor end-tuned tank and the parallel line.

The most widely used tuner design is the capacitor end-tuned tank; an example of this design can be seen in Fig. 1. This type is presently used mainly in sets as a built-in tuner, although several external converters used this design. This design has very good sensitivity and stability when properly aligned.

The other basic design uses parallel lines, tuned by a movable shorting bar. A schematic of this design can be seen in Figs. 2 and 3. This type of tuner is used mainly in external converters, although one major manufacturer uses it as a built-in tuner. This design is also very stable when properly built, and is quite easy to align.

Practically all modern UHF tuners and converters use a special UHF tube for the oscillator and a special UHF crystal for the mixer. Same manufacturers are introducing new tuners this year that use transistors and nuvistors in their circuits. We'll discuss them when they start appearing in sets regularly.

Be Careful

Several words of caution are needed before you attempt to service UHF tuners or converters. Extreme care should be exercised in the movement and placement of parts, because stray capacitance causes lead length and position to be very critical at UHF frequencies. It is advisable, when replacing a part, to use an exact replacement and place it exactly in the original position.

Most UHF tuners are built by companies specializing in this field, so parts may often be obtained from more than one source; simply compare tuners in different sets visually or by the EIA source-code number stamped on the tuner case.

Since lead length is so critical, many parts—especially capacitors—have no leads at all. Disc and tubular capacitors may be attached directly to tube socket pins and to other parts by soldering directly to the surface plating of the capacitor. (This type of construction makes these small capacitors extremely susceptible to physical damage, so

Table 1
Preliminary Tests for UHF

1. Replace the UHF oscillator and preamp tubes, if necessary.
2. Replace the UHF mixer crystal (or tube). In most tuners and converters the polarity of the diode is unimportant; in a few, a small bias current is applied to the crystal, and polarity makes a world of difference. Turn it for least snow.
3. Be sure the correct filament and plate voltages are supplied.
4. Check the UHF-VHF changeover switch.
5. If a preamp is attached to the tuner or converter, make sure it is operating.
6. Check the VHF tuner. Problems that occur only in the UHF position of the tuner will not affect VHF reception. (Substituting an external converter might thus mislead a technician into thinking the UHF tuner was at fault.)
7. Be sure there isn't an antenna problem. This is quite frequent in UHF areas.

inside & out

Facts you'll need to know . . . soon!

by Clayton Volz

great care must be used when removing or inserting the oscillator tube in its socket; undue wiggling of the tube can easily break the capacitors or pull the plating loose.) When replacing capacitors of this type do not overheat them, or the plating will burn off.

Quite often, small pieces of wire, fixed metal plates, or tabs and short loops of wire are used as "gimmick" capacitors for injection circuits and alignment adjustments. Consequently, do not clip off "loose" wires or move them around unless you are sure of their purpose.

When you are called upon to service a set with a UHF reception problem, take time to make a few checks before tearing into the UHF tuner or converter. Table 1 shows these preliminary tests.

Servicing Mechanical Faults

One of the most common problems with UHF tuners or converters of both basic designs displays itself when the tuner or converter is tuned. This condition shows up as flickering, flashing, shifting of frequency, or complete cutting out when trying to tune in a UHF station, and is caused by poor or dirty contact between the wipers and rotor shaft, or between the shorting-bar wipers and the parallel lines. In some cases, applying a small amount of a liquid contact cleaner to the wipers and working the tuner back and forth will correct this problem. However, in more drastic cases additional steps are needed.

If this problem is severe in a capacitor end-tuned unit, remove the wipers and clean any old oil and grime off the wipers and the rotor shaft. A regular pencil eraser does a good job of polishing the contact surfaces. If the wipers have lost pressure against the rotor, re-tension them by *carefully* adding a little more bend. Re-install the wipers and solder them securely to the chassis; then put a little nondrying tuner lube between the wipers and shaft (work the tuner back and forth to distribute the lube).

For this same problem in a parallel-line unit, clean all the old oil and dry lube from the lines and wipers, and use a piece of pencil eraser to polish the contact surfaces.

Table 2
UHF Oscillator Faults

Fault	Cure
1. Poor contact between wipers and parallel lines or between wipers and capacitor rotor shaft.	Clean, lube and tension wipers.
2. Tube socket pins spread.	Tighten socket pins.
3. Plating pulled loose on small capacitor attached to tube socket pin.	Use exact replacement.
4. Poor solder connections on tube socket pins.	Resolder connections.
5. Poor connection between chassis and metal ring of tube socket.	Solder metal ring to chassis.
6. Tuner cover plates missing or not making good contact to chassis.	Replace or correct poor contact.
7. Drop of oil or other foreign material between plates of end-tuned capacitor.	Clean and remove oil or other material.
8. End-tuned capacitor stator plates shifted in position.	Recenter stator to rotor plates with appropriate shims and secure in position by resoldering stator or tank to mount.
9. End-tuned capacitor rotor loose.	Recenter rotor by use of adjustable thrust bearing and secure.

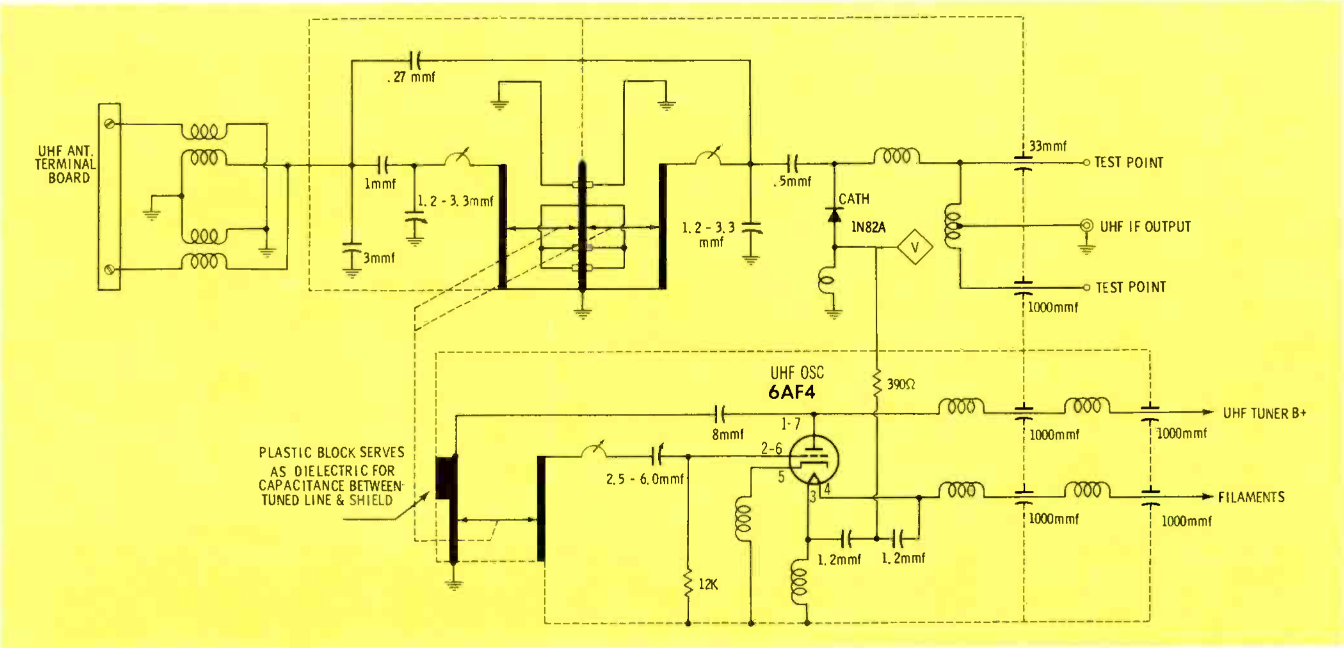


Fig. 2. Parallel-line tuning characterizes the units used mostly in external-type converters.

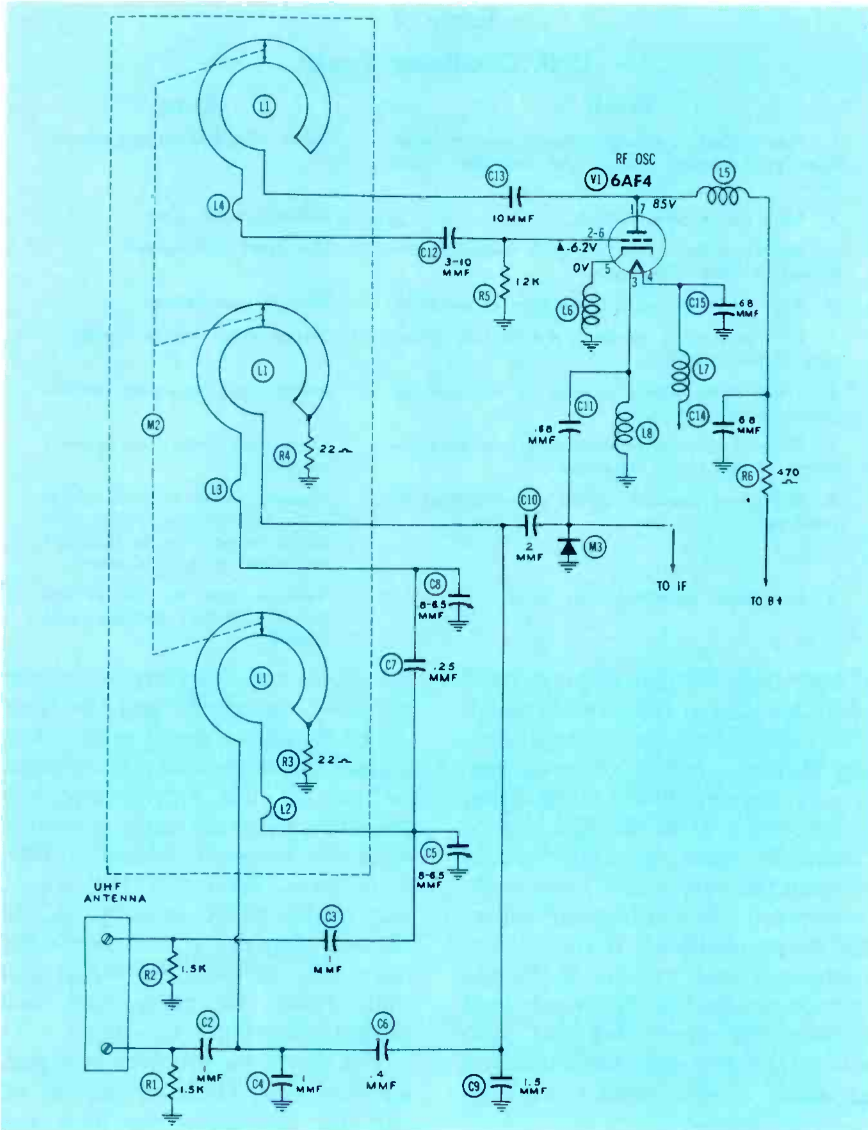


Fig. 3. *Inductuner is a form of parallel-line tuning used in many older outboard converters.*

If the wipers have lost their pressure against the lines, re-tension them by spreading them apart very carefully. A small amount of nondrying tuner lube worked back and forth between the wipers and parallel lines will complete the job.

Electronic Troubleshooting

Once you are certain the UHF tuner or converter is the source of trouble, attack the problem logically by determining if the oscillator, mixer, or RF and antenna stage is at fault. As most UHF problems occur in the oscillator circuit, it would be wise to start there.

Oscillators

Most UHF tuners and converters have a feed-through capacitor or tie point to carry plate voltage to the tube. This is a convenient point to determine whether the oscillator is functioning. Connect a voltmeter, set for the 250 or 300 volt range, between this point and chassis. As you turn on the set, observe the voltmeter. If the oscillator is functioning, within 15 to 30 seconds you will see the voltage fall quite low and then kick back up as the oscillator starts. In tuners using a 6AF4 or similar tube as the oscillator, the voltage at the tie point will usually be between 50 and 90 volts unless the dropping resistor is inside the tuner.

With your voltmeter still connected, tune slowly across the whole UHF band, watching the voltmeter as you tune. Any serious dips in voltage should be regarded with suspicion; make a mental note of the *lowest* voltage as you tune across the band. Next, kill the oscillator by touching the tuned circuits or by grounding the control grid. The voltmeter reading should drop as much as 40 volts if the oscillator was working.

Sudden or large dips in voltage while tuning can be caused by poor wiper contact, defective parts, shield plates not in place or making poor contact, tube shield not in place, oscillator tube off tolerance or wrong type (try several new ones), or misadjustment of the oscillator circuit.

Some tuners and converters have gimmicks to adjust for proper oscillator operation across the band. These gimmicks sometimes take the usual form of short lengths of insulated wire twisted together; other types may be small metal plates (on the tank) that may be bent toward or away from the chassis, or short lengths of heavy wire that may be bent toward or away from the tank circuit. These gimmicks are adjusted to make the oscillator reading as flat as possible across the whole band. At a voltage dip point, adjust them for an increase in voltage; then recheck across the whole band and if necessary, compromise the adjustment for flat tracking.

If in this check you should find the oscillator not functioning, intermittent, or shifting in frequency, make a good visual check of the stage. Some of the more common problems and solutions are shown in Table 2.

Mixer

If the oscillator circuit is working normally and at the correct frequen-

• *Please turn to page 100*

Table 3
RF Troubles

Fault	Cure
1. Poor contact between wipers and lines or wipers and shaft.	Clean, lube, and tension wipers.
2. End-tuned capacitor stator plates shifted in position.	Recenter stator to rotor plates with shims and secure in position by resoldering stator or tank to mount.
3. Drop of oil or other foreign material between plates of end-tuned capacitor.	Clean and remove oil or other material.

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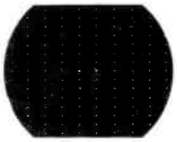
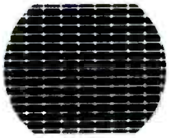


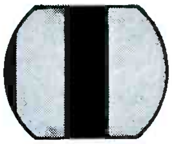
Dot Pattern



Crosshatch

Vertical Lines

Horizontal Lines



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Circle 13 on literature card

two way talk

Field Servicing TWO-WAY RADIO

by LEO G. SANDS

For field servicing two-way radio, certain pieces of test equipment are indispensable to the technician. Unlike the permanent test setup in the shop, this test equipment must be portable. This does not mean it is handheld, but that it can be moved easily from one location to another. Some manufacturers have built battery powered test equipment that is both light and rugged. Others rely on the ingenuity of the technician to transport the instruments and provide power for them under field conditions. This can be done by using a portable gasoline generator, or a DC-to-AC inverter working off the auto battery.

Frequency Adjustments

The overall performance of a two-way radio system depends a great deal upon proper *netting* of all receivers and transmitters. This is done by first setting the base station transmitter precisely on frequency—as measured by an accurate frequency meter. All the system receivers are then zeroed to the base transmitter frequency.

As shown in Fig. 1, the frequency of a mobile receiver can be checked by metering the discriminator output, provided the discriminator has been "calibrated" exactly to the center frequency of the last IF. The local oscillator is adjusted for a zero meter reading while the set is receiving an unmodulated signal from the base. The meter should be a DC VTVM with zero center.

A meter is not normally required to adjust the frequency of a receiver employing a gated beam FM detector (Fig. 2). The quadrature coil, and then the oscillator, is tuned for maximum undistorted sound output. For more precision, however, the base station can be modulated with a tone, and maximum audio output measured by an AC voltmeter across the speaker voice coil.

Measurement and adjustment of mobile transmitter frequency can be done in the field with a portable battery-operated frequency meter, or an AC-operated meter powered by a DC-to-AC inverter.

Field-Strength Tests

The transmitting antenna and final RF power amplifier must be tuned and impedance matched so maximum power is radiated by the antenna. Some technicians make these adjustments while monitoring final plate or cathode current, tuning the final amplifier for a dip and adjusting the antenna trimmer for rated load (input power). Others use a field-strength meter placed some distance from the antenna. The output circuits are then tuned for maximum radiated field strength. This technique is most effective if the meter is located some distance away, but this might necessitate an observer at the meter and some means of communication between the observer and the technician doing the tuning.

RF Power and SWR

A more convenient way to tune the final and antenna is to use a bidirectional in-line RF wattmeter. This instrument connects in series with the antenna system (Fig. 3). Both the final amplifier trimmer and the antenna trimmer are tuned to obtain a maximum meter reading (within the final's rated plate current limit) when the instrument is set to indicate forward power. When it is set to indicate reflected power, the unit measures the amount of power *not* radiated by the antenna. Comparing forward and reflected power, you can arrive at the standing wave ratio; some instrument scales are calibrated in SWR as well as watts. Table I shows the relationship between reflected power and SWR.

Failure to get a low SWR reading (1.5:1 or less) is usually an indication of mismatch between the transmitter and coax or between the coax and antenna. In some cases, the antenna length may be incorrect. It may be necessary to "prune" the antenna radiator until the optimum SWR point has been reached; if the antenna is too short, a longer one

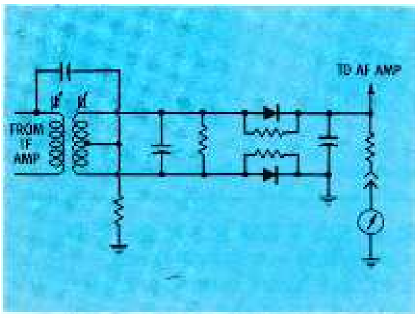

Fig. 1. Receiver frequency is metered by measuring the discriminator output with a VTVM.

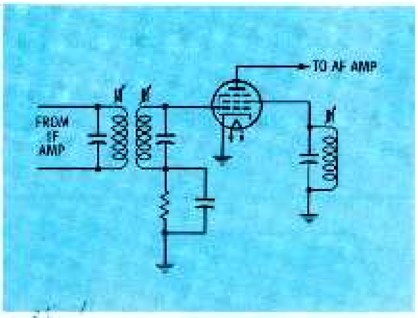

Fig. 2. With this detector, the receiver frequency is measured by listening to the audio.

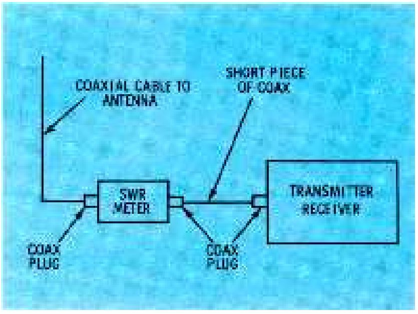

Fig. 3. An in-line wattmeter can be placed in series with the final amplifier and antenna.

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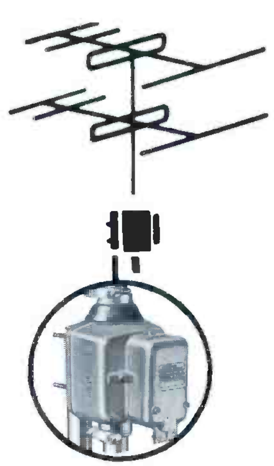

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may have to be installed and pruned to the correct length.

Checking Modulation

Quite often, garbled or weak audio at the receiver is the result of over or under modulation in the transmitter. Overmodulation will not only cause garbled sound, but may cause interference on adjacent channels.

The best method of checking the modulation of the transmitter is by use of an FCC-approved modulation meter, such as that shown in Fig. 4. This particular meter is portable in that it has self-contained batteries and can readily be transported into the field without need for AC power. Some such instruments have several uses: They are a frequency meter for measuring transmitter frequency; they can measure modulation; and they generate accurate RF signals suitable for aligning the receiver.

RF Signals

A signal generator, equipped with an accurate attenuator to measure receiver sensitivity, is essential to any two-way radio setup—and field servicing is no exception. True, it is easier to check the unit in the shop, but this is not always accurate, since the radio may operate under conditions far different from those on the workbench.

For field work, you need not have a generator with a very high output; something on the order of 100 uv is plenty for most purposes.

Circuit Testing

Several models of two-way radio are equipped with pin jacks for plugging in an external voltmeter. These are for monitoring key test points in

Table 1

SWR vs Power

SWR	Percent of Reflected Power
1:1	0 %
1.2:1	10 %
1.5:1	20 %
1.8:1	30 %
2.3:1	40 %
3:1	50 %
4:1	60 %
5.5:1	70 %
9:1	80 %
13:1	85 %
19:1	90 %

both transmitter and receiver. In many units, sockets facilitate the use of special test meters to measure several circuits by means of a switch arrangement. One such instrument is pictured in Fig. 5. A test set like this is a real boon to the field technician because he needn't probe individual test points with a VOM or VTVM. He thus has both hands free to tune the set.

Measuring Battery Voltage

In mobile units, there is little you can do about unstable input voltage, except to report it to the customer for further action by his auto mechanic. Measuring the voltage at the

Fig. 4. Portable, multichannel frequency meters like this are excellent for field service.

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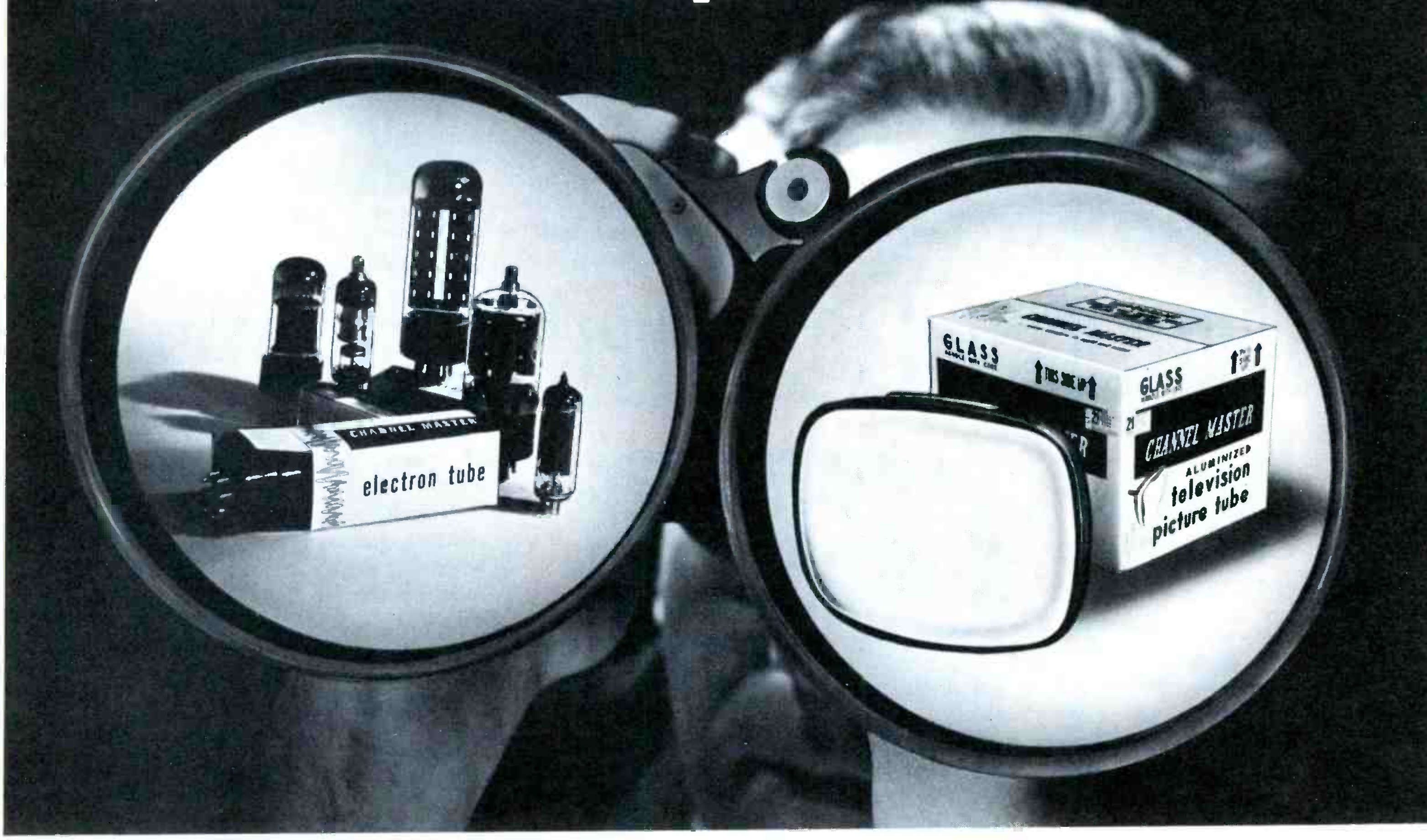

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battery terminals with an ordinary VOM or VTVM may not be conclusive, unless you measure while the battery is under load—such as with the two-way transmitter keyed.

If the voltage across a 12 volt battery measures higher than 14.4 volts with the engine running and the mobile unit turned on, you should let an auto electrician adjust the regulator. With the engine turned off, the voltage reading should not drop below 11.6 volts under load—except in very cold weather. If turning on the lights causes the voltage to drop, chances are the battery is defective and should be replaced or recharged.

Finding Noise

Noisy transmissions from a mobile unit sometimes occurs when ignition and other noise gets into the transmitter. The noise may enter through the power input leads or via the microphone cable. If the noise appeared suddenly, it could be caused by a broken microphone shield or other ground connection.

If the noise is absent when the engine is turned off, the trouble is not likely in the transmitter itself.

Fig. 5. A meter to be plugged into the several test receptacles on mobile two-way radios.

In any event, a sensitive oscilloscope connected between auto ground and the radio ground will indicate if there is a poor connection. If this test shows no noise, connect the scope ground to the radio ground and probe the various inputs (such as voltage, mike, and antenna) for noise.

Normal transmitting range and reduced receiving range, especially when sensitivity checks out okay, may be due to ignition or other vehicle-generated noise. This noise may not necessarily be audible, but may be RF noise desensitizing the receiver. Such noise can cause limiting action, making the receiver insensitive to weak signals. In an FM receiver, offending noise may often be rendered inaudible by the limiters, but still affect stages ahead of the limiters.

The problem of poor transmission and normal reception *can* be the fault of a defective antenna system, but this can be detected by measuring SWR with an in-line RF wattmeter as explained earlier.

Servicing Marine Two-Way

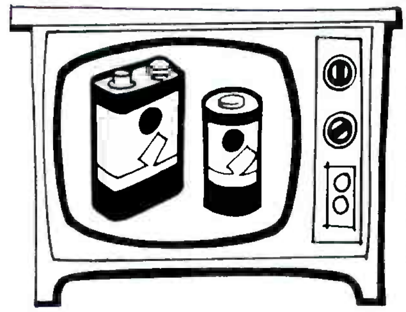
Heretofore, the mobile radio technician has been concerned mainly with field servicing of base stations and mobile units in cars, trucks, and trains. New FCC Regulations are causing the use of VHF-FM equipment on boats to expand at a rapid rate, and more two-way radio technicians will be making service calls on boats. While HF marine radiotelephones are normally serviced by marine radio specialists, many of these specialists are not yet equipped to service VHF-FM equipment.

A VHF-FM marine radiotelephone is similar to a land mobile unit except that it is equipped to

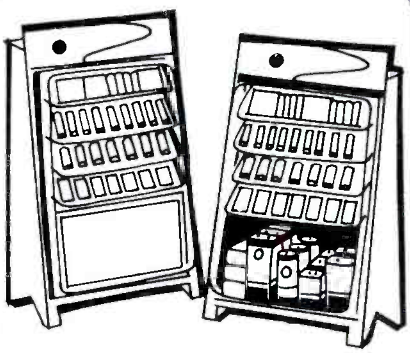
Why It pays you to stock and sell RCA Transistor Radio Batteries

1. A HUGE MARKET. Over 60 million transistor radios (more than 1-per-family) are in use today, assuring a continuing demand for the special types of batteries they require.

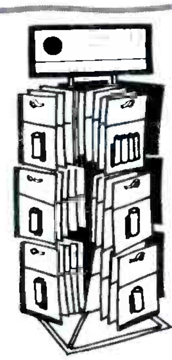
2. GET THE MOST OUT OF THE RADIO BATTERY BUSINESS with the *NAME* people associate with radio . . . *RCA*.



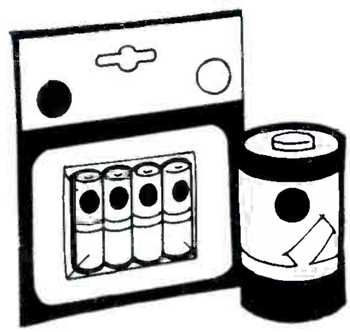
3. NETWORK TV ADVERTISING —on Walt Disney's "Wonderful World of Color" over NBC —brings sales messages for RCA transistor radio batteries into millions of TV homes.



4. COUNTERTOP DISPLAYS less than a foot wide! Attractively display batteries without sacrificing an unnecessary inch of valuable counter space.



5. PRE-PACKAGED SELECTION of the fastest moving battery types—based on known national movement. Ideal way to test your battery sales potential at minimum investment.



6. YOUR CHOICE. Conventionally packaged batteries or modern blister-pack. Choose the type of packaging more suited to your operation.

You don't have to be a merchandising expert to show a profit on RCA transistor radio batteries. Your Authorized RCA Battery Distributor provides you with a counter merchandiser best suited to your needs, keeps it stocked with the types that move fastest in your area. From there on, the RCA name and nationwide TV advertising take over your selling job.

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Company __________

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State __________

operate on several channels. It employs wideband (±15 kc) FM instead of narrowband (±5 kc).

Some boats are equipped with single- or dual-channel VHF-FM mobile units for telephone service only. These are narrowband sets for communicating through land mobile telephone service stations, or with common carrier stations in the Domestic Public Radio Service. The phone company installs and services these units, using their own two-way radio technicians. Wideband sets are used when the station is licensed in the Maritime Radio Service for communicating through public coast stations.

Field servicing on a boat is sometimes easier than in a car because there is generally more room. At dockside, AC power is usually available for your test equipment and soldering iron. Most large boats now have 117 volts AC available from their own generators. For those that don't, a portable gasoline-engine-driven AC generator will come in handy. Most small boats are equipped with 12-volt batteries, while larger ones have 32- or 110-volt batteries, making an inverter sometimes impractical.

Solving Unusual Complaints

At a base station in Chicago, transmission was fine but reception was very poor. The trouble was traced to a strong interference signal that was desensitizing the receiver. By driving around the area, while metering the limiters of the mobile unit, the source of trouble was traced to a meat packing plant about a mile away. An ultraviolet lamp was at fault. When the owner was advised, he made corrections which stopped the illegal radiation of interfering signals.

In a Washington, D.C. system, base-to-mobile communications was very poor—it was not possible to talk more than two miles. When measured with a VOM, the line voltage was found to be less than 100 volts, but steady. A *Variac* boosted the line voltage to 115 volts and the system worked fine.

In Duluth, Minnesota, the base-to-mobile range in one system dropped off drastically when the temperature dipped below zero. By use of an in-line wattmeter and a VOM, the trouble was finally traced to the antenna transmission line. The inner conductor of the coaxial cable would shrink and pull out of contact with the pin in the receptacle at the antenna. The cable was cut off near the top and the plug resoldered into place.

At a wireless relay station near Chicago, the station transmitter would turn on by itself without a signal from the control station or one of the mobile units. The trouble was eventually traced to a nearby base station operating on the adjacent channel. Its modulation could not be heard, but its carrier was strong enough to quiet the relay receiver and actuate the transmitter. In this case, the cure was achieved by FCC action; the other station changed to a different channel.

Conclusion

From the foregoing, it is easy to see that field servicing two-way radio isn't a screwdriver and pliers job. Practically every service call necessitates the use of a different piece of equipment. This equipment, though sometimes specialized, enables the technician to do a quality job with a minimum of time and effort. ▲

Circle 19 on literature card

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Makes complete tube test in seconds. Checks average set in a few minutes. Discovers weak tubes that need replacement. *Satisfies more customers. Sells more tubes. Saves call-backs. Insures your reputation. Pays for itself over and over again.* Net, $169.95

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Circle 20 on literature card

Good Test Equipment Doesn't Cost... IT PAYS

by Wayne Lemons

In the day of the swashbuckling, individualistic mechanic it was a popular adage that "the better the mechanic, the less equipment he needs." Even in those days, the adage wasn't true except in extremely rare cases. Good test equipment was usually found in just one kind of shop—the best in town.

The blustering screwdriver mechanic was his own best promoter but, as I recall, he was seldom very successful. True, he lured a good many customers with his low prices, but this gay ne'er-do-well was a victim of his own pride in not using any equipment. The townspeople laughed behind his back, "Just give ole Joe a pat on the back, tell him it can't be done, and he'll work for nothing." Joe never believed that he was anything but a screwdriver mechanic, and so he never was.

To be sure, we still have Joe's descendants in electronics today, but the ranks are thinning. Color TV, transistors, and complex circuitry all take their toll. Gradually the full realization is taking over that no one can do even a passable job without equipment. Good equipment is not only highly desirable—it's an economic necessity. Competition has forced every shop owner to increase production, without increasing expenses or raising prices. Doubtless there is nothing that raises production so economically as does good test equipment.

Not long ago I questioned a highly successful service technician on just why he had so much test equipment. And more specifically, why he has just plunked down $300 more for a new piece. His answers, I thought, got right to the heart of the matter.

"Good equipment pays off in quicker diagnosis," he said. "If this new piece of equipment saves me just one hour a week, and it's almost sure to do that, it will pay for itself in just one year. But that's not the only reason I buy test equipment, probably not even the best reason."

"What are some others?" I asked.

"Well," he continued, "I'd say the greatest reasons are what you might call psychological factors. For example, good equipment pays off in customer satisfaction."

"Just how?" I asked.

"Like this," he said. "People, by their very nature, seem to trust machines more than they do other people. Today, if you go to a doctor you expect him to be in tune with the 'space age.' You might not be satisfied with a superficial thump and a diagnosis of, say, duodenal ulcers. But if that same doctor makes a complex interpretation of a highly complicated apparatus that has flashing lights and fluctuating meters, nothing short of dying with a coronary would make you doubt his prognostication. Even though you know that an electronic gadget is sometimes temperamental, still you never think to doubt its veracity."

"The same thing is true of Mrs. Jones and her TV." he continued. "If in two minutes I tell her the set has a defective horizontal oscillator, she's likely to suspect me of padding the bill—no matter how small it is. If, on the other hand, I connect the proper piece of test equipment, crank out a few answers, perhaps even substitute for the tube, she *believes*. It's as simple as that. In addition, I have proved to myself that my assumed diagnosis is correct, and I'm in a pretty good position to estimate just what the repair will cost."

"Then you've pretty much presold the bill," I commented.

"Yes, and besides, I have a pretty good chance of getting some word-of-mouth advertising as a bonus. Can't you just hear Mrs. Jones expounding, 'Why he just connected a big machine to my TV set and showed me exactly what was wrong. He sure knows what he's doing!' "

"I see your point," I said, "but you have so much good equipment. Is it all really necessary?"

"Let's put it this way," he said, "there's not one piece up there that I care to sell."

"But don't you have some instruments that do similar jobs?"

"Yes," he replied, "but there's no such thing as an all-purpose instrument. Every piece of equipment I have will do some specific job better than any other. Of course several functions overlap, but I'm always on the lookout for the instrument that will do a specific job quicker. For instance, carpenters could get along with just a handsaw, but they find that a power saw makes certain jobs faster and easier. Yet, you don't see carpenters throwing away their handsaws for the handsaw still has its place . . . some jobs it will do better than any power tool.

"I notice you have two scopes. Why is that? You can't use them both at once."

"I don't have to use them both at once to justify two scopes," he said. "The one over there is a large, general purpose scope that's been around for quite a while. It's a good scope but not wideband. I finally got a wideband scope, for I saw a lot of places I could use one. I don't do too much color work yet, so perhaps I couldn't have justified it on that score alone, but I could justify the wideband 3" model I got because of its portability. It takes up very little room on the service bench, and it's easy to move around from one bench to another. If I need a scope to take on a service call for setting a *Synchroguide* or something, this little job is ideal. Since the price wasn't bad, I just couldn't see myself doing without one."

"Isn't that a new VTVM over there?" I asked. "That makes about three for you doesn't it?"

Here is a real "must" for anyone servicing or planning to service color TV sets.

No longer must you send two men to a customer's home to pull in his entire color set. Now, one man can simply remove the chassis and bring it back to your shop for testing, troubleshooting and alignment in your RCA Color TV Test Jig.

Look at some of the extra advantages built into this money-saving unit:

- **Minimizes costly damage claims.** Pulling chassis eliminates possibility of scratching or damaging a customer's cabinet when transporting it to and from his home.
- **Saves time.** Eliminates need to reconverge a customer's set when chassis is returned. Convergence control panel on Test Jig provides static and dynamic convergence for CTC-10, 11, 12 and 15 chassis.
- **Versatile.** Can be used with CTC-4, 5, 7, 9, 10, 11, 12 and 15 chassis.
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The RCA Color TV Test Jig is available through your Authorized RCA Parts and Accessories Distributor. See him this week to find out how this versatile instrument can help you capitalize on the growing Color TV servicing market.

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"I guess it does," he smiled, "but I'm not apologizing. I use that one mostly for transistor servicing. Have you noticed how much more of that service we're getting lately? It has two low-voltage scales that are almost a necessity for measuring transistor bias accurately. I saw no reason to start servicing transistors with two strikes against me if I could help it."

"What's this unit over here?" I said, pointing to an unfamiliar piece of equipment beside a stereo alignment generator.

"That's a distortion analyzer. I never knew how much I needed one until I put this one to work a few weeks back. You know the age of hi-fi is already here, and few shops have any dependable way of telling if an amplifier is *really* hi-fi. The 'ear method' is highly unreliable, temperamental, and easily deceived. It's silly to compete with the 'golden ears'; they could argue with my tin ear from now on. But you won't find any of them arguing with my distortion meter. In fact, you can hear some of them bragging around town about how low their intermodulation distortion is. They just had it checked, and you know where? At my shop, of course!"

"Well," I conceded, "I can see you're sold on test equipment, and you're pretty sure of why."

"All good reasons, too," he interrupted, "but there's a better one."

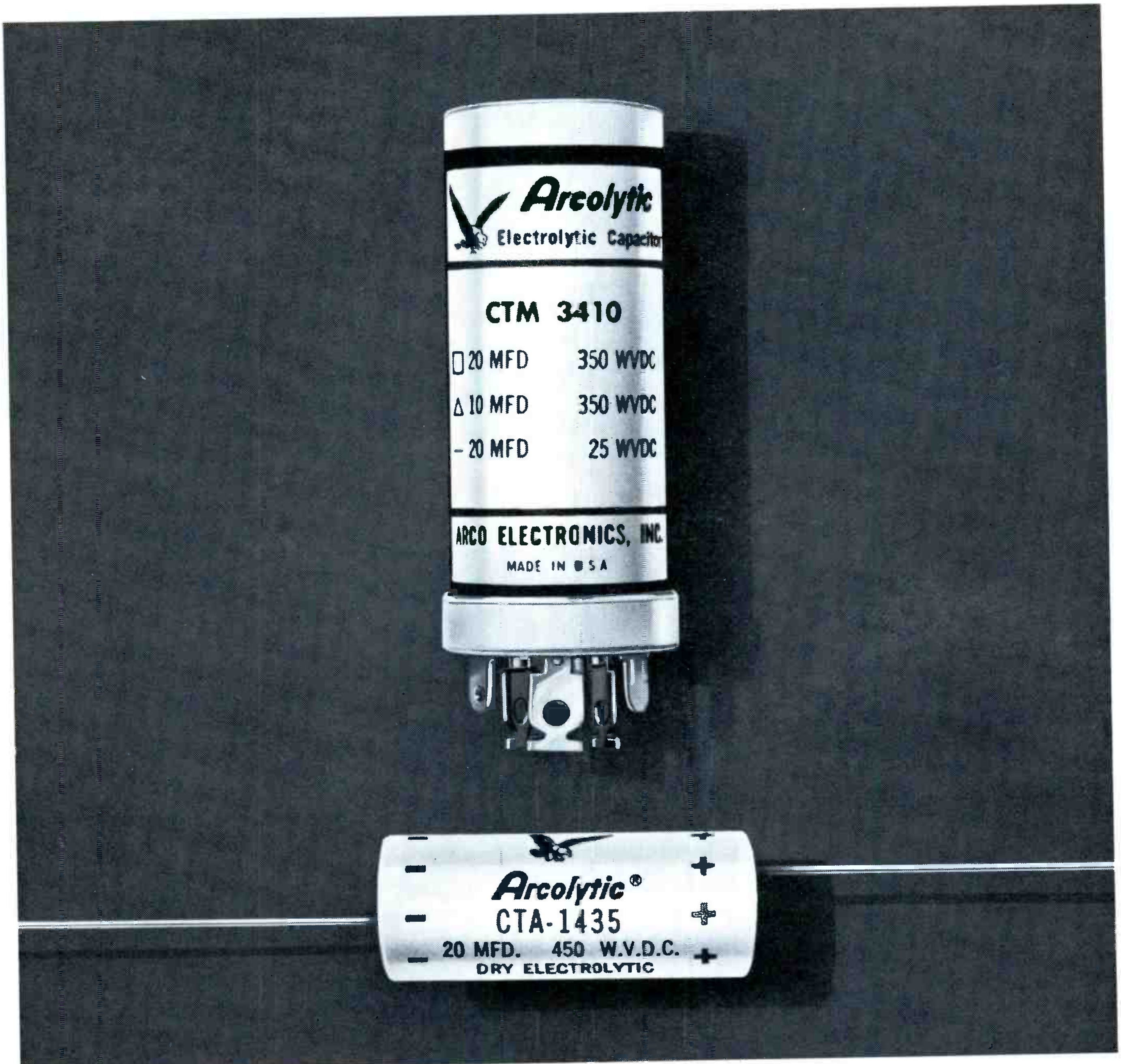
"What could that be?" I wanted to know.

"Me," he laughed. "I'm the biggest reason. New equipment gives me a shot in the arm. It actually makes me anxious to get to work in the morning, anxious to try out what may be a much faster way of diagnosing trouble. Also, it makes me happy to have my customers impressed, and it gives me more confidence in what I'm doing. Last, but certainly not least, it makes me feel more like the professional I say I am, and a lot less hesitant to charge what a job is worth.

"Believe me, test equipment—good test equipment—means I can make a quicker and better diagnosis, repair more sets, have fewer callbacks, gain more prestige, increase customer goodwill, and step up my word-of-mouth advertising. But the frosting on the cake is that good test instruments let me enjoy what I do and really do what I enjoy."

I couldn't argue with that. ▲

"Whaddya wear those ear-muffs for in the middle of the summer . . . huh? I say, whaddya wear those ear-muffs . . . ."



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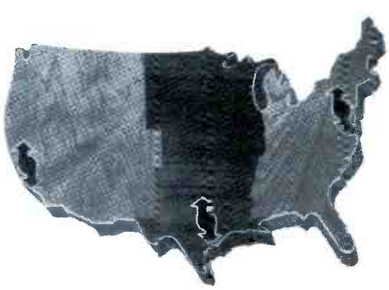

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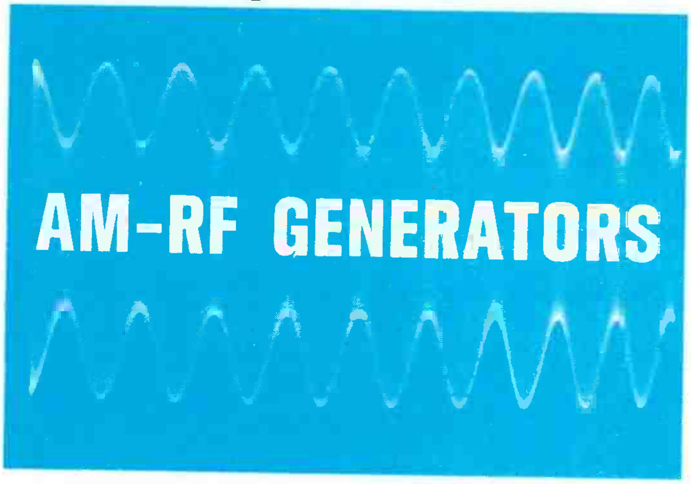
Circle 23 on literature card

Shop Talk

Curing troubles in AM-RF GENERATORS



by ALLAN F. KINCKINER

The most common type of shop generator, the RF signal generator, is rarely subjected to quality checks. Aside from checking frequency accuracy once in a while by heterodyning with a radio station, the actual quality of the generator signals are often taken for granted. If the instrument is to be maintained at its maximum servicing capabilities, however, it should be checked periodically. Otherwise, faults may develop without your awareness.

Recently, for example, our shop generator flamed up inside. The fire destroyed switch and coil components available only from the company that made the generator, and obtaining new ones was going to involve a long wait. As our luck would have it, we were swamped with work requiring an RF generator, so an old unit that had been retired was returned to duty. Although frequency indications were reasonably accurate on the dial, certain other functions of the generator did not measure up; in fact, some shortcomings were quite obvious.

Fig. 2. Waveform flattening shows distortion.

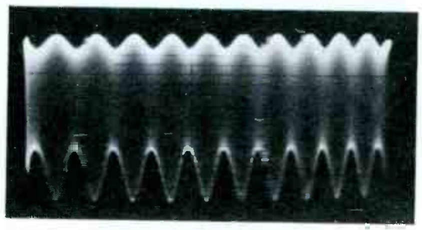


Fig. 3. Modulation envelopes were changed.

First, when aligning push buttons on an old radio, chirps were noted on both sides of the beat signal between the generator and the station being set up on the push buttons.

Second, in aligning transistor radios, there was a serious disparity between radios of apparently equal sensitivity. Also, the sensitivity measured with the generator signal didn't jibe with actual sensitivity as indicated by the ability of the radios to receive stations.

Third, this generator was useless in chasing down modulation hum. One way to track down this fault is to tune the radio to the RF signal of the generator, and then turn off the modulation so the radio receives the RF signal only. If the trouble is true modulation hum, you will still hear the hum in the speaker. While the set is being fed the unmodulated signal, suspected parts can be substituted, tubes changed, or capacitors shunted until the hum disappears. The substitute generator had too much hum of its own to be used for this purpose.

Here's how we set about "cleaning up" the output from this tired unit. We eliminated all of its shortcomings, using a scope to check distortions in the generator signals. The circuit diagram of the generator is shown in Fig. 1, and is typical of many service generators in present use.

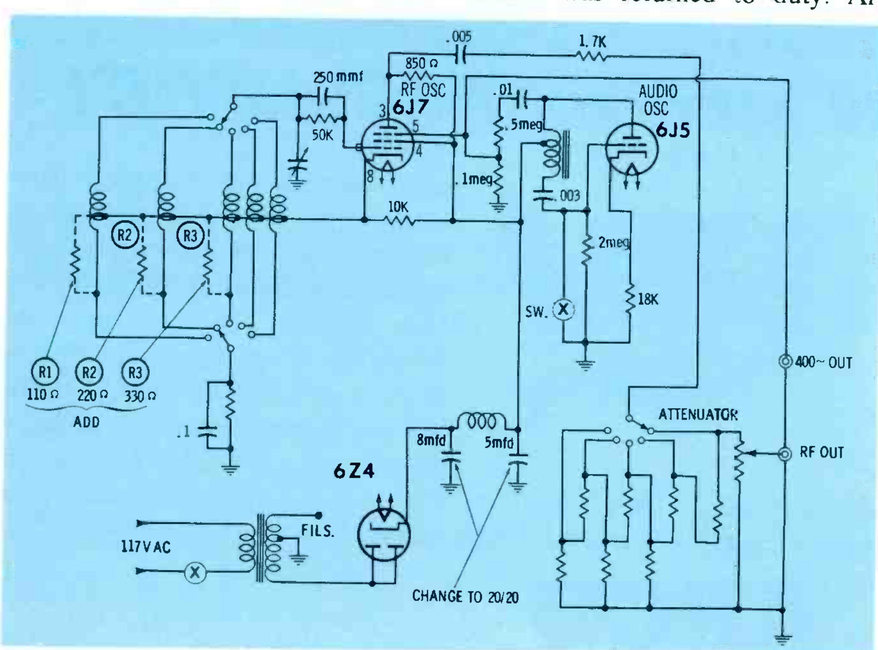


Fig. 1. Signal generator of a type used quite commonly for radio and television alignment.

Generator Shortcomings

Oscilloscope traces, taken with a direct probe at the generator output and with the scope sweep set at 1/6 of the RF output frequency, revealed signal distortions that explained some shortcomings of the instrument. Fig. 2 is the waveform we saw first—the RF signal without modulation. Extreme distortion was obvious on the three lowest bands of the generator—from 100 kc to 3 mc. This distortion, caused by spurious oscillations on either side of the main signal frequency, explained the chirps noted when aligning the push buttons. These extra oscillations are characteristic of Hartley oscillator

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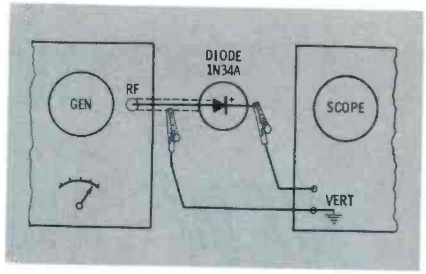
Here's the famous MIGHTY MITE, America's fastest selling tube checker, with an all-new look and many new exclusive features. MIGHTY MITE III brings you even greater portability, versatility and operating simplicity beyond comparison. Controls are set as fast and simply as A-B-C right from the speedy set-up cards in the cover. The new functional cover can be quickly removed and placed in a spot with more light for faster reading of the set-up data or "cradled" in the specially designed handle as a space saver as shown above. New unique design also prevents cover from shutting on fingers or cutting of line cords as in older models.

In a nut shell . . . the MIGHTY MITE III is so very popular because it checks for control grid contamination and gas just like the earlier "eye tube" gas checkers (100 megohm sensitivity) and then with a flick of a switch, checks the tube for inter-element shorts and cathode emission at full operating levels. Sencore calls this *"the stethoscope approach"* . . . as each element is checked individually to be sure that the tube is operating like new. User after user has helped coin the phrase *"this checker won't lie to me"*. Most claim that it will outperform large mutual conductance testers costing hundreds of dollars more and is a real winner in finding those "tough dogs" in critical circuits such as color TV and FM stereo.

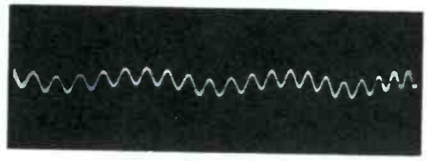
See Your Parts Distributor -- And See The Mighty Mite III For Yourself!

SENCORE 426 SOUTH WESTGATE DRIVE ADDISON, ILLINOIS

Circle 24 on literature card



(A) Diode connection



(B) Audio signal

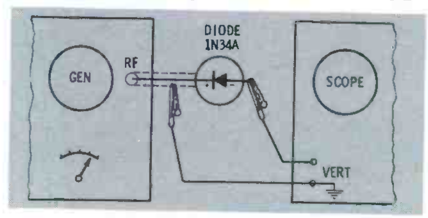
Fig. 4. Detecting only the positive signals.

circuits when the tap is too high on the coil.

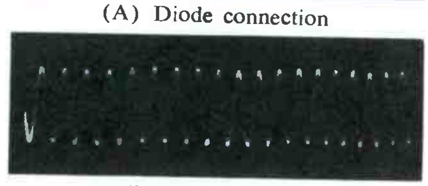
Next, we scoped these same RF frequencies with the generator's 400 cps modulation. You can see the result in Fig. 3. Note the difference in the upper and lower modulation envelopes. Fig. 3 was taken with a direct probe, but the scope sweep was set for 1/10 the *modulation* frequency.

The difference between the upper and lower edges of the modulation envelope in Fig. 3 results from unbalanced modulation of the carrier. This can be shown better by using detector probes with the scope. In Fig. 4A, the diode detects positive modulation, resulting in a small audio signal (Fig. 4B). In Fig. 5A, with the diode reversed, the probe detects the negative envelope; the much greater audio signal is shown in Fig. 5B.

These unequal signals explain the apparent disparity between generator signal levels in equally sensitive transistor radios. Sets that detect in a positive mode would develop only the audio level in Fig. 4B, whereas those using negative detection would develop much greater audio—as in Fig. 5B. The hum con-



(A) Diode connection



(B) Audio signal

Fig. 5. Detecting only the negative signals.

STOP! LOOK! SAVE!

All crystal controlled

A STANDARD COLOR BAR GENERATOR at 1/2 THE COST OF OTHERS

only $124^{50}

the all new SENCORE
CG126 STANDARD COLOR BAR GENERATOR

A standard color bar, white dot, crosshatch generator especially made for field service on color TV . . . and at a great savings to you.

Check these outstanding features and you will see why this generator belongs on the top of your list for color TV servicing.

All patterns crystal controlled offering "rock like" stability. You'll think the patterns are painted on the TV screen.

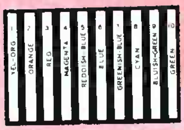
Simplified operation speeds up every servicing job. Just dial the standard keyed bars, white dots, crosshatch, vertical bars or horizontal bars and watch them "pop" on the screen. That's all there is to it.

Exclusive adjustable dot size. The white dots can be adjusted to the size that satisfies your needs by a screwdriver adjustment on the rear. No need to argue about dot size anymore. Just select the size that you like to work with best.

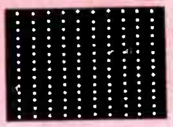
Pretuned RF output to Channel 4. Other low channels can be selected if Channel 4 is being used in your area by simple slug adjustment. Patterns are injected directly into antenna terminals, simplifying operation and saving servicing time.

Reserved output on color bars for forcing signal through defective color circuits. The color output control is calibrated at 100 percent at the center of rotation, representing normal output. A reserve up to 200 percent is available on the remainder of rotation.

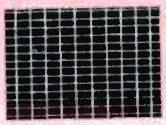
Smaller and more portable. With color receivers weighing much more than black and white TV, portable equipment becomes essential for home servicing. The CG126 weighs less than 10 pounds and measures only 11" x 8" x 6".



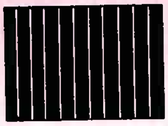
Ten standard keyed color bars (RCA type) that automatically provide all colors at specified NTSC phases . . . but without need of interpretation when servicing.



Stable white dots with new exclusive dot size adjustment in rear.



Stabilized crosshatch pattern for simplifying convergence adjustments.



10 thin white vertical lines for horizontal dynamic convergence adjustments . . . often missing on other generators.

14 thin horizontal lines for vertical dynamic convergence. Also missing on many high priced generators.

March into your local parts distributor and demand the CG126 Sencore color generator that sells at ½ the price of others. Don't let him switch you.

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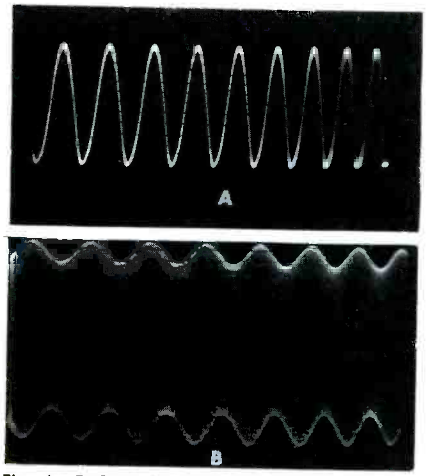


Fig. 6. Definite improvement of both signals.

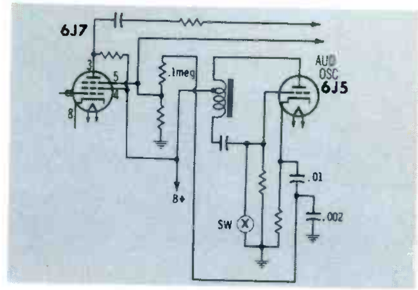
tent, indicated by the wavy shape of the line in Fig. 4B, also explains the hum heard when the unmodulated signal is fed to a receiver.

Corrective Measures

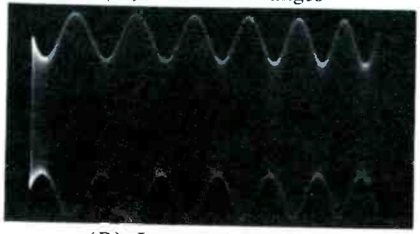
Clearing up the various troubles was comparatively simple. First, the hum was removed by replacing the worn out 8-8 mfd filter with a new 20-20 mfd unit. Distortion of the RF signal (Fig. 2) was corrected by adding ½ watt resistors—R1, R2, and R3 in Fig. 1—across the feedback windings of the coils. The unmodulated RF signals then became the good sine waves shown in Fig. 6A, and the modulation became balanced as in Fig. 6B.

The best values of R1, R2, and R3 can be determined experimentally. The procedure is to feed the unmodulated RF signal directly to the scope, and shunt the feedback (low-end) winding with resistors, using the largest resistance that will convert the RF signal to reasonably pure sine waves across the entire band. In scoping, adjust the scope sweep so that five to ten cycles of the waveform are presented. Be careful not to overload the scope, for this will appear as distortion when there is none.

Modulation in Fig. 6B is only about 20% but it was easily brought up to 40% by making the changes shown in Fig. 7A. This last modification was not entirely necessary, but the 40% modulated signal in Fig. 7B is somewhat easier to use for alignment.



(A) Circuit changes



(B) Improved envelope

Fig. 7. Revisions include repositioning .01, adding .002, and changing .5 meg to .1 meg.

Conclusion

While faults noted in this article were in a rather old generator, similar signal defects have been found in considerably newer ones. Since the circuit of this specific generator is so common, the same corrective measures will apply.

Just use your scope to (1) determine the need for corrective action and (2) monitor the results of your improvements. Periodic checks can also make sure your generator is kept in good shape and ready for instant action. ▲

by Larry Allen

aligning TV with a SIGNAL GENERATOR

"But," they say, "the sets do show pictures, and the sound comes through loud enough on commercials!" So the difficulty of aligning a TV receiver tempts the technician to overlook the need for "touching up" the adjustments. Old-timers are fond of saying, "Leave well enough alone." However, this does not change the fact that the servicing job would be more complete if alignment were touched up, even though thorough sweep alignment jobs are left to those more technically skilled and properly equipped.

Television alignment is neglected terribly. Partly, this is because it is deemed a difficult job, requiring special sweep alignment equipment. Too, many technicians shy away from alignment because they haven't been trained properly in the fine techniques of a good alignment job. Finally, alignment—and the training to accomplish it—is neglected because of the popular fable that TV sets seldom need alignment. Is this really true? Let's examine the question in detail.

No conscientious service technician would think of sending a table radio or a transistor portable out of his shop without "touching up" the alignment. And why not? . . . it's such a simple thing to do, takes little extra time, and keeps performance at its peak. And, after all, IF transformers and RF coils *do* age from year to year.

On the other hand, television alignment is ignored completely by many of those same technicians. Don't the coils in a TV set age?

Sweep Alignment vs Touchups

At this point, some will say that TV alignment is better left alone unless equipment is available for sweep alignment. And they are right, *if* the technician isn't trained in how to align a receiver properly. However, a technician armed with a knowledge of correct tuning action, and who knows how to attain this action, can perform a satisfactory touchup job in most TV receivers without sweep generator or scope. The procedure doesn't take very much time, and the result is a set that operates far better than one left to drift off alignment from year to year with no attention whatsoever. The instruments required are a signal generator and VTVM.

Don't take this to imply that sweep alignment is not important. It is. In fact, a thorough alignment job, with sweep generator, marker adder, scope, and accurate marker generator, cannot be equalled by the simple procedures we're going to outline here. Never overlook the advantages of performing any job with the best equipment available. However, don't let *badly needed* alignment go undone just because you don't have special equipment or because your sweep generator or scope happens to be temporarily out of order.

Need for Alignment

How can you decide whether a set needs alignment? This is important, for you may be faced with the decision to align or not to align, and you'll want to be reasonably sure it's needed before you proceed. Of course, the easy way is to use your sweep equipment to look at the response curve; but we've ruled that out for this article, since your sweep generator or scope is out of order. . . . Therefore, we will have to depend on other clues.

First, consider set sensitivity. Most modern TV sets have considerable gain in the IF stages. When the set is off-channel (not receiving a station) the RF and IF stages run at maximum gain, and noise in the RF and mixer stages will appear on the screen as snow—see Fig. 1. If this snow is missing, especially on low-band channels, the set is suffering from poor gain. Make sure weak tubes are not causing the trouble; substitute for the RF, mixer, and IF tubes (you might check the video stage, too, just to be safe).

Next, check the set on weak stations. (If you have only locals, try padding the signal down to simulate a weak station.) A bit of experience

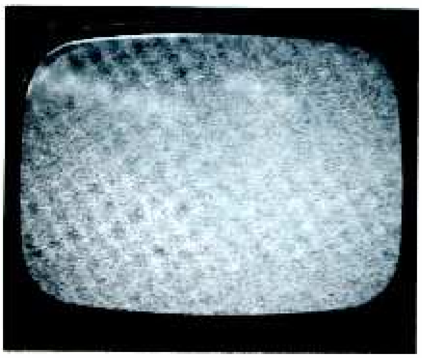
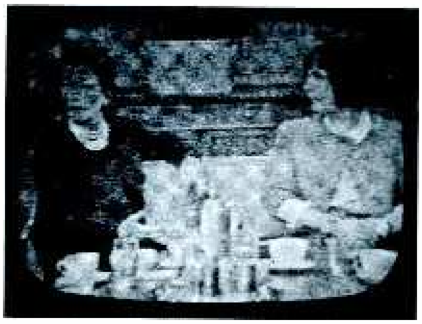
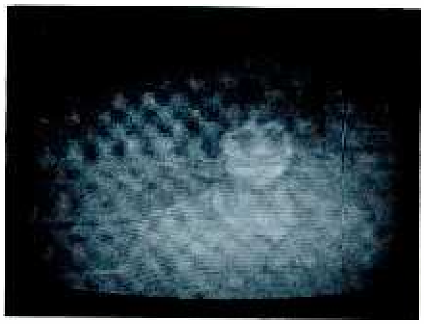


Fig. 1. Snow when IF stages are at high gain.

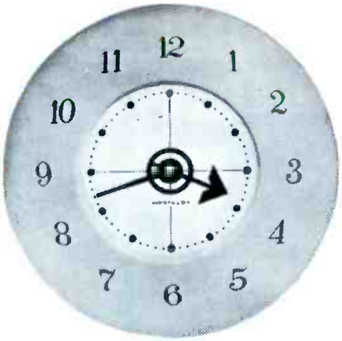


(A) IF gain high; RF weak; much snow



(B) IF gain diminished; little snow

Fig. 2. Showing the difference in the picture when lack of gain is in RF stage or IF stage.



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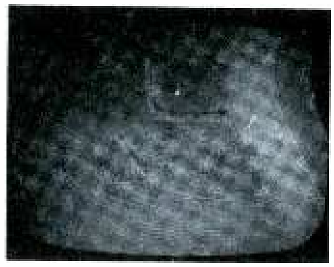

(A) At one end sound is strong.

(B) Toward center note clarity.

Fig. 3. Alignment can be tested by observing the effects of fine tuning on pic and sound.

(C) Picture softened; sound weaker.

with signals at your shop will tell you whether or not the set should show a good picture. A weak picture, through lots of snow (Fig. 2A), usually points to RF trouble; the same weak picture, but accompanied by very weak snow (Fig. 2B), usually denotes poor IF sensitivity. Since tubes are not the trouble, make sure the supply voltages are normal. Also check AGC voltage to make sure it's not cutting down the IF gain on *weak* signals (it's supposed to reduce gain only on strong signals).

Finally, set the channel selector to a fairly strong local station. The picture should be sharp and clear, with no ringing (tunable ghosts) and no smear. Try the fine tuning control. It should move the response of the set sharply from good sound with no picture (Fig. 3A) to a point of sharp picture with good sound (Fig. 3B). As you turn it farther, the sound should diminish slightly, and the picture may get fuzzy (Fig. 3C).

If you see ringing, and turning the fine tuning control causes the ghosts to shift radically across the screen, sometimes changing to smear as well, the set probably needs alignment. When there is smear caused by poor IF alignment, off-station snow will probably appear in streaks (Fig. 4) instead of as in Fig. 1. If the fine tuning control seems too broad, and has very little effect on the picture, misaligned IF stages are probably the cause; this particular symptom is often accompanied by very weak snow on vacant channels.

Any or all of these symptoms can indicate the need for alignment. Remember that other troubles in the RF, oscillator, mixer, or IF stages can be responsible for symptoms such as these, but a rapid way to pinpoint such faults is to go through a quick alignment. If other troubles exist, they'll reveal themselves as you align the set.

Setting Up for Alignment

Assuming that you suspect alignment, setting up is relatively easy. (This advantage makes troubleshooting by alignment rather attractive.) Let your signal generator warm up for a half-hour or so while you check tubes and clean out the chassis; don't let warmup drift confuse alignment procedures.

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Most tuners provide a convenient test point that connects to the mixer grid; this is a good spot to connect the generator for IF alignment. Use a .001 mfd capacitor in series with the hot lead, to prevent any possibility of grounding mixer bias through the generator output circuit. Set the generator output at zero, to start with.

Connect your VTVM to the video detector output, so it will measure the negative DC voltage developed by the signal. This will be your indicator during alignment. If you prefer, you can connect directly at the video crystal output, but it is often more convenient to connect to a point past the peaking coils; the crystal is sometimes in a can and hard to reach. Check the schematic to be sure you connect to a point that isn't blocked for DC by a coupling capacitor.

Next, use the alignment instructions with the service notes to identify the coils and determine the frequency to be used with each. Most instructions are for sweep alignment, but the information can be used just as well for signal-generator alignment, if you know what to look for. For *sweep* alignment, a marker generator shows various frequency points along the curve. Each marker frequency is affected most by only one or two adjustments in the IF strip; the instruction sheet always indicates which markers are affected by which adjustments or coils. This is your clue to which signal generator frequency you will use with each IF adjustment.

An easy way to keep track of the adjustments is to pencil the frequencies right on the schematic, with an arrow pointing to the proper coil or trimmer, and with a notation to tune for minimum or maximum. This labelling eliminates turning back and forth to the alignment instructions, schematic, and layout drawing (for locating adjustments). Anything that saves time makes this servicing procedure even more effective as a troubleshooting aid.

Aligning the IF's

The alignment itself is simple and quick. Carefully set the generator to the frequency for the first adjustment in the IF strip, turn the output control wide open, and note the VTVM reading. Reduce the generator output until the reading drops to minimum; set the generator output for a reading slightly above this minimum and adjust the coil (or trimmer) for maximum reading. If the reading gets very high—as when alignment is 'way off—reduce the generator output and adjust again.

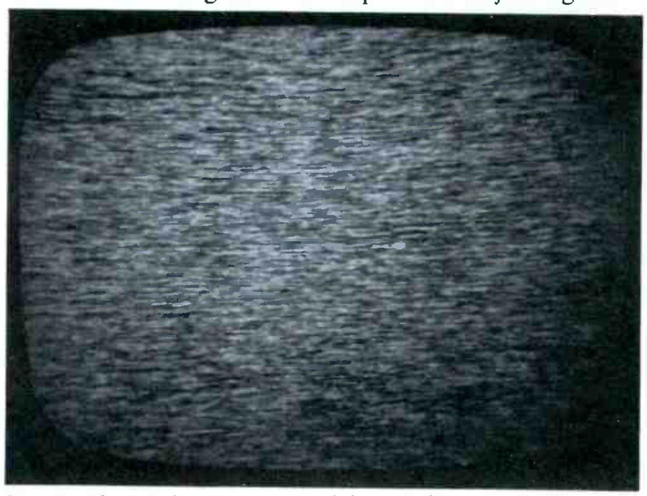
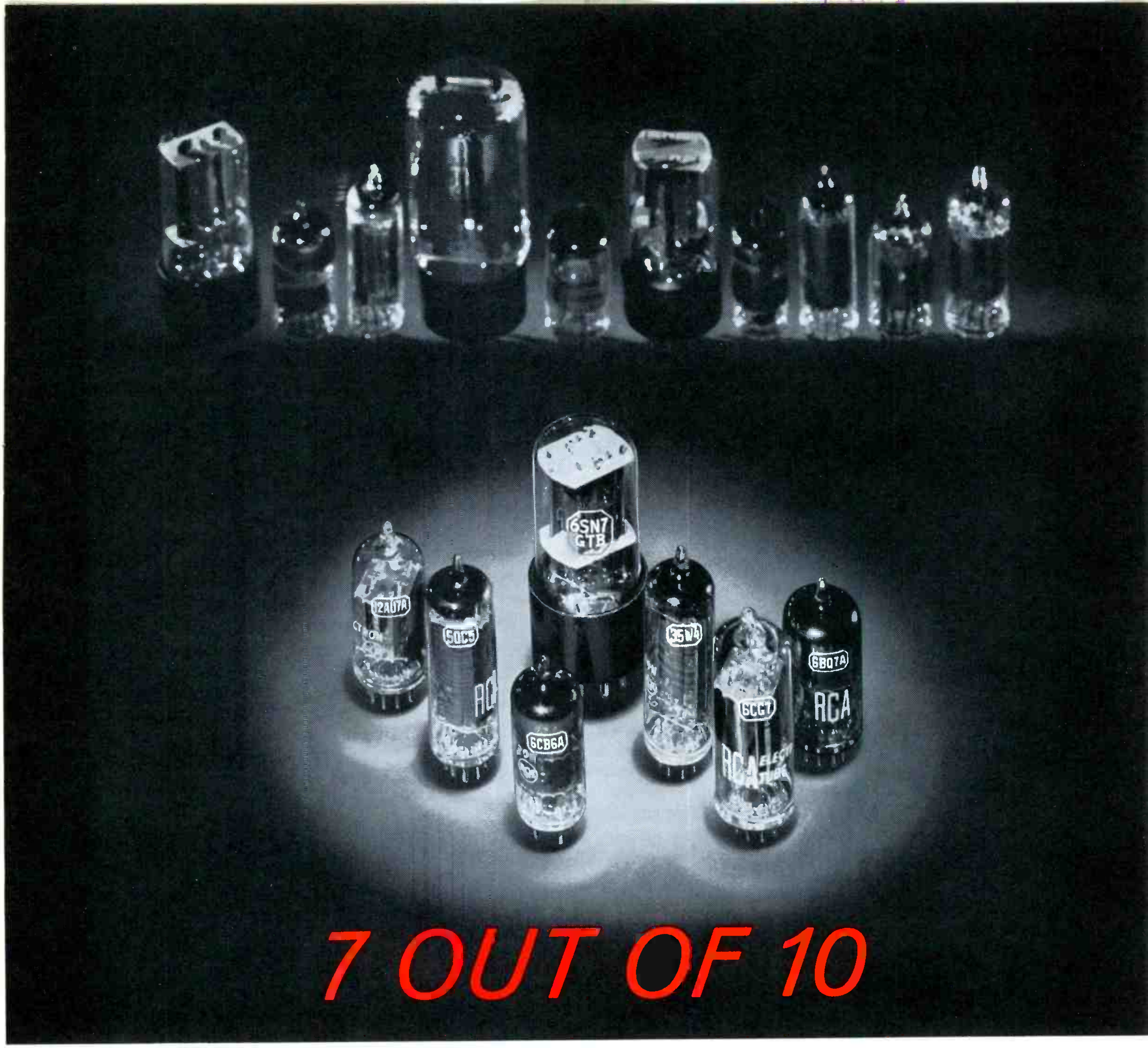


Fig. 4. Elongated snow is caused by misalignment of IF stages.



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Proceed on through the remaining adjustments according to the foregoing instructions, changing the generator frequency and output settings to suit each adjustment. Remember: Set the generator frequency first; then find maximum and minimum VTVM readings and set the generator output for a reading between these extremes; lastly, adjust the slug for maximum indications.

The exceptions to this procedure are those trap adjustments marked to be tuned for "minimum." With most of these, you'll have to use maximum generator output to get a VTVM reading. Simply set the generator frequency to the specified frequency, turn the generator output wide open, and adjust the trap for minimum indication on the VTVM.

We said earlier that other troubles will often reveal themselves during IF alignment. This is true, and you should watch for symptoms. For example, a certain adjustment may fail to show a peak. This may indicate the coil is defective, a bypass capacitor associated with it is open, or perhaps the tube itself is poor (even though it tests okay). The point is, of course, to investigate the failure of any adjustment to peak or dip properly. Move each slug slightly in both directions to make sure tuning action is definite.

By using this troubleshooting method, which is popular among transmitter technicians, many troubles can be found that would be otherwise very difficult to track down. A broken slug in an IF coil, or a few shorted turns, can be especially hard to pinpoint in any other way. Even an open decoupling capacitor may slip past you unless you try tuning the coil whose "low end" it holds at RF ground.

Other faults can reveal themselves during IF alignment. A set that intermittently breaks into oscillation can often be cured by alignment.

Fig. 5. Grainy highlights make good reference point during oscillator adjustments.

Or, a faulty decoupling or screen bypass capacitor can be uncovered by the tendency of a stage to oscillate when it's peaked. Thus you can see—a quick alignment procedure may also be a quick troubleshooting procedure in the IF stages.

The Sound Channels

Sound IF alignment is even simpler than video IF alignment. Even the most elaborate system usually consists of only one stage of 4.5 mc amplification before the detector. (We're considering only intercarrier sets, since split-sound sets are seldom seen anymore.) While you are adjusting the sound IF, you can also adjust the sound takeoff coil and the 4.5 mc traps that follow the video detector.

A good spot for connecting the generator is at the video detector output (where the VTVM was connected for video IF alignment). The best indicator is your VTVM, equipped with a demodulator probe. This combination can be connected across the output winding of the sound detector coil during most adjustments. However, you'll have to connect somewhere else when you align the detector coil itself.

Set the generator for 4.5 mc, without modulation, and the output control for enough signal to cause a reading on the VTVM. Adjust the takeoff coil and the IF coils for *maximum* indication on the meter.

Move the probe and VTVM to the cathode (or grid, if that is the driven element) of the CRT and increase generator output until again you get a meter reading. Tune the 4.5 mc traps in the video circuit for a *minimum* indication.

Final adjustment for sound depends on the detector circuit, but you can make a reasonably close approximation as follows: For a discriminator or ratio detector, tune the primary for maximum station sound (don't try using a generator with AM modulation); then tune the secondary for maximum *undistorted* sound. For a quadrature type demodulator, tune the grid coil for maximum; then adjust the quadrature coil for maximum undistorted sound. Always use a station signal for final sound adjustment, as an AM generator will generally mislead your ear. The AC portion of your

• *Please turn to page 104*

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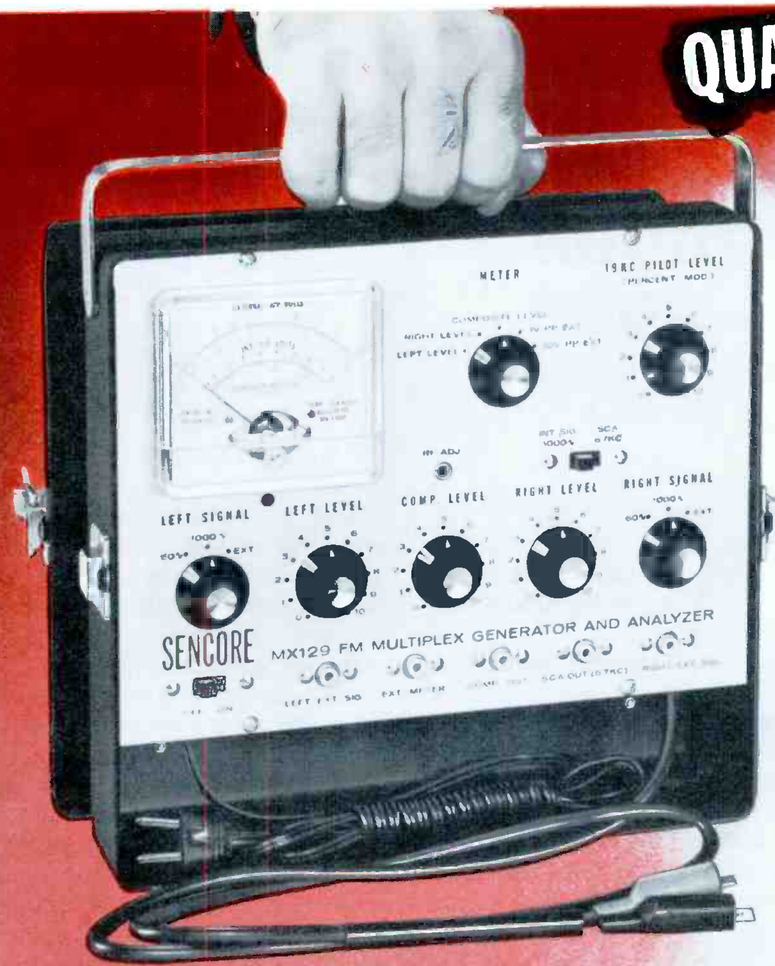

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The MX129 becomes a complete trouble shooting analyzer with the addition of a meter calibrated in peak to peak volts and Decibels. No other equipment is required for checking channel separation or alignment. A jack marked EXT. METER is provided for connecting the meter to the stereo speakers or at other points after detection.

Here are the signals available on the MX129 for alignment, trouble shooting and analyzing:

- FM-RF carrier with composite multiplex audio signal just like that transmitted from the FM station: 38kc suppressed carrier, 19kc pilot and 67kc SCA signal. This signal available at RF output cable.
- Multiplex signal is formed by either 60 cycle or 1000 cycle internal tones for greater flexibility in testing.
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- 19kc pilot calibrated directly in percentage of modulation; can be generated separately for 19kc amplifier peaking by turning down left and right channels.
- External 67kc SCA (subscription) signal available at jack marked SCA OUT (67KC) for trap adjustment. This signal, not found on some high priced multiplex generators, is very important on new stereo receivers with adjustable 67kc traps.
- Composite signals, same as described above, available on jacks marked COMP. OUT for signal injection beyond the FM detector.

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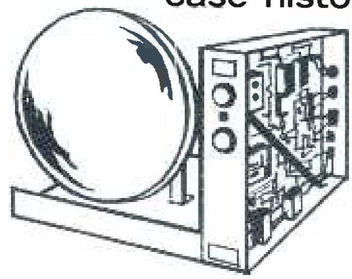
INSTRUMENTS Simplify Color TOUGH DOGS

Take a lesson in servicing from these case histories.



by George F. Corne, Jr. and Forest H. Belt

If you have begun servicing color receivers, you have already discovered the truth in the statement that good test equipment is a necessity in modern electronics servicing. The day when you could service by "feel" is long past. To emphasize the need for good test equipment, let's follow the steps taken in solving a couple of service problems that—except for proper test equipment and techniques—would have been tough dogs.

The Darker It Gets

The visual symptoms in this first case didn't offer many clues to just which stage in the receiver was at fault. The set was an Admiral Chassis 24F2, and the symptom was low brightness.

These symptoms could be caused by a defect in any of several circuits in a color set—video, brightness, high voltage, or any of the networks associated with the picture tube. In fact, one good technician had already declared this set to be a "dog" after spending much fruitless time troubleshooting the first three stages mentioned.

One misleading fact was that, at maximum setting of the brightness and contrast controls, and with careful adjustment of the CRT screen controls, an almost acceptable picture was obtained. However, the picture under these conditions was defocused, with a tendency to bloom. We questioned the technician, and found further that the gray scale didn't change.

Combing our information for clues, we deduced that the trouble must be in the CRT networks, or in some associated stage. As a start, we measured voltages at the cathodes and grids of the picture tube—hoping to find an additional clue.

Cathode voltages were okay. When we measured grid voltages, however, we obtained our first real indicator of the troubled stage: The voltages at all grids were down about 50 volts from normal. Tracing backward through the DC coupling net-

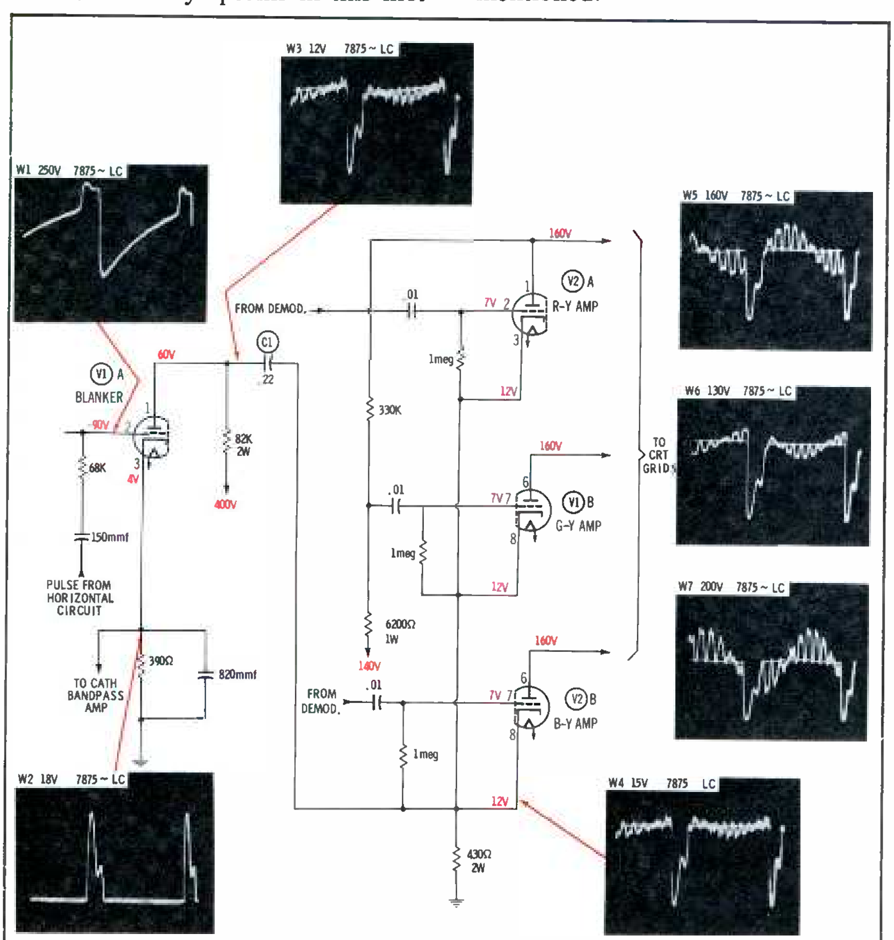


Fig. 1. Average conduction of color difference amplifiers is set by operation of blanker.

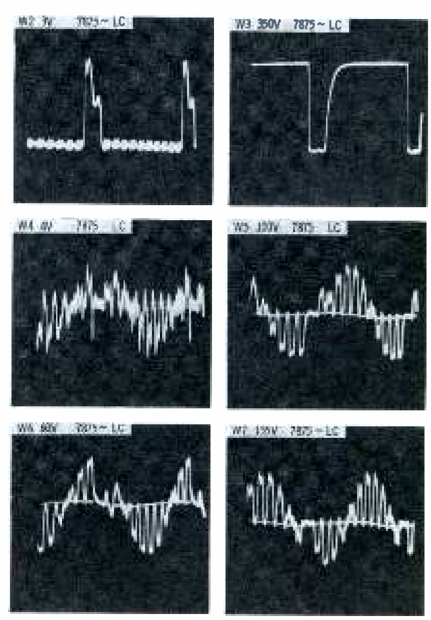


Fig. 2. The waveforms throughout difference amplifiers and blanker circuits were wrong.

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10 WATT E-10B

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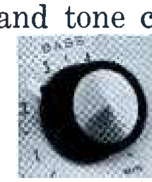

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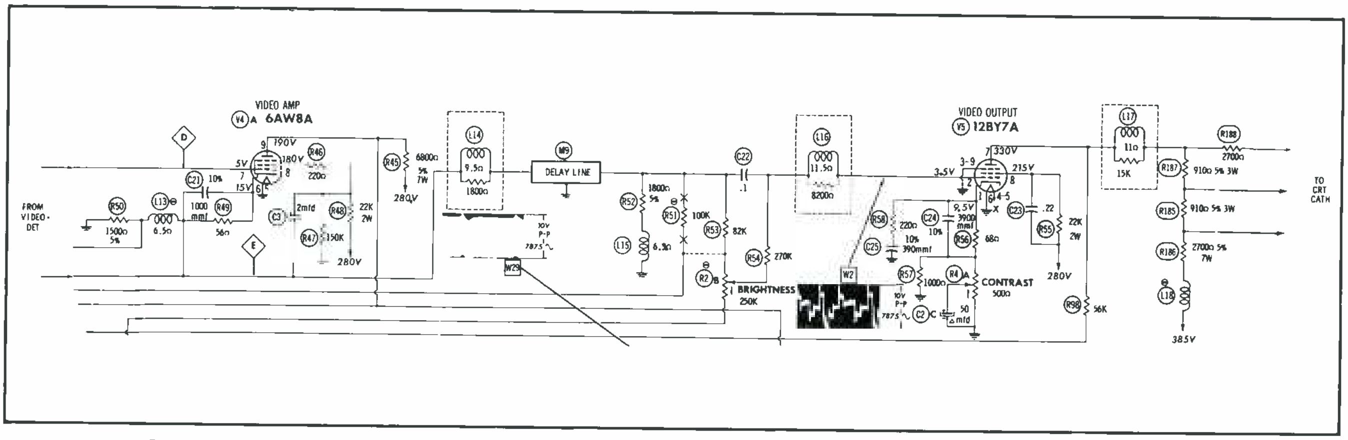

Fig. 3. This "bootstrap" video circuit in CTC7 chassis is typical of those used in the majority of color receivers.

works to the plates of the color difference amplifiers, we naturally found the plate voltages on each of these tubes to be low by the same amount. (Normal operating voltages and signal waveforms in this receiver are shown in Fig. 1.)

Remembering that the defect was affecting all three grids equally, we knew we had to analyze whatever circuits were common to all three. Using a VTVM, we followed our first voltage clue and checked the B+ source to the plate circuit of the difference amplifiers; the source voltage was okay. Under normal conditions, bias between grid and cathode of the difference amplifiers is around –5 volts. Measuring this bias voltage, we found only a –1 volt bias (13 volts on the grids; 14 volts on the cathodes) on each of the tubes. The resistance of common cathode resistor R1 was found to be 430 ohms—just as it should be. The cathode voltage was only 1 volt above normal, so we assumed current through the tubes wasn't excessive.

Turning to our scope and a low-cap probe, we started signal tracing for clues. We connected a keyed-rainbow color-bar generator to the set so we'd have a constant color

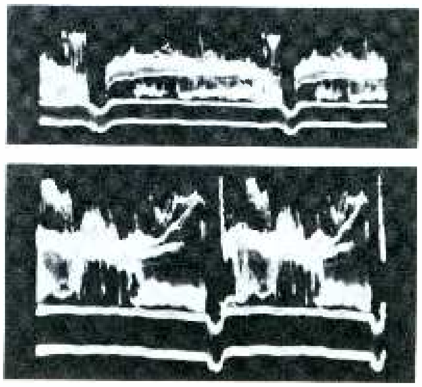

Fig. 4. Waveforms present at grid of 12BY7.

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and video signal to trace. Fig. 2 shows the waveforms we found at all important points.

An acceptable color signal was present on each picture tube grid, but something was missing. We easily noticed there was no horizontal blanking pulse in W5, W6, or W7. W4 also lacked a horizontal pulse, so apparently something was amiss in the blanker.

W3 contained a pulse, and what a pulse it was—an amplitude of 350 volts! Normally, the pulse at this point is only 15 volts peak to peak. W1 was normal, proving the trouble was in the blanker stage.

The VTVM disclosed the plate voltage had increased to 300 volts; a check at the grid and cathode revealed almost normal DC voltages: –90 and 4 volts, respectively.

It turned out that C1 was open, in the plate circuit of the blanker. This removed the horizontal keying pulse from the cathodes of the difference amplifiers, causing a shift in their average conduction and plate voltages. This in turn changed the DC voltages at the CRT grids, thus dimming all three rasters.

Incidentally, instead of the usual direct CRT bias system, a few newer color receivers set CRT operating bias indirectly via the blanker circuit. A switch selects different load resistors in the blanker plate circuit. See "Know Your '64 Color Circuits" in the November, 1963 issue for a more detailed description.

In solving this problem, we used the VTVM, scope (with LC probe), and color-bar generator to make a simple troubleshooting exercise out of what could easily have been a difficult task. From this you can see that instruments make a world of difference in everyday troubleshooting. Now let's follow another problem to its logical solution, keeping in mind the time we can save by using test instruments. We'll also see how a misleading conclusion can be avoided by the judicious choice of service techniques.

A Blinker

The receiver in our second example, an RCA Chassis CTC7A, had caused its owner hardly any trouble up to the time we saw it. In fact, this was the first time the chassis had been removed from the cabinet. Five or six years of operation without a chassis fault is unusual.

As in our previous case, the visible symptoms in this particular set weren't indicative of trouble in any particular circuit. During normal programs, the raster would suddenly become brighter, with a marked increase in contrast, and a tendency at times to overload. We called this blinking, as the symptom might appear and disappear almost as quickly as you could blink your eye. To further complicate the matter, the set would sometimes play for hours without a sign of trouble.

On the bench, we found we could make the trouble come and go almost at will by tapping lightly on the chassis. This didn't offer much of a clue though—we could tap *anyplace* on the chassis or the bench and get the same results.

We almost dismissed the thought of AGC trouble (remember the overloading tendency) for the fault now seemed like a poor contact or other intermittent connection. Since the defect was affecting contrast, we connected our scope to the grid of V5 (Fig. 3) to

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monitor the video signal from video amplifier V4A. Then we jarred the chassis and saw the normal 18 volt waveform (Fig. 4A) jump to the 30 volt waveform in Fig. 4B. Photos A and B were both taken without changing the veritcal gain of the scope.

Checking the circuit of V4, we scoped its grid waveform, and found the same change in amplitude. Leaving our scope connected to point D, we gently wiggled tubes in the tuner and IF strip, assuming the trouble was in some stage prior to V4A. This action produced no indication on the scope so we did the same to V4A and V5. Pressing either, however gently, produced the symptom. We decided the bad connection must be on the printed board containing both tubes and their circuit components.

Measuring the DC voltages on both tubes (Fig. 5), with and without the symptom, isolated the trouble to the 12BY7 circuit; the voltage on the grid of V5 shifted from a –2 volts to 3.5 volts when the symptom was present.

A visual inspection of the board revealed nothing. However, we were aware that the mounting eyelets on this and similar boards have caused trouble in the past, so we checked this possibility. Pressing the board to produce the symptom, we connected one end of a clip lead to chassis, and touched the other end to the copper foil at each eyelet. The instant we touched it to the point marked in Fig. 6, the scope trace and the picture returned to normal.

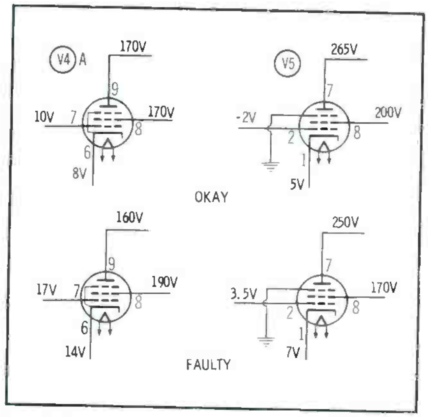

Fig. 5. Voltages on V4A and V5 offered clues.

Why was the initial scope indication misleading? This lug served as the grounding point for L15 and the delay line shield. Network R52-L15 serve as a parallel portion of the detector load through the delay line. The change in load affected the video signal and the DC voltages in both stages.

You might wonder if we could have located this particular faulty connection without the clip lead. Here's one easy way: Once you've pinpointed the general area, connect your ohmmeter between each tube pin and other circuit points, one at a time; press on the board and take note of any change in resistance reading. In our example, we connected one lead to pin 6 of V4; the resistance measured around 900 ohms. Then we flexed the board, and the resistance increased to approximately 1500 ohms, indicating some low resistance path was opening. The rest was simple! ▲

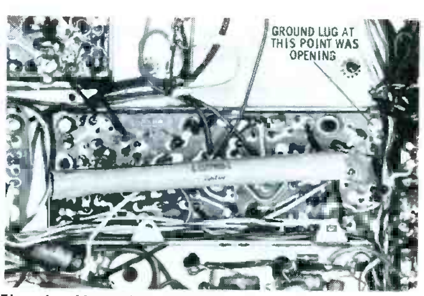

Fig. 6. Mounting eyelets very often serve as grounding lug for several circuit components.

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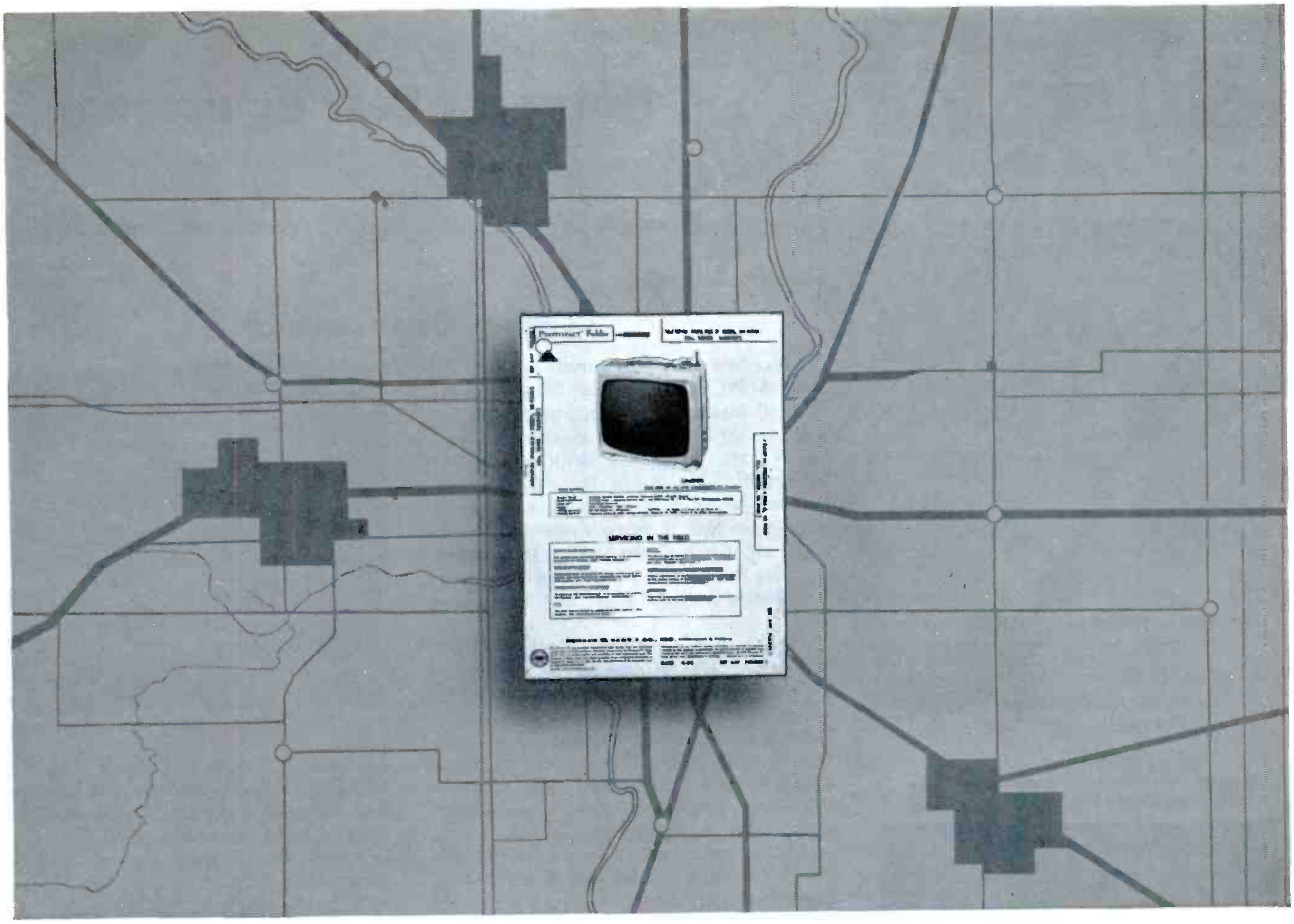

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Notes on Test Equipment

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

by Stephen Kirk

Compact Color Generator

This new unit (pictured in Fig. 1) from SENCORE uses the "keyed offset-carrier" method of producing color bars. This method gives ten distinct vertical color bars, beginning with a yellow-orange and continuing through the various shades of red and blue, and finally ending up with a green stripe on the extreme right side of the screen. In addition to color bars, the CG 126 provides dots, crosshatch, vertical bars, and horizontal bars.

Fig. 2 is a simplified block diagram of the CG 126. Notice in the upper left corner there is a crystal-controlled 189 kc oscillator. The signal from this oscillator is shaped and then used to produce the vertical bars. This same oscillator also triggers a 15,750 cps counter (multivibrator) which provides a horizontal sync signal. A 13,500 cps counter is also operated from the 189 kc oscillator; this counter triggers a 900 cps stage to give horizontal bars and a 60 cps counter to furnish vertical sync information.

Color bars are produced by the 3.56 mc (3.563795) oscillator, in conjunction with keying information supplied by the 189 kc shaper. Color is derived because the 3.56 mc oscillator is exactly 15,750 cps removed from the color set's 3.58 (3.579545) mc oscillator. This means that for each horizontal scan there is one cycle (360°) of phase shift. The color demodulators in the receiver sense the phase differences and a complete rainbow spectrum is displayed on the screen. The keying information blanks out nine spaces in the color spectrum, so the color pattern appears on the screen in ten vertical stripes, with a black bar between each.

All the information from these oscil-

Fig. 1. CG 126 has three front-panel knobs.

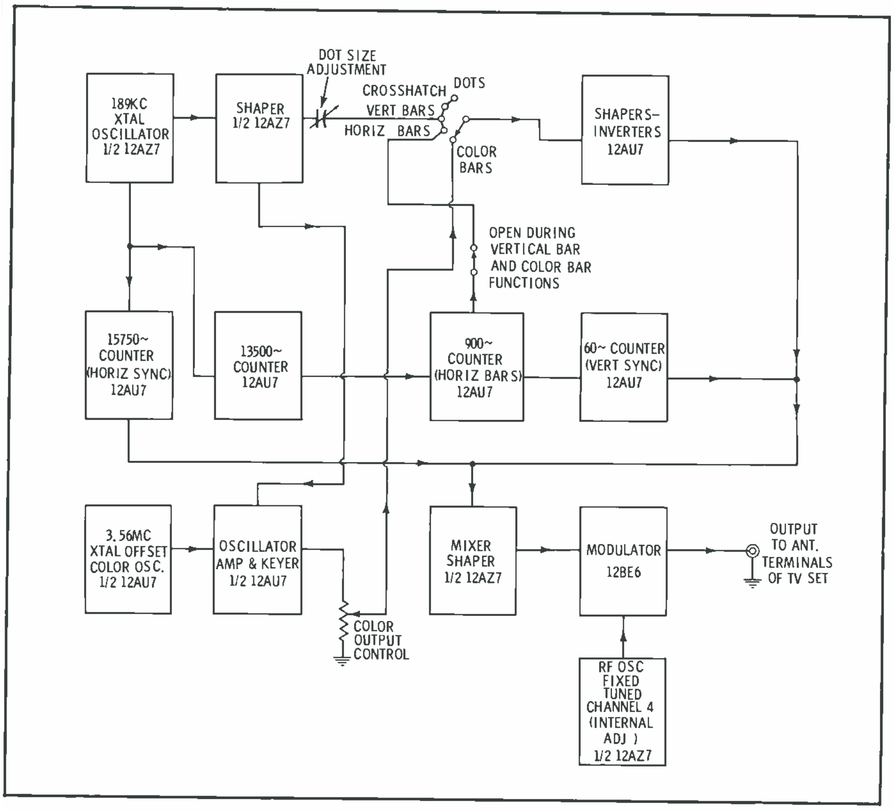

Fig. 2. Block diagram of stages used to produce color bars and the various convergence patterns.

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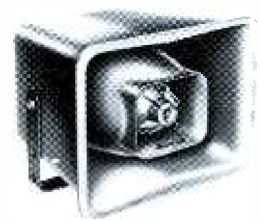
Low level system, moderate crowds or areas, patios, pool areas, motels, parking areas, etc.	Voice and music sound reinforcement. Compact size. Fiberglas reinforced polyester housing.	 UNIVERSITY MODEL MLC	15 watts 150-15,000 cps 120° dispersion 12$\frac{3}{4}$" x 9$\frac{1}{8}$" dia. 10$\frac{5}{8}$" deep
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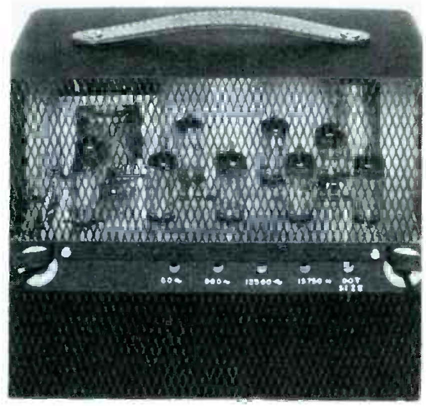

Fig. 3. The dot size and the counter adjustments are accessible from the rear of unit.

lators, shapers, and counters is fed to a mixer and then to an RF modulator. The modulator is fed an RF signal from a carrier oscillator that is factory adjusted to channel 4; however, the frequency may be changed in the field to either channel 3 or 5.

Modulating the RF signal with the dot or bar information means that you need only connect the CG 126 to the antenna terminals of the color set and turn the channel selector to channel 4. Unlike SENCORE's CA 122, there are no video or sync output signals independent of those contained in the modulated RF signal.

In addition to a pattern selector switch on the front panel, there is an OFF-STANDBY-ON slide switch and a COLOR OUTPUT control. The color output control is normally set for about midrange (100%) but may be advanced to 200% when troubleshooting a weak color stage. A drawing on the front panel indicates the correct order in which color bars should appear on the screen. Any deviation from this indicates a defective stage or misadjustment of controls in the color set.

The rear apron of the CG 126 (Fig. 3) has the four counter controls and a DOT SIZE adjustment. The 15,750 cps counter should be adjusted only if the set will lock in on a station but will not sync with a pattern from the generator. (Allow fifteen minutes warmup time before making any adjustments.) The 60 cps adjustment is for vertical sync, but for vertical jitter or lack of interlace the 13,500 cps counter adjustment is the one likely at fault.

We tested the unit on several different brands of color receivers. We had no difficulty making the necessary setup adjustments using only the crosshatch and dot patterns produced by the CG 126. We found the vertical and horizontal bars could be used for making fine checks on the convergence, especially at the edges.

Our CG 126 was out of horizontal sync when it arrived, but it was a simple matter to remedy by turning the 15,750 cps counter control until the pattern locked in. There was also a slight weave in the pattern but this disappeared after the suggested warmup time. The "operating hints" booklet packed with the unit contains information explaining the above, and what to adjust if corrective

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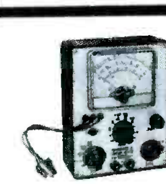

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action is needed. Readjustment of the counters is a simple process that doesn't require a scope—just any normally operating TV set.

The color bars locked in on all sets in their proper hue, and adjusting the tint control on the sets moved the magenta bar (we usually use the number 4 magenta bar as a check on tint) from the number 3 through the number 5 position. In addition to their uses in servicing, the color bars on a generator let you be sure the customer can make correct tint adjustments. They also prove to the customer (and yourself) that the set is capable of producing color, even though no color program is available for a check.

The CG 126 measures 8" x 11" x 6", making it easy to carry on service calls. Cord hooks are provided to stow the line cord and output cable with two or three quick wraps. This looks like a good generator for the shop that needs a second "knock about" generator, especially for home servicing.

For further information, circle 75 on literature card

Distortion Seeker

Not too many moons ago, the average one of us had not even heard of a Distortion Meter, much less thought of buying one. Today the AC VTVM and Distortion Meter are the proud possessions and tools of the trade for many technicians—and are being considered by a good many more. Higher and higher amplifier capabilities have forced us to stop depending on our built-in distortion indicator, the ear, and turn to the scientific approach, one not affected by physiological whims nor wishful thinking.

To fill this gap, EICO engineers have developed the Model 902 (Fig. 4) which combines the functions of an AC VTVM, an intermodulation (IM) distortion meter, and a harmonic distortion meter, all in one package. It can be purchased in either kit or wired form.

Fig. 4. Distortion meter and AC VTVM features well planned layout of the controls.

Just how can we use an instrument of this sort? And how does it work? Let's break its functions down into the three separate categories, beginning with the AC VTVM.

In this section, shown in block form in Fig. 5, we have amplifiers and attenuators designed to have flat frequency response from 10 cps to 100 kc. Low level audio signals, such as the output of microphones or phono cartridges, are fed directly from the input terminal into a cathode follower amplifier. High level signals are fed into a 60 db attenuator so as to not overload the cathode follower amplifier. Following this is a 10 db step attenuator which acts as a range selector. The output of the attenuator is amplified by two more amplifier stages and this signal is then fed to a diode bridge which rectifies it; the resultant rms value is then indicated on the meter.

The 10 db step attenuator makes it easy to calculate decibels. Each time you switch one range higher you simply add 10 db; if you go one range lower, you subtract 10 db. For example, if the input to an amplifier reads –3 db on one scale and the output reads +1 db on the next higher scale, the total gain of the amplifier is –3 + 10 +1, or 8 db. Zero (0) db is the industry standard of 1 mw across 600 ohms, so the db ranges are accurate only with an impedance of 600 ohms.

The AC VTVM will read full scale on audio signals as small as 10 mv (.01 volt) rms and up to 300 volts. The db scale is calibrated from –20 to +2; the total decibel range is from –60 to +52. Convenient tables are included with the instrument so that you can determine the exact power output delivered by an amplifier into all standard impedances from 3.2 to 600 ohms, from 1 mw to 100 watts.

Next, we'll consider the IM analyzer section. IM distortion occurs when a defect in an amplifier produces a new frequency from two other frequencies fed into the input. As an example, an amplifier having a 5000 cps signal and 40 cps signal fed into the input simultaneously should have only 5000 cps and 40 cps signals in the output. There should be no sum or difference frequencies such as would occur in a nonlinear amplifier.

Fig. 6 shows the IM distortion section in block form. Two signals, one high frequency (7 kc) and one low frequency (60 cps), are fed into a resistance-bridge mixer especially designed to produce no intermodulation distortion of its own. The mixed signals are fed into the audio amplifier being tested.

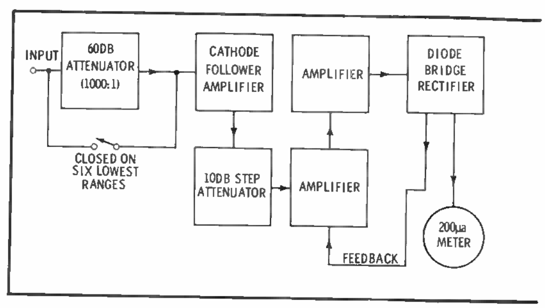

Fig. 5. Block diagram of AC VTVM section.

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Use Quam Hi-Fi Speakers in new systems, as extension speakers in existing hi-fi systems, and as replacement improvements in stereo consoles. They'll open your way to exciting new sales!

Write for your free copy of the new Quam Hi-Fi Catalog HF-64.

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Circle 46 on literature card

The output of the amplifier is fed to a cathode follower and to a high-pass filter which permits the high frequency signal to pass but blocks the original 60 cps signal. However, if the 60 cps signal, in passing through the amplifier under test, has modulated the high frequency, it "rides through" on the 7 kc signal. The high frequency signal is amplified, along with whatever modulation has been superimposed on it, and fed directly to the AC VTVM section.

With the OPERATION switch in IM CAL position, the CAL control is adjusted for a specific reading on the meter. The switch is then set to read % distortion. This feeds the output of the high-frequency amplifier to a detector circuit that detects any modulation that may be on the 7 kc "carrier." Following the detector, a low-pass filter rejects all traces of 7 kc signal, but allows any detected 60 cps signal to pass on to the VTVM. The lower the meter reading, the better the amplifier. The 902 will read 0.3% distortion full scale on its most sensitive range.

A good amplifier should have less than 1% IM distortion at rated power output. Most amplifiers will have less distortion when operating below their rated outputs than at full output. The untrained ear has a difficult time detecting even 10% distortion but the critical music lover can be driven to distraction. The total inherent IM distortion of the 902 itself is approximately .05%.

When an amplifier creates a new frequency from a harmonic of the input signal, harmonic distortion results. For example: If you insert a 1000 cps signal into the input of an amplifier, you should have little or no 2000 cps (second harmonic) or 3000 cps (third harmonic) signals in the output. Excessive harmonic distortion indicates nonlinearity in the amplifier.

In order to measure harmonic distortion with the 902, you must have an audio generator that supplies a good sine wave with a high signal-to-noise ratio. The sine wave signal is fed into the amplifier under test (see Fig. 7). The amplifier output is fed into the 902 where it is amplified and routed to a Wien Bridge rejection filter. This filter can be adjusted with two front panel controls to reject any frequency in the audio range from 20 to 20,000 cps.

The idea, in other words, is to feed a known frequency—say 400 cps—through the test amplifier, reject the 400 cps signal at the output, and send the remainder to be metered. Any reading on the meter indicates that the amplifier has created some new signal—such as an 800 cps second harmonic or a 1200 cps third harmonic.

Good amplifiers will have much less than 1% harmonic distortion at rated output, though not many years ago 5% and even 10% were considered permissible. The inherent harmonic distortion of the 902 is 0.1% or less.

Our first check using the 902 was made on a small AC-DC radio that sounded fair, but seemed to lack "something" in the way of tone quality—even with a large speaker attached. I guess we shouldn't have been surprised to find that both the IM and harmonic distortion at 1 watt output were almost 11%. At .1 watt output, the total harmonic distortion dropped to just under 3%.

We tried a feedback trick or two to see if we could improve the condition, but nothing seemed to help much. A 10 megohm resistor from the plate of the output tube (a 50C5) to the plate of the first AF amplifier (a 12AV6) gave a slight reduction (to about 10%) in both harmonic and IM distortion; any resistor smaller than this value increased

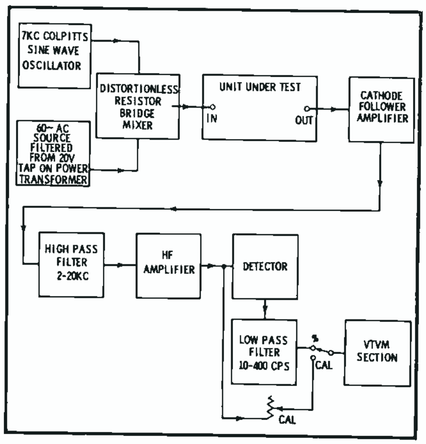
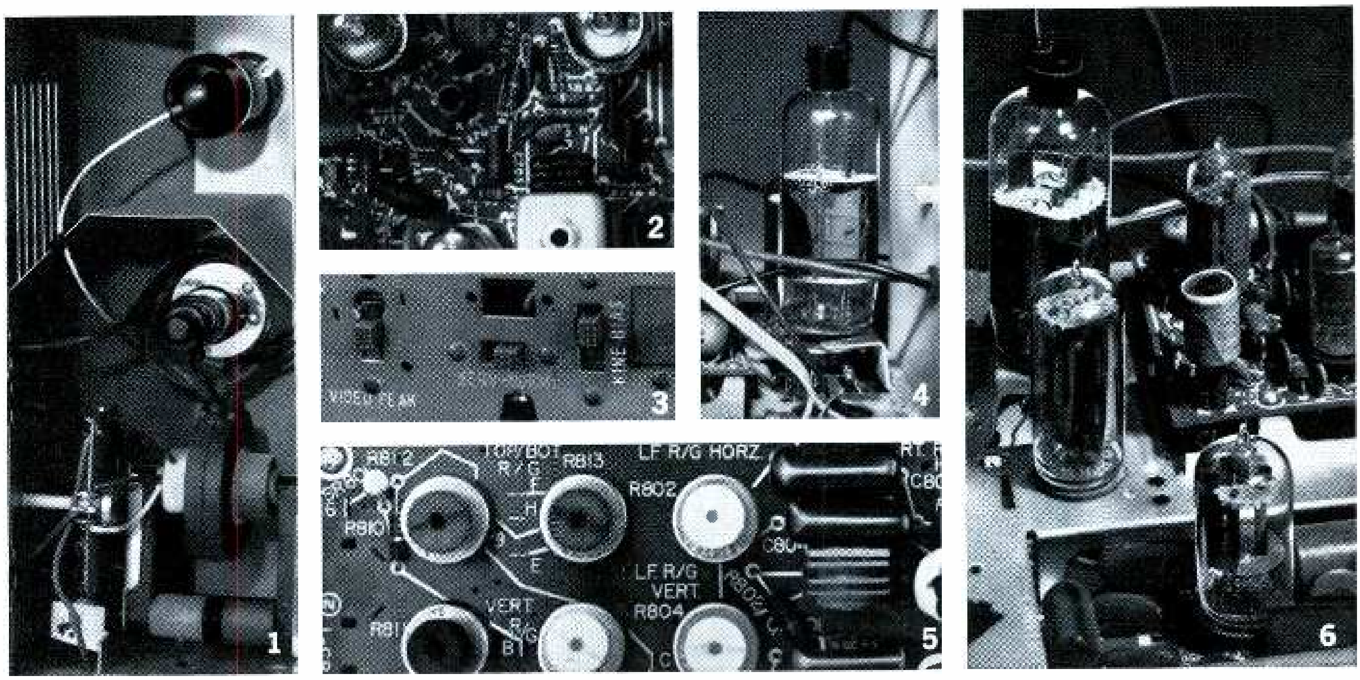


Fig. 6. Output of intermodulation detector passes through low-pass filter to VTVM section.

CTC 15 Color TV Chassis gives brighter, sharper picture; has greater reliability; is easier to service... than any previous RCA Victor Color TV Chassis!



RCA Victor's new CTC 15 chassis keeps all the performance-proved virtues of the CTC 12 . . . but adds these engineering improvements that should please both you and your customers:

The picture is brighter, better. It's brighter because a new design in the high voltage section (1) gives 30% more current output at the same voltage. The picture tube circuits are designed for effective use of this higher power.

It's sharper because the picture tube screen voltages have been boosted . . . giving a smaller, sharper dot pattern with less blooming. The video amplifier has better phase response.

It's steadier because of substantially improved vertical hold circuits.

A new picture "tone control" . . . it's a video peaking switch (3) . . . offers three choices of picture quality: soft, normal and sharp. When snow and ghosts are your problem, use the soft setting for a smoother, more pleasing picture. When the signal is better, make the most of it with the normal or sharp setting.

Less color fringing results from a new clamp diode in the convergence circuit and rearranged controls are easier to use. And UHF reception is improved by new circuitry that reduces snivets . . . those black vertical lines near the center of the picture.

Greater reliability . . . longer component life. Heat build-up has been reduced by housing the flyback transformer and the regulator tube in separate compartments.

The horizontal output tube (4) is placed on a raised "cooling shelf" outside the H.V. compartment. Its position allows free flow of air around its base. Three conventional tubes have been replaced by novars (6). They run cooler and last longer. One of them is the hardest working tube in the set—the horizontal output tube.

And dark heater tubes are used in all high-performance circuits.

To further increase life, the focus rectifier is now specially designed for additional life expectancy.

Easier servicing. Circuit tracing is easier and faster . . . the new schematic solid-line roadmaps (2) go point-to-point, and component labels are larger.

It's easier to service the high voltage compartment . . . it has a hinged cover and better arrangement.

Color setup has been simplified by the addition of a conveniently placed 3-position bias switch (3) which accommodates wide variations of picture-tube characteristics.

RG controls (5) on the convergence board have also been rearranged for your convenience. Now you use the entire top row to make adjustments according to the horizontal lines in a crosshatch pattern; the entire second row is for the vertical lines.

Color TV is the technician's big bread and butter business . . . for years to come. We stand ready to help in every possible way to make this fast-growing business a profitable one for technicians —and for dealers as well.

See Walt Disney's "Wonderful World of Color," Sundays, NBC-TV Network.

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distortion above the amount produced originally.

We then checked the output stage by itself and found that the distortion was only 3% at 1 watt. This meant that most of the distortion was in the first audio stage. This stage had grid leak biasing, which is common in these small radios. For curiosity, we tried cathode biasing and found we could reduce the total harmonic distortion to about 4% at 1 watt output, if we left the cathode resistor unbypassed. With this same setup, the distortion dropped to just about 1% for .1 watt output.

We then checked a TV set having a push-pull audio output stage. We assumed that normal playing level would be below 1 watt, so we set the output for 1.48 volts (1 watt Equivalent Sine Wave Power at 3.2 ohms, according to the chart supplied with the 902) and measured the IM distortion. It was 2.4%, which we considered low enough for practical purposes.

The next unit checked was a nice-sounding amplifier with a rated output capability of 20 watts. We connected it to a good quality 8 ohm speaker and connected the 902 for IM testing. We adjusted the IM OUTPUT control for 10.5 volts (20 watts ESWP) across the speaker. We checked the IM frequencies for the normal 4:1 ratio, turned the FUNCTION switch to IM, and set the OPERATION switch to CAL. The meter range switch was set to IM CAL and the meter adjusted for a full scale 3 volt reading. We then turned the OPERATION switch to "%," and the meter dropped back to near zero. We rotated the meter range switch to the .3% position and the meter read .26%. No wonder the amplifier sounded good.

Most late model amplifiers are even better, we found. Those designed primarily for PA applications have less than 1% IM distortion at their rated output. We checked one 12-year-old PA amplifier and found 5% distortion at one-half the rated output and a whopping 13% at full rated output.

We found the 902 to be a valuable asset in both rating and servicing amplifiers. Anyone should be able to operate it with just thirty minutes of practice. It even convinces the "golden ears": the audiophile may argue with *your* ears, but he has no recourse when he reads the distortion (or lack of it) on the meter of the 902! ▲

For further information, circle 76 on literature card

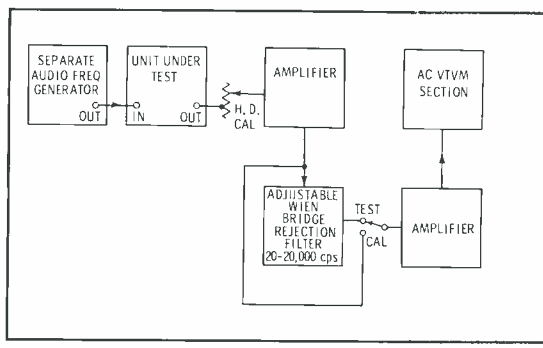


Fig. 7. A separate audio generator supplies signal sources for harmonic distortion tests.

TARZIAN RADIO-TV TIPS:

How to achieve trouble-free replacement of Selenium with Silicon Rectifiers

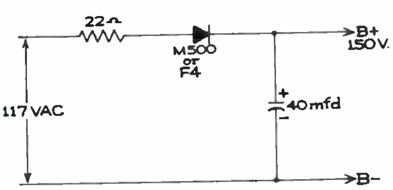
■ Substituting silicon for selenium rectifiers is highly desirable, but silicon units have extremely low impedance. When the rectifier conducts, a heavy pulse of current passes into the capacitor and through the power line. You can see this if you connect an oscilloscope across the surge limiting resistor. The strong pulse can cause interference by mixing with incoming video or radio signals.

Here are the symptoms you will notice, and here is the simple way to eliminate them.

POSSIBLE TROUBLE

Objectionable hum in radio,
or,
TV picture brightness fluctuates during pulse,
A black or white horizontal bar is generated across the picture tube (and can be shifted from top to bottom of picture by reversing ac plug),
The bar may interfere with the sync signal and the picture will pull out of vertical synchronization.

RADIO



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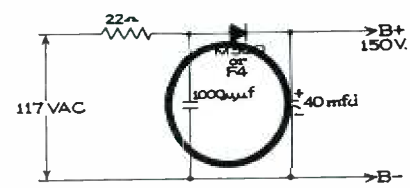


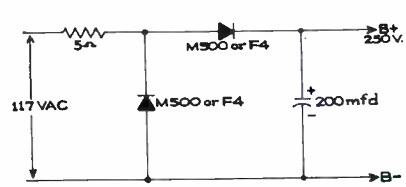
After

SOLUTION

Install a 1000 mmfd capacitor between the resistor and the rectifier, from the rectifier end of the resistor to the negative line (see circles). The RC combination provides necessary filtering action.

You'll also notice a sharp reduction in rectifier failure formerly caused by transient voltages fed in off the line.

TELEVISION



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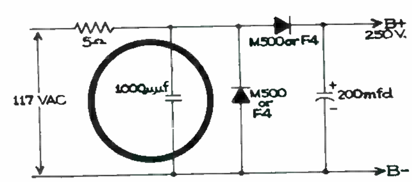

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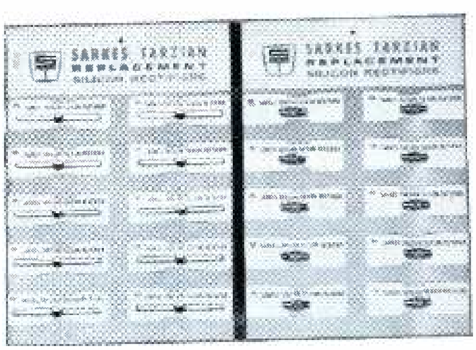
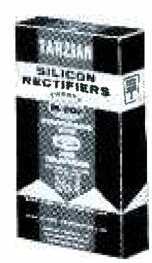


The Tarzian Replacement Line includes silicon rectifiers and conversion kits, tube replacement silicon rectifiers, and "condensed stack" selenium rectifiers. Immediately available from distributors throughout the nation, in the quantities and ratings you want most.

FREE CATALOG 62-DL-4 contains complete information on all Tarzian Replacement Line Rectifiers. Send for your copy today—be sure your files are up to date on the rectifier line voted first choice among service technicians throughout the United States.



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Circle 47 on literature card

Test Equipment on Parade

The very life's blood of the electronics servicing business is good test equipment. Every serviceman should be aware of instruments for every possible use in his job Each year, imaginative manufacturers come up with newer and more versatile units that simplify some service or troubleshooting activity. Here is a representative listing of instruments that have been introduced within the past six months. Some are shown here for the first time.

Examine them. Note their uses and imagine how you might put them to work in your servicing activities. If any one of them will save you time, or make your efforts more effective and profitable, you will want to see your distributor about buying it.

Capacitance Decade

This device contains several precision capacitors, switch selected to provide capacitance values from very low to very high. A decade finds much use for quick and easy substitution in experimental circuits.

The *Hallicrafters* Model HD-1 in Fig. 1 provides 10,000 capacitance values in steps from .0001 mfd to 1.0 mfd through 16 individual slide switches.

Capacitance-Resistance Tester

A capacitance tester not only checks values, but also uncovers shorts, leakage, and opens, usually by simulating DC conditions of the circuit in which the capacitor operates. A resistance tester tests resistors similarly.

The *Hallicrafters* Model HC-1 shown in Fig. 2 is a combination capacitance-resistance tester. The heart of the instrument is a capacitance-resistance bridge provid-

Fig. 1. A capacitance decade box aids in the location of suspected defective capacitors.

ing four capacitance ranges from 10 mmf to 2000 mfd, and three resistance ranges from .5 ohm to 5 megohms. A low AC voltage is provided to safely test transistor-circuit electrolytic capacitors. For DC testing, switch-selected ranges of 50, 100, 150, and 450 volts are available. A tuning eye is provided to indicate balance of the RC bridge.

Color Generator

In today's TV service shop, color signal generators are becoming commonplace. Convergence, chroma circuits, demodulators—all require this special generator for proper and quick adjustment.

Fig. 2. Capacitor testers subject the capacitor to stress encountered in the circuit.

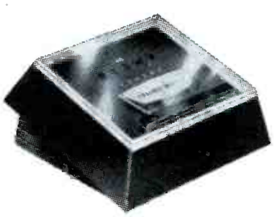
Here's the only excuse you may have for not installing the world's best manual rotator at our REDUCED PRICES...

...you just don't use manual rotators in your area!

Say, on the other hand, you *do* sell them. And believe with all your heart in selling the very best. What else can you do then but go with Channel Master rotators? Especially when you can now get our manual model at reduced prices.

This is the one rotator, remember, that makes all others look like also-rans; because it alone has the high torque to turn the heaviest antenna array easily—plus the ruggedness to keep it on course in foulest weather.

For instance: In addition to simplest fingertip control, accurate repeatability, continuous instant direction indication, (and lots of other good features), only Tenn-A-Liners give you:



model 9520

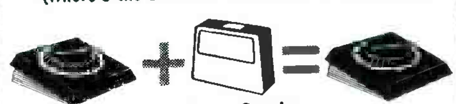
- Built-in *hard-steel* thrust bearings (not soft aluminum parts). So friction-free the Tenn-A-Liner will turn ice-loaded installations as heavy as 330 lbs.
- *Hard-steel* precision-machined gears (not stamped). So rugged that they won't strip or bind. Will continue to operate even in 70 mile gale winds.
- *Pushbutton* "On-Off" Switch (brand-new) that prevents reception interference caused by wind vibration.

... **now** *what's your excuse for not calling your nearest Channel Master distributor?*

NEW! Unique Gemini Rotator/Amplifier. ... for fast, neat *2-in-1* installations that save you money 4 ways.

(A simple explanation of what the Gemini is—for those dealers who have heard about this product's terrific profit success story).

(Where's the booster? It's hidden in the rotator).



World's first all-in-one rotator-amplifier combination! Only 1 unit on mast—1 housing on set—1 transmission line.
Choice of 2 Models:
NEW! TV/FM Gemini, Model 9518.
"TV ONLY" Gemini, Model 9527
(includes Built-in FM Trap).

Tried our superb Automatic Rotators? There's nothing better. They're available at our regular prices.

CHANNEL MASTER ROTATORS

ELLENVILLE, NEW YORK

Circle 18 on literature card

Fig. 3. A gun-killer color generator speeds convergence, facilitates purity adjustments.

The *Hickok* Model 662 (Fig. 3) generates all the signals necessary to perform convergence—vertical bars, horizontal bars, a cross-hatch pattern, and a dot pattern. In addition, a color signal is provided for troubleshooting and aligning color circuits. The video output of the generator can be fed into the detector circuit; the RF is fed into the receiver's antenna terminals. Dot, bar, and crosshatch signals are based on a system of 500 intersect points with a 5:4 aspect ratio. This assures that dot coverage includes the critical and hard-to-converge areas in the corners and along the edges of the CRT.

Continuity Tester

A continuity tester is handy not only in the shop but also on service calls, to check for open circuits in power cords, tube filaments, and printed boards.

A combination flashlight and continuity tester is shown in Fig. 4. This *Eveready* 308CT is shatter-

Fig. 4. A combination flashlight-continuity tester serves dual role for the technician.

Fig. 5. This distortion meter is also AC vacuum-tube voltmeter and decibel meter.

proof and resistant to oil, water, and grease.

Distortion Meter

A distortion meter measures the percentage of intermodulation or harmonic distortion present in an audio signal. The instrument shown in Fig. 5 is not only a distortion meter but is also a sensitive AC VTVM and db meter.

When used as a distortion meter, the *EICO* Model 902 has an input impedance of .5 megohm and an output impedance of 600 ohms. When used as an AC VTVM, its input impedance is 2 megohms. For measuring IM distortion, five ranges are provided—from .3% to 30%. For measuring harmonic distortion, six ranges are provided—from .3% to 100%.

The AC VTVM has a frequency response from 10 cps to 100 kc. It will measure from .0002 to 300 volts rms in ten ranges.

Field-Strength Meter

For the proper location of TV antennas, and as an aid in tuning two-way radio transmitters, a field-strength meter is invaluable.

An accurate all-transistor FSM is the *Blonder-Tongue* FSP-3. It

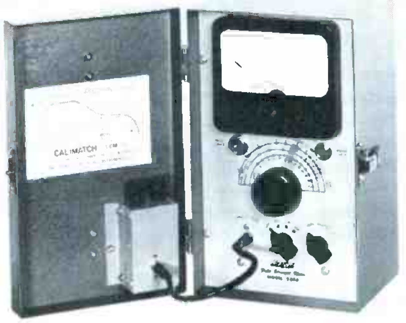


Fig. 6. A field-strength meter for measuring the strength of any VHF or UHF carrier.

Fig. 7. This FSM can be used to measure the strength of FM as well as VHF TV channels.

can be used to measure field intensity, check amplifier gain, measure the attenuation in any passive device, balance MATV systems, check for signals causing spurious interference, and measure amplifier cross modulation. With adapters, the instrument can also be used as a wattmeter to find the relative strengths of transmitter output and spurious emissions.

The FSP-3 has a frequency range continuous from 52 to 220 mc, and bandwidth at half-power points (3 db down) of .5 mc. With an input impedance of 75 ohms, the instrument will measure from 0 uv to 3 volts by use of ten switch-selected ranges. It will likewise measure from .25 micromicrowatts to 10 watts in ten ranges.

Another 75 ohm FSM is the *Hickok* Model 235A, shown in Fig. 6. This is the first unit we've encountered that works on both VHF and UHF. It covers TV channels 2-13 and 14-83, reading the absolute field strength of the video carrier. Requiring one "B" and two "A" batteries, the unit is completely portable.

Fig. 7 is a picture of a *Sadelco* TV-FM field-strength meter having four sensitivity ranges to provide readings from 0 uv to 1 volt, and −33 to +60 db. The completely transistorized Model FS-1-B is portable, and operates for several months on nothing but two 9 volt batteries. It has a 75 ohm input impedance.

Oscilloscope

Oscilloscopes, once frowned upon by radio repairmen as bothersome rather than helpful, have become an important tool to modern technicians.

Fig. 8. A 5 mc scope featuring a 1 volt P-P calibrator and a retrace blanking amplifier.

Since it has a bandwidth to 5 mc, the *Hallicrafters* Model HO-1 precision 5″ oscilloscope shown in Fig. 8 is suitable for both color and monochrome servicing. The scope features retrace blanking, a 1 volt peak-to-peak calibrator, automatic sync, 0-140° variable phasing, up to 400 kc horizontal response, and frequency-compensated attenuators. In addition, the HO-1 has provisions for beam modulation on the Z axis.

A direct-reading scope with a frequency response from 10 cps to 4.7 mc is shown in Fig. 9. This 5″

Fig. 9. A direct reading wideband scope is useful for either monochrome or color TV.

SENCORE Model PS 127 features retrace blanking, measurement of peak-to-peak waveforms up to 500 volts, direct connection to the CRT deflection plates (and cathode), Z axis input, and horizontal frequency response from 10 cps to over 400 kc. Sensitivity is .05 volts peak-to-peak for 1″ deflection.

Power Converter

A power converter is used to convert one voltage value to a higher or lower level. Converters are used where a DC voltage is required that is higher or lower than that available.

The *Linear Systems* Century Model DC-to-DC converter shown in Fig. 10 is a solid-state unit. It has voltage outputs from 650 to 850 volts at 500 to 400 ma, 250 to 325 volts at 200 ma, and a bias output from 0 to –120 volts at 20 ma. The unit operates at 91% efficiency with 275 watts output, and shows only an 8% drop from no load to full load.

Power Supply

A well regulated power supply is a must for any shop servicing auto or mobile two-way radios. The supply can double as a battery eliminator and battery charger. Units with small power capabilities can be used only for powering transistor radios, but their ripple must be low.

Fig. 10. A 275 watt power converter with a drop of only 8% from no load to full load.

Fig. 11. Variable DC supply can be used for transistor radios if ripple is low enough.

Fig. 11 shows a power supply that can provide any voltage up to 15 volts, at currents as high as 15 amps. On this unit, the *Hallicrafters* Model HP-1, an unfiltered output is provided for charging batteries. The filtered output features maximum ripple of .3% rms.

A 0-30 volt DC, 500 ma supply—manufactured by *Digital Electronics*—is shown in Fig. 12. Termed the Model 1526, this transistorized unit has a regulation of .5% for any load change, and .25% at full load over a 10% line variation. Ripple is less than .002% rms at full load—plenty low for powering the most sensitive transistorized equipment.

R-C Bridge & R-C-L Comparator

An R-C bridge is used to test resistors and capacitors for value, opens, shorts, and leakage. An instrument which performs all these tasks is the *EICO* Model 965. As an R-C-L comparator, the 965—shown in Fig. 13—can be used to find the value of unknown resistances, capacitances, or inductances.

The unit has capacitance ranges from 5 mmf to 5000 mfd in five ranges, and resistance ranges from .5 ohm to 500 megohms. The instrument can also be used as a DC vacuum-tube volt-milliammeter, for it has voltage ranges to 500 volts at an input impedance of 10 megohms,

Fig. 12. A well filtered, adjustable battery eliminator—always best for transistor sets.

Fig. 13. Comparator determines the value of unknown resistance, capacitance, inductance.

and milliammeter ranges from .01 ua to 15 ma.

Resistance Decade

A resistance decade supplies various combinations of switch-selected resistors much like the capacitance decade does. By manipulation of the switches, a variety of different resistance values can be selected.

The *Hallicrafters* Model HD-2 shown in Fig. 14 provides 10,000,000 possible resistance combinations in steps of 1 ohm, from 1 ohm to 10 megohms. Twenty-eight slide switches make this selection possible.

Signal Generator

Signal generators come in all sizes and ranges. The *Hallicrafters* Model HG-1 is shown in Fig. 15. This instrument has six fundamental frequency ranges from 50 kc to 55 mc, and two harmonic ranges from 55 to 220 mc. The RF signal output

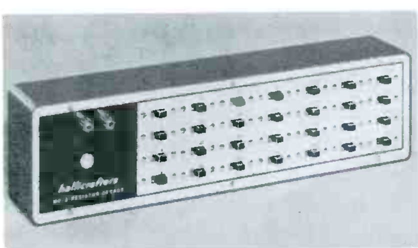


Fig. 14. This resistance decade provides 10,000,000 combinations—1 ohm to 10 meg.

Fig. 15. This generator provides modulated RF or CW from 50 kc to 220 mc in 8 ranges.

Fig. 16. This instrument generates UHF signals from VHF TV signals.

Fig. 17. Transistorized FM generator with a battery or AC power supply.

is supplied to a 50 ohm, 24″ cable, and the level is adjustable via a three position coarse attenuator and a variable fine attenuator. A 400 cps tone can be switched to modulate the carrier, or taken off at banana jacks.

The *Standard Kollsman* "Translator," which will convert any VHF channel to any UHF channel, is shown in Fig. 16. It will convert color information or monochrome equally well. The unit has two tuning controls: a UHF and a VHF channel selector. A bias control is provided for adjusting the output signal level from 100 uv to 10 mv (or higher, depending on the strength of the incoming VHF signal).

Stereo Multiplex Generator

For servicing FM stereo equipment, a multiplex generator soon becomes a necessity. More than just a signal generator, this instrument measures separation between stereo channels and provides a tone signal for either channel or both, and usually offers either a modulated or unmodulated RF signal. In addition, it has a crystal-controlled 19 kc pilot signal.

The *Hickok* Model 727 shown in Fig. 17 has all these features. Separation is 35 db or better in the unit, and there is a choice of RF (100 mc), composite stereo output, or frequencies of 19, 38, or 67 kc.

The *SENCORE* Model MX 129 is pictured in Fig. 18. This instrument provides frequencies of 19 or 67 kc, and a 100 mc signal—either CW, or modulated at 60 or 1000 cps. The output is 0-7 volts peak to peak, with a calibrated impedance of 300 ohms. Two meter scales are provided for making external measurements:

Fig. 18. Multiplexing generator with a P-P voltage and decibel meter.

Fig. 19. A 4.5 mc crystal is provided with this instrument to align TV sound circuits.

3 and 30 volts peak to peak, full scale. The scales are also calibrated in decibels for direct measurement of separation.

Sweep Frequency Generator

Sweep generators are very useful in determining the frequency response of tuned circuits. For working on radios and TV's, a sweep generator aids in aligning a tuned circuit or a stagger-tuned group to the exact bandpass it was designed to pass.

Fig. 19 shows the *EICO* Model 369 Sweep & Marker Generator. The sweep generator, which is independent of the marker generator, has five ranges from 3 to 220 mc. The marker frequency ranges from 2 to 225 mc. A 4.5 mc crystal, plugged into a socket, automatically turns on a fixed-frequency oscillator whose signal provides a fixed marker for alignment of TV sound sections.

Transistor Analyzer

The *Triplett* Model 3490-A transistor analyzer shown in Fig. 20 is capable of setting up nearly any kind of transistor test desired. Also, it allows plotting of transistor characteristic curves to determine the transistor's usefulness in particular applications.

Fig. 20. An analyzer for precision testing of signal and power transistors and diodes.

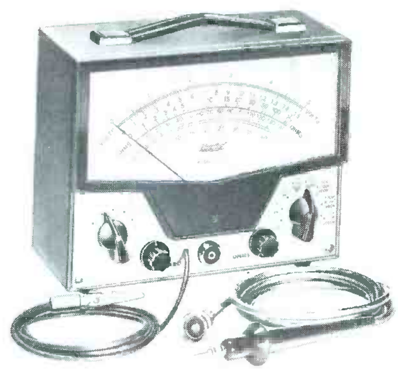


Fig. 21. This VTVM will measure up to 1500 volts AC and DC, has 8 resistance ranges.

The 3490-A, capable of reading reverse current leakage as minute as 100 nanoamperes on a 6 ua meter, has three meters which independently and continuously monitor the transistor under test. Also included are the features of continuously adjustable collector current up to 30 amps, voltage control for transistor supply electrodes, and an input bias reversing switch. The 3490-A measures AC and DC beta; alpha; Iceo, Icbo, and Iebo leakage; punch-through; saturation; and floating potential. It will test diodes and rectifiers, zener diodes, and silicon-controlled rectifiers.

Tube-Transistor-Diode Tester

Hickok has a Model 800A which tests tubes, transistors, and diodes. It will handle *novars,* 5- and 7-pin *nuvistors,* and 10-pin *compactrons.* The instrument has three Gm ranges which are indicated directly on the meter—0-3000, 6000, and 15,000 umhos. Interelement leakage up to 10 megohms can be read on the meter, which is push-button controlled for reversing its polarity.

Vacuum-Tube Voltmeter

A VTVM is used when measurements with a VOM might upset performance by loading the circuit. Several have been introduced in the past few months.

A VTVM designed to measure from a few millivolts to 1500 volts, on both AC and DC scales, is shown in Fig. 21. This *Hickok* Model 470A has eight peak-to-peak voltage ranges: 0-1.4, 4, 14, 40, 140, 400, 1400, and 4000, with a frequency response from 15 cps to 2.5 mc. It also has eight resistance ranges: from x1 to x10K. ▲

VTVM or VOM

(Continued from page 29)

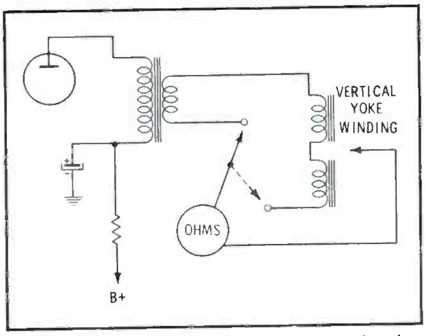


Fig. 5. Ohmmeter tests secondary and yoke.

coupling capacitor between stages can be traced easily by using the AC meter.

DC voltage measurements should be made only after it has been determined where proper AC signals do not appear. An open plate load resistor or size control will be obvious from the missing plate voltage. It is a good idea to turn the size control through its range while making this observation, especially when it is mounted on printed circuitry. The ohmmeter can make the final identification of most faulty parts.

No Raster

If high voltage is present, the DC voltmeter should be used between the grid and cathode of the CRT to determine if cutoff bias has been placed on the CRT by some defect in the brightness control or video output plate circuits. When there is no handy way to test the CRT, a rough idea of cathode emission can be obtained by placing a sensitive milliammeter (1 ma) in series with the cathode and adjusting the brightness control for maximum while watching the meter deflection. CRT's draw very little beam current, seldom more than 400 ua (.4 ma).

When there is no high voltage, the AC VTVM will tell you whether

"Sidney is quite eager to get the society trade!"

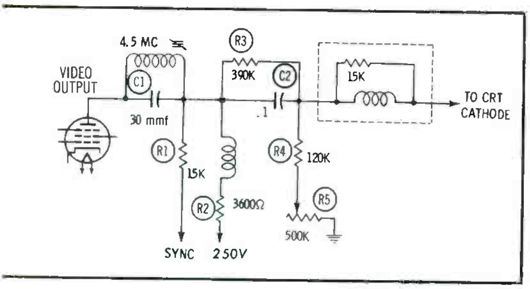


Fig. 6. Defective C2 caused the low contrast.

the oscillator signal is reaching the grid of the horizontal output stage. It should be nearly 100 volts peak-to-peak, so the VTVM will show only about 25 volts. A DC measurement of grid bias will indicate the condition of the coupling capacitor and show if drive is being developed. The grid resistor and the cathode circuit can be checked with the ohmmeter.

The screen voltage can be very revealing; if it is down 25% to 30%, the fault is probably in the plate or boost circuit. Anything that reduces the plate voltage in a class C stage will increase the screen current, causing a larger drop across the screen resistor and consequent reduced screen voltage. Of course, be sure the resistor itself is okay.

Ohmmeter measurements in the flyback and boost circuits, including the yoke, are in order once the oscillator and output stages are cleared of suspicion.

No Voltage Clues

From the foregoing case histories, you can see how your VTVM can be used to troubleshoot most stages of a TV receiver. But it is only fair to point out some of the pitfalls—faults that display no measureable voltage clues—and show you how to skirt around them.

One case of low contrast caused a certain technician considerable grief when he tried servicing it with only a VTVM. The sound was fine, so he looked for trouble in the video stage. DC voltages all checked within 5% of normal, so he didn't even bother tracing with the AC portion of his VTVM. When resistance readings failed to turn up anything in either the video or CRT circuits, he decided to look for trouble in the video IF sections. Still no luck.

Finally, he returned to the video and CRT circuits (see Fig. 6), replacing components as he went. When he substituted a new C2, the trouble cleared up. Even tracing with the AC portion of his VTVM wouldn't show this particular trouble, because the DC-coupled arrangement caused the fault to change the video waveshapes drastically; the meter couldn't see much difference in the *effective* (rms) reading.

Another troublesome case points up the fact that certain sync troubles are extremely difficult, if not impossible, to pinpoint with a VTVM. The circuit was that in Fig. 7, and the symptom was a complete lack of either horizontal or vertical sync. DC voltage readings in the sync section were all normal, and resistance readings revealed nothing. Sync signal voltages are not large enough in these circuits to show any significant AC reading on the VTVM, so the technician resorted to parts substitution. Finally, a new sync coupling capacitor (C3) solved the problem. But much time had been wasted (and several extra components) before the fault was found.

One of the most baffling cases was a set that had intermittent horizontal sync on local stations; the

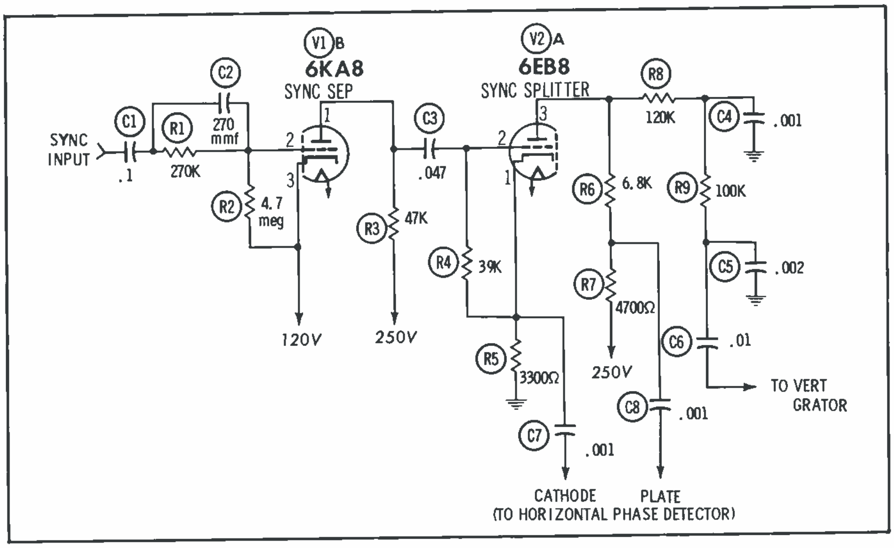


Fig. 7. VTVM has limitations for some symptoms, therefore special test equipment saves time.

set owner had no trouble whatever on the station from a town about 50 miles away. Naturally, this pointed to AGC trouble, but voltage and resistance checks cleared the AGC stage of any apparent faults. The sync and horizontal AFC circuits were checked the same way, but to no avail. After much probing in IF circuits, and while just "fiddling around," the technician suddenly discovered that when he tried adjusting the horizontal hold coil, the AC reading at the plate of the keyed AGC tube was erratic—but only on strong local stations. (Imagine the strange combination of sheer lucky circumstances that caused him finally to stumble across this fact.) With this clue, he decided to check the horizontal output and oscillator stages. A two-hour testing session there turned up nothing. Everything seemed okay, and he gave it up in exasperation.

Three days later he tried again. This time he decided to rebuild the entire horizontal sync circuit. Starting at the sync splitter, he worked his way through the diode AFC system to the horizontal oscillator. When he changed the coupling capacitor at the grid of the oscillator, the symptom disappeared. A total of seven servicing hours had been spent.

Use It Wisely

Used expertly, the VTVM can help a good technician find his way to the trouble spot quite rapidly. But learn to spot the limitations of the instrument in small-signal pulse circuits (sync and video). Don't let yourself stumble blindly into hours and hours of wasted time.

Your VTVM is one of the most versatile instruments you can own, but certainly is not the only instrument you should own. If the trouble can't be spotted by usual procedures, set the VTVM aside before you become disgusted, and use the specialized equipment that is built for showing waveshapes, peak-to-peak voltages, and tiny pulse signals. ▲

UHF Tuners

(Continued from page 36)

cies, you should proceed to the mixer stage. This is a very simple stage consisting of an oscillator injection circuit (capacitive or inductive), an RF injection circuit (capacitive or inductive), a mixer (usually a UHF crystal diode), and a load circuit.

The injection circuits are usually short wire lengths or small capacitors that can be checked by visual examination. Injection current may be checked by measuring mixer crystal current; ½ to 3 ma is normal, depending on the particular model. This current is sometimes adjustable by bending the loop circuit lead or a small metal flap over it. In some tuners, proper injection is determined by connecting a sensitive DC VTVM at the output side of the crystal; .03 to .35 volts is the normal range of readings to expect.

The load circuit usually consists of a load coil roughly tuned to the output frequency, and a small UHF bypass capacitor. In a tuner, the load coil is tuned to the set IF; in a converter, to the VHF channel frequency. In some tuners and converters, this load circuit is tunable for best response and gain.

Most problems in the mixer stage consist of poorly soldered connections, open load coils (particularly if the coil is tapped), and shorted or open coaxial leads.

Antenna-RF

The antenna and RF stages of a UHF tuner or converter usually consist of one or two tuned stages and an input circuit. In most units presently in use, there is no amplification in these stages. They are used to reduce oscillator radiation and to help select the desired frequencies. Units have been designed recently that do use UHF preamplification, and you'll be seeing more of them in the months to come.

The antenna input circuit may be inductively or capacitively coupled. It is almost always a 300 ohm balanced input. Some units use a small balun to couple to an unbalanced tube-input circuit. Always check the antenna circuit for possible lightning damage. Frequently, you will find isolating capacitors and resistors, coupling capacitors, inductive coupling coils, or the balun damaged after an electrical or a heavy thunderstorm.

The antenna and RF tuning stages are subject to few problems as they consist only of tuned circuits and coupling devices—either inductive or capacitive. A few common problems and solutions appear in Table 3.

Special Hints

In some capacitor end-tuned tuners and converters, the only supports for the antenna and RF stage tank circuit is a solder mount at the "cold" end of the tank. Sometimes the stator end of the tank shifts position, throwing the antenna or RF stage out of alignment. After recentering the tank and stator, you can put small styrofoam supports between the stator end of the tank and the partition walls to help support the tank.

Another very popular capacitor end-tuned tuner has an oscillator tank that has three stator plates. The two outside plates are attached to the center plate and main tank element by swaging. These plates have a tendency to move after a period of time, throwing the oscillator off frequency. When repairing this tuner, recenter the two outside stator plates and secure them to the center plate with a couple of drops of solder placed at the "cold" end of the stator plates. Be sure the rotor plates can't touch the solder during tuning. Great care must be exercised to prevent solder from flowing *between* the stator plates.

UHF tuner or converter repairs often necessitate realignment. Procedure varies considerably, but here are some general hints. You'll need a UHF sweep generator, UHF marker generator, VHF marker generator, scope, scope preamp, and adapter jigs as specified in the alignment procedure for each tuner or converter.

The alignment of parallel-line tuners and converters is usually quite simple, as most of them have high-end and low-end adjustments for the oscillator, RF, and antenna stages. Low-end adjustments are usually ceramic trimmer capacitors, and high-end adjustments are made by pushing short metal foil strips closer together or spreading them farther apart.

In capacitor end-tuned units, it is usual to have high-end and low-end adjustments for the oscillator stage only. The antenna and RF stages usually have only a high-end adjustment (a movable metal plate or a threaded machine screw). These stages are then tracked to the oscillator alignment by "winging" or "knifing" the slotted outer plates of the antenna and RF rotors at specified intervals across the entire tuning band.

Shall You Try It?

If you are a reasonably competent technician, and can do neat, careful work, you can do UHF tuner repairs. UHF tuners will require much greater care than you've been accustomed to with VHF tuners, but it is entirely possible for you to do a comnetent job of servicing them.

Tuner companies will repair most popular brands at a nominal charge. If you don't feel up to taking the chance of damaging a delicate tuner, by all means don't hesitate to make use of tuner repair services. But if you are willing to undertake the careful servicing techniques outlined in this article, you may well become the UHF tuner expert in your area. ▲

DC Scope

(Continued from page 31)

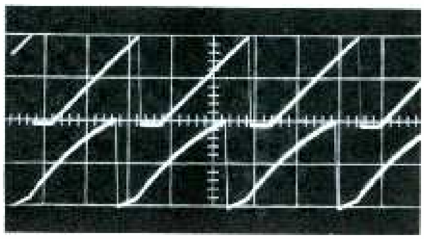


Fig. 9. Same sweep—shown on DC and AC.

without distortion. However, as the signal duration lengthens, the natural curve becomes more apparent, and affects the waveform shape more noticeably. Since there are no coupling capacitors in the vertical deflection amplifier of a DC scope, there is none of this type of distortion with either long or short pulses.

Waveform distortion in AC scopes is not limited to square waves. Such distortion can also occur in composite waveforms or in sawtooth sweeps as shown in Fig. 9. In this photograph the scope was switched from DC to AC, using the same input signal, and the presentations were superimposed by double exposure. The DC presentation is shown at the top. Both the AC and DC presentations of this 8 cps sawtooth cover two vertical divisions (20 volts), but the AC presentation shows obvious distortion.

No Low Frequency Cutoff

In addition to causing distortion at lower frequencies, an AC scope is bound to have a low frequency *cutoff point*. As this point is approached, the signal amplitude will be reduced. This is demonstrated in Fig. 10.

The scope was switched from AC to DC with the same input signal, and the presentations superimposed. For the first exposure, the scope was set for AC, and a 40 volt input signal was gradually reduced in frequency until a drop in amplitude was noted. When the reduction occurred, the scope was switched to DC, and a second exposure made. As you can see, the AC presentation occupies about three vertical divisions, indicating an incorrect 30 volts, while the DC presentation shows a full four vertical divisions, indicating the true 40 volts.

Some manufacturers offset this condition by rating the low limit in their AC scopes well above the

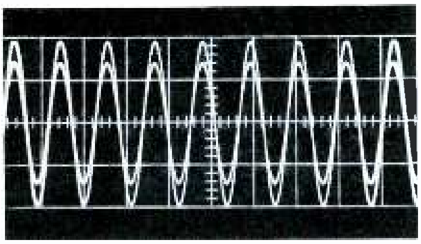


Fig. 10. AC scope has a low frequency cutoff.

actual cutoff point. While this is a good practice, it is quite possible that the technician using the scope will not remember the low limit, or will not know the exact frequency of the signal he is measuring. Either way, he could have an error without knowing it.

Disadvantages

After so many advantages, you may wonder if there are any disadvantages to a DC scope. There are probably two *important* ones.

The first one is price. All other features being equal, a DC scope will cost more than an AC scope. Here's why: The power supply of a DC scope must be regulated to a very close tolerance. Any slight variation in power supply voltage can cause the scope presentation to drift. DC scopes are more susceptible to drift since the input grids are not isolated from the supply as they are in an AC coupled scope.

The second disadvantage will become apparent if the average DC voltage level and the signal amplitude are not within the same range. If they're not, you may not be able to see them both (or at least measure both accurately) without switching vertical sensitivity or repositioning the trace. As an example, suppose you are measuring a 10 volt signal on a 100 volt plate. If the vertical deflection is set to show 100 volts at full scale, the 10 volts would represent only 10% of full scale. If you set the vertical deflection for 10 volts full scale, you will have to reposition the trace vertically to bring it down into view.

So our first advantage—simultaneous measurement—is somewhat offset by the rule that the signal level and DC level must be within the same general range for accurate simultaneous measurement. But by proper technique, you can still use a DC scope to save considerable time and effort in servicing television receivers. A future article will show how. ▲

Signal Generator

(Continued from page 66)

VTVM can be used as an indicator across the speaker voice coil, but station sound isn't always steady enough to be very reliable. Your ear will be reasonably accurate; if in doubt, just tune for a reduction in volume in either direction, and then center the adjustment exactly between these two points.

Finalizing IF Alignment

Sometimes, this generator-VTVM system of alignment results in a set that is *almost* aligned properly, but not quite. (Of course, this can happen with sweep alignment, too.) What do you do in these cases? Don't just drop it at that point, for there is a touchup technique that will let you develop exact performance. Here's how it works.

Tune to a strong local station and carefully check the action of the fine tuning control. Make sure the oscillator slug is set so that fine tuning range extends to a point just beyond the picture, with sound okay, as in Fig. 3A. As the fine tuning control is turned back toward a normal picture, the video should appear crisp, with highlights, as in Fig. 3B. Rotation just a little further should smooth out the video, with very little change in the sound level. If IF alignment is still slightly wrong, control action will *not* be as we've just described; rotation will cause ringing or smear in the video, or excessive loss of sound as the control is turned.

To remedy this, start with the first adjustment in the video IF, carefully noting its setting so you can return it to that point if necessary. Tune the adjustment slowly to either side, while "rocking" the fine tuning control back and forth through its range. If adjustment improves the fine tuning action, you are nearing the proper IF response. If no improvement results, return the first slug to its original position and try the next one.

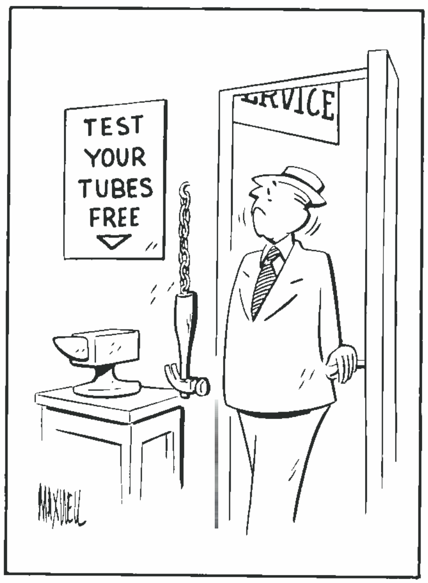
Very seldom will it be necessary to tune more than one or two of the IF adjustments during this "rocking" procedure. If it appears that more slugs than two are wrong, your initial alignment is probably not correct, and you should go through the entire procedure once again. Once you're thoroughly familiar with the way a set *should* tune, you can check and finalize your alignment job down to a very fine degree.

Wrapping It Up

Check each station the set is supposed to receive. Be sure the oscillator slug for each active channel is correctly adjusted. Always start with the highest channel (this is absolutely necessary for some sets, so make it a habit with all). Set the fine tuning control at midrange, and tune the oscillator slug for that channel until a crisp picture appears—as in Fig. 3B. Try the fine tuning control; it should cause the picture to look like Fig. 3A at one end, and should tune smoothly to a sharp picture about midway of its rotation. Set the control for the grainy highlights seen in Fig. 5, and leave it there for a reference point; don't move the fine tuning at all during any of the remaining oscillator adjustments.

Proceeding from the highest channel toward the lowest, use station signals to set the oscillator slug for each active channel to a point where the picture looks just like Fig. 5. As you rotate the channel selector to the several stations, they should all appear the same at this setting of the fine tuner. Then, with fine tuning control near midrange, a clear picture—with good sound—should appear on every station without your having to touch the fine tuning control. This is the very best way to leave a set—so the owner has as little to do as possible to receive each station.

As was pointed out earlier, don't



substitute this type of alignment for a thorough sweep alignment if a thorough sweep alignment is what a set needs. But, for those sets that need only touchup, or when a sweep generator and scope aren't handy, this system of alignment with a simple signal generator will get the job done in fine form. Try it a couple of times; you'll master the technique easily.

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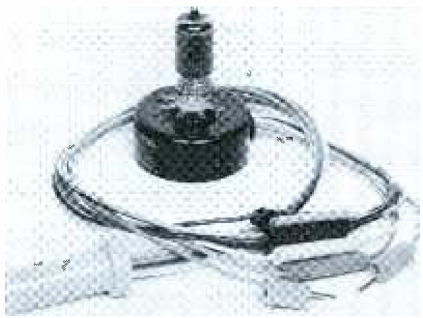

Socket Test Adapter

Do you automatically pull the chassis when you need to check tube voltages or resistances, or do you save time by using a test adapter? Maybe you have become accustomed to picking an adapter from your tool box and plugging it into the tube socket where you have isolated the trouble. If so, you should be interested in this new test adapter idea.

This new servicing tool, called a *Universal Harness Test Adapter,* is made by Pomona Electronics Co., Inc., of Pomona, California, and is available at your parts distributor in three styles—for 7, 8, and 9 pin tube sockets. It provides quick checking, from the top side of the chassis, of tube voltages, circuit resistances, and signals (including video). The harness places the tube and the test points about two feet from the chassis where measuring is easier. Another unique feature is its provision for measuring current: The harness wire for any pin may be opened—by unplugging its pin-plug connector—and a meter inserted for monitoring current. Banana-plug adapters are included to permit use with most VOM's.

Using the 7 pin Model 1737, we checked voltages, resistances, currents, and signals on several TV sets and a few AM-FM radios. We found that it works very well except that, as would be expected, the readings taken in RF, IF, and video stages were not always reliable because of the long, unshielded leads. However, if you keep in mind these limitations, this will be a useful new tool for your bench or caddy. ▲

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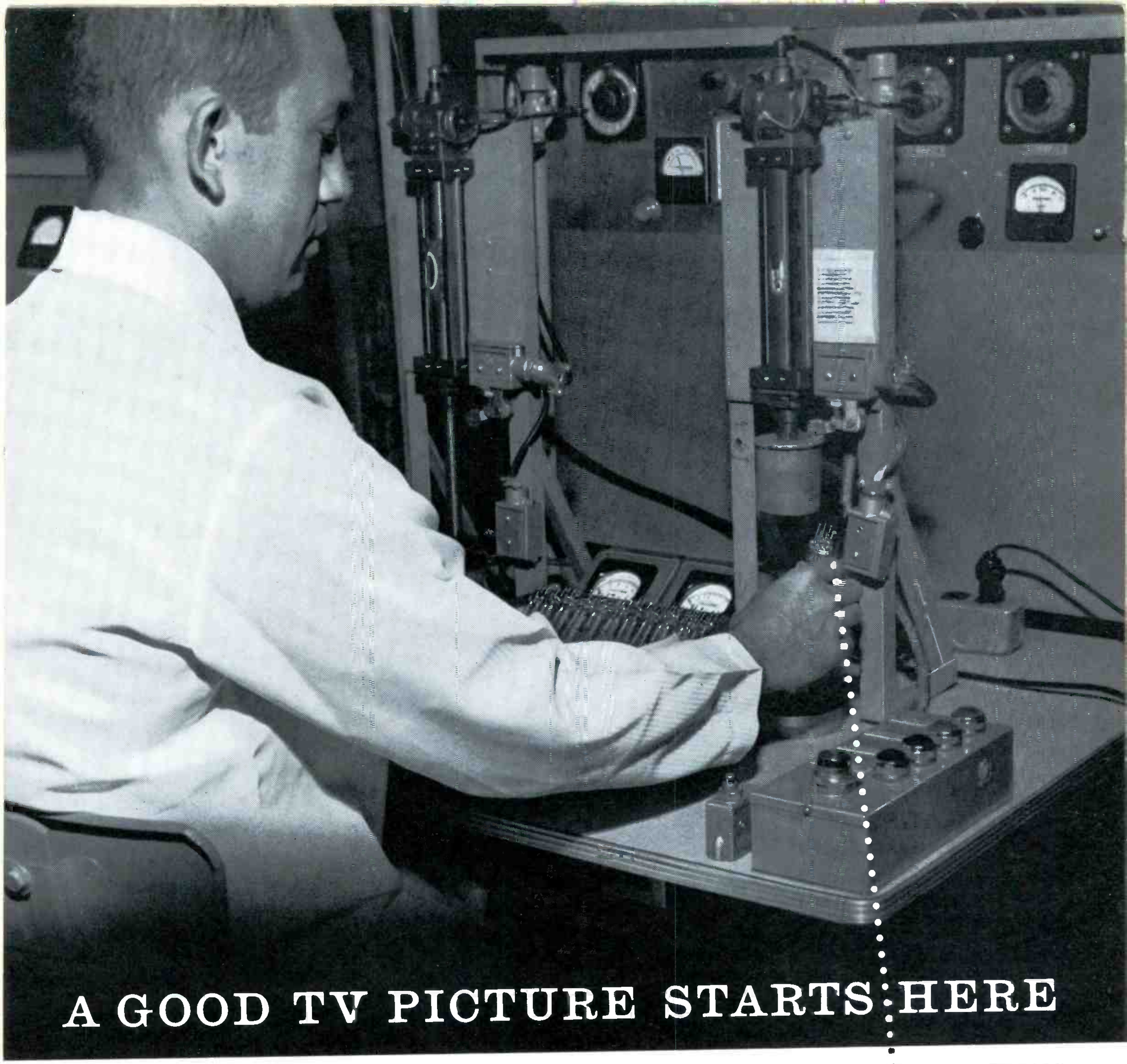
134. *B & K*—Catalog AP-21R describing uses for and specifications of new Model 1074 Television Analyst, Model 1076 Television Analyst, Model 850 Color Generator, Model 960 Transistor Radio Analyst, new Model 445 CRT Tester-Rejuvenator, new Model 250 Substitution Master, Model 375 *Dynamatic* VTVM, Model 360 *V-O-Matic VOM*, Models 700 and 600 *Dyna-Quik* Tube Testers, and Model 1070 *Dyna-Sweep* Circuit Analyzer.*
135. *EICO* — New 32-page, 1964 catalog of test instruments, hi-fi components, tape recorders, Citizens band, and amateur radio equipment.*
136. *HICKOK*—Complete descriptive and specification information on newly introduced equipment—Model 662 installer's color generator; Model 580 portable tube tester; Model 727 multiplex generator; Model 235A portable field strength meter.
137. *JACKSON*—Complete catalog describing all types of electronic test equipment for servicing and other applications.*
138. *MERCURY ELECTRONICS* — Catalog giving full information on Models 1000, 1100, and 1200 Tube Testers, Models 202 and 203 Self-Service Tube Testers, new Model 301 Combination Tester, new Model 501 Component Substitutor, and Model 800 CRT Tester-Reactivator.
139. *SECO*—Product sheet describing Model 88TC *caddy pack* tube tester; a tube caddy with built-in tester.*
140. *SENCORE*—Question-and-answer bulletin on new Model MX-129 *Multiplex Analyzer*.*
141. *SIMPSON*—Latest series of VOM's are described in test-equipment bulletin; also information on line of automotive test equipment.*
142. *SUN ELECTRIC*—Information on 4½" rectangular panel meter.
143. *TRIPLETT*—Brand new test equipment catalog No. 45-T, listing complete line of testers and accessories.*

TOOLS

144. *BERNS*—Data on unique 3-in-1 picture-tube repair tools, on *Audio Pin-Plug Crimper* that enables technician to make solderless plug and ground connections, and on new-style *ION* adjustable "beam bender" for CRT's.*
145. *ENTERPRISE DEVELOPMENT*—Time saving techniques in brochure from Endeco demonstrate improved desoldering and resoldering techniques for speeding up and simplifying operations on PC boards.*
146. *LUXO LAMP*—Catalog on line of "touch-and-stay-put" lamps.

TUBES & TRANSISTORS

147. *SEMITRONICS*—New updated 16" x 20" wall chart CH10 lists replacements and interchangeability for transistors and diodes.



It Depends on a Leakproof Stem Seal

The slightest leakage of air weakens the high vacuum of a TV picture tube...resulting in a costly callback and a dissatisfied customer for you. This is why RCA takes extra precautions to maintain the vacuum in Silverama picture tubes.

Potential trouble spots are the glass-to-metal lead-wire seals in the electron-gun stem assembly (below). At RCA, stem assemblies are batch tested for leakage in a supersensitive leak detector *before* they go into electron guns.

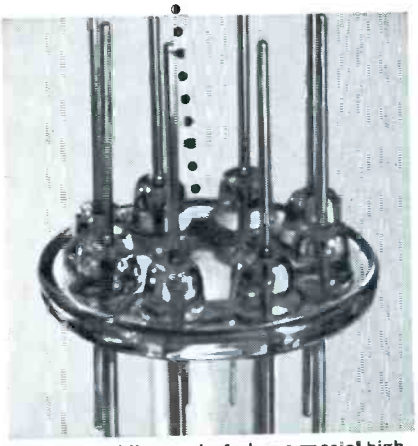
So sensitive is this detector that it can pinpoint a leak that would not affect tube performance for years...a leak so tiny that no other inspection method could hope to find it.

Yet the slightest sign of a leak is cause for rejection of a stem. This extra precaution is one more example of the care that goes into every phase of Silverama manufacture ...and one more reason why RCA Silverama should be your first choice in replacement picture tubes.

Silverama is made with an all-new electron gun, finest parts and materials, and a glass envelope that has been thoroughly cleaned and inspected prior to re-use.

RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.

The Most Trusted Name in Electronics



Stem assemblies are tested on a special high-vacuum leak detector. Detector is a helium mass-spectrometer, detecting passage of helium "tracer" gas through any of the glass-to-metal seals. A stem assembly passing this rigorous test is ready to become a vital part of an RCA Silverama® Picture Tube.

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